Formation of corrosion products on zinc in wet supercritical and subcritical CO_2: In-situ spectroscopic study

Formation of corrosion products on zinc was investigated with in-situ Raman and FTIR when exposed to wet supercritical carbon dioxide ($scCO_2$) and subsequent depressurization. Zinc oxide (ZnO) and smithsonite ($ZnCO_3$) formed on zinc in $scCO_2$. The dissolved water precipitated as liquid water in the reaction cell during depressurization. Formation of ZnO, $ZnCO_3$ and a needle-like zinc hydroxy carbonate species on zinc was observed inside a sessile water droplet during conditions simulating the depressurization phase. Addition of oxygen accelerated the formation of the carbonate species due to higher cathodic activity that increased zinc dissolution.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Ceramic materials, CNRS, Université de Bordeaux, ICMCB, Top Analytica Oy, SSAB
Contributors: Kaleva, A., Tassaing, T., Saarimaa, V., Le Bourdon, G., Väisänen, P., Markkula, A., Levänen, E.
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ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Materials Science(all)
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Source: Scopus
Source ID: 85087488046
Research output: Contribution to journal › Article › Scientific › peer-review

Optimization of photogenerated charge carrier lifetimes in ald grown tio_2 for photonic applications

Titanium dioxide (TiO_2) thin films are widely employed for photocatalytic and photovoltaic applications where the long lifetime of charge carriers is a paramount requirement for the device efficiency. To ensure the long lifetime, a high temperature treatment is used which restricts the applicability of TiO_2 in devices incorporating organic or polymer components. In this study, we exploited low temperature (100–150 $^{\circ}$ C) atomic layer deposition (ALD) of 30 nm TiO_2 thin films from tetrakis(dimethylamido)titanium. The deposition was followed by a heat treatment in air to find the minimum temperature requirements for the film fabrication without compromising the carrier lifetime. Femto-to nanosecond transient absorption spectroscopy was used to determine the lifetimes, and grazing incidence X-ray diffraction was employed for structural analysis. The optimal result was obtained for the TiO_2 thin films grown at 150 $^{\circ}$ C and heat-treated at as low as 300 $^{\circ}$ C. The deposited thin films were amorphous and crystallized into anatase phase upon heat treatment at 300–500 $^{\circ}$ C. The average carrier lifetime for amorphous TiO_2 is few picoseconds but increases to >400 ps upon crystallization at 500 $^{\circ}$ C. The samples deposited at 100 $^{\circ}$ C were also crystallized as anatase but the carrier lifetime was <100 ps.

General information

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Organisations: Materials Science and Environmental Engineering, Physics, Research group: Surface Science, Research group: ORC, Research group: Chemistry & Advanced Materials
Contributors: Khan, R., Ali-Löytty, H., Saari, J., Valden, M., Tukiainen, A., Lahtonen, K., Tkachenko, N. V.
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Peer-reviewed: Yes

Publication information

Journal: Nanomaterials
Volume: 10
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Article number: 1567
ISSN (Print): 2079-4991
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ASJC Scopus subject areas: Chemical Engineering(all), Materials Science(all)
Keywords: Atomic layer deposition, Lifetime of charge carriers, Thin films, Titanium dioxide, Transient absorption spectroscopy
Electronic versions:

Optimization of Photogenerated Charge Carrier 2020
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Source: Scopus
Source ID: 85089562888
Research output: Contribution to journal › Article › Scientific › peer-review

Nucleation and growth behavior of Er^{3+}doped oxyfluorophosphate glasses

The nucleation and growth behavior of glasses with the composition (75 NaPO3-25 CaF2)100-x-(TiO2/ZnO/MgO)x, with x = 0 and x = 1.5 (in mol%) is investigated. The glasses possess similar activation energy for crystallization and Johnson-Mehl-Avrami exponent, with value 2 confirming bulk crystallization of crystals with needle like shape. The Ti and Mg glasses exhibit broader nucleation curve and higher Tn max than the x = 0 and Zn glasses due to their stronger field strength. The crystal growth rates were determined and validated using SEM. Finally, we showed that the nucleation and growth of glasses can be controlled due to the large difference between onset of crystallization and maximum nucleation temperature which is crucial when preparing novel transparent glass-ceramics.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Research group: Photonics Glasses, BioMediTech, Research group: Biomaterials and Tissue Engineering Group, Fondazione LINKS – Leading Innovation & Knowledge for Society
Contributors: Ojha, N., Szczodra, A., Boetti, N. G., Massera, J., Petit, L.
Number of pages: 14
Pages: 25703-25716
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Peer-reviewed: Yes

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Original language: English
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DOIs:

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URLs:

http://urn.fi/URN:NBN:fi:tuni-202009287148
Source: Scopus
Source ID: 85091239098
Research output: Contribution to journal › Article › Scientific › peer-review

Additive manufacturing of monolithic supercapacitors with biopolymer separator

In this paper, additive layer-by-layer fabrication of a fully screen printed monolithic supercapacitor exhibiting performance comparable with supercapacitors prepared using lamination is reported. A novel separator material improves the performance of the monolithic supercapacitor, is easily applicable using scalable processes such as screen and stencil printing, and is based on sustainable biomaterials. The additive monolithic manufacturing offers advantages for system integration and avoids the need of an additional alignment step as needed in the fabrication of laminated supercapacitors. Previously, the monolithically fabricated supercapacitors showed higher equivalent series resistance (ESR) and leakage current than the laminated ones. By using microfibrillated cellulose (MFC) and chitosan as separator materials ESR and leakage current were decreased. These disposable and non-toxic aqueous electrolyte supercapacitors are optimized for autonomous sensor systems, for example in Internet-of-Things (IoT) applications, with capacitance of 200–300 mF and ESR of about 10 Ω. The new composite separator material consisting of MFC and chitosan has good adhesion on the electrodes and the substrate, is easy to apply using printing and coating processes, and does not diffuse into the porous electrode. Graphic Abstract: [Figure not available: see fulltext.].

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Electrical Engineering, Automation Technology and Mechanical Engineering, BioMediTech, Abo Akademi University
Contributors: Arvani, M., Keskinen, J., Railanmaa, A., Siljander, S., Björkqvist, T., Tuukkanen, S., Lupo, D.
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ISSN (Print): 0021-891X
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Electrochemistry, Materials Chemistry
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Electronic versions:

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Source: Scopus
Source ID: 85085106449
Research output: Contribution to journal › Article › Scientific › peer-review

Utilizing Gelatinized Starchy Waste from Rice Noodle Factory as Substrate for L(+)-Lactic Acid Production by Amylolytic Lactic Acid Bacterium Enterococcus faecium K-1
To valorize starchy waste from rice noodle factory, bioconversion of gelatinized starchy waste (GSW) to value-added product as L(+)-lactic acid, the monomer for polylactate synthesis, was investigated using amylolytic lactic acid bacterium, Enterococcus faecium K-1. Screening for appropriate nitrogen source to replace expensive organic nitrogen sources revealed that corn steep liquor (CSL) was the most suitable regarding high efficacy for L(+)-LA achievement and low-cost property. The successful applying statistic experimental design, Plackett-Burman design incorporated with central composite design (CCD), predicted the maximum L(+)-LA of 93.07 g/L from the optimized medium (OM) containing 125.7 g/L GSW and 207.3 g/L CSL supplemented with CH_3COONa, $MgSO_4$, $MnSO_4$, K_2HPO_4, $CaCl_2$, $(NH_4)_2HC_6H_5O_7$, and Tween80. Minimizing the medium cost by removal of all inorganic salts and Tween80 from OM was not an effect on L(+)-LA yield. Fermentation using the optimized medium without minerals (OM-Mi) containing only GSW (125.7 g/L) and CSL (207.3 g/L) in a 10-L fermenter was also successful. Thinning GSW with α-amylase from Lactobacillus plantarum S21 increased L(+)-LA productivity in the early stage of 24-h fermentation. Not only showing the feasible bioconversion process for GSW utilizing as a substrate for L(+)-LA production, this research also demonstrated the efficient model for industrial starchy waste valorization.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Chiang Mai University, North Dakota State University
Contributors: Unban, K., Khanongnuch, R., Kanpiengjai, A., Shetty, K., Khanongnuch, C.
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ISSN (Print): 0273-2289
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Biochemistry, Applied Microbiology and Biotechnology, Molecular Biology
Keywords: ALAB, Enterococcus faecium, L-lactic acid, Low-cost medium, Starchy waste
DOIs:

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Source: Scopus
Source ID: 85084316077

Evaluation of scaffold microstructure and comparison of cell seeding methods using micro-computed tomography-based tools

Micro-computed tomography (micro-CT) provides a means to analyse and model three-dimensional (3D) tissue engineering scaffolds. This study proposes a set of micro-CT-based tools firstly for evaluating the microstructure of scaffolds and secondly for comparing different cell seeding methods. The pore size, porosity and pore interconnectivity of supercritical CO2 processed poly(l-lactide-co-ε-caprolactone) (PLCL) and PLCL/β-tricalcium phosphate scaffolds were analysed using computational micro-CT models. The models were supplemented with an experimental method, where iron-labelled microspheres were seeded into the scaffolds and micro-CT imaged to assess their infiltration into the scaffolds. After examining the scaffold architecture, human adipose-derived stem cells (hASCs) were seeded into the scaffolds using five different cell seeding methods. Cell viability, number and 3D distribution were evaluated. The distribution of the cells was analysed using micro-CT by labelling the hASCs with ultrasmall paramagnetic iron oxide nanoparticles. Among the tested seeding methods, a forced fluid flow-based technique resulted in an enhanced cell infiltration throughout the scaffolds compared with static seeding. The current study provides an excellent set of tools for the development of scaffolds and for the design of 3D cell culture experiments.

General information

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Organisations: BioMediTech, Research group: Biomaterials and Tissue Engineering Group, Research group: Computational Biophysics and Imaging Group, Orton Orthopaedic Hospital, Tampere University Hospital
Contributors: Palmroth, A., Pitkänen, S., Hannula, M., Paakinaho, K., Hyttinen, J., Miettinen, S., Kellomäki, M.
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DOIs:
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Bibliographical note

INT=bmte,"Miettinen, Susanna"
Research output: Contribution to journal › Article › Scientific › peer-review

Utilizing Neurons for Digital Logic Circuits: A Molecular Communications Analysis

With the advancement of synthetic biology, several new tools have been conceptualized over the years as alternative treatments for current medical procedures. As part of this work, we investigate how synthetically engineered neurons can operate as digital logic gates that can be used towards bio-computing inside the brain and its impact on epileptic seizure-like behaviour. We quantify the accuracy of logic gates under high firing rates amid a network of neurons and by how much it can smooth out uncontrolled neuronal firings. To test the efficacy of our method, simulations composed of computational models of neurons connected in a structure that represents a logic gate are performed. Our simulations demonstrate the accuracy of performing the correct logic operation, and how specific properties such as the firing rate can play an important role in the accuracy. As part of the analysis, the mean squared error is used to quantify the quality of our proposed model and predict the accurate operation of a gate based on different sampling frequencies. As an application, the logic gates were used to smooth out epileptic seizure-like activity in a biological neuronal network, where the results demonstrated the effectiveness of reducing its mean firing rate. Our proposed system has the potential to be used in future approaches to treating neurological conditions in the brain.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Electrical Engineering, Waterford Institute of Technology, Tampere University, Telecommunications Software and Systems Group (TSSG)
Contributors: Adonias, G. L., Yastrebova, A., Barros, M. T., Koucheryavy, Y., Cleary, F., Balasubramaniam, S.
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ASJC Scopus subject areas: Biotechnology, Bioengineering, Medicine (miscellaneous), Biomedical Engineering, Pharmaceutical Science, Computer Science Applications, Electrical and Electronic Engineering
Keywords: Boolean algebra, Logic gates, nano communications, nanonetworks, synthetic biology
DOIs:
10.1109/TNB.2020.2975942

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EXT="Balasubramaniam, Sasitharan"
Source: Scopus
Source ID: 85083430394
Research output: Contribution to journal › Article › Scientific › peer-review

Transparent Yb^{3+} doped phosphate glass-ceramics
Yb^{3+} doped oxyfluorophosphate glasses with the composition (98.75) [90$NaPO_3$-(10-x) Na_2O-xNaF] - 1.25Yb_2O_3 (in mol%) with x = 0, 2.5, 5, 7.5 and 10 were prepared using a standard melting process. The progressive replacement of Na_2O by NaF leads to an increase in the number of Q^2 units at the expense of the Q^1 units. This increase in the polymerization of the glass network leads to a shift of the optical band gap to lower wavelength, to a slight increase in the intensity of the emission at 1000 nm and more importantly to a change in the glass crystallization process. Indeed, both surface and bulk crystallization were observed in the glass with x = 0 while surface crystallization only occurs when NaF is added in the phosphate network. The heat treatment leads to the precipitation of at least three crystalline phases: as x increases, the $NaPO_3$ phase grows at the expense of $Na_5P_3O_{10}$. All glasses precipitate the Yb containing crystal, $NaYbP_2O_7$ which leads to an increase in the intensity of the emission at 1000 nm compared to the emission at 975 nm. We show for the first time to the best of our knowledge that transparent Yb^{3+} doped phosphate glass-ceramics can be obtained within this glass system when free of NaF.

General information
Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Fondazione LINKS – Leading Innovation & Knowledge for Society, CNRS, Université de Bordeaux, ICMCB
Contributors: Hongisto, M., Veber, A., Boetti, N. G., Danto, S., Jubera, V., Petit, L.
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Journal: Ceramics International
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Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry
Keywords: Glass-ceramic, Luminescence, Phosphate glass, XRD, Yb
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Source: Scopus
Source ID: 85077933290
Research output: Contribution to journal › Article › Scientific › peer-review

Investigation of well-defined pinholes in TiO_2 electron selective layers used in planar heterojunction perovskite solar cells
The recently introduced perovskite solar cell (PSC) technology is a promising candidate for providing low-cost energy for future demands. However, one major concern with the technology can be traced back to morphological defects in the electron selective layer (ESL), which deteriorates the solar cell performance. Pinholes in the ESL may lead to an increased surface recombination rate for holes, if the perovskite absorber layer is in contact with the fluorine-doped tin oxide (FTO) substrate via the pinholes. In this work, we used sol-gel-derived mesoporous TiO_2 thin films prepared by block co-polymer templating in combination with dip coating as a model system for investigating the effect of ESL pinholes on the photovoltaic performance of planar heterojunction PSCs. We studied TiO_2 films with different porosities and film

thicknesses, and observed that the induced pinholes only had a minor impact on the device performance. This suggests that having narrow pinholes with a diameter of about 10 nm in the ESL is in fact not detrimental for the device performance and can even, to some extent improve their performance. A probable reason for this is that the narrow pores in the ordered structure do not allow the perovskite crystals to form interconnected pathways to the underlying FTO substrate. However, for ultrathin (~20 nm) porous layers, an incomplete ESL surface coverage of the FTO layer will further deteriorate the device performance.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, Abo Akademi University, National University of Science & Technology (NUST), Paderborn University
Contributors: Masood, M. T., Qudsia, S., Hadadian, M., Weinberger, C., Nyman, M., Ahläng, C., Dahlström, S., Liu, M., Vivo, P., Österbacka, R., Smått, J. H.
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Journal: Nanomaterials
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ASJC Scopus subject areas: Chemical Engineering(all), Materials Science(all)
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Source: Scopus
Source ID: 85078423754
Research output: Contribution to journal › Article › Scientific › peer-review

The thermal contact resistance of a steel-ceramic interface with oxide intermediates

Metal structures covered by refractories are widely employed in high temperature processes such as incineration and metal production. The thermal resistance in refractories used in high temperature processes is associated with different phases, phase boundaries and porosity in the refractory and with the thermal contact resistance between the refractory and the metal interface. Here, a light flash method was used to evaluate the thermal contact resistance of the ceramic/steel interface at temperatures of 25, 100, 200, 300 and 400 °C. The material combinations studied were a commonly-used reference ceramic, Pyroceram 9606, and pressure vessel steel with oxidizing treatment at 450 and 650 °C for 50 h. Thermal resistance at a ceramic/steel interface increased significantly when a porous oxide layer was formed on the steel surface. The thermal contact resistance of the interface varied from 0.1 to 0.4 × 10^{-3} m^2K/W, depending on the temperature and the oxidization of the steel sample.

General information

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Organisations: Materials Science and Environmental Engineering, Environmental Systems R & D, Valmet Technologies Oy
Contributors: Silvonen, J., Levänen, E., Uusitalo, M.
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Publication information

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Article number: 1720057
ISSN (Print): 2331-1916
Original language: English

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Keywords: heat conduction, light flash, oxidation, refractory, thermal contact resistance
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10.1080/23311916.2020.1720057
Source: Scopus
Source ID: 85079383199
Research output: Contribution to journal › Article › Scientific › peer-review

In-flightwind field identification and prediction of parafoil systems

The wind field is an essential factor that affects accurate homing and flare landing of parafoil systems. In order to obtain the ambient wind field during the descent of a parafoil system, a combination method of in-flight wind field identification and prediction is proposed. First, a wind identification method only using global position system information is derived based on the flight dynamics of parafoil systems. Then a wind field prediction model is constructed using the atmospheric dynamics, and the low-altitude wind field is predicted based on the identified wind field of high-altitude. Finally, simulations of wind field identification and prediction are conducted. The results demonstrate that the proposed method can identify the wind fields precisely and also predict the wind fields reasonably. This method can potentially be applied in practical parafoil systems to provide wind field information for homing tasks.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Computing Sciences, Research group: Predictive Society and Data Analytics (PSDA), Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Anhui Science and Technology University, Aalto University, Peking University, University of Applied Sciences Upper Austria, School of Management, Nankai University
Contributors: Gao, H., Tao, J., Dehmer, M., Emmert-Streib, F., Sun, Q., Chen, Z., Xie, G., Zhou, Q.
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ISSN (Print): 2076-3417
Original language: English
ASJC Scopus subject areas: Materials Science(all), Instrumentation, Engineering(all), Process Chemistry and Technology , Computer Science Applications, Fluid Flow and Transfer Processes
Keywords: Autonomous homing, Identification, Parafoil system, Prediction, Wind field
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Source: Scopus
Source ID: 85082646563
Research output: Contribution to journal › Article › Scientific › peer-review

Efficient Conversion of Light to Chemical Energy: Directional, Chiral Photoswitches with Very High Quantum Yields

Photochromic systems have been used to achieve a number of engineering functions such as light energy conversion, molecular motors, pumps, actuators, and sensors. Key to practical applications is a high efficiency in the conversion of light to chemical energy, a rigid structure for the transmission of force to the environment, and directed motion during isomerization. We present a novel type of photochromic system (diindane diazocines) that converts visible light with an efficiency of 18 % to chemical energy. Quantum yields are exceptionally high with >70 % for the cis–trans isomerization and 90 % for the back-reaction and thus higher than the biochemical system rhodopsin (64 %). Two diastereomers (meso and racemate) were obtained in only two steps in high yields. Both isomers are directional switches with high conversion rates (76–99 %). No fatigue was observed after several thousands of switching cycles in both systems.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Graz University of Technology, University of Jyväskylä, Christian-Albrechts-Universität zu Kiel

Contributors: Moormann, W., Tellkamp, T., Stadler, E., Röhricht, F., Näther, C., Puttreddy, R., Rissanen, K., Gescheidt, G. , Herges, R.
Number of pages: 6
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Publication date: 2020
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ASJC Scopus subject areas: Catalysis, Chemistry(all)
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Electronic versions:

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Source: Scopus
Source ID: 85086003194
Research output: Contribution to journal › Article › Scientific › peer-review

Modelling of a pressure swing adsorption unit by deep learning and artificial Intelligence tools
Syngas is one of the main sources available for the production of pure H_2 and synthetic fuels, among others. Pressure swing adsorption (PSA) is considered to be an efficient alternative for pre-treatment of syngas. However, it displays very complex dynamical behaviour. This work proposes the development of different Artificial Intelligence based models for the prediction of the dynamic behaviour of several process output variables. A classical model of ANNs, a machine learning model and a deep learning model was here developed. It was found that Deep Learning networks were the only ones capable of fully representing the dynamic behaviour of the PSA unit, whereas the other models were only partially capable of predicting it. Thus, it is proposed a reliable real-time soft sensor for a PSA unit based on Deep Leaning strategy. This strategy provides bases to overtake several problems associated to this processes control, operation and optimization.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation Technology and Mechanical Engineering, Universidade do Porto
Contributors: Oliveira, L. M. C., Koivisto, H., Iwakiri, I. G., Loureiro, J. M., Ribeiro, A. M., Nogueira, I. B.
Publication date: 2020
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Article number: 115801
ISSN (Print): 0009-2509
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Industrial and Manufacturing Engineering
Keywords: Artificial intelligence, Artificial neural networks, Deep learning, Machine learning, Pressure swing adsorption, Syngas
DOIs:

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EXT="Nogueira, Idelfonso B.R."
Source: Scopus
Source ID: 85085301174
Research output: Contribution to journal › Article › Scientific › peer-review

CFD modeling the diffusional losses of nanocluster-sized particles and condensing vapors in 90° bends of circular tubes
Particle and vapor measurements typically include sampling tubing causing sampling losses therein. Correcting measured concentrations from the sampling losses using the calculated penetration efficiencies of straight tubes is a satisfactory approximation if sub-micrometer particles are of interest. However, in addition to inertial impaction of larger particles,

bends in the tubing can cause a significant increase in diffusional losses of particles smaller than 5 nm or of condensing vapor, such as sulfuric acid. Here, the effects of 90° bends with various curvatures (dimensionless curvatures of 1.3−67) on the diffusional losses in a wide range of Reynolds (25−10000) and Schmidt (0.48−1400) numbers were simulated using computational fluid dynamics. The results were parametrized to output the functions for the penetration efficiencies of a bend.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group
Contributors: Olin, M., Dal Maso, M.
Number of pages: 10
Publication date: 2020
Peer-reviewed: Yes

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Volume: 150
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ISSN (Print): 0021-8502
Original language: English
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Keywords: Bend, Diffusion, Nanocluster, Sulfuric acid
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Source: Scopus
Source ID: 85087771556
Research output: Contribution to journal › Article › Scientific › peer-review

Kinetics and modelling of thiosulphate biotransformations by haloalkaliphilic Thioalkalivibrio versutus
Biotransformation of thiosulphate by Thioalkalivibrio versutus was studied under haloalkaline conditions (pH 10, 0.66–1.2 M Na^+) using batch assays and modelling tools for possible sulphur recovery from haloalkaline industrial streams. The thiosulphate was fully biotransformed to sulphate or to sulphate and elemental sulphur at initial $S_2O_3^{2-}$-S concentrations of 25–550 mM within 10 days. The highest biotransformation rate of 2.66 mM [$S_2O_3^{2-}$-S] h^{-1} was obtained at initial $S_2O_3^{2-}$-S concentration of 550 mM with half saturation constant (K_s) of 54.5 mM [$S_2O_3^{2-}$-S]. At initial concentrations below 100 mM $S_2O_3^{2-}$-S, the main product was sulphate whilst at above 100 mM also elemental sulphur was produced with up to 29% efficiency. The model approach developed incorporated $S_2O_3^{2-}$ biotransformation to SO_4^{2-} and S^0. The kinetic modelling results were compatible (R^2 > 0.90) with the experimental data. The maximum growth rate (μ_m) was 0.048 h^{-1} (0.47 mM $C_5H_7NO_2$ h^{-1}) and the maximum growth yield 0.18 mM $C_5H_7NO_2$/mM $S_2O_3^{2-}$-S (20 g cell/mol $S_2O_3^{2-}$-S). The high rate thiosulphate biotransformation and elemental sulphur recovery results together with the developed kinetic model can be used for bioprocess design and operation. The potential industrial applications would aim at sustainable resource recovery from industrial haloalkaline and sulphurous process and/or effluent streams.

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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, Yildiz Technical University
Contributors: Hajdu-Rahkama, R., Özkaya, B., Lakaniemi, A. M., Puhakka, J. A.
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ASJC Scopus subject areas: Chemistry(all), Environmental Chemistry, Chemical Engineering(all), Industrial and Manufacturing Engineering

Keywords: Haloalkaliphilic sulfur oxidizing bacteria, Kinetics, Resource recovery, Sulfur disproportionation, Thioalkalivibrio versutus, Thiosulfate biotransformation
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Power production and microbial community composition in thermophilic acetate-fed up-flow and flow-through microbial fuel cells

The microbial communities developed from a mixed-species culture in up-flow and flow-through configurations of thermophilic (55 °C) microbial fuel cells (MFCs), and their power production from acetate, were investigated. The up-flow MFC was operated for 202 days, obtaining an average power density of 0.13 W/m^3, and Tepidiphilus was the dominant transcriptionally-active microorganisms. The planktonic community developed in the up-flow MFC was used to inoculate a flow-through MFC resulting in the proliferation of Ureibacillus, whose relative abundance increased from 1 to 61% after 45 days. Despite the differences between the up-flow and flow-through MFCs, including the anode electrode, hydrodynamic conditions, and the predominant microorganism, similar ($p = 0.05$) volumetric power (0.11–0.13 W/m^3), coulombic efficiency (16–18%) and acetate consumption rates (55–69 mg/L/d) were obtained from both. This suggests that though MFC design can shape the active component of the thermophilic microbial community, the consortia are resilient and can maintain similar performance in different MFC configurations.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, Natl. University of Ireland, Galway, Indian Institute of Technology Hyderabad
Contributors: Dessì, P., Chatterjee, P., Mills, S., Kokko, M., Lakaniemi, A., Collins, G., Lens, P. N.
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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
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Research output: Contribution to journal › Article › Scientific › peer-review

Transcription closed and open complex formation coordinate expression of genes with a shared promoter region

Many genes are spaced closely, allowing coordination without explicit control through shared regulatory elements and molecular interactions. We study the dynamics of a stochastic model of a gene-pair in a head-to-head configuration, sharing promoter elements, which accounts for the rate-limiting steps in transcription initiation. We find that only in specific regions of the parameter space of the rate-limiting steps is orderly coexpression exhibited, suggesting that successful cooperation between closely spaced genes requires the coevolution of compatible rate-limiting step configuration. The model predictions are validated using in vivo single-cell, single-RNA measurements of the dynamics of pairs of genes sharing promoter elements. Our results suggest that, in E. coli, the kinetics of the rate-limiting steps in active transcription can play a central role in shaping the dynamics of gene-pairs sharing promoter elements.

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MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Research group: Laboratory of Biosystem Dynamics-LBD
Contributors: Häkkinen, A., Oliveira, S. M., Neeli-Venkata, R., Ribeiro, A. S.
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Original language: English
ASJC Scopus subject areas: Biotechnology, Biophysics, Bioengineering, Biomaterials, Biochemistry, Biomedical Engineering
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Source: Scopus
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Effects of elevated pressures on the activity of acidophilic bioleaching microorganisms
This study reports effects of elevated pressures on the oxidation of a soluble ferrous iron and low-grade sulphidic ore as little is known about biological iron and sulphur oxidation under these conditions. Pressure effects were studied in a pressurised batch-operated stirred tank reactor using acidophilic enrichment cultures. The oxidation of soluble Fe^{2+} by enrichment culture dominated by Leptospirillum ferriphilum, Sulfobacillus sp. and Ferrimicrobium acidiphilum increased with increasing pressure induced by technical air to up to +3 bar (0.63 bar P_{O2}) and was inhibited at +7 bar (1.47 bar P_{O2}). Elevated pressures induced by nitrogen (low oxygen partial pressure) were tolerated up to +40 bar. Another enrichment culture dominated by Acidithiobacillus ferrivorans, Sulfobacillus sp. and F. acidiphilum partially oxidised the ore at pressures up to +20 bar induced with air (4.2 bar P_{O2}). This is the first study reporting activity of acidophiles under pressurised conditions in a stirred tank reactor.

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ASJC Scopus subject areas: Biotechnology, Bioengineering, Environmental Engineering, Biomedical Engineering
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Source: Scopus
Source ID: 85070494949
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Controlled Orientations of Neighboring Tetracene Units by Mixed Self-Assembled Monolayers on Gold Nanoclusters for High-Yield and Long-Lived Triplet Excited States through Singlet Fission
Although tetracene (Tc) is well-known as a good candidate for singlet fission (SF), the number of high-yield and long-lived triplet excited states through SF is extremely limited because of the relative acceleration of the reverse triplet-triplet annihilation (TTA) considering the energy matching between a singlet and two triplet states. Systematic control of electronic interactions between two neighboring units using conventional covalent linkages and molecular assembly

methods to optimize these kinetic processes is quite difficult because of the complicated synthesis and random orientations. In this study, we propose a novel supramolecular strategy utilizing mixed self-assembled monolayers (SAMs) with two different chain lengths. Specifically, mixed Tc-SAMs on gold nanoclusters, which are prepared using Tc-modified heterodisulfides with two different chain lengths, attain high-yield SF (ΦSF ≈ 90%) and individual triplet yields (ΦT ≈ 160%). The obtained ΦSF is the highest value among Tc derivatives in homogeneous solution to the best of our knowledge.

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Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, Keio University, Kobe University
Contributors: Saegusa, T., Sakai, H., Nagashima, H., Kobori, Y., Tkachenko, N. V., Hasobe, T.
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ASJC Scopus subject areas: Catalysis, Chemistry(all), Biochemistry, Colloid and Surface Chemistry
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Source ID: 85072270985
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Effects of anode materials on electricity production from xylose and treatability of TMP wastewater in an up-flow microbial fuel cell

The aim of this study was to determine an optimal anode material for electricity production and COD removal from xylose containing synthetic wastewater in an up-flow microbial fuel cell (MFC), and assess its suitability for treatment of thermomechanical pulping (TMP) wastewater with an enrichment culture at 37 °C. The anode materials tested included carbon-based electrodes (graphite plate, carbon cloth and zeolite coated carbon cloth), metal-based electrodes (tin coated copper) and a metal-carbon assembly (granular activated carbon in stainless steel cage). During continuous operation with xylose, COD removal was 77–86% of which 25–28% was recovered as electricity. The highest power density of 333 (±15) mW/m ^{2}was obtained with the carbon cloth electrode. However, based on an overall analysis including electrode performance, surface area and scalability, the granular activated carbon in stainless steel cage (GAC in SS cage) was chosen to be used as electrode for bioelectrochemical treatment of TMP wastewater. The TMP fed MFC was operated in continuous mode with 1.8 days hydraulic retention time, resulting in 47 (±13%) COD removal of which 1.5% was recovered as electricity with the average power production of 10–15 mW/m ^{2}. During operation with TMP wastewater, membrane fouling increased the polarization resistance causing a 50% decrease in power production within 30 days. This study shows that MFC pretreatment removes half of the TMP wastewater COD load, reducing the energy required for aerobic treatment.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Bio- and Circular Economy, Materials Science and Environmental Engineering, Natl. University of Ireland, Galway, Indian Institute of Technology Hyderabad, Microscopy Center, Kyung Hee University
Contributors: Haavisto, J., Dessì, P., Chatterjee, P., Honkanen, M., Noori, M. T., Kokko, M., Lakaniemi, A. M., Lens, P. N., Puhakka, J. A.
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Original language: English
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Research output: Contribution to journal › Article › Scientific › peer-review

Multiresonant High-Q Plasmonic Metasurfaces

Resonant metasurfaces are devices composed of nanostructured subwavelength scatterers that generate narrow optical resonances, enabling applications in filtering, nonlinear optics, and molecular fingerprinting. It is highly desirable for these applications to incorporate such devices with multiple high-quality-factor resonances; however, it can be challenging to obtain more than a pair of narrow resonances in a single plasmonic surface. Here, we demonstrate a multiresonant metasurface that operates by extending the functionality of surface lattice resonances, which are the collective responses of arrays of metallic nanoparticles. This device features a series of resonances with high-quality factors (Q ~ 40), an order of magnitude larger than what is typically achievable with plasmonic nanoparticles, as well as a narrow free spectral range. This design methodology can be used to better tailor the transmission spectrum of resonant metasurfaces and represents an important step toward the miniaturization of optical devices.

General information

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Organisations: Physics, Research group: Nonlinear Optics, Iridian Spectral Technologies, University of Rochester Institute of Optics
Contributors: Reshef, O., Saad-Bin-Alam, M., Huttunen, M. J., Carlow, G., Sullivan, B. T., Ménard, J. M., Dolgaleva, K., Boyd, R. W.
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Scopus rating (2019): CiteScore 20.5 SJR 5.786 SNIP 2.271
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: gold nanoparticles, nanophotonics, Plasmonics, resonant metasurface, surface lattice resonance
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Shedding frequency in cavitation erosion evolution tracking

Cavitation erosion is a concern for most hydraulic machinery. An especially damaging type of cavitation is cloud cavitation. This type of cavitation is characterized by a growth-collapse cycle in which a group of vapor bubbles first grows together in a low-pressure region and then collapses almost simultaneously when the pressure recovers. Measuring the frequency of these collapse events is possible by acoustic emission (AE), as demonstrated in this study, in which a cavitation tunnel is

utilized to create cloud cavitation in the vicinity of a sample surface. These samples were equipped with AE sensors, and the initially high frequency AE signal was demodulated to detect the relatively low frequency cloud cavitation shedding. It was found that when the cavitation number is increased, AE successfully detects the changes in this frequency, confirmed by comparing the results to video analysis and to simulations from literature. Additionally, the frequency increases when cavitation erosion progresses, thus providing means to track the erosion stage. It is concluded that the presented method is suitable for both detecting the transition from cloud to sheet cavitation and the erosion evolution in the experimental cavitation tunnel. The method could probably be extended to non-intrusive hydraulic machine monitoring, as this type of cloud cavitation is common in hydrofoils.

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Organisations: Automation Technology and Mechanical Engineering, Materials Science and Environmental Engineering, Université Grenoble Alpes
Contributors: Ylönen, M., Franc, J. P., Miettinen, J., Saarenrinne, P., Fivel, M.
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Ratings:

Scopus rating (2019): CiteScore 5.1 SJR 1.18 SNIP 1.829
Original language: English
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Keywords: Acoustic emission, Cavitation erosion, Cloud cavitation, Shedding frequency
DOIs:

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Source: Scopus
Source ID: 85067547906
Research output: Contribution to journal › Article › Scientific › peer-review

Influence of ions to modulate hydrazone and oxime reaction kinetics to obtain dynamically cross-linked hyaluronic acid hydrogels
Dynamic covalent chemistry forming hydrazone and oxime linkages is attractive due to its simplicity, selectivity and compatibility under aqueous conditions. However, the low reaction rate at physiological pH hampers its use in biomedical applications. Herein, we present different monovalent and bivalent aqueous salt solutions as bio-friendly, non-toxic catalysts which can drive the hydrazone and oxime reactions with excellent efficacy at physiological pH. Direct comparison of hydrazone and oxime reactions using a small molecule model, without any salt catalysis, indicated that oxime formation is 6-times faster than hydrazone formation. Addition of different salts (NaCl, NaBr, KCl, LiCl, $LiClO_4$, Na_2SO_4, $MgCl_2$ and $CaCl_2$) accelerated the pseudo-first-order reaction kinetics by ~1.2-4.9-fold for acylhydrazone formation and by ~1.5-6.9-fold for oxime formation, in a concentration-dependent manner. We further explored the potential of such catalysts to develop acylhydrazone and oxime cross-linked hyaluronic acid (HA) hydrogels with different physicochemical properties without changing the degree of chemical modification. Analogous to the small molecule model system, the addition of monovalent and divalent salts as catalysts significantly reduced the gelling time. The gelling time for the acylhydrazone cross-linked HA-hydrogel (1.6 wt%) could be reduced from 300 min to 1.2 min by adding 100 mM $CaCl_2$, while that for the oxime cross-linked HA-hydrogel (1.2 wt%) could be reduced from 68 min to 1.1 min by adding 50 mM $CaCl_2$. This difference in the gelling time also resulted in hydrogels with differential swelling properties as measured after 24 h. Our results are the first to demonstrate the use of salts, for catalyzing hydrogel formation under physiologically relevant conditions.

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MoE publication type: A1 Journal article-refereed
Organisations: BioMediTech, Research group: Biomaterials and Tissue Engineering Group, University of Montreal, Uppsala University
Contributors: Wang, S., Nawale, G. N., Oommen, O. P., Hilborn, J., Varghese, O. P.
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Volume: 10
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Original language: English
ASJC Scopus subject areas: Bioengineering, Biochemistry, Polymers and Plastics, Organic Chemistry
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Source: Scopus
Source ID: 85070404630
Research output: Contribution to journal › Article › Scientific › peer-review

Chlorine induced high-temperature corrosion mechanisms in HVOF and HVAF sprayed Cr_3C_2-based hardmetal coatings

A novel method that combines thermal analysis and traditional furnace corrosion tests was used to study the corrosion behaviour of thermally sprayed Cr_3C_2-based hardmetal coatings at 450 °C and 550 °C under a KCl deposit. This method enabled the identification of the onset temperature of chlorine-induced oxidation to be within 450–500 °C. Two corrosion mechanisms were suggested for these temperatures. At 450 °C, the corrosion rate was slow and mainly controlled by the formation of K_2CrO_4. Exposure at 550 °C caused the formation of fine interconnected secondary-carbide precipitates in the metal matrix. Their fast corrosion was identified as the major cause of degradation.

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Surface Engineering, Valmet Automation Oy
Contributors: Fantozzi, D., Matikainen, V., Uusitalo, M., Koivuluoto, H., Vuoristo, P.
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Original language: English
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Keywords: A. Metal matrix composites, A. Superalloys, B. SEM, B. TGA, B. XRD, C. Chlorination, C. High temperature corrosion, C. Thermodynamic diagrams
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EXT="Uusitalo, Mikko"
Source: Scopus
Source ID: 85072275416
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Characterisation and in vitro and in vivo evaluation of supercritical-CO2-foamed β-TCP/PLCL composites for bone applications

Most synthetic bone grafts are either hard and brittle ceramics or paste-like materials that differ in applicability from the gold standard autologous bone graft, which restricts their widespread use. Therefore, the aim of the study was to develop an elastic, highly porous and biodegradable β-tricalciumphosphate/poly(L-lactide-co-ε-caprolactone) (β-TCP/PLCL) composite for bone applications using supercritical CO2 foaming. Ability to support osteogenic differentiation was tested in human adipose stem cell (hASC) culture for 21 d. Biocompatibility was evaluated for 24 weeks in a rabbit femur-defect model. Foamed composites had a high ceramic content (50 wt%) and porosity (65-67 %). After 50 % compression, in an aqueous environment at 37 °C, tested samples returned to 95 % of their original height. Hydrolytic degradation of β-

TCP/PLCL composite, during the 24-week follow-up, was very similar to that of porous PLCL scaffold both in vitro and in vivo. Osteogenic differentiation of hASCs was demonstrated by alkaline phosphatase activity analysis, alizarin red staining, soluble collagen analysis, immunocytochemical staining and qRT-PCR. In vitro, hASCs formed a pronounced mineralised collagen matrix. A rabbit femur defect model confirmed biocompatibility of the composite. According to histological Masson-Goldner's trichrome staining and micro-computed tomography, β-TCP/PLCL composite did not elicit infection, formation of fibrous capsule or cysts. Finally, native bone tissue at 4 weeks was already able to grow on and in the β-TCP/PLCL composite. The elastic and highly porous β-TCP/PLCL composite is a promising bone substitute because it is osteoconductive and easy-to-use and mould intraoperatively.

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MoE publication type: A1 Journal article-refereed
Organisations: BioMediTech
Contributors: Pitkänen, S., Paakinaho, K., Pihlman, H., Ahola, N., Hannula, M., Asikainen, S., Manninen, M., Morelius, M., Keränen, P., Hyttinen, J., Kellomäki, M., Laitinen-Vapaavuori, O., Miettinen, S.
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Original language: English
ASJC Scopus subject areas: Bioengineering, Biochemistry, Biomaterials, Biomedical Engineering, Cell Biology
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Source: Scopus
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Photochemistry of dithiophosphinate $Ni(S_2P(i\text{-}Bu)_2)_2$ complex in CCl_4. Transient species and TD-DFT calculations
Femtosecond spectroscopy and nanosecond laser flash photolysis were used to study the photophysical and photochemical transformations of the bis-diisobutyl-dithiophosphinate Ni(II)complex ($Ni(S_2P(i\text{-}Bu)_2)_2$ = $Ni(dtpi)_2$, where $dtpi^- \equiv {}^-S_2P(i\text{-}Bu)_2$)in CCl_4 solutions. The radiation of second harmonic (405 nm)of Ti:Sapphire laser transfers the $Ni(dtpi)_2$ complex to an excited ^{1}LMCT state. Its decay in CCl_4 is described by three exponents with time constants 0.58, 2.0 and ~150 ps. The first process apparently involves the fast transitions from ^{1}LMCT state to ^{3}LMCT due to the intersystem crossing (ISC)and then to lower-lying “hot” ^{3}LF (Ligand Field)state. The second time constant, most likely, corresponds to the vibrational cooling of this “hot” ^{3}LF state. And the third slow process is the transition from ^{3}LF state to ground state (^{1}GS). The quantum yield of photochemical transformation under the 405 irradiation is close to zero, so the study of photochemistry was performed with a nanosecond flash photolysis at 308 nm. In this case an electron transfer from the excited $Ni(dtpi)_2$ complex to a solvent molecule leads to the appearance of primary intermediate, the $[ClNi(dtpi)(dtpi^{[rad]})]$complex, in which a $dtpi^{[rad]}$ radical is coordinated with a nickel ion via one sulfur atom. In the fast reaction with $Ni(dtpi)_2$, this complex forms a long-lived dimer $ClNi(dtpi)(dtpi^{[rad]})[Ni(dtpi)_2]$. This intermediate for a few hundred microseconds decays in the reaction of recombination with the formation of $(dtpi)_2$ disulphide and unstable ClNi(dtpi)complex. The insoluble $NiCl_2$ salt falled in CCl_4 as the sediment due to the reaction of two ClNi(dtpi)complexes. The quantum chemical calculations allowed to determine the geometry of the intermediate complexes arising in the photochemistry of $Ni(S_2P(i\text{-}Bu)_2)_2$ complex.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Voevodsky Institute of Chemical Kinetics and Combustion SB RAS, Novosibirsk State University, Boreskov Institute of Catalysis SB RAS, Nikolaev Institute of Inorganic Chemistry SB RAS
Contributors: Solovyev, A. I., Mikheylis, A. V., Plyusnin, V. F., Shubin, A. A., Grivin, V. P., Larionov, S. V., Tkachenko, N. V., Lemmetyinen, H.
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Alkane and wax ester production from lignin-related aromatic compounds
Lignin has potential as a sustainable feedstock for microbial production of industrially relevant molecules. However, the required lignin depolymerization yields a heterogenic mixture of aromatic monomers that are challenging substrates for the microorganisms commonly used in the industry. Here, we investigated the properties of lignin-related aromatic compounds (LRAs), namely coumarate, ferulate, and caffeate, in the synthesis of biomass and products in an LRA-utilizing bacterial host Acinetobacter baylyi ADP1. The biosynthesis products, wax esters, and alkanes are relevant compounds for the chemical and fuel industries. Here, wax esters were produced by a native pathway of ADP1, whereas alkanes were produced by a synthetic pathway introduced to the host. Using individual LRAs as substrates, the growth and product formation were monitored with internal biosensors and off-line analytics. Of the tested LRAs, coumarate was the most propitious in terms of product synthesis. Wax esters were produced from coumarate with yield and titer of 37 mg/gcoumarate and 202 mg/L, whereas alkanes were produced with a yield of 62.3 µg /gcoumarate and titer of 152 µg/L. This study demonstrates the microbial preference for certain LRAs and highlights the potential of A. baylyi ADP1 as a host for LRA upgrading to value-added products.

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Contributors: Salmela, M., Lehtinen, T., Efimova, E., Santala, S., Santala, V.
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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Applied Microbiology and Biotechnology
Keywords: Acinetobacter baylyi ADP1, alkane, lignin, wax ester
DOIs:

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Source ID: 85070728183
Research output: Contribution to journal › Article › Scientific › peer-review

Observation of Coexistence of Yu-Shiba-Rusinov States and Spin-Flip Excitations
We investigate the spectral evolution in different metal phthalocyanine molecules on NbSe2 surface using scanning tunnelling microscopy (STM) as a function of the coupling with the substrate. For manganese phthalocyanine (MnPc), we demonstrate a smooth spectral crossover from Yu-Shiba-Rusinov (YSR) bound states to spin-flip excitations. This has not been observed previously and it is in contrast to simple theoretical expectations. We corroborate the experimental findings using numerical renormalization group calculations. Our results provide fundamental new insight on the behavior of atomic

scale magnetic/SC hybrid systems, which is important, for example, for engineered topological superconductors and spin logic devices.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Aalto University, Jozef Stefan Institute, University of Ljubljana
Contributors: Kezilebieke, S., Žitko, R., Dvorak, M., Ojanen, T., Liljeroth, P.
Number of pages: 6
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Scopus rating (2019): CiteScore 20.5 SJR 5.786 SNIP 2.271
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: Magnetic impurity, scanning tunneling microscopy (STM), spin-flip excitation, superconductor, Yu-Shiba-Rusinov state
Electronic versions:

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http://urn.fi/URN:NBN:fi:tty-201909052070
Source: Scopus
Source ID: 85069329661
Research output: Contribution to journal › Article › Scientific › peer-review

An architectural understanding of natural sway frequencies in trees

The relationship between form and function in trees is the subject of a longstanding debate in forest ecology and provides the basis for theories concerning forest ecosystem structure and metabolism. Trees interact with the wind in a dynamic manner and exhibit natural sway frequencies and damping processes that are important in understanding wind damage. Tree-wind dynamics are related to tree architecture, but this relationship is not well understood. We present a comprehensive view of natural sway frequencies in trees by compiling a dataset of field measurement spanning conifers and broadleaves, tropical and temperate forests. The field data show that a cantilever beam approximation adequately predicts the fundamental frequency of conifers, but not that of broadleaf trees. We also use structurally detailed tree dynamics simulations to test fundamental assumptions underpinning models of natural frequencies in trees. We model the dynamic properties of greater than 1000 trees using a finite-element approach based on accurate three-dimensional model trees derived from terrestrial laser scanning data. We show that (1) residual variation, the variation not explained by the cantilever beam approximation, in fundamental frequencies of broadleaf trees is driven by their architecture; (2) slender trees behave like a simple pendulum, with a single natural frequency dominating their motion, which makes them vulnerable to wind damage and (3) the presence of leaves decreases both the fundamental frequency and the damping ratio. These findings demonstrate the value of new three-dimensional measurements for understanding wind impacts on trees and suggest new directions for improving our understanding of tree dynamics from conifer plantations to natural forests.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Computing Sciences, University of Oxford, SCION, University of Connecticut, Delft University of Technology, Wageningen University and Research Centre, University of Massachusetts Amherst, National Parks Board, University of Melbourne, Oregon State University, Universiteit Gent, National Physical Laboratory, University College London, NERC National Centre for Earth Observation (NCEO), 16 Center for International Forestry Research (CIFOR), Swedish University of Agricultural Sciences, INRA
Contributors: Jackson, T., Shenkin, A., Moore, J., Bunce, A., van Emmerik, T., Kane, B., Burcham, D., James, K., Selker, J., Calders, K., Origo, N., Disney, M., Burt, A., Wilkes, P., Raumonen, P., Gonzalez de Tanago Menaca, J., Lau, A., Herold, M., Goodman, R. C., Fourcaud, T., Malhi, Y.
Number of pages: 1

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Original language: English
ASJC Scopus subject areas: Biotechnology, Biophysics, Bioengineering, Biomaterials, Biochemistry, Biomedical Engineering
Keywords: finite-element analysis, fundamental frequency, natural frequencies, terrestrial laser scanning, tree architecture , wind damage
DOIs:

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Source: Scopus
Source ID: 85067464325
Research output: Contribution to journal › Article › Scientific › peer-review

Tailoring Second-Harmonic Emission from (111)-GaAs Nanoantennas
Second-harmonic generation (SHG) in resonant dielectric Mie-scattering nanoparticles has been hailed as a powerful platform for nonlinear light sources. While bulk-SHG is suppressed in elemental semiconductors, for example, silicon and germanium due to their centrosymmetry, the group of zincblende III-V compound semiconductors, especially (100)-grown AlGaAs and GaAs, have recently been presented as promising alternatives. However, major obstacles to push the technology toward practical applications are the limited control over directionality of the SH emission and especially zero forward/backward radiation, resulting from the peculiar nature of the second-order nonlinear susceptibility of this otherwise highly promising group of semiconductors. Furthermore, the generated SH signal for (100)-GaAs nanoparticles depends strongly on the polarization of the pump. In this work, we provide both theoretically and experimentally a solution to these problems by presenting the first SHG nanoantennas made from (111)-GaAs embedded in a low index material. These nanoantennas show superior forward directionality compared to their (100)-counterparts. Most importantly, based on the special symmetry of the crystalline structure, it is possible to manipulate the SHG radiation pattern of the nanoantennas by changing the pump polarization without affecting the linear properties and the total nonlinear conversion efficiency, hence paving the way for efficient and flexible nonlinear beam-shaping devices.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Nonlinear Optics, Physics, Australian National University, Friedrich-Schiller-University Jena, School of Engineering and Information Technology, University of New South Wales (UNSW) Australia, Russian Academy of Sciences
Contributors: Sautter, J. D., Xu, L., Miroshnichenko, A. E., Lysevych, M., Volkovskaya, I., Smirnova, D. A., Camacho-Morales, R., Zangeneh Kamali, K., Karouta, F., Vora, K., Tan, H. H., Kauranen, M., Staude, I., Jagadish, C., Neshev, D. N. , Rahmani, M.
Number of pages: 7
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ISSN (Print): 1530-6984
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Scopus rating (2019): CiteScore 20.5 SJR 5.786 SNIP 2.271
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: Dielectric nanoantennas, directional emission, III-V semiconductors, Mie resonance, multipolar interference, second harmonic generation
DOIs:

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Source: Scopus
Source ID: 85067057047
Research output: Contribution to journal › Article › Scientific › peer-review

Synthetic metabolic pathway for the production of 1-alkenes from lignin-derived molecules

Background: Integration of synthetic metabolic pathways to catabolically diverse chassis provides new opportunities for sustainable production. One attractive scenario is the use of abundant waste material to produce a readily collectable product, which can reduce the production costs. Towards that end, we established a cellular platform for the production of semivolatile medium-chain α-olefins from lignin-derived molecules: we constructed 1-undecene synthesis pathway in Acinetobacter baylyi ADP1 using ferulate, a lignin-derived model compound, as the sole carbon source for both cell growth and product synthesis. Results: In order to overcome the toxicity of ferulate, we first applied adaptive laboratory evolution to A. baylyi ADP1, resulting in a highly ferulate-tolerant strain. The adapted strain exhibited robust growth in 100 mM ferulate while the growth of the wild type strain was completely inhibited. Next, we expressed two heterologous enzymes in the wild type strain to confer 1-undecene production from glucose: a fatty acid decarboxylase UndA from Pseudomonas putida, and a thioesterase 'TesA from Escherichia coli. Finally, we constructed the 1-undecene synthesis pathway in the ferulate-tolerant strain. The engineered cells were able to produce biomass and 1-undecene solely from ferulate, and excreted the product directly to the culture headspace. Conclusions: In this study, we employed a bacterium Acinetobacter baylyi ADP1 to integrate a natural aromatics degrading pathway to a synthetic production route, allowing the upgradation of lignin derived molecules to value-added products. We developed a highly ferulate-tolerant strain and established the biosynthesis of an industrially relevant chemical, 1-undecene, solely from the lignin-derived model compound. This study reports the production of alkenes from lignin derived molecules for the first time and demonstrates the potential of lignin as a sustainable resource in the bio-based synthesis of valuable products.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy
Contributors: Luo, J., Lehtinen, T., Efimova, E., Santala, V., Santala, S.
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Article number: 48
ISSN (Print): 1475-2859
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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Applied Microbiology and Biotechnology
Keywords: 1-Alkenes, Acinetobacter baylyi, Adaptive laboratory evolution, Ferulate, Lignin
DOIs:

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Source: Scopus
Source ID: 85062867820
Research output: Contribution to journal › Article › Scientific › peer-review

Mining tailings as raw materials for reaction-sintered aluminosilicate ceramics: Effect of mineralogical composition on microstructure and properties

This paper presents studies on the utilization of aluminosilicate-based mining tailings as raw materials for mullite-based ceramics. Based on the 3:2 stoichiometric composition, mullite was synthesised by reactive sintering with a series of powder mixtures with alumina additions. X-ray diffractometry and scanning electron microscopy analyses revealed that, at the specific mineralogical composition, mullite structure formed surrounded by an amorphous glass phase in reaction-sintered powder mixtures. Results demonstrated that the chemical and mineralogical composition of mining tailings do have an effect on mullite formation possibilities and, only with the particular mineralogical composition, the mullite formation is possible regardless of the correct Al:Si ratio in tailings. Physical and mechanical properties of the formed ceramics were defined, showing comparable values to 3:2 mullite reference. Mullite structure formation enables a better thermal resistance up to above 1450 °C of the formed tailings-based ceramics compared to other aluminosilicates, reflecting their utilization potential for refractory ceramic applications.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland , Geologian tutkimuskeskus
Contributors: Karhu, M., Lagerbom, J., Solismaa, S., Honkanen, M., Ismailov, A., Räisänen, M. L., Huttunen-Saarivirta, E. , Levänen, E., Kivikytö-Reponen, P.
Pages: 4840-4848
Publication date: Mar 2019
Peer-reviewed: Yes
Early online date: 2018

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Journal: Ceramics International
Volume: 45
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ISSN (Print): 0272-8842
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Scopus rating (2019): CiteScore 6.1 SJR 0.891 SNIP 1.31
Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry
Keywords: Mining tailings, Mullite, Reaction sintering, Refractory ceramics, Utilization
DOIs:

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Bibliographical note
EXT="Lagerbom, Juha"
Source: Scopus
Source ID: 85057276435
Research output: Contribution to journal › Article › Scientific › peer-review

Solvent Welding and Imprinting Cellulose Nanofiber Films Using Ionic Liquids
Cellulose nanofiber films (CNFF) were treated via a welding process using ionic liquids (ILs). Acid-base-conjugated ILs derived from 1,5-diazabicyclo[4.3.0]non-5-ene [DBN] and 1-ethyl-3-methylimidazolium acetate ([emim][OAc]) were utilized. The removal efficiency of ILs from welded CNFF was assessed using liquid-state nuclear magnetic resonance (NMR) spectroscopy and Fourier transform infrared spectroscopy (FTIR). The mechanical and physical properties of CNFF indicated surface plasticization of CNFF, which improved transparency. Upon treatment, the average CNFF toughness increased by 27%, and the films reached a Young's modulus of ~5.8 GPa. These first attempts for IL "welding" show promise to tune the surfaces of biobased films, expanding the scope of properties for the production of new biobased materials in a green chemistry context. The results of this work are highly relevant to the fabrication of CNFFs using ionic liquids and related solvents.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Paper Converting and Packaging, Universidad Del Bío-Bío, Aalto University
Contributors: Reyes, G., Borghei, M., King, A. W. T., Lahti, J., Rojas, O. J.
Pages: 502-514
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Volume: 20
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ISSN (Print): 1525-7797
Ratings:

Scopus rating (2019): CiteScore 10 SJR 1.61 SNIP 1.276
Original language: English
ASJC Scopus subject areas: Bioengineering, Biomaterials, Polymers and Plastics, Materials Chemistry
DOIs:

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Source: Scopus
Source ID: 85059629357
Research output: Contribution to journal › Article › Scientific › peer-review

Kinetics and thermochemistry of the reaction of 3-methylpropargyl radical with molecular oxygen

We have measured the kinetics and thermochemistry of the reaction of 3-methylpropargyl radical (but-2-yn-1-yl) with molecular oxygen over temperature (223-681 K) and bath gas density ($1.2\text{-}15.0\times1016\ cm\text{-}3$) ranges employing photoionization mass-spectrometry. At low temperatures (223-304 K), the reaction proceeds overwhelmingly by a simple addition reaction to the $\text{-}CH2$ end of the radical, and the measured $CH3CCCH2•+O2$ reaction rate coefficient shows negative temperature dependence and depends on bath gas density. At intermediate temperatures (340-395 K), the addition reaction equilibrates and the equilibrium constant was determined at different temperatures. At high temperatures (465-681 K), the kinetics is governed by O_2 addition to the third carbon atom of the radical, and rate coefficient measurements were again possible. The high temperature $CH3CCCH2•+O2$ rate coefficient is much smaller than at low T, shows positive temperature dependence, and is independent of bath gas density. In the intermediate and high temperature ranges, we observe a formation signal for ketene (ethenone). The reaction was further investigated by combining the experimental results with quantum chemical calculations and master equation modeling. By making small adjustments ($2\text{-}3kJmol\text{-}1$) to the energies of two key transition states, the model reproduces the experimental results within uncertainties. The experimentally constrained master equation model was used to simulate the $CH3CCCH2•+O2$ reaction system at temperatures and pressures relevant to combustion.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Helsinki, Hungarian Academy of Sciences
Contributors: Pekkanen, T. T., Timonen, R. S., Lendvay, G., Rissanen, M. P., Eskola, A. J.
Number of pages: 8
Pages: 299-306
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Mechanical Engineering, Physical and Theoretical Chemistry
Keywords: Ab initio quantum chemistry, Combustion chemistry, Experimental gas kinetics, Master equation modeling, Propargyl radical
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Source ID: 85049566548
Research output: Contribution to journal › Article › Scientific › peer-review

A Pentacene-based Nanotube Displaying Enriched Electrochemical and Photochemical Activities

Unlike previously well-studied, acyclic pentacene oligomers, the first synthesis of a cyclic pentacene trimer with a fixed tubular conformation is reported. A short-step synthesis starting from common pentacenequinone yielded the target molecule with a 1.5 nanometer length and a subnanometer pore. Steady-state spectroscopic analyses revealed that the close proximity of the non-conjugated, three pentacene chromophores allows the nanotube to display stepwise electrochemical/chemical oxidation characteristics. Furthermore, time-resolved transient absorption measurements elucidated the generation of an excited triplet state of the nanotube, with high quantum yield reaching about 180 % through intramolecular singlet fission and a very long triplet lifetime.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Tokyo Institute of Technology, University of Yamanashi, Keio University
Contributors: Kuroda, K., Yazaki, K., Tanaka, Y., Akita, M., Sakai, H., Hasobe, T., Tkachenko, N. V., Yoshizawa, M.
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Peer-reviewed: Yes
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Publication information
Journal: Angewandte Chemie - International Edition
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Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all)
Keywords: macrocycles, nanotubes, pentacene, singlet fission, triplet states
DOIs:

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Source: Scopus
Source ID: 85059193866
Research output: Contribution to journal › Article › Scientific › peer-review

Cost-optimal energy performance measures in a new daycare building in cold climate
New municipal service buildings must be energy effective, and cost-optimality is one of the criteria for selecting the suitable energy performance improvement measures. A daycare building in a cold climate was studied by means of simulation-based, multi-objective optimisation. Using a genetic algorithm, both target energy use and life-cycle cost of the selected measures were minimised. It was found that extensive insulation of the building envelope is not a cost-optimal method to reduce the daycare building energy use. Improving energy efficiency of the ventilation system, utilising solar energy on-site and employing a light control strategy are preferable ways of improving the building energy performance. Ground-source heat pump is a more cost-optimal heating system for the daycare building than district heating. The cost-optimal sizing of the heat pump is small, only 28% of the required maximum heating power. Abbreviations: AHU: air handling unit; CAV: constant air volume; COMBI: comprehensive development of nearly zero-energy municipal service buildings; COP: coefficient of performance; DH: district heating; DHW: domestic hot water; EPBD: energy performance of buildings directive; EU: European Union; FINVAC: Finnish Association of HVAC Societies; GSHP: ground-source heat pump; HRU: heat recovery unit; IDA ICE: IDA Indoor Climate and Energy; LED: light-emitting diode; MOBO: multi-objective building optimisation tool; NSGA-II: Non-dominated Sorting Genetic Algorithm II; nZEB: nearly zero-energy building; PV: photovoltaic; TRY: test reference year; VAV: variable air volume; ZEB: zero-energy building

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Civil Engineering, Equa Simulation Finland Oy, Aalto University, Sweco Finland Oy
Contributors: Sankelo, P., Jokisalo, J., Nyman, J., Vinha, J., Sirén, K.
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Publication information
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Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes
Keywords: Building simulation, daycare building, life-cycle cost, multi-objective optimisation, simulation-based optimisation , target energy use
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Source ID: 85043677926
Research output: Contribution to journal › Article › Scientific › peer-review

Textile-integrated three-dimensional printed and embroidered structures for wearable wireless platforms
In this paper, we present fabrication and performance evaluation of three-dimensional (3D) printed and embroidered textile-integrated passive ultra high frequency radio frequency identification (RFID) platforms. The antennas were manufactured by 3D printing a stretchable silver conductor directly on an elastic band. The electric and mechanical joint between the 3D printed antennas and microchips was formed by gluing with conductive epoxy glue, by printing the antenna directly on top of the microchip structure, and by embroidering with conductive yarn. Initially, all types of fabricated RFID tags achieved read ranges of 8–9 meters. Next, the components were tested for wetting as well as for harsh cyclic strain and bending. The immersing and cyclic bending slightly affected the performance of the tags. However, they did not stop the tags from working in an acceptable way, nor did they have any permanent effect. The epoxy-glued or 3D printed antenna–microchip interconnections were not able to endure harsh stretching. On the other hand, the tags with the embroidered antenna–microchip interconnections showed excellent wireless performance, both during and after a 100 strong stretching cycles. Thus, the novel approach of combining 3D printing and embroidery seems to be a promising way to fabricate textile-integrated wireless platforms.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Wireless Identification and Sensing Systems Research Group
Contributors: He, H., Chen, X., Ukkonen, L., Virkki, J.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering (miscellaneous), Polymers and Plastics
Keywords: antennas, embroidery, interconnections, passive ultra high frequency radio frequency identification, stretchable electronics, textile-integrated electronics, three-dimensional printing, wearable platforms
DOIs:
10.1177/0040517517750649
Source: Scopus
Source ID: 85045101109
Research output: Contribution to journal › Article › Scientific › peer-review

Reliability evaluation of wearable radio frequency identification tags: Design and fabrication of a two-part textile antenna
Passive radio frequency identification-based technology is a convincing approach to the achievement of versatile energy- and cost-efficient wireless platforms for future wearable applications. By using two-part antenna structures, the antenna-electronics interconnections can remain non-stressed, which can significantly improve the reliability of the textile-embedded wireless components. In this article, we describe fabrication of two-part stretchable and non-stretchable passive ultra-high frequency radio frequency identification textile tags using electro-textile and embroidered antennas, and test their reliability when immersed as well as under cyclic strain. The results are compared to tags with traditional one-part dipole antennas fabricated from electro-textiles and by embroidery. Based on the results achieved, the initial read ranges of the two-part antenna tags, around 5 m, were only slightly shorter than those of the one-part antenna tags. In addition, the tag with two-part antennas can maintain high performance in a moist environment and during continuous stretching, unlike the one-part antenna tag where the antenna-integrated circuit attachment is under stress.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Wireless Identification and Sensing Systems Research Group

Contributors: Chen, X., Ukkonen, L., Virkki, J.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering (miscellaneous), Polymers and Plastics
Keywords: E-textile antenna, embroidery antenna, radio frequency identification
DOIs:

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Source: Scopus
Source ID: 85045121603
Research output: Contribution to journal › Article › Scientific › peer-review

Towards the EU emissions targets of 2050: optimal energy renovation measures of Finnish apartment buildings
Member countries of the European Union have released targets to reduce carbon dioxide emissions by 80% by the year 2050. Energy use in buildings is a major source of these emissions, which is why this study focused on the cost-optimal renovation of Finnish apartment buildings. Apartment buildings from four different construction years (pre-1976, 1976–2002, 2003–2009 and post-2010) were modelled, using three different heating systems: district heating, ground-source heat pump and exhaust air heat pump. Multi-objective optimisation was utilised to find the most cost-effective energy renovation measures. Most cost-effective renovation measures were ground-source heat pumps, demand-based ventilation and solar electricity. Additional thermal insulation of walls was usually too expensive. By performing only the cost-effective renovations, the emissions could be reduced by 80%, 82%, 69% and 68%, from the oldest to the newest buildings, respectively. This could be done with the initial investment cost of 296, 235, 115 and 104 €/m^2, respectively.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Civil Engineering, Aalto University, Nanjing Tech University
Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.
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Peer-reviewed: Yes
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Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595
Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes
Keywords: apartment building, Cost-optimal renovation, energy performance, greenhouse gas emissions, multi-objective optimisation
DOIs:

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Source: Scopus
Source ID: 85058681434
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of apartment building energy renovation on hourly power demand
Optimal energy renovations of apartment buildings in Finland have a great impact on annual energy demand. However, reduction of energy demand does not necessarily translate into similar changes in peak power demand. Four different types of apartment buildings, representing the Finnish apartment building stock, were examined after optimal energy retrofits to see the influence of retrofitting on hourly power demand. Switching from district heating to ground-source heat pumps reduced emissions significantly under current energy mix. However, the use of ground-source heat pumps

increased hourly peak electricity demand by 46–153%, compared to district heated apartment buildings. The corresponding increase in electrical energy demand was 30–108% in the peak month of January. This could increase the use of high emission peak power plants and negate some of the emission benefits. Solar thermal collectors and heat recovery systems could reduce purchased heating energy to zero in summer. Solar electricity could reduce median power demand in summer, but had only a little effect on peak power demand. The reduction in peak power demand after energy retrofits was less than the reduction in energy demand.

General information
Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Civil Engineering, Aalto University, Nanjing Tech University
Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.
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ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes
Keywords: apartment building, district heating, energy performance, Energy retrofits, greenhouse gas emissions, power demand
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Source ID: 85065643393
Research output: Contribution to journal › Article › Scientific › peer-review

Volatile fatty acid adsorption on anion exchange resins: kinetics and selective recovery of acetic acid
The removal of volatile fatty acids was examined through adsorption on anion exchange resins in batch systems. During the initial screening step, granular activated carbon and 11 anion exchange resins were tested and the resins Amberlite IRA-67 and Dowex optipore L-493 were chosen for further investigation. The adsorption kinetics and diffusion mechanism and adsorption isotherms of the two resins for VFA were evaluated. Based on the selective adsorption capacity of the resins, a sequential batch process was tested to achieve separation of acetic acid from the VFA mixture and selective recoveries > 85% acetic acid and ~ 75% propionic acid was achieved.

General information
Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Institute for Water Education
Contributors: Eregowda, T., Rene, E. R., Rintala, J., Lens, P. N.
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Peer-reviewed: Yes

Publication information
Journal: Separation Science and Technology (Philadelphia)
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Process Chemistry and Technology, Filtration and Separation
Keywords: anion-exchange resins, Brunauer-Emmett-Teller model, selective recovery, Volatile fatty acids
DOIs:

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Source: Scopus
Source ID: 85065190589
Research output: Contribution to journal › Article › Scientific › peer-review

Quality and Capacity Analysis of Molecular Communications in Bacterial Synthetic Logic Circuits

Synthetic logic circuits have been proposed as potential solutions for theranostics of biotechnological problems. One proposed model is the engineering of bacteria cells to create logic gates, and the communication between the bacteria populations will enable the circuit operation. In this paper, we analyse the quality of bacteria-based synthetic logic circuit through molecular communications that represent communication along a bus between three gates. In the bacteria-based synthetic logic circuit, the system receives environmental signals as molecular inputs and will process this information through a cascade of synthetic logic gates and free diffusion channels. We analyse the performance of this circuit by evaluating its quality and its relationship to the channel capacity of the molecular communications links that interconnect the bacteria populations. Our results show the effect of the molecular environmental delay and molecular amplitude differences over both the channel capacity and circuit quality. Furthermore, based on these metrics we also obtain an optimum region for the circuit operation resulting in an accuracy of 80% for specific conditions. These results show that the performance of synthetic biology circuits can be evaluated through molecular communications, and lays the groundwork for combined systems that can contribute to future biomedical and biotechnology applications.

General information

Publication status: Accepted/In press
MoE publication type: A1 Journal article-refereed
Organisations: Electrical Engineering, Waterford Institute of Technology
Contributors: Martins, D. P., Barros, M. T., Balasubramaniam, S.
Publication date: 2019
Peer-reviewed: Yes

Publication information

Journal: IEEE Transactions on Nanobioscience
ISSN (Print): 1536-1241
Ratings:

Scopus rating (2019): CiteScore 5.4 SJR 0.62 SNIP 1.01
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Medicine (miscellaneous), Biomedical Engineering, Pharmaceutical Science, Computer Science Applications, Electrical and Electronic Engineering
Keywords: Engineered bacteria, Logic circuits, Logic gates, Microorganisms, Molecular communication (telecommunication), Molecular communications, Sensors, Sociology, Statistics, Synthetic logic circuits
DOIs:

10.1109/TNB.2019.2930960
Source: Scopus
Source ID: 85070392121
Research output: Contribution to journal › Article › Scientific › peer-review

High-speed production of antibacterial fabrics using liquid flame spray

Healthcare associated infections (HAIs) are known as one of the major problems of the modern healthcare system, which result in additional cost and mortality. It has also been shown that pathogenic bacteria are mostly transferred via surfaces in healthcare settings. Therefore, antibacterial surfaces, which include fabrics and textiles, can be used in a healthcare environment to reduce the transfer of pathogenic bacteria, hence reducing HAIs. Silver nanoparticles have been shown to have broad spectrum antibacterial properties, and therefore they have been incorporated into fabrics to provide antibacterial functionality. Liquid flame spray (LFS) nanoparticle synthesis allows nanoparticles to be produced and deposited on surfaces at speeds up to and beyond 300 m/min. Herein, LFS is used to deposit silver nanoparticles onto two fabrics that are commonly used in the hospital environment with the aim of producing antibacterial fabrics. A thin plasma coating on top of the fabrics after silver deposition is used to improve nanoparticle adhesion. Fabrics coated with silver nanoparticles demonstrated antibacterial properties against Escherichia coli. Nanoparticle imaging and surface chemical characterization are performed using scanning electron microscopy and X-ray photoelectron spectroscopy. The highlights of this research are as follows: • high-speed synthesis and deposition of silver nanoparticles on fabrics; • plasma coating onto fabrics with silver nanoparticles; • antibacterial fabrics for potential use in healthcare environments.

General information

Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Aerosol Synthesis, Physics, Abo Akad Univ, Abo Akademi University, Dept Phys, RISE Research Institutes of Sweden AB, Turun yliopisto, University of Eastern Finland
Contributors: Brobbey, K. J., Haapanen, J., Tuominen, M., Mäkelä, J., Gunell, M., Eerola, E., Saarinen, J. J., Toivakka, M.
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Publication information

Journal: Textile Research Journal
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Scopus rating (2019): CiteScore 2.6 SJR 0.462 SNIP 1.44
Original language: English
ASJC Scopus subject areas: Chemical Engineering (miscellaneous), Polymers and Plastics
Keywords: antibacterial, fabrics, liquid flame spray, nanoparticles, plasma deposition, silver
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10.1177/0040517519866952
Source: Scopus
Source ID: 85071117647
Research output: Contribution to journal › Article › Scientific › peer-review

Activity Level and Body Mass Index as Predictors of Physical Workload During Working Career

The increasing prevalence of inactivity and obesity, along with aging, has implications on work capacity of labor force. This study reports the relationships between activity level and BMI by age with objectively measured physical workload. Data were examined from a sample of 19 481 Finnish employees using an estimate of minute-to-minute oxygen consumption based on R-R interval recordings. The mean estimated $\%VO_2max$ during the working day was 12.1 (±3.6) and 15.1 (±4.5)% for men and women, respectively. Based on a linear model, the mean $\%VO_2max$ increased by 1.5%-unit per 10-year increase in age, by 2.1%-unit per 5 kg/m^2 increase in BMI, and decreased by 1.6%-unit if improving physical activity class by two ($p < 0.001$ for all). Overweight and obesity, together with inactivity, notably increases workload throughout the career, even though at young adulthood, the daily workload is almost the same for each person regardless of the BMI, activity level, or gender. This study highlights the importance of regular physical activity and normal weight in protecting the worker from excessive physical (cardiovascular) workload during the whole working career.

General information

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Organisations: BioMediTech, Research group: Personal Health Informatics-PHI, Tyoterveyslaitos
Contributors: Mänttäri, S. K., Oksa, J. A., Virkkala, J., Pietilä, J. A.
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Ratings:

Scopus rating (2019): CiteScore 3.6 SJR 0.529 SNIP 1.996
Original language: English
ASJC Scopus subject areas: Safety, Risk, Reliability and Quality, Safety Research, Public Health, Environmental and Occupational Health, Chemical Health and Safety
Keywords: Aging worker, Big data, Functional capacity, Physical activity, Work ability
Electronic versions:

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http://urn.fi/URN:NBN:fi:tuni-201910153869
Source: Scopus
Source ID: 85072749291
Research output: Contribution to journal › Article › Scientific › peer-review

Structure and Dynamics of Thermosensitive pDNA Polyplexes Studied by Time-Resolved Fluorescence Spectroscopy

Combining multiple stimuli-responsive functionalities into the polymer design is an attractive approach to improve nucleic acid delivery. However, more in-depth fundamental understanding how the multiple functionalities in the polymer structures are influencing polyplex formation and stability is essential for the rational development of such delivery systems. Therefore, in this study the structure and dynamics of thermosensitive polyplexes were investigated by tracking the behavior of labeled plasmid DNA (pDNA) and polymer with time-resolved fluorescence spectroscopy using fluorescence resonance energy transfer (FRET). The successful synthesis of a heterofunctional poly(ethylene glycol) (PEG) macroinitiator containing both an atom transfer radical polymerization (ATRP) and reversible addition-fragmentation chain-transfer (RAFT) initiator is reported. The use of this novel PEG macroinitiator allows for the controlled polymerization of cationic and thermosensitive linear triblock copolymers and labeling of the chain-end with a fluorescent dye by maleimide-thiol chemistry. The polymers consisted of a thermosensitive poly(N-isopropylacrylamide) (PNIPAM, N), hydrophilic PEG (P), and cationic poly(2-(dimethylamino)ethyl methacrylate) (PDMAEMA, D) block, further referred to as NPD. Polymer block D chain-ends were labeled with Cy3, while pDNA was labeled with FITC. The thermosensitive NPD polymers were used to prepare pDNA polyplexes, and the effect of the N/P charge ratio, temperature, and composition of

the triblock copolymer on the polyplex properties were investigated, taking nonthermosensitive PD polymers as the control. FRET was observed both at 4 and 37 °C, indicating that the introduction of the thermosensitive PNIPAM block did not compromise the polyplex structure even above the polymer's cloud point. Furthermore, FRET results showed that the NPD- and PD-based polyplexes have a less dense core compared to polyplexes based on cationic homopolymers (such as PEI) as reported before. The polyplexes showed to have a dynamic character meaning that the polymer chains can exchange between the polyplex core and shell. Mobility of the polymers allow their uniform redistribution within the polyplex and this feature has been reported to be favorable in the context of pDNA release and subsequent improved transfection efficiency, compared to nondynamic formulations.

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Chemistry & Advanced Materials, Utrecht University, Helsinki University, Chemistry and Advanced Materials
Contributors: Fliervoet, L. A., Lisitsyna, E. S., Durandin, N. A., Kotsis, I., Maas-Bakker, R. F., Yliperttula, M., Hennink, W. E., Vuorimaa-Laukkanen, E., Vermonden, T.
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Ratings:

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Original language: English
ASJC Scopus subject areas: Bioengineering, Biomaterials, Polymers and Plastics, Materials Chemistry
Electronic versions:

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Source: Scopus
Source ID: 85073002500
Research output: Contribution to journal › Article › Scientific › peer-review

Large-scale efficient water harvesting using bioinspired micro-patterned copper oxide nanoneedle surfaces and guided droplet transport
As the Earth's atmosphere contains an abundant amount of water as vapors, a device which can capture a fraction of this water could be a cost-effective and practical way of solving the water crisis. There are many biological surfaces found in nature which display unique wettability due to the presence of hierarchical micro-nanostructures and play a major role in water deposition. Inspired by these biological microstructures, we present a large scale, facile and cost-effective method to fabricate water-harvesting functional surfaces consisting of high-density copper oxide nanoneedles. A controlled chemical oxidation approach on copper surfaces was employed to fabricate nanoneedles with controlled morphology, assisted by bisulfate ion adsorption on the surface. The fabricated surfaces with nanoneedles displayed high wettability and excellent fog harvesting capability. Furthermore, when the fabricated nanoneedles were subjected to hydrophobic coating, these were able to rapidly generate and shed coalesced droplets leading to further increase in fog harvesting efficiency. Overall, ~99% and ~150% increase in fog harvesting efficiency was achieved with non-coated and hydrophobic layer coated copper oxide nanoneedle surfaces respectively when compared to the control surfaces. As the transport of the harvested water is very important in any fog collection system, hydrophilic channels inspired by leaf veins were made on the surfaces via a milling technique which allowed an effective and sustainable way to transport the captured water and further enhanced the water collection efficiency by ~9%. The system presented in this study can provide valuable insights towards the design and fabrication of fog harvesting systems, adaptable to arid or semi-arid environmental conditions.

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MoE publication type: A1 Journal article-refereed
Organisations: BioMediTech, Research group: Surface Science, Physics, Research group: Bioinspired Materials and Robotics (BMR)
Contributors: Sharma, V., Yiannacou, K., Karjalainen, M., Lahtonen, K., Valden, M., Sariola, V.
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Issue number: 10
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Scopus rating (2019): CiteScore 1
Original language: English
ASJC Scopus subject areas: Engineering(all), Bioengineering, Atomic and Molecular Physics, and Optics, Materials Science(all), Chemistry(all)
Electronic versions:

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URLs:

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Source: Scopus
Source ID: 85073635162
Research output: Contribution to journal › Article › Scientific › peer-review

Mechanical impact stimulation platform tailored for high-resolution light microscopy
High frequency (HF) mechanical vibration has been used in vitro to study the cellular response to mechanical stimulation and induce stem cell differentiation. However, detailed understanding of the effect of the mechanical cues on cellular physiology is lacking. To meet this limitation, we have designed a system, which enables monitoring of living cells by high-resolution light microscopy during mechanical stimulation by HF vibration or mechanical impacts. The system consists of a commercial speaker, and a 3D printed sample vehicle and frame. The speaker moves the sample in the horizontal plane, allowing simultaneous microscopy. The HF vibration (30–200 Hz) performances of two vehicles made of polymer and aluminum were characterized with accelerometer. The mechanical impacts were characterized by measuring the acceleration of the aluminum vehicle and by time lapse imaging. The lighter polymer vehicle produced higher HF vibration magnitudes at 30–50 Hz frequencies than the aluminum vehicle. However, the aluminum vehicle performed better at higher frequencies (60–70 Hz, 90–100 Hz, 150 Hz). Compatibility of the system in live cell experiments was investigated with epithelial cells (MDCKII, expressing Emerald-Occludin) and HF (0.56 G_{peak}, 30 Hz and 60 Hz) vibration. Our findings indicated that our system is compatible with high-resolution live cell microscopy. Furthermore, the epithelial cells were remarkable stable under mechanical vibration stimulation. To conclude, we have designed an inexpensive tool for the studies of cellular biophysics, which combines versatile in vivo like mechanical stimuli with live cell imaging, showing a great potential for several cellular applications.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: BioMediTech, Research group: Computational Biophysics and Imaging Group
Contributors: Halonen, H. T., Hyttinen, J. A., Ihalainen, T. O.
Publication date: 2019
Peer-reviewed: Yes

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Journal: HEALTH AND TECHNOLOGY
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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Applied Microbiology and Biotechnology, Biomedical Engineering
Keywords: HF vibration, In vitro mechanical stimulation, Live cell imaging, Mechanical impacts, Mechanobiology, Real-time imaging
Electronic versions:

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DOIs:

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URLs:

http://urn.fi/URN:NBN:fi:tuni-201911296440
Source: Scopus
Source ID: 85074696220
Research output: Contribution to journal › Article › Scientific › peer-review

Deposition of dry particles on a fin-and-tube heat exchanger by a coupled soft-sphere DEM and CFD

In this study, a novel computational model is utilized for investigating fouling of two commonly encountered heat exchanger fin shapes in an air-conditioning application. The computational method utilizes the discrete element method (DEM) coupled with a large-eddy simulation (LES) framework. The fin-and-tube heat exchangers (FTHE) are investigated for three different Reynolds numbers (Re_{Dh} =243, 528, 793), three different particle sizes (D_p= 5, 10, 20 μm) and two different adhesive particle types based on the experimental values in the literature. The code is first benchmarked from the CFD and DEM viewpoints. A comprehensive fouling study of the FTHE's, consisting of altogether 36 simulations, is then carried out. The major numerical findings of the paper consist of the following four features. First, with low adhesive particles, the plain fin shape has a 3.45 higher volume fouling rate with Re_{Dh} =793 than at Re_{Dh} =264. With the herringbone fin shape, and the low adhesive particles, the volume fouling rate is 1.76 higher with Re_{Dh} =793 than at Re_{Dh} =264. Second, for the high adhesive particles, the plain fin has a 5.4 times higher volume fouling rate at Re_{Dh} =793 than for Re_{Dh} =264. The herringbone fin shape has a 3.92 times higher volume fouling rate with the highest Reynolds number of Re_{Dh} =793 compared to Re_{Dh} =264. Third, high adhesive particles have 3.0 times higher volume fouling rate than low adhesive particles for both fin shapes, all particle sizes and all Reynolds numbers combined. And finally, herringbone fins have 1.74 times higher volume fouling rate than plain fins for low adhesive particles. For high adhesive particles, herringbone has 1.8 times higher volume fouling rate and when both particle types are summed together, herringbone has a 1.78 times higher volume fouling rate than the plain fin shape. As a major finding of the study, the high adhesive particle collection efficiency increases monotonously with the Stokes and Reynolds numbers while low adhesive particle collection efficiency poses a non-monotonous trend.

General information

Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, Aalborg University, Aalto University
Contributors: Välikangas, T., Hærvig, J., Kuuluvainen, H., Dal Maso, M., Peltonen, P., Vuorinen, V.
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Peer-reviewed: Yes

Publication information

Journal: International Journal of Heat and Mass Transfer
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ISSN (Print): 0017-9310
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Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Mechanical Engineering, Fluid Flow and Transfer Processes
Keywords: CFD-DEM, Dry-particle, Fin-and-tube heat exchanger, Fouling, Herringbone fin, Large-eddy simulation, Plain fin, Soft sphere
DOIs:

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http://urn.fi/URN:NBN:fi:tuni-202001151307. Embargo ends: 15/01/22
Source: Scopus
Source ID: 85075984403
Research output: Contribution to journal › Article › Scientific › peer-review

Synergistic Computational-Experimental Discovery of Highly Selective PtCu Nanocluster Catalysts for Acetylene Semihydrogenation

Semihydrogenation of acetylene (SHA) in an ethylene-rich stream is an important process for polymer industries. Presently, Pd-based catalysts have demonstrated good acetylene conversion (X_{C2H2}), however, at the expense of ethylene selectivity (S_{C2H4}). In this study, we have employed a systematic approach using density functional theory (DFT) to identify the best catalyst in a Cu-Pt system. The DFT results showed that with a 55 atom system at ~1.1 Pt/Cu ratio for $Pt_{28}Cu_{27}/Al_2O_3$, the d-band center shifted -2.2 eV relative to the Fermi level leading to electron-saturated Pt, which allows only adsorption of ethylene via a π-bond, resulting in theoretical 99.7% S_{C2H4} at nearly complete X_{C2H2}. Based on the DFT results, Pt-Cu/Al_2O_3 (PtCu) and Pt/Al_2O_3 (Pt) nanocatalysts were synthesized via cluster beam deposition (CBD), and their properties and activities were correlated with the computational predictions. For bimetallic PtCu, the electron microscopy results show the formation of alloys. The bimetallic PtCu catalyst closely mimics the DFT predictions in terms of both electronic structure, as confirmed by X-ray photoelectron spectroscopy, and catalytic activity. The alloying of Pt with Cu was responsible for the high C_2H_4 specific yield resulting from electron transfer between Cu and Pt, thus making PtCu a promising catalyst for SHA.

General information
Publication status: E-pub ahead of print
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Research group: Materials and Molecular Modeling, INL - International Iberian Nanotechnology, University of Swansea, Edifici CM3, Iowa State University, U.S. Department of Energy, Catalan Institute for Research and Advanced Studies (ICREA)
Contributors: Ayodele, O. B., Cai, R., Wang, J., Ziouani, Y., Liang, Z., Spadaro, M. C., Kovnir, K., Arbiol, J., Akola, J., Palmer, R. E., Kolen'Ko, Y. V.
Number of pages: 7
Pages: 451-457
Publication date: 2019
Peer-reviewed: Yes

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Journal: ACS CATALYSIS
ISSN (Print): 2155-5435
Ratings:

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Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all)
Keywords: alloys, cluster beam deposition, hydrogenation, microkinetic model, nanoclusters
DOIs:

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Source: Scopus
Source ID: 85076730121
Research output: Contribution to journal › Article › Scientific › peer-review

Characterization of the anisotropic deformation of the right ventricle during open heart surgery
Digital Image Correlation (DIC) was used for studying the anisotropic behavior of the thin walled right ventricle of the human heart. Strains measured with Speckle Tracking Echocardiography (STE) were compared with the DIC data. Both DIC and STE were used to measure longitudinal strains of the right ventricle in the beginning of an open-heart surgery as well as after the cardiopulmonary bypass. Based on the results, the maximum end-systolic strains obtained with the DIC and STE change similarly during the surgery with less than 10% difference. The difference is largely due to the errors in matching the longitudinal direction in the two methods, sensitivity of the measurement to the positioning of the virtual extensometer of in both STE and DIC, and physiological difference of the measurements as the DIC measures the top surface of the heart whereas the STE obtains the data from below. The anisotropy of the RV was measured using full field principal strains acquired from the DIC displacement fields. The full field principal strains cover the entire region of interest instead of just two points as the virtual extensometer approach used by the STE. The principal strains are not direction dependent measures, and therefore are more independent of the anatomy of the patient and the exact positioning of the virtual strain gage or the STE probe. The results show that the longitudinal strains alone are not enough to fully characterize the behavior of the heart, as the deformation of the heart can be very anisotropic, and the anisotropy changes during the surgery, and from patient to patient.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Materials Characterization, Hospital Heart Center, Tampere University
Contributors: Soltani, A., Lahti, J., Järvelä, K., Laurikka, J., Kuokkala, V. T., Hokka, M.
Number of pages: 12
Publication date: 2019
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Journal: COMPUTER METHODS IN BIOMECHANICS AND BIOMEDICAL ENGINEERING
ISSN (Print): 1025-5842
Ratings:

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Original language: English
ASJC Scopus subject areas: Bioengineering, Biomedical Engineering, Human-Computer Interaction, Computer Science Applications
Keywords: anisotropy, biomaterial characterization, deformation, digital image correlation, heart muscle, Human biomechanics, motion
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Research output: Contribution to journal › Article › Scientific › peer-review

How well can we predict cluster fragmentation inside a mass spectrometer?
Fragmentation of molecular clusters inside mass spectrometers is a significant source of uncertainty in a wide range of chemical applications. We have measured the fragmentation of sulfuric acid clusters driving atmospheric new-particle formation, and developed a novel model, based on first principles calculations, capable of quantitatively predicting the extent of fragmentation.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Helsinki, Beijing University of Chemical Technology, CNRS, Centre National de la Recherche Scientifique (CNRS), Universite de Bordeaux - PRES, Lab Bordelais Rech Informat, PICTURA Res Grp, UMR 5800
Contributors: Passananti, M., Zapadinsky, E., Zanca, T., Kangasluoma, J., Myllys, N., Rissanen, M. P., Kurtén, T., Ehn, M. , Attoui, M., Vehkamäki, H.
Number of pages: 4
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ISSN (Print): 1359-7345
Ratings:

Scopus rating (2019): CiteScore 9.8 SJR 1.992 SNIP 1.144
Original language: English
ASJC Scopus subject areas: Catalysis, Electronic, Optical and Magnetic Materials, Ceramics and Composites, Chemistry(all), Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry
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http://www.scopus.com/inward/record.url?scp=85065980333&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
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Research output: Contribution to journal › Article › Scientific › peer-review

Less Is More: Enhancement of Second-Harmonic Generation from Metasurfaces by Reduced Nanoparticle Density
We investigate optical second-harmonic generation (SHG) from metasurfaces where noncentrosymmetric V-shaped gold nanoparticles are ordered into regular array configurations. In contrast to expectations, a substantial enhancement of the SHG signal is observed when the number density of the particles in the array is reduced. More specifically, by halving the number density, we obtain over 5-fold enhancement in SHG intensity. This striking result is attributed to favorable interparticle interactions mediated by the lattice, where surface-lattice resonances lead to spectral narrowing of the plasmon resonances. Importantly, however, the results cannot be explained by the improved quality of the plasmon resonance alone. Instead, the lattice interactions also lead to further enhancement of the local fields at the particles. The experimental observations agree very well with results obtained from numerical simulations including lattice interactions.

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MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Institute of Physics, Nicolaus Copernicus University, University of Eastern Finland, CRPP
Contributors: Czaplicki, R., Kiviniemi, A., Huttunen, M. J., Zang, X., Stolt, T., Vartiainen, I., Butet, J., Kuittinen, M., Martin, O. J., Kauranen, M.
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Publication information

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ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
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http://urn.fi/URN:NBN:fi:tuni-201910223989. Embargo ended: 13/11/19
URLs:
https://arxiv.org/abs/1808.06439 (ArXiv version)
Source: Scopus
Source ID: 85058303843
Research output: Contribution to journal › Article › Scientific › peer-review

Dynamic decoupling of biomass and wax ester biosynthesis in Acinetobacter baylyi by an autonomously regulated switch

For improving the microbial production of fuels and chemicals, gene knock-outs and overexpression are routinely applied to intensify the carbon flow from substrate to product. However, their possibilities in dynamic control of the flux between the biomass and product synthesis are limited, whereas dynamic metabolic switches can be used for optimizing the distribution of carbon and resources. The production of single cell oils is especially challenging, as the synthesis is strictly regulated, competes directly with biomass, and requires defined conditions, such as nitrogen limitation. Here, we engineered a metabolic switch for redirecting carbon flow from biomass to wax ester production in Acinetobacter baylyi ADP1 using acetate as a carbon source. Isocitrate lyase, an essential enzyme for growth on acetate, was expressed under an arabinose inducible promoter. The autonomous downregulation of the expression is based on the gradual oxidation of the arabinose inducer by a glucose dehydrogenase gcd. The depletion of the inducer, occurring simultaneously to acetate consumption, switches the cells from a biomass mode to a lipid synthesis mode, enabling the efficient channelling of carbon to wax esters in a simple batch culture. In the engineered strain, the yield and titer of wax esters were improved by 3.8 and 3.1 folds, respectively, over the control strain. In addition, the engineered strain accumulated wax esters 19% of cell dry weight, being the highest reported among microbes. The study provides important insights into the dynamic engineering of the biomass-dependent synthesis pathways for the improved production of biocompounds from low-cost and sustainable substrates.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy
Contributors: Santala, S., Efimova, E., Santala, V.
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ISSN (Print): 2214-0301
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Scopus rating (2018): CiteScore 7.4 SJR 1.699 SNIP 1.112
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering
Keywords: Acetate, Autonomous circuit, Decoupling, Dynamic control, Lipid biosynthesis, Wax esters
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URLs:

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Source: Scopus
Source ID: 85053844687
Research output: Contribution to journal › Article › Scientific › peer-review

The importance of controlled mismatch of biomechanical compliances of implantable scaffolds and native tissue for articular cartilage regeneration

Scaffolds for articular cartilage repair have to be optimally biodegradable with simultaneous promotion of hyaline cartilage formation under rather complex biomechanical and physiological conditions. It has been generally accepted that scaffold structure and composition would be the best when it mimics the structure of native cartilage. However, a reparative construct mimicking the mature native tissue in a healing tissue site presents a biological mismatch of reparative stimuli. In this work, we studied a new recombinant human type III collagen-polylactide (rhCol-PLA) scaffolds. The rhCol-PLA scaffolds were assessed for their relative performance in simulated synovial fluids of 1 and 4 mg/mL sodium hyaluronate with application of model-free analysis with Biomaterials Enhanced Simulation Test (BEST). Pure PLA scaffold was used as a control. The BEST results were compared to the results of a prior in vivo study with rhCol-PLA. Collectively the data indicated that a successful articular cartilage repair require lower stiffness of the scaffold compared to surrounding cartilage yet matching the strain compliance both in static and dynamic conditions. This ensures an optimal combination of load transfer and effective oscillatory nutrients supply to the cells. The results encourage further development of intelligent scaffold structures for optimal articular cartilage repair rather than simply trying to imitate the respective original tissue.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Aalto University, Seqvera Ltd., University of Helsinki
Contributors: Gasik, M., Zühlke, A., Haaparanta, A., Muhonen, V., Laine, K., Bilotsky, Y., Kellomäki, M., Kiviranta, I.
Publication date: 30 Nov 2018
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Publication information

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Issue number: NOV
Article number: 187
ISSN (Print): 2296-4185
Ratings:

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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Histology, Biomedical Engineering
Keywords: Articular cartilage, Biomechanics, Collagen, PLA, Scaffold, Synovial fluid, Testing
Electronic versions:

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Source: Scopus
Source ID: 85058709882
Research output: Contribution to journal › Article › Scientific › peer-review

Aminobenzylated 4-Nitrophenols as Antibacterial Agents Obtained from 5-Nitrosalicylaldehyde through a Petasis Borono-Mannich Reaction

Multidrug-resistant bacteria are one of the current biggest threats to public health and are responsible for most nosocomial infections. Herein, we report the efficient and facile synthesis of antibacterial agents aminoalkylphenols, derived from 5-nitrosalicyladehyde and prepared through a Petasis borono-Mannich multicomponent reaction. Minimum inhibitory concentrations (MICs) as low as 1.23 μM for a chlorine derivative were determined for multidrug-resistant Gram-positive bacteria, namely, Staphylococcus aureus and Enterococcus faecalis, two of the main pathogens responsible for infections in a hospital environment. The most promising antibacterial agents were further tested against eight strains of four Gram-positive species in order to elucidate their antibacterial broadness. In vitro cytotoxicity assays of the most active aminoalkylphenol revealed considerably lower toxicity against mammalian cells, as concentrations one order of magnitude higher than the determined MICs were required to induce human keratinocyte cell death. The phenol moiety was verified to be important in deeming the antibacterial properties of the analyzed compounds, although no correlation between such properties and their antioxidant activity was observed. A density functional theory computational study substantiated the ability of aminoalkylphenols to serve as precursors of ortho-quinone methides.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, CBIOS-Universidade Lusófona Research Center for Biosciences and Health Technologies, National Institute of Health, Faculdade de Farmacia da Universidade de Lisboa
Contributors: Rimpiläinen, T., Andrade, J., Nunes, A., Ntungwe, E., Fernandes, A. S., Vale, J. R., Rodrigues, J., Gomes, J. P., Rijo, P., Candeias, N. R.
Number of pages: 12
Pages: 16191-16202
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Publication information
Journal: ACS Omega
Volume: 3
Issue number: 11
ISSN (Print): 2470-1343
Ratings:

Scopus rating (2018): CiteScore 1.4 SJR 0.754 SNIP 0.683
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
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Source: Scopus
Source ID: 85057603661
Research output: Contribution to journal › Article › Scientific › peer-review

High-Yield Generation of Triplet Excited States by an Efficient Sequential Photoinduced Process from Energy Transfer to Singlet Fission in Pentacene-Modified CdSe/ZnS Quantum Dots
Singlet fission (SF) is expected to improve photoenergy conversion systems by generating two electrons from one photon. Pentacenes meet the energy-level matching condition between a singlet and two triplet states: [$E(S_1) \geq 2E(T_1)$]. However, the molar absorption coefficients of pentacenes in the approximately 400–500 nm region are limited, whereas quantum dots, such as CdSe/ZnS (QD), possess high fluorescence quantum yields and particle-size-dependent fluorescence wavelengths. Thus, a combination of QD (D) and pentacene (A) provides a system of both an enhanced light-harvesting efficiency throughout the solar spectrum and an efficient conversion of the harvested light into the triplet states by SF. Based on these points, m-phenylene-bridged triisopropylsilane (TIPS)-pentacene dimer-functionalized QD (denoted as m-$(Pc)_2$-QD) was synthesized to examine the sequential photoinduced process from energy transfer to SF. In femtosecond transient absorption measurements, initial energy transfer from QD to pentacene (quantum yield: 87 %) and subsequent SF were efficiently observed. The quantum yield of triplet states of pentacene units (Φ_T) based on the excitation of QD attained is 160±6.7 %.

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, Keio University
Contributors: Sakai, H., Inaya, R., Tkachenko, N. V., Hasobe, T.
Number of pages: 10
Pages: 17062-17071
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Publication information
Journal: Chemistry - A European Journal
Volume: 24
Issue number: 64
ISSN (Print): 0947-6539
Ratings:

Scopus rating (2018): CiteScore 8.7 SJR 1.842 SNIP 0.98
Original language: English
ASJC Scopus subject areas: Catalysis, Organic Chemistry

Keywords: energy transfer, pentacene, quantum dot, sequential photophysical process, singlet fission
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Research output: Contribution to journal › Article › Scientific › peer-review

Molecular-Scale Ligand Effects in Small Gold-Thiolate Nanoclusters

Because of the small size and large surface area of thiolate-protected Au nanoclusters (NCs), the protecting ligands are expected to play a substantial role in modulating the structure and properties, particularly in the solution phase. However, little is known on how thiolate ligands explicitly modulate the structural properties of the NCs at atomic level, even though this information is critical for predicting the performance of Au NCs in application settings including as a catalyst interacting with small molecules and as a sensor interacting with biomolecular systems. Here, we report a combined experimental and theoretical study, using synchrotron X-ray spectroscopy and quantum mechanics/molecular mechanics simulations, that investigates how the protecting ligands impact the structure and properties of small $Au_{18}(SR)_{14}$ NCs. Two representative ligand types, smaller aliphatic cyclohexanethiolate and larger hydrophilic glutathione, are selected, and their structures are followed experimentally in both solid and solution phases. It was found that cyclohexanethiolate ligands are significantly perturbed by toluene solvent molecules, resulting in structural changes that cause disorder on the surface of $Au_{18}(SR)_{14}$ NCs. In particular, large surface cavities in the ligand shell are created by interactions between toluene and cyclohexanethiolate. The appearance of these small molecule-accessible sites on the NC surface demonstrates the ability of Au NCs to act as a catalyst for organic phase reactions. In contrast, glutathione ligands encapsulate the Au NC core via intermolecular interactions, minimizing structural changes caused by interactions with water molecules. The much better protection from glutathione ligands imparts a rigidified surface and ligand structure, making the NCs desirable for biomedical applications due to the high stability and also offering a structural-based explanation for the enhanced photoluminescence often reported for glutathione-protected Au NCs.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Dalhousie University, Universitat Autonoma de Barcelona, Spain, Catalan Institute for Research and Advanced Studies (ICREA), Carnegie Mellon University, National University of Singapore, Norwegian Univ. of Sci. and Technol.
Contributors: Chevrier, D. M., Raich, L., Rovira, C., Das, A., Luo, Z., Yao, Q., Chatt, A., Xie, J., Jin, R., Akola, J., Zhang, P.
Number of pages: 7
Pages: 15430-15436
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Publication information

Journal: Journal of the American Chemical Society
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Ratings:
Scopus rating (2018): CiteScore 24.4 SJR 7.468 SNIP 2.652
Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all), Biochemistry, Colloid and Surface Chemistry
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Source: Scopus
Source ID: 85056236370
Research output: Contribution to journal › Article › Scientific › peer-review

Chromatographic studies of n-Propyl Propionate: Adsorption equilibrium, modelling and uncertainties determination

The n-Propyl Propionate (ProPro) is a compound that has several possible industrial applications. However, the current production route of this component presents several problems, such as the downstream purification. In this way, chromatographic separation could be an alternative solution to the downstream purification. In this work experimental studies of the ProPro reaction system separation in a chromatographic fixed bed unit packed with Amberlyst 46 were performed. The adsorption equilibrium isotherms and the corresponding Langmuir model parameters were determined. A phenomenological model to represent the process was developed and validated through the experimental data. Meanwhile, it is proposed the characterization of the uncertainties of all steps and its extension to the model prediction, which allowed to estimate the model parameters with a reduced number of experiments, when compared with other reports in the literature; nevertheless, the final results lead to a statistically more reliable model.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, Research group: Automation and Systems Theory, Universidade do Porto, Federal Univ. of Bahia
Contributors: Nogueira, I. B., Faria, R. P., Requião, R., Koivisto, H., Martins, M. A., Rodrigues, A. E., Loureiro, J. M., Ribeiro, A. M.
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Journal: Computers and Chemical Engineering
Volume: 119
ISSN (Print): 0098-1354
Ratings:

Scopus rating (2018): CiteScore 6.1 SJR 0.932 SNIP 1.562
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Computer Science Applications
Keywords: Adsorption equilibrium isotherms, Confidence region, Fixed bed adsorptive unit, n-Propyl Propionate, Particle swarm optimization
DOIs:

10.1016/j.compchemeng.2018.09.020
Source: Scopus
Source ID: 85054180293
Research output: Contribution to journal › Article › Scientific › peer-review

Tribocorrosion behaviour of aluminium bronze in 3.5 wt.% NaCl solution
Tribocorrosion behaviour of aluminium bronze CuAl10Fe5Ni5 in 3.5 wt.% NaCl solution was investigated in a pin-on-disc facility containing an electrochemical cell. Oxidising capacity and contact pressure to alumina counterbody were varied. Pure corrosion occurred as selective dissolution of α phase included in the eutectoid structure. Contact to counterbody introduced plastic deformation, extrusion of the material and abrasive wear. Wear-corrosion interactions varied between the two contact pressures, with lower material losses appearing at the higher pressure. The significant acceleration of material degradation by the interactions was not clearly reflected to kinetics or thermodynamics of corrosion. These results are presented and discussed here.

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MoE publication type: A1 Journal article-refereed
Organisations: Photonics, VTT Technical Research Centre of Finland
Contributors: Huttunen-Saarivirta, E., Isotahdon, E., Metsäjoki, J., Salminen, T., Carpén, L., Ronkainen, H.
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Journal: Corrosion Science
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Ratings:

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Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Materials Science(all)
Keywords: Corrosion, Plastic deformation, Selective dissolution, Tribocorrosion, Wear
DOIs:

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Bibliographical note
EXT="Huttunen-Saarivirta, E."
EXT="Isotahdon, E."
EXT="Metsäjoki, J."
Source: Scopus
Source ID: 85053038794

Novel osteoconductive β-tricalcium phosphate/poly(L-lactide-co-ε-caprolactone) scaffold for bone regeneration: a study in a rabbit calvarial defect

The advantages of synthetic bone graft substitutes over autogenous bone grafts include abundant graft volume, lack of complications related to the graft harvesting, and shorter operation and recovery times for the patient. We studied a new synthetic supercritical CO_2 –processed porous composite scaffold of β-tricalcium phosphate and poly(L-lactide-co-caprolactone) copolymer as a bone graft substitute in a rabbit calvarial defect. Bilateral 12 mm diameter critical size calvarial defects were successfully created in 18 rabbits. The right defect was filled with a scaffold moistened with bone marrow aspirate, and the other was an empty control. The material was assessed for applicability during surgery. The follow-up times were 4, 12, and 24 weeks. Radiographic and micro-CT studies and histopathological analysis were used to evaluate new bone formation, tissue ingrowth, and biocompatibility. The scaffold was easy to shape and handle during the surgery, and the bone-scaffold contact was tight when visually evaluated after the implantation. The material showed good biocompatibility and its porosity enabled rapid invasion of vasculature and full thickness mesenchymal tissue ingrowth already at four weeks. By 24 weeks, full thickness bone ingrowth within the scaffold and along the dura was generally seen. In contrast, the empty defect had only a thin layer of new bone at 24 weeks. The radiodensity of the material was similar to the density of the intact bone. In conclusion, the new porous scaffold material, composed of microgranular β-TCP bound into the polymer matrix, proved to be a promising osteoconductive bone graft substitute with excellent handling properties. [Figure not available: see fulltext.].

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Electronics and Communications Engineering, Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, Faculty of Veterinary Medicine, University of Helsinki, Orton Orthopaedic Hospital, Muonio Health Center
Contributors: Pihlman, H., Keränen, P., Paakinaho, K., Linden, J., Hannula, M., Manninen, I. K., Hyttinen, J., Manninen, M. , Laitinen-Vapaavuori, O.
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Publication information

Journal: Journal of Materials Science: Materials in Medicine
Volume: 29
Issue number: 10
Article number: 156
ISSN (Print): 0957-4530
Ratings:

Scopus rating (2018): CiteScore 4.7 SJR 0.612 SNIP 0.855
Original language: English
ASJC Scopus subject areas: Biophysics, Bioengineering, Biomaterials, Biomedical Engineering
DOIs:

10.1007/s10856-018-6159-9
Source: Scopus
Source ID: 85054473480

Molecular Communications Pulse-based Jamming Model for Bacterial Biofilm Suppression

Studies have recently shown that the bacteria survivability within biofilms is responsible for the emergence of superbugs. The combat of bacterial infections, without enhancing its resistance to antibiotics, includes the use of nanoparticles to quench the quorum sensing of these biofilm-forming bacteria. Several sequential and parallel multi-stage communication processes are involved in the formation of biofilms. In this paper, we use proteomic data from a wet lab experiment to identify the communication channels that are vital to these processes.We also identified the main proteins from each channel and propose the use of jamming signals from synthetically engineered bacteria to suppress the production of those proteins. This biocompatible technique is based on synthetic biology and enables the inhibition of biofilm formation. We analyse the communications performance of the jamming process, by evaluating the path loss for a number of conditions that include different engineered bacterial population sizes, distances between the populations and molecular signal power. Our results show that sufficient molecular pulsebased jamming signals are able to prevent the biofilm formation by creating lossy communications channels (almost -3 dB for certain scenarios). From these results, we define the main design parameters to develop a fully operational bacteria-based jamming system.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Waterford Institute of Technology, Kasetsart University
Contributors: Martins, D. P., Leetanasaksakul, K., Barros, M. T., Thamchaipenet, A., Donnelly, W., Balasubramaniam, S.
Number of pages: 12
Pages: 533-542
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Journal: IEEE Transactions on Nanobioscience
Volume: 17
Issue number: 4
ISSN (Print): 1536-1241
Ratings:

Scopus rating (2018): CiteScore 5 SJR 0.541 SNIP 0.792
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Medicine (miscellaneous), Biomedical Engineering, Pharmaceutical Science, Computer Science Applications, Electrical and Electronic Engineering
Keywords: Biofilm suppression, Communications systems, Jamming, Synthetic logic circuits
DOIs:

10.1109/TNB.2018.2871276
Source: Scopus
Source ID: 85053611196
Research output: Contribution to journal › Article › Scientific › peer-review

Temperature control as key factor for optimal biohydrogen production from thermomechanical pulping wastewater
This study evaluates the use of non-pretreated thermo-mechanical pulping (TMP) wastewater as a potential substrate for hydrogen production by dark fermentation. Batch incubations were conducted in a temperature gradient incubator at temperatures ranging from 37 to 80 °C, using an inoculum from a thermophilic, xylose-fed, hydrogen-producing fluidised bed reactor. The aim was to assess the short-term response of the microbial communities to the different temperatures with respect to both hydrogen yield and composition of the active microbial community. High throughput sequencing (MiSeq) of the reversely transcribed 16S rRNA showed that Thermoanaerobacterium sp. dominated the active microbial community at 70 °C, resulting in the highest hydrogen yield of 3.6 (±0.1) mmol H_2 g^{-1} COD_{tot} supplied. Lower hydrogen yields were obtained at the temperature range from 37 to 65 °C, likely due to consumption of the produced hydrogen by homoacetogenesis. No hydrogen production was detected at temperatures above 70 °C. Thermomechanical pulping wastewaters are released at high temperatures (50–80 °C), and thus dark fermentation at 70 °C could be sustained using the heat produced by the pulp and paper plant itself without any requirement for external heating.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Research group: Industrial Bioengineering and Applied Organic Chemistry, Natl. University of Ireland, Galway, Institute for Water Education, UNESCO–IHE
Contributors: Dessì, P., Porca, E., Lakaniemi, A., Collins, G., Lens, P. N.
Number of pages: 8
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Publication information
Journal: Biochemical Engineering Journal
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Ratings:

Scopus rating (2018): CiteScore 6 SJR 0.904 SNIP 1.167
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Environmental Engineering, Biomedical Engineering
Keywords: Dark fermentation, MiSeq, Pulp and paper mill wastewater, Thermoanaerobacterium, Thermomechanical pulping, Thermophilic
Electronic versions:

Temperature control as key factor

Dessi et al. 2018 - Temperature control for optimal biohydrogen production from TMP wastewater. Embargo ended: 7/06/20

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URLs:
http://urn.fi/URN:NBN:fi:tty-201901231145
Source: Scopus
Source ID: 85048157059
Research output: Contribution to journal › Article › Scientific › peer-review

Electro-concentration for chemical-free nitrogen capture as solid ammonium bicarbonate

Source-separated urine is a promising stream for nutrient capture using electrochemical technologies. It contains the majority of macronutrients present in municipal wastewater in a concentrated, high ionic conductivity liquid and in N:P:K ratios suitable for agricultural application. The purpose of this study was to recover nutrients from urine, and particularly nitrogen as a solid without any chemical addition. Simulated source-separated urine was concentrated using a three-compartment electrochemical system, applying a range of current densities and feed compositions. Electro-concentration into a liquid concentrate reached maximum recovery of 72:61:79% for N:P:K, respectively, from a synthetic feed simulating ureolysed and digested urine, with a specific electrical energy consumption of 47 MJ/kg N and current efficiency of 67% for ammonium. Cooling the concentrate to −18 °C resulted in solid ammonium bicarbonate crystal formation in samples with high ammonium bicarbonate ionic product and high relative ammonium bicarbonate ionic strength. Precipitation started to occur when ammonium bicarbonate ionic product was higher than 2.25 M^2 and ammonium bicarbonate accounted for more than 62% of the total ionic strength of the feed. The maximum observed nitrogen recovery into solid ammonium bicarbonate reached 17% using a current density of 100 A m^{-2}. Based on these results, electro-concentration is a promising technology for urine nutrient capture. However, capture as solid ammonium bicarbonate is feasible only if higher recovery efficiencies are achieved by removing competing ions.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, University of Queensland
Contributors: Jermakka, J., Thompson Brewster, E., Ledezma, P., Freguia, S.
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Volume: 203
ISSN (Print): 1383-5866
Ratings:
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Original language: English
ASJC Scopus subject areas: Analytical Chemistry, Filtration and Separation
Keywords: Ammonium bicarbonate precipitation, Electro-concentration, Nutrient recovery, Urine
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Source: Scopus
Source ID: 85045218335
Research output: Contribution to journal › Article › Scientific › peer-review

Performance of a biotrickling filter for the anaerobic utilization of gas-phase methanol coupled to thiosulphate reduction and resource recovery through volatile fatty acids production

The anaerobic removal of continuously fed gas-phase methanol (2.5–30 g/m^3.h) and the reduction of step-fed thiosulphate (1000 mg/L) was investigated in a biotrickling filter (BTF) operated for 123 d at an empty bed residence time (EBRT) of 4.6 and 2.3 min. The BTF performance during steady step-feed and special operational phases like intermittent liquid trickling in 6 and 24 h cycles and operation without pH regulation were evaluated. Performance of the BTF was not affected and nearly 100% removal of gas-phase methanol was achieved with an EC_{max} of 21 g/m^3.h. Besides, >99% thiosulphate reduction was achieved, in all the phases of operation. The production of sulphate, H_2S and volatile fatty acids (VFA) was monitored and a maximum of 2500 mg/L of acetate, 200 mg/L of propionate, 150 mg/L of isovalerate and 100 mg/L isobutyrate was produced.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Institute for Water Education
Contributors: Eregowda, T., Matanhike, L., Rene, E. R., Lens, P. N.
Number of pages: 10
Pages: 591-600
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Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 263
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2018): CiteScore 11.1 SJR 2.157 SNIP 1.858
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
Keywords: Anaerobic, Biotrickling filter (BTF), Gas-phase methanol, Steady and intermittent BTF operation, Thiosulphate reduction, Volatile fatty acid
DOIs:

10.1016/j.biortech.2018.04.095
Source: Scopus
Source ID: 85047081553
Research output: Contribution to journal › Article › Scientific › peer-review

Effects of pyrolysis temperature on the hydrologically relevant porosity of willow biochar
Biochar pore space consists of porosity of multiple length scales. In direct water holding applications like water storage for plant water uptake, the main interest is in micrometre-range porosity since these pores are able to store water that is easily available for plants. Gas adsorption measurements which are commonly used to characterize the physical pore structure of biochars are not able to quantify this pore-size range. While pyrogenetic porosity (i.e. pores formed during pyrolysis process) tends to increase with elevated process temperature, it is uncertain whether this change affects the pore space capable to store plant available water. In this study, we characterized biochar porosity with x-ray tomography which provides quantitative information on the micrometer-range porosity. We imaged willow dried at 60 °C and biochar samples pyrolysed in three different temperatures (peak temperatures 308, 384, 489 °C, heating rate 2 °C min^{-1}). Samples were carefully prepared and traced through the experiments, which allowed investigation of porosity development in micrometre size range. Pore space was quantified with image analysis of x-ray tomography images and, in addition, nanoscale porosity was examined with helium ion microscopy. The image analysis results show that initial pore structure of the raw material determines the properties of micrometre-range porosity in the studied temperature range. Thus, considering the pore-size regime relevant to the storage of plant available water, pyrolysis temperature in the studied range does not provide means to optimize the biochar structure. However, these findings do not rule out that process temperature may affect the water retention properties of biochars by modifying the chemical properties of the pore surfaces.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Natural Resources Institute Finland (Luke), Jyväskylän yliopisto, Foshan University, Zhejiang A & F University
Contributors: Hyväluoma, J., Hannula, M., Arstila, K., Wang, H., Kulju, S., Rasa, K.
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Journal: Journal of Analytical and Applied Pyrolysis
Volume: 134
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Ratings:

Scopus rating (2018): CiteScore 6.2 SJR 1.11 SNIP 1.256
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
Keywords: Biochar, Image analysis, Porosity, Slow pyrolysis, X-ray tomography
DOIs:

10.1016/j.jaap.2018.07.011

Bibliographical note
EXT="Kulju, Sampo"
Source: Scopus
Source ID: 85050304071
Research output: Contribution to journal › Article › Scientific › peer-review

Photoinduced Energy Transfer in ZnCdSeS Quantum Dot-Phthalocyanines Hybrids
In this article, interaction between ZnCdSeS quantum dot (QD) and phthalocyanines with variable linker has been reported. Steady-state and time-resolved spectroscopic investigation reveals that only photoinduced energy transfer occurs from QD to phthalocyanines. To evaluate quantitatively the energy transfer, the Poisson statistics of QD-dye complex formation was used in the analysis of steady-state and time-resolved emission quenching, which allows to estimate the energy transfer rate constant for an ideal one-to-one complex. The measured rate constants are compared to the rates evaluated based on the classic Förster theory, which shows roughly 1 nm discrepancy in the energy transfer distance estimation, or one order in magnitude discrepancy in the transfer rate constants.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Universidad Autónoma de Madrid, Instituto Madrileño de Estudios Avanzados (IMDEA)-Nanociencia, Mersin University
Contributors: Mandal, S., Garcia Iglesias, M., Ince, M., Torres, T., Tkachenko, N. V.
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Volume: 3
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
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Source: Scopus
Source ID: 85052704543
Research output: Contribution to journal › Article › Scientific › peer-review

A new method to optimize natural convection heat sinks
The performance of a heat sink cooled by natural convection is strongly affected by its geometry, because buoyancy creates flow. Our model utilizes analytical results of forced flow and convection, and only conduction in a solid, i.e., the base plate and fins, is solved numerically. Sufficient accuracy for calculating maximum temperatures in practical applications is proved by comparing the results of our model with some simple analytical and computational fluid dynamics (CFD) solutions. An essential advantage of our model is that it cuts down on calculation CPU time by many orders of magnitude compared with CFD. The shorter calculation time makes our model well suited for multi-objective optimization, which is the best choice for improving heat sink geometry, because many geometrical parameters with opposite effects influence the thermal behavior. In multi-objective optimization, optimal locations of components and optimal dimensions of the fin array can be found by simultaneously minimizing the heat sink maximum temperature, size, and mass. This paper presents the principles of the particle swarm optimization (PSO) algorithm and applies it as a basis for optimizing existing heat sinks.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Mechanical Engineering and Industrial Systems
Contributors: Lampio, K., Karvinen, R.
Pages: 2571-2580

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Peer-reviewed: Yes

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Journal: Heat and Mass Transfer/Waerme- und Stoffuebertragung
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Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Fluid Flow and Transfer Processes
DOIs:

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Source: Scopus
Source ID: 85028537040
Research output: Contribution to journal › Article › Scientific › peer-review

Selenate removal in biofilm systems: Effect of nitrate and sulfate on selenium removal efficiency, biofilm structure and microbial community
BACKGROUND: Selenium (Se) discharged into natural waterbodies can accumulate over time and have negative impacts on the environment. Se-laden wastewater streams can be treated using biological processes. However, the presence of other electron acceptors in wastewater, such as nitrate (NO_3^-) and sulfate (SO_4^{2-}), can influence selenate (SeO_4^{2-}) reduction and impact the efficiency of biological treatment systems. RESULTS: SeO_4^{2-} removal by biofilms formed from an anaerobic sludge inoculum was investigated in the presence of NO_3^- and SO_4^{2-} using drip flow reactors operated continuously for 10days at pH7.0 and 30°C. The highest total Se (~60%) and SeO_4^{2-} (~80%) removal efficiencies were observed when the artificial wastewater contained SO_4^{2-}. A maximum amount of 68μmol Se cm^{-2} was recovered from the biofilm matrix in SO_4^{2-}+SeO_4^{2-} exposed biofilms and biofilm mass was 2.7-fold increased for biofilms grown in the presence of SO_4^{2-}. When SeO_4^{2-} was the only electron acceptor, biofilms were thin and compact. In the simultaneous presence of NO_3^- or SO_4^{2-}, biofilms were thicker (> 0.6mm), less compact and exhibited gas pockets. CONCLUSION: The presence of SO_4^{2-} had a beneficial effect on biofilm growth and the SeO_4^{2-} removal efficiency, while the presence of NO_3^- did not have a significant effect on SeO_4^{2-} removal by the biofilms.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Montana State University (MSU), Bhabha Atomic Research Centre, UPEM
Contributors: Tan, L. C., Espinosa-Ortiz, E. J., Nancharaiah, Y. V., van Hullebusch, E. D., Gerlach, R., Lens, P. N.
Pages: 2380-2389
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Peer-reviewed: Yes
Early online date: 1 Jan 2018

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Volume: 93
Issue number: 8
ISSN (Print): 0268-2575
Ratings:

Scopus rating (2018): CiteScore 4.8 SJR 0.715 SNIP 0.891
Original language: English
ASJC Scopus subject areas: Biotechnology, Chemical Engineering(all), Renewable Energy, Sustainability and the Environment, Fuel Technology, Waste Management and Disposal, Pollution, Organic Chemistry, Inorganic Chemistry
Keywords: Biofilm, Biofilm characterization, Co-electron acceptors, Nitrate, Selenate, Selenium removal, Sulfate
DOIs:

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Source ID: 85043713774
Research output: Contribution to journal › Article › Scientific › peer-review

High Bending-Mode Sensitivity of Printed Piezoelectric Poly(vinylidenefluoride- co-trifluoroethylene) Sensors
Printable piezoelectric sensors were fabricated on a flexible polyethylene terephthalate (PET) substrate. Solution-processed piezoelectric poly(vinylidenefluoride-co-trifluoroethylene) ink was used as an active layer. Evaporated silver on PET was used as the bottom electrode and the painted silver glue as the top electrode. The sensors were poled using a

high dc electric field from 25 to 65 MV m^{-1}, yielding piezoelectric normal direction sensitivities up to 25 pC N^{-1}. Bending-mode sensitivities showed values up to 200 nC N^{-1}, which is 4 orders of magnitude larger than the force sensitivity in the normal direction. The high bending-mode sensitivities suggest suitability for detecting small forces, such as single fiber bonds or cardiomyocyte cell-beating force.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Nokia Technologies, University of Twente
Contributors: Rajala, S., Schouten, M., Krijnen, G., Tuukkanen, S.
Number of pages: 7
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Publication date: 23 Jul 2018
Peer-reviewed: Yes

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Journal: ACS Omega
Volume: 3
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ISSN (Print): 2470-1343
Ratings:

Scopus rating (2018): CiteScore 1.4 SJR 0.754 SNIP 0.683
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
Electronic versions:

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DOIs:

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http://urn.fi/URN:NBN:fi:tty-201808072055

Bibliographical note
EXT="Rajala, Satu"
Source: Scopus
Source ID: 85050457848
Research output: Contribution to journal › Article › Scientific › peer-review

Fluid flow simulations meet high-speed video: Computer vision comparison of droplet dynamics
Hypothesis: While multiphase flows, particularly droplet dynamics, are ordinary in nature as well as in industrial processes, their mathematical and computational modelling continue to pose challenging research tasks - patent approaches for tackling them are yet to be found. The lack of analytical flow field solutions for non-trivial droplet dynamics hinders validation of computer simulations and, hence, their application in research problems. High-speed videos and computer vision algorithms can provide a viable approach to validate simulations directly against experiments. Experiments: Droplets of water (or glycerol-water mixtures) impacting on both hydrophobic and superhydrophobic surfaces were imaged with a high-speed camera. The corresponding configurations were simulated using a lattice-Boltzmann multiphase scheme. Video frames from experiments and simulations were compared, by means of computer vision, over entire droplet impact events. Findings: The proposed experimental validation procedure provides a detailed, dynamic one-on-one comparison of a droplet impact. The procedure relies on high-speed video recording of the experiments, computer vision, and on a software package for the analyzation routines. The procedure is able to quantitatively validate computer simulations against experiments and it is widely applicable to multiphase flow systems in general.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Natural Resources Institute Finland (Luke), BioFluidix GmbH, Faculty of Information Technology, Jyväskylän yliopisto
Contributors: Kulju, S., Riegger, L., Koltay, P., Mattila, K., Hyväluoma, J.
Number of pages: 9
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Publication information
Journal: Journal of Colloid and Interface Science
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ISSN (Print): 0021-9797
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Scopus rating (2018): CiteScore 9 SJR 1.29 SNIP 1.342
Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Biomaterials, Surfaces, Coatings and Films, Colloid and Surface Chemistry
Keywords: Computer vision, Droplet, Experimental, High-speed video, Hydrophobic, Lattice Boltzmann, Simulation
DOIs:

10.1016/j.jcis.2018.03.053

Bibliographical note
EXT="Kulju, S."
Source: Scopus
Source ID: 85044153494
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of surfactant type and sonication energy on the electrical conductivity properties of nanocellulose-CNT nanocomposite films

We present a detailed study on the influence of sonication energy and surfactant type on the electrical conductivity of nanocellulose-carbon nanotube (NFC-CNT) nanocomposite films. The study was made using a minimum amount of processing steps, chemicals and materials, to optimize the conductivity properties of free-standing flexible nanocomposite films. In general, the NFC-CNT film preparation process is sensitive concerning the dispersing phase of CNTs into a solution with NFC. In our study, we used sonication to carry out the dispersing phase of processing in the presence of surfactant. In the final phase, the films were prepared from the dispersion using centrifugal cast molding. The solid films were analyzed regarding their electrical conductivity using a four-probe measuring technique. We also characterized how conductivity properties were enhanced when surfactant was removed from nanocomposite films; to our knowledge this has not been reported previously. The results of our study indicated that the optimization of the surfactant type clearly affected the formation of freestanding films. The effect of sonication energy was significant in terms of conductivity. Using a relatively low 16 wt. % concentration of multiwall carbon nanotubes we achieved the highest conductivity value of 8.4 S/cm for nanocellulose-CNT films ever published in the current literature. This was achieved by optimizing the surfactant type and sonication energy per dry mass. Additionally, to further increase the conductivity, we defined a preparation step to remove the used surfactant from the final nanocomposite structure.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Faculty of Biomedical Sciences and Engineering, VTT Technical Research Centre of Finland
Contributors: Siljander, S., Keinänen, P., Räty, A., Ramakrishnan, K. R., Tuukkanen, S., Kunnari, V., Harlin, A., Vuorinen, J., Kanerva, M.
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Original language: English
ASJC Scopus subject areas: Catalysis, Molecular Biology, Spectroscopy, Computer Science Applications, Physical and Theoretical Chemistry, Organic Chemistry, Inorganic Chemistry
Keywords: Carbon nanotubes, Conductivity, Nanocellulose, Nanocomposite, Surfactant
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http://urn.fi/URN:NBN:fi:tty-201807302026

Bibliographical note
INT=mol,"Räty, Anna"
EXT="Harlin, Ali"

Source: Scopus
Source ID: 85048936349
Research output: Contribution to journal › Article › Scientific › peer-review

The effect of carbon and nickel additions on the precursor synthesis of Cr_3C_2-Ni nanopowder

Decreasing crystal size to nanoscale is a proven method to enhance material properties. In this study, nanosize Cr_3C_2 and Cr_3C_2-Ni were synthetized and the reaction sequence was studied. Aqueous precursors using only water-soluble raw materials with varying carbon contents and a nickel addition were spray-dried. Glycine was used as a carbon source and chromium acetate hydroxide as a chromium source in the precursor solutions. Nickel nitrate hexahydrate was introduced as a nickel source to yield a metallic binder into the carbide nanopowder.Resulting powders were heat-treating to identify an applicable precursor composition producing the targeted Cr_3C_2 phase with crystal size of tens of nanometers. Thermal synthesis tests of the precursor powders to yield Cr_3C_2 took place at a temperature between 900 and 1300 °C under an Argon atmosphere. The synthesis of nanosize Cr_3C_2-Ni powder was successful at 1000 °C in 30 min, in a case of the best precursor. In order to produce the carbide phase with no residual oxide traces, relative carbon load has to be 48 wt%, while the stoichiometric amount of carbon in Cr_3C_2 is 13 wt%. When also introducing the nickel source into the precursor, an even higher carbon load was required. The carbon surplus needed to enable the Cr_3C_2 synthesis attributes to the non-homogeneity of the precursor composition.The chemical synthesis starting from water-soluble raw materials is a promising way of preparing nanosize Cr_3C_2-Ni with the targeted phase configuration.

General information

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Organisations: Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland
Contributors: Kaunisto, K., Kotilainen, M., Karhu, M., Lagerbom, J., Vuorinen, T., Honkanen, M., Vippola, M., Turunen, E.
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ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry
Keywords: A. Nanosize CrC synthesis, A. Powders: chemical preparation, B. Grain size, D. Carbides, E. Wear parts
DOIs:

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Bibliographical note

EXT="Vuorinen, Tommi"
EXT="Lagerbom, Juha"
EXT="Kaunisto, Kimmo"
Source: Scopus
Source ID: 85042300396
Research output: Contribution to journal › Article › Scientific › peer-review

The effects of laser patterning 10CeTZP-Al_2O_3 nanocomposite disc surfaces: Osseous differentiation and cellular arrangement in vitro

Customized square grid arrangements of different groove depths (1.0, 1.5 and 3.0 μm) and separations (10 and 30 μm) were successfully laser patterned, using a nanosecond pulsed fibre laser, on the surface of 10 mol% ceria-stabilized zirconia and alumina (10CeTZP-Al_2O_3) nanocomposite discs (diameter: 10 mm; thickness: 1.5 mm). The patterned surfaces and the in vitro biological response of osteoblasts (SAOS-2) towards them were thoroughly analysed. In terms of composition, the laser treatment was found to cause superficial monoclinic-tetragonal zirconia phase transformation and alumina evaporation. In vitro, the most effective grid configuration for osseous differentiation was found to be 1.5 μm groove depth and 10 μm groove separation, and confocal microscopy revealed that the cells show a tendency to be sorted as groove depth increases. It is thought that custom-made patterns could be produced to guide cell attachment in vivo, which could favour implant integration and reduce healing time.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Mechanical Engineering and Industrial Systems, Nanoker Research, Universidad de Oviedo
Contributors: Goyos-Ball, L., Prado, C., Díaz, R., Fernández, E., Ismailov, A., Kumpulainen, T., Levänen, E., Torrecillas, R., Fernández, A.
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Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry
Keywords: Alumina, Cellular arrangement, Ceramic nanocomposite, Laser patterning, Osseous differentiation, Zirconia
DOIs:

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Source: Scopus
Source ID: 85042621677
Research output: Contribution to journal › Article › Scientific › peer-review

Influence of the phosphate glass melt on the corrosion of functional particles occurring during the preparation of glass-ceramics

We report our findings on the impact of the glass composition on the corrosion of microparticles occurring during the preparation of glass-ceramics using the direct doping method. Microparticles (MPs) with the composition $Sr_4Al_{14}O_{25}:Eu^{2+},Dy^{3+}$ with blue-green persistent luminescence were chosen as the changes in their spectroscopic properties can be related to the MPs' corrosion. The MPs were added in phosphate-based glasses with different compositions. When using the same doping parameters, the glass system with the composition $90NaPO_3$-$10Na_2O$ (mol%) was found to be the least corrosive on the MPs whereas the glass system with the composition $90NaPO_3$-10NaF (mol%) is the most corrosive on the MPs probably due to their different viscosity at 575 °C, the temperature at which the MPs are added in the glass melts.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Research group: Nanophotonics, Turun Yliopisto/Turun Biomateriaalikeskus, Laboratory of Photonics
Contributors: Ojha, N., Laihinen, T., Salminen, T., Lastusaari, M., Petit, L.
Pages: 11807-11811
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Early online date: 1 Jan 2018

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Ratings:

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Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry
Keywords: Corrosion, Direct doping method, Glass melt, Phosphate glass-ceramics, SrAlO:Eu, Dy microparticles
DOIs:

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Source: Scopus
Source ID: 85044921933
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of Co-Adsorbate and Hole Transporting Layer on the Photoinduced Charge Separation at the TiO_2-Phthalocyanine Interface

Understanding the primary processes of charge separation (CS) in solid-state dye-sensitized solar cells (DSSCs) and, in particular, analysis of the efficiency losses during these primary photoreactions is essential for designing new and efficient photosensitizers. Phthalocyanines (Pcs) are potentially interesting sensitizers having absorption in the red side of the optical spectrum and known to be efficient electron donors. However, the efficiencies of Pc-sensitized DSSCs are lower than that of the best DSSCs, which is commonly attributed to the aggregation tendency of Pcs. In this study, we employ ultrafast spectroscopy to discover why and how much does the aggregation affect the efficiency. The samples were prepared on a standard fluorine-doped tin oxide (FTO) substrates covered by a porous layer of TiO_2 nanoparticles, functionalized by a Pc sensitizer and filled by a hole transporting material (Spiro-MeOTAD). The study demonstrates that the aggregation can be suppressed gradually by using co-adsorbates, such as chenodeoxycholic acid (CDCA) and oleic acid, but rather high concentrations of co-adsorbate is required. Gradually, a few times improvement of quantum efficiency was observed at sensitizer/co-adsorbate ratio Pc/CDCA = 1:10 and higher. The time-resolved spectroscopy studies were complemented by standard photocurrent measurements of the same sample structures, which also confirmed gradual increase in photon-to-current conversion efficiency on mixing Pc with CDCA.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Universidad Autónoma de Madrid, Instituto Madrileño de Estudios Avanzados (IMDEA)-Nanociencia, Departamento de Química Orgánica
Contributors: Virkki, K., Tervola, E., Medel, M., Torres, T., Tkachenko, N. V.
Number of pages: 12
Pages: 4947-4958
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ISSN (Print): 2470-1343
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Scopus rating (2018): CiteScore 1.4 SJR 0.754 SNIP 0.683
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
DOIs:

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Source: Scopus
Source ID: 85046661219
Research output: Contribution to journal › Article › Scientific › peer-review

A Ceramide-Regulated Element in the Late Endosomal Protein LAPTM4B Controls Amino Acid Transporter Interaction

Membrane proteins are functionally regulated by the composition of the surrounding lipid bilayer. The late endosomal compartment is a central site for the generation of ceramide, a bioactive sphingolipid, which regulates responses to cell stress. The molecular interactions between ceramide and late endosomal transmembrane proteins are unknown. Here, we uncover in atomistic detail the ceramide interaction of Lysosome Associated Protein Transmembrane 4B (LAPTM4B), implicated in ceramide-dependent cell death and autophagy, and its functional relevance in lysosomal nutrient signaling. The ceramide-mediated regulation of LAPTM4B depends on a sphingolipid interaction motif and an adjacent aspartate residue in the protein's third transmembrane (TM3) helix. The interaction motif provides the preferred contact points for ceramide while the neighboring membrane-embedded acidic residue confers flexibility that is subject to ceramide-induced conformational changes, reducing TM3 bending. This facilitates the interaction between LAPTM4B and the amino acid transporter heavy chain 4F2hc, thereby controlling mTORC signaling. These findings provide mechanistic insights into how transmembrane proteins sense and respond to ceramide.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, University of Helsinki Faculty of Medicine, Minerva Foundation Institute for Medical Research Helsinki, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Laboratory of Physics, Abo Akademi University, Queens College, City University of New York, University of Helsinki
Contributors: Zhou, K., Dichlberger, A., Martinez-Seara, H., Nyholm, T. K., Li, S., Kim, Y. A., Vattulainen, I., Ikonen, E., Blom, T.

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Peer-reviewed: Yes

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Journal: ACS Central Science
Volume: 4
Issue number: 5
ISSN (Print): 2374-7943
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Scopus rating (2018): CiteScore 12.2 SJR 4.94 SNIP 2.058
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
DOIs:

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Source: Scopus
Source ID: 85047534763
Research output: Contribution to journal › Article › Scientific › peer-review

Wet etching of dilute nitride GaInNAs, GaInNAsSb, and GaNAsSb alloys lattice-matched to GaAs
We have studied the etching of GaInNAs, GaInNAsSb, and GaNAsSb alloys by NH_4OH, H_2SO_4, and H_3PO_4 based solutions. NH_4OH based solutions resulted in smooth surface, while other solutions created rougher and granular surfaces. The etch rates were found to increase with the Sb content. For GaInNAs, x-ray photoelectron spectroscopy revealed the enrichment of In on the etched surfaces, indicating In or In oxides having a smaller removal rate compared to Ga or Ga oxides. The enrichment of In was associated with smoother surfaces after etching and an enhanced photoluminescence caused by lower surface recombination due to reduced surface state density.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Research group: ORC, Department of Physics and Astronomy, University of Turku, Turun Yliopisto/Turun Biomateriaalikeskus
Contributors: Raappana, M., Polojärvi, V., Aho, A., Mäkelä, J., Aho, T., Tukiainen, A., Laukkanen, P., Guina, M.
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Volume: 136
ISSN (Print): 0010-938X
Ratings:

Scopus rating (2018): CiteScore 10.3 SJR 2.131 SNIP 2.759
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Materials Science(all)
Keywords: A. Alloy, B. AFM, B. XPS, C. Acid corrosion, C. Alkaline corrosion, C. Passivity
Electronic versions:

WCPEC-7 Manuscript_Timo Aho. Embargo ended: 31/03/20
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http://urn.fi/URN:NBN:fi:tuni-201910223985. Embargo ended: 31/03/20

Bibliographical note
EXT="Mäkelä, Jaakko"
EXT="Laukkanen, Pekka"
Source: Scopus
Source ID: 85044276587
Research output: Contribution to journal › Article › Scientific › peer-review

Switchable light reflectance in dilute magneto-optical colloids based on nickel ferrite nanowires

Optical properties of diluted narrow band gap magnetic semiconductor nanowire colloids are controlled by modest magnetic fields under 100 Oe. High aspect ratio $NiFe_2O_4$ nanowires are used to achieve responsiveness to magnetic field, light absorption and -scattering. Visible light reflectance of the diluted colloids can be either increased or decreased depending on the nanowire alignment relative to the direction of the light propagation. The prepared colloids can be applied as magneto-optical switches or as smart window devices.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Institute of Physics, University of Tartu, Riga Technical University, CRPP, University of Latvia
Contributors: Sutka, A., Timusk, M., Joost, U., Ignatans, R., Maiorov, M.
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Publication information

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Volume: 16
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Scopus rating (2018): CiteScore 0.9 SJR 0.216 SNIP 0.317
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Condensed Matter Physics, Mechanics of Materials, Surfaces and Interfaces, Surfaces, Coatings and Films
Keywords: Colloid, Ferrimagnetic, Magneto-optical, Nanowire, $NiFe_2O_4$
DOIs:

10.1380/ejssnt.2018.119

Bibliographical note

INT=fot,"Joost, Urmas"
Source: Scopus
Source ID: 85047369076
Research output: Contribution to journal › Article › Scientific › peer-review

Characteristics of nFOG, an aerosol-based wet thin film coating technique

An atmospheric pressure aerosol-based wet thin film coating technique called the nFOG is characterized and applied in polymer film coatings. In the nFOG, a fog of droplets is formed by two air-assist atomizers oriented toward each other inside a deposition chamber. The droplets settle gravitationally and deposit on a substrate, forming a wet film. In this study, the continuous deposition mode of the nFOG is explored. We determined the size distribution of water droplets inside the chamber in a wide side range of 0.1–100 μm and on the substrate using aerosol measurement instruments and optical microscopy, respectively. The droplet size distribution was found to be bimodal with droplets of approximately 30–50 μm contributing the most to the mass of the formed wet film. The complementary measurement methods allow us to estimate the role of different droplet deposition mechanisms. The obtained results suggest that the deposition velocity of the droplets is lower than the calculated terminal settling velocity, likely due to the flow fields inside the chamber. Furthermore, the mass flux of the droplets onto the substrate is determined to be in the order of 1 g/m^3s, corresponding to a wet film growth rate of 1 μm/s. Finally, the nFOG technique is demonstrated by preparing polymer films with thicknesses in the range of approximately 0.1–20 μm.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Physics, Materials Science, RISE Bioscience and Materials, Research Institutes of Sweden, Lund University
Contributors: Harra, J., Tuominen, M., Juuti, P., Rissler, J., Koivuluoto, H., Haapanen, J., Niemelä-Anttonen, H., Stenroos, C., Teisala, H., Lahti, J., Kuusipalo, J., Vuoristo, P., Mäkelä, J. M.
Number of pages: 10
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ISSN (Print): 1547-0091
Ratings:

Scopus rating (2018): CiteScore 2.4 SNIP 0.716
Original language: English
ASJC Scopus subject areas: Chemistry(all), Surfaces and Interfaces, Surfaces, Coatings and Films, Colloid and Surface Chemistry
Keywords: Aerosol measurement, Droplet size distribution, nFOG, Polymer film, Wet coating technique
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10.1007/s11998-017-0022-7

Bibliographical note
EXT="Tuominen, Mikko"
Source: Scopus
Source ID: 85045145179
Research output: Contribution to journal › Article › Scientific › peer-review

Membrane bound COMT isoform is an interfacial enzyme: General mechanism and new drug design paradigm
The enzyme catechol-O-methyltransferase (COMT) has water soluble (S-COMT) and membrane associated (MB-COMT), bitopic, isoforms. Of these MB-COMT is a drug target in relation to the treatment of Parkinson's disease. Using a combination of computational and experimental protocols, we have determined the substrate selection mechanism specific to MB-COMT. We show: (1) substrates with preferred affinity for MB-COMT over S-COMT orient in the membrane in a fashion conducive to catalysis from the membrane surface and (2) binding of COMT to its cofactor ADOMET induces conformational change that drives the catalytic surface of the protein to the membrane surface, where the substrates and Mg^{2+} ions, required for catalysis, are found. Bioinformatics analysis reveals evidence of this mechanism in other proteins, including several existing drug targets. The development of new COMT inhibitors with preferential affinity for MB-COMT over S-COMT is now possible and insight of broader relevance, into the function of bitopic enzymes, is provided.

General information
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Organisations: Physics, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Universite de Geneve
Contributors: Magarkar, A., Parkkila, P., Viitala, T., Lajunen, T., Mobarak, E., Licari, G., Cramariuc, O., Vauthey, E., Róg, T., Bunker, A.
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Source ID: 85044968200
Research output: Contribution to journal › Article › Scientific › peer-review

Uncertainty in multispectral lidar signals caused by incidence angle effects
Multispectral terrestrial laser scanning (TLS) is an emerging technology. Several manufacturers already offer commercial dual or three wavelength airborne laser scanners, while multispectral TLS is still carried out mainly with research instruments. Many of these research efforts have focused on the study of vegetation. The aim of this paper is to study the uncertainty of the measurement of spectral indices of vegetation with multispectral lidar. Using two spectral indices as examples, we find that the uncertainty is due to systematic errors caused by the wavelength dependency of laser incidence angle effects. This finding is empirical, and the error cannot be removed by modelling or instrument modification. The discovery and study of these effects has been enabled by hyperspectral and multispectral TLS, and it has become a

subject of active research within the past few years. We summarize the most recent studies on multi-wavelength incidence angle effects and present new results on the effect of specular reflection from the leaf surface, and the surface structure, which have been suggested to play a key role. We also discuss the consequences to the measurement of spectral indices with multispectral TLS, and a possible correction scheme using a synthetic laser footprint.

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Organisations: Mathematics, Department of Navigation and Positioning, FGI
Contributors: Kaasalainen, S., Åkerblom, M., Nevalainen, O., Hakala, T., Kaasalainen, M.
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Non-intersecting leaf insertion algorithm for tree structure models
We present an algorithm and an implementation to insert broadleaves or needleleaves into a quantitative structure model according to an arbitrary distribution, and a data structure to store the required information efficiently. A structure model contains the geometry and branching structure of a tree. The purpose of this work is to offer a tool for making more realistic simulations of tree models with leaves, particularly for tree models developed from terrestrial laser scanning (TLS) measurements. We demonstrate leaf insertion using cylinder-based structure models, but the associated software implementation is written in a way that enables the easy use of other types of structure models. Distributions controlling leaf location, size and angles as well as the shape of individual leaves are user definable, allowing any type of distribution. The leaf generation process consist of two stages, the first of which generates individual leaf geometry following the input distributions, while in the other stage intersections are prevented by carrying out transformations when required. Initial testing was carried out on English oak trees to demonstrate the approach and to assess the required computational resources. Depending on the size and complexity of the tree, leaf generation takes between 6 and 18 min. Various leaf area density distributions were defined, and the resulting leaf covers were compared with manual leaf harvesting measurements. The results are not conclusive, but they show great potential for the method. In the future, if our method is demonstrated to work well for TLS data from multiple tree types, the approach is likely to be very useful for three-dimensional structure and radiative transfer simulation applications, including remote sensing, ecology and forestry, among others.

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Organisations: Mathematics, Forest Research, Department of Applied Health Research, NERC National Centre for Earth Observation (NCEO), University of Salford, Newcastle University, United Kingdom, York St John University
Contributors: Åkerblom, M., Raumonen, P., Casella, E., Disney, M. I., Danson, F. M., Gaulton, R., Schofield, L. A., Kaasalainen, M.
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Research output: Contribution to journal › Article › Scientific › peer-review

Weighing trees with lasers: Advances, challenges and opportunities

Terrestrial laser scanning (TLS) is providing exciting new ways to quantify tree and forest structure, particularly above-ground biomass (AGB). We show how TLS can address some of the key uncertainties and limitations of current approaches to estimating AGB based on empirical allometric scaling equations (ASEs) that underpin all large-scale estimates of AGB. TLS provides extremely detailed non-destructive measurements of tree form independent of tree size and shape. We show examples of three-dimensional (3D) TLS measurements from various tropical and temperate forests and describe how the resulting TLS point clouds can be used to produce quantitative 3D models of branch and trunk size, shape and distribution. These models can drastically improve estimates of AGB, provide new, improved large-scale ASEs, and deliver insights into a range of fundamental tree properties related to structure. Large quantities of detailed measurements of individual 3D tree structure also have the potential to open new and exciting avenues of research in areas where difficulties of measurement have until now prevented statistical approaches to detecting and understanding underlying patterns of scaling, form and function. We discuss these opportunities and some of the challenges that remain to be overcome to enable wider adoption of TLS methods.

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Organisations: Mathematics, Department of Applied Health Research, NERC National Centre for Earth Observation (NCEO), National Physical Laboratory, Universiteit Gent, School of Geography, University of Leeds
Contributors: Disney, M. I., Boni Vicari, M., Burt, A., Calders, K., Lewis, S. L., Raumonen, P., Wilkes, P.
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EXT="Lewis, S. L."

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Research output: Contribution to journal › Article › Scientific › peer-review

Aqueous synthesis of Z-scheme photocatalyst powders and thin-film photoanodes from earth abundant elements

Solid-state narrow band gap semiconductor heterostructures with a Z-scheme charge-transfer mechanism are the most promising photocatalytic systems for water splitting and environmental remediation under visible light. Herein, we construct all-solid Z-scheme photocatalytic systems from earth abundant elements (Ca and Fe) using an aqueous synthesis procedure. A novel Z-scheme two-component $Fe_2O_3/Ca_2Fe_2O_5$ heterostructure is obtained in a straightforward manner by soaking various iron-containing nanoparticles (amorphous and crystalline) with $Ca(NO_3)_2$ and performing short (20min) thermal treatments at 820°C. The obtained powder materials show high photocatalytic performances for methylene blue dye degradation under visible light (45 mW/cm^2), exhibiting a rate constant up to 0.015min^{-1}. The heterostructure exhibits a five-fold higher activity compared to that of pristine hematite. The experiments show that amorphous iron-containing substrate nanoparticles trigger the $Fe_2O_3/Ca_2Fe_2O_5$ heterostructure formation. We extended our study to produce $Fe_2O_3/Ca_2Fe_2O_5$ nanoheterostructure photoanodes via the electrochemical deposition of amorphous iron-containing sediment were used. The visible-light (15mW/cm^2) photocurrent increases from 183$\mu A/cm^2$ to 306$\mu A/cm^2$ after coupling hematite and $Ca_2Fe_2O_5$. Notably, the powders and photoanodes exhibit distinct charge-transfer mechanisms evidenced by the different stabilities of the heterostructures under different working conditions.

General information

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Contributors: Šutka, A., Vanags, M., Joost, U., Šmits, K., Ruža, J., Ločs, J., Kleperis, J., Juhna, T.
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Soft hydrazone crosslinked hyaluronan- and alginate-based hydrogels as 3D supportive matrices for human pluripotent stem cell-derived neuronal cells

Regenerative medicine, especially cell therapy combined with a supportive biomaterial scaffold, is considered to be a potential treatment for various deficits in humans. Here, we have produced and investigated the detailed properties of injectable hydrazone crosslinked hyaluronan-polyvinyl alcohol (HA-PVA) and alginate-polyvinyl alcohol (AL-PVA) hydrogels to be used as a supportive biomaterial for 3D neural cell cultures. To the best of our knowledge, this is the first time the polymerization and properties of hydrazone crosslinked AL-PVA hydrogel have been reported. The effect of the degree of substitution and molecular weight of the polymer components as well as the polymer concentration of the hydrogel on the swelling, degradation and mechanical properties of the hydrogels is reported. Furthermore, we studied the effect of the above parameters on the growth of human pluripotent stem cell-derived neuronal cells. The most neural cell supportive HA-PVA hydrogel was composed of high molecular weight HA component with brain-mimicking mechanical properties and decreased polymer concentration. AL-PVA hydrogel, with stiffness quite similar to brain tissue, was also shown to be similarly supportive. Neuronal spreading and 3D network formation was enhanced inside the softest hydrogels.

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Contributors: Karvinen, J., Joki, T., Ylä-Outinen, L., Koivisto, J. T., Narkilahti, S., Kellomäki, M.
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Research output: Contribution to journal › Article › Scientific › peer-review

Improved Stability of Atomic Layer Deposited Amorphous TiO_2 Photoelectrode Coatings by Thermally Induced Oxygen Defects

Amorphous titanium dioxide (a-TiO_2) combined with an electrocatalyst has shown to be a promising coating for stabilizing traditional semiconductor materials used in artificial photosynthesis for efficient photoelectrochemical solar-to-fuel energy conversion. In this study we report a detailed analysis of two methods of modifying an undoped thin film of atomic layer deposited (ALD) a-TiO_2 without an electrocatalyst to affect its performance in water splitting reaction as a protective photoelectrode coating. The methods are high-temperature annealing in ultrahigh vacuum and atomic hydrogen exposure. A key feature in both methods is that they preserve the amorphous structure of the film. Special attention is paid to the changes in the molecular and electronic structure of a-TiO_2 induced by these treatments. On the basis of the photoelectrochemical results, the a-TiO_2 is susceptible to photocorrosion but significant improvement in stability is achieved after heat treatment in vacuum at temperatures above 500 °C. On the other hand, the hydrogen treatment does not increase the stability despite the ostensibly similar reduction of a-TiO_2. The surface analysis allows us to interpret the improved stability to the thermally induced formation of O^- species within a-TiO_2 that are essentially electronic defects in the anionic framework.

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Contributors: Hannula, M., Ali-Löytty, H., Lahtonen, K., Sarlin, E., Saari, J., Valden, M.
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Research output: Contribution to journal › Article › Scientific › peer-review

Improved fatty aldehyde and wax ester production by overexpression of fatty acyl-CoA reductases

Background: Fatty aldehydes are industrially relevant compounds, which also represent a common metabolic intermediate in the microbial synthesis of various oleochemicals, including alkanes, fatty alcohols and wax esters. The key enzymes in biological fatty aldehyde production are the fatty acyl-CoA/ACP reductases (FARs) which reduce the activated acyl molecules to fatty aldehydes. Due to the disparity of FARs, identification and in vivo characterization of reductases with different properties are needed for the construction of tailored synthetic pathways for the production of various compounds. Results: Fatty aldehyde production in Acinetobacter baylyi ADP1 was increased by the overexpression of three different FARs: a native A. baylyi FAR Acr1, a cyanobacterial Aar, and a putative, previously uncharacterized dehydrogenase (Ramo) from Nevskia ramosa. The fatty aldehyde production was followed in real-time inside the cells with a luminescence-based tool, and the highest aldehyde production was achieved with Aar. The fate of the overproduced fatty aldehydes was studied by measuring the production of wax esters by a native downstream pathway of A. baylyi, for which fatty aldehyde is a specific intermediate. The wax ester production was improved with the overexpression of Acr1 or Ramo compared to the wild type A. baylyi by more than two-fold, whereas the expression of Aar led to only subtle wax ester production. The overexpression of FARs did not affect the length of the acyl chains of the wax esters. Conclusions: The fatty aldehyde production, as well as the wax ester production of A. baylyi, was improved with the overexpression of a key enzyme in the pathway. The wax ester titer (0.45 g/l) achieved with the overexpression of Acr1 is the highest reported without hydrocarbon supplementation to the culture. The contrasting behavior of the different reductases highlight the significance of in vivo characterization of enzymes and emphasizes the possibilities provided by the diversity of FARs for pathway and product modulation.

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Contributors: Lehtinen, T., Efimova, E., Santala, S., Santala, V.
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Source ID: 85041848256
Research output: Contribution to journal › Article › Scientific › peer-review

Design, synthesis, and structure-property relationships of Er^{3+} -doped TiO_2 luminescent particles synthesized by sol-gel

Titania particles doped with various concentrations of Erbium were synthesized by the sol-gel method followed by different heat treatments. The shape and the grain growth of the particles were noticeably affected by the concentration of Erbium and the heat treatment conditions. An infrared emission at 1530 nm, as well as green and red up-conversion emissions at 550 and 670 nm, were observed under excitation at 976 nm from all of the synthesized particles. The emission spectra and lifetime values appeared to be strongly influenced by the presence of the different crystalline phases. This work presents important guidelines for the synthesis of functional Er^{3+} -doped titania particles with controlled and tailored

spectroscopic properties for photonic applications.

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Organisations: Photonics, Research group: Photonics Glasses, Politecnico di Torino, Istituto Superiore Mario Boella, CERICOL, nLIGHT Corporation, Centro S3
Contributors: Lopez-Iscoa, P., Pugliese, D., Boetti, N. G., Janner, D., Baldi, G., Petit, L., Milanese, D.
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Upconversion from fluorophosphate glasses prepared with NaYF4:Er^{3+},Yb^{3+}nanocrystals

The direct doping method was applied to fabricate upconverter fluorophosphate glasses in the system ($90NaPO_3$-(10-x)Na_2O-xNaF) (mol%) by adding $NaYF_4$:Er^{3+},Yb^{3+} nanocrystals. An increase in the network connectivity, a red shift of the optical band gap and a decrease in the thermal properties occur when Na_2O is progressively replaced by NaF. To ensure the survival and the dispersion of the nanocrystals in the glasses with x = 0 and 10, three doping temperatures (T_{doping}) (525, 550 and 575 °C) at which the nanocrystals were added in the glass melt after melting and 2 dwell times (3 and 5 minutes) before quenching the glasses were tested. Using 5 wt% of the $NaYF_4$:Er^{3+},Yb^{3+} nanocrystals, green emission from the $NaYF_4$:Er^{3+},Yb^{3+} nanocrystals-containing glasses was observed using a 980 nm pumping, the intensity of which depends on the glass composition and on the direct doping parameters (T_{doping} and dwell time). The strongest upconversion was obtained from the glass with x = 10 prepared using a T_{doping} of 550 °C and a 3 min dwell time. Finally, we showed that the upconversion, the emission at 1.5 µm and of the transmittance spectra of the nanocrystals-containing glasses could be measured to verify if decomposition of the nanocrystals occurred in glass melts during the preparation of the glasses.

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Contributors: Ojha, N., Tuomisto, M., Lastusaari, M., Petit, L.
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Conjugated Heat Transfer Simulation of a Fin-and-Tube Heat Exchanger

Heat transfer and pressure drop of a fin-and-tube heat exchanger are studied by taking into account the conjugated heat transfer between the flow and the fin. The temperature distribution of the fin is calculated in respect to the convective heat transfer of the air flowing through the tube bank channel. Contemporary enhancement methods emphasize the importance of local turbulence augmentation which effects the convective heat transfer. In this paper, the importance of conjugated heat transfer, where the temperature of the flow and fin are coupled together is emphasized and compared with a constant surface temperature boundary condition simulation and experiment, which are found in the literature.

General information

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Contributors: Välikangas, T., Karvinen, R.
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Adsorption of furfural from torrefaction condensate using torrefied biomass

Torrefaction is a biomass energy densification process that generates a major byproduct in the form of torrefaction condensate. Microbial conversion of torrefaction condensate could be an attractive option for energy integration within torrefaction process. However, torrefaction condensate contains several compounds, such as furfural, 5-hydroxymethylfurfural and guaiacol that are inhibitory to microbes. In this study, for the first time, we reported detoxification of torrefaction condensate, by removing the major inhibitory compound furfural, using torrefied biomass and later used the detoxified torrefaction condensate for anaerobic digestion. The effect of varying torrefaction temperature (225–300 °C), torrefied biomass dosage (25–250 g/L), initial pH (2.0–9.0), and contact time (1–12 h) on furfural adsorption was studied with batch adsorption experiments. The furfural adsorption on torrefied biomass was best represented by pseudo second order kinetic model. The adsorption of furfural and other inhibitory compounds on torrefied biomass was likely a hydrophobic interaction. A maximum of 60% of furfural was adsorbed from torrefaction condensate containing 9000 mg furfural/L using 250 g/L of torrefied biomass in batch adsorption. For, column (20 mm internal diameter and 200 mm bed height), the saturation time for furfural adsorption was around 50 min. Anaerobic digestion of the detoxified torrefaction condensate shows that the lag phase in methane production was reduced from 25 d to 15 d for 0.2 volatile solid $(VS)_{substrate}$:$VS_{inoculum}$ loading. The study shows that torrefaction condensate can be effectively detoxified using torrefied biomass for microbial conversion and can be integrated within the torrefied biomass pellet production process.

General information

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Contributors: Doddapaneni, T. R. K. C., Jain, R., Praveenkumar, R., Rintala, J., Romar, H., Konttinen, J.
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Fin-and-tube heat exchanger enhancement with a combined herringbone and vortex generator design
Vortex generators (VGs) are the most commonly investigated enhancement methods in the field of improved heat exchangers. The aim of present work is to study the effect of VGs in a fin-and-tube heat exchanger (FTHE) with herringbone fin shape. The delta winglet VG design with length (s) and height (H) is selected based on previous studies. The investigated VG design is simple and considered realistic from the manufacturing point of view. The combined enhancement with herringbone fin and the VG is evaluated by simulating the conjugate heat transfer and the air flow. The structured mesh is created for both solid and fluid domains to solve the model numerically using a coupled open source solver in OpenFOAM. The influence of flow condition on the performance enhancement is studied by changing the Reynolds number in a range Re=1354–6157. The study showed that VGs not only increase the heat transfer in the herringbone fin but also decrease the pressure drop. The highest and longest investigated VG design is found to perform the best because of its ability to delay the flow detachment from the tube, to feed high kinetic energy flow to the recirculation zone and to create longitudinal vortices in the downstream region from the VG. The fin with VG design s=0.5D and H=0.6F_p enhances the overall performance by 5.23% in comparison to the fin without VG. The results demonstrated the usefulness of VGs for the performance enhancement in connection with a herringbone fin design.

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Contributors: Välikangas, T., Singh, S., Sørensen, K., Condra, T.
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ASJC Scopus subject areas: Condensed Matter Physics, Mechanical Engineering, Fluid Flow and Transfer Processes
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Source ID: 85034060389

Regeneration of sulfur-poisoned Pd-based catalyst for natural gas oxidation

Sulfur deactivation and regeneration behavior of the Pd/Al_2O_3 catalyst has been investigated via experimental characterization and density functional theory (DFT) simulations. During the sulfur exposure, PdO crystallites grow slightly while bulk $Al_2(SO_4)_3$ forms on the support. DFT calculations indicate that SO_x species interact strongly with the catalyst surface making it chemically inactive in agreement with the experimental results. During the regeneration treatment (CH_4 conditions), PdO particles reduce, $Al_2(SO_4)_3$ is partially removed, and the activity for CH_4 conversion is increased. No full recovery can be observed due to remaining $Al_2(SO_4)_3$, the formation of encapsulating sulfur species, and the partial reduction of PdO particles. To reoxidize Pd, the catalyst is further regenerated (O_2 conditions). The resulting CH_4 conversion is at the same level than with the regenerated catalyst. Thus, a small amount of $Al_2(SO_4)_3$ appears to have a stronger effect on the performance than the state of Pd.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, Physics, Research area: Computational Physics, Research group: Materials and Molecular Modeling, Univ of Oulu, Aalto University, Dinex Ecocat Oy, Norwegian University of Science and Technology
Contributors: Honkanen, M., Wang, J., Kärkkäinen, M., Huuhtanen, M., Jiang, H., Kallinen, K., Keiski, R. L., Akola, J., Vippola, M.
Number of pages: 13
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Publication information

Journal: Journal of Catalysis
Volume: 358
ISSN (Print): 0021-9517
Ratings:

Scopus rating (2018): CiteScore 11.3 SJR 2.254 SNIP 1.756
Original language: English
ASJC Scopus subject areas: Catalysis, Physical and Theoretical Chemistry
Keywords: Catalytic testing, Density functional theory simulations, Fourier transform infrared spectrometry, Pd-based catalyst, Regeneration, Sulfur poisoning, Transmission electron microscopy
DOIs:

10.1016/j.jcat.2017.12.021
Additional files:

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Source: Scopus
Source ID: 85039986144
Research output: Contribution to journal › Article › Scientific › peer-review

Composition and role of the attached and planktonic microbial communities in mesophilic and thermophilic xylose-fed microbial fuel cells

A mesophilic (37 °C) and a thermophilic (55 °C) two-chamber microbial fuel cell (MFC) were studied and compared for their power production from xylose and the microbial communities involved. The anode-Attached, membrane-Attached, and planktonic microbial communities, and their respective active subpopulations, were determined by next generation sequencing (Illumina MiSeq), based on the presence and expression of the 16S rRNA gene. Geobacteraceae accounted for 65% of the anode-Attached active microbial community in the mesophilic MFC, and were associated to electricity generation likely through direct electron transfer, resulting in the highest power production of 1.1 W m^{-3}. A lower maximum power was generated in the thermophilic MFC (0.2 W m^{-3}), likely due to limited acetate oxidation and the competition for electrons by hydrogen oxidizing bacteria and hydrogenotrophic methanogenic archaea. Aerobic microorganisms, detected among the membrane-Attached active community in both the mesophilic and thermophilic MFC, likely acted as a barrier for oxygen flowing from the cathodic chamber through the membrane, favoring the strictly anaerobic exoelectrogenic microorganisms, but competing with them for xylose and its degradation products. This study provides novel information on the active microbial communities populating the anodic chamber of mesophilic and thermophilic xylose-fed MFCs, which may help in developing strategies to favor exoelectrogenic microorganisms at the expenses of competing microorganisms.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Natl. University of Ireland, Galway, Institute for Water Education, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education
Contributors: Dessì, P., Porca, E., Haavisto, J., Lakaniemi, A., Collins, G., Lens, P. N.
Number of pages: 12
Pages: 3069-3080
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: RSC Advances
Volume: 8
Issue number: 6
ISSN (Print): 2046-2069
Ratings:

Scopus rating (2018): CiteScore 6.5 SJR 0.807 SNIP 0.799
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
Electronic versions:

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10.1039/c7ra12316g
URLs:

http://urn.fi/URN:NBN:fi:tty-201802081202
Source: Scopus
Source ID: 85040867034
Research output: Contribution to journal › Article › Scientific › peer-review

Decomposition of persistent luminescent microparticles in corrosive phosphate glass melt
Findings on the decomposition of persistent luminescent (PeL) $SrAl_2O_4:Eu^{2+},Dy^{3+}$ microparticles (MPs) in phosphate glass melt under static condition are reported. PeL phosphate glasses with the composition ($50P_2O_5$-$10Na_2O$-40SrO) (in mol%) were prepared by adding the MPs in the glass melt. The decomposition of the MPs occurs during the preparation of the glass and leads to changes in the Eu^{2+} sites and to the formation of Eu^{3+} which decreases the PeL properties of the glasses. The decomposition of the MPs depends on the temperature at which the MPs are added in the melt and also on the time before casting the melts.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Photonics, Research group: Nanophotonics, Turun Yliopisto/Turun Biomateriaalikeskus
Contributors: Ojha, N., Nguyen, H., Laihinen, T., Salminen, T., Lastusaari, M., Petit, L.
Pages: 207-214
Publication date: 2018
Peer-reviewed: Yes

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Journal: Corrosion Science
Volume: 135
ISSN (Print): 0010-938X
Ratings:

Scopus rating (2018): CiteScore 10.3 SJR 2.131 SNIP 2.759
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Materials Science(all)
Keywords: Corrosion, Decomposition, Persistent luminescence, Phosphate glasses, SrAlO:Eu,Dy microparticles
DOIs:

10.1016/j.corsci.2018.02.050

Bibliographical note
INT=fot,"Nguyen, H."
Source: Scopus
Source ID: 85042665831
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of N/S ratio on anoxic thiosulfate oxidation in a fluidized bed reactor: Experimental and artificial neural network model analysis

Anoxic thiosulfate ($S_2O_3^{2-}$) oxidation using autotrophic denitrification by a mixed culture of nitrate reducing, sulfur oxidizing bacteria (NR-SOB) was studied in a fluidized bed reactor (FBR). The long-term performance of the FBR was evaluated for 306 days at three nitrogen-to-sulfur (N/S) molar ratios (0.5, 0.3 and 0.1) and a hydraulic retention time (HRT) of 5 h. $S_2O_3^{2-}$ removal efficiencies >99% were obtained at a N/S ratio of 0.5 and a $S_2O_3^{2-}$ and nitrate (NO_3^-) loading rate of 820 (±84) mg S-$S_2O_3^{2-}$ L^{-1} d^{-1} and 173 (±10) mg N-NO_3^- L^{-1} d^{-1}, respectively. The $S_2O_3^{2-}$ removal efficiency decreased to 76% and 26% at N/S ratios of 0.3 and 0.1, respectively, and recovered to 80% within 3 days after increasing the N/S ratio from 0.1 back to 0.5. The highest observed half-saturation (K_s) and inhibition (K_I) constants of the biofilm-grown NR-SOB obtained from batch cultivations were 172 and 800 mg S-$S_2O_3^{2-}$ L^{-1}, respectively. Thiobacilus denitrificans was the dominant microorganism in the FBR. Artificial neural network modeling successfully predicted $S_2O_3^{2-}$ and NO_3^- removal efficiencies and SO_4^{2-} production in the FBR. Additionally, results from the sensitivity analysis showed that the effluent pH was the most influential parameter affecting the $S_2O_3^{2-}$ removal efficiency.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, University of Cassino and Southern Lazio, ENEA/CREATE/Università Degli Studi Napoli Federico II
Contributors: Khanongnuch, R., Di Capua, F., Lakaniemi, A., Rene, E. R., Lens, P. N.
Pages: 171-181
Publication date: 2018
Peer-reviewed: Yes
Early online date: 1 Jan 2018

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Volume: 68
ISSN (Print): 1359-5113
Ratings:

Scopus rating (2018): CiteScore 4.7 SJR 0.754 SNIP 1.043
Original language: English
ASJC Scopus subject areas: Bioengineering, Biochemistry, Applied Microbiology and Biotechnology
Keywords: Anoxic thiosulfate oxidation, Artificial neutral network, Kinetic constants, Nitrate reducing-sulfur oxidizing bacteria, Thiobacilus denitrificans
Electronic versions:

Effect of NtoS ratio on anoxic thiosulfate oxidation in a fluidized bed reactor- experimental and artificial neural network model analysis. Embargo ended: 23/02/19
DOIs:

10.1016/j.procbio.2018.02.018
URLs:

http://urn.fi/URN:NBN:fi:tty-201811282779. Embargo ended: 23/02/19
Source: Scopus
Source ID: 85044110451
Research output: Contribution to journal › Article › Scientific › peer-review

Efficient photon upconversion at remarkably low annihilator concentrations in a liquid polymer matrix: when less is more

A green-to-blue triplet-triplet annihilation upconversion of 24.5% quantum yield was achieved at a remarkably low 600 μM annihilator concentration in a viscous polymer matrix. This was made possible by utilizing a ZnTPP-based photosensitizer with exceptionally long 11 ms phosphorescence lifetime. Higher 3 mM annihilator concentration resulted in lower 24% upconversion quantum yield.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering
Contributors: Durandin, N. A., Isokuortti, J., Efimov, A., Vuorimaa-Laukkanen, E., Tkachenko, N. V., Laaksonen, T.
Number of pages: 4
Pages: 14029-14032
Publication date: 2018
Peer-reviewed: Yes

Publication information

Journal: Chemical Communications
Volume: 54

Issue number: 99
ISSN (Print): 1359-7345
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Scopus rating (2018): CiteScore 11.6 SJR 2.177 SNIP 1.145
Original language: English
ASJC Scopus subject areas: Catalysis, Electronic, Optical and Magnetic Materials, Ceramics and Composites, Chemistry(all), Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry
Keywords: triplet-triplet annihilation, triplet-triplet energy transfer, triplet state lifetime, upconversion, triplet fusion
Electronic versions:

Efficient photon upconversion at remarkably low annihilator concentrations: when less is more. Embargo ended: 22/11/19
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URLs:

http://urn.fi/URN:NBN:fi:tty-201901141089. Embargo ended: 22/11/19
Source: Scopus
Source ID: 85058301188
Research output: Contribution to journal › Article › Scientific › peer-review

Bioactive glass induced osteogenic differentiation of human adipose stem cells is dependent on cell attachment mechanism and mitogen-activated protein kinases

Bioactive glasses (BaGs) are widely utilised in bone tissue engineering (TE) but the molecular response of cells to BaGs is poorly understood. To elucidate the mechanisms of cell attachment to BaGs and BaG-induced early osteogenic differentiation, we cultured human adipose stem cells (hASCs) on discs of two silica-based BaGs S53P4 (23.0 Na_2O-20.0 CaO-4.0 P_2O_5-53.0 SiO_2 (wt-%)) and 1-06 (5.9 Na_2O-12.0 K_2O-5.3 MgO-22.6 CaO-4.0 P_2O_5-0.2 B_2O_3-50.0 SiO_2) in the absence of osteogenic supplements. Both BaGs induced early osteogenic differentiation by increasing alkaline phosphatase activity (ALP) and the expression of osteogenic marker genes RUNX2a and OSTERIX. Based on ALP activity, the slower reacting 1-06 glass was a stronger osteoinducer. Regarding the cell attachment, cells cultured on BaGs had enhanced integrinβ1 and vinculin production, and mature focal adhesions were smaller but more dispersed than on cell culture plastic (polystyrene). Focal adhesion kinase (FAK), extracellular signal-regulated kinase (ERK1/2) and c-Jun N-terminal kinase (JNK)-induced c-Jun phosphorylations were upregulated by glass contact. Moreover, the BaG-stimulated osteoinduction was significantly reduced by FAK and mitogen-activated protein kinase (MAPK) inhibitors, indicating an important role for FAK and MAPKs in the BaG-induced early osteogenic commitment of hASCs. Upon indirect insert culture, the ions released from the BaG discs could not reproduce the observed cellular changes, which highlighted the role of direct cell-BaG interactions in the osteopotential of BaGs. These findings gave valuable insight into the mechanism of BaG-induced osteogenic differentiation and therefore provided knowledge to aid the future design of new functional biomaterials to meet the increasing demand for clinical bone TE treatments.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, The National Science Centre, Poland, Tampere University Hospital, Johan Gadolin Process Chemistry Centre, Abo Akademi University, University of Tampere
Contributors: Ojansivu, M., Wang, X., Hyväri, L., Kellomäki, M., Hupa, L., Vanhatupa, S., Miettinen, S.
Number of pages: 19
Pages: 53-71
Publication date: 2018
Peer-reviewed: Yes

Publication information

Journal: European Cells and Materials
Volume: 35
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Ratings:

Scopus rating (2018): CiteScore 6.4 SJR 1.171 SNIP 1.062
Original language: English
ASJC Scopus subject areas: Bioengineering, Biochemistry, Biomaterials, Biomedical Engineering, Cell Biology
Keywords: Bioactive glass, Cell attachment, Cell signalling, Focal adhesion, Mesenchymal stem cell, Mitogen-activated protein kinase, Osteogenic differentiation
DOIs:

10.22203/eCM.v035a05

Bibliographical note

EXT="Ojansivu, M."
EXT="Vanhatupa, S."

Source: Scopus
Source ID: 85052576307
Research output: Contribution to journal › Article › Scientific › peer-review

Deactivation of Pt/SiO_2-ZrO_2 diesel oxidation catalysts by sulphur, phosphorus and their combinations

The impact of sulphur, phosphorus and water and their co-exposure on a monolith-type Pt/SiO_2-ZrO_2 diesel oxidation catalyst was investigated. The accelerated laboratory-scale sulphur treatments for Pt/SiO_2-ZrO_2 were done with and without water (S- and SW-treatments, respectively) at 400 °C. Similarly, the phosphorus treatment with water (PW-treatment) as well as the co-exposure of phosphorus, sulphur and water (PSW-treatment) were also done to find out the interactions between the impurities. The studied catalysts were characterized by using several techniques and the activity of the catalyst was tested in lean diesel exhaust gas conditions. Based on the XPS and the elemental analysis, more phosphorus was adsorbed on the Pt/SiO_2-ZrO_2 catalyst than sulphur. Sulphur, in the presence and absence of water, was found to have a negligible effect on the CO and C_3H_6 light-off temperatures (T_{90}) over the fresh Pt/SiO_2-ZrO_2, whereas the T_{90} values of CO and C_3H_6 increased by 30–45 °C as a result of the PW-treatment and by 15–35 °C after the PSW-treatment. Based on the Transmission electron microscope (TEM) analyses, no morphological changes on the Pt/SiO_2-ZrO_2 surfaces were observed due to the phosphorus treatment. Therefore, the reason for the lower activity after the PW-treatment could be the formation of phosphates that are decreasing the specific surface area of the catalyst, blocking the accessibility of the reactants to the catalyst pores and active sites. However, it is worth noting that sulphur decreased the amount of adsorbed phosphorus and thus, inhibited the poisoning effect of phosphorus.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization, Dinex Ecocat Oy, Univ of Oulu, Aalto University
Contributors: Väliheikki, A., Kärkkäinen, M., Honkanen, M., Heikkinen, O., Kolli, T., Kallinen, K., Huuhtanen, M., Vippola, M., Lahtinen, J., Keiski, R. L.
Number of pages: 11
Pages: 409-419
Publication date: 5 Dec 2017
Peer-reviewed: Yes

Publication information

Journal: Applied Catalysis B-Environmental
Volume: 218
ISSN (Print): 0926-3373
Ratings:
Scopus rating (2017): CiteScore 17.3 SJR 3.152 SNIP 2.367
Original language: English
ASJC Scopus subject areas: Catalysis, Environmental Science(all), Process Chemistry and Technology
Keywords: DOC, Phosphorus, Platinum, Silicon-zirconium oxide, Sulphur dioxide
DOIs:
10.1016/j.apcatb.2017.06.068
Source: Scopus
Source ID: 85021933594
Research output: Contribution to journal › Article › Scientific › peer-review

Photodynamic self–disinfecting surface using pyridinium phthalocyanine

We have synthesized novel phthalocyanine with four pyridyl substituents connected to α-phthalo-positions via direct C-C bond. The Zn complex and tetracationic derivatives of phthalocyanine were also synthesized and the dyes were impregnated into filter paper to prepare photoactive antimicrobial surface. The photodynamic antimicrobial efficacy of the dyed paper samples was evaluated by a simple and fast setup using bioluminescent microbes. Escherichia coli and Acinetobacter baylyi ADP1 strains carrying bacterial luciferase genes were used in the screening experiment. The most efficient compound, tetracationic zinc derivative 8, was investigated further. The compound was highly water soluble, had high molar absorptivity and exhibited good adhesion to the filter paper without leaching into the solution. The singlet oxygen quantum yield of tetracationic zinc derivative 8 in water was found out to be 30 ± 20%. According to the cell viability assay test performed on E. coli wild type in solution, the molecule had similar or better photo toxicity as the reference photosensitizer, tetrakis (1-methyl-pyridinium-4-yl)porphyrin (TMPyP). Antimicrobial efficacy of the dye 8 on photoactive surface was studied by live cell assessment through colony forming unit (CFU) counting. The colored surface demonstrated 3 log reduction in CFU against E. coli and A. baylyi ADP1 just after 1 h of illumination with the white light of low intensity.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Institut für Physik
Contributors: George, L., Müller, A., Röder, B., Santala, V., Efimov, A.
Number of pages: 9
Pages: 334-342
Publication date: 1 Dec 2017
Peer-reviewed: Yes

Publication information
Journal: Dyes and Pigments
Volume: 147
ISSN (Print): 0143-7208
Ratings:

Scopus rating (2017): CiteScore 5.6 SJR 0.819 SNIP 1.009
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Process Chemistry and Technology
Keywords: Antimicrobial, Photodynamic antimicrobial chemotherapy, Pyridinium phthalocyanine, Self-disinfecting surface, Singlet oxygen
DOIs:

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Source: Scopus
Source ID: 85027896139
Research output: Contribution to journal › Article › Scientific › peer-review

Oxygen and water vapor transmission rates of starch-poly(vinyl alcohol) barrier coatings for flexible packaging paper
Creating efficient water-borne dispersions based mainly on renewable materials for coating of flexible packaging paper was the aim of this study. The effects of an ethylene modified poly(vinyl alcohol) grade and a standard poly(vinyl alcohol) on the oxygen and water vapor barrier performance of corn starch and potato starch coatings was studied. The results showed that a coating composition with a high fraction of a renewable polymer was effective in keeping the oxygen barrier at a technically and commercially applicable level. An ethylene modified poly(vinyl alcohol) grade was found to provide lower oxygen transmission rates at high relative humidity, as compared to a standard poly(vinyl alcohol) grade. The oxygen barrier properties of blends of starch and poly(vinyl alcohol) were similar to that of the pure modified poly(vinyl alcohol) in the range from 0% starch to 60% starch. This was observed with both hydroxypropylated and octenyl succinate modified starch grades. The drying conditions of the mixed starch:poly(vinyl alcohol) coatings were based on drying trials with pure poly(vinyl alcohol) coatings. Drying at moderate temperatures indicated the possibility to slightly decrease water vapor transmission rate by higher drying temperature. Several secondary effects of increased drying temperature such as coating hold-out and formation of defects may also be of importance.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Karlstad University
Contributors: Christophliemk, H., Johansson, C., Ullsten, H., Järnström, L.
Number of pages: 7
Pages: 218-224
Publication date: 1 Dec 2017
Peer-reviewed: Yes

Publication information
Journal: Progress in Organic Coatings
Volume: 113
ISSN (Print): 0300-9440
Ratings:

Scopus rating (2017): CiteScore 5.1 SJR 0.844 SNIP 1.334
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Surfaces, Coatings and Films, Organic Chemistry, Materials Chemistry
Keywords: Barrier coating, Drying, Oxygen transmission rate, Poly(vinyl alcohol), Starch, Water vapor transmission rate
DOIs:

10.1016/j.porgcoat.2017.04.019
Source: Scopus
Source ID: 85019946529
Research output: Contribution to journal › Article › Scientific › peer-review

Production of long chain alkyl esters from carbon dioxide and electricity by a two-stage bacterial process

Microbial electrosynthesis (MES) is a promising technology for the reduction of carbon dioxide into value-added multicarbon molecules. In order to broaden the product profile of MES processes, we developed a two-stage process for microbial conversion of carbon dioxide and electricity into long chain alkyl esters. In the first stage, the carbon dioxide is reduced to organic compounds, mainly acetate, in a MES process by Sporomusa ovata. In the second stage, the liquid end-products of the MES process are converted to the final product by a second microorganism, Acinetobacter baylyi in an aerobic bioprocess. In this proof-of-principle study, we demonstrate for the first time the bacterial production of long alkyl esters (wax esters) from carbon dioxide and electricity as the sole sources of carbon and energy. The process holds potential for the efficient production of carbon-neutral chemicals or biofuels.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Research group: Bio- and Circular Economy, Wuhan University of Technology
Contributors: Lehtinen, T., Efimova, E., Tremblay, P. L., Santala, S., Zhang, T., Santala, V.
Number of pages: 7
Pages: 30-36
Publication date: 1 Nov 2017
Peer-reviewed: Yes

Publication information

Journal: Bioresource Technology
Volume: 243
ISSN (Print): 0960-8524
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Original language: English
ASJC Scopus subject areas: Bioengineering
Keywords: Acinetobacter baylyi ADP1, Carbon dioxide fixation, Carbon neutral, Microbial electrosynthesis, Oleochemicals
Electronic versions:

Wax esters with MES R1. Embargo ended: 23/06/19
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10.1016/j.biortech.2017.06.073
URLs:

http://urn.fi/URN:NBN:fi:tuni-201910033687
Source: Scopus
Source ID: 85021253675
Research output: Contribution to journal › Article › Scientific › peer-review

DoGlycans-Tools for Preparing Carbohydrate Structures for Atomistic Simulations of Glycoproteins, Glycolipids, and Carbohydrate Polymers for GROMACS

Carbohydrates constitute a structurally and functionally diverse group of biological molecules and macromolecules. In cells they are involved in, e.g., energy storage, signaling, and cell-cell recognition. All of these phenomena take place in atomistic scales, thus atomistic simulation would be the method of choice to explore how carbohydrates function. However, the progress in the field is limited by the lack of appropriate tools for preparing carbohydrate structures and related topology files for the simulation models. Here we present tools that fill this gap. Applications where the tools discussed in this paper are particularly useful include, among others, the preparation of structures for glycolipids, nanocellulose, and glycans linked to glycoproteins. The molecular structures and simulation files generated by the tools are compatible with GROMACS.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Research group: Biological Physics and Soft Matter, University of Helsinki, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, MEMPHYS - Centre for Biomembrane Physics , University of Southern Denmark, Laboratory of Physics
Contributors: Danne, R., Poojari, C., Martinez-Seara, H., Rissanen, S., Lolicato, F., Róg, T., Vattulainen, I.
Number of pages: 6
Pages: 2401-2406
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Publication information
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Volume: 57
Issue number: 10
ISSN (Print): 1549-9596
Ratings:

Scopus rating (2017): CiteScore 6.9 SJR 1.349 SNIP 1.213
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Computer Science Applications, Library and Information Sciences
DOIs:

10.1021/acs.jcim.7b00237
Source: Scopus
Source ID: 85031999962
Research output: Contribution to journal › Article › Scientific › peer-review

Starch-poly(vinyl alcohol) barrier coatings for flexible packaging paper and their effects of phase interactions
Starch and poly(vinyl alcohol) based barrier coatings for flexible packaging papers were studied. Both octenyl succinate modified and hydroxypropylated corn and potato starches were blended with regular and ethylene modified poly(vinyl alcohol) to increase the water vapor barrier properties and enhance the flexibility of the starch coatings, in order to accomplish superior barrier performance. Phase separation between starch and poly(vinyl alcohol) was studied in detail, both in the solution and in dry draw-down coatings on paper. The barrier performance of the coated paper was evaluated with respect to water vapor transmission rate. Conditions for the creation of a thin surface layer consisting of only one of the pure polymers were identified and discussed in terms of phase separation in solution migration of poly(vinyl alcohol) to the uppermost surface layer. The phase separation promoted low water vapor transmission rates also with a rather high fraction of starch in the coatings.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Karlstad University
Contributors: Christophliemk, H., Ullsten, H., Johansson, C., Järnström, L.
Number of pages: 10
Pages: 13-22
Publication date: 1 Oct 2017
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Journal: Progress in Organic Coatings
Volume: 111
ISSN (Print): 0300-9440
Ratings:

Scopus rating (2017): CiteScore 5.1 SJR 0.844 SNIP 1.334
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Surfaces, Coatings and Films, Organic Chemistry, Materials Chemistry
Keywords: Barrier coating, PVOH, Starch, Turbidity, Viscosity, WVTR, XPS
DOIs:

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Source ID: 85019450052
Research output: Contribution to journal › Article › Scientific › peer-review

New Evidence for the Mechanism of Action of a Type-2 Diabetes Drug Using a Magnetic Bead-Based Automated Biosensing Platform
The mechanism of action (MOA) of the first line type-2 diabetes drug metformin remains unclear despite its widespread usage. However, recent evidence suggests that the mitochondrial copper (Cu)-binding action of metformin may contribute toward the drug's MOA. Here, we present a novel biosensing platform for investigating the MOA of metformin using a magnetic microbead-based agglutination assay which has allowed us to demonstrate for the first time the interaction between Cu and metformin at clinically relevant low micromolar concentrations of the drug, thus suggesting a potential pathway of metformin's blood-glucose lowering action. In this assay, cysteine-functionalized magnetic beadswere agglutinated in the presence of Cu due to cysteine's Cu-chelation property. Addition of clinically relevant doses of metformin resulted in disaggregation of Cu-bridged bead-clusters, whereas the effect of adding a closely related but blood-

glucose neutral drug propanediimidamide (PDI) showed completely different responses to the clusters. The entire assay was integrated in an automated microfluidics platform with an advanced optical imaging unit by which we investigated these aggregation-disaggregation phenomena in a reliable, automated, and user-friendly fashion with total assay time of 17 min requiring a sample (metformin/PDI) volume of 30 μL. The marked difference of Cu-binding action between the blood-glucose lowering drug metformin and its inactive analogue PDI thus suggests that metformin's distinctive Cu-binding properties may be required for its effect on glucose homeostasis. The novel automated platform demonstrating this novel investigation thus holds the potential to be utilized for investigating significant and sensitive molecular interactions via magnetic bead-based agglutination assay.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Danmarks Tekniske Universitet, DTU Informatik, University of Dundee, Academia Sinica Taiwan
Contributors: Uddin, R., Nur-E-Habiba, N., Rena, G., Hwu, E. T., Boisen, A.
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Peer-reviewed: Yes

Publication information
Journal: ACS Sensors
Volume: 2
Issue number: 9
ISSN (Print): 1424-8220
Ratings:
Scopus rating (2017): CiteScore 4.3 SJR 0.584 SNIP 1.593
Original language: English
ASJC Scopus subject areas: Bioengineering, Fluid Flow and Transfer Processes, Process Chemistry and Technology, Instrumentation
Keywords: agglutination assay, biosensor, magnetic beads, metformin, molecular interactions, optical imaging, type-2 diabetes
DOIs:
10.1021/acssensors.7b00384

Bibliographical note
INT=keb,"Nur-E-Habiba, N."
Source: Scopus
Source ID: 85029817525
Research output: Contribution to journal › Article › Scientific › peer-review

Membrane Binding of Recoverin: From Mechanistic Understanding to Biological Functionality
Recoverin is a neuronal calcium sensor involved in vision adaptation that reversibly associates with cellular membranes via its calcium-activated myristoyl switch. While experimental evidence shows that the myristoyl group significantly enhances membrane affinity of this protein, molecular details of the binding process are still under debate. Here, we present results of extensive molecular dynamics simulations of recoverin in the proximity of a phospholipid bilayer. We capture multiple events of spontaneous membrane insertion of the myristoyl moiety and confirm its critical role in the membrane binding. Moreover, we observe that the binding strongly depends on the conformation of the N-terminal domain. We propose that a suitable conformation of the N-terminal domain can be stabilized by the disordered C-terminal segment or by binding of the target enzyme, i.e., rhodopsin kinase. Finally, we find that the presence of negatively charged lipids in the bilayer stabilizes a physiologically functional orientation of the membrane-bound recoverin.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Physics, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Institute of Experimental Botany of the Academy of Sciences of the Czech Republic, University of Stuttgart, University of Helsinki
Contributors: Timr, Š., Pleskot, R., Kadlec, J., Kohagen, M., Magarkar, A., Jungwirth, P.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
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Research output: Contribution to journal › Article › Scientific › peer-review

Exhaust emissions of non-road mobile machine: Real-world and laboratory studies with diesel and HVO fuels

Exhaust emissions emitted by a non-road mobile machine were studied chasing a tractor in real-world conditions and repeating the same transient tests with a similar engine on an engine dynamometer where additionally, non-road steady state tests were carried out. The engines were equipped with an oxidation catalyst (DOC) and a selective catalytic reduction (SCR) system, and they were fuelled by fossil diesel fuel with ultra-low sulphur content and hydrotreated vegetable oil (HVO). By substituting diesel fuel with HVO the on-road emissions of nitrogen oxides (NO_x) reduced 20% and particle number 44%, the emission factors being EF_{NOx} = 1.62 ± 0.04 g/kWh and EF_N = (28.2 ± 7.8) × 10^{13} #/kWh. Similar trend was observed for NO_x at laboratory although the emissions were somewhat smaller than on-road. In contrast to real-world, in the laboratory experiment the EF_N was only 2% smaller with HVO than with diesel, and these emission factors were almost one order of magnitude smaller than observed on-road. The number size distribution and volatility measurements showed that in real-world experiments small nucleation mode particles were formed during uphill and during downhill in engine braking conditions. These were not observed at laboratory. However, nucleation mode particles were observed in the laboratory experiments at high load steady driving conditions. At steady state tests the emissions strongly depended on engine load and engine speed with both fuels.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Physics, Research area: Aerosol Physics, University of Helsinki, Turku University of Applied Sciences
Contributors: Pirjola, L., Rönkkö, T., Saukko, E., Parviainen, H., Malinen, A., Alanen, J., Saveljeff, H.
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ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry
Keywords: Diesel engine, Exhaust emissions, HVO, NO, Particle size distribution, Real-world emissions, Tractor
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URLs:
http://urn.fi/URN:NBN:fi:tty-201712192400. Embargo ended: 13/04/19
Additional files:
Appendix A_Pirjola_rev_TUTCRIS
Source: Scopus
Source ID: 85017566506
Research output: Contribution to journal › Article › Scientific › peer-review

Effects of different nickel species on autotrophic denitrification driven by thiosulfate in batch tests and a fluidized-bed reactor

Nickel is a common heavy metal and often occurs with nitrate (NO_3^-) in effluents from mining and metal-finishing industry. The present study investigates the effects of increasing concentrations (5–200 mg Ni/L) of $NiEDTA^{2-}$ and $NiCl_2$ on autotrophic denitrification with thiosulfate ($S_2O_3^{2-}$) in batch tests and a fluidized-bed reactor (FBR). In batch bioassays, 50 and 100 mg Ni/L of $NiEDTA^{2-}$ only increased the transient accumulation of NO_2^-, whereas 25–100 mg Ni/L of $NiCl_2$ inhibited denitrification by 9–19%. NO_3^- and NO_2^- were completely removed in the FBR at feed $NiEDTA^{2-}$ and $NiCl_2$ concentrations as high as 100 and 200 mg Ni/L, respectively. PCR-DGGE revealed the dominance of Thiobacillus denitrificans and the presence of the sulfate-reducing bacterium Desulfovibrio putealis in the FBR microbial community at all feed nickel concentrations investigated. Nickel mass balance, thermodynamic modeling and solid phase characterization indicated that nickel sulfide, phosphate and oxide precipitated in the FBR during $NiCl_2$ injection.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Research group: Bio- and Circular Economy, University of Cassino and Southern Lazio, UPEM, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education
Contributors: Di Capua, F., Milone, I., Lakaniemi, A., Hullebusch, E. D., Lens, P. N., Esposito, G.
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Journal: Bioresource Technology
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Scopus rating (2017): CiteScore 10 SJR 2.029 SNIP 1.84
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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Autotrophic denitrification, EDTA, Fluidized-bed reactor, Nickel, Thiosulfate
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INT=keb,"Di Capua, Fransesco"
Source: Scopus
Source ID: 85019042670
Research output: Contribution to journal › Article › Scientific › peer-review

Dissolution-induced nanowire synthesis on hot-dip galvanized surface in supercritical carbon dioxide

In this study, we demonstrate a rapid treatment method for producing a needle-like nanowire structure on a hot-dip galvanized sheet at a temperature of 50 °C. The processing method involved only supercritical carbon dioxide and water to induce a reaction on the zinc surface, which resulted in growth of zinc hydroxycarbonate nanowires into flower-like shapes. This artificial patina nanostructure predicts high surface area and offers interesting opportunities for its use in industrial high-end applications. The nanowires can significantly improve paint adhesion and promote electrochemical stability for organic coatings, or be converted to ZnO nanostructures by calcining to be used in various semiconductor applications.

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Ceramic materials, Top Analytica Oy, SSAB
Contributors: Kaleva, A., Saarimaa, V., Heinonen, S., Nikkanen, J., Markkula, A., Väisänen, P., Levänen, E.
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ISSN (Print): 2079-4991
Ratings:

Scopus rating (2017): SNIP 0.947
Original language: English
ASJC Scopus subject areas: Materials Science(all), Chemical Engineering(all)
Keywords: Nanowire, Supercritical carbon dioxide, Zinc hydroxycarbonate
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Source: Scopus
Source ID: 85025460868
Research output: Contribution to journal › Article › Scientific › peer-review

The effects of calcium and potassium on CO_2 gasification of birch wood in a fluidized bed

Birch wood was leached of its naturally occurring ash forming elements and doped with three concentrations of calcium or potassium before being gasified in a laboratory bubbling fluidized bed reactor. The wood samples were pelletized and inserted into a fluidized bed reactor where they were first pyrolyzed with N_2 and then gasified with CO_2. In addition to tracking the gas concentration of the exit gas, char samples were taken from the fluidized bed and analyzed to study the char properties. The presence of potassium in the biomass was found to have a significant influence on the structure of the resulting char, however potassium did not have an observable catalytic effect on the overall gasification reaction rate with CO_2 due to the formation of a unreactive coke layer on the char surface. In contrast, calcium did increase the char conversion rate and is likely the primary active catalyst in gasification of birch wood with CO_2.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Industrial Bioengineering and Applied Organic Chemistry, Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Universidad de Sevilla, Johan Gadolin Process Chemistry Centre, Abo Akademi University, Univ of Oulu
Contributors: Kramb, J., Gómez-Barea, A., DeMartini, N., Romar, H., Doddapaneni, T. R. K. C., Konttinen, J.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry
Keywords: Biomass, Catalysts, Char, Fluidized bed, Gasification
DOIs:

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Source ID: 85012050856
Research output: Contribution to journal › Article › Scientific › peer-review

Electron microscopic studies of natural gas oxidation catalyst – Effects of thermally accelerated aging on catalyst microstructure

Structural changes of PtPd nanoparticles in a natural gas oxidation catalyst were studied at elevated temperatures in air and low-oxygen conditions and in situ using environmental transmission electron microscopy (ETEM). The fresh catalyst shows x particles on the γ-Al_2O_3 support. At 700 °C, the noble metal oxide decomposes and Pt gets trapped by PdO particles followed by formation of metallic Pd and Pt containing particles. At 1000 °C, the particles had a metallic Pd and Pt containing core surrounded by PdO particles. In addition, the presence of

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MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Research group: Materials Characterization, Danmarks Tekniske Universitet, DTU Informatik, Aalto University, Univ of Oulu, Dinex Ecocat Oy
Contributors: Honkanen, M., Hansen, T. W., Jiang, H., Kärkkäinen, M., Huuhtanen, M., Heikkinen, O., Kallinen, K., Lahtinen, J., Keiski, R. L., Wagner, J. B., Vippola, M.
Number of pages: 11
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Publication date: 1 May 2017
Peer-reviewed: Yes

Publication information
Journal: Journal of Catalysis
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ISSN (Print): 0021-9517
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Scopus rating (2017): CiteScore 11.4 SJR 2.397 SNIP 1.865
Original language: English
ASJC Scopus subject areas: Catalysis, Physical and Theoretical Chemistry
Keywords: Environmental transmission electron microscope, Low-oxygen conditions, Natural gas oxidation, Palladium, Platinum, Sintering, Thermal aging
DOIs:

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Honkanen et al_accepted manuscript
Source: Scopus
Source ID: 85016079754
Research output: Contribution to journal › Article › Scientific › peer-review

Bioamine-crosslinked gellan gum hydrogel for neural tissue engineering
Neural tissue engineering and three-dimensional in vitro tissue modeling require the development of biomaterials that take into account the specified requirements of human neural cells and tissue. In this study, an alternative method of producing biomimetic hydrogels based on gellan gum (GG) was developed by replacing traditional crosslinking methods with the bioamines spermidine and spermine. These bioamines were proven to function as crosslinkers for GG hydrogel at +37 °C, allowing for the encapsulation of human neurons. We studied the mechanical and rheological properties of the formed hydrogels, which showed biomimicking properties comparable to naïve rabbit brain tissue under physiologically relevant stress and strain. Human pluripotent stem cell-derived neuronal cells demonstrated good cytocompatibility in the GG-based hydrogels. Moreover, functionalization of GG hydrogels with laminin resulted in cell type-specific behavior: neuronal cell maturation and neurite migration.

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MoE publication type: A1 Journal article-refereed
Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Biomaterials and Tissue Engineering Group, Materials Science, Research group: Plastics and Elastomer Technology, BioMediTech Institute and Faculty of Medicine and Life Sciences
Contributors: Koivisto, J. T., Joki, T., Parraga, J. E., Paakkönen, R., Yla-Outinen, L., Salonen, L., Jönkkäri, I., Peltola, M., Ihalainen, T. O., Narkilahti, S., Kellomäki, M.
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Ratings:

Scopus rating (2017): CiteScore 4.5 SJR 0.768 SNIP 0.8
Original language: English
ASJC Scopus subject areas: Bioengineering, Biomaterials, Biomedical Engineering
Keywords: 3D cell culture, gellan gum, human pluripotent stem cells, hydrogel, laminin, neuronal cells
DOIs:

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Bibliographical note
EXT="Ihalainen, Teemu O."

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Source ID: 85018274634
Research output: Contribution to journal › Article › Scientific › peer-review

Calcium Directly Regulates Phosphatidylinositol 4,5-Bisphosphate Headgroup Conformation and Recognition

The orchestrated recognition of phosphoinositides and concomitant intracellular release of Ca^{2+} is pivotal to almost every aspect of cellular processes, including membrane homeostasis, cell division and growth, vesicle trafficking, as well as secretion. Although Ca^{2+} is known to directly impact phosphoinositide clustering, little is known about the molecular basis for this or its significance in cellular signaling. Here, we study the direct interaction of Ca^{2+} with phosphatidylinositol 4,5-bisphosphate ($PI(4,5)P_2$), the main lipid marker of the plasma membrane. Electrokinetic potential measurements of $PI(4,5)P_2$ containing liposomes reveal that Ca^{2+} as well as Mg^{2+} reduce the zeta potential of liposomes to nearly background levels of pure phosphatidylcholine membranes. Strikingly, lipid recognition by the default $PI(4,5)P_2$ lipid sensor, phospholipase C delta 1 pleckstrin homology domain (PLC δ1-PH), is completely inhibited in the presence of Ca^{2+}, while Mg^{2+} has no effect with 100 nm liposomes and modest effect with giant unilamellar vesicles. Consistent with biochemical data, vibrational sum frequency spectroscopy and atomistic molecular dynamics simulations reveal how Ca^{2+} binding to the $PI(4,5)P_2$ headgroup and carbonyl regions leads to confined lipid headgroup tilting and conformational rearrangements. We rationalize these findings by the ability of calcium to block a highly specific interaction between PLC δ1-PH and $PI(4,5)P_2$, encoded within the conformational properties of the lipid itself. Our studies demonstrate the possibility that switchable phosphoinositide conformational states can serve as lipid recognition and controlled cell signaling mechanisms.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Physics, German Center for Diabetes Research (DZD e.V.), Institute of Experimental Botany of the Academy of Sciences of the Czech Republic, Pennsylvania State University, University of Wrocław, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, J. Heyrovský Institute of Physical Chemistry, University of Helsinki, MEMPHYS, University of Southern Denmark
Contributors: Bilkova, E., Pleskot, R., Rissanen, S., Sun, S., Czogalla, A., Cwiklik, L., Róg, T., Vattulainen, I., Cremer, P. S., Jungwirth, P., Coskun, Ü.
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Publication information

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Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all), Biochemistry, Colloid and Surface Chemistry
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Bibliographical note

EXT="Cwiklik, Lukasz"
Source: Scopus
Source ID: 85016148911
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Hierarchical Self-Assembly of Halogen-Bonded Block Copolymer Complexes into Upright Cylindrical Domains

Self-assembly of block copolymers into well-defined, ordered arrangements of chemically distinct domains is a reliable strategy for preparing tailored nanostructures. Microphase separation results from the system, minimizing repulsive interactions between dissimilar blocks and maximizing attractive interactions between similar blocks. Supramolecular methods have also achieved this separation by introducing small-molecule additives binding specifically to one block by noncovalent interactions. Here, we use halogen bonding as a supramolecular tool that directs the hierarchical self-assembly of low-molecular-weight perfluorinated molecules and diblock copolymers. Microphase separation results in a lamellar-within-cylindrical arrangement and promotes upright cylindrical alignment in films upon rapid casting and without further annealing. Such cylindrical domains with internal lamellar self-assemblies can be cleaved by solvent treatment of bulk films, resulting in separated and segmented cylindrical micelles stabilized by halogen-bond-based supramolecular crosslinks. These features, alongside the reversible nature of halogen bonding, provide a robust modular approach for nanofabrication.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Supramolecular photochemistry, VTT Technical Research Centre of Finland, Aalto University, Politecnico di Milano, Italian Institute of Technology, Università del Salento
Contributors: Milani, R., Houbenov, N., Fernandez-Palacio, F., Cavallo, G., Luzio, A., Haataja, J., Giancane, G., Saccone, M., Priimägi, A., Metrangolo, P., Ikkala, O.
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ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Biochemistry, Environmental Chemistry, Materials Chemistry, Biochemistry, medical
Keywords: block copolymers, halogen bond, hierarchical self-assembly, nanofabrication, supramolecular complexes
Electronic versions:

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Source: Scopus
Source ID: 85014778403
Research output: Contribution to journal › Article › Scientific › peer-review

Benchmarking DFT methods with small basis sets for the calculation of halogen-bond strengths
In recent years, halogen bonding has become an important design tool in crystal engineering, supramolecular chemistry and biosciences. The fundamentals of halogen bonding have been studied extensively with high-accuracy computational methods. Due to its non-covalency, the use of triple-zeta (or larger) basis sets is often recommended when studying halogen bonding. However, in the large systems often encountered in supramolecular chemistry and biosciences, large basis sets can make the calculations far too slow. Therefore, small basis sets, which would combine high computational speed and high accuracy, are in great demand. This study focuses on comparing how well density functional theory (DFT) methods employing small, double-zeta basis sets can estimate halogen-bond strengths. Several methods with triple-zeta basis sets are included for comparison. Altogether, 46 DFT methods were tested using two data sets of 18 and 33 halogen-bonded complexes for which the complexation energies have been previously calculated with the high-accuracy CCSD(T)/CBS method. The DGDZVP basis set performed far better than other double-zeta basis sets, and it even outperformed the triple-zeta basis sets. Due to its small size, it is well-suited to studying halogen bonding in large systems.

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Organisations: Chemistry and Bioengineering, Research group: Supramolecular photochemistry
Contributors: Siiskonen, A., Priimägi, A.
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Publication information
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ISSN (Print): 1610-2940
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Original language: English
ASJC Scopus subject areas: Catalysis, Computer Science Applications, Physical and Theoretical Chemistry, Organic Chemistry, Computational Theory and Mathematics, Inorganic Chemistry

Keywords: Basis set, Benchmarking, Density functional theory, Halogen bonding
Electronic versions:

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Source: Scopus
Source ID: 85011684872
Research output: Contribution to journal › Article › Scientific › peer-review

Biological removal of selenate and ammonium by activated sludge in a sequencing batch reactor

Wastewaters contaminated by both selenium and ammonium need to be treated prior to discharge into natural water bodies, but there are no studies on the simultaneous removal of selenium and ammonium. A sequencing batch reactor (SBR) was inoculated with activated sludge and operated for 90 days. The highest ammonium removal efficiency achieved was 98%, while the total nitrogen removal was 75%. Nearly a complete chemical oxygen demand removal efficiency was attained after 16 days of operation, whereas complete selenate removal was achieved only after 66 days. The highest total Se removal efficiency was 97%. Batch experiments showed that the total Se in the aqueous phase decreased by 21% with increasing initial ammonium concentration from 50 to 100 mg L^{-1}. This study showed that SBR can remove both selenate and ammonium via, respectively, bioreduction and partial nitrification-denitrification and thus offer possibilities for treating selenium and ammonium contaminated effluents.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, UPEM, Homi Bhabha National Institute, Mumbai, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education
Contributors: Mal, J., Nancharaiah, Y. V., van Hullebusch, E. D., Lens, P. N.
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Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Activated sludge, Elemental selenium, Selenate bioreduction, Sequencing batch reactor, Simultaneous nitrification and denitrification
DOIs:

10.1016/j.biortech.2016.12.112
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Source ID: 85009200824
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Aligned Poly(ε-caprolactone) Nanofibers Guide the Orientation and Migration of Human Pluripotent Stem Cell-Derived Neurons, Astrocytes, and Oligodendrocyte Precursor Cells In Vitro

Stem cell transplantations for spinal cord injury (SCI) have been studied extensively for the past decade in order to replace the damaged tissue with human pluripotent stem cell (hPSC)-derived neural cells. Transplanted cells may, however, benefit from supporting and guiding structures or scaffolds in order to remain viable and integrate into the host tissue. Biomaterials can be used as supporting scaffolds, as they mimic the characteristics of the natural cellular environment. In this study, hPSC-derived neurons, astrocytes, and oligodendrocyte precursor cells (OPCs) are cultured on aligned poly(ε-caprolactone) nanofiber platforms, which guide cell orientation to resemble that of spinal cord in vivo. All cell types are shown to efficiently spread over the nanofiber platform and orient according to the fiber alignment. Human neurons and astrocytes require extracellular matrix molecule coating for the nanofibers, but OPCs grow on nanofibers without additional treatment. Furthermore, the nanofiber platform is combined with a 3D hydrogel scaffold with controlled thickness, and nanofiber-mediated orientation of hPSC-derived neurons is also demonstrated in a 3D environment. In this work, clinically relevant materials and substrates for nanofibers, fiber coatings, and hydrogel scaffolds are used and combined with cells suitable for developing functional cell grafts for SCI repair.

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MoE publication type: A1 Journal article-refereed
Organisations: Materials Science, Research group: Materials Characterization
Contributors: Hyysalo, A., Ristola, M., Joki, T., Honkanen, M., Vippola, M., Narkilahti, S.
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Ratings:

Scopus rating (2017): CiteScore 5.7 SJR 1.017 SNIP 0.776
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Biomaterials, Polymers and Plastics, Materials Chemistry
Keywords: 3D environment, Differentiated neural cell, Human pluripotent stem cell, Nanofiber, Orientation
DOIs:

10.1002/mabi.201600517
Source: Scopus
Source ID: 85017192272
Research output: Contribution to journal › Article › Scientific › peer-review

Two cations, two mechanisms: Interactions of sodium and calcium with zwitterionic lipid membranes
Adsorption of metal cations onto a cellular membrane changes its properties, such as interactions with charged moieties or the propensity for membrane fusion. It is, however, unclear whether cells can regulate ion adsorption and the related functions via locally adjusting their membrane composition. We employed fluorescence techniques and computer simulations to determine how the presence of cholesterol - a key molecule inducing membrane heterogeneity - affects the adsorption of sodium and calcium onto zwitterionic phosphatidylcholine bilayers. We found that the transient adsorption of sodium is dependent on the number of phosphatidylcholine head groups, while the strong surface binding of calcium is determined by the available surface area of the membrane. Cholesterol thus does not affect sodium adsorption and only plays an indirect role in modulating the adsorption of calcium by increasing the total surface area of the membrane. These observations also indicate how lateral lipid heterogeneity can regulate various ion-induced processes including adsorption of peripheral proteins, nanoparticles, and other molecules onto membranes.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Physics, University of Helsinki, J. Heyrovský Institute of Physical Chemistry, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic
Contributors: Javanainen, M., Melcrová, A., Magarkar, A., Jurkiewicz, P., Hof, M., Jungwirth, P., Martinez-Seara, H.
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Publication date: 2017
Peer-reviewed: Yes

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Original language: English
ASJC Scopus subject areas: Catalysis, Electronic, Optical and Magnetic Materials, Ceramics and Composites, Chemistry(all), Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry
Electronic versions:

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DOIs:

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Supramolecular control of liquid crystals by doping with halogen-bonding dyes

Introducing photochromic or polymeric dopants into nematic liquid crystals is a well-established method to create stimuli-responsive photonic materials with the ability to "control light with light". Herein, we demonstrate a new material design concept by showing that specific supramolecular interactions between the host liquid crystal and the guest dopants enhance the optical performance of the doped liquid crystals. By varying the type and strength of the dopant-host interaction, the phase-transition temperature, the order parameter of the guest molecules, and the diffraction signal in response to interference irradiation, can be accurately engineered. Our concept points out the potential of supramolecular interactions in liquid-crystal photonics, being valuable for optimizing the design of dye-doped functional liquid-crystalline systems.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Research group: Chemistry & Advanced Materials, Département de Chimie, Succ. Centre-Ville, Politecnico di Milano, Università degli Studi di Milano, Tokyo Institute of Technology, VTT Technical Research Centre of Finland
Contributors: Vapaavuori, J., Siiskonen, A., Dichiarante, V., Forni, A., Saccone, M., Pilati, T., Pellerin, C., Shishido, A., Metrangolo, P., Priimagi, A.
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Peer-reviewed: Yes

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Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
Electronic versions:

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URLs:

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Research output: Contribution to journal › Article › Scientific › peer-review

Cultivation of Scenedesmus acuminatus in different liquid digestates from anaerobic digestion of pulp and paper industry biosludge

Different undiluted liquid digestates from mesophilic and thermophilic anaerobic digesters of pulp and paper industry biosludge with and without thermal pretreatment were characterized and utilized for cultivating Scenedesmus acuminatus. Higher S. acuminatus biomass yields were obtained in thermophilic digestates (without and with pretreatment prior to anaerobic digestion (AD): 10.2 ± 2.2 and 10.8 ± 1.2 g L^{-1}, respectively) than in pretreated mesophilic digestates (7.8 ± 0.3 g L^{-1}), likely due to differences in concentration of sulfate, iron, and/or other minor nutrients. S. acuminatus removed over 97.4% of ammonium and 99.9% of phosphate and sulfate from the digestates. Color (74–80%) and soluble COD (29–39%) of the digestates were partially removed. Different AD processes resulted in different methane yields (18–126 L CH_4 kg^{-1} VS), digestate compositions, and microalgal yields. These findings emphasize the importance of optimizing each processing step in wood-based biorefineries and provide information for pulp and paper industry development for enhancing value generation.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy

Contributors: Tao, R., Lakaniemi, A., Rintala, J. A.
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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
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Source ID: 85029373417
Research output: Contribution to journal › Article › Scientific › peer-review

Dynamic response to process disturbances—A comparison between TMB/SMB models in transient regime
The modelling and design of Simulated moving bed (SMB) processes is normally done using the True moving bed (TMB) approximation. Several studies show that average values obtained at cyclic steady state for SMB units approach the TMB unit at steady state and that this approach is better as the number of columns in the SMB increases. However, studies that evaluate this equivalence under dynamic conditions are scarce. The objective of this work is to perform an analysis of the transient behaviour of two SMB units, with four and eight columns, and compare the results with the ones obtained for a TMB unit. An analysis of the impact of operating variables on the processes performance parameters is performed. The results show that TMB/SMB equivalence is valid only for conditions that do not violate the regeneration/separation regions and that the transient behaviour of the four columns SMB can resemble more the TMB.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Univ Porto, Universidade do Porto, Fac Med, Dept Med Imaging
Contributors: Nogueira, I. B., Ribeiro, A. M., Rodrigues, A. E., Loureiro, J. M.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Computer Science Applications
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DOIs:

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Source: Scopus
Source ID: 85012284107
Research output: Contribution to journal › Article › Scientific › peer-review

Particle emissions characterization from a medium-speed marine diesel engine with two fuels at different sampling conditions

Particle emission characteristics for a medium-speed four-stroke marine diesel engine were studied using a variety of sampling systems. Measurements were conducted at 25% and 75% load employing a heavy fuel oil (HFO) and a lighter marine distillate oil. The measurements, especially with HFO, revealed that marine exhaust particles mostly consist of nanometer sized ash particles on which heavy volatile species condense during exhaust dilution and cooling. The soot mode number concentration was low with both fuels tested, in particular when HFO was used. Total particle number emissions ranged in the order of 5.2–6.9 × 10^{15} per kg of fuel and formed a monomodal size distribution when a porous tube diluter combined with an ageing chamber and operating at low dilution ratio was used for sampling. The levels and size distributions obtained in the lab using a porous tube diluter were similar to the ones reported in the literature studying ship plumes following atmospheric dilution. Lab measurements with ejector-type diluters mostly led to bi-modal distributions that did not well resemble atmospheric size distributions. Moreover, the nucleation mode formed with the ejector diluters was variable in size and concentration. When used with dilution air at ambient temperature, ejector diluters were inappropriate for primary dilution due to clogging.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Aerosol Physics Laboratory, VTT Technical Research Centre of Finland, Finnish Meteorological Institute
Contributors: Ntziachristos, L., Saukko, E., Lehtoranta, K., Rönkkö, T., Timonen, H., Simonen, P., Karjalainen, P., Keskinen, J.
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ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry
Keywords: Heavy fuel oil, Light fuel oil, Marine emissions, Particle emissions, Soot particles
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10.1016/j.fuel.2016.08.091
Source: Scopus
Source ID: 84984817885
Research output: Contribution to journal › Article › Scientific › peer-review

The effect of low-temperature pretreatment on the solubilization and biomethane potential of microalgae biomass grown in synthetic and wastewater media

Microalgae have been suggested as a sustainable raw material for biofuel production in the form of methane via anaerobic digestion. Here, pretreatments at 60–80 °C were investigated, aiming to study the impact of algae culture media on biomethane potential and pretreatment efficiency. Chlorella vulgaris and mixed culture of native algae species (dominating by Scenedesmus sp.) were grown in synthetic medium, wastewater (sterilized and non-sterilized) and digestate from anaerobic digestion of pulp and paper biosludge (sterilized and non-sterilized). The biomethane potential for native microalgal biomass varied between 154 and 252 L CH_4 kg^{-1} VS depending on culture media. The efficiency of the low-temperature pretreatment (80 °C, 3 h) for solubilization (9–12%) of C. vulgaris and native algae biomass was similar for algae grown in sterilized and non-sterilized wastewater media. The pretreatment increased the biomethane potential of native algae biomass by 11–24%.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry

Contributors: Kinnunen, V., Rintala, J.
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Publication date: 1 Dec 2016
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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Anaerobic digestion, Digestate, Microalgae, Pulp and paper industry, Wastewater
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Source: Scopus
Source ID: 84988027316
Research output: Contribution to journal › Article › Scientific › peer-review

Magnesium aminoclay enhances lipid production of mixotrophic Chlorella sp. KR-1 while reducing bacterial populations
Improving lipid productivity and preventing overgrowth of contaminating bacteria are critical issues relevant to the commercialization of the mixotrophic microalgae cultivation process. In this paper, we report the use of magnesium aminoclay (MgAC) nanoparticles for enhanced lipid production from oleaginous Chlorella sp. KR-1 with simultaneous control of KR-1-associated bacterial growth in mixotrophic cultures with glucose as the model substrate. Addition of 0.01–0.1 g/L MgAC promoted microalgal biomass production better than the MgAC-less control, via differential biocidal effects on microalgal and bacterial cells (the latter being more sensitive to MgAC's bio-toxicity than the former). The inhibition effect of MgAC on co-existing bacteria was, as based on density-gradient-gel-electrophoresis (DGGE) analysis, largely dosage-dependent and species-specific. MgAC also, by inducing an oxidative stress environment, increased both the cell size and lipid content of KR-1, resulting in a considerable, ~25% improvement of mixotrophic algal lipid productivity (to ~410 mg FAME/L/d) compared with the untreated control.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Chungnam National University, Korea Institute of Energy Research, Gachon University
Contributors: Kim, B., Praveenkumar, R., Lee, J., Nam, B., Kim, D. M., Lee, K., Lee, Y. C., Oh, Y. K.
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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
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Source: Scopus
Source ID: 84982219447
Research output: Contribution to journal › Article › Scientific › peer-review

Mild pressure induces rapid accumulation of neutral lipid (triacylglycerol) in Chlorella spp.
Effective enhancement of neutral lipid (especially triacylglycerol, TAG) content in microalgae is an important issue for commercialization of microalgal biorefineries. Pressure is a key physical factor affecting the morphological, physiological, and biochemical behaviors of organisms. In this paper, we report a new stress-based method for induction of TAG accumulation in microalgae (specifically, Chlorella sp. KR-1 and Ch. sp. AG20150) by very-short-duration application of mild pressure. Pressure treatments of 10–15 bar for 2 h resulted in a considerable, ~55% improvement of the

10–100 g/L cells' TAG contents compared with the untreated control. The post-pressure-treatment increase of cytoplasmic TAG granules was further confirmed by transmission electron microscopy (TEM). Notwithstanding the increased TAG content, the total lipid content was not changed by pressurization, implying that pressure stress possibly induces rapid remodeling/transformation of algal lipids rather than de novo biosynthesis of TAG.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Chungnam National University, Korea Institute of Energy Research
Contributors: Ramasamy, P., Kim, B., Lee, J., Vijayan, D., Lee, K., Nam, B., Jeon, S. G., Kim, D. M., Oh, Y. K.
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Original language: English
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Source: Scopus
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Research output: Contribution to journal › Article › Scientific › peer-review

Grain orientation dependent Nb-Ti microalloying mediated surface segregation on ferritic stainless steel
Surface segregation and oxide formation anisotropy on Ti-Nb stabilized ferritic stainless steel (EN 1.4521) were studied by XPS and Electron Backscatter Diffraction. Competitive surface segregation of Si, Nb and Ti was initiated at ~550. °C, and segregation was favored to the open surface sites of 〈111〉 oriented grains. Furthermore, the surface segregation of Cr was strongly limited at the locations of stable Ti(CN)- and (NbTi)C-type precipitates. Consequently, the oxidation resistance of stainless steels can be enhanced cost-efficiently, without alloy additions, by optimizing the microstructure to facilitate the fast and uniform growth of protective oxide scale.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Department of Materials Science, Research group: Materials Characterization
Contributors: Ali-Löytty, H., Hannula, M., Honkanen, M., Östman, K., Lahtonen, K., Valden, M.
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Peer-reviewed: Yes

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Journal: Corrosion Science
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Original language: English
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Keywords: A. Stainless steel, B. SEM, B. XPS, C. Interfaces, C. Oxidation, C. Segregation
DOIs:

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Source: Scopus
Source ID: 84979753478
Research output: Contribution to journal › Article › Scientific › peer-review

Increased survival rate by local release of diclofenac in a murine model of recurrent oral carcinoma

Despite aggressive treatment with radiation and combination chemotherapy following tumor resection, the 5-year survival rate for patients with head and neck cancer is at best only 50%. In this study, we examined the therapeutic potential of localized release of diclofenac from electrospun nanofibers generated from poly(d,l-lactide-co-glycolide) polymer. Diclofenac was chosen since anti-inflammatory agents that inhibit cyclooxygenase have shown great potential in their ability to directly inhibit tumor growth as well as suppress inflammation-mediated tumor growth. A mouse resection model of oral carcinoma was developed by establishing tumor growth in the oral cavity by ultrasound-guided injection of 1 million SCC-9 cells in the floor of the mouth. Following resection, mice were allocated into four groups with the following treatment: 1) no treatment, 2) implanted scaffolds without diclofenac, 3) implanted scaffolds loaded with diclofenac, and 4) diclofenac given orally. Small animal ultrasound and magnetic resonance imaging were utilized for longitudinal determination of tumor recurrence. At the end of 7 weeks following tumor resection, 33% of mice with diclofenac-loaded scaffolds had a recurrent tumor, in comparison to 90%-100% of the mice in the other three groups. At this time point, mice with diclofenac-releasing scaffolds showed 89% survival rate, while the other groups showed survival rates of 10%-25%. Immunohistochemical staining of recurrent tumors revealed a near 10-fold decrease in the proliferation marker Ki-67 in the tumors derived from mice with diclofenac-releasing scaffolds. In summary, the local application of diclofenac in an orthotopic mouse tumor resection model of oral cancer reduced tumor recurrence with significant improvement in survival over a 7-week study period following tumor resection. Local drug release of anti-inflammatory agents should be investigated as a therapeutic option in the prevention of tumor recurrence in oral squamous carcinoma.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Clinic for Radiology and Neuroradiology, University Hospital Schleswig-Holstein, Institute of Biochemistry, University Hospital Cologne
Contributors: Will, O. M., Purcz, N., Chalaris, A., Heneweer, C., Boretius, S., Purcz, L., Nikkola, L., Ashammakhi, N., Kalthoff, H., Glüer, C. C., Wiltfang, J., Açil, Y., Tiwari, S.
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Elimination of arsenic-containing emissions from gasification of chromated copper arsenate wood

The behavior of arsenic in chromated copper arsenate containing wood during gasification was modeled using thermodynamic equilibrium calculations. The results of the model were validated using bench-scale gasification tests. It is shown that over 99.6% of arsenic can be removed from the product gas by a hot filter when the gas is cooled below the predicted condensation temperature.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Energy Technology and Thermal Process Chemistry, Gasification Technologies Inc., Gas Technology Institute
Contributors: Kramb, J., Konttinen, J., Backman, R., Salo, K., Roberts, M.
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Original language: English
ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry
Keywords: Arsenic, CCA wood, Equilibrium modeling, Gasification
DOIs:

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Source ID: 84965081806
Research output: Contribution to journal › Article › Scientific › peer-review

Long-term stability of bioelectricity generation coupled with tetrathionate disproportionation
To prevent uncontrolled acidification of the environment, reduced inorganic sulfur compounds (RISCs) can be bioelectrochemically removed from water streams. The long-term stability of bioelectricity production from tetrathionate ($S_4O_6^{2-}$) was studied in highly acidic conditions (pH <2.5) in two-chamber fed-batch microbial fuel cells (MFCs). The maximum current density was improved from previously reported 80 mA m^{-2} to 225 mA m^{-2} by optimizing the external resistance. The observed reaction products of tetrathionate disproportionation were sulfate and elemental sulfur. In long-term run, stable electricity production was obtained for over 700 days with the average current density of 150 mA m^{-2}. The internal resistance of the MFC decreased over time and no biofouling was observed. This study shows that tetrathionate is an efficient substrate also for long-term bioelectricity production.

General information
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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Sulonen, M. L. K., Lakaniemi, A. M., Kokko, M. E., Puhakka, J. A.
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Keywords: Acidophile, Disproportionation, Long-term stability, Microbial fuel cell, Tetrathionate
DOIs:

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Source ID: 84974777755
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3D micro-nano structured hybrid scaffolds: An investigation into the role of nanofiber coating on viability, proliferation and differentiation of seeded mesenchymal stem cells
The introduction of a three dimensional scaffold providing the closest analogies to extracellular matrix (ECM) is currently a key strategy for tackling many challenges in tissue repair. Here, we present a new hybrid scaffold constructed by coating electrospun chitosan/polyethylene oxide (PEO) nanofibers on commercial BioTek polystyrene (PS) scaffold obtained from Sigma Aldrich. The viability and proliferation rate of mesenchymal stem cells (MSCs) seeded on micro-nano structured hybrid scaffold (MNHS) and commercial PS scaffolds were analyzed by MTT assay. The results of the MTT assay revealed a higher degree of viability and proliferation rate in MSCs seeded on MNHS compared with the commercial PS scaffold. DAPI images also confirmed the higher degree of attachment and viability of MSCs seeded on MNHS. Moreover,

MSCs on both scaffolds differentiated to osteoblasts and adipocytes cells, as reflected by the images obtained from Alizarin Red and Oil Red-O staining. Alkaline phosphatase activity (ALP) and calcium content assays revealed that the MNHS has a higher potential for osteogenic differentiation than the commercial scaffold. To quantify the osteoblast and adipocyte gene expression, quantitative RT-PCR was carried out for MNHS, commercial scaffold and Tissue culture polystyrene (TCPS). It was found that MNHS can express a higher level of Runt-related transcription factor 2 (Runx2), osteonectin and osteocalcin in osteogenic differentiation as well as increased expression of PPARγ and UCP-1 in adipogenic differentiation. The enhancement of the attachment, viability and proliferation as well as bi-lineage differentiation may result from the biochemical and structural analogies of MNHS to native ECM. Furthermore, it was observed that biocompatible MNHS scaffold can potentially be utilized as a suitable scaffold for bone and connective tissue engineering.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Fibre Materials, Tarbiat Modares University, Isfahan University of Medical Sciences, VTT Technical Research Centre of Finland
Contributors: Pilehrood, M. K., Atashi, A., Sadeghi-Aliabadi, H., Nousiainen, P., Harlin, A.
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Scopus rating (2016): CiteScore 2.3 SJR 0.324 SNIP 0.486
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Biomedical Engineering, Materials Science(all), Condensed Matter Physics
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Bibliographical note
EXT="Harlin, Ali"
Source: Scopus
Source ID: 84983416664
Research output: Contribution to journal › Article › Scientific › peer-review

Modeling of the catalytic effects of potassium and calcium on spruce wood gasification in CO_2
Using previously reported thermogravimetric analysis measurements, the effects of calcium and potassium on the char gasification rate of spruce wood were modeled. Spruce wood was leached of inorganic ash elements and doped with measured amounts of potassium and calcium. The wood was gasified in an isothermal thermogravimetric analysis device in CO_2 where the devolatilization of the wood, char formation and char gasification all occurred inside the preheated reactor. A new method for separating the effects of devolatilization and char gasification is presented. Kinetic models were evaluated for their ability to describe the observed catalytic effects of potassium and calcium on the gasification rate. Two modified versions of the random pore model were able to accurately describe the measured conversion rates and the parameters of the kinetic models were found to be dependent on the calcium and potassium concentrations. Empirical correlations were developed to predict the char conversion rate from only the potassium and calcium concentration of the sample.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Johan Gadolin Process Chemistry Centre, Abo Akademi University, VTT Technical Research Centre of Finland
Contributors: Kramb, J., DeMartini, N., Perander, M., Moilanen, A., Konttinen, J.
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Original language: English
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Keywords: Biomass, Gasification, Modeling, Reaction kinetics
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Bibliographical note
EXT="Moilanen, Antero"
Source: Scopus
Source ID: 84959431503
Research output: Contribution to journal › Article › Scientific › peer-review

Hydrothermal carbonization of pulp mill streams
The progress of the conversion, the yield, the structure and the morphology of the produced carbonaceous materials as a function of time were systematically studied with pyrolysis-GC/FID and FESEM microscope. The conversion of galactoglucomannan, bleached kraft pulp and TEMPO oxidized cellulose nanofibrils followed the reaction route of glucose being slower though with fibrous material, higher molar mass and viscosity. The conversion of kraft lignin was minor following completely different reaction route. Carbonaceous particles of different shape and size were produced with yields between 23% and 73% after 4 h with being higher for lignin than carbohydrates. According to the results, potential pulp mill streams represent lignocellulosic resources for generation of carbonaceous materials.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland
Contributors: Wikberg, H., Ohra-aho, T., Honkanen, M., Kanerva, H., Harlin, A., Vippola, M., Laine, C.
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Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Galactoglucomannan, Hydrothermal carbonization, Kraft lignin, Kraft pulp, Pulp mill
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Bibliographical note
EXT="Harlin, Ali"
Source: Scopus
Source ID: 84963954557
Research output: Contribution to journal › Article › Scientific › peer-review

The influence of high-temperature sulfuric acid solution ageing on the properties of laminated vinyl-ester joints
A carbon fiber powder doped corrosion layer is used as an inner layer in large composite tanks to improve their chemical and wear resistance. In joints fabricated on site, this layer is embedded into the structure. This study evaluates the lap shear strength of specimens, simulating a laminated joint in between the corrosion layer and the inner joint laminate. Lap-shear tests were carried out for as-fabricated and aged laminates at room temperature and at elevated temperature. Ageing was carried out for half a year in a 95 °C pressurized sulfuric acid solution. The tests showed that, after ageing, the room temperature shear strength remained unaltered but high-temperature shear strength was lowered. When the

temperature increased, the failure location shifted from the interface between the doped layer and the joint laminate to the doped layer. Thermal analysis and microscopy were employed to clarify the reasons for the observed behavior.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Outotec Research Center, Aalto University
Contributors: Lindgren, M., Wallin, M., Kakkonen, M., Saarela, O., Vuorinen, J.
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Keywords: Aging, Lap-shear, Sulfuric acid, Vinyl ester
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EXT="Lindgren, M."
Source: Scopus
Source ID: 84973340146
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Spontaneous formation of three-dimensionally ordered Bi-rich nanostructures within $GaAs_{1-x}Bi_x$/GaAs quantum wells
In this work, we report on the spontaneous formation of ordered arrays of nanometer-sized Bi-rich structures due to lateral composition modulations in Ga(As,Bi)/GaAs quantum wells grown by molecular beam epitaxy. The overall microstructure and chemical distribution is investigated using transmission electron microscopy. The information is complemented by synchrotron x-ray grazing incidence diffraction, which provides insight into the in-plane arrangement. Due to the vertical inheritance of the lateral modulation, the Bi-rich nanostructures eventually shape into a three-dimensional assembly. Whereas the Bi-rich nanostructures are created via two-dimensional phase separation at the growing surface, our results suggest that the process is assisted by Bi segregation which is demonstrated to be strong and more complex than expected, implying both lateral and vertical (surface segregation) mass transport. As demonstrated here, the inherent thermodynamic miscibility gap of Ga(As,Bi) alloys can be exploited to create highly uniform Bi-rich units embedded in a quantum confinement structure.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Hausvogteiplatz 5-7
Contributors: Luna, E., Wu, M., Hanke, M., Puustinen, J., Guina, M., Trampert, A.
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Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Electrical and Electronic Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: GaAsBi, phase separation and segregation, self organization, TEM

DOIs:
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Bibliographical note
EXT="Wu, M."
Source: Scopus
Source ID: 84978884196
Research output: Contribution to journal › Article › Scientific › peer-review

The Influence of Phosphorus Exposure on a Natural-Gas-Oxidation Catalyst
Phosphorus is found to have a deactivating effect on the catalytic activity of the studied natural-gas-oxidation catalyst. Accelerated laboratory-scale phosphorus treatment was done to the $PtPd/Al_2O_3$ natural gas oxidation catalyst. The effect of phosphorus after low (0.065 M) and high (0.13 M) phosphorus concentration treatments was studied by using an inductively coupled plasma optical emission spectroscopy, N_2 physisorption, X-ray diffraction, field emission scanning electron microscopy, transmission electron microscopy, and X-ray photoelectron spectroscopy. In addition, the behavior of the catalyst was studied by a Gasmet FT-IR gas analyzer. Based on the received results it can be concluded that phosphorus was adsorbed on the surface by chemical bonds forming phosphates (PO_4). In addition, the partial transformation of PdO to Pd was observed. Due to the phosphorus adsorption both the CO and CH_4 oxidation activities were lower after the phosphorus treatments compared with the fresh catalyst.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, University of Oulu, Aalto University, Dinex Ecocat Oy, COMP Centre of Excellence, Department of Applied Physics, Aalto University
Contributors: Kärkkäinen, M., Kolli, T., Honkanen, M., Heikkinen, O., Väliheikki, A., Huuhtanen, M., Kallinen, K., Lahtinen, J., Vippola, M., Keiski, R. L.
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Scopus rating (2016): CiteScore 4.3 SJR 0.975 SNIP 0.855
Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all)
Keywords: Methane degradation, Palladium, Platinum, Poisoning
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Source: Scopus
Source ID: 84977071141
Research output: Contribution to journal › Article › Scientific › peer-review

Development of Magnetic Losses During Accelerated Corrosion Tests for Nd-Fe-B Magnets Used in Permanent Magnet Generators
Sintered Nd-Fe-B magnets are critical components in permanent magnet wind generators. They are the strongest permanent magnets available and thus enable the construction of light and effective devices, but their stability in corrosive environments is limited. In this work, the formation of corrosion losses in two types of Nd-Fe-B alloys was studied. Magnets were in a magnetized state during the corrosion test, enabling monitoring of the development of losses in magnetic flux along with those in weight. Parallel flux and weight loss measurements conducted during corrosion tests showed that percentage weight losses were lower than the total flux losses. Scanning electron microscope studies of corroded specimens disclosed that the magnets first underwent dissolution of the grain-boundary phase, followed by the detachment and movement of the loosened grains in the magnetic field. The degradation was accelerated by oxidation of the matrix phase, which introduced further damage by volume expansion.

General information
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Organisations: Department of Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland

Contributors: Isotahdon, E., Huttunen-Saarivirta, E., Kuokkala, V.
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Issue number: 6
ISSN (Print): 0010-9312
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Scopus rating (2016): CiteScore 3.5 SJR 1.075 SNIP 1.488
Original language: English
ASJC Scopus subject areas: Materials Science(all), Chemical Engineering(all), Chemistry(all)
Keywords: Corrosion, Corrosion losses, Highly accelerated stress test (HAST test), Improved corrosion resistance sintered Nd-Fe-B magnets, Improved stability sintered Nd-Fe-B magnets, Nd-Fe-B, Permanent magnet, Scanning electron microscopy, Thermal losses, Wind power
DOIs:

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URLs:

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http://www.scopus.com/inward/record.url?scp=84973626857&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84973626857
Research output: Contribution to journal › Article › Scientific › peer-review

Wetting hysteresis induced by temperature changes: Supercooled water on hydrophobic surfaces
The state and stability of supercooled water on (super)hydrophobic surfaces is crucial for low temperature applications and it will affect anti-icing and de-icing properties. Surface characteristics such as topography and chemistry are expected to affect wetting hysteresis during temperature cycling experiments, and also the freezing delay of supercooled water. We utilized stochastically rough wood surfaces that were further modified to render them hydrophobic or superhydrophobic. Liquid flame spraying (LFS) was utilized to create a multi-scale roughness by depositing titanium dioxide nanoparticles. The coating was subsequently made non-polar by applying a thin plasma polymer layer. As flat reference samples modified silica surfaces with similar chemistries were utilized. With these substrates we test the hypothesis that superhydrophobic surfaces also should retard ice formation. Wetting hysteresis was evaluated using contact angle measurements during a freeze-thaw cycle from room temperature to freezing occurrence at -7 °C, and then back to room temperature. Further, the delay in freezing of supercooled water droplets was studied at temperatures of -4 °C and -7 °C. The hysteresis in contact angle observed during a cooling-heating cycle is found to be small on flat hydrophobic surfaces. However, significant changes in contact angles during a cooling-heating cycle are observed on the rough surfaces, with a higher contact angle observed on cooling compared to during the subsequent heating. Condensation and subsequent frost formation at sub-zero temperatures induce the hysteresis. The freezing delay data show that the flat surface is more efficient in enhancing the freezing delay than the rougher surfaces, which can be rationalized considering heterogeneous nucleation theory. Thus, our data suggests that molecular flat surfaces, rather than rough superhydrophobic surfaces, are beneficial for retarding ice formation under conditions that allow condensation and frost formation to occur.

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Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, KTH Royal Institute of Technology, Surface and Corrosion Science, SP Technical Research Institute of Sweden, Department of Civil and Architectural Engineering, Nanostructure Physics
Contributors: Heydari, G., Sedighi Moghaddam, M., Tuominen, M., Fielden, M., Haapanen, J., Mäkelä, J. M., Claesson, P. M.
Number of pages: 13
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Journal: Journal of Colloid and Interface Science
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Ratings:

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Original language: English
ASJC Scopus subject areas: Surfaces, Coatings and Films, Electronic, Optical and Magnetic Materials, Biomaterials, Colloid and Surface Chemistry
Keywords: Contact angle, Hydrophobization, Liquid flame spray (LFS), Morphology, Multi-scale roughness, Plasma polymerization, Supercooled water, Superhydrophobicity, Wetting hysteresis, Wood
DOIs:

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Source: Scopus
Source ID: 84955276633
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of heavy metal co-contaminants on selenite bioreduction by anaerobic granular sludge

This study investigated bioreduction of selenite by anaerobic granular sludge in the presence of heavy metals and analyzed the fate of the bioreduced selenium and the heavy metals. Selenite bioreduction was not significantly inhibited in the presence of Pb(II) and Zn(II). More than 92% of 79 mg/L selenite was removed by bioreduction even in the presence of 150 mg/L of Pb(II) or 400 mg/L of Zn(II). In contrast, only 65-48% selenite was bioreduced in the presence of 150-400 mg/L Cd(II). Formation of elemental selenium or selenide varied with heavy metal type and concentration. Notably, the majority of the bioreduced selenium (70-90% in the presence of Pb and Zn, 50-70% in the presence of Cd) and heavy metals (80-90% of Pb and Zn, 60-80% of Cd) were associated with the granular sludge. The results have implications in the treatment of selenium wastewaters and biogenesis of metal selenides.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, UPEM, Bhabha Atomic Research Centre, Environmental Engineering and Water Technology Department, UNESCO-IHE Institute for Water Education
Contributors: Mal, J., Nancharaiah, Y. V., van Hullebusch, E. D., Lens, P. N. L.
Number of pages: 8
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Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Anaerobic granular sludge, Biosorption, Heavy metal removal, Metal selenide, Selenite bioreduction
DOIs:

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Source: Scopus
Source ID: 84961305364
Research output: Contribution to journal › Article › Scientific › peer-review

Metal chalcogenide quantum dots: Biotechnological synthesis and applications

Metal chalcogenide (metal sulfide, selenide and telluride) quantum dots (QDs) have attracted considerable attention due to their quantum confinement and size-dependent photoemission characteristics. QDs are one of the earliest products of nanotechnology that were commercialized for tracking macromolecules and imaging cells in life sciences. An array of physical, chemical and biological methods have been developed to synthesize different QDs. Biological production of QDs follow green chemistry principles, thereby use of hazardous chemicals, high temperature, high pressure and production of by-products is either minimized or completely avoided. In the past decade, significant progress has been made wherein a diverse range of living organisms, i.e. viruses, bacteria, fungi, microalgae, plants and animals have been explored for synthesis of all three types of metal chalcogenide QDs. However, better understanding of the biological mechanisms that mediate the synthesis of metal chalcogenides and control the growth of QDs is needed for improving their yield and properties as well as addressing issues that arise during scale-up. In this review, we present the current status of the biological synthesis and applications of metal chalcogenide QDs. Where possible, the role of key biological macromolecules in controlled production of the nanomaterials is highlighted, and also technological bottlenecks limiting widespread implementation are discussed. The future directions for advancing biological metal chalcogenide synthesis are presented.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Mal, J., Nancharaiah, Y. V., Van Hullebusch, E. D., Lens, P. N. L.
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Pages: 41477-41495
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
DOIs:

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Source: Scopus
Source ID: 84966421058
Research output: Contribution to journal › Article › Scientific › peer-review

Human Adipose Stem Cells Differentiated on Braided Polylactide Scaffolds is a Potential Approach for Tendon Tissue Engineering

Growing number of musculoskeletal defects increases the demand for engineered tendon. Our aim was to find an efficient strategy to produce tendon-like matrix in vitro. To allow efficient differentiation of human adipose stem cells (hASCs) toward tendon tissue, we tested different medium compositions, biomaterials, and scaffold structures in preliminary tests. This is the first study to report that medium supplementation with 50 ng/mL of growth and differentiation factor-5 (GDF-5) and 280 μM l-ascorbic acid are essential for tenogenic differentiation of hASCs. Tenogenic medium (TM) was shown to significantly enhance tendon-like matrix production of hASCs compared to other tested media groups. Cell adhesion, proliferation, and tenogenic differentiation of hASCs were supported on braided poly(l/d)lactide (PLA) 96l/4d copolymer filament scaffolds in TM condition compared to foamed poly(l-lactide-co-ε-caprolactone) (PLCL) 70L/30CL scaffolds. A uniform cell layer formed on braided PLA 96/4 scaffolds when hASCs were cultured in TM compared to maintenance medium (MM) condition after 14 days of culture. Furthermore, total collagen content and gene expression of tenogenic marker genes were significantly higher in TM condition after 2 weeks of culture. The elastic modulus of PLA 96/4 scaffold was more similar to the elastic modulus reported for native Achilles tendon. Our study showed that the optimized TM is needed for efficient and rapid in vitro tenogenic extracellular matrix production of hASCs. PLA 96/4 scaffolds together with TM significantly stimulated hASCs, thus demonstrating the potential clinical relevance of this novel and emerging approach to tendon injury treatments in the future.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Tampere University Hospital, Univ Helsinki, Helsinki University Central Hospital, University of Helsinki, Cent Hosp, Dept Med, Div Nephrol, University of Twente
Contributors: Vuornos, K., Björninen, M., Talvitie, E., Paakinaho, K., Kellomäki, M., Huhtala, H., Miettinen, S., Seppänen-Kaijansinkko, R., Haimi, S.
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Original language: English

ASJC Scopus subject areas: Bioengineering, Biochemistry, Biomedical Engineering, Biomaterials
DOIs:
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EXT="Vuornos, Kaisa"
Source: Scopus
Source ID: 84961782193
Research output: Contribution to journal › Article › Scientific › peer-review

Importance of maintenance data quality in extended warranty simulation
As manufacturing industries are transforming towards service orientation, predicting the costs of product-service systems is becoming essential. Simulation is one possibility for evaluating the costs and risks involved in product-service systems, such as extended warranty agreements. We conducted a case study with a globally operating manufacturer of industrial goods who also provides services for the equipment. We created equipment performance simulation (EPSi) models and a tool, EPSitor, for using the models in predicting extended warranty costs. However, reliable simulation results require good quality maintenance and operation data from existing installations. We discovered that it is difficult to collect the data needed for simulations and there were many challenges with data quality. Quality problems were mainly observed in manually collected data. Insufficient data quality leads to a wider margin of error in the simulation models, which increases business risk. Identifying these challenges is the first step in transforming the data collection routines to support equipment performance simulations. The key to long-term business benefits of simulation is to acknowledge the importance of data quality and to establish efficient data collection routines. Future research should find ways to motivate maintenance technicians to collect good quality data. This would contribute to more accurate cost analysis and thus to better profitability of extended warranty contracts.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems, Research group: Käyttövarmuuden suunnittelu ja kunnossapito, Research area: Life-cycle Management, Aalto University
Contributors: Mahlamäki, K., Niemi, A., Jokinen, J., Borgman, J.
Number of pages: 8
Pages: 3-10
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Publication information
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Original language: English
ASJC Scopus subject areas: Electrical and Electronic Engineering, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Bioengineering, Signal Processing, Strategy and Management
Keywords: Asset management, Data quality, Hitman factors
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http://www.scopus.com/inward/record.url?scp=84960940492&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
INT=mei,"Jokinen, Juuso"
Source: Scopus
Source ID: 84960940492
Research output: Contribution to journal › Article › Scientific › peer-review

Accelerated deactivation studies of the natural-gas oxidation catalyst-Verifying the role of sulfur and elevated temperature in catalyst aging
Accelerated deactivation, caused by thermal aging (TA) and/or sulfur+water poisoning (SW), of the PtPd/γ-Al_2O_3 natural-gas oxidation catalyst was studied. Thermal aging and poisoning treatments were performed separately and with varied combinations and comprehensive characterization of the catalyst was carried out after each step. The fresh catalyst has small, oxidized PtPd particles (<5nm) uniformly distributed in the γ-alumina washcoat. After the SW-treatment, a small amount of bulk aluminum sulfate was observed near the slightly grown noble metal particles. During the thermal aging, γ-alumina changed to δ-/θ- and α-alumina. In addition, total decomposition of oxidized Pt and partly decomposition of oxidized Pd occurred resulting in the formation of the grown noble metal particles with a bimetallic PtPd core and a

polycrystalline PdO shell. Also few, small (~5nm) bimetallic PtPd particles were still detected. In the TA+SW-treated catalyst with grown noble metal particles, a small amount of bulk aluminum sulfate was detected and it was randomly distributed over the noble metal particles and washcoat. The activity in the terms of methane conversion over the TA-, SW-, and SW+TA-treated catalysts was similar but it was decreased compared to the fresh catalyst. The activity of the TA+SW-treated catalyst was drastically decreased compared to the fresh catalyst due to significant morphological changes and aluminum sulfate formation.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, University of Oulu, Aalto University, Chalmers University of Technology, Dinex Ecocat Oy
Contributors: Honkanen, M., Kärkkäinen, M., Kolli, T., Heikkinen, O., Viitanen, V., Zeng, L., Jiang, H., Kallinen, K., Huuhtanen, M., Keiski, R. L., Lahtinen, J., Olsson, E., Vippola, M.
Number of pages: 10
Pages: 439-448
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Early online date: 1 Oct 2015

Publication information

Journal: Applied Catalysis B-Environmental
ISSN (Print): 0926-3373
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ASJC Scopus subject areas: Catalysis, Process Chemistry and Technology, Environmental Science(all)
Keywords: Deactivation, Palladium, Platinum, Sulfur poisoning, Thermal aging
Electronic versions:

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Source: Scopus
Source ID: 84943638016
Research output: Contribution to journal › Article › Scientific › peer-review

Cell-wall disruption and lipid/astaxanthin extraction from microalgae: Chlorella and Haematococcus

Recently, biofuels and nutraceuticals produced from microalgae have emerged as major interests, resulting in intensive research of the microalgal biorefinery process. In this paper, recent developments in cell-wall disruption and extraction methods are reviewed, focusing on lipid and astaxanthin production from the biotechnologically important microalgae Chlorella and Haematococcus, respectively. As a common, critical bottleneck for recovery of intracellular components such as lipid and astaxanthin from these microalgae, the composition and structure of rigid, thick cell-walls were analyzed. Various chemical, physical, physico-chemical, and biological methods applied for cell-wall breakage and lipid/astaxanthin extraction from Chlorella and Haematococcus are discussed in detail and compared based on efficiency, energy consumption, type and dosage of solvent, biomass concentration and status (wet/dried), toxicity, scalability, and synergistic combinations. This report could serve as a useful guide to the implementation of practical downstream processes for recovery of valuable products from microalgae including Chlorella and Haematococcus.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Korea Institute of Energy Research, KAIST
Contributors: Kim, D. Y., Vijayan, D., Praveenkumar, R., Han, J. I., Lee, K., Park, J. Y., Chang, W. S., Lee, J. S., Oh, Y. K.
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Peer-reviewed: Yes

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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Astaxanthin, Chlorella, Extraction, Haematococcus, Lipid
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Research output: Contribution to journal › Article › Scientific › peer-review

Remarkable Dependence of the Final Charge Separation Efficiency on the Donor-Acceptor Interaction in Photoinduced Electron Transfer

The unprecedented dependence of final charge separation efficiency as a function of donor-acceptor interaction in covalently-linked molecules with a rectilinear rigid oligo-p-xylene bridge has been observed. Optimization of the donor-acceptor electronic coupling remarkably inhibits the undesirable rapid decay of the singlet charge-separated state to the ground state, yielding the final long-lived, triplet charge-separated state with circa 100% efficiency. This finding is extremely useful for the rational design of artificial photosynthesis and organic photovoltaic cells toward efficient solar energy conversion.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Kyoto Women's University, Tokushima University, Kobe University, Japan Science and Technology Agency, University of Tokyo
Contributors: Higashino, T., Yamada, T., Yamamoto, M., Furube, A., Tkachenko, N. V., Miura, T., Kobori, Y., Jono, R., Yamashita, K., Imahori, H.
Pages: 629-633
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Publication information

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Volume: 55
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis
Keywords: Charge separation, Electron transfer, Electronic coupling, Exciplexes, Marcus theory
DOIs:

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Source ID: 84958749577
Research output: Contribution to journal › Article › Scientific › peer-review

Preferential adsorption of Cu in a multi-metal mixture onto biogenic elemental selenium nanoparticles

Preferential adsorption of Cu contained in wastewaters is desirable as the Cu can then be reprocessed and reused more easily. In this study, biogenic elemental selenium nanoparticles (BioSeNPs) were assessed for their ability to preferentially adsorb Cu from an equimolar mixture containing Cu, Cd and Zn. Variations in metal to BioSeNPs ratios and initial metal solution pH improved the preferential adsorption capacity of BioSeNPs toward Cu, with the ratio of Cu adsorbed to combined Cd and Zn adsorbed varying from 2.3 to 6.6. More than 78% of the added Cu was adsorbed at an initial metal solution pH of 5.2 and metal to BioSeNPs ratio of $0.21 mg mg^{-1}$ when the ratio of Cu adsorbed to the sum of Cd and Zn adsorbed was 2.3. Infrared spectroscopy revealed that the Cu, Cd and Zn were interacting with the hydroxyl and carboxyl surface functional groups of the BioSeNPs. The modeling of BioSeNPs' acid-base titration revealed the presence of high concentrations of carboxylic groups ($C=60.3 mol kg^{-1}$) with a pK_a of 3.9, providing further evidence of their interaction with Cu. The adsorption of Cu resulted in a lower colloidal stability of the BioSeNPs as indicated by more than 99% retention of added BioSeNPs after adsorption of heavy metals and filtration. BioSeNPs showed a good preferential adsorption capacity toward Cu as compared to other adsorbent. This study provides a proof-of-concept for the preferential adsorption of Cu onto BioSeNPs which are present in the effluent of a bioreactor treating selenium oxyanions containing wastewater.

General information

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Organisations: Department of Chemistry and Bioengineering, Tampere University of Technology, Research group: Industrial Bioengineering and Applied Organic Chemistry, Université Paris-Est

Contributors: Jain, R., Dominic, D., Jordan, N., Rene, E. R., Weiss, S., van Hullebusch, E. D., Hübner, R., Lens, P. N. L.
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Publication date: 2016
Peer-reviewed: Yes
Early online date: 2015

Publication information
Journal: Chemical Engineering Journal
Volume: 284
ISSN (Print): 1385-8947
Ratings:

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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Industrial and Manufacturing Engineering, Environmental Chemistry
Keywords: Biogenic, Copper, FT-IR, Heavy metals, Preferential adsorption, Selenium nanoparticles
DOIs:

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Source ID: 84942540702
Research output: Contribution to journal › Article › Scientific › peer-review

Composites of high-temperature thermomechanical pulps and polylactic acid
High-temperature thermomechanical pulps (HT-TMP, defibrated at 150 to 170 °C) were compared to a reference TMP (defibrated at 130 °C) as a reinforcement for polylactic acid (PLA). Composites were prepared by melt compounding, followed by injection molding, gradually increasing the used fiber content from 0 to 20 wt.%. The injection-molded specimens were characterized by tensile and impact strength tests, scanning electron microscopy, water absorption tests, and differential scanning calorimetry. The TMP fiber damage was also characterized before and after melt compounding by optical analysis. At 20% fiber content, the Young's modulus increased significantly, while the tensile strength remained unchanged and the impact strength decreased slightly. All fibers suffered damage during melt compounding, but the tensile strength remained about the same as in pure PLA. All types of TMP were able to increase the PLA rate of crystallization. The HT-TMP fibers were dispersed more evenly in PLA than the 130 °C TMP. The 170 °C TMP produced composites of lower water absorption than the other two TMP types, probably because of its lower hemicellulose content and its higher surface coverage by lignin.

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Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Aalto University
Contributors: Solala, I., Koistinen, A., Siljander, S., Vuorinen, J., Vuorinen, T.
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ASJC Scopus subject areas: Waste Management and Disposal, Environmental Engineering, Bioengineering
Keywords: High-temperature thermomechanical pulp, Hydrophobic fibers, Mechanical properties, Polylactic acid, Thermal properties, Wood fiber composites
DOIs:

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Source: Scopus
Source ID: 84949921508
Research output: Contribution to journal › Article › Scientific › peer-review

Biological and Bioelectrochemical Recovery of Critical and Scarce Metals
Metal-bearing solid and liquid wastes are increasingly considered as secondary sources of critical and scarce metals. Undoubtedly, microorganisms are a cost-effective resource for extracting and concentrating diffuse elements from

secondary sources. Microbial biotechnology for extracting base metals from ores and treatment of metal-laden wastewaters has already been applied at full scale. By contrast, microbe-metal interactions in the recovery of scarce metals and a few critical metals have received attention, whereas the recovery of many others has been barely explored. Therefore, this article explores and details the potential application of microbial biotechnologies in the recovery of critical and scarce metals. In the past decade bioelectrochemical systems have emerged as a new technology platform for metal recovery coupled to the removal of organic matter. Overview of potential applications of microorganisms in critical metal recovery.Engineering of microbe-metal interactions for recovering rare earth elements and platinum group metals.Reductive mineral dissolution is a new dimension to biomining.Bioelectrochemical systems offer a new technology platform in metal recovery.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Biofouling and Biofilm Processes Section, Bhabha Atomic Research Centre, Council of Scientific and Industrial Research India, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education
Contributors: Nancharaiah, Y. V., Mohan, S. V., Lens, P. N. L.
Number of pages: 19
Pages: 137-155
Publication date: 2016
Peer-reviewed: Yes

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Research output: Contribution to journal › Article › Scientific › peer-review

High-Yield Excited Triplet States in Pentacene Self-Assembled Monolayers on Gold Nanoparticles through Singlet Exciton Fission

One of the major drawbacks of organic-dye-modified self-assembled monolayers on metal nanoparticles when employed for efficient use of light energy is the fact that singlet excited states on dye molecules can be easily deactivated by means of energy transfer to the metal surface. In this study, a series of 6,13-bis(triisopropylsilylethynyl)pentacene-alkanethiolate monolayer protected gold nanoparticles with different particle sizes and alkane chain lengths were successfully synthesized and were employed for the efficient generation of excited triplet states of the pentacene derivatives by singlet fission. Time-resolved transient absorption measurements revealed the formation of excited triplet states in high yield (172±26%) by suppressing energy transfer to the gold surface.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Keio University
Contributors: Kato, D., Sakai, H., Tkachenko, N. V., Hasobe, T.
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ASJC Scopus subject areas: Chemistry(all), Catalysis
Keywords: Gold, Nanoparticles, Pentacene, Self-assembled monolayers, Singlet fission
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Research output: Contribution to journal › Article › Scientific › peer-review

Superfluorinated Ionic Liquid Crystals Based on Supramolecular, Halogen-Bonded Anions

Unconventional ionic liquid crystals in which the liquid crystallinity is enabled by halogen-bonded supramolecular anions [C_nF_{2n+1}-I···I···I-C_nF_{2n+1}]$^-$ are reported. The material system is unique in many ways, demonstrating for the first time 1)ionic, halogen-bonded liquid crystals, and 2)imidazolium-based ionic liquid crystals in which the occurrence of liquid crystallinity is not driven by the alkyl chains of the cation.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry
Contributors: Cavallo, G., Terraneo, G., Monfredini, A., Saccone, M., Priimägi, A., Pilati, T., Resnati, G., Metrangolo, P., Bruce, D. W.
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis
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Electronic versions:

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Research output: Contribution to journal › Article › Scientific › peer-review

Fire-safe and environmentally friendly nanocomposites based on layered double hydroxides and ethylene propylene diene elastomer

In this work we describe layered double hydroxide (LDH), known as naturally occurring hydrotalcite, based rubber composites that can serve as outstanding fire retardant elastomeric materials. The preparation and detailed characterization of these composites are presented in this study. The inherent slow sulfur cure nature of EPDM rubber is considerably improved by the addition of LDH as realised by the observation of a shortening of the vulcanization time and an improvement of ultimate rheometric torque. This behavior of LDH signifies not only the filler-like character of itself, but also offers vulcanization active surface properties of layered double hydroxide particles. A good rubber-filler interaction was also realised by observing a positive shift of the glass transition temperature of ethylene propylene diene rubber (EPDM) in dynamic mechanical analysis (DMA). The flame retardant property was studied by the cone calorimeter test. The cone calorimeter investigation with sulfur cured gum rubber compounds found a peak heat release rate (PHRR) value of 654 kW m^{-2}. However, at a higher phr loading of Zn-Al LDH i.e., at 40 phr and 100 phr, the PHRR is diminished to 311 kW m^{-2} and 161 kW m^{-2}, respectively. Thus, this present work can pave the way to fabricate environmentally friendly fire retardant elastomeric composites for various applications.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Institut für Werkstoffwissenschaft, Leibniz-Institut für Polymerforschung Dresden E.V., IMDEA Materials Institute, Cochin University of Science and Technology
Contributors: Basu, D., Das, A., Wang, D. Y., George, J. J., Stöckelhuber, K. W., Boldt, R., Leuteritz, A., Heinrich, G.
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Research output: Contribution to journal › Article › Scientific › peer-review

Metrics for polyphonic sound event detection
This paper presents and discusses various metrics proposed for evaluation of polyphonic sound event detection systems used in realistic situations where there are typically multiple sound sources active simultaneously. The system output in this case contains overlapping events, marked as multiple sounds detected as being active at the same time. The polyphonic system output requires a suitable procedure for evaluation against a reference. Metrics from neighboring fields such as speech recognition and speaker diarization can be used, but they need to be partially redefined to deal with the overlapping events. We present a review of the most common metrics in the field and the way they are adapted and interpreted in the polyphonic case. We discuss segment-based and event-based definitions of each metric and explain the consequences of instance-based and class-based averaging using a case study. In parallel, we provide a toolbox containing implementations of presented metrics.

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Organisations: Department of Signal Processing, Research group: Audio research group
Contributors: Mesaros, A., Heittola, T., Virtanen, T.
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ASJC Scopus subject areas: Fluid Flow and Transfer Processes, Process Chemistry and Technology, Computer Science Applications, Engineering(all), Materials Science(all), Instrumentation
Keywords: Audio content analysis, Audio signal processing, Computational auditory scene analysis, Evaluation of sound event detection, Everyday sounds, Pattern recognition, Polyphonic sound event detection, Sound events
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Decoding the Morphological Diversity in Two Dimensional Crystalline Porous Polymers by Core Planarity Modulation
Two new chemically stable triazine- and phenyl-core-based crystalline porous polymers (CPPs) have been synthesized using a single-step template-free solvothermal route. Unique morphological diversities were observed for these CPPs [2,3-DhaTta (ribbon) and 2,3-DhaTab (hollow sphere)] by simply altering the linker planarity. A detailed time-dependent study established a significant correlation between the molecular level structures of building blocks with the morphology of CPPs. Moreover, a DFT study was done for calculating the interlayer stacking energy, which revealed that the extent of stacking efficiency is responsible for governing the morphological diversity in these CPPs.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: CSIR-National Chemical Laboratory, Indian Institute of Technology Kanpur, Indian Institute of Technology Bombay, Jacobs University Bremen, Polymer Science and Engineering Division
Contributors: Halder, A., Kandambeth, S., Biswal, B. P., Kaur, G., Roy, N. C., Addicoat, M., Salunke, J. K., Banerjee, S., Vanka, K., Heine, T., Verma, S., Banerjee, R.
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Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all)
Keywords: covalent organic frameworks, density functional calculations, dihedral angles, morphology, stacking interactions
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Source: Scopus
Source ID: 84960155135
Research output: Contribution to journal › Article › Scientific › peer-review

Enhanced adsorption of orthophosphate and copper onto hydrochar derived from sewage sludge by KOH activation
Hydrothermal carbonization producing hydrochar from organic waste is increasingly gaining attention to deal with the challenge of excess waste activated sludge produced during centralized aerobic wastewater treatment. Hydrochar is used as an adsorbent for the removal of organics, metals and biotic contaminants. This study demonstrated the application of KOH activated hydrochar, called enhanced hydrochar (EHC) derived from sewage sludge, for the removal of orthophosphate from wastewater by means of batch adsorption, zetametry and infrared spectroscopy. The maximum Q_e-PO_4^{3-} of EHC was 14.3 mg orthophosphate adsorbed per g of EHC when the initial orthophosphate concentration was increased to 150 mg L^{-1}. The application of orthophosphate removal by EHC from the effluent of a constructed wetland was demonstrated by achieving more than 97% orthophosphate removal at an EHC dosage of 6.0 g L^{-1} and an initial orthophosphate concentration of 13.1 mg L^{-1}. pH dependent adsorption experiments and infrared spectroscopy showed the orthophosphate removal by EHC was due to the replacement of hydroxyl groups by orthophosphate in the EHC. Acid-base titration showed the KOH washing of the raw hydrochar (RHC) led to a 1.7 times increase in the hydroxyl groups in EHC compared to RHC. This study further confirmed the higher uptake capacity of EHC compared to RHC towards copper as a model divalent cation. EHC can thus be applied for the removal of both anions (orthophosphate) and cations (copper) from wastewater.

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Zurich University of Applied Sciences

Contributors: Spataru, A., Jain, R., Chung, J. W., Gerner, G., Krebs, R., Lens, P. N. L.
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
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Source: Scopus
Source ID: 84994048409
Research output: Contribution to journal › Article › Scientific › peer-review

Nonlinear transmittance and optical power limiting in magnesium ferrite nanoparticles: effects of laser pulsewidth and particle size

We report comparative measurements of size dependent nonlinear transmission and optical power limiting in nanocrystalline magnesium ferrite ($MgFe_2O_4$) particles excited by short (nanosecond) and ultrashort (femtosecond) laser pulses. A standard sol-gel technique is employed to synthesize particles in the size range of 10-50 nm, using polyvinyl alcohol as the chelating agent. The structure and morphology of the samples are studied using X-ray diffraction, scanning electron microscopy and transmission electron microscopy. Growth of the particles in time is tracked through Fourier transform infrared spectroscopy. Nonlinear transmission measurements have been carried out using the open aperture Z-scan technique employing 532 nm, 5 nanosecond pulses and 800 nm, 100 femtosecond pulses, respectively. The measured optical nonlinearity is primarily of a reverse saturable absorption (RSA) nature, arising mostly from excited state absorption for nanosecond excitation, and two-photon absorption for femtosecond excitation. The optical limiting efficiency is found to increase with particle size for both cases. The calculated nonlinear parameters indicate that these materials are potential candidates for optical limiting applications.

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MoE publication type: A1 Journal article-refereed
Organisations: Photonics, National Institute of Technology Karnataka, International and Inter University Centre for Nanoscience and Nanotechnology, Mahatma Gandhi University, Raman Research Institute
Contributors: Perumbilavil, S., Sridharan, K., Abraham, A. R., Janardhanan, H. P., Kalarikkal, N., Philip, R.
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Source: Scopus
Source ID: 84995977139
Research output: Contribution to journal › Article › Scientific › peer-review

The formation and physical properties of the particle emissions from a natural gas engine

Natural gas engine particle emissions were studied using an old gasoline engine modified to run with natural gas. The tests were steady-state tests performed on two different low loads in an engine dynamometer. Exhaust particle number concentration, size distribution, volatility and electric charge were measured. Exhaust particles were observed to have peak diameters below 10 nm. To get the full picture of particle emissions from natural gas engines, size range 1-5 nm is relevant and important to take into consideration. A particle size magnifier (PSM) was used in this engine application for measuring particles smaller than 3 nm and it proved to be a useful instrument when measuring natural gas engine exhaust particles. It is concluded that the detected particles probably originated from the engine cylinders or their vicinity and grew to detectable sizes in the sampling process because a small fraction of the particles were observed to carry electric charge and the particles did not evaporate totally at 265°C.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Engineering materials science and solutions (EMASS), Urban circular bioeconomy (UrCirBio), Atmospheric Composition Research, VTT Technical Research Centre of Finland, Finnish Meteorological Institute
Contributors: Alanen, J., Saukko, E., Lehtoranta, K., Murtonen, T., Timonen, H., Hillamo, R., Karjalainen, P., Kuuluvainen, H., Harra, J., Keskinen, J., Rönkkö, T.
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Original language: English
ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry
Keywords: Fine particle emission, Internal combustion engine, Natural gas, Particle formation
DOIs:

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Source ID: 84941782885
Research output: Contribution to journal › Article › Scientific › peer-review

Modeling carbon dioxide transport in PDMS-based microfluidic cell culture devices

Maintaining a proper pH level is crucial for successful cell culturing. Mammalian cells are commonly cultured in incubators, where the cell culture medium is saturated with a mixture of air and 5% carbon dioxide (CO<inf>2</inf>). Therefore, to keep cell culture medium pH in an acceptable level outside these incubators, a suitable CO<inf>2</inf> concentration must be dissolved in the medium. However, it can be very difficult to control and measure precisely local concentration levels. Furthermore, possible undesired concentration gradients generated during long-term cell culturing are almost impossible to detect. Therefore, we have developed a computational model to estimate CO<inf>2</inf> transport in silicone-based microfluidic devices. An extensive set of experiments was used to validate the finite element model. The model parameters were obtained using suitable measurement set-ups and the model was validated using a fully functional cell cultivation device. The predictions obtained by the simulations show very good responses to experiments. It is shown in this paper how the model helps to understand the dynamics of CO<inf>2</inf> transport in silicone-based cell culturing devices possessing different geometries, thus providing cost-effective means for studying different device designs under a variety of experimental conditions without the need of actual testing. Finally, based on the results from the computational model, an alternative strategy for feeding CO<inf>2</inf> is proposed to accelerate the system performance such that a faster and more uniform CO<inf>2</inf> concentration response is achieved in the area of interest.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Automation Science and Engineering, Department of Materials Science, Research group: Paper Converting and Packaging, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), BioMediTech

Contributors: Mäki, A. J., Peltokangas, M., Kreutzer, J., Auvinen, S., Kallio, P.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Applied Mathematics, Industrial and Manufacturing Engineering
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URLs:

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Bibliographical note
ORG=ase,0.9
ORG=mol,0.1
Source: Scopus
Source ID: 84938149959
Research output: Contribution to journal › Article › Scientific › peer-review

Polypyrrole coating on poly-(lactide/glycolide)-β-tricalcium phosphate screws enhances new bone formation in rabbits
Polypyrrole (PPy) has gained interest as an implant material due to its multifunctional properties and its high compatibility with several cell and tissue types. For the first time, the biocompatibility and osteointegration of PPy coating, incorporated with chondroitin sulfate (CS), were studied in vivo by implanting PPy-coated bioabsorbable bone fixation composite screws of poly-(lactide/glycolide) copolymer (PLGA) and β-tricalcium phosphate (TCP) into New Zealand white rabbits. Uncoated bioabsorbable polymer composite screws and commercially available stainless steel cortical screws were used as reference implants. The rabbits were euthanized 12 and 26 weeks after the implantation. The systemic effects were evaluated from food and water consumption, body weight, body temperature, clinical signs, blood samples, internal organ weights, and histological examination. Local effects were studied from bone tissue and surrounding soft tissue histology. New bone formation was evaluated by micro-computed tomography, tetracycline labeling and torsion tests. Torsion tests were performed in order to capture the peak value of the torsion force during the course of the screw's loosening. The coated screws induced significantly more bone formation than the uncoated screws. In addition, none of the implants induced any systemic or local toxicity. The results suggest that PPy is biocompatible with bone tissue and is a potential coating for enhancing osteointegration in orthopedic implants.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Research group: Computational Biophysics and Imaging Group, Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), Fudan University, University of Wollongong, VTT Technical Research Centre of Finland, Tampere University Hospital, University of Oulu, Univ Helsinki, Helsinki University Central Hospital, University of Helsinki, Cent Hosp, Dept Med, Div Nephrol, University of Twente
Contributors: Zhao, M. D., Björninen, M., Cao, L., Wang, H. R., Pelto, J., Li, X. Q., Hyttinen, J., Jiang, Y. Q., Kellomäki, M. , Miettinen, S., Sándor, G. K., Seppänen, R., Haimi, S., Dong, J.
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Keywords: absorbable screw, biocompatibility, in vivo, osteointegration, polypyrrole (PPy)
DOIs:

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EXT="Pelto, Jani"
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Research output: Contribution to journal › Article › Scientific › peer-review

Graphene-intercalated Fe_2O_3/TiO_2 heterojunctions for efficient photoelectrolysis of water
Interfacial modification of α-Fe_2O_3/TiO_2 multilayer photoanodes by intercalating few-layer graphene (FLG) was found to improve water splitting efficiency due to superior transport properties, when compared to individual iron and titanium oxides and heterojunctions thereof. Both metal oxides and graphene sheets were grown by plasma-enhanced chemical vapor deposition. Compared to the onset potential achieved for α-Fe_2O_3 films (1 V vs. RHE), the α-Fe_2O_3/TiO_2 bilayer structure yielded a better onset potential (0.3 V vs. RHE). Heterojunctioned bilayers exhibited a higher photocurrent density (0.32 mA cm^{-2} at 1.23 V vs. RHE) than the single α-Fe_2O_3 layer (0.22 mA cm^{-2} at 1.23 V vs. RHE), indicating more efficient light harvesting and higher concentration of photogenerated charge carriers. For more efficient charge transport at the interface, a few layer graphene sheet was intercalated into the α-Fe_2O_3/TiO_2 interface, which substantially increased the photocurrent density to 0.85 mA cm^{-2} (1.23 V vs. RHE) and shifted the onset potential (0.25 V vs. RHE). Ultrafast transient absorption spectroscopy studies indicated that the incorporation of FLG between the α-Fe_2O_3 and TiO_2 layers resulted in reduced recombination in the α-Fe_2O_3 layer. The results showed that graphene intercalation improved the charge separation and the photocurrent density of the FTO/α-Fe_2O_3/FLG/TiO_2 system.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Universitat zu Koln, Institute of Inorganic Chemistry, Ruhr-Universität Bochum
Contributors: Kaouk, A., Ruoko, T. P., Gönüllü, Y., Kaunisto, K., Mettenbörger, A., Gurevich, E., Lemmetyinen, H., Ostendorf, A., Mathur, S.
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Scopus rating (2015): CiteScore 3.5 SJR 0.947 SNIP 0.838
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ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
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Source: Scopus
Source ID: 84948652698
Research output: Contribution to journal › Article › Scientific › peer-review

Simultaneous nutrient removal and lipid production with Chlorella vulgaris on sterilized and non-sterilized anaerobically pretreated piggery wastewater
Piggery wastewater is a potent nutrient source for microalgal lipid production. Wastewater has been usually sterilized when used for microalgal cultivation. This is uneconomical in large-scale applications. Therefore, lipid productivity of

Chlorella vulgaris CY5 using sterilized and non-sterilized diluted anaerobically pretreated piggery wastewater was studied in batch reactors. The maximum average lipid productivity was obtained after 12 days of incubation and it was higher with the sterilized wastewater than with the non-sterilized one (117g/L/d vs. 91.3g/L/d), due to the higher biomass concentration. Because of the unexpected increase of dissolved organic carbon (DOC) in the cultures, second experiment was conducted to characterize the composition of produced DOC in non-sterilized wastewater. Carbohydrate content increased in the liquid phase but decreased in the biomass after nitrogen had been exhausted. After 12 days of incubation, soluble chemical oxygen demand (COD<inf>s</inf>) was 414±56mg/L, biomass production was 2.8±0.15g/L, and lipid content was 30.3±1.2wt%. Average lipid productivity from day zero to day 12 was 70.5±1.1g/L/d. C. vulgaris removed nutrients from the non-sterilized wastewater and produced oleaginous biomass, although the lipid productivity was higher with sterilized wastewater.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), Center of Bioscience and Biotechnology, Research Center for Energy Technology and Strategy, National Cheng Kung University, Department of Environmental Engineering, Department of Chemical Engineering
Contributors: Marjakangas, J. M., Chen, C. Y., Lakaniemi, A. M., Puhakka, J. A., Whang, L. M., Chang, J. S.
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Keywords: Aerobic process, Lipid production, Microalgae, Piggery wastewater, Sterilization, Wastewater treatment
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Source: Scopus
Source ID: 84939202209
Research output: Contribution to journal › Article › Scientific › peer-review

Tri-functionality of Fe3O4-embedded carbon microparticles in microalgae harvesting

Microalgae have received significant attention as promising resources for biodiesel. However, the downstream processes for the production of biodiesel, which range from cultivation, harvesting, dewatering, and lipid extraction to oil upgrading, are economically impracticable and can be improved. Therefore, efficient microalgal harvesting and integrated technologies are required to realize microalgae-based biodiesel. Herein, tri-functional (cationic, magnetic, and lipophilic) carbon microparticles filled with magnetite (Fe<inf>3</inf>O<inf>4</inf>) are synthesized through one-step aerosol spray pyrolysis and applied in microalgal harvesting and serial microalgal lipid entrapment. Carbon microparticles are tri-functional in the following respects: (i) the cationic carbon microparticles facilitate flocculation with anionic microalgae due to electrostatic attractions; (ii) the magnetic properties of the carbon microparticles, owing to embedded magnetites, enable the separation of microalgal flocs from low concentration cultures (~2gL⁻¹) with a separation efficiency of 99%; and (iii) the lipophilicity enables the recovery of lipid droplets extracted from oleaginous microalgae. Microalgal lipids are directly separated through adsorption onto magnetic carbon microparticles from concentrated microalgal slurries after harvesting. The tri-functionality may facilitate the integrated use of magnetic carbon microparticles in microalgal biorefineries and the tri-functional microparticles could potentially be applied in various areas such as biomedicine, catalysis, magnetism, energy materials, and environmental remediation.

General information

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Organisations: Urban circular bioeconomy (UrCirBio), KAIST, Korea Institute of Energy Research
Contributors: Seo, J. Y., Lee, K., Ramasamy, P., Kim, B., Lee, S. Y., Oh, Y. K., Park, S. B.
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Keywords: Aerosol spray pyrolysis, Cationic functionality, Lipophilicity, Magnetic materials, Microalgae harvesting
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Source ID: 84933567826
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of rubber polarity on selective wetting of carbon nanotubes in ternary blends
Based on atomic force microscopy (AFM) and Fourier transform infrared spectroscopy (FTIR) analysis of the rubber-filler gel (wetting concept) the kinetics of selective wetting of carbon nanotubes (CNTs) in ternary styrene butadiene rubber (SBR)/butadiene rubber (BR)/natural rubber (NR) blends was qualitatively and quantitatively characterized. Almost all CNTs are found to be wetted by the non-polar NR but not by the other non-polar rubber like BR or weakly polar SBR. It was proposed that phospholipids, which are linked to the α-terminal of NR can interact with the CNT surface through cation-π interactions forming strong bonding between NR and CNTs. Using the corrected surface tension value of NR, which involves the effect of phospholipids found in our previous work the selective wetting of CNTs in ternary rubber blends can be well predicted using the Z-model for a thermodynamic equilibrium state. By replacing the non-polar BR by a polar rubber like nitrile butadiene rubber (NBR) as a blend component CNTs are wetted by NBR slightly more than by NR thanks to the strong interaction between CNTs and nitrile groups of NBR. SBR remains unbound to CNTs in both blends.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Institut für Polymerwerkstoffe E.V., Martin-Luther-University Halle-Wittenberg, Fraunhofer IWM, Vodafone Department of Mobile Communications Systems, Leibniz-Institut für Polymerforschung Dresden E.V., Vietnamese Academy of Science and Technology Institute of Chemistry, Polymer Service GmbH Merseburg
Contributors: Le, H. H., Parsaker, M., Sriharish, M. N., Henning, S., Menzel, M., Wießner, S., Das, A., Do, Q. K., Heinrich, G., Radusch, H. J.
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ASJC Scopus subject areas: Chemical Engineering(all), Physical and Theoretical Chemistry, Polymers and Plastics, Organic Chemistry, Materials Chemistry
Keywords: Carbon nanotubes, Manocomposites, Rubber blends, Selective filler wetting
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Comparison of different cationized proteins as biomaterials for nanoparticle-based ocular gene delivery

Cationized polymers have been proposed as transfection agents for gene therapy. The present work aims to improve the understanding of the potential use of different cationized proteins (atelocollagen, albumin and gelatin) as nanoparticle components and to investigate the possibility of modulating the physicochemical properties of the resulting nanoparticle carriers by selecting specific protein characteristics in an attempt to improve current ocular gene-delivery approaches. The toxicity profiles, as well as internalization and transfection efficiency, of the developed nanoparticles can be modulated by modifying the molecular weight of the selected protein and the amine used for cationization. The most promising systems are nanoparticles based on intermediate molecular weight gelatin cationized with the endogenous amine spermine, which exhibit an adequate toxicological profile, as well as effective association and protection of pDNA or siRNA molecules, thereby resulting in higher transfection efficiency and gene silencing than the other studied formulations.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Federal University of Rio Grande do Sul , University of Santiago de Compostela (USC), University Clinical Hospital of Santiago de Compostela (IDIS)
Contributors: Zorzi, G. K., Párraga, J. E., Seijo, B., Sanchez, A.
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Keywords: Cationized proteins, Gene therapy, Nanoparticles, pDNA, siRNA
DOIs:

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Research output: Contribution to journal › Article › Scientific › peer-review

Submolecular Plasticization Induced by Photons in Azobenzene Materials

We demonstrate experimentally for the first time that the illumination of azobenzene derivatives leads to changes in molecular environment similar to those observed on heating but that are highly heterogeneous at the submolecular scale. This localized photoplasticization, which can be associated with a free volume gradient, helps to understand the puzzling phenomenon of photoinduced macroscopic material flow and photoexpansion upon illumination far below the glass transition temperature (T_g). The findings stem from the correlation of infrared (IR) spectral band shifts measured upon illumination with those measured at controlled temperatures for two amorphous DR1-functionalized azo derivatives, a polymer, pDR1A, and a molecular glass, gDR1. This new approach reveals that IR spectroscopy can be used as an efficient label-free molecular-scale thermometer that allows the assignment of an effective temperature (T_{eff}) to each moiety in these compounds when irradiated. While no band shift is observed upon illumination for the vibrational modes assigned to backbone moieties of pDR1A and gDR1 and a small band shift is found for the spacer moiety, dramatic band shifts are recorded for the azo moiety, corresponding to an increase in T_{eff} of up to nearly 200 °C and a molecular environment that is equivalent to thermal heating well above the bulk T_g of the material. An irradiated azo-containing material thus combines characteristic properties of amorphous materials both below and above its bulk T_g. The direct measurement of T_{eff} is a powerful probe of the local environment at the submolecular scale, paving the way toward better rationalization of photoexpansion and the athermal malleability of azo-containing materials upon illumination below their T g.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Département de Chimie, Succ. Centre-Ville, Royal Military College of Canada

Contributors: Vapaavuori, J., Laventure, A., Bazuin, C. G., Lebel, O., Pellerin, C.
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Volume: 137
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ASJC Scopus subject areas: Catalysis, Chemistry(all), Biochemistry, Colloid and Surface Chemistry
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Source ID: 84946020103
Research output: Contribution to journal › Article › Scientific › peer-review

Cultivation of Nannochloropsis for eicosapentaenoic acid production in wastewaters of pulp and paper industry
The eicosapentaenoic acid (EPA) containing marine microalga Nannochloropsis oculata was grown in an effluent from anaerobic digestion of excess activated sludge from a wastewater treatment plant serving a combination of a pulp and a paper mill and a municipality (digester effluent, DE), mixed with the effluent of the same wastewater treatment plant. The maximum specific growth rate and photosynthesis of N. oculata were similar in the DE medium and in artificial sea water medium (ASW) but after 7. days, algae grown in the DE medium contained seven times more triacylglycerols (TAGs) per cell than cells grown in ASW, indicating mild stress in the DE medium. However, the volumetric rate of EPA production was similar in the ASW and DE media. The results suggest that N. oculata could be used to produce EPA, utilizing the nutrients available after anaerobic digestion of excess activated sludge of a pulp and paper mill.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), University of Turku, Department of Biochemistry/Molecular Plant Biology, Department of Biochemistry/Food Chemistry and Food Development
Contributors: Polishchuk, A., Valev, D., Tarvainen, M., Mishra, S., Kinnunen, V., Antal, T., Yang, B., Rintala, J., Tyystjärvi, E.
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Source ID: 84936059366
Research output: Contribution to journal › Article › Scientific › peer-review

Molecular Design of Light-Responsive Hydrogels, for in Situ Generation of Fast and Reversible Valves for Microfluidic Applications

Reversible light-responsive hydrogel valves with response characteristics compatible for microfluidics have been obtained by optimization of molecular design of spiropyran photoswitches and gel composition. Self-protonating gel formulations were exploited, wherein acrylic acid was copolymerized in the hydrogel network as an internal proton donor, to achieve a swollen state of the hydrogel in water at neutral pH. Light-responsive properties were endowed upon the hydrogels by copolymerization of spiropyran chromophores, using electron withdrawing and donating groups to tune the gel-swelling and shrinkage behavior. In all cases, the shrinkage was determined by the water diffusion rate, while for the swelling the isomerization kinetics is the rate-determining step. For one hydrogel, reversible and reproducible volume changes were observed. Finally, gel-valves integrated within microfluidic channels were fabricated, allowing reversible and repeatable operation, with opening and closing of the valve in minutes.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Eindhoven University of Technology, Dublin City University
Contributors: Ter Schiphorst, J., Coleman, S., Stumpel, J. E., Ben Azouz, A., Diamond, D., Schenning, A. P. H. J.
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ASJC Scopus subject areas: Materials Chemistry, Chemical Engineering(all), Chemistry(all)
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Research output: Contribution to journal › Article › Scientific › peer-review

Effects of anode potentials on bioelectrogenic conversion of xylose and microbial community compositions

The results on the effects of different anode potentials on current densities, coulombic efficiencies and microbial communities are contradictory and have not been studied with xylose, an important constituent of lignocellulosic materials. In this study, the effects of different anode potentials (+0.2, 0 and -0.2V vs. Ag/AgCl) on current generation, xylose degradation and microbial communities were examined with an exoelectrogenic enrichment culture originating from anaerobic sludge. Anode potential of +0.2V (vs. Ag/AgCl) resulted in the highest current density and coulombic efficiency of 1.5±0.2A/m² and 62±11%, respectively, and there was no accumulation of soluble metabolites. With anode potentials of 0 and -0.2V the current densities remained low and acetate, butyrate and propionate were detected in the end of batch runs. Different anode potentials resulted in substantial differences in the anodic bacterial species. At more positive anode potentials, Ochrobactrum intermedium reported to be capable of direct electron transfer dominated. At more negative anode potentials, a known mediator-producer, Alcaligenes faecalis, and Desulfitobacterium hafnience, that has been reported to use mediated electron transfer, were detected. This study shows that the anode potential has a substantial effect on microbial communities and on xylose metabolism.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio)
Contributors: Kokko, M. E., Mäkinen, A. E., Sulonen, M. L. K., Puhakka, J. A.
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Original language: English
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Source ID: 84936752873
Research output: Contribution to journal › Article › Scientific › peer-review

Enhanced photoactive and photoelectrochemical properties of TiO2 sol-gel coated steel by the application of SiO2 intermediate layer

Photocatalysis is a promising solution for purifying air and water from pollutants, yet more efficient photocatalytic materials are needed. A new approach is proposed in this paper for enhancing the photoactive and photoelectrical properties of anatase TiO_2 films by applying an intermediate SiO_2 film between the TiO_2 film and the stainless steel substrate. TiO_2 and SiO_2 coatings are synthesized by a sol-gel method and the thickness of TiO_2 film is varied in order to obtain improved understanding on the role of thickness in photocatalytic and electrochemical performance. The obtained coatings are systematically characterized in terms of microstructure using such techniques as field-emission scanning electron microscopy (FE-SEM), Raman spectroscopy and X-ray diffraction (XRD), that demonstrate, e.g., the anatase phase structure of the TiO_2 films. The enhanced photocatalytic properties of SiO_2/TiO_2 coatings as compared to TiO_2 films are verified using methylene blue (MB) discoloration tests, while the improved photoelectrochemical properties are shown by potentiodynamic i-V scans, open circuit potential (OCP) monitoring and electrochemical impedance spectroscopy (EIS). We attribute the beneficial effect of the intermediate SiO_2 film on the photocatalytic and photoelectrochemical performance to the high electrical resistance of the SiO_2 that imposes a high-energy barrier for electron transfer and, therefore, (partly) insulates the TiO_2 film from the substrate and acts as a capacitor for photo-generated electrons under illumination. The presented results show an effective way of enhancing the photocatalytic performance of anatase TiO_2 films.

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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Frontier Photonics, Department of Materials Science, Research group: Ceramic materials, Optoelectronics Research Centre, Research group: Nanophotonics, Research group: Surface Engineering, Research group: Materials Characterization
Contributors: Nikkanen, J. P., Huttunen-Saarivirta, E., Salminen, T., Hyvärinen, L., Honkanen, M., Isotahdon, E., Heinonen, S., Levänen, E.
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Original language: English
ASJC Scopus subject areas: Catalysis, Process Chemistry and Technology, Environmental Science(all)
Keywords: Electrical resistance, Electrochemical impedance spectroscopy, Photocatalysis, Substrate, Titanium dioxide
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Source: Scopus
Source ID: 84937762118
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Searching for a robust strategy for minimizing alkali chlorides in fluidized bed boilers during burning of high SRF-energy-share fuel

To meet the increasing volume of waste to be treated via energy recovery, high SRF-energy-share fuel is being fired in conventional waste-to-energy facilities. In this work, corrosion related risk during firing of 70 e-% share (target fuel) is studied and compared against the base case fuel containing 50 e-% share. Cl and S concentration is highest in the target fuel as a direct result of increasing the proportion of SRF in the fuel mixture. Br, Zn and Pb showed the same trend. Meanwhile, the concentration of Na, K, Al and Si are highly dependent on the type of the SRF fired. The corrosion risk of the base and target fuels are analyzed using the composition of the fine aerosol fraction and deposit samples measured near the vicinity of the superheater. Surprisingly aerosols for the target fuel are less risky - having less Cl and more S, than that of the base fuel. The effects of sulfur based additives - elemental sulfur and sulfate injection, and fuel substitution on the risk of superheater corrosion are likewise analyzed. All these strategies can reduce the concentration of Cl in the aerosols, however it is concluded that sulfate injection is considered as a robust strategy for mitigating alkali chloride formation. Sulfate injection is able to reduce Cl in the aerosols and deposits regardless of the quality of the fuel mixture. Robust strategies are important in ensuring the boiler performance during high SRF-energy share firing. An attempt of linking the quality of the deposits and the properties of the flue gas and aerosols around the superheater using partial least squares regression is also presented.

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Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), University of Jyväskylä, Valmet Technologies Oy, VTT Technical Research Centre of Finland, Department of Chemistry, Renewable Natural Resources and Chemistry of Living Environment, Stora Enso
Contributors: Bajamundi, C. J. E., Vainikka, P., Hedman, M., Silvennoinen, J., Heinanen, T., Taipale, R., Konttinen, J.
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Research output: Contribution to journal › Article › Scientific › peer-review

Surface Modified Biodegradable Electrospun Membranes as a Carrier for Human Embryonic Stem Cell-Derived Retinal Pigment Epithelial Cells

Human embryonic stem cell-derived retinal pigment epithelial (hESC-RPE) cells are currently undergoing clinical trials to treat retinal degenerative diseases. Transplantation of hESC-RPE cells in conjuction with a supportive biomaterial carrier holds great potential as a future treatment for retinal degeneration. However, there has been no such biodegradable material that could support the growth and maturation of hESC-RPE cells so far. The primary aim of this work was to create a thin porous poly (L-lactide-co-caprolactone) (PLCL) membrane that could promote attachment, proliferation, and maturation of the hESC-RPE cells in serum-free culture conditions. The PLCL membranes were modified by atmospheric pressure plasma processing and coated with collagen IV to enhance cell growth and maturation. Permeability of the membranes was analyzed with an Ussing chamber system. Analysis with scanning electron microscopy, contact angle measurement, atomic force microscopy, and X-ray photoelectron spectroscopy demonstrated that plasma surface

treatment augments the surface properties of the membrane, which enhances the binding and conformation of the protein. Cell proliferation assays, reverse transcription-polymerase chain reaction, indirect immunofluoresence staining, trans-epithelial electrical resistance measurements, and in vitro phagocytosis assay clearly demonstrated that the plasma treated PLCL membranes supported the adherence, proliferation, maturation and functionality of hESC-RPE cells in serum-free culture conditions. Here, we report for the first time, how PLCL membranes can be modified with atmospheric pressure plasma processing to enable the formation of a functional hESC-RPE monolayer on a porous biodegradable substrate, which have a potential as a tissue-engineered construct for regenerative retinal repair applications.

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Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), University of Ulster
Contributors: Sorkio, A., Porter, P. J., Juuti-Uusitalo, K., Meenan, B. J., Skottman, H., Burke, G. A.
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Source ID: 84940705576
Research output: Contribution to journal › Article › Scientific › peer-review

Influence of relative humidity and physical load during storage on dustiness of inorganic nanomaterials: implications for testing and risk assessment
Dustiness testing using a down-scaled EN15051 rotating drum was used to investigate the effects of storage conditions such as relative humidity and physical loading on the dustiness of five inorganic metal oxide nanostructured powder materials. The tests consisted of measurements of gravimetrical respirable dustiness index and particle size distributions. Water uptake of the powders during 7 days of incubation was investigated as an explanatory factor of the changes. Consequences of these varying storage conditions in exposure modelling were tested using the control banding and risk management tool NanoSafer. Drastic material-specific effects on powder respirable dustiness index were observed with the change in TiO<inf>2</inf> from 30 % RH (639 mg/kg) to 50 % RH (1.5 mg/kg). All five tested materials indicate a decreasing dustiness index with relative humidity increasing from 30 to 70 % RH. Test of powder water uptake showed an apparent link with the decreasing dustiness index. Effects of powder compaction appeared more material specific with both increasing and decreasing dustiness indices observed as an effect of compaction. Tests of control banding exposure models using the measured dustiness indices in three different exposure scenarios showed that in two of the tested materials, one 20 % change in RH changed the exposure banding from the lowest level to the highest. The study shows the importance of powder storage conditions prior to tests for classification of material dustiness indices. It also highlights the importance of correct storage information and relative humidity and expansion of the dustiness test conditions specifically, when using dustiness indices as a primary parameter for source strength in exposure assessment.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Materials Characterization, Engineering materials science and solutions (EMASS), Department of Micro and Nanotechnology, Denmark Technical University DTU, Finnish Institute of Occupational Health, CIC biomaGUNE, National Research Centre for the Working Environment
Contributors: Levin, M., Rojas, E., Vanhala, E., Vippola, M., Liguori, B., Kling, K. I., Koponen, I. K., Mølhave, K., Tuomi, T. , Gregurec, D., Moya, S., Jensen, K. A.
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ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Modelling and Simulation, Chemistry(all), Materials Science(all), Bioengineering
Keywords: Dustiness, Exposure assessment, Nanotechnology, Occupational health, Powder storage, Rotating drum
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Research output: Contribution to journal › Article › Scientific › peer-review

Evaluation of crushing strength of spray-dried MgAl2O4 granule beds

The crushing strengths of four different experimental magnesium aluminate spinel (MgAl2O4) granule beds were monitored with the axial die pressing test after heat treatments. Precursor, magnesium hydroxide (Mg(OH)2) and magnesium oxide (MgO) as Mg precursor and aluminium oxide hydroxide Al(O)OH and α-Al2O3 as Al precursor, were used for experimental granules, which were manufactured via a dispersion manufacturing and spray-drying process. After spray-drying, granules were heat treated in air at 1000, 1100, 1200, 1300 and 1400 °C. In order to understand the potential effect of precursor, phase structure, morphology, particle size distribution and density of granules on crushing strength behaviour, scanning X-ray diffraction (XRD) was used together with electron microscopy (SEM) and laser diffraction (LDPA) for characterisation. All precursor mixtures formed spherical granules during the spray-drying process and pure spinel phase structure during heat treatment. The crushing strength test results indicated that the Al precursor clearly affected the crushing strength behaviour of experimental granule beds. The highest strength was observed for granule beds with Al(O)OH) as Al and Mg(OH)2 as Mg precursor.

General information

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Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland
Contributors: Kanerva, U., Suhonen, T., Lagerbom, J., Levänen, E.
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Issue number: 7
ISSN (Print): 0272-8842
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ASJC Scopus subject areas: Ceramics and Composites, Process Chemistry and Technology, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Materials Chemistry
Keywords: Axial pressing, Granule, MgAl<inf>2</inf>O<inf>4</inf> spinel, The crushing strength
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Bibliographical note

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Source: Scopus
Source ID: 84929271760

Sol-gel synthesis of quaternary (P2O5)55-(CaO)25-(Na2O)(20-x)-(TiO2) x bioresorbable glasses for bone tissue engineering applications (x = 0, 5, 10, or 15)

In the present study, we report a new and facile sol-gel synthesis of phosphate-based glasses with the general formula of (P2O5)55-(CaO)25-(Na2O)(20-x)-(TiO2) x , where x = 0, 5, 10 or 15, for bone tissue engineering applications. The sol-gel synthesis method allows greater control over glass morphology at relatively low processing temperature (200 °C) in comparison with phosphate-based melt-derived glasses (~1000 °C). The glasses were analyzed using several characterization techniques, including x-ray diffraction (XRD), (31)P magic angle spinning nuclear magnetic resonance ((31)P MAS-NMR), Fourier transform infrared (FTIR) spectroscopy and energy-dispersive x-ray (EDX) spectroscopy, which confirmed the amorphous and glassy nature of the prepared samples. Degradation was assessed by measuring the ion release and pH change of the storage medium. Cytocompatibility was also confirmed by culturing osteoblast-like osteosarcoma cell line MG-63 on the glass microparticles over a seven-day period. Cell attachment to the particles was imaged using scanning electron microscopy (SEM) and confocal laser scanning microscopy (CLSM). The results revealed the potential of phosphate-based sol-gel derived glasses containing 5 or 10 mol% TiO2, with high surface area, ideal dissolution rate for cell attachment and easily metabolized dissolution products, for bone tissue engineering applications.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), UCL Eastman Dental Institute
Contributors: Foroutan, F., Walters, N. J., Owens, G. J., Mordan, N. J., Kim, H. W., de Leeuw, N. H., Knowles, J. C.
Number of pages: 1
Pages: 45025
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Peer-reviewed: Yes

Publication information

Journal: Biomedical materials (Bristol, England)
Volume: 10
Issue number: 4
Ratings:

Scopus rating (2015): CiteScore 5.1 SJR 1.118 SNIP 1.118
Original language: English
ASJC Scopus subject areas: Bioengineering, Biomaterials, Biomedical Engineering
DOIs:

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Research output: Contribution to journal › Article › Scientific › peer-review

High quality sub-10 nm graphene nanoribbons by on-chip PS-b-PDMS block copolymer lithography

A block copolymer self-assembly holds great promise as a rapid, cheap and scalable approach to nanolithography. We present a straightforward method for fabrication of sub-10 nm line patterns from a lamellar polystyrene-b-polydimethylsiloxane (SD) block copolymer with a total average molecular weight of 10.5 kg mol^{-1}. Thin SD films directly spin cast onto silicon substrates and on graphene, form regular line patterns of sub-10 nm pitch on the substrates after a few minutes of annealing at 45 °C in the presence of toluene vapour. Perfect pattern alignment was achieved by confining the films inside the trenches of graphoepitaxial substrates. The SD template was furthermore used as a lithographic mask to fabricate high-quality sub-10 nm graphene nanoribbons. This was realized by one step oxygen plasma treatment, which accomplishes three tasks: hardening the PDMS block by oxidation, and etching both the PS block and the graphene under PS. Raman analysis supports the formation of graphene nanoribbons with an average distance between defects corresponding to the oxidized PDMS pitch, with no sign of defects generated in the ribbon channel. This suggests a high degree of protection of the nanoribbons by the hard oxidized PDMS mask formed in situ during oxygen plasma etching.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Department of Micro and Nanotechnology, Danmarks Tekniske Universitet, DTU Informatik, Center for Nanostructured Graphene, Trinity College Dublin
Contributors: Rasappa, S., Caridad, J. M., Schulte, L., Cagliani, A., Borah, D., Morris, M. A., Bøggild, P., Ndoni, S.
Number of pages: 7
Pages: 66711-66717
Publication date: 29 Jul 2015
Peer-reviewed: Yes

Publication information
Journal: RSC Advances
Volume: 5
Issue number: 82
ISSN (Print): 2046-2069
Ratings:

Scopus rating (2015): CiteScore 3.5 SJR 0.947 SNIP 0.838
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
DOIs:

10.1039/c5ra11735f
URLs:

http://www.scopus.com/inward/record.url?scp=84938940393&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84938940393
Research output: Contribution to journal › Article › Scientific › peer-review

Electricity production by a microbial fuel cell fueled by brewery wastewater and the factors in its membrane deterioration
Electricity production from brewery wastewater using dual-chamber microbial fuel cells (MFCs) with a tin-coated copper mesh in the anode was investigated by changing the hydraulic retention time (HRT). The MFCs were fed with wastewater samples from the inlet (inflow, MFC-1) and outlet (outflow, MFC-2) of an anaerobic digester of a brewery wastewater treatment plant. Both chemical oxygen demand removal and current density were improved by decreasing HRT. The best MFC performance was with an HRT of 0.5 d. The maximum power densities of 8.001 and 1.843 μW/cm² were obtained from reactors MFC-1 and MFC-2, respectively. Microbial diversity at different conditions was studied using PCR-DGGE profiling of 16S rRNA fragments of the microorganisms from the biofilm on the anode electrode. The MFC reactor had mainly Geobacter, Shewanella, and Clostridium species, and some bacteria were easily washed out at lower HRTs. The fouling characteristics of the MFC Nafion membrane and the resulting degradation of MFC performance were examined. The ion exchange capacity, conductivity, and diffusivity of the membrane decreased significantly after fouling. The morphology of the Nafion membrane and MFC degradation were studied using scanning electron microscopy and attenuated total reflection-Fourier transform infrared spectroscopy.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Portland State University, Department of Civil and Environmental Engineering, Yildiz Technical University
Contributors: Çetinkaya, A. Y., Köroğlu, E. O., Demir, N. M., Baysoy, D. Y., Özkaya, B., Çakmakçi, M.
Number of pages: 9
Pages: 1068-1076
Publication date: 20 Jul 2015
Peer-reviewed: Yes

Publication information
Journal: Chinese Journal of Catalysis
Volume: 36
Issue number: 7
ISSN (Print): 0253-9837
Ratings:

Scopus rating (2015): CiteScore 3.4 SJR 0.579 SNIP 0.805
Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all)
Keywords: Anaerobic processe, Biofilm, Microbial community, Microbial fuel cell, Wastewater treatment
DOIs:

10.1016/S1872-2067(15)60833-6
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Bibliographical note
EXT="Çakmakçi, Mehmet"
Source: Scopus
Source ID: 84934932934
Research output: Contribution to journal › Article › Scientific › peer-review

Lithography-free oxide patterns as templates for self-catalyzed growth of highly uniform GaAs nanowires on Si(111)

We report self-catalyzed growth of GaAs nanowires (NWs) on Si/SiO<inf>x</inf> patterns fabricated by a lithography-free method. The patterns are defined using droplet epitaxy of GaAs nanocrystals, spontaneous oxidation, and thermal annealing. We investigate the influence of the size and density of the nucleation sites on the NW growth process and show that this approach enables the fabrication of highly uniform GaAs NWs with controllable density. The pattern fabrication and NW growth process are studied and discussed in relation to the surface morphology and chemical properties of the Si/SiO<inf>x</inf> patterns. Furthermore, the optical quality of the NWs is investigated by photoluminescence experiments performed for GaAs-AlGaAs core-shell NWs.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Augmented Human Activities (AHA), Frontier Photonics, Department of Physics and Astronomy, University of Turku, University of Turku
Contributors: Hakkarainen, T. V., Schramm, A., Mäkelä, J., Laukkanen, P., Guina, M.
Publication date: 18 Jul 2015
Peer-reviewed: Yes

Publication information

Journal: Nanotechnology
Volume: 26
Issue number: 27
Article number: 275301
ISSN (Print): 0957-4484
Ratings:

Scopus rating (2015): CiteScore 6.6 SJR 1.257 SNIP 1.117
Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Electrical and Electronic Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all)
Keywords: droplet epitaxy, GaAs, nanowires, self-catalyzed
DOIs:

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Bibliographical note

EXT="Laukkanen, P."
Source: Scopus
Source ID: 84934916555
Research output: Contribution to journal › Article › Scientific › peer-review

Lipid production by eukaryotic microorganisms isolated from palm oil mill effluent

Microbial oil production combined with wastewater management is one option for a more sustainable future. Micrographs of microbial cultures enriched from palm oil mill effluent (POME) showed lipid inclusion in the eukaryotic cells, indicating the cells can accumulate lipids. However, enriching the culture did not increase the total lipids. Therefore, eukaryotic microorganisms were isolated from POME to investigate whether these microorganisms are potential lipid producers. Four strains were isolated, and their lipid synthesis capabilities were compared with known oleaginous yeasts in a synthetic oil-free medium. Two strains (identified as Galactomyces geotrichum and Graphium penicillioides) had the potential to accumulate lipid accumulation based on the increase in triacylglycerol content. G. penicillioides was the most promising strain for lipid production as this strain accumulated more lipids than the well-known oleaginous yeast Cryptococcus curvatus (29.1 ± 3.0. wt% vs. 20.2 ± 2.9. wt%). To our knowledge, oil synthesis and accumulation by G. penicillioides have not previously been reported.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), National Cheng Kung University, Center of Bioscience and Biotechnology, Research Center for Energy Technology and Strategy, Neste Oil Oyj
Contributors: Marjakangas, J. M., Lakaniemi, A. M., Koskinen, P. E. P., Chang, J. S., Puhakka, J. A.
Number of pages: 7
Pages: 48-54
Publication date: 5 Jul 2015
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Journal: Biochemical Engineering Journal
Volume: 99
ISSN (Print): 1369-703X
Ratings:

Scopus rating (2015): CiteScore 4.6 SJR 0.952 SNIP 1.075
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Biomedical Engineering, Environmental Engineering
Keywords: Filamentous fungi, Lipid accumulation, Microbial growth, Palm oil mill effluent, Physiology, Yeast
DOIs:

10.1016/j.bej.2015.03.006
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Bibliographical note
EXT="Koskinen, Perttu E. P."
Source: Scopus
Source ID: 84924943977
Research output: Contribution to journal › Article › Scientific › peer-review

The influence of SrO and CaO in silicate and phosphate bioactive glasses on human gingival fibroblasts
In this paper, we investigate the effect of substituting SrO for CaO in silicate and phosphate bioactive glasses on the human gingival fibroblast activity. In both materials the presence of SrO led to the formation of a CaP layer with partial Sr substitution for Ca. The layer at the surface of the silicate glass consisted of HAP whereas at the phosphate glasses it was close to the DCPD composition. In silicate glasses, SrO gave a faster initial dissolution and a thinner reaction layer probably allowing for a continuous ion release into the solution. In phosphate glasses, SrO decreased the dissolution process and gave a more strongly bonded reaction layer. Overall, the SrO-containing silicate glass led to a slight enhancement in the activity of the gingival fibroblasts cells when compared to the SrO-free reference glass, S53P4. The cell activity decreased up to 3 days of culturing for all phosphate glasses containing SrO. Whereas culturing together with the SrO-free phosphate glass led to complete cell death at 7 days. The glasses containing SrO showed rapid cell proliferation and growth between 7 and 14 days, reaching similar activity than glass S53P4. The addition of SrO in both silicate and phosphate glasses was assumed beneficial for proliferation and growth of human gingival fibroblasts due to Sr incorporation in the reaction layer at the glass surface and released in the cell culture medium.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, Integrated Technologies for Tissue Engineering Research (ITTE), Turun Yliopisto/Turun Biomateriaalikeskus, Åbo Akademi University, Process Chemistry Centre, University of Turku, Department of Prosthetic Dentistry, Clinic of Oral Diseases, Turku University Central Hospital
Contributors: Massera, J., Kokkari, A., Närhi, T., Hupa, L.
Publication date: 25 Jun 2015
Peer-reviewed: Yes

Publication information
Journal: Journal of Materials Science: Materials in Medicine
Volume: 26
Issue number: 6
Article number: 196
ISSN (Print): 0957-4530
Ratings:

Scopus rating (2015): CiteScore 4.8 SJR 0.786 SNIP 1.018
Original language: English
ASJC Scopus subject areas: Biophysics, Biomaterials, Bioengineering, Biomedical Engineering
DOIs:

10.1007/s10856-015-5528-x
Source: Scopus
Source ID: 84935013205
Research output: Contribution to journal › Article › Scientific › peer-review

Catalytic effect of Ca and K on CO2 gasification of spruce wood char
Gasification is one route to produce chemicals and liquid fuels from biomass. The gasification of the char is catalyzed by alkali and alkaline earth metals in the biomass. In this work the catalytic effect of calcium (Ca) and potassium (K) on CO_2 gasification of spruce wood was studied using a thermo gravimetric analyzer (TGA). The ash-forming elements were first

removed from the wood using an acid leaching method. Then, various concentrations of K and Ca were absorbed to the wood by ion-exchange to carboxylic and phenolic groups, impregnation of K_2CO_3 or physically mixing of CaC_2O_4. The prepared spruce samples were placed in a mesh holder and gasified in the TGA at 850°C in 100% CO_2. The results demonstrate that the gasification rate of the char increased linearly with an increase in the concentration of Ca or K. Crystalline CaC_2O_4 distributed only at the surface of the wood particles resulted in low catalytic activity. The catalytic activity of Ca was higher than K in the beginning of char gasification but the catalytic effect of Ca decreased earlier than the catalytic effect of potassium. Further, the char structure was investigated by SEM-EDX. The SEM analysis from interrupted gasification experiments showed the formation of $CaCO_3$ and K_2CO_3 layer on the char surface. By adding corresponding levels of Ca and K as the original spruce to the acid washed sample, a similar gasification reactivity was obtained at 850 °C.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Abo Akademi University, Åbo Akademi University, University of Jyväskylä, Process Chemistry Center, VTT Technical Research Centre of Finland
Contributors: Perander, M., DeMartini, N., Brink, A., Kramb, J., Karlström, O., Hemming, J., Moilanen, A., Konttinen, J., Hupa, M.
Number of pages: 9
Pages: 464-472
Publication date: 15 Jun 2015
Peer-reviewed: Yes

Publication information
Journal: Fuel
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ISSN (Print): 0016-2361
Ratings:
Scopus rating (2015): CiteScore 6.9 SJR 1.781 SNIP 2.111
Original language: English
ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry
Keywords: Biomass, Calcium, Char reactivity, CO, Gasification, Potassium
DOIs:
10.1016/j.fuel.2015.02.062
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http://www.scopus.com/inward/record.url?scp=84924100908&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
EXT="Kramb, J."
Source: Scopus
Source ID: 84924100908
Research output: Contribution to journal › Article › Scientific › peer-review

A facile route to synthesis of S-doped TiO_2 nanoparticles for photocatalytic activity

There is always a market for cost effective methods of pollution degradation and one of the best areas to keep costs down is through synthesis techniques. This paper provides a simple technique to synthesise porous TiO_2 nanoparticles with increased surface area through a scaffold template technique. Their photocatalytic activity is enhanced by incorporating sulphur as a dopant and were validated by analysing the degradation of malachite green (MG). The materials were doped at a molar ratio of 100:1 (Ti:S) and calcined at different temperatures to adjust the anatase/rutile content. Detailed characterisation of the materials was undertaken using XRD, BET, XPS, TEM and FTIR. The nanoparticles displayed a microporous structure and had an increased surface area of 115 $m^2 g^{-1}$ which was reduced by doping and temperature induced phase transformation. Photocatalytic testing showed that the doped materials calcined at 700 °C preformed the best in. It was observed that 20 mg l^{-1} of MG was decomposed in 30 min using a 40 W UV bulb at pH 9 and the results surpassed those achieved by the commercial catalyst P25 which was also tested for comparison.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Trinity College Dublin, University College Cork, Materials Chemistry and Analysis Group, Centre for Research on Adaptive Nanostructures and Nanodevices
Contributors: McManamon, C., O'Connell, J., Delaney, P., Rasappa, S., Holmes, J. D., Morris, M. A.
Pages: 51-57!
Publication date: 30 May 2015

Peer-reviewed: Yes

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Journal: Journal of Molecular Catalysis A: Chemical
Volume: 406
ISSN (Print): 1381-1169
Ratings:

Scopus rating (2015): CiteScore 6.1 SJR 1.052 SNIP 1.262
Original language: English
ASJC Scopus subject areas: Catalysis, Physical and Theoretical Chemistry, Process Chemistry and Technology
Keywords: Band gap, Photocatalysis, S-doped, TiO<inf>2</inf>
DOIs:

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URLs:

http://www.scopus.com/inward/record.url?scp=84930210395&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84930210395
Research output: Contribution to journal › Article › Scientific › peer-review

Biomimetic collagen I and IV double layer Langmuir-Schaefer films asmicroenvironment for human pluripotent stem cell derived retinal pigment epithelial cells
The environmental cues received by the cells from synthetic substrates invitro are very different from those they receive invivo. In this study, we applied the Langmuir-Schaefer (LS) deposition, a variant of Langmuir-Blodgett technique, to fabricate a biomimetic microenvironment mimicking the structure and organization of native Bruch's membrane for the production of the functional human embryonic stem cell derived retinal pigment epithelial (hESC-RPE) cells. Surface pressure-area isotherms were measured simultaneously with Brewster angle microscopy to investigate the self-assembly of human collagens type I and IV on air-subphase interface. Furthermore, the structure of the prepared collagen LS films was characterized with scanning electron microscopy, atomic force microscopy, surface plasmon resonance measurements and immunofluorescent staining. The integrity of hESC-RPE on double layer LS films was investigated by measuring transepithelial resistance and permeability of small molecular weight substance. Maturation and functionality of hESC-RPE cells on double layer collagen LS films was further assessed by RPE-specific gene and protein expression, growth factor secretion, and phagocytic activity. Here, we demonstrated that the prepared collagen LS films have layered structure with oriented fibers corresponding to architecture of the uppermost layers of Bruch's membrane and result in increased barrier properties and functionality of hESC-RPE cells as compared to the commonly used dip-coated controls.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Tampere University of Technology, BioMediTech, Frontier Photonics, Integrated Technologies for Tissue Engineering Research (ITTE), Aalto University, BioMediTech, Univ Tampere, University of Tampere, BioMediTech, BMT FM5, Centre for Drug Research, Faculty of Pharmacy, Helsinki University, Department of Forest Products Technology, School of Chemical Technology, Division of Biopharmaceutical Sciences
Contributors: Sorkio, A. E., Vuorimaa-Laukkanen, E. P., Hakola, H. M., Liang, H., Ujula, T. A., Valle-Delgado, J. J., Österberg, M., Yliperttula, M. L., Skottman, H.
Number of pages: 13
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Publication date: 1 May 2015
Peer-reviewed: Yes

Publication information
Journal: Biomaterials
Volume: 51
ISSN (Print): 0142-9612
Ratings:

Scopus rating (2015): CiteScore 16.2 SJR 3.404 SNIP 2.013
Original language: English
ASJC Scopus subject areas: Biomaterials, Bioengineering, Ceramics and Composites, Mechanics of Materials, Biophysics
Keywords: Biomimetic material, Collagen structure, Human embryonic stem cell, Langmuir Blodgett film, Retina, Retinal pigment epithelial cell
DOIs:

10.1016/j.biomaterials.2015.02.005
URLs:

http://www.scopus.com/inward/record.url?scp=84924859980&partnerID=8YFLogxK (Link to publication in Scopus)

Source: WOS
Source ID: 000351796700025
Research output: Contribution to journal › Article › Scientific › peer-review

Workplace performance of a loose-fitting powered air purifying respirator during nanoparticle synthesis

Nanoparticle (particles with diameter ≤100 nm) exposure is recognized as a potentially harmful size fraction for pulmonary particle exposure. During nanoparticle synthesis, the number concentrations in the process room may exceed 10 × 10⁶ cm^{−3}. During such conditions, it is essential that the occupants in the room wear highly reliable high-performance respirators to prevent inhalation exposure. Here we have studied the in-use program protection factor (PPF) of loose-fitting powered air purifying respirators, while workers were coating components with TiO<inf>2</inf> or Cu<inf>x</inf>O<inf>y</inf> nanoparticles under a hood using a liquid flame spray process. The PPF was measured using condensation particle counters, an electrical low pressure impactor, and diffusion chargers. The room particle concentrations varied from 4 × 10⁶ to 40 × 10⁶ cm^{−3}, and the count median aerodynamic diameter ranged from 32 to 180 nm. Concentrations inside the respirator varied from 0.7 to 7.2 cm^{−3}. However, on average, tidal breathing was assumed to increase the respirator concentration by 2.3 cm^{−3}. The derived PPF exceeded 1.1 × 10⁶, which is more than 40 × 10³ times the respirator assigned protection factor. We were unable to measure clear differences in the PPF of respirators with old and new filters, among two male and one female user, or assess most penetrating particle size. This study shows that the loose-fitting powered air purifying respirator provides very efficient protection against nanoparticle inhalation exposure if used properly.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research group: Aerosol Synthesis, National Research Centre for the Working Environment, Finnish Institute of Occupational Health, Helsinki University, TNO
Contributors: Koivisto, A. J., Aromaa, M., Koponen, I. K., Fransman, W., Jensen, K. A., Mäkelä, J. M., Hämeri, K. J.
Publication date: 9 Apr 2015
Peer-reviewed: Yes

Publication information

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Volume: 17
Issue number: 4
ISSN (Print): 1388-0764
Ratings:

Scopus rating (2015): CiteScore 3.8 SJR 0.568 SNIP 0.725
Original language: English
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Condensed Matter Physics, Modelling and Simulation, Chemistry(all), Materials Science(all), Bioengineering
Keywords: Aerosol, Air purifying respirator, Filtration, Occupational safety, Protection factor, Respirator performance
DOIs:

10.1007/s11051-015-2990-9
URLs:

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Bibliographical note

EXT="Koivisto, Antti J."
Source: Scopus
Source ID: 84927730047
Research output: Contribution to journal › Article › Scientific › peer-review

Multi-stable dynamics of the non-adiabatic repressilator

The assumption of the fast binding of transcription factors (TFs) to promoters is a typical point in studies of synthetic genetic circuits functioning in bacteria. Although the assumption is effective for simplifying the models, it becomes questionable in the light of in vivo measurements of the times TF spends searching for its cognate DNA sites. We investigated the dynamics of the full idealized model of the paradigmatic genetic oscillator, the repressilator, using deterministic mathematical modelling and stochastic simulations. We found (using experimentally approved parameter values) that decreases in the TF binding rate changes the type of transition between steady state and oscillation. As a result, this gives rise to the hysteresis region in the parameter space, where both the steady state and the oscillation coexist. We further show that the hysteresis is persistent over a considerable range of the parameter values, but the presence of the oscillations is limited by the low rate of TF dimer degradation. Finally, the stochastic simulation of the model confirms the hysteresis with switching between the two attractors, resulting in highly skewed period distributions. Moreover, intrinsic noise stipulates trains of large-amplitude modulations around the stable steady state outside the hysteresis region, which makes the period distributions bimodal.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Mathematics, Research group: MAT Inverse Problems, Mathematical modelling with wide societal impact (MathImpact), Department of Theoretical Physics, Lebedev Physical Institution
Contributors: Potapov, I., Zhurov, B., Volkov, E.
Publication date: 6 Mar 2015
Peer-reviewed: Yes

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Journal: Journal of the Royal Society. Interface
Volume: 12
Issue number: 104
Article number: 20141315
ISSN (Print): 1742-5689
Ratings:

Scopus rating (2015): CiteScore 7.5 SJR 1.823 SNIP 1.554
Original language: English
ASJC Scopus subject areas: Biophysics, Biotechnology, Bioengineering, Biomedical Engineering, Biomaterials, Biochemistry
Keywords: Adiabatic, Bimodality, Genetic oscillator, Hysteresis, Multi-stability
DOIs:

10.1098/rsif.2014.1315
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Source: Scopus
Source ID: 84923240824
Research output: Contribution to journal › Article › Scientific › peer-review

Fluidized-bed denitrification of mining water tolerates high nickel concentrations
This study revealed that fluidized-bed denitrifying cultures tolerated soluble Ni concentrations up to 500mg/L at 7-8 and 22°C. From 10 to 40mg/L of feed Ni, denitrification resulted in complete nitrate and nitrite removal. The concomitant reduction of 30mg/L of sulfate produced 10mg/L of sulfide that precipitated nickel, resulting in soluble effluent Ni below 22mg/L. At this stage, Dechloromonas species were the dominant denitrifying bacteria. From 60 to 500mg/L of feed Ni, nickel remained in solution due to the inhibition of sulfate reduction. At soluble 60mg/L of Ni, denitrification was partially inhibited prior to recover after 34days of enrichment by other Ni-tolerant species (including Delftia, Zoogloea and Azospira) that supported Dechloromonas. Subsequently, the FBR cultures completely removed nitrate even at 500mg/L of Ni. Visual Minteq speciation model predicted the formation of NiS, $NiCO_3$ and $Ni_3(PO_4)_2$, whilst only $Ni_3(PO_4)_2$ was detected by XRD.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), Université Paris-Est, Laboratoire Géomatériaux et Environnement (EA 4508), UPEM
Contributors: Zou, G., Papirio, S., van Hullebusch, E. D., Puhakka, J. A.
Number of pages: 7
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Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 179
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2015): CiteScore 9.2 SJR 2.243 SNIP 1.899
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Denitrification, Denitrifying communities, Fluidized-bed reactor, Nickel, X-ray diffraction
DOIs:

10.1016/j.biortech.2014.12.044
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Source: Scopus
Source ID: 84919934975
Research output: Contribution to journal › Article › Scientific › peer-review

Second-harmonic generation imaging of semiconductor nanowires with focused vector beams

We use second-harmonic generation (SHG) with focused vector beams to investigate individual vertically aligned GaAs nanowires. Our results provide direct evidence that SHG from oriented nanowires is mainly driven by the longitudinal field along the nanowire growth axis. Consequently, focused radial polarization provides a superior tool to characterize such nanowires compared to linear polarization, also allowing this possibility in the native growth environment. We model our experiments by describing the SHG process for zinc-blende structure and dipolar bulk nonlinearity.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research area: Optics, Research group: Nonlinear Optics, Tampere University of Technology, Frontier Photonics, Aalto University, Department of Micro- and Nanosciences, Aalto University, Department of Applied Physics and Nanomicroscopy Center
Contributors: Bautista, G., Mäkitalo, J., Chen, Y., Dhaka, V., Grasso, M., Karvonen, L., Jiang, H., Huttunen, M. J., Huhtio, T., Lipsanen, H., Kauranen, M.
Number of pages: 6
Pages: 1564-1569
Publication date: 6 Feb 2015
Peer-reviewed: Yes

Publication information

Journal: Nano Letters
Volume: 15
Issue number: 3
ISSN (Print): 1530-6984
Ratings:

Scopus rating (2015): CiteScore 22.9 SJR 8.359 SNIP 3.071
Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Bioengineering, Chemistry(all), Materials Science(all), Mechanical Engineering
Keywords: modeling, nonlinear imaging, radial polarization, Second-harmonic generation, semiconductor
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Bibliographical note

AUX=fys,"Grasso, Marco"
EXT="Dhaka, Veer"
EXT="Huttunen, Mikko J."
Source: Scopus
Source ID: 84924595561
Research output: Contribution to journal › Article › Scientific › peer-review

Second-Harmonic Generation from Metal Nanoparticles: Resonance Enhancement versus Particle Geometry

We demonstrate that optical second-harmonic generation (SHG) from arrays of noncentrosymmetric gold nanoparticles depends essentially on particle geometry. We prepare nanoparticles with different geometrical shapes (L and T) but similar wavelengths for the polarization-dependent plasmon resonances. In contrast to recent interpretations emphasizing resonances at the fundamental frequency, the T shape leads to stronger SHG when only one, instead of both, polarization component of the fundamental field is resonant. This is explained by the character of plasmon oscillations supported by the two shapes. Our numerical simulations for both linear and second-order responses display unprecedented agreement with measurements.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research area: Optics, Research group: Nonlinear Optics, Frontier Photonics, Institute of Photonics, Univ Eastern Finland, University of Eastern Finland, Sch Pharm
Contributors: Czaplicki, R., Mäkitalo, J., Siikanen, R., Husu, H., Lehtolahti, J., Kuittinen, M., Kauranen, M.

Number of pages: 5
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Peer-reviewed: Yes
Early online date: 18 Dec 2014

Publication information
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Volume: 15
Issue number: 1
ISSN (Print): 1530-6984
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Scopus rating (2015): CiteScore 22.9 SJR 8.359 SNIP 3.071
Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Bioengineering, Chemistry(all), Materials Science(all), Mechanical Engineering
Keywords: Metal nanoparticles, nonlinear optics, plasmonic resonances, second-harmonic generation
DOIs:

10.1021/nl503901e
Additional files:

Supplementary_info_to_Nano_Lett._15_(2015)_530-534_R.Czaplicki_open
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Source: WOS
Source ID: 000348086100083
Research output: Contribution to journal › Article › Scientific › peer-review

Oxidation half-reaction of aqueous nucleosides and nucleotides via photoelectron spectroscopy augmented by ab initio calculations

Oxidative damage to DNA and hole transport between nucleobases in oxidized DNA are important processes in lesion formation for which surprisingly poor thermodynamic data exist, the relative ease of oxidizing the four nucleobases being one such example. Theoretical simulations of radiation damage and charge transport in DNA depend on accurate values for vertical ionization energies (VIEs), reorganization energies, and standard reduction potentials. Liquid-jet photoelectron spectroscopy can be used to directly study the oxidation half-reaction. The VIEs of nucleic acid building blocks are measured in their native buffered aqueous environment. The experimental investigation of purine and pyrimidine nucleotides, nucleosides, pentose sugars, and inorganic phosphate demonstrates that photoelectron spectra of nucleotides arise as a spectral sum over their individual chemical components; that is, the electronic interactions between each component are effectively screened from one another by water. Electronic structure theory affords the assignment of the lowest energy photoelectron band in all investigated nucleosides and nucleotides to a single ionizing transition centered solely on the nucleobase. Thus, combining the measured VIEs with theoretically determined reorganization energies allows for the spectroscopic determination of the one-electron redox potentials that have been difficult to establish via electrochemistry.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Computational Science X (CompX), University of Southern California, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Max-Planck-Institut für Dynamik und Selbstorganisation, Department of Physical Chemistry, Helmholtz Center Berlin
Contributors: Schroeder, C. A., Pluharová, E., Seidel, R., Schroeder, W. P., Faubel, M., Slavíçek, P., Winter, B., Jungwirth, P., Bradforth, S. E.
Number of pages: 9
Pages: 201-209
Publication date: 14 Jan 2015
Peer-reviewed: Yes

Publication information
Journal: Journal of the American Chemical Society
Volume: 137
Issue number: 1
ISSN (Print): 0002-7863
Ratings:

Scopus rating (2015): CiteScore 22.4 SJR 6.775 SNIP 2.6
Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all), Biochemistry, Colloid and Surface Chemistry

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10.1021/ja508149e
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http://www.scopus.com/inward/record.url?scp=84921038760&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84921038760
Research output: Contribution to journal › Article › Scientific › peer-review

Perfluoro-1,1′-biphenyl and perfluoronaphthalene and their derivatives as π-acceptors for anions

Addition of anions to perfluorinated 1,1′-biphenyl 1 or naphthalene 2 results in a shift of the ^{19}F NMR signals. However, any specific interaction cannot be assigned to this effect. In order to study the interaction in more detail, the salt derivatives 3 and 4 were prepared and studied by single crystal X-ray diffraction revealing weak anion-π interactions in the solid state.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, University of Jyväskylä, Institut für Organische Chemie, RWTH Aachen
Contributors: Yi, H., Albrecht, M., Valkonen, A., Rissanen, K.
Number of pages: 4
Pages: 746-749
Publication date: 1 Jan 2015
Peer-reviewed: Yes

Publication information

Journal: New Journal of Chemistry
Volume: 39
Issue number: 1
ISSN (Print): 1144-0546
Ratings:
Scopus rating (2015): CiteScore 4 SJR 0.935 SNIP 0.825
Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis, Materials Chemistry
DOIs:
10.1039/c4nj01654h
URLs:
http://www.scopus.com/inward/record.url?scp=84919782132&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84919782132
Research output: Contribution to journal › Article › Scientific › peer-review

A comparison of five optical surface topography measurement methods

The results of optical surface topography measurement techniques have been questioned in the past because of possible measurement artifacts due to light penetration into the paper. We compared the topography measurement results from five optical techniques: laser profilometry, shape-from-focus, stripe projection, chromatic sensing, and photometric stereo. These techniques were tested on coated and uncoated papers with a PPS roughness range from 0.7 μm to 7.7 μm. We made the measurement results directly comparable by measuring exactly the same regions on the paper samples and registering the resulting topography maps. We then calculated the point-wise Pearson correlation between the maps at different wavelength bands to obtain quantitative values for the similarity of the measurement results at different structure sizes. The correspondences between the measured topography maps were also examined through multivariate linear regression and roughness indices evaluated at two different structure sizes. For rougher grades like office paper or sack paper, the topography measurements from the five measurement techniques showed corresponding results. For a moderately smooth lightweight coated (LWC) paper, the measured topographies agreed to some degree, and for smooth supercalendered (SC) and woodfree coated (WFC) papers, the agreement was poor. From the available data, it is impossible to tell which of the measurement techniques delivers the true surface topography of smooth papers.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Automation Science and Engineering, Field robotics for efficient work sites (FIRE), Graz University of Technology
Contributors: Mettänen, M., Hirn, U.
Number of pages: 12

Pages: 27-38
Publication date: 1 Jan 2015
Peer-reviewed: Yes

Publication information
Journal: TAPPI Journal
Volume: 14
Issue number: 1
ISSN (Print): 0734-1415
Ratings:

Scopus rating (2015): SJR 0.44 SNIP 0.718
Original language: English
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
Electronic versions:

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URLs:

http://urn.fi/URN:NBN:fi:tty-201701241070
URLs:

http://www.scopus.com/inward/record.url?scp=84923164333&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84923164333
Research output: Contribution to journal › Article › Scientific › peer-review

Chemolithotrophic denitrification in biofilm reactors
Chemolithotrophic denitrification is an inexpensive and advantageous process for nitrate removal and represents a promising alternative to classical denitrification with organics. Chemolithotrophic denitrifiers are microorganisms able to reduce nitrate and nitrite using inorganic compounds as source of energy. Ferrous iron, sulfur-reduced compounds (e.g. hydrogen sulfide, elemental sulfur and thiosulfate), hydrogen gas, pyrite and arsenite have been used as inorganic electron donors resulting in diverse outcomes. In the last 40years, a large number of engineered systems have been used to maintain chemolithotrophic denitrification and improve rate and efficiency of the process. Among them, biofilm reactors proved to be robust and high-performing technologies. Packed bed reactors are particularly suitable for the removal of low nitrate concentrations, since high retention times are required to complete denitrification. Fluidized bed and membrane biofilm reactors result in the highest denitrification rates (>20kg N-NO<inf>3</inf>⁻/m³d) when hydrogen gas and sulfur reduced compounds are used as electron donors. Hydrogen gas pressure and current intensity rule the performance of membrane biofilm and biofilm electrode reactors, respectively. Biofouling is the most common and detrimental issue in biofilm reactors. Bed fluidization and hydrogen supply limitation are convenient and effective solutions to mitigate biofouling.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Department of Civil and Mechanical Engineering, University of Cassino and Southern Lazio
Contributors: Di Capua, F., Papirio, S., Lens, P. N. L., Esposito, G.
Number of pages: 15
Pages: 643-657
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Peer-reviewed: Yes
Early online date: 15 Jun 2015

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Journal: Chemical Engineering Journal
Volume: 280
ISSN (Print): 1385-8947
Ratings:

Scopus rating (2015): CiteScore 8.6 SJR 1.676 SNIP 1.912
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Industrial and Manufacturing Engineering, Environmental Chemistry
Keywords: Biofilm, Biofilm electrode reactor, Chemolithotrophic denitrification, Fluidized bed reactor, Membrane biofilm reactor, Packed bed reactor
DOIs:

10.1016/j.cej.2015.05.131

Bibliographical note
AUX=keb,"Di Capua, Francesco"
EXT="Papirio, Stefano"
Source: Scopus
Source ID: 84932636341
Research output: Contribution to journal › Article › Scientific › peer-review

Characterisation of novel regenerated cellulosic, viscose, and cotton fibres and the dyeing properties of fabrics
There is a global demand for constant increase in the production of textile fibres. Currently, the market for cellulosic fibres is dominated by cotton and viscose fibres. However, new alternative cellulosic fibres are being sought to meet the growing demand. The dyeing properties of novel fibres aiming at the marketplace are among the properties that determine their applicability to textiles. Recently, a novel process for producing cellulosic fibres, the Biocelsol process, has been scaled up so that the spinning of yarn from Biocelsol fibres is now possible. In this study, the reactive dye Levafix CA Blue was applied to cellulosic fabrics made from viscose, cotton, and Biocelsol yarns. The crystalline structure and morphology of the fibres were studied by Fourier transform infrared spectroscopy and field-emission scanning electron microscopy. The crystalline structure and morphology of the Biocelsol fibres resembled those of viscose fibres, but, owing to higher water absorption, the Biocelsol fabric had a higher dye exhaustion. The colour yield of the Biocelsol fabric was 62% and 41% higher than that of cotton and viscose fabrics respectively, suggesting that less dye is needed to gain a shade in Biocelsol fabric than in viscose and cotton fabrics.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Fibre Materials, Research group: Materials Characterization, Engineering materials science and solutions (EMASS)
Contributors: Kamppuri, T., Vehviläinen, M., Puolakka, A., Honkanen, M., Vippola, M., Rissanen, M.
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Peer-reviewed: Yes

Publication information
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ISSN (Print): 1472-3581
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Scopus rating (2015): CiteScore 2.2 SJR 0.425 SNIP 0.97
Original language: English
ASJC Scopus subject areas: Chemistry (miscellaneous), Chemical Engineering(all), Materials Science (miscellaneous)
DOIs:

10.1111/cote.12163
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http://www.scopus.com/inward/record.url?scp=84941702129&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84941940416
Research output: Contribution to journal › Article › Scientific › peer-review

Water-responsive dual-coloured photonic polymer coatings based on cholesteric liquid crystals
This work describes a straightforward method to prepare patterned photonic coatings which alter their colour when exposed to water. Various kinds of dual-coloured patterns were made, which become visible or fade away when placed in water. These effects are reversible and can be repeated many times.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Laboratory of Functional Organic Materials and Devices, Eindhoven University of Technology
Contributors: Stumpel, J. E., Broer, D. J., Schenning, A. P. H. J.
Number of pages: 4
Pages: 94650-94653
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: RSC Advances
Volume: 5
Issue number: 115
ISSN (Print): 2046-2069
Ratings:

Scopus rating (2015): CiteScore 3.5 SJR 0.947 SNIP 0.838
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
DOIs:

10.1039/c5ra18017a
URLs:

http://www.scopus.com/inward/record.url?scp=84946926560&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84946926560
Research output: Contribution to journal › Article › Scientific › peer-review

Coulomb explosion during the early stages of the reaction of alkali metals with water
Alkali metals can react explosively with water and it is textbook knowledge that this vigorous behaviour results from heat release, steam formation and ignition of the hydrogen gas that is produced. Here we suggest that the initial process enabling the alkali metal explosion in water is, however, of a completely different nature. High-speed camera imaging of liquid drops of a sodium/potassium alloy in water reveals submillisecond formation of metal spikes that protrude from the surface of the drop. Molecular dynamics simulations demonstrate that on immersion in water there is an almost immediate release of electrons from the metal surface. The system thus quickly reaches the Rayleigh instability limit, which leads to a 'coulomb explosion' of the alkali metal drop. Consequently, a new metal surface in contact with water is formed, which explains why the reaction does not become self-quenched by its products, but can rather lead to explosive behaviour.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Computational Science X (CompX), Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Technische Universität Braunschweig
Contributors: Mason, P. E., Uhlig, F., Vaněk, V., Buttersack, T., Bauerecker, S., Jungwirth, P.
Number of pages: 5
Pages: 250-254
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Nature Chemistry
Volume: 7
Issue number: 3
ISSN (Print): 1755-4330
Ratings:

Scopus rating (2015): CiteScore 36 SJR 11.144 SNIP 4.588
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
DOIs:

10.1038/nchem.2161
URLs:

http://www.scopus.com/inward/record.url?scp=84923338638&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84923338638
Research output: Contribution to journal › Article › Scientific › peer-review

Multifunctional ultrasmall nanoplatforms for vascular-targeted interstitial photodynamic therapy of brain tumors guided by real-time MRI
Photodynamic therapy (PDT) for brain tumors appears to be complementary to conventional treatments. A number of studies show the major role of the vascular effect in the tumor eradication by PDT. For interstitial PDT (iPDT) of brain tumors guided by real-time imaging, multifunctional nanoparticles consisting of a surface-localized tumor vasculature targeting neuropilin-1 (NRP-1) peptide and encapsulated photosensitizer and magnetic resonance imaging (MRI) contrast agents, have been designed. Nanoplatforms confer photosensitivity to cells and demonstrate a molecular affinity to NRP-1. Intravenous injection into rats bearing intracranial glioma exhibited a dynamic contrast-enhanced MRI for angiogenic endothelial cells lining the neovessels mainly located in the peripheral tumor. By using MRI completed by NRP-1 protein

expression of the tumor and brain adjacent to tumor tissues, we checked the selectivity of the nanoparticles. This study represents the first in vivo proof of concept of closed-head iPDT guided by real-time MRI using targeted ultrasmall nanoplatforms.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Université de Lorraine, Lille University Hospital - CHRU, Marcilly-sur-Eure, CHU de Nancy, Claude Bernard-University
Contributors: Bechet, D., Auger, F., Couleaud, P., Marty, E., Ravasi, L., Durieux, N., Bonnet, C., Plénat, F., Frochot, C., Mordon, S., Tillement, O., Vanderesse, R., Lux, F., Perriat, P., Guillemin, F., Barberi-Heyob, M.
Number of pages: 14
Pages: 657-670
Publication date: 2015
Peer-reviewed: Yes

Publication information

Journal: NANOMEDICINE: NANOTECHNOLOGY BIOLOGY AND MEDICINE
Volume: 11
Issue number: 3
ISSN (Print): 1549-9634
Ratings:

Scopus rating (2015): CiteScore 11.4 SJR 1.857 SNIP 1.69
Original language: English
ASJC Scopus subject areas: Molecular Medicine, Bioengineering, Biomedical Engineering, Materials Science(all), Medicine (miscellaneous), Pharmaceutical Science, Medicine(all)
Keywords: Brain tumor, iPDT, Multifunctional nanoplatforms, Real-time MRI, Targeting
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http://www.scopus.com/inward/record.url?scp=84933510120&partnerID=8YFLogxK (Link to publication in Scopus)
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Source ID: 84933510120
Research output: Contribution to journal › Article › Scientific › peer-review

Efficient preparation of shuffled DNA libraries through recombination (Gateway) cloning

Efficient and robust subcloning is essential for the construction of high-diversity DNA libraries in the field of directed evolution. We have developed a more efficient method for the subcloning of DNAshuffled libraries by employing recombination cloning (Gateway). The Gateway cloning procedure was performed directly after the gene reassembly reaction, without additional purification and amplification steps, thus simplifying the conventional DNA shuffling protocols. Recombination-based cloning, directly from the heterologous reassembly reaction, conserved the high quality of the library and reduced the time required for the library construction. The described method is generally compatible for the construction of DNA-shuffled gene libraries.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Fimlab Laboratories Ltd, Next Biomed Technologies NBT Oy, Karolinska University Hospital, Tampere University Hospital
Contributors: Lehtonen, S. I., Taskinen, B., Ojala, E., Kukkurainen, S., Rahikainen, R., Riihimäki, T. A., Laitinen, O. H., Kulomaa, M. S., Hytönen, V. P.
Number of pages: 6
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Peer-reviewed: Yes

Publication information

Journal: Protein Engineering Design and Selection
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ISSN (Print): 1741-0126
Ratings:

Scopus rating (2015): CiteScore 4.9 SJR 1.301 SNIP 0.798
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Medicine(all), Biochemistry, Molecular Biology

Keywords: Directed evolution, DNA library, DNA shuffling, Phage display recombination cloning
DOIs:
10.1093/protein/gzu050
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http://www.scopus.com/inward/record.url?scp=84983121996&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84983121996
Research output: Contribution to journal › Article › Scientific › peer-review

Enqueˆte de la variabilit´ cycle-`-cycle du NO dans la combustion homog`ne

Cyclic variability of spark ignition engines is recognized as a scatter in the combustion parameter recordings during actual operation in steady state conditions. Combustion variability may occur due to fluctuations in both early flame kernel development and in turbulent flame propagation with an impact on fuel consumption and emissions. In this study, a detailed chemistry model for the prediction of NO formation in homogeneous engine conditions is presented. The Wiebe parameterization is used for the prediction of heat release; then the calculated thermodynamic data are fed into the chemistry model to predict NO evolution at each degree of crank angle. Experimental data obtained from literature studies were used to validate the mean NO levels calculated. Then the model was applied to predict the impact of cyclic variability on mean NO and the amplitude of its variation. The cyclic variability was simulated by introducing random perturbations, which followed a normal distribution, to the Wiebe function parameters. The results of this approach show that the model proposed better predicts mean NO formation than earlier methods. Also, it shows that to the non linear formation rate of NO with temperature, cycle-to-cycle variation leads to higher mean NO emission levels than what one would predict without taking cyclic variation into account.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Aristotle University of Thessaloniki, Laboratory of Applied Thermodynamics
Contributors: Karvountzis-Kontakiotis, A., Ntziachristos, L.
Number of pages: 13
Pages: 111-123
Publication date: 2015
Peer-reviewed: Yes

Publication information

Journal: OIL AND GAS SCIENCE AND TECHNOLOGY : REVUE DE L'INSTITUT FRANCAIS DU PETROLE
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Issue number: 1
ISSN (Print): 1294-4475
Ratings:
Scopus rating (2015): CiteScore 2.1 SJR 0.361 SNIP 0.733
Original language: French
ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology
DOIs:
10.2516/ogst/2013199
URLs:
http://www.scopus.com/inward/record.url?scp=84924341440&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84924341440
Research output: Contribution to journal › Article › Scientific › peer-review

Switchavidin: Reversible biotin-avidin-biotin bridges with high affinity and specificity

Switchavidin is a chicken avidin mutant displaying reversible binding to biotin, an improved binding affinity toward conjugated biotin, and low nonspecific binding due to reduced surface charge. These properties make switchavidin an optimal tool in biosensor applications for the reversible immobilization of biotinylated proteins on biotinylated sensor surfaces. Furthermore, switchavidin opens novel possibilities for patterning, purification, and labeling. (Graph Presented).

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Multi-scaled biodata analysis and modelling (MultiBAM), Fimlab Laboratories Ltd, Johannes Kepler University, Tampere University Hospital
Contributors: Taskinen, B., Zauner, D., Lehtonen, S. I., Koskinen, M., Thomson, C., Kähkönen, N., Kukkurainen, S., Määttä, J. A. E., Ihalainen, T. O., Kulomaa, M. S., Gruber, H. J., Hytönen, V. P.

Number of pages: 11
Pages: 2233-2243
Publication date: 17 Dec 2014
Peer-reviewed: Yes

Publication information
Journal: Bioconjugate Chemistry
Volume: 25
Issue number: 12
ISSN (Print): 1043-1802
Ratings:

Scopus rating (2014): CiteScore 8.7 SJR 1.711 SNIP 1.164
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Organic Chemistry, Pharmaceutical Science, Biomedical Engineering, Pharmacology, Medicine(all)
DOIs:

10.1021/bc500462w
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Source: Scopus
Source ID: 84918539954
Research output: Contribution to journal › Article › Scientific › peer-review

Time-resolved fluorescence methods (IUPAC technical report)
This IUPAC Technical Report describes and compares the currently applied methods for measuring and analyzing time-resolved fluorescence traces using phase-modulation fluorometry as well as pulse fluorometry (direct emission decay measurements, single-photon timing, streak camera measurements, fluorescence upconversion, and optical Kerr gating). The paper starts with a brief description of the basic principles for time and frequency domain fluorescence spectroscopy. The fundamental equations are given, and recommendations for adequate use are emphasized. The up-to-date, commonly employed excitation sources and photodetectors are described in detail. The analysis of time-resolved fluorescence data is discussed. Attention is paid to possible artifacts, and remedies are presented on how to avoid them or to account for them. Finally, fluorescence lifetime standards for the nanosecond and picosecond timescales are collected.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics, Ecole Normale Superieure de Cachan, Yamagata University, Hasselt University, Humboldt-Universität zu Berlin, CNRS, IRAMIS, LIDYL, Laboratoire Francis Perrin, KU Leuven
Contributors: Lemmetyinen, H., Tkachenko, N. V., Valeur, B., Hotta, J. I., Ameloot, M., Ernsting, N. P., Gustavsson, T., Boens, N.
Number of pages: 30
Pages: 1969-1998
Publication date: 1 Dec 2014
Peer-reviewed: Yes

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Volume: 86
Issue number: 12
ISSN (Print): 0033-4545
Ratings:

Scopus rating (2014): CiteScore 5.3 SJR 1.103 SNIP 1.347
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
Keywords: Fluorescence spectroscopy, Iupac analytical chemistry division, Iupac organic and biomolecular chemistry division, Iupac physical and biophysical chemistry division, Phase-modulation fluorometry, Pulse fluorometry, Time-resolved fluorescence
DOIs:

10.1515/pac-2013-0912
URLs:

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Source: Scopus
Source ID: 84928726054

Improved biomass and lipid production in a mixotrophic culture of Chlorella sp. KR-1 with addition of coal-fired flue-gas

Industrial CO_2-rich flue-gases, owing to their eco-toxicity, have yet to be practically exploited for microalgal biomass and lipid production. In this study, various autotrophic and mixotrophic culture modes for an oleaginous microalga, Chlorella sp. KR-1 were compared for the use in actual coal-fired flue-gas. Among the mixotrophic conditions tested, the fed-batch feedings of glucose and the supply of air in dark cycles showed the highest biomass (561mg/Ld) and fatty-acid methyl-ester (168mg/Ld) productivities. This growth condition also resulted in the maximal population of microalgae and the minimal population and types of KR-1-associated-bacterial species as confirmed by particle-volume-distribution and denaturing-gradient-gel-electrophoresis (DGGE) analyses. Furthermore, microalgal lipid produced was assessed, based on its fatty acid profile, to meet key biodiesel standards such as saponification, iodine, and cetane numbers.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Korea Institute of Energy Research, Gachon University
Contributors: Praveenkumar, R., Kim, B., Choi, E., Lee, K., Park, J. Y., Lee, J. S., Lee, Y. C., Oh, Y. K.
Number of pages: 6
Pages: 500-505
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Peer-reviewed: Yes

Publication information

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Volume: 171
ISSN (Print): 0960-8524
Ratings:

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Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal, Medicine(all)
Keywords: Chlorella sp., Coal-fired flue-gas, Fed-batch, Lipid, Mixotrophic culture
DOIs:

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URLs:

http://www.scopus.com/inward/record.url?scp=84908669116&partnerID=8YFLogxK (Link to publication in Scopus)
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Source ID: 84908669116
Research output: Contribution to journal › Article › Scientific › peer-review

Rapid, Brushless Self-assembly of a PS-b-PDMS Block Copolymer for Nanolithography

Block copolymers (BCP) are highly promising self-assembling precursors for scalable nanolithography. Very regular BCP nanopatterns can be used as on-chip etch masks. The first step in the processing of BCP thin films is usually the chemical modification of the substrate surface, typically by grafting of a brush layer that renders the surface energy neutral relative to the constituent blocks. We provide here a first study on rapid, low temperature self-assembly of PS-. b-PDMS (polystyrene-. block-polydimethylsiloxane) on silicon substrates without a brush layer. We show that it forms line and antidot patterns after short solvo-thermal annealing. Unlike previous reports on this system, low temperature and short annealing time provide self-assembly in homogeneous thin films covering large substrate areas. This on-chip mask was then used for pattern transfer to the underlying silicon substrate. SEM (scanning electron microscope) images reveal silicon nanowires relative to the PDMS patterns of the BCP mask.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Department of Micro and Nanotechnology, Danmarks Tekniske Universitet, DTU Informatik, Center for Nanostructured Graphene, Trinity College Dublin
Contributors: Rasappa, S., Schulte, L., Borah, D., Morris, M. A., Ndoni, S.
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ASJC Scopus subject areas: Biotechnology, Colloid and Surface Chemistry, Physical and Theoretical Chemistry, Materials Chemistry, Surfaces, Coatings and Films
Keywords: Aspect ratio, Brushless, Dry etching, Lines and antidots, Pattern transfer, PS-b-PDMS, Self-assembly, Silicon nanostructures, Soft mask template, Solvo-thermal annealing
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Source ID: 84919650698
Research output: Contribution to journal › Article › Scientific › peer-review

Mixotrophic cultivation of oleaginous Chlorella sp. KR-1 mediated by actual coal-fired flue gas for biodiesel production

Flue gases mainly consist of CO<inf>2</inf> that can be utilized to facilitate microalgal culture for bioenergy production. In the present study, to evaluate the feasibility of the utilization of flue gas from a coal-burning power plant, an indigenous and high-CO<inf>2</inf>-tolerant oleaginous microalga, Chlorella sp. KR-1, was cultivated under mixotrophic conditions, and the results were evaluated. When the culture was mediated by flue gas, highest biomass (0.8 g cells/L·d) and FAME (fatty acid methyl esters) productivity (121 mg/L·d) were achieved in the mixotrophic mode with 5 g/L glucose, 5 mM nitrate, and a flow rate of 0.2 vvm. By contrast, the photoautotrophic cultivation resulted in a lower biomass (0.45 g cells/L·d) and a lower FAME productivity (60.2 mg/L·d). In general, the fatty acid profiles of Chlorella sp. KR-1 revealed meaningful contents (>40 % of saturated and mono-unsaturated fatty acids) under the mixotrophic condition, which enables the obtainment of a better quality of biodiesel than is possible under the autotrophic condition. Conclusively then, it was established that a microalgal culture mediated by flue gas can be improved by adoption of mixotrophic cultivation systems.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Korea Institute of Energy Research, Pusan National University, Gachon University, Korea Basic Science Institute
Contributors: Praveenkumar, R., Kim, B., Choi, E., Lee, K., Cho, S., Hyun, J. S., Park, J. Y., Lee, Y. C., Lee, H. U., Lee, J. S., Oh, Y. K.
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ISSN (Print): 1615-7591
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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Medicine(all)
Keywords: Biodiesel, Chlorella sp. KR-1, Coal-fired flue gas, Mixotrophic culture
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Research output: Contribution to journal › Article › Scientific › peer-review

Molecular engineering of avidin and hydrophobin for functional self-assembling interfaces

Control over the functionality of interfaces through biomolecular engineering is a central tool for nanoscale technology as well as many current applications of biology. In this work we designed fusion proteins that combined the surface adhesion and interfacial activity of a hydrophobin-protein together with the high affinity biotin-binding capability of an avidin-protein. We found that an overall architecture that was based on a circularly permuted version of avidin, dual-chain avidin, and

hydrophobin gave a highly functional combination. The protein was produced in the filamentous fungus Trichoderma reesei and was efficiently purified using an aqueous two-phase partitioning procedure. The surface adhesive properties were widely different compared to wild-type avidin. Functional characterization showed that the protein assembled on hydrophobic surfaces as a thin layer even at very low concentrations and efficiently bound a biotinylated compound. The work shows how the challenge of creating a fusion protein with proteins that form multimers can be solved by structural design and how protein self-assembly can be used to efficiently functionalize interfaces.

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Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), VTT Technical Research Centre of Finland, Fimlab Laboratories Ltd, Tampere University Hospital, Aalto University
Contributors: Kurppa, K., Hytönen, V. P., Nakari-Setälä, T., Kulomaa, M. S., Linder, M. B.
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Keywords: Avidin, Biofunctional surface, Hydrophobin, Nanomaterial, Protein engineering
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Research output: Contribution to journal › Article › Scientific › peer-review

Bioprocessing of enhanced cellulase production from a mutant of Trichoderma asperellum RCK2011 and its application in hydrolysis of cellulose
A mutant strain of Trichoderma asperellum RCK2011 was developed through UV-irradiation for enhanced cellulase production and lower catabolite repression. The production of FPase, CMCase and β-glucosidase was optimized under solid state fermentation; up to 20 mM of glucose did not inhibit cellulase production. The mutant strain T. asperellum SR1-7 produced FPase (2.2 IU/gds), CMCase (13.2 IU/gds), and β-glucosidase (9.2 IU/gds) under optimized conditions, which is, 1.4, 1.3, 1.5-fold higher than the wild type. The wild as well as mutant strain produced the cellulases at pH range, 4.0-10.0. Saccharification of pretreated corn cob, wheat straw, and sugarcane bagasse by cellulase from mutant strain SR1-7 resulted in release of reducing sugar at the rate of 530.0 mg/g, 290.0 mg/g, and 335.0 mg/g of substrate, respectively; this is 1.6-fold higher than the wild type strain. © 2014 Published by Elsevier Ltd.

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Contributors: Raghuwanshi, S., Deswal, D., Karp, M., Kuhad, R. C.
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Source: researchoutputwizard
Source ID: 1327
Research output: Contribution to journal › Article › Scientific › peer-review

Light-fuelled transport of large dendrimers and proteins
This work presents a facile water-based supramolecular approach for light-induced surface patterning. The method is based upon azobenzene- functionalized high-molecular weight triazine dendrimers up to generation 9, demonstrating that even very large globular supramolecular complexes can be made to move in response to light. We also demonstrate light-fuelled macroscopic movements in native biomolecules, showing that complexes of apoferritin protein and azobenzene can effectively form light-induced surface patterns. Fundamentally, the results establish that thin films comprising both flexible and rigid globular particles of large diameter can be moved with light, whereas the presented material concepts offer new possibilities for the yet marginally explored biological applications of azobenzene surface patterning.

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Contributors: Koskela, J. E., Liljeström, V., Lim, J., Simanek, E. E., Ras, R. H. A., Priimagi, A., Kostiainen, M. A.
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Research output: Contribution to journal › Article › Scientific › peer-review

Assessment of metabolic flux distribution in the thermophilic hydrogen producer Caloramator celer as affected by external pH and hydrogen partial pressure
Background: Caloramator celer is a strict anaerobic, alkalitolerant, thermophilic bacterium capable of converting glucose to hydrogen (H_2), carbon dioxide, acetate, ethanol and formate by a mixed acid fermentation. Depending on the growth conditions C. celer can produce H_2 at high yields. For a biotechnological exploitation of this bacterium for H_2 production it is crucial to understand the factors that regulate carbon and electron fluxes and therefore the final distribution of metabolites to channel the metabolic flux towards the desired product.Results: Combining experimental results from batch fermentations with genome analysis, reconstruction of central carbon metabolism and metabolic flux analysis (MFA), this study shed light on glucose catabolism of the thermophilic alkalitolerant bacterium C. celer. Two innate factors pertaining to culture conditions have been identified to significantly affect the metabolic flux distribution: culture pH and partial pressures of H_2 (P_{H2}). Overall, at alkaline to neutral pH the rate of biomass synthesis was maximized, whereas at acidic pH the lower growth rate and the less efficient biomass formation are accompanied with more efficient energy recovery from the substrate indicating high cell maintenance possibly to sustain intracellular pH homeostasis. Higher H_2 yields were

associated with fermentation at acidic pH as a consequence of the lower synthesis of other reduced by-products such as formate and ethanol. In contrast, P_{H2} did not affect the growth of C. celer on glucose. At high P_{H2} the cellular redox state was balanced by rerouting the flow of carbon and electrons to ethanol and formate production allowing unaltered glycolytic flux and growth rate, but resulting in a decreased H_2 synthesis.Conclusion: C. celer possesses a flexible fermentative metabolism that allows redistribution of fluxes at key metabolic nodes to simultaneously control redox state and efficiently harvest energy from substrate even under unfavorable conditions (i.e. low pH and high P_{H2}). With the H_2 production in mind, acidic pH and low P_{H2} should be preferred for a high yield-oriented process, while a high productivity-oriented process can be achieved at alkaline pH and high P_{H2}.

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Tampere University of Technology, Urban circular bioeconomy (UrCirBio), Lunds Universitet / Lunds Tekniska Högskola, Lund Univ, Lund University, Department of Applied Microbiology
Contributors: Ciranna, A., Pawar, S. S., Santala, V., Karp, M., van Niel, E. W. J.
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Structure and barrier properties of human embryonic stem cell-derived retinal pigment epithelial cells are affected by extracellular matrix protein coating

Extracellular matrix (ECM) interactions play a vital role in cell morphology, migration, proliferation, and differentiation of cells. We investigated the role of ECM proteins on the structure and function of human embryonic stem cell-derived retinal pigment epithelial (hESC-RPE) cells during their differentiation and maturation from hESCs into RPE cells in adherent differentiation cultures on several human ECM proteins found in native human Bruch's membrane, namely, collagen I, collagen IV, laminin, fibronectin, and vitronectin, as well as on commercial substrates of xeno-free CELLstart™ and Matrigel™. Cell pigmentation, expression of RPE-specific proteins, fine structure, as well as the production of basal lamina by hESC-RPE on different protein coatings were evaluated after 140 days of differentiation. The integrity of hESC-RPE epithelium and barrier properties on different coatings were investigated by measuring transepithelial resistance. All coatings supported the differentiation of hESC-RPE cells as demonstrated by early onset of cell pigmentation and further maturation to RPE monolayers after enrichment. Mature RPE phenotype was verified by RPE-specific gene and protein expression, correct epithelial polarization, and phagocytic activity. Significant differences were found in the degree of RPE cell pigmentation and tightness of epithelial barrier between different coatings. Further, the thickness of self-assembled basal lamina and secretion of the key ECM proteins found in the basement membrane of the native RPE varied between hESC-RPE cultured on compared protein coatings. In conclusion, this study shows that the cell culture substrate has a major effect on the structure and basal lamina production during the differentiation and maturation of hESC-RPE potentially influencing the success of cell integrations and survival after cell transplantation.

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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), BioMediTech, Ita-Suomen yliopisto, Tampere University Hospital

Contributors: Sorkio, A., Hongisto, H., Kaarniranta, K., Uusitalo, H., Juuti-Uusitalo, K., Skottman, H.
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Research output: Contribution to journal › Article › Scientific › peer-review

A 3D Alzheimer's disease culture model and the induction of P21-activated kinase mediated sensing in iPSC derived neurons
The recent progress in stem cell techniques has broadened the horizon for invitro disease modeling. For desired invivo like phenotypes, not only correct cell type specification will be critical, the microenvironmental context will be essential to achieve relevant responses. We demonstrate how a three dimensional (3D) culture of stem cell derived neurons can induce invivo like responses related to Alzheimer's disease, not recapitulated with conventional 2D cultures. To acquire a neural population of cells we differentiated neurons from neuroepithelial stem cells, derived from induced pluripotent stem cells. p21-activated kinase mediated sensing of Aβ oligomers was only possible in the 3D environment. Further, the 3D phenotype showed clear effects on F-actin associated proteins, connected to the disease processes. We propose that the 3D invitro model has higher resemblance to the AD pathology than conventional 2D cultures and could be used in further studies of the disease.

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MoE publication type: A1 Journal article-refereed
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Contributors: Zhang, D., Pekkanen-Mattila, M., Shahsavani, M., Falk, A., Teixeira, A. I., Herland, A.
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ASJC Scopus subject areas: Biomaterials, Bioengineering, Ceramics and Composites, Mechanics of Materials, Biophysics
Keywords: 3D culture, Alzheimer's disease, IPSCs, Mechanotransduction, Neuron, Self-assembling peptide
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Large-area arrays of three-dimensional plasmonic subwavelength-sized structures from azopolymer surface-relief gratings

The field of plasmonics allows for confinement and control of light on the nanoscale. Due to potentially strong resonant interactions that light can have with metal nanoscale structures, metals are a good candidate to tailor interactions with light, e.g., periodic arrays of subwavelength metal structures can support extremely narrow resonances and show enhanced transmission. The field of plasmonics has evolved from using simple geometries to the desire to create complex nanostructures for improved control. The availability of fabrication techniques that provide for complex structures, however, is paired with the seemingly inevitable increase in complexity of fabrication techniques themselves. We present a facile and scalable method for the fabrication of periodic arrays of unique three-dimensional subwavelength-sized structures such as tapered holes and pyramidically shaped subwavelength-sized particles. The procedure consists of holographic inscription of a two-dimensional surface-relief grating in an azobenzene-containing polymer film, evaporative gold deposition and broad-beam ion milling of the relief structure. The method allows the fabrication of highly uniform arrays with tunable lattice parameters and dimensions over large sample areas. The optical response of the fabricated structures is determined experimentally and through simulation, which confirm the unique plasmonic response of the structures. While the proposed fabrication method has clear benefits for plasmonics, it could easily be applied also in other fields, for example by using other coating materials.

General information

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Organisations: Frontier Photonics, Delft University of Technology, COMP Centre of Excellence, Department of Applied Physics, Aalto University, Aalto University
Contributors: Moerland, R. J., Koskela, J. E., Kravchenko, A., Simberg, M., Van Der Vegte, S., Kaivola, M., Priimagi, A., Ras, R. H. A.
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Stearate Modified Zinc-Aluminum Layered Double Hydroxides and Acrylonitrile Butadiene Rubber Nanocomposites

The aim of this investigation is to highlight the potentials of layered double hydroxides (LDH) and to serve as a replacement for zinc oxide and stearic acid from the basic rubber formulation. This will eventually result in about a 10× significant reduction of Zn^{2+} ion concentration in the final compound. The unique advantage of stearate ion-modified LDH is the delivery of zinc ions to accelerate and stearate ions to activate the vulcanization process. Furthermore, it can also reinforce the rubber matrix by virtue of its layered structure as nanofiller.

General information

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Organisations: Engineering materials science and solutions (EMASS), Vodafone Department of Mobile Communications Systems, Leibniz-Institut für Polymerforschung Dresden E.V., Rubber Technology Centre, Indian Institute of Technology Kharagpur
Contributors: Eshwaran, S. B., Basu, D., Kutlu, B., Leuteritz, A., Wagenknecht, U., Stöckelhuber, K. W., Naskar, K., Das, A., Heinrich, G.
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Repeated use of stable magnetic flocculant for efficient harvest of oleaginous Chlorella sp.
In the present study, a simple magnetic-particle recycling strategy was developed for harvest of the oleaginous microalga Chlorella sp. KR-1. The method entails the flocculation of microalgal cells and bare-Fe_3O_4 magnetic particles (bMP) by electrostatic attraction and the subsequent recovery of the bMP from the harvested flocs by electrostatic repulsion below and above the isoelectric points (IEP), respectively. For 10 recycles, the bMP showed 94-99% and 90-97% harvest and recovery efficiencies, respectively. Furthermore, neither the use of bMP nor pH adjustment showed any adverse effect on the microalgal cell growth or the co-existing bacterial species, as confirmed from the subsequent medium-recycling test and denaturing gradient gel electrophoresis (DGGE) analysis.

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Organisations: Urban circular bioeconomy (UrCirBio), Korea Institute of Energy Research, Chungnam National University, KAIST
Contributors: Lee, K., Lee, S. Y., Praveenkumar, R., Kim, B., Seo, J. Y., Jeon, S. G., Na, J. G., Park, J. Y., Kim, D. M., Oh, Y. K.
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Keywords: Electrostatic interaction, Harvest, Magnetic particles, Medium recycling, Microalgae
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Research output: Contribution to journal › Article › Scientific › peer-review

Direct observation of the collapse of the delocalized excess electron in water
It is generally assumed that the hydrated electron occupies a quasi-spherical cavity surrounded by only a few water molecules in its equilibrated state. However, in the very moment of its generation, before water has had time to respond to the extra charge, it is expected to be significantly larger in size. According to a particle-in-a-box picture, the frequency of its absorption spectrum is a sensitive measure of the initial size of the electronic wavefunction. Here, using transient terahertz spectroscopy, we show that the excess electron initially absorbs in the far-infrared at a frequency for which accompanying ab initio molecular dynamics simulations estimate an initial delocalization length of ≈40 Å. The electron

subsequently shrinks due to solvation and thereby leaves the terahertz observation window very quickly, within ≈200 fs.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Computational Science X (CompX), University of Zurich, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic
Contributors: Savolainen, J., Uhlig, F., Ahmed, S., Hamm, P., Jungwirth, P.
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Research output: Contribution to journal › Article › Scientific › peer-review

Nickel-based HVOF coatings promoting high temperature corrosion resistance of biomass-fired power plant boilers
There are over 1000 biomass boilers in Europe, and the number is increasing due to actions for reducing greenhouse gas emissions. Biomass boilers often experience strong corrosion due to harmful elements in fuels. In biomass burning, detrimental components include especially chlorine, potassium and heavy metals, which can cause chlorine-induced active oxidation or hot corrosion by molten phases even at fairly low temperatures. In order to increase the corrosion resistance of heat exchanger components, either more alloyed steels or protective coatings should be applied. High velocity oxy-fuel (HVOF) sprayed coatings may provide corrosion protection for low alloy tube materials. Three nickel based thermal spray coatings (Ni-24Cr-16.5Mo, Ni-22Cr

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Contributors: Oksa, M., Auerkari, P., Salonen, J., Varis, T.
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Research output: Contribution to journal › Article › Scientific › peer-review

Effect of non-rubber components of NR on the carbon nanotube (CNT) localization in SBR/NR blends

Carbon nanotubes (CNTs) are mixed into SBR/NR and SBR/IR blends using a wet mixing process. The phase specific localization of CNTs in rubber blends is predicted theoretically using surface energy data of blend components and determined experimentally by means of the wetting concept. Almost all CNTs are found to be localized in the SBR matrix of SBR/IR blends due to the better affinity of CNTs to SBR than to IR. In contrast, a high CNT loading localized in the NR phase of SBR/NR blends results from the presence of phospholipids in NR. Electrical and mechanical properties of the rubber blends depend strongly on CNT localization. A lower CNT loading in SBR matrix of SBR/NR blends imparts a better wet grip and lower rolling resistance to tire tread compounds.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Martin-Luther-University Halle-Wittenberg, Styron Deutschland GmbH, Fraunhofer IWM, Leibniz-Institut für Polymerforschung Dresden E.V., Dau Mot University, Tribhuvan University, Vodafone Department of Mobile Communications Systems
Contributors: Le, H. H., Parsekar, M., Ilisch, S., Henning, S., Das, A., Stöckelhuber, K. W., Beiner, M., Ho, C. A., Adhikari, R., Wießner, S., Heinrich, G., Radusch, H. J.
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ASJC Scopus subject areas: Organic Chemistry, Materials Chemistry, Polymers and Plastics, Chemical Engineering(all)
Keywords: carbon nanotubes, filler localization, nanocomposites, rubber blends
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Research output: Contribution to journal › Article › Scientific › peer-review

Fabrication of 3-D nanodimensioned electric double layer capacitor structures using block copolymer templates

The need for materials for high energy storage has led to very significant research in supercapacitor systems. These can exhibit electrical double layer phenomena and capacitances up to hundreds of F/g. Here, we demonstrate a new supercapacitor fabrication methodology based around the microphase separation of PS-b-PMMA which has been used to prepare copper nanoelectrodes of dimension ~13 nm. These structures provide excellent capacitive performance with a maximum specific capacitance of ~836 F/g for a current density of 8.06 A/g at a discharge current as high as 75 mA. The excellent performance is due to a high surface area: volume ratio. We suggest that this highly novel, easily fabricated structure might have a number of important applications.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Materials Chemistry and Analysis Group, University College Cork, Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Trinity College Dublin, Tyndall National Institute at National University of Ireland, Cork
Contributors: Rasappa, S., Borah, D., Senthamaraikannan, R., Faulkner, C. C., Holmes, J. D., Morris, M. A.
Number of pages: 7
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Publication date: 2014
Peer-reviewed: Yes

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ISSN (Print): 1533-4880
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Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Biomedical Engineering, Materials Science(all), Condensed Matter Physics
Keywords: 3-D Nanostructure, Block Copolymer, Capacitance, Copper Nanowires, PS-b-PMMA, Supercapacitor
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Research output: Contribution to journal › Article › Scientific › peer-review

Magnetophoretic harvesting of oleaginous Chlorella sp. by using biocompatible chitosan/magnetic nanoparticle composites
The consumption of energy and resources such as water in the cultivation and harvesting steps should be minimized to reduce the overall cost of biodiesel production from microalgae. Here we present a biocompatible and rapid magnetophoretic harvesting process of oleaginous microalgae by using chitosan-Fe_3O_4 nanoparticle composites. Over 99% of microalgae was harvested by using the composites and the external magnetic field without changing the pH of culture medium so that it may be reused for microalgal culture without adverse effect on the cell growth. Depending on the working volume (20-500mL) and the strength of surface magnetic-field (3400-9200G), the process of harvesting microalgae took only 2-5min. The method presented here not only utilizes permanent magnets without additional energy for fast harvesting but also recycles the medium effectively for further cultivation of microalgae, looking ahead to a large scale economic microalgae-based biorefinement.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Korea Institute of Energy Research, Chungnam National University, Korea District Heating Corp.
Contributors: Lee, K., Lee, S. Y., Na, J. G., Jeon, S. G., Praveenkumar, R., Kim, D. M., Chang, W. S., Oh, Y. K.
Number of pages: 4
Pages: 575-578
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Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
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Scopus rating (2013): CiteScore 9 SJR 2.405 SNIP 2.464
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Chitosan, Harvesting, Magnetic nanoparticle, Medium recycling, Microalgae
DOIs:

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Source: Scopus
Source ID: 84886601332
Research output: Contribution to journal › Article › Scientific › peer-review

Reversible biofunctionalization of surfaces with a switchable mutant of avidin
Label-free biosensors detect binding of prey molecules (″ analytes″) to immobile bait molecules on the sensing surface. Numerous methods are available for immobilization of bait molecules. A convenient option is binding of biotinylated bait molecules to streptavidin-functionalized surfaces, or to biotinylated surfaces via biotin-avidin-biotin bridges. The goal of this study was to find a rapid method for reversible immobilization of biotinylated bait molecules on biotinylated sensor

chips. The task was to establish a biotin-avidin-biotin bridge which was easily cleaved when desired, yet perfectly stable under a wide range of measurement conditions. The problem was solved with the avidin mutant M96H which contains extra histidine residues at the subunit-subunit interfaces. This mutant was bound to a mixed self-assembled monolayer (SAM) containing biotin residues on 20% of the oligo(ethylene glycol)-terminated SAM components. Various biotinylated bait molecules were bound on top of the immobilized avidin mutant. The biotin-avidin-biotin bridge was stable at pH ≥3, and it was insensitive to sodium dodecyl sulfate (SDS) at neutral pH. Only the combination of citric acid (2.5%, pH 2) and SDS (0.25%) caused instantaneous cleavage of the biotin-avidin-biotin bridge. As a consequence, the biotinylated bait molecules could be immobilized and removed as often as desired, the only limit being the time span for reproducible chip function when kept in buffer (2-3 weeks at 25 C). As expected, the high isolectric pH (pI) of the avidin mutant caused nonspecific adsorption of proteins. This problem was solved by acetylation of avidin (to pI <5), or by optimization of SAM formation and passivation with biotin-BSA and BSA.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Johannes Kepler University, Fimlab Laboratories Ltd, University of Salzburg, University of Basel, University of South Bohemia, Goethe-University Frankfurt
Contributors: Pollheimer, P., Taskinen, B., Scherfler, A., Gusenkov, S., Creus, M., Wiesauer, P., Zauner, D., Schöfberger, W., Schwarzinger, C., Ebner, A., Tampé, R., Stutz, H., Hytönen, V. P., Gruber, H. J.
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Publication information

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Volume: 24
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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Organic Chemistry, Pharmaceutical Science, Biomedical Engineering, Pharmacology
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URLs:

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Source: Scopus
Source ID: 84886070072
Research output: Contribution to journal › Article › Scientific › peer-review

Mechanisms of acceleration and retardation of water dynamics by ions

There are fundamental and not yet fully resolved questions concerning the impact of solutes, ions in particular, on the structure and dynamics of water, which can be formulated as follows: Are the effects of ions local or long-ranged? Is the action of cations and anions on water cooperative or not? Here, we investigate how the reorientation and hydrogen-bond dynamics of water are affected by ions in dilute and concentrated aqueous salt solutions. By combining simulations and analytic modeling, we first show that ions have a short-ranged influence on the reorientation of individual water molecules and that depending on their interaction strength with water, they may accelerate or slow down water dynamics. A simple additive picture combining the effects of the cations and anions is found to provide a good description in dilute solutions. In concentrated solutions, we show that the average water reorientation time ceases to scale linearly with salt concentration due to overlapping hydration shells and structural rearrangements which reduce the translational displacements induced by hydrogen-bond switches and increase the solution viscosity. This effect is not ion-specific and explains why all concentrated salt solutions slow down water dynamics. Our picture, which is demonstrated to be robust vis-a-vis a change in the force-field, reconciles the seemingly contradictory experimental results obtained by ultrafast infrared and NMR spectroscopies, and suggests that there are no long-ranged cooperative ion effects on the dynamics of individual water molecules in dilute solutions.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Computational Science X (CompX), Columbia University in the City of New York, Lund University, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, UMR ENS-CNRS-UPMC 8640
Contributors: Stirnemann, G., Wernersson, E., Jungwirth, P., Laage, D.
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis, Biochemistry, Colloid and Surface Chemistry
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Source: Scopus
Source ID: 84882270662
Research output: Contribution to journal › Article › Scientific › peer-review

Development and characterization of poly(ε-caprolactone) hollow fiber membranes for vascular tissue engineering
The fabrication of tissue-engineered scaffolds for small-caliber blood vessels still remains a challenge. In the present work, we prepared poly(ε-caprolactone) (PCL) hollow fiber (HF) membranes, suitable for small-diameter blood vessel regeneration, by a phase separation spinning technique. The difficulty of processing PCL, a highly elastic material prone to suffer die swelling by extrusion, was overcome by tailoring the dope solution temperature and extrusion flow rate during the spinning procedure. The influence of the composition of the coagulation bath (water, ethanol, isopropanol) on the HF membrane physico-chemical properties (morphology, transport and mechanical properties) and cell attachment and proliferation was studied. The HF membranes fabricated using ethanol as coagulation bath had the most uniform morphology, good mechanical and transport properties and showed human adipose stem cell attachment and proliferation. Therefore, these fibers are promising scaffolds for small-caliber blood vessel regeneration.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), University of Cantabria, University of Twente
Contributors: Diban, N., Haimi, S., Bolhuis-Versteeg, L., Teixeira, S., Miettinen, S., Poot, A., Grijpma, D., Stamatialis, D.
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Volume: 438
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Original language: English
ASJC Scopus subject areas: Physical and Theoretical Chemistry, Materials Science(all), Biochemistry, Filtration and Separation
Keywords: Adipose stem cell, Hollow fiber, Phase-inversion, Poly(ε-caprolactone), Vascular regeneration
DOIs:

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Source: Scopus
Source ID: 84876440642
Research output: Contribution to journal › Article › Scientific › peer-review

Shape-dependent plasmonic response and directed self-assembly in a new semiconductor building block, indium-doped cadmium oxide (ICO)

The influence of particle shape on plasmonic response and local electric field strength is well-documented in metallic nanoparticles. Morphologies such as rods, plates, and octahedra are readily synthesized and exhibit drastically different extinction spectra than spherical particles. Despite this fact, the influence of composition and shape on the optical properties of plasmonic semiconductor nanocrystals, in which free electrons result from heavy doping, has not been well-studied. Here, we report the first observation of plasmonic resonance in indium-doped cadmium oxide (ICO) nanocrystals, which exhibit the highest quality factors reported for semiconductor nanocrystals. Furthermore, we are able to independently control the shape and free electron concentration in ICO nanocrystals, allowing for the influence of shape on the optical response of a plasmonic semiconductor to be conclusively demonstrated. The highly uniform particles may be self-assembled into ordered single component and binary nanocrystal superlattices, and in thin films, exhibit negative permittivity in the near infrared (NIR) region, validating their use as a new class of tunable low-loss plasmonic building blocks for 3-D optical metamaterials.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Pennsylvania, Purdue University, Department of Electrical and Systems Engineering
Contributors: Gordon, T. R., Paik, T., Klein, D. R., Naik, G. V., Caglayan, H., Boltasseva, A., Murray, C. B.
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Publication date: 12 Jun 2013
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Volume: 13
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ISSN (Print): 1530-6984
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Original language: English
ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: indium-doped cadmium oxide, metamaterials, nanocrystal superlattices, Plasmonics, shape effects, transparent conducting oxide
DOIs:
10.1021/nl4012003
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Bibliographical note
EXT="Caglayan, Humeyra"
Source: Scopus
Source ID: 84879097164
Research output: Contribution to journal › Article › Scientific › peer-review

Screening pretreatment methods to enhance thermophilic anaerobic digestion of pulp and paper mill wastewater treatment secondary sludge

The effect of hydrothermal (150°C for 10min and 70°C for 40min), enzymatic (Accelerase 1500, 0.07g/g volatile solids (VS)), ultrasound (45kHz for 30min) and chemical pretreatments (HNO_3 at pH3 and NaOH at pH12) alone or in combination on the chemical composition and methane yield of the pulp and paper mill secondary sludge was studied in batch assays at 55°C. In total, 12 different pretreatment combinations were compared. Chemical analyses showed that all pretreatments except for HNO_3 and ultrasound pretreatments improved the organic matter solubilization. Among the studied pretreatments, hydrothermal (150°C, 10min) pretreatment alone or in combination with enzymatic and/or ultrasound pretreatment had the highest impact on sludge solubilization and methane yield. The increase in methane yield was 31% (from 108ml/g $VS_{original}$ to 141ml/g$VS_{original}$). In addition, enzymatic pretreatment also improved the methane yields but only when combined with hydrothermal pretreatment at 150°C or ultrasound+hydrothermal pretreatment at 150°C. On the other hand, ultrasound pretreatment did not improve the methane yields while acid and alkaline pretreatments resulted in lower methane yields than control. Improved hydrolysis and higher methane production rates noticed in assays subjected to hydrothermal pretreatment alone or in combination with enzymes and/or ultrasound could make these treatments more attractive in reducing the retention times required during full-scale anaerobic digestion of pulp and paper mill wastewater sludges.

General information
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MoE publication type: A1 Journal article-refereed

Organisations: Tampere University of Technology, Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä
Contributors: Bayr, S., Kaparaju, P., Rintala, J.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Industrial and Manufacturing Engineering, Environmental Chemistry
Keywords: Anaerobic digestion, Methane yield, Pretreatment, Pulp and paper mill, Secondary sludge
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Research output: Contribution to journal › Article › Scientific › peer-review

Immobilized bioactive agents onto polyurethane surface with heparin and phosphorylcholine group
Heparin (HEP) and phosphorylcholine groups (PC) were grafted onto the polyurethane (PU) surface in order to improve biocompatibility and anticoagulant activity. After the surface grafting sites of PU were amplified with the primary amine groups of polyethylenimine (PEI), heparin was covalently linked onto the surface by the reaction between the amino group and the carboxyl group. PC groups were covalently immobilized on the PU-PEI surface through the reaction between the amino group and the aldehyde group of phosphorylcholine glyceraldehyde (PCGA). The surface density of primary amine groups was determined by a ninhydrin assay. The amino group density reached a maximum of 0.88 μmol/cm^2 upon incorporation of 10 wt% PEI. The amount of heparin covalently immobilized on the PU-PEI surface was determined by the toluidine blue method. The grafting chemistry resulted in the comparatively dense immobilization of HEP (2.6 μg/cm^2) and PC to the PU-PEI surfaces. The HEP and PC modified surfaces were characterized by water uptake (PU 0.15 mg/cm^2, PU-PEI 3.54 mg/cm^2, PU-HEP 2.04 mg/cm^2, PU-PC 2.38 mg/cm^2), water contact angle (PU 95.3, PU-PEI 34.0, PU-HEP 39.5, PU-PC 37.2), attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR), X-ray photoelectron spectroscopy (XPS), atomic force microscopy (AFM), and scanning electron microscope (SEM). The results demonstrated that the PUPEI surface was successfully grafted with HEP and PC. The hydrophilicity and hemocompatibility of these grafted surfaces were significantly improved. These results suggested that the PU-HEP and PU-PC composite films are promising candidates for blood contacting tissue engineering.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Tianjin University, Shihezi University, School of Chemical Engineering and Technology, Tianjin Chest Hospital
Contributors: Tan, M., Feng, Y., Wang, H., Zhang, L., Khan, M., Guo, J., Chen, Q., Liu, J.
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ASJC Scopus subject areas: Organic Chemistry, Materials Chemistry, Polymers and Plastics, Chemical Engineering(all)
Keywords: hemocompatibility, heparin, phosphorylcholine group, polyethylenimine, polyurethane
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Source: Scopus
Source ID: 84877763417
Research output: Contribution to journal › Article › Scientific › peer-review

The sensitivity of random polymer brush-lamellar polystyrene-b-polymethylmethacrylate block copolymer systems to process conditions

The use of random copolymer brushes (polystyrene- r-polymethylmethacrylate - PS- r-PMMA) to 'neutralise' substrate surfaces and ordain perpendicular orientation of the microphase separated lamellae in symmetric polystyrene- b-polymethylmethacrylate (PS- b-PMMA) block copolymers (BCPs) is well known. However, less well known is how the brushes interact with both the substrate and the BCP, and how this might change during thermal processing. A detailed study of changes in these films for different brush and diblock PS- b-PMMA molecular weights is reported here. In general, self-assembly and pattern formation is altered little, and a range of brush molecular weights are seen to be effective. However, on extended anneal times, the microphase separated films can undergo dimension changes and loss of order. This process is not related to any complex microphase separation dynamics but rather a degradation of methacrylate components in the film. The data suggest that care must be taken in interpretation of structural changes in these systems as being due to BCP only effects.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Tyndall National Institute at National University of Ireland, Cork, Materials Chemistry and Analysis Group, University College Cork, Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Trinity College Dublin, Leixlip Co.
Contributors: Borah, D., Rasappa, S., Senthamaraikannan, R., Shaw, M. T., Holmes, J. D., Morris, M. A.
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Issue number: 1
ISSN (Print): 0021-9797
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Original language: English
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Biomaterials, Surfaces, Coatings and Films, Colloid and Surface Chemistry
Keywords: Microphase separation, Polymer brush, Polystyrene-b-polymethylmethacrylate, Polystyrene-r-polymethylmethacrylate, Surface morphology
DOIs:

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Source: Scopus
Source ID: 84873060382
Research output: Contribution to journal › Article › Scientific › peer-review

Fabrication of a sub-10 nm silicon nanowire based ethanol sensor using block copolymer lithography

This paper details the fabrication of ultrathin silicon nanowires (SiNWs) on a silicon-on-insulator (SOI) substrate as an electrode for the electro-oxidation and sensing of ethanol. The nanowire surfaces were prepared by a block copolymer (BCP) nanolithographic technique using low molecular weight symmetric poly(styrene)-block-poly(methyl methacrylate) (PS-b-PMMA) to create a nanopattern which was transferred to the substrate using plasma etching. The BCP orientation was controlled using a hydroxyl-terminated random polymer brush of poly(styrene)-random-poly(methyl methacrylate) (HO-PS-r-PMMA). TEM cross-sections of the resultant SiNWs indicate an anisotropic etch process with nanowires of sub-10 nm feature size. The SiNWs obtained by etching show high crystallinity and there is no evidence of defect inclusion or amorphous region production as a result of the pattern transfer process. The high density of SiNWs at the substrate

surface allowed the fabrication of a sensor for cyclic voltammetric detection of ethanol. The sensor shows better sensitivity to ethanol and a faster response time compared to widely used polymer nanocomposite based sensors.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Frontier Photonics, Materials Chemistry and Analysis Group, University College Cork, Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Trinity College Dublin, Tyndall National Institute at National University of Ireland, Cork, Collinstown Industrial Estate
Contributors: Rasappa, S., Borah, D., Faulkner, C. C., Lutz, T., Shaw, M. T., Holmes, J. D., Morris, M. A.
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ASJC Scopus subject areas: Bioengineering, Chemistry(all), Electrical and Electronic Engineering, Mechanical Engineering, Mechanics of Materials, Materials Science(all)
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Source: Scopus
Source ID: 84872971946
Research output: Contribution to journal › Article › Scientific › peer-review

Chemically tailored dielectric-to-metal transition for the design of metamaterials from nanoimprinted colloidal nanocrystals

We demonstrate optical metamaterial design using colloidal gold nanocrystal building blocks. In the solid state, chemically exchanging the nanocrystals' surface-capping molecules provides a tailorable dielectric-to-metal transition exhibiting a 10^{10} range in DC conductivity and dielectric permittivity ranging from everywhere positive to everywhere negative throughout the visible-to-near-IR. Direct, wide-area nanoimprinting of subwavelength superstructures at room temperature, on plastic and glass substrates, affords plasmonic resonances ranging from 660 to 1070 nm, in agreement with numerical simulations.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Pennsylvania, Department of Electrical and Systems Engineering
Contributors: Fafarman, A. T., Hong, S. H., Caglayan, H., Ye, X., Diroll, B. T., Paik, T., Engheta, N., Murray, C. B., Kagan, C. R.
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Volume: 13
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ISSN (Print): 1530-6984
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Scopus rating (2013): CiteScore 22.6 SJR 9.081 SNIP 3.355
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ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Condensed Matter Physics, Mechanical Engineering
Keywords: ammonium thiocyanate, dielectric function, gold nanoparticles, ligand exchange, Plasmonics, soft lithography
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Source: Scopus
Source ID: 84873680258
Research output: Contribution to journal › Article › Scientific › peer-review

A potential nonthrombogenic small-diameter vascular scaffold with polyurethane/poly(ethylene glycol) hybrid materials by electrospinning technique

A small-diameter vascular graft (inner diameter 4 mm) was fabricated from polyurethane (PU) and poly(ethylene glycol) (PEG) solutions by electrospinning technology. The fiber diameter decreased from 1023±185 nm to 394±106 nm with increasing weight ratio of PEG in electrospinning solutions. The PU/PEG scaffolds showed randomly nanofibrous morphology and well-interconnected porous structure. The hydrophilicity of these scaffolds was improved significantly with increasing weight ratio of PEG. The mechanical properties of electrospun PU/PEG scaffolds were obviously different from that of pure PU scaffold, which was caused by plasticizing or hardening effect imparted by PEG composition. Under hydrated state, the PU/PEG scaffolds demonstrated low mechanical performance due to the hydrophilic property of materials. Compared with dry PU/PEG scaffolds with the same weight ratio of PEG, the tensile strength and elastic modulus of hydrated PU/PEG scaffolds decreased significantly, while the elongation at break increased. The results demonstrated that the electrospun PU/PEG hybrid tubular scaffolds are potential candidates for artificial blood vessels.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Tianjin University, School of Chemical Engineering and Technology
Contributors: Wang, H., Feng, Y., Zhao, H., Fang, Z., Khan, M., Guo, J.
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ASJC Scopus subject areas: Condensed Matter Physics, Chemistry(all), Materials Science(all), Bioengineering, Biomedical Engineering
Keywords: Electrospinning, Nanofiber, Poly(ethylene glycol), Polyurethane, Vascular scaffold
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Source ID: 84876246258
Research output: Contribution to journal › Article › Scientific › peer-review

A 'clusters-in-liquid' method for calculating infrared spectra identifies the proton-transfer mode in acidic aqueous solutions

In liquid water the transfer of an excess proton between two water molecules occurs through the Zundel cation, H 2 O···H + ···OH 2. The proton-transfer mode is the asymmetric stretch of the central O···H + ···O moiety, but there is no consensus on its identification in the infrared spectra of acidic aqueous solutions. Also, in experiments with protonated gas-phase water clusters, its position shifts with cluster size, which makes its relationship with solution spectra unclear. Here we introduce a 'clusters-in-liquid' approach for calculating the infrared spectrum from any set of charges, even single protons. We apply this procedure to multistate empirical valence-bond trajectories of protonated liquid water and to ab initio molecular dynamics of the protonated water dimer and hexamer in the gas phase. The calculated proton-transfer mode is manifested in both systems as a peak near 1,740% cm -1, in quantitative agreement with a band of similar frequency in the experimental infrared spectrum of protonated water clusters.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Computational Science X (CompX), Tallinn Technical University, Institute of Chemistry, Hebrew University of Jerusalem
Contributors: Kulig, W., Agmon, N.
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ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
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Source: Scopus
Source ID: 84871565081
Research output: Contribution to journal › Article › Scientific › peer-review

New reports on anti-bacterial and anti-candidal activities of fatty acid methyl esters (FAME) obtained from Scenedesmus bijugatus var. bicellularis biomass
The present study evaluates the efficiency of fatty acid methyl esters (FAMEs) obtained from microalgal (Scenedesmus bijugatus var bicellularis) biomass as an antimicrobial agent against Staphylococcus aureus, Escherichia coli and Candida albicans. The FAME profiles were determined through Gas Chromatography (GC) with a Flame Ionization detector (FID). The FAMEs showed inhibitory activity against all three microorganisms and thereby exhibited both anti-bacterial and anti-candidal activity. GC-FID analysis reveals about 30 different FAMEs. Out of these, various pharmacologically active FAMEs like stearic acid methyl ester (C18:0) (0.6% w/w), oleic acid methyl ester (C18:1) (1% w/w), linoleic acid methyl ester (C18:2) (1.40% w/w), linolenic acid methyl ester (C18:3) (6.26%), eicosapentanoic acid methyl ester (C20:5) (1.13% w/w), erucic acid methyl ester (C22:1) (1.03% w/w) and docosahexenoic acid methyl ester (C22:6) (2.27% w/w) were detected, which accounted for the bioactivity. These results clearly indicate that the FAMEs of S. bijugatus var. bicellularis have strong antimicrobial properties and could thus be used as an effective source against microbial diseases.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Bharathidasan University, King Saud University College of Science
Contributors: Mubarakali, D., Praveenkumar, R., Shenbagavalli, T., Mari Nivetha, T., Parveez Ahamed, A., Al-Dhabi, N. A. , Thajuddin, N.
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Publication information
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
DOIs:

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Source: Scopus
Source ID: 84868128339
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Influence of ionic liquids on the dielectric relaxation behavior of CNT based elastomer nanocomposites

The influence of an imidazolium type ionic liquid (IL) on the relaxation behavior of carbon-nanotube (CNT) based polychloroprene nanocomposites prepared by melt mixing has been investigated by broadband dielectric spectroscopy. It is demonstrated that the presence of the ionic liquid modifies the relaxation behavior of the pure rubber matrix and leads to a significant increase of the conductivity for the CNT/rubber composites. For the unfilled rubber, a distinct glass transition of the IL is observed for high concentrations demonstrating that the IL forms a separate phase. The increased conductivity of the CNT-filled rubber composites is related to a physical coupling between CNTs and rubber matrix mediated by IL leading to a better dispersion of the CNTs.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Deutsches Institut für Kautschuktechnologie e.V., Leibniz-Institut für Polymerforschung Dresden E.V., Technische Universität Dresden, Vodafone Department of Mobile Communications Systems
Contributors: Steinhauser, D., Subramaniam, K., Das, A., Heinrich, G., Klüppel, M.
Number of pages: 10
Pages: 927-936
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ISSN (Print): 1788-618X
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Scopus rating (2012): CiteScore 3.2 SJR 0.915 SNIP 1.605
Original language: English
ASJC Scopus subject areas: Polymers and Plastics, Materials Chemistry, Chemical Engineering(all), Organic Chemistry, Physical and Theoretical Chemistry
Keywords: Dielectric spectroscopy, Ionic liquid, Nanocomposites, Relaxation dynamics, Rubber
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10.3144/expresspolymlett.2012.98
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Research output: Contribution to journal › Article › Scientific › peer-review

Fabrication of ssDNA/oligo(ethylene glycol) monolayers and complex nanostructures by an irradiation-promoted exchange reaction

Creative design: An approach to preparing mixed monolayers of thiolated single-stranded DNA (ssDNA) and oligo(ethylene glycol)s (OEG-AT) in a broad range of compositions as well as ssDNA/OEG-AT patterns of any required shape (see top figure) has been shown. A combination of this approach with surface-initiated enzymatic polymerization allows complex 3D DNA nanostructures to be sculpted with high spatial precision (bottom).

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Universitat Heidelberg, Duke University
Contributors: Khan, M. N., Tjong, V., Chilkoti, A., Zharnikov, M.
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Scopus rating (2012): CiteScore 16.5 SJR 6.407 SNIP 2.329
Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis
Keywords: chemical lithography, DNA structures, monolayers, nanostructures, polymer brushes
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Source: Scopus
Source ID: 84867091572
Research output: Contribution to journal › Article › Scientific › peer-review

Biomimetic surface modification of polycarbonateurethane film via phosphorylcholine-graft for resisting platelet adhesion
Phosphorylcholine groups were covalently introduced onto a polycarbonateurethane (PCU) surface in order to create a biomimetic structure on the polymer surfaces. After introducing primary amine groups onto the polymer surface by 1,6-hexanediamine, phosphorylcholine groups were covalently linked onto the surface by the reductive amination between the amino group and the aldehyde group of phosphorylcholine glyceraldehyde (PCGA). The results of water contact angle test, X-ray photoelectron spectroscopy (XPS), and X-ray fluorescence spectrometer (XRF) analysis of the modified films indicated that PCGA had already been covalently linked to the PCU surface. The topographies and surface roughnesses were both imaged and measured by atomic force microscopy (AFM). Scanning electron microscopy (SEM) observation of the PCU films after treatment with platelet-rich plasma demonstrated that platelets had rarely adhered to the surface of the PCGA-grafted PCU films but had mainly adhered to the surface of the blank PCU films. The platelet adhesion result indicated that the PC modified PCU films could resist platelet adhesion after grafting with PCGA, and that these PCGA-grafted PCU materials, potentially, might be applied as blood-contacting materials.

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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Tianjin University, School of Chemical Engineering and Technology
Contributors: Gao, W., Feng, Y., Lu, J., Khan, M., Guo, J.
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Volume: 20
Issue number: 10
ISSN (Print): 1598-5032
Ratings:

Scopus rating (2012): CiteScore 2.2 SJR 0.569 SNIP 0.801
Original language: English
ASJC Scopus subject areas: Organic Chemistry, Materials Chemistry, Polymers and Plastics, Chemical Engineering(all)
Keywords: Biomimetic, Phosphorylcholine glyceraldehydes, Platelet adhesion, Polycarbonateurethane, Surface modification
DOIs:

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Source: Scopus
Source ID: 84867230066
Research output: Contribution to journal › Article › Scientific › peer-review

Impact of biodiesel application at various blending ratios on passenger cars of different fueling technologies
The effect of biodiesel on emissions of diesel passenger cars is a combination of the fuel properties, the blending ratio, and the vehicle technology. In this study, saturated and unsaturated biodiesel fuels were tested neat (B100) and in 30% blend with fossil diesel (B30) on two Euro 3 diesel passenger cars of different engine technologies, namely common rail and unit injector. The measured dataset is enlarged by introducing B10 results from an earlier study [15] in order to produce generalized conclusions over a wider range of blends. None of these vehicles was equipped with a particle filter and different conclusions might be reached for filter-equipped vehicles. The results indicate that the influence of biodiesel on pollutant emissions primarily depends on the blending ratio and secondly on the level of unsaturation and engine technology. Tailpipe CO_2, NO_x and PM emissions with biodiesel varied from -1% to +3%, -1% to 14%, and -18% to -

35%, respectively, compared to fossil diesel. The difference over fossil diesel generally increased with an increasing blending ratio. CO and HC emissions increased over the fossil diesel but remained at low levels and did not threaten the compliance of the vehicles with their respective emission limits. Use of biodiesel on the common rail vehicle led to a smaller NO_x increase and a higher PM reduction than in the unit-injector case. The unsaturated fuel generally led to higher NO_x emissions from both engine technologies. However, the maximum blending ratio of saturated biodiesel is limited to around B30 due to cold-flow limitations. Hence, the saturated vs. unsaturated species ratio should be carefully designed in market fuels in order to optimize environmental and operational benefits. Overall, it appears that blends up to 10% v/v may be introduced with limited urban air quality implications.

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MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Aristotle University of Thessaloniki, Laboratory of Applied Thermodynamics, European Commission-JRC
Contributors: Kousoulidou, M., Ntziachristos, L., Fontaras, G., Martini, G., Dilara, P., Samaras, Z.
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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry
Keywords: Biodiesel, Fuel injection technology, Unsaturation level, Vehicle emissions
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Source: Scopus
Source ID: 84861986728
Research output: Contribution to journal › Article › Scientific › peer-review

Molecular mechanisms of ion-specific effects on proteins
The specific binding sites of Hofmeister ions with an uncharged 600-residue elastin-like polypeptide, $(VPGVG)_{120}$, were elucidated using a combination of NMR and thermodynamic measurements along with molecular dynamics simulations. It was found that the large soft anions such as SCN^- and I^- interact with the polypeptide backbone via a hybrid binding site that consists of the amide nitrogen and the adjacent α-carbon. The hydrocarbon groups at these sites bear a slight positive charge, which enhances anion binding without disrupting specific hydrogen bonds to water molecules. The hydrophobic side chains do not contribute significantly to anion binding or the corresponding salting-in behavior of the biopolymer. Cl^- binds far more weakly to the amide nitrogen/α-carbon binding site, while SO_4^{2-} is repelled from both the backbone and hydrophobic side chains of the polypeptide. The Na^+ counterions are also repelled from the polypeptide. The identification of these molecular-level binding sites provides new insights into the mechanism of peptide-anion interactions.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Computational Science X (CompX), Texas A and M University, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic
Contributors: Rembert, K. B., Paterová, J., Heyda, J., Hilty, C., Jungwirth, P., Cremer, P. S.
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis, Biochemistry, Colloid and Surface Chemistry
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Source: Scopus
Source ID: 84862532625
Research output: Contribution to journal › Article › Scientific › peer-review

Structural characteristics and flammability of fire retarding EPDM/layered double hydroxide (LDH) nanocomposites

A high performance elastomeric flame retardant nanocomposite was prepared which was based on maleic anhydride grafted ethylene-propylene-diene terpolymer (mEPDM), a one-step synthesised organo-layered double hydroxide (LDH), and an intumescent flame retardant (FR) comprised of pentaerythritol (PER), ammonium polyphosphate (APP) and methyl cyanoacetate (MCA). The morphology, fire behavior and mechanical properties of the flame-retarded mEPDM/LDH nanocomposite have been studied in detail. Wide angle X-ray scattering (WAXS), small angle X-ray scattering (SAXS) and TEM observation confirmed an exfoliated structure of LDH in a particular composite containing 2 phr (parts per hundred) LDH and 38 phr FR. As an effective flame retardant synergistic agent, MgAl-LDH shows a significant decrease in the heat release rate (HRR), low mass loss (ML) and low fire growth rate (FIGRA) of the nanocomposite. The flame retardant mechanism has been proposed, which is mainly due to the condensed phase flame retardant mechanism to form reinforced char layers during combustion, leading to the low volatiles produced. Moreover, as far as the mechanical properties of the vulcanizates are concerned, in all cases of flame retardant mEPDM and flame retarded mEPDM/LDH nanocomposites, they exhibit superior values compared to the gum compound.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Leibniz-Institut für Polymerforschung Dresden E.V. , Vodafone Department of Mobile Communications Systems
Contributors: Wang, D. Y., Das, A., Leuteritz, A., Mahaling, R. N., Jehnichen, D., Wagenknecht, U., Heinrich, G.
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Publication information

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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
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Source: Scopus
Source ID: 84863098130
Research output: Contribution to journal › Article › Scientific › peer-review

Demonstration of increased lipid accumulation potential of stigeoclonium sp., Kütz. BUM11007 under nitrogen starved regime: A new source of lipids for biodiesel production

The fresh water microalga Stigeoclonium sp., Kütz. BUM11007 was investigated for their property to be a suitable candidate for biodiesel production. The growth, lipid content and fatty acid profiles of the organism were determined under both normal and nitrogen free conditions with Chu 10 medium. A maximum biomass concentration 2.84±0.11 g/l with lipid content 138.21±9.82 mg/g and lipid productivity 15.07±0.67 mg/l·d was obtained under nutrient sufficient condition. In contrast to which under nitrogen depleted regimes in a two phase culturing system, biomass yield 2.798±0.18 g/l with increased lipid content 407.18 ± 11.6 mg/g at lipid productivity 43.68 ± 1.82 mg/l · d were recorded. The fatty acid methyl ester profiles revealed the presence of 16:0 (palmitic), 18:0 (stearic), 18:1 (oleic) and 18:2 (linoleic) methyl esters as the

major components. The results show the ability of the algae to be a promising feedstock source for biodiesel production.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Bharathidasan University, Fisk University
Contributors: Praveenkumar, R., Johncy, K., MubarakAli, D., Vijayan, D., Thajuddin, N., Gunasekaran, M.
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Publication information
Journal: Journal of Biobased Materials and Bioenergy
Volume: 6
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Ratings:

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ASJC Scopus subject areas: Biomaterials, Bioengineering, Renewable Energy, Sustainability and the Environment
Keywords: Biodiesel, FAME Production, Lipid Extraction, Nitrogen Starvation, Stigeoclonium
DOIs:

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Source: Scopus
Source ID: 84865034973
Research output: Contribution to journal › Article › Scientific › peer-review

Highly exfoliated natural rubber/Clay composites by "propping-open procedure": The influence of fatty-acid chain length on exfoliation
A high degree of exfoliation of MMT in NR is achieved by using the so-called "propping-open approach" in which a stepwise expansion of the interlayer spacing of MMT takes place. The nanostructure is characterized by WAXD and TEM which indicate different extents of clay dispersion depending on the fatty-acid chain length. Curing kinetics of different nanocomposites is studied and interestingly low activation energies of the vulcanization process are observed in the case of NR/EMMT nanocomposites. The incorporation of EMMT dramatically affects composite properties whereas DMA indicates significant reduction of tan δ peak height and the tensile strength approximately doubles from 14 to 30 MPa with only 5 phr EMMT.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Leibniz-Institut für Polymerforschung Dresden E.V. , Vodafone Department of Mobile Communications Systems
Contributors: Rooj, S., Das, A., Stöckelhuber, K. W., Reuter, U., Heinrich, G.
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Journal: Macromolecular Materials and Engineering
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Issue number: 4
ISSN (Print): 1438-7492
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Scopus rating (2012): CiteScore 3.7 SJR 0.963 SNIP 1.187
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Organic Chemistry, Polymers and Plastics, Materials Chemistry
Keywords: curing kinetics, exfoliation, Mooney-Rivlin equation, nanocomposites, propping-open approach
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Human adipose tissue extract induces angiogenesis and adipogenesis in vitro

The induction of adequate vascularization, a major challenge in tissue engineering, has been tried with numerous methods but with unsatisfactory results. Adipose tissue, an active endocrine organ with dense vasculature, secretes a wide number of angiogenic and adipogenic factors and seems an attractive source for these bioactive factors. We produced a novel cell-free extract from mature human adipose tissue (adipose tissue extract [ATE]) and analyzed the ability of this extract to induce angiogenesis and adipogenesis in vitro and studied the cytokine and growth factor composition of ATE with ELISA and cytokine array. We demonstrate that ATE, when added as cell culture supplement, effectively induced triglyceride accumulation in human adipose stem cells at concentrations from 200 μg/mL upward in less than a week and caused elevated levels of adipocyte differentiation markers (proliferator-activated receptor gamma and acyl-CoA-binding protein) when treated with at least 350 μg/mL of ATE. ATE induced angiogenesis from 450 μg/mL upward after a week in vitro. ATE contained numerous angiogenic and adipogenic factors, for example, vascular endothelial growth factor, basic fibroblast growth factor, interleukin-6, adiponectin, angiogenin, leptin, and insulin-like growth factor-I, as well as lower levels of a wide variety of other cytokines. We here present a novel cell-free angiogenesis-and adipogenesis-inducing agent that is cell-free and easy to produce, and its effect is dose dependent and its composition can be easily modified. Therefore, ATE is a promising novel agent to be used for angiogenesis induction to overcome the challenge of vascularization and for adipogenesis induction in a wide variety of tissue engineering applications in vitro and in vivo. ATE is also efficient for reproduction and modeling of natural adipogenesis in vitro for, for example, obesity and diabetes studies.

General information

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Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Tampere University Hospital, University of Tampere, Medical School, BioMediTech
Contributors: Sarkanen, J. R., Kaila, V., Mannerström, B., Räty, S., Kuokkanen, H., Miettinen, S., Ylikomi, T.
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Publication information

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ASJC Scopus subject areas: Bioengineering, Biochemistry, Biomedical Engineering, Biomaterials, Medicine(all)
DOIs:

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Source: Scopus
Source ID: 84855405319
Research output: Contribution to journal › Article › Scientific › peer-review

Utilization of agrowaste polymers in PVC/NBR alloys: Tensile, thermal, and morphological properties

Poly(vinyl chloride)/nitrile butadiene rubber (PVC/NBR) alloys were melt-mixed using a Brabender Plasticorder at 180 °C and 50rpm rotor speed. Alloys obtained by melt mixing from PVC and NBR were formulated with wood-flour- (WF-) based olive residue, a natural byproduct from olive oil extraction industry. WF was progressively increased from 0 to 30phr. The effects of WF loadings on the tensile properties of the fabricated samples were inspected. The torque rheometry, which is an indirect indication of the melt strength, is reported. The pattern of water uptake for the composites was checked as a function WF loading. The fracture mode and the quality of bonding of the alloy with and without filler are studied using electron scanning microscope (SEM).

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Engineering materials science and solutions (EMASS), Al Balqa Applied University, Leibniz-Institut für Polymerforschung Dresden E.V.
Contributors: Mousa, A., Heinrich, G., Kretzschmar, B., Wagenknecht, U., Das, A.

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Ratings:

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Original language: English
ASJC Scopus subject areas: Chemical Engineering(all)
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10.1155/2012/121496
URLs:

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Source: Scopus
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Research output: Contribution to journal › Article › Scientific › peer-review

Osteogenic medium is superior to growth factors in differentiation of human adipose stem cells towards boneforming cells in 3D culture
Human adipose stem cells (hASCs) have been recently used to treat bone defects in clinical practice. Yet there is a need for more optimal scaffolds and cost-effective approaches to induce osteogenic differentiation of hASCs. Therefore, we compared the efficiency of bone morphogenetic proteins (BMP-2 and BMP-7), vascular endothelial growth factor (VEGF), and osteogenic medium (OM) for the osteo-induction of hASCs in 3D culture. In addition, growth factors were tested in combination with OM. Commercially available bioactive glass scaffolds (BioRestore) and biphasic calcium phosphate granules (BoneCeramic) were evaluated as prospective carriers for hASCs. Both biomaterials supported hASC-viability, but BioRestore resulted in higher cell number than BoneCeramic, whereas BoneCeramic supported more significant collagen production. The most efficient osteo-induction was achieved with plain OM, promoting higher alkaline phosphatase activity and collagen production than growth factors. In fact, treatment with BMP-2 or VEGF did not increase osteogenic differentiation or cell number significantly more than maintenance medium with either biomaterial. Moreover, BMP-7 treatment consistently inhibited proliferation and osteogenic differentiation of hASCs. Interestingly, there was no benefit from growth factors added to OM. This is the first study to demonstrate that OM enhances hASC-differentiation towards bone-forming cells significantly more than growth factors in 3D culture.

General information
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Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE), Tampere University Hospital, University of Twente, BioMediTech, Onbone Oy, Univ of Oulu
Contributors: Tirkkonen, L., Haimi, S., Huttunen, S., Wolff, J., Pirhonen, E., Sándor, G. K., Miettinen, S.
Number of pages: 15
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Scopus rating (2012): CiteScore 0.9 SJR 0.294 SNIP 0.183
Original language: English
ASJC Scopus subject areas: Biochemistry, Cell Biology, Bioengineering, Biomedical Engineering, Biomaterials, Medicine(all)
Keywords: 3D scaffolds, Adipose stem cells, Bioactive glass, Biphasic calcium phosphate, Bone tissue engineering, Growth factors, In vitro culture, Mesenchymal stem cells, Osteogenic differentiation
URLs:

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Source: Scopus
Source ID: 84878388600
Research output: Contribution to journal › Article › Scientific › peer-review

Screening ethnically diverse human embryonic stem cells identifies a chromosome 20 minimal amplicon conferring growth advantage

The International Stem Cell Initiative analyzed 125 human embryonic stem (ES) cell lines and 11 induced pluripotent stem (iPS) cell lines, from 38 laboratories worldwide, for genetic changes occurring during culture. Most lines were analyzed at an early and late passage. Single-nucleotide polymorphism (SNP) analysis revealed that they included representatives of most major ethnic groups. Most lines remained karyotypically normal, but there was a progressive tendency to acquire changes on prolonged culture, commonly affecting chromosomes 1, 12, 17 and 20. DNA methylation patterns changed haphazardly with no link to time in culture. Structural variants, determined from the SNP arrays, also appeared sporadically. No common variants related to culture were observed on chromosomes 1, 12 and 17, but a minimal amplicon in chromosome 20q11.21, including three genes expressed in human ES cells, ID1, BCL2L1 and HM13, occurred in >20% of the lines. Of these genes, BCL2L1 is a strong candidate for driving culture adaptation of ES cells.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), University of Sheffield, International Centre for Life, A-STAR, Immunos, Royan Institute, mediaX and H*STAR Stanford University Stanford, Sheffield Children's NHS Trust, University of Nottingham, Keck School of Medicine of USC, Hebrew University of Jerusalem, Tel Aviv University, Sackler Faculty of Medicine, Cedars-Sinai Medical Institute, University of Geneva, Manchester Academic Health Sciences Centre, Cellartis AB, University of Manchester, Genome Institute of Singapore, Hoffmann-LaRoche, Seoul National University College of Medicine, Bioprocessing Technology Institute, Roslin Cells Ltd., University of Melbourne, Harvard Stem Cell Institute, University of Edinburgh, Masaryk University, WiCell Research Institute, Hopital Cantonal Fribourgois, Department of Applied Physics, Lis Maternity Hospital Israel, Central South University China, Hadassah University Medical Center, Institute of Experimental Botany of the Academy of Sciences of the Czech Republic, University College London, National Institute for Biological Standards and Control, Karolinska University Hospital, Jawaharlal Nehru Centre for Advanced Scientific Research, NYU Langone Medical Center, Shanghai Jiaotong University, Vavilov Institute of General Genetics, Reproductive Genetics Institute, Monash University, CHA University, Vrije Universiteit Brussel, Mount Sinai Hospital, GE Healthcare, UK, Kyoto Women's University, Leiden University Medical Center - LUMC, University of Helsinki, Yale School of Medicine, Viacyte, Hospital for Sick Children University of Toronto, University of New South Wales (UNSW) Australia, Gladstone Institute of Cardiovascular Disease, CSIRO Energy Centre
Contributors: Amps, K., Andrews, P. W., Anyfantis, G., Armstrong, L., Avery, S., Baharvand, H., Baker, J., Baker, D., Munoz, M. B., Beil, S., Benvenisty, N., Ben-Yosef, D., Biancotti, J. C., Bosman, A., Brena, R. M., Brison, D., Caisander, G. , Camarasa, M. V., Chen, J., Chiao, E., Choi, Y. M., Choo, A. B. H., Collins, D., Colman, A., Crook, J. M., Daley, G. Q., Dalton, A., De Sousa, P. A., Denning, C., Downie, J., Dvorak, P., Montgomery, K. D., Feki, A., Ford, A., Fox, V., Fraga, A. M., Frumkin, T., Ge, L., Gokhale, P. J., Golan-Lev, T., Gourabi, H., Gropp, M., Guangxiu, L., Hampl, A., Harron, K., Healy, L., Herath, W., Holm, F., Hovatta, O., Hyllner, J., Inamdar, M. S., Irwanto, A. K., Ishii, T., Jaconi, M., Jin, Y., Kimber, S., Kiselev, S., Knowles, B. B., Kopper, O., Kukharenko, V., Kuliev, A., Lagarkova, M. A., Laird, P. W., Lako, M., Laslett, A. L. , Lavon, N., Lee, D. R., Lee, J. E., Li, C., Lim, L. S., Ludwig, T. E., Ma, Y., Maltby, E., Mateizel, I., Mayshar, Y., Mileikovsky, M., Minger, S. L., Miyazaki, T., Moon, S. Y., Moore, H., Mummery, C., Nagy, A., Nakatsuji, N., Narwani, K., Oh, S. K. W., Oh, S. K., Olson, C., Otonkoski, T., Pan, F., Park, I. H., Pells, S., Pera, M. F., Pereira, L. V., Qi, O., Raj, G. S., Reubinoff, B., Robins, A., Robson, P., Rossant, J., Salekdeh, G. H., Schulz, T. C., Sermon, K., Mohamed, J. S., Shen, H., Sherrer, E., Sidhu, K., Sivarajah, S., Skottman, H., Spits, C., Stacey, G. N., Strehl, R., Strelchenko, N., Suemori, H., Sun, B., Suuronen, R., Takahashi, K., Tuuri, T., Venu, P., Verlinsky, Y., Oostwaard, D. W. V., Weisenberger, D. J., Wu, Y. , Yamanaka, S., Young, L., Zhou, Q.
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Peer-reviewed: Yes

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ASJC Scopus subject areas: Biotechnology, Bioengineering, Medicine(all), Molecular Medicine, Biomedical Engineering, Applied Microbiology and Biotechnology
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Source: Scopus
Source ID: 83255189758
Research output: Contribution to journal › Article › Scientific › peer-review

Synthesis of depsipeptides from L-amino acids and lactones

By using the corresponding L-amino acid sodium as initiator, e{open}-caprolactone-depsipeptides CL-Ala and CL-Leu were prepared by the reactions of e{open}-caprolactone (CL) with L-alanine and L-leucine, respectively, and p-dioxanone-depsipeptide (PDO-Leu) was prepared by the reaction of p-dioxanone (PDO) with L leucine. Two poly(e{open}-caprolactone) oligomers (PCL-Ala and PCL-Leu) of different molecular weights with depsipeptide unit were synthesized by controlling the feed ratio of L-amino acid sodium and CL. The presence of the depsipeptide structure in these obtained products was confirmed by ^{1}H NMR spectra and the molecular weight of the poly(e{open}-caprolactone) oligomers was measured by gel permeation chromatography (GPC). These products contain a hydroxyl group and a carboxyl group in one molecule, which means they could act as bifunctional monomers for further polymerization to prepare high molecular weight polymers. By this way, the depsipeptide unit could be introduced into the polymers and the biodegradation rates of the novel polymers could be well controlled in vivo by the tailored molecular structures.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Tianjin University, School of Chemical Engineering and Technology
Contributors: Cao, H., Feng, Y., Wang, H., Zhang, L., Khan, M., Guo, J.
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DOIs:

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Source ID: 83355176163
Research output: Contribution to journal › Article › Scientific › peer-review

Versatile bio-ink for covalent immobilization of chimeric avidin on sol-gel substrates

A bio-ink for covalent deposition of thermostable, high affinity biotin-binding chimeric avidin onto sol-gel substrates was developed. The bio-ink was prepared from heterobifunctional crosslinker 6-maleimidohexanoic acid N-hydroxysuccinimide which was first reacted either with 3-aminopropyltriethoxysilane or 3-aminopropyldimethylethoxysilane to form silane linkers 6-maleimide- N-(3-(triethoxysilyl)propyl)hexanamide or -(ethoxydimethylsilyl)propyl)-hexanamide. C-terminal cysteine genetically engineered to chimeric avidin was reacted with the maleimide group of silane linker in methanol/PBS solution to form a suspension, which was printed on sol-gel modified PMMA film. Different concentrations of chimeric avidin and ratios between silane linkers were tested to find the best properties for the bio-ink to enable gravure or inkjet printing. Bio-ink prepared from 3-aminopropyltriethoxysilane was found to provide the highest amount of active immobilized chimeric avidin. The developed bio-ink was shown to be valuable for automated fabrication of avidin-functionalized polymer films.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Univ of Oulu, VTT Technical Research Centre of Finland, Tampere University Hospital
Contributors: Heikkinen, J. J., Kivimäki, L., Määttä, J. A. E., Mäkelä, I., Hakalahti, L., Takkinen, K., Kulomaa, M. S., Hytönen, V. P., Hormi, O. E. O.
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Original language: English
ASJC Scopus subject areas: Biotechnology, Colloid and Surface Chemistry, Physical and Theoretical Chemistry, Surfaces and Interfaces
Keywords: Avidin-biotin technology, Biomolecule immobilization, Biosensing, Chimeric avidin, Maleimide, Printing, Sol-gel
DOIs:

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Research output: Contribution to journal › Article › Scientific › peer-review

The effect of organic loading rate and retention time on hydrogen production from a methanogenic CSTR
The possibility of shifting a methanogenic process for hydrogen production by changing the process parameters viz., organic loading rate (OLR) and hydraulic retention time (HRT) was evaluated. At first, two parallel semi-continuously fed continuously stirred tank reactors (CSTR) were operated as methanogenic reactors (M1 and M2) for 78days. Results showed that a methane yield of 198-218L/kg volatile solids fed (VS_{fed}) was obtained when fed with grass silage at an OLR of 2kgVS/m^3/d and HRT of 30days. After 78days of operation, hydrogen production was induced in M2 by increasing the OLR from 2 to 10kgVS/m^3/d and shortening the HRT from 30 to 6days. The highest H_2 yield of 42L/kgVS$_{fed}$ was obtained with a maximum H_2 content of 24%. The present results thus demonstrate that methanogenic process can be shifted towards hydrogen production by increasing the OLR and decreasing HRT.

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Organisations: Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä
Contributors: Pakarinen, O., Kaparaju, P., Rintala, J.
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ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Grass silage, Hydrogen, Methane, Shifting, VFA
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Towards universal enrichment nanocoating for IR-ATR waveguides
Polymer multilayered nanocoating capable of concentrating various chemical substances at IR-ATR waveguide surfaces is described. The coating affinity to an analyte played a pivotal role in sensitivity enhancement of the IR-ATR measurements, since the unmodified waveguide did not show any analyte detection.

General information
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Organisations: Frontier Photonics, Clemson University, School of Materials Science and Engineering/COMSET, University of Delaware, Massachusetts Institute of Technology
Contributors: Giammarco, J., Zdyrko, B., Petit, L., Musgraves, J. D., Hu, J., Agarwal, A., Kimerling, L., Richardson, K., Luzinov, I.
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Research output: Contribution to journal › Article › Scientific › peer-review

Defined-size DNA triple crossover construct for molecular electronics: Modification, positioning and conductance properties

We present a novel, defined-size, small and rigid DNA template, a so-called B-A-B complex, based on DNA triple crossover motifs (TX tiles), which can be utilized in molecular scale patterning for nanoelectronics, plasmonics and sensing applications. The feasibility of the designed construct is demonstrated by functionalizing the TX tiles with one biotin-triethylene glycol (TEG) and efficiently decorating them with streptavidin, and furthermore by positioning and anchoring single thiol-modified B-A-B complexes to certain locations on a chip via dielectrophoretic trapping. Finally, we characterize the conductance properties of the non-functionalized construct, first by measuring DC conductivity and second by utilizing AC impedance spectroscopy in order to describe the conductivity mechanism of a single B-A-B complex using a detailed equivalent circuit model. This analysis also reveals further information about the conductivity of DNA structures in general.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Jyväskylän yliopisto, Adult Stem Cells, School of Management (JKK)
Contributors: Linko, V., Leppiniemi, J., Paasonen, S. T., Hytönen, V. P., Jussi Toppari, J.
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Research output: Contribution to journal › Article › Scientific › peer-review

Hybrid nanoparticle design based on cationized gelatin and the polyanions dextran sulfate and chondroitin sulfate for ocular gene therapy

We describe the development of hybrid nanoparticles composed of cationized gelatin and the polyanions CS and DS for gene therapy in the ocular surface. The physicochemical properties of the nanoparticles that impact their bioperformance, such as average size and zeta potential, can be conveniently modulated by changing the ratio of polymers and the crosslinker. These systems associate plasmid DNA and are able to protect it from DNase I degradation. We corroborate that the introduction of CS or DS in the formulation decreases the in vitro toxicity of the nanoparticles to human corneal cells without compromising the transfection efficiency. These nanoparticles are potential candidates for the development of safer and more effective nanomedicines for ocular therapy. New hybrid nanoparticles composed of cationized gelatin and natural polyanions are developed and characterized. The incorporation of chondroitin sulfate or dextran sulfate in cationized gelatin nanoparticles decreases their toxicity while preserving their transfection efficiency in human corneal cells. These nanoparticles are potential candidates for the development of safer and more effective nanomedicines for ocular therapy.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), University of Santiago de Compostela (USC)
Contributors: Zorzi, G. K., Párraga, J. E., Seijo, B., Sánchez, A.
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Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Biomaterials, Polymers and Plastics, Materials Chemistry
Keywords: Drug delivery systems, Gelation, Nanoparticles, Nanotechnology
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Source: Scopus
Source ID: 79959848036
Research output: Contribution to journal › Article › Scientific › peer-review

Two-stage anaerobic digestion of tomato, cucumber, common reed and grass silage in leach-bed reactors and upflow anaerobic sludge blanket reactors

Anaerobic digestion of tomato, cucumber, common reed and grass silage was studied in four separate two-stage reactor configuration consisting of leach bed reactor (LBR) and upflow anaerobic sludge blanket reactor (UASB). LBR studies showed that COD solubilization for cucumber and grass silage was higher (50%) than tomato (35%) and common reed (15%). Results also showed that 31-39% of initial TKN present in tomato and cucumber was solubilized in the leachates and 47-54% of the solubilized TKN was converted to NH_4-N. The corresponding values for common reed and grass silage were 38-50% and 18-36%, respectively. Biomethanation of the leachates in UASB reactors resulted in methane yields of 0.03-0.14m^3 CH_4 $kg^{-1}VS_{fed}$ for the studied crop materials. Thus, high COD solubilization, high nitrogen mineralization and solubilization rates were feasible during anaerobic digestion of lignocellulosic materials in a two-stage LBR-UASB reactor system.

General information

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Contributors: Jagadabhi, P. S., Kaparaju, P., Rintala, J.

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Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Biogas, Crop materials, Leach bed reactor, Leachate, Two-stage
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Source: Scopus
Source ID: 79951945757
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Osteoconductive properties of poly(96L/4D-lactide)/beta-tricalcium phosphate in long term animal model
The objective of this study was to determine the effect of calcium phosphate mineral content on the bone in-growth at the expense of composite of co-polylactide polymer charged with 2 different ratios of β-TCP granules (10 and 24 w-% of β-TCP). The evaluation was realized in a long term rabbit bone model. After 24, 48 and 76 weeks, the implants were examined by micro CT, scanning electron microscopy (SEM) using backscattered electron (BSE) and light microscopy (polarized and blue light microscopy). No foreign body reaction was detected during the 76 weeks follow-up in any of the test samples. Polymer hydrolysis began at approximately 24 weeks, by 76 weeks, the pure polymer implant had begun to release P(96L/4D)LA particles and show signs of peripheral localized bone resorption. A decrease in the amount of CaP was noticed between 24 and 76 weeks in both 10 wt-% and 24 wt-% β-TCP/P(96L/4D)LA composites. The study showed that the highest bone in-growth was with 24 wt-% β-TCP/P(96L/4D)LA composite. Bone in-growth and mineralization were evident for the composites associated with specific peripheral bone architecture. Fluorescent labelling demonstrated high bone in-growth and remodeling at the interface, while for pure co-polymer no bone remodeling or bone activity was maintained after 48 weeks. The study demonstrated the positive effect of calcium phosphate content into P(96L/4D)LA. This kind of composite is a suitable resorbable osteoconductive matrix, which provides long term stability required for ligament fixation device.

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Contributors: Daculsi, G., Goyenvalle, E., Cognet, R., Aguado, E., Suokas, E. O.
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Scopus rating (2011): CiteScore 11.3 SJR 3.302 SNIP 2.203
Original language: English
ASJC Scopus subject areas: Biomaterials, Bioengineering, Ceramics and Composites, Mechanics of Materials, Biophysics
Keywords: Bone regeneration, Co-polylactide/beta-tricalcium phosphate, Composite, Long term study
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Source: Scopus
Source ID: 79951769703
Research output: Contribution to journal › Article › Scientific › peer-review

Chimeric avidin shows stability against harsh chemical conditions-biochemical analysis and 3D structure

Avidin and its bacterial analog streptavidin have been widely used in applications in life sciences. Recently, we described a highly thermostable engineered avidin, called chimeric avidin, which is a hybrid of avidin and avidin-related protein 4. Here, we report a protocol for pilot-scale production in E. coli and the X-ray structure of chimeric avidin. The ligand-binding properties of chimeric avidin were explored with isothermal titration calorimetry. We found chimeric avidin to be more stable against various harsh organic solvents at elevated temperatures compared to avidin and streptavidin. The properties of chimeric avidin make it a potential tool for new applications in biotechnology. Biotechnol. Bioeng. 2011; 108:481-490.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), University of Tampere Institute of Medical Technology, Hebrew University of Jerusalem
Contributors: Määttä, J. A., Eisenberg-Domovich, Y., Nordlund, H. R., Hayouka, R., Kulomaa, M. S., Livnah, O., Hytönen, V. P.
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Peer-reviewed: Yes

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Keywords: Avidin-biotin, Nanobiotechnology, Protein engineering, Thermodynamics, X-ray structure
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Source ID: 78751523876
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Enrichment polymer layers for detection of volatile vapors by ATR FT-IR

Fourier Transformed Infrared Spectroscopy (FT-IR) is an effective analytical method for the identification of organic compounds be they man made or naturally produced. There is, however, a limitation to what a normal FT-IR can detect if an analyte is in vapor phase or in low concentration. To this end, we have applied enrichment polymer layer systems (EPLS) to an attenuated total reflection (ATR) crystal waveguide to enhance detection capability for the method. These EPLS are comprised of polymers with different functionality along the backbone and provide unique interaction capabilities that can attract volatile chemicals and concentrate them in the evanescence wave region. The thickness of the polymer layers is kept on 30-50nm level. The EPLS were characterized by atomic force microscopy, ellipsometry and FT-IR. The overall goal of this work is to construct a "universal" sensor platform capable of detecting a wide range of volatile organic chemicals via infrared spectroscopy.

General information

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Organisations: Frontier Photonics, Massachusetts Institute of Technology, School of Materials Science and Engineering/COMSET, Clemson University, Department of Materials Science and Engineering, University of Delaware
Contributors: Giammarco, J. M., Zdyrko, B., Hu, J., Agarwal, A., Kimerling, L., Carlie, N., Petit, L., Richardson, K., Luzinov, I.
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all)
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Source: Scopus
Source ID: 80051876637
Research output: Contribution to journal › Article › Scientific › peer-review

Effect of micro-aeration and leachate replacement on COD solubilization and VFA production during mono-digestion of grass-silage in one-stage leach-bed reactors

The effect of micro-aeration and leachate replacement with fresh water on chemical oxygen demand (COD) solubilization and volatile fatty acid (VFA) production during the mono-digestion of grass-silage in one-stage leach-bed reactors (LBRs) was investigated in four LBRs, L0 (control), L1, L2 and L3 in batch mode at 35 ± 1 °C for 57 days. Results showed that leachate replacement without pH adjustment (L3) resulted in 2.7 and 1.3 times more SCOD in the leachate compared to control (L0) or leachate replacement with initial pH adjustment (L1), respectively. Micro-aeration at flow rate of 1 L min^{-1} (2.5 L of air) in L2 resulted in 4-fold increase in VFA production (from 2.2 to 9 g L^{-1}) without any significant increase in cumulative SCOD in the leachate. Increasing the air flow rate to 4 L min^{-1} (24 L of air) in L2 resulted in a decrease in SCOD extraction. Leachate replacement without pH adjustment (L3) resulted in higher (mean) specific SCOD production (0.51 g SCOD g^{-1} VS_{added}) than control (L0, 0.34 g SCOD g^{-1} VS_{added}), leachate replacement with initial pH adjustment (L1, 0.33 g SCOD g^{-1} VS_{added}) or micro-aeration (L2, 0.32 g SCOD g^{-1} VS_{added}). These results suggest that the challenge of hydrolysis during anaerobic digestion of particulate substrates like grass-silage can be improved by micro-aeration and leachate replacement methods with or without pH adjustment.

General information

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Contributors: Jagadabhi, P. S., Kaparaju, P., Rintala, J.
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DOIs:

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Source ID: 73749087133
Research output: Contribution to journal › Article › Scientific › peer-review

Surface science analysis and surface modification methods for biomaterials research

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Surface Science, Department of Physics, Department of Biomedical Engineering, University of Tampere Institute of Medical Technology, Department of Biomedical Engineering
Contributors: Kanninen, L., Jokinen, N., Lahtonen, K., Jussila, P., Ali-Löytty, H., Hirsimäki, M., Leppiniemi, J., Hytönen, V., Kulomaa, M., Ahola, N., Paakinaho, K., Kellomäki, M., Valden, M.
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Original language: English
ASJC Scopus subject areas: Bioengineering, Biochemistry, Biomaterials, Biomedical Engineering, Cell Biology
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Source: Scopus
Source ID: 84860892200
Research output: Contribution to journal › Article › Scientific › peer-review

On entropy-based molecular descriptors: Statistical analysis of real and synthetic chemical structures
This paper presents an analysis of entropy-based molecular descriptors. Specifically, we use real chemical structures, as well as synthetic isomeric structures, and investigate properties of and among descriptors with respect to the used data set by a statistical analysis. Our numerical results provide evidence that synthetic chemical structures are notably different to real chemical structures and, hence, should not be used to investigate molecular descriptors. Instead, an analysis based on real chemical structures is favorable. Further, we find strong hints that molecular descriptors can be partitioned into distinct classes capturing complementary information.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: TU Vienna, Technical University Darmstadt, Computational Biology and Machine Learning, School of Medicine
Contributors: Dehmer, M., Varmuza, K., Borgert, S., Emmert-Streib, F.
Number of pages: 9
Pages: 1655-1663
Publication date: 27 Jul 2009
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Publication information
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ISSN (Print): 1549-9596
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Scopus rating (2009): SJR 1.039 SNIP 1.219
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Computer Science Applications, Library and Information Sciences
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10.1021/ci900060x
URLs:

http://www.scopus.com/inward/record.url?scp=68149167631&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 68149167631
Research output: Contribution to journal › Article › Scientific › peer-review

Biogas production from boreal herbaceous grasses - Specific methane yield and methane yield per hectare
The objective of this study was to determine the specific methane yields of four grass species (cocksfoot, tall fescue, reed canary grass and timothy) cultivated under boreal conditions as well as how harvesting time and year of cultivation affects the specific methane yields per ha. The specific methane yields of all grasses and all harvests varied from 253 to 394 Nl CH_4/kg volatile solids (VS) added. The average specific methane yield of the 1st harvest of all grasses was higher than the 2nd harvests. In this study the methane and energy yields from different harvest years were ranged from 1200 to 3600 Nm^3 CH_4/ha/a, corresponding from 12 to 36 MWh_{CH4}/ha/a. The methane yield per hectare of the 1st harvest was always higher than that of the 2nd harvest per hectare because of the higher dry matter yield and specific methane yield. High biomass yield per hectare, good digestibility and regrowth ability after harvesting are important factors when choosing grass species for biogas production. If 30% of fallow and the second harvest of grassland were cultivated grasses and harvested for biogas production in Finland, the energy produced could be 4.9 TWh_{CH4}.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Seppälä, M., Paavola, T., Lehtomäki, A., Rintala, J.
Number of pages: 7
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Publication date: Jun 2009
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
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Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Biogas production, Grass, Harvest time, Specific methane yield
DOIs:

10.1016/j.biortech.2009.01.044
Source: Scopus
Source ID: 62649158890
Research output: Contribution to journal › Article › Scientific › peer-review

Impact of crop species on bacterial community structure during anaerobic co-digestion of crops and cow manure
The bacterial communities in three continuously stirred tank reactors co-digesting cow manure with grass silage, oat straw, and sugar beet tops, respectively, were investigated by 16S rRNA gene-based fingerprints and clone libraries. The analyses revealed both clearly distinct and similar phylotypes in the bacterial communities between the reactors. The major groups represented in the three reactors were Clostridia, unclassified Bacteria, and Bacteroidetes. Phylotypes affiliated with Bacilli or Deltaproteobacteria were unique to the sugar beet and straw reactor, respectively. Unclassified Bacteria dominated in sugar beet reactor while in the straw and grass reactor Clostridia was the dominant group. An increase in organic loading rate from 2 to 3 kg volatile solids m^{-3} d^{-1} resulted in larger changes in the bacterial community in the straw compared to grass reactor. The study shed more light on the evolution of bacterial community during anaerobic co-digestion of different crops and manure to methane.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Tampere University of Technology, Jyväskylän yliopisto, Jyväskylä Innovation Ltd., University of Jyväskylä
Contributors: Wang, H., Lehtomäki, A., Tolvanen, K., Puhakka, J., Rintala, J.
Number of pages: 5
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Peer-reviewed: Yes

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Journal: Bioresource Technology
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Scopus rating (2009): SJR 1.915 SNIP 2.235
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Anaerobic digestion, Bacterial community structure, Continuously stirred tank reactor, Denature gradient gel electrophoresis, Terminal restriction fragment length polymorphism
DOIs:

10.1016/j.biortech.2008.10.040
URLs:

http://www.scopus.com/inward/record.url?scp=58149189873&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
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Contribution: organisation=keb bio,FACT1=1

Source: researchoutputwizard
Source ID: 11706
Research output: Contribution to journal › Article › Scientific › peer-review

Storing energy crops for methane production: Effects of solids content and biological additive

The effect of storage on chemical characteristics and CH_4 yield (taking into account loss of VS during storage) of a mixture of grasses and ryegrass, ensiled as such (low solids content) and after drying (medium and high solids) with and without biological additive, were studied in field and laboratory trials. Up to 87% and 98% of CH_4 yield was preserved with low solids grass (initial TS 15.6%) and high solids ryegrass (initial TS 30.4%), respectively, after storage for 6 months, while under suboptimal conditions at most 37% and 52% of CH_4 yield were lost. Loss in CH_4 yield was mainly due to VS loss, presumably caused by secondary fermentation as also suggested by increasing pH during storage. Biological additive did not assist in preserving the CH_4 yield.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Pakarinen, O., Lehtomäki, A., Rissanen, S., Rintala, J.
Number of pages: 9
Pages: 7074-7082
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Peer-reviewed: Yes

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Journal: Bioresource Technology
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Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology, Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Anaerobic digestion, Biogas, Energy crop, Grass, Storage
DOIs:

10.1016/j.biortech.2008.01.007
Source: Scopus
Source ID: 44449146372
Research output: Contribution to journal › Article › Scientific › peer-review

Effects of storage on characteristics and hygienic quality of digestates from four co-digestion concepts of manure and biowaste

This study evaluated the effects of storage in northern winter conditions (5 °C) on the characteristics and nutrients separation of digestates from co-digestion of manure and biowaste as well as the hygienic quality of the digestates after digestion and storage. During 3-11 months' storage average nitrogen losses and reductions of total solids (TS) and volatile solids (VS) were 0-15%. With some exceptions, soluble chemical oxygen demand (SCOD) had increased slightly (from ~6.5 to ~7.5 g/l) after 3 months' storage, while after 9-11 months' it had decreased from 8.3-11 to 5.6-8.4 g/l. The concentrations of P_{tot} and PO4-P in the separated liquid fractions decreased 40-57% after 3 months' storage and 71-91% after 9 months' storage compared to the initial concentrations. The methane potential losses during 9-11 months' storage corresponded 0-10% of the total methane potential without storage. The hygienic quality of the digestates from the 55 °C reactor and during storage fulfilled the Animal By-Products Regulation (ABPR) demands while the 35 °C digestate contained 0-105 cfu/g of indicator bacteria (faecal coliforms, enterobacteria, enterococcus) and >10 cfu/g of spiked salmonella, which amounts decreased slowly during storage. Sulphite reducing clostridia was not affected by either digestion or storage.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Paavola, T., Rintala, J.
Number of pages: 10
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Journal: Bioresource Technology
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Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology, Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Biowaste, Digestate, Hygienic quality, Manure, Solid/liquid separation
DOIs:

10.1016/j.biortech.2008.01.005
Source: Scopus
Source ID: 44449089925
Research output: Contribution to journal › Article › Scientific › peer-review

Group-specific quantification of methanotrophs in landfill gas-purged laboratory biofilters by tyramide signal amplification-fluorescence in situ hybridization
The aim of this study was to quantitatively analyse methanotrophs in two laboratory landfill biofilters at different biofilter depths and at temperatures which mimicked the boreal climatic conditions. Both biofilters were dominated by type I methanotrophs. The biofilter depth profiles showed that type I methanotrophs occurred in the upper layer, where relatively high O_2 and low CH_4 concentrations were present, whereas type II methanotrophs were mostly distributed in the zone with high CH_4 and low O_2 concentrations. The number of type I methanotrophic cells declined when the temperature was raised from 15 °C to 23 °C, but increased when lowered to 5 °C. A slight decrease in type II methanotrophs was also observed when the temperature was raised from 15 °C to 23 °C, whereas cell numbers remained constant when lowered to 5 °C. The results indicated that low temperature conditions favored both type I and type II methanotrophs in the biofilters.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Tampere Institute of Medical Technology, University of Jyväskylä
Contributors: Wang, H., Einola, J., Heinonen, M., Kulomaa, M., Rintala, J.
Number of pages: 8
Pages: 6426-6433
Publication date: Sep 2008
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Journal: Bioresource Technology
Volume: 99
Issue number: 14
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2008): SJR 1.736 SNIP 2.724
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Biofilter, Landfill cover soil, Methane oxidation, Methanotrophs, Tyramide signal amplification-fluorescence in situ hybridization
DOIs:

10.1016/j.biortech.2007.11.050
Source: Scopus
Source ID: 43849105101
Research output: Contribution to journal › Article › Scientific › peer-review

Anaerobic digestion of grass silage in batch leach bed processes for methane production
Anaerobic digestion of grass silage in batch leach bed reactors, with and without a second stage upflow anaerobic sludge blanket (UASB) reactor, was evaluated. Sixty six percent of the methane potential in grass was obtained within the 55 days solids retention time in the leach bed-UASB process without pH adjustment, whereas in the one-stage leach bed process 20% of the methane potential in grass was extracted. In two-stage operation, adjustment of the pH of influent to the leach bed reactor to 6 with HCl led to inhibition of both hydrolysis/acidogenesis and methanogenesis. In the leach bed-UASB process 39% of the carbohydrates and 58% of the acid soluble lignin were solubilised within the 49 days of operation, whereas Klason lignin was most recalcitrant. The methane potential of the digestates varied from 0.141 to

0.204 m^3 CH_4 kg^{-1} added volatile solids.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Lehtomäki, A., Huttunen, S., Lehtinen, T. M., Rintala, J. A.
Number of pages: 12
Pages: 3267-3278
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Journal: Bioresource Technology
Volume: 99
Issue number: 8
ISSN (Print): 0960-8524
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Scopus rating (2008): SJR 1.736 SNIP 2.724
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Anaerobic digestion, Energy crop, Leach bed, Methane production, UASB
DOIs:
10.1016/j.biortech.2007.04.072
Source: Scopus
Source ID: 38849145183
Research output: Contribution to journal › Article › Scientific › peer-review

Leachate and gaseous emissions from initial phases of landfilling mechanically and mechanically-biologically treated municipal solid waste residuals
In this study, the behaviour, and leachate and gaseous emissions during the initial phases of landfilling mechanically (M) and mechanically-biologically (MB) treated municipal solid waste residuals in northern climatic conditions was compared using two landfill lysimeters (112 m^3). The results demonstrate that the strong acid phase of M residuals degradation lasts at least 2 years, while in the MB residuals the acid phase lasts only a few months. The SCOD and NH_4-N concentrations varied 20-100 g/l and 600-1800 mg/l in M leachate and 1-4 g/l and 100-400 mg/l in MB leachate, respectively. The leaching of SCOD was approximately 40-fold (24.2 and 0.6 kg/t TS) and leaching of NH_4-N approximately 5-fold (356 and 60 g/t TS) from the M than MB residuals; thus the effect of biological stabilisation was more marked on the leaching of SCOD than of NH_4-N. Moreover gas (methane, carbon dioxide and nitrous oxide) emissions were several-fold higher from the M than MB residuals.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, Matti Ettala Ltd., University of Jyväskylä
Contributors: Sormunen, K., Einola, J., Ettala, M., Rintala, J.
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Scopus rating (2008): SJR 1.736 SNIP 2.724
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Landfill, Mechanical-biological, Methane, Nitrogen, Organic matter
DOIs:
10.1016/j.biortech.2007.05.009

Source: Scopus
Source ID: 38849165441
Research output: Contribution to journal › Article › Scientific › peer-review

Effects of solid-liquid separation on recovering residual methane and nitrogen from digested dairy cow manure

The feasibility of optimizing methane and nitrogen recovery of samples obtained from farm biogas digester (35 °C) and post-storage tank (where digested material is stored for 9-12 months) was studied by separating the materials into different fractions using 2, 1, 0.5 and 0.25 mm sieves. Mass-balances revealed that digested material mainly consists of <0.25 mm (60-69%) and >2 mm (18-27%) fractions, while fractions between 2 and 0.25 mm made the rest. Incubation of solid fractions >0.25 mm of digester material at 35 °C resulted in specific methane yields of 0.060-0.085 m^3 kg^{-1} volatile solids (VS) during initial 30-50 d and 0.16-0.18 m^3 kg^{-1} VS at the end of 340 d incubation. Similarly, fractions >0.25 mm of post-storage tank material produced 0.055-0.092 m^3 kg^{-1} VS and 0.13-0.16 m^3 kg^{-1} VS of methane after 30-50 d and after 250 d, respectively. Methane yields for fractions ≤0.25 mm of post-storage tank was 0.03 m^3 kg^{-1} VS after 30-50 d and 0.05 m^3 kg^{-1} VS after 250 d compared to 0.20 m^3 kg^{-1} VS and 0.41 m^3 kg^{-1} VS, respectively for the same fraction of digester material. Separation of digested cow manure into solids and liquid fractions to recover methane may be feasible only for post-storage tank material and not for digester material. Nitrogen management would not be feasible with neither material as total nitrogen and ammonium-nitrogen concentrations were equally distributed among the segregated fractions.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Kaparaju, P. L. N., Rintala, J. A.
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Peer-reviewed: Yes

Publication information

Journal: Bioresource Technology
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Ratings:

Scopus rating (2008): SJR 1.736 SNIP 2.724
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology, Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Anaerobic digestion, Digested material, Farm-scale digester, Fractionation, Methane, Post-storage tank
DOIs:

10.1016/j.biortech.2006.11.046
Source: Scopus
Source ID: 34848884581
Research output: Contribution to journal › Article › Scientific › peer-review

Anaerobic on-site treatment of kitchen waste in combination with black water in UASB-septic tanks at low temperatures

Anaerobic on-site treatment of a mixture of black water and kitchen waste (BWKW) was studied using two-phased upflow anaerobic sludge blanket (UASB) septic tanks at the low temperatures of 20 and 10 °C. Black water (BW) was also treated alone as reference. The two-phased UASB-septic tanks removed over 95% of total suspended solids (TSS) and 90% of total chemical oxygen demand (COD_t) from both BWKW (effluent COD_t 171-199 mg/l) and BW (effluent COD_t 92-100 mg/l). Also, little dissolved COD (COD_{dis}) was left in the final effluents (BW 48-70 mg/l; BWKW 110-113 mg/l). Part of total nitrogen (N_{tot}) was removed (BW 18% and BWKW 40%) and especially at 20 °C ammonification was efficient. A two-phased process was required to obtain the high removals with BWKW at 10 °C, while with BW a single-phased process may have sufficed even at 10 °C. BWKW also produced more methane than BW alone. Sludge in phases 1 of BW and BWKW treatment was not completely stabilised after 198 d of operation.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Luostarinen, S., Rintala, J.
Number of pages: 7
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Publication information
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Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Anaerobic wastewater treatment, Black water, Kitchen waste, Low temperature, UASB-septic tank
DOIs:

10.1016/j.biortech.2006.07.022
Source: Scopus
Source ID: 33846677724
Research output: Contribution to journal › Article › Scientific › peer-review

Hydrolysis rates, methane production and nitrogen solubilisation of grey waste components during anaerobic degradation
Municipal grey waste (i.e. the remaining fraction in municipal waste management systems in which putrescibles (biowaste) and other recyclables (paper, metals, glass) are source-segregated) was manually sorted into six main fractions on the basis of composition and also separated by sieving (100 mm mesh size) into two fractions, oversized and undersized, respectively. In practice, in waste management plant the oversized fraction is (or will be) used to produce refuse-derived fuel and the undersized landfilled after biological stabilisation. The methane yields and nitrogen solubilisation of the grey waste and the different fractions (all studied samples were first milled to 5 mm particle samples) were determined in a 237-day methane production batch assay and in a water elution test, respectively. The grey waste was found to contained remnants of putrescibles and also a high amount of other biodegradable waste, including packaging, cartons and cardboard, newsprint, textiles and diapers. These waste fractions comprised 41%-w/w of the grey waste and produced 40-210 m^3 methane (total solids (TS))$^{-1}$ and less than 0.01 $gNH_4\text{-}NkgTS^{-1}_{added}$ except diapers which produced 9.8 $gNH_4\text{-}N\ kgTS^{-1}_{added}$ in the batch assays. In the case of the two sieved fractions and on mass bases, most of the methane originated from the oversized fraction, whereas most of the NH_4-N was solublised from the undersized fraction. The first-order kinetic model described rather well the degradation of each grey waste fraction and component, showing the different components to be in the range 0.021-0.058 d^{-1}, which was around one-sixth of the values reported for the source-segregated putrescible fraction of MSW.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Jyväskylä, Jyväskylän yliopisto, Russian Academy of Sciences
Contributors: Jokela, J. P. Y., Vavilin, V. A., Rintala, J. A.
Number of pages: 8
Pages: 501-508
Publication date: Mar 2005
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 96
Issue number: 4
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2005): SJR 1.278 SNIP 1.99
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Anaerobic degradation, Components, Grey waste, Hydrolysis rate, Landfill, Methane, Municipal solid waste, Nitrogen, Solubilisation, Source-segregation
DOIs:

10.1016/j.biortech.2004.03.009
Source: Scopus
Source ID: 7544250470
Research output: Contribution to journal › Article › Scientific › peer-review

Modeling solid waste decomposition

The hydrolysis rate coefficients of sorted municipal waste were evaluated from the biochemical methane potential tests using non-linear regression. A distributed mathematical model of anaerobic digestion of rich (food) and lean (non-food) solid wastes with greatly different rates of polymer hydrolysis/acidogenesis was developed to describe the balance between the rates of hydrolysis/acidogenesis and methanogenesis. The model was calibrated using previously published experimental data [Biores. Technol. 52 (1995) 245] obtained upon various initial food waste loadings. Simulations of one- and two-stage digestion systems were carried out. The results showed that initial spatial separation of food waste and inoculum enhances methane production and waste degradation in a one-stage solid-bed digester at high waste loading. A negative effect of vigorously mixing at high waste loading reported in some papers was discussed. It was hypothesized that the initiation methanogenic centers developing in time and expanding in space under minimal mixing conditions might be a key factor for efficient anaerobic conversion of solid waste into methane.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Russian Academy of Sciences, University of Jyväskylä, Jyväskylän yliopisto
Contributors: Vavilin, V. A., Lokshina, L. Y., Jokela, J. P. Y., Rintala, J. A.
Number of pages: 13
Pages: 69-81
Publication date: Aug 2004
Peer-reviewed: Yes

Publication information

Journal: Bioresource Technology
Volume: 94
Issue number: 1
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2004): SJR 1.19 SNIP 1.658
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Distributed mathematical model, Food waste, Hydrolysis kinetics, Initiation methanogenic centers, One- and two-stage anaerobic digestion, Solids biodegradation
DOIs:

10.1016/j.biortech.2003.10.034
Source: Scopus
Source ID: 1842663304
Research output: Contribution to journal › Article › Scientific › peer-review

Comparison of laboratory-scale thermophilic biofilm and activated sludge processes integrated with a mesophilic activated sludge process

A combined thermophilic-mesophilic wastewater treatment was studied using a laboratory-scale thermophilic activated sludge process (ASP) followed by mesophilic ASP or a thermophilic suspended carrier biofilm process (SCBP) followed by mesophilic ASP, both systems treating diluted molasses (dilution factor 1:500 corresponding GF/A-filtered COD (COD_{filt}) of 1900±190 mgl^{-1}). With hydraulic retention times (HRTs) of 12-18 h the thermophilic ASP and thermophilic SCBP removed 60±13% and 62±7% of COD_{filt}, respectively, with HRT of 8 h the removals were 48±1% and 69±4%. The sludge volume index (SVI) was notably lower in the thermophilic SCBP (measured from suspended sludge) than in the thermophilic ASP. Under the lowest HRT the mesophilic ASP gave better performance (as SVI, COD_{filt}, and COD_{tot} removals) after the thermophilic SCBP than after the thermophilic ASP. Measured sludge yields were low (less than 0.1 kg suspended solids (SS) kg $COD_{filt\ removed}^{-1}$) in all processes. Both thermophilic treatments removed 80-85% of soluble COD (COD_{sol}) whereas suspended COD (COD_{susp}) and colloidal COD (COD_{col}) were increased. Both mesophilic post-treatments removed all COD_{col} and most of the COD_{susp} from the thermophilic effluents. In conclusion, combined thermophilic-mesophilic treatment appeared to be easily operable and produced high effluent quality.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Suvilampi, J., Lehtomäki, A., Rintala, J.
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Publication date: Jul 2003

Peer-reviewed: Yes

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Journal: Bioresource Technology
Volume: 88
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ISSN (Print): 0960-8524
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Scopus rating (2003): SJR 0.942 SNIP 1.673
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Activated sludge process, Combined treatment, Mesophilic, Suspended carrier biofilm process, Thermophilic
DOIs:

10.1016/S0960-8524(03)00006-3
Source: Scopus
Source ID: 0037411631
Research output: Contribution to journal › Article › Scientific › peer-review

Modeling of anaerobic degradation of solid slaughterhouse waste: Inhibition effects of long-chain fatty acids or ammonia
The anaerobic bioconversion of solid poultry slaughterhouse wastes was kinetically investigated. The modified version of <METHANE> simulation model was applied for description of experimental data in mesophilic laboratory digester and assays. Additionally, stages of formation and consumption of long chain fatty acids (LCFA) were included in the model. Batch data on volatile solids, ammonium, acetate, butyrate, propionate, LCFA concentrations, pH level, cumulative volume, and methane partial pressure were used for model calibration. As a reference, the model was used to describe digestion of solid sorted household waste. Simulation results showed that an inhibition of polymer hydrolysis by volatile fatty acids and acetogenesis by NH_3 or LCFA could be responsible for the complex system dynamics during degradation of lipid- and protein-rich wastes.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Russian Academy of Sciences, University of Jyväskylä, Jyväskylän yliopisto
Contributors: Lokshina, L. Y., Vavilin, V. A., Salminen, E., Rintala, J.
Number of pages: 18
Pages: 15-32
Publication date: Apr 2003
Peer-reviewed: Yes

Publication information
Journal: Applied Biochemistry and Biotechnology
Volume: 109
Issue number: 1-3
ISSN (Print): 0273-2289
Ratings:

Scopus rating (2003): SJR 0.444 SNIP 0.695
Original language: English
ASJC Scopus subject areas: Biochemistry, Genetics and Molecular Biology(all), Biochemistry, Biotechnology, Bioengineering
Keywords: Ammonia, Anaerobic digestion, Inhibition, Long-chain fatty acids, Model, Poultry slaughterhouse waste, Sorted solid household waste
DOIs:

10.1385/ABAB:109:1-3:15
Source: Scopus
Source ID: 0038459271
Research output: Contribution to journal › Article › Scientific › peer-review

Anaerobic digestion of organic solid poultry slaughterhouse waste - A review
This work reviews the potential of anaerobic digestion for material recovery and energy production from poultry slaughtering by-products and wastes. First, we describe and quantify organic solid by-products and wastes produced in poultry farming and poultry slaughterhouses and discuss their recovery and disposal options. Then we review certain fundamental aspects of anaerobic digestion considered important for the digestion of solid slaughterhouse wastes. Finally, we present an overview of the future potential and current experience of the anaerobic digestion treatment of these materials.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Jyväskylä, Jyväskylän yliopisto
Contributors: Salminen, E., Rintala, J.
Number of pages: 14
Pages: 13-26
Publication date: 2002
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 83
Issue number: 1
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2002): SJR 0.868 SNIP 1.278
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Ammonia, Anaerobic digestion, Inhibition, Long-chain fatty acids, Nutrients recovery, Renewable energy, Solid poultry slaughterhouse waste
DOIs:

10.1016/S0960-8524(01)00199-7
Source: Scopus
Source ID: 0036158732
Research output: Contribution to journal › Article › Scientific › peer-review

Anaerobically digested poultry slaughterhouse wastes as fertiliser in agriculture
Chemical and physical analysis, 27-d plant growth assays with carrot (Daucus carota) and Chinese cabbage (Brassica campestris var. chinensis), and 5-d phytotoxicity assays with Chinese cabbage and perennial ryegrass (Lolium perenne) were used to investigate the suitability of anaerobically digested poultry slaughterhouse waste for fertiliser in agriculture and the effect of aerobic post-treatment on the properties of the digested material.The digested material appeared to be rich in nitrogen. In 27-d assays with digested material as nitrogen source, carrots grew almost as well as those fertilised with a commercial mineral fertiliser used as reference, whereas, the growth of Chinese cabbage was inhibited. In further 5-d phytotoxicity assays, the digested material inhibited the germination and root growth of ryegrass and Chinese cabbage, apparently because of organic acids present in it. Aerobic post-treatment of the material reduced its phytotoxicity but, probably due to the volatilisation of ammonia, resulted in loss of nitrogen.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Jyväskylä, Jyväskylän yliopisto
Contributors: Salminen, E., Rintala, J., Härkönen, J., Kuitunen, M., Högmander, H., Oikari, A.
Number of pages: 8
Pages: 81-88
Publication date: 2001
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 78
Issue number: 1
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2001): SJR 0.537 SNIP 1.208
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology
Keywords: Aerobic post-treatment, Ammonia, Anaerobically digested material, Organic acids, Phytotoxicity assays, Plant growth assays, Poultry slaughterhouse waste
DOIs:

10.1016/S0960-8524(00)00160-7
Source: Scopus
Source ID: 0035142679

Biological treatment of pulp and paper mill process and wastewaters under thermophilic conditions - A review

The pulp and paper industry generates high-temperature process and wastewaters, which are normally cooled down to about 40°C or less before external biological treatment. So far, treatment at high temperature has rarely been employed in the pulp and paper industry or other industrial wastewater treatment. High temperature is generally considered to suppress the performance of activated sludge and other processes. In this paper, we review some theories and recent findings from laboratory and pilot studies on biological treatment at high temperature. Experimental studies clearly indicate that biological (anaerobic, aerobic, and anaerobic-aerobic) treatment at high temperature (50-60°C) is feasible. The thermophilic process has been shown to be stable over long periods of operation, and the process removal efficiency and loading rates are comparable to, if not higher than, those achieved in the mesophilic process. Furthermore, the thermophilic process can be readily started with sludge from a mesophilic process. Biological treatment at high temperature is thus workable and may well obviate the need to cool wastewater altogether. Further studies and full-scale implementation will disclose in detail the effects of high temperature on loading potential and excess sludge production.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, Department of Biological Science
Contributors: Suvilampi, J., Lepistö, R., Rintala, J.
Number of pages: 6
Pages: 320-325
Publication date: 2001
Peer-reviewed: Yes

Publication information

Journal: Paperi ja puu
Volume: 83
Issue number: 4
ISSN (Print): 0031-1243
Ratings:

Scopus rating (2001): SJR 0.32 SNIP 0.583
Original language: English
ASJC Scopus subject areas: Chemical Engineering (miscellaneous), Materials Science (miscellaneous)
Keywords: Aerobic, Anaerobic, High temperature, Pulp and paper industry wastewaters, Thermophilic treatment
Source: Scopus
Source ID: 0034982577
Research output: Contribution to journal › Article › Scientific › peer-review

Biokalvojen rakenteen ja toiminnan simulointi tuo uutta tietoa rasvoista

The article discusses the importance of lipid membranes in biological systems and the use of molecular dynamics simulations to explore their structure and function. Results from a recent study on the effects of polyunsaturation on a phospholipid membrane are presented [Biophys. J. 73 (1997) 2907].

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Oulu
Contributors: Hyvönen, M. T., Rantala, T. T., Ala-Korpela, M.
Number of pages: 4
Pages: 222-225
Publication date: 1999
Peer-reviewed: Yes

Publication information

Journal: Kemia - Kemi
Volume: 26
Issue number: 3
ISSN (Print): 0355-1628
Ratings:

Scopus rating (1999): SJR 0.129 SNIP 0.113
Original language: Finnish
ASJC Scopus subject areas: Chemical Engineering(all)
URLs:

http://www.scopus.com/inward/record.url?scp=0043139016&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 0043139016
Research output: Contribution to journal › Article › Scientific › peer-review

Start-up and Operation of Laboratory-Scale Thermophilic Upflow Anaerobic Sludge Blanket Reactors Treating Vegetable Processing Wastewaters

Thermophilic anaerobic treatment of hot vegetable processing wastewaters was studied in laboratory-scale UASB reactors at 55°C. The high-strength wastewater streams, deriving from steam peeling and blanching of carrot, potato and swede were used. The reactors were inoculated with mesophilic granular sludge. Stable thermophilic methanogenesis with about 60% COD removal was reached within 28 days. During the 134 day study period the loading rate was increased up to 24 $kg_{COD}\ m^{-3}\ day^{-1}$. High treatment efficiency of more than 90% COD removal and concomitant methane production of 7.3 $m^3\ CH_4\ m^{-3}\ day^{-1}$ were achieved. The anaerobic process performance was not affected by the changes in the wastewater due to the different processed vegetables. The results demonstrated the feasibility of thermophilic anaerobic treatment of vegetable processing wastewaters in UASB reactors.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Science and Environmental Engineering, Tampere University of Technology, University of Jyväskylä, Jyväskylän yliopisto, Aalto University
Contributors: Lepistö, S. S., Rintala, J. A.
Number of pages: 9
Pages: 331-339
Publication date: Mar 1997
Peer-reviewed: Yes

Publication information
Journal: Journal of Chemical Technology and Biotechnology
Volume: 68
Issue number: 3
ISSN (Print): 0268-2575
Original language: English
ASJC Scopus subject areas: Biotechnology, Chemical Engineering(all), Bioengineering, Chemistry(all)
Keywords: Anaerobic treatment, Food industry, Granular sludge, Start-up, Thermophilic, Vegetable processing wastewater
DOIs:
10.1002/(SICI)1097-4660(199703)68:3<331::AID-JCTB657>3.0.CO;2-Z
URLs:
http://www.scopus.com/inward/record.url?scp=0030616058&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
Contribution: organisation=bio,FACT1=1
Source: researchoutputwizard
Source ID: 30520
Research output: Contribution to journal › Article › Scientific › peer-review

A two-stage thermophilic anaerobic process for the treatment of source sorted household solid waste

Hydrolysis and acidification of source sorted household solid waste (SSHSW) at 70°C was studied using continuous stirred tank reactor (CSTR). The soluble COD/total initial COD-ratio of the SSHSW increased from 25 to 35% during the CSTR treatment. A thermophilic (55°C) upflow anaerobic sludge blanket (UASB) reactor removed up to 80% of the COD in the liquid fraction of the SSHSW treated at 70°C.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: The Anaerobic Microbiology/Biotechnology Group, Department of Environmental Science and Engineering , Danmarks Tekniske Universitet, DTU Informatik
Contributors: Rintala, J. A., Ahring, B. K.
Number of pages: 6
Pages: 1097-1102
Publication date: Oct 1994
Peer-reviewed: Yes

Publication information

Journal: Biotechnology Letters
Volume: 16
Issue number: 10
ISSN (Print): 0141-5492
Original language: English
ASJC Scopus subject areas: Microbiology, Applied Microbiology and Biotechnology, Bioengineering, Biotechnology
DOIs:
10.1007/BF01022410
Source: Scopus
Source ID: 0028036651
Research output: Contribution to journal › Article › Scientific › peer-review

Thermophilic anaerobic digestion of source-sorted household solid waste: the effects of enzyme additions

Thermophilic (55° C) methanation of source-sorted household solid waste (HSW) was studied in batch and in continuous experiments. Furthermore, the effects of additions of xylanase, lipase, protease and a mixture of these on the methanation were tested. In the batch studies, comparative assays with active and inactive enzymes were used to elucidate the role of the added enzymes. The results showed that the HSW was readily digestible, up to 400-590 $mlCH_4 \cdot g^{-1}$ volatile solids (VS) was produced. Only with protease added, at a concentration of 1.1 Anson protease $units \cdot kg^{-1}$ VS was a higher specific methanogenic activity found with active enzymes compared to inactive (autoclaved) enzymes or without enzyme addition. The methane yield by conversion of the HSW in the batch assays and in the reactor studies was not increased by enzyme additions (enzyme mixture).

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: The Anaerobic Microbiology/Biotechnology Group, Department of Biotechnology, Danmarks Tekniske Universitet, DTU Informatik
Contributors: Rintala, J. A., Ahring, B. K.
Number of pages: 4
Pages: 916-919
Publication date: Feb 1994
Peer-reviewed: Yes

Publication information

Journal: Applied Microbiology and Biotechnology
Volume: 40
Issue number: 6
ISSN (Print): 0175-7598
Original language: English
ASJC Scopus subject areas: Microbiology (medical), Microbiology, Bioengineering, Biotechnology
DOIs:
10.1007/BF00173999
Source: Scopus
Source ID: 0028258804
Research output: Contribution to journal › Article › Scientific › peer-review

Sorption and retention of ethylene glycol monoethyl ether (EGME) on silicas

Sorption of ethylene glycol monoethyl ether (EGME) was studied gravimetrically and correlated with the results of retention experiments where samples wetted with EGME were evacuated. If a sorption measurement is done conventionally by increasing the vapor pressure slowly by small steps, molecules are packed smoothly along the surface, and a fairly flat isotherm is obtained. If the sample is directly exposed to a high vapor pressure or the normal sorption mode is disturbed by directly reducing the pressure, more EGME is sorbed. Then some of the molecules may be fixed only at their hydroxy ends. The evacuation curves are best interpreted in a semilogarithmic form, by which the value of the monolayer capacity can be estimated. EGME can be used for surface area measurements of silicas, but with porous samples areas that are too large are probably obtained. When EGME is packed smoothly on standard silica TK 800, one molecule occupies an area of 0.44 nm^2, computed by the BET equation with three parameters, or 1 mg of EGME covers 3.0 m^2.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Rakennetekniikka, Tampere University of Technology, University of Tampere
Contributors: Kellomäki, A., Kuula-Väisänen, P., Nieminen, P.
Number of pages: 6

Pages: 373-378
Publication date: 1989
Peer-reviewed: Yes

Publication information
Journal: Journal of Colloid and Interface Science
Volume: 129
Issue number: 2
ISSN (Print): 0021-9797
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ASJC Scopus subject areas: Colloid and Surface Chemistry, Physical and Theoretical Chemistry, Surfaces and Interfaces
DOIs:
10.1016/0021-9797(89)90450-5
URLs:
http://www.scopus.com/inward/record.url?scp=45149145866&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 45149145866
Research output: Contribution to journal › Article › Scientific › peer-review

A Finite Cluster Approach to the Electron-Hole Pair Damping of the Adsorbate Vibration: CO Adsorbed on Cu(100)
Abstract: A finite cluster method is applied to describe the energy transfer from the adsorbate vibrations to the electron-hole pair excitations. For CO stretch vibration on Cu(100) surface a value of 0.5 meV is found for the consequent damping (corresponding to the lifetime of $1.3 \cdot 10^{-12}$ s) in an agreement with a recently measured vibrational line width. The mechanism behind the electron-hole pair excitations is found to be charge oscillations between the molecular $2\pi^*$ resonance and the substrate, caused by the molecular vibration. Cluster size effects have been found to be negligible.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chalmers University of Technology, University of California, Santa Barbara
Contributors: Rantala, T. T., Rosén, A., Hellsing, B.
Number of pages: 9
Pages: 173-181
Publication date: 1986
Peer-reviewed: Yes

Publication information
Journal: Studies in Surface Science and Catalysis
Volume: 26
Issue number: C
ISSN (Print): 0167-2991
Original language: English
ASJC Scopus subject areas: Condensed Matter Physics, Catalysis, Physical and Theoretical Chemistry, Materials Chemistry, Surfaces, Coatings and Films
DOIs:
10.1016/S0167-2991(09)61238-6
Source: Scopus
Source ID: 77956976821
Research output: Contribution to journal › Article › Scientific › peer-review

Mixed carbon substrates: a necessary nuisance or a missed opportunity?
Although fermentation with single carbon sources is the preferred mode of operation in current industrial biotechnology, the use of multiple substrates has been continuously investigated throughout the years. Generally, microbial metabolism varies significantly when cells are presented with mixed carbon substrates compared to a single carbon-energy source, as different nutrients interact in complex ways within the metabolic network. By exploiting these distinct modes of interaction, researchers have identified unique opportunities to optimize metabolism using mixed carbon sources. Here we review situations where process yield and productivity are markedly improved through the judicious introduction of substrate mixtures. Our goal is to illustrate that with proper design of the choice of substrates and the way they are introduced to cultures, metabolic optimization with mixed substrates can be a unique strategy that complements genetic engineering techniques to enhance cell performance beyond what is accomplished in single substrate fermentations.

General information
Publication status: Published
MoE publication type: A2 Review article in a scientific journal

Organisations: Materials Science and Environmental Engineering, Massachusetts Institute of Technology, Department of Chemical Engineering
Contributors: Liu, N., Santala, S., Stephanopoulos, G.
Number of pages: 7
Pages: 15-21
Publication date: 1 Apr 2020
Peer-reviewed: Yes

Publication information
Journal: CURRENT OPINION IN BIOTECHNOLOGY
Volume: 62
ISSN (Print): 0958-1669
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Biomedical Engineering
DOIs:

10.1016/j.copbio.2019.07.003
Source: Scopus
Source ID: 85071874245
Research output: Contribution to journal › Review Article › Scientific › peer-review

Applications of nanocellulose/nanocarbon composites: Focus on biotechnology and medicine

Nanocellulose/nanocarbon composites are newly emerging smart hybrid materials containing cellulose nanoparticles, such as nanofibrils and nanocrystals, and carbon nanoparticles, such as “classical” carbon allotropes (fullerenes, graphene, nanotubes and nanodiamonds), or other carbon nanostructures (carbon nanofibers, carbon quantum dots, activated carbon and carbon black). The nanocellulose component acts as a dispersing agent and homogeneously distributes the carbon nanoparticles in an aqueous environment. Nanocellulose/nanocarbon composites can be prepared with many advantageous properties, such as high mechanical strength, flexibility, stretchability, tunable thermal and electrical conductivity, tunable optical transparency, photodynamic and photothermal activity, nanoporous character and high adsorption capacity. They are therefore promising for a wide range of industrial applications, such as energy generation, storage and conversion, water purification, food packaging, construction of fire retardants and shape memory devices. They also hold great promise for biomedical applications, such as radical scavenging, photodynamic and photothermal therapy of tumors and microbial infections, drug delivery, biosensorics, isolation of various biomolecules, electrical stimulation of damaged tissues (e.g., cardiac, neural), neural and bone tissue engineering, engineering of blood vessels and advanced wound dressing, e.g., with antimicrobial and antitumor activity. However, the potential cytotoxicity and immunogenicity of the composites and their components must also be taken into account.

General information
Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: BioMediTech, Research group: Micro and Nanosystems Research Group, Automation Technology and Mechanical Engineering, Research group: Plastics and Elastomer Technology, Institute of Physiology of the Czech Academy of Sciences, Slovak University of Agriculture in Nitra
Contributors: Bacakova, L., Pajorova, J., Tomkova, M., Matejka, R., Broz, A., Stepanovska, J., Prazak, S., Skogberg, A., Siljander, S., Kallio, P.
Number of pages: 32
Publication date: 2020
Peer-reviewed: Yes

Publication information
Journal: Nanomaterials
Volume: 10
Issue number: 2
Article number: 196
ISSN (Print): 2079-4991
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Materials Science(all)
Keywords: Carbon nanotubes, Cellulose nanocrystals, Diamond nanoparticles, Drug delivery, Fullerenes, Graphene, Nanofibrillated cellulose, Sensors, Tissue engineering, Wound dressing
Electronic versions:

Applications of Nanocellulose Nanocarbon 2020
DOIs:

10.3390/nano10020196
URLs:

http://urn.fi/URN:NBN:fi:tuni-202003242831

Source: Scopus
Source ID: 85078449208
Research output: Contribution to journal › Review Article › Scientific › peer-review

Understanding the Role of Lipids in Signaling Through Atomistic and Multiscale Simulations of Cell Membranes

Cell signaling controls essentially all cellular processes. While it is often assumed that proteins are the key architects coordinating cell signaling, recent studies have shown more and more clearly that lipids are also involved in signaling processes in a number of ways. Lipids do, for instance, act as messengers, modulate membrane receptor conformation and dynamics, and control membrane receptor partitioning. Further, through structural modifications such as oxidation, the functions of lipids as part of signaling processes can be modified. In this context, in this article we discuss the understanding recently revealed by atomistic and coarse-grained computer simulations of nanoscale processes and underlying physicochemical principles related to lipidsrsquo functions in cellular signaling.

General information

Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Research group: Biological Physics and Soft Matter, Research area: Computational Physics, Physics, Indian Institute of Science Education and Research Bhopal, Helsinki University
Contributors: Manna, M., Nieminen, T., Vattulainen, I.
Number of pages: 19
Pages: 421-439
Publication date: 6 May 2019
Peer-reviewed: Yes

Publication information

Journal: ANNUAL REVIEW OF BIOPHYSICS
Volume: 48
ISSN (Print): 1936-122X
Ratings:

Scopus rating (2019): CiteScore 18.3 SJR 7.456 SNIP 2.86
Original language: English
ASJC Scopus subject areas: Biophysics, Structural Biology, Bioengineering, Biochemistry, Cell Biology
Keywords: computer simulations, lipids, molecular dynamics, multiscale simulations, signaling
DOIs:

10.1146/annurev-biophys-052118-115553

Bibliographical note

EXT="Manna, Moutusi"
Source: Scopus
Source ID: 85065827906
Research output: Contribution to journal › Review Article › Scientific › peer-review

Effects of wastewater constituents and operational conditions on the composition and dynamics of anodic microbial communities in bioelectrochemical systems

Over the last decade, there has been an ever-growing interest in bioelectrochemical systems (BES) as a sustainable technology enabling simultaneous wastewater treatment and biological production of, e.g. electricity, hydrogen, and further commodities. A key component of any BES degrading organic matter is the anode where electric current is biologically generated from the oxidation of organic compounds. The performance of BES depends on the interactions of the anodic microbial communities. To optimize the operational parameters and process design of BES a better comprehension of the microbial community dynamics and interactions at the anode is required. This paper reviews the abundance of different microorganisms in anodic biofilms and discusses their roles and possible side reactions with respect to their implications on the performance of BES utilizing wastewaters. The most important operational parameters affecting anodic microbial communities grown with wastewaters are highlighted and guidelines for controlling the composition of microbial communities are given.

General information

Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Chemistry and Bioengineering, Laboratory for MEMS Applications, Universitat Freiburg im Breisgau, Karlsruhe Institute of Technology, Insitute for Technical Physics, Germany, University of Bremen
Contributors: Kokko, M., Epple, S., Gescher, J., Kerzenmacher, S.
Number of pages: 14
Pages: 376-389
Publication date: 1 Jun 2018

Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 258
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2018): CiteScore 11.1 SJR 2.157 SNIP 1.858
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
Keywords: Bioelectrochemical system, Exoelectrogen, Microbial community, Wastewater
DOIs:

10.1016/j.biortech.2018.01.090
Source: Scopus
Source ID: 85043472557
Research output: Contribution to journal › Review Article › Scientific › peer-review

Waves in hyperbolic and double negative metamaterials including rogues and solitons
The topics here deal with some current progress in electromagnetic wave propagation in a family of substances known as metamaterials. To begin with, it is discussed how a pulse can develop a leading edge that steepens and it is emphasised that such self-steepening is an important inclusion within a metamaterial environment together with Raman scattering and third-order dispersion whenever very short pulses are being investigated. It is emphasised that the self-steepening parameter is highly metamaterial-driven compared to Raman scattering, which is associated with a coefficient of the same form whether a normal positive phase, or a metamaterial waveguide is the vehicle for any soliton propagation. It is also shown that the influence of magnetooptics provides a beautiful and important control mechanism for metamaterial devices and that, in the future, this feature will have a significant impact upon the design of data control systems for optical computing. A major objective is fulfiled by the investigations of the fascinating properties of hyperbolic media that exhibit asymmetry of supported modes due to the tilt of optical axes. This is a topic that really merits elaboration because structural and optical asymmetry in optical components that end up manipulating electromagnetic waves is now the foundation of how to operate some of the most successful devices in photonics and electronics. It is pointed out, in this context, that graphene is one of the most famous plasmonic media with very low losses. It is a two-dimensional material that makes the implementation of an effective-medium approximation more feasible. Nonlinear non-stationary diffraction in active planar anisotropic hyperbolic metamaterials is discussed in detail and two approaches are compared. One of them is based on the averaging over a unit cell, while the other one does not include sort of averaging. The formation and propagation of optical spatial solitons in hyperbolic metamaterials is also considered with a model of the response of hyperbolic metamaterials in terms of the homogenisation ('effective medium') approach. The model has a macroscopic dielectric tensor encompassing at least one negative eigenvalue. It is shown that light propagating in the presence of hyperbolic dispersion undergoes negative (anomalous) diffraction. The theory is ten broadened out to include the influence of the orientation of the optical axis with respect to the propagation wave vector. Optical rogue waves are discussed in terms of how they are influenced, but not suppressed, by a metamaterial background. It is strongly discussed that metamaterials and optical rogue waves have both been making headlines in recent years and that they are, separately, large areas of research to study. A brief background of the inevitable linkage of them is considered and important new possibilities are discussed. After this background is revealed some new rogue wave configurations combining the two areas are presented alongside a discussion of the way forward for the future.

General information
Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Photonics, University of Salford, Sapienza University, IICBA, UMR 6174, Original Perspectives Ltd, Aalto University, ITMO University, Taras Shevchenko National University of Kyiv, Nazarbayev University
Contributors: Boardman, A. D., Alberucci, A., Assanto, G., Grimalsky, V. V., Kibler, B., McNiff, J., Nefedov, I. S., Rapoport, Y. G., Valagiannopoulos, C. A.
Publication date: 9 Oct 2017
Peer-reviewed: Yes

Publication information
Journal: Nanotechnology
Volume: 28
Issue number: 44
Article number: 444001
ISSN (Print): 0957-4484
Ratings:

Scopus rating (2017): CiteScore 5.2 SJR 1.079 SNIP 0.885
Original language: English

ASJC Scopus subject areas: Bioengineering, Chemistry(all), Materials Science(all), Mechanics of Materials, Mechanical Engineering, Electrical and Electronic Engineering
Keywords: rogues, solitons, waves
DOIs:

10.1088/1361-6528/aa6792
Source: Scopus
Source ID: 85032180863
Research output: Contribution to journal › Review Article › Scientific › peer-review

Liquid flame spray—a hydrogen-oxygen flame based method for nanoparticle synthesis and functional nanocoatings
In this review article, a specific flame spray pyrolysis method, Liquid Flame Spray (LFS), is introduced to produce nanoparticles using a coflow type hydrogen-oxygen flame utilizing pneumatically sprayed liquid precursor. This method has been widely used in several applications due to its characteristic features, from producing nanopowders and nanostructured functional coatings to colouring of art glass and generating test aerosols. These special characteristics will be described via the example applications where the LFS has been applied in the past 20 years.

General information
Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Physics, Research group: Aerosol Synthesis, Research area: Aerosol Physics
Contributors: Mäkelä, J. M., Haapanen, J., Harra, J., Juuti, P., Kujanpää, S.
Number of pages: 14
Pages: 141-154
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: KONA POWDER AND PARTICLE JOURNAL
Volume: 2017
Issue number: 34
ISSN (Print): 0288-4534
Ratings:

Scopus rating (2017): CiteScore 3.6 SJR 0.494 SNIP 0.939
Original language: English
ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Materials Science(all), Engineering(all)
Keywords: Aerosol, Flame spray pyrolysis, Functional coatings, Nanoparticle, Nanopowder
Electronic versions:

mäkelä et al. 2017
DOIs:

10.14356/kona.2017020
URLs:

http://urn.fi/URN:NBN:fi:tty-201703131166
Source: Scopus
Source ID: 85011710580
Research output: Contribution to journal › Review Article › Scientific › peer-review

Recent advances in nutrient removal and recovery in biological and bioelectrochemical systems
Nitrogen and phosphorous are key pollutants in wastewater to be removed and recovered for sustainable development. Traditionally, nitrogen removal is practiced through energy intensive biological nitrification and denitrification entailing a major cost in wastewater treatment. Recent innovations in nitrogen removal aim at reducing energy requirements and recovering ammonium nitrogen. Bioelectrochemical systems (BES) are promising for recovering ammonium nitrogen from nitrogen rich waste streams (urine, digester liquor, swine liquor, and landfill leachate) profitably. Phosphorus is removed from the wastewater in the form of polyphosphate granules by polyphosphate accumulating organisms. Alternatively, phosphorous is removed/recovered as Fe-P or struvite through chemical precipitation (iron or magnesium dosing). In this article, recent advances in nutrients removal from wastewater coupled to recovery are presented by applying a waste biorefinery concept. Potential capabilities of BES in recovering nitrogen and phosphorous are reviewed to spur future investigations towards development of nutrient recovery biotechnologies.

General information
Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Department of Chemistry and Bioengineering
Contributors: Nancharaiah, Y. V., Venkata Mohan, S., Lens, P. N. L.
Pages: 173–185

Publication date: Sep 2016
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 215
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2016): CiteScore 9.9 SJR 2.215 SNIP 1.945
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Microbial fuel cells, Nitrogen removal, Phosphorus removal, Waste biorefinery, Wastewater
DOIs:

10.1016/j.biortech.2016.03.129
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Source ID: 84962019395
Research output: Contribution to journal › Review Article › Scientific › peer-review

Metals removal and recovery in bioelectrochemical systems: A review
Metal laden wastes and contamination pose a threat to ecosystem well being and human health. Metal containing waste streams are also a valuable resource for recovery of precious and scarce elements. Although biological methods are inexpensive and effective for treating metal wastewaters and in situ bioremediation of metal(loid) contamination, little progress has been made towards metal(loid) recovery. Bioelectrochemical systems are emerging as a new technology platform for removal and recovery of metal ions from metallurgical wastes, process streams and wastewaters. Biodegradation of organic matter by electroactive biofilms at the anode has been successfully coupled to cathodic reduction of metal ions. Until now, leaching of Co(II) from LiCoO<inf>2</inf> particles, and removal of metal ions i.e. Co(III/II), Cr(VI), Cu(II), Hg(II), Ag(I), Se(IV), and Cd(II) from aqueous solutions has been demonstrated. This article reviews the state of art research of bioelectrochemical systems for removal and recovery of metal(loid) ions and pertaining removal mechanisms.

General information
Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), CSIR-Indian Institute of Chemical Technology, Bhabha Atomic Research Centre
Contributors: Nancharaiah, Y. V., Venkata Mohan, S., Lens, P.
Number of pages: 13
Pages: 102-114
Publication date: 2015
Peer-reviewed: Yes
Early online date: 17 Jun 2015

Publication information
Journal: Bioresource Technology
Volume: 195
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2015): CiteScore 9.2 SJR 2.243 SNIP 1.899
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Bioelectrochemical treatment (BET), Biorecovery, Heavy metals, Microbial fuel cells, Wastewater treatment
DOIs:

10.1016/j.biortech.2015.06.058
URLs:

http://www.scopus.com/inward/record.url?scp=84931864864&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84945442633
Research output: Contribution to journal › Review Article › Scientific › peer-review

Stimuli-responsive photonic polymer coatings
This feature article focuses on the highlights in the development of photonic polymer coatings that can change their volume or surface topology in a reversible, dynamic fashion when exposed to an external stimulus. Topographic response is established using hydrogels or liquid crystal polymer networks. By changing the surface corrugation in response to light various functional coating properties can be modulated, for instance wettability and/or mechanical friction. The same

volume changes in photonic coatings caused by different stimuli lead to changes in light reflection.

General information
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MoE publication type: A2 Review article in a scientific journal
Organisations: Eindhoven University of Technology
Contributors: Stumpel, J. E., Broer, D. J., Schenning, A. P. H. J.
Number of pages: 10
Pages: 15839-15848
Publication date: 28 Dec 2014
Peer-reviewed: Yes

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Volume: 50
Issue number: 100
ISSN (Print): 1359-7345
Ratings:

Scopus rating (2014): CiteScore 11.6 SJR 2.692 SNIP 1.427
Original language: English
ASJC Scopus subject areas: Chemistry(all), Catalysis, Ceramics and Composites, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Materials Chemistry, Metals and Alloys
DOIs:

10.1039/c4cc05072j
URLs:

http://www.scopus.com/inward/record.url?scp=84911908006&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
EXT="Stumpel, Jelle"
Source: Scopus
Source ID: 84911908006
Research output: Contribution to journal › Review Article › Scientific › peer-review

Enablers and barriers of smart data-based asset management services in industrial business networks
Recent academic research has paid particular attention to how digitalization disrupts current business models and business environments. Furthermore, servitization has gained significant attention. However, so far only a fraction of the wide range of opportunities related to digitalization has been realized. In this paper we aim to better understand the drivers, limitations and stakeholder expectations in different industrial business environments. In the proposed paper, we address digitalization in the area of engineering asset management from the following perspectives: (1) enablers and barriers of digitalized asset management service business, (2) availability and use of data for decision-making support, and (3) changes for business models. We also further contemplate which decision-making situations need to be supported by digital asset services. The paper is based on data received from a company workshop and a literature review.

General information
Publication status: Published
MoE publication type: A3 Part of a book or another research book
Organisations: Mechanical Engineering and Industrial Systems, Research area: Design, Development and LCM, VTT Technical Research Centre of Finland
Contributors: Ahonen, T., Hanski, J., Hyvärinen, M., Kortelainen, H., Uusitalo, T., Vainio, H., Kunttu, S., Koskinen, K.
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Pages: 51-60
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Publication series
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ASJC Scopus subject areas: Automotive Engineering, Aerospace Engineering, Mechanical Engineering, Fluid Flow and Transfer Processes
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Bibliographical note
jufoid=79273
Source: Scopus
Source ID: 85056662614
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Understanding selenium biogeochemistry in engineered ecosystems: Transformation and analytical methods
Selenium is used extensively in many industries, and it is necessary for human nutrition. On the other hand, it is also toxic at slightly elevated concentrations. With the advent of industrialisation, selenium concentrations in the environment due to anthropogenic activities have increased. Treatment of selenium-laden wastewaters and bioremediation are of increasing importance for counteracting contamination. Developing an effective treatment process requires the identification of all the selenium chemical species and their concentrations in engineered settings. This chapter collates the available techniques for identifying and quantifying various selenium species in gas, liquid, and solid phases, including X-ray absorption spectroscopy, electron microscopy, and liquid/gas chromatography. This chapter also throws light on isotopic fractionation and sequential extraction methods used to study the behaviour of selenium. Prior to the discussion of analytical methods, this chapter discusses selenium mineralogy and biochemistry. Finally, the chapter concludes by discussing potential future analytical techniques that will further improve our understanding of selenium biogeochemistry in engineered bioprocesses.

General information
Publication status: Published
MoE publication type: A3 Part of a book or another research book
Organisations: Chemistry and Bioengineering, UPEM, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, University of Applied Sciences and Arts Northwestern Switzerland (FHNW), Wageningen University and Research Centre, Laboratoire de Biochimie Théorique
Contributors: Jain, R., Van Hullebusch, E. D., Lenz, M., Farges, F.
Number of pages: 24
Pages: 33-56
Publication date: 2 Sep 2017

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Publisher: Springer International Publishing
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ISBN (Electronic): 9783319578316
ASJC Scopus subject areas: Engineering(all), Chemical Engineering(all), Environmental Science(all), Immunology and Microbiology(all), Chemistry(all)
Keywords: Bioremediation, Elemental speciation, Redox labile elements, Trace elements
DOIs:
10.1007/978-3-319-57831-6_2
Source: Scopus
Source ID: 85034980155
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Nanostructured Ionomeric Elastomers
Driven by the desire to find an alternative way of vulcanizing elastomers without sulfur, researchers have widely explored ionic crosslinking techniques. The opportunity was taken to play with the functionality of the host polymer and its modification process to develop nanostructured ionic elastomers. Neutralization of polar elastomers by various divalent metal cations has been the route most employed for fabrication of this class of material. Ionic association or aggregation on the molecular level results in microphase separation of certain regions and, hence, enables easier processing. Thermally labile ionic domains introduced into the network make the entire material thermoresponsive and, therefore, it is possible to obtain reversible transition of dynamic mechanical properties. The unique network structure of these materials has led to outstanding physical properties that have not been achieved so far for conventional sulfidic networks. Consequently, many multifunctional and smart materials have been envisaged and designed using these systems. A detailed overview is provided on the various nanostructured ionic elastomers developed over the years. It would not be exaggerating to mention in the context of the discussion that nanostructured ionic elastomers will definitely open up new horizons in materials research.

General information
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MoE publication type: A3 Part of a book or another research book
Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Apollo Tyres Limited, Leibniz-Institut für Polymerforschung Dresden E.V., Vodafone Department of Mobile Communications Systems
Contributors: Basu, D., Das, A., Stöckelhuber, K. W., Wießner, S.
Number of pages: 32
Pages: 235-266

Publication date: 17 Aug 2016

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Editors: Stöckelhuber, K. W., Das, A., Klüppel, M.
ISBN (Print): 9783319476957
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Name: Advances in Polymer Science
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ASJC Scopus subject areas: Chemical Engineering(all), Polymers and Plastics, Organic Chemistry
Keywords: Elastomers, Ionic crosslinking, Self healing rubber
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URLs:
http://www.scopus.com/inward/record.url?scp=84994670333&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
JUFOID=50551
Source: Scopus
Source ID: 84994670333
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Framework for optimization and scheduling of a copper production plant
This work presents a nonlinear optimization and scheduling approach applied to a copper production plant. The solution maximizes smelting furnace production and provides valid converting schedules by simulating the evolution of the process over the optimization horizon. The production process is briefly described and the main models used to predict and calculate furnace and converter parameters are detailed. Though the solution is concentrated on the main elements, copper and iron, the optimization framework enables easy future augmentation with more complex models. A schedule optimization case is presented.

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Publication status: Published
MoE publication type: A3 Part of a book or another research book
Organisations: Department of Automation Science and Engineering, Research area: Dynamic Systems, Research area: Measurement Technology and Process Control
Contributors: Suominen, O., Mörsky, V., Ritala, R., Vilkko, M.
Number of pages: 6
Pages: 1243-1248
Publication date: 25 Jun 2016

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Publisher: Elsevier Science B.V.
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ISSN (Print): 1570-7946
ASJC Scopus subject areas: Chemical Engineering(all), Computer Science Applications
Keywords: copper smelting, modelling, nonlinear optimization, Scheduling
DOIs:
10.1016/B978-0-444-63428-3.50212-5
URLs:
http://www.scopus.com/inward/record.url?scp=84994385954&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
JUFOID=70254
Source: Scopus
Source ID: 84994385954
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Two models for hydraulic cylinders in flexible multibody simulations

In modelling hydraulic cylinders interaction between the structural response and the hydraulic system needs to be taken into account. In this chapter two approaches for modelling flexible multibody systems coupled with hydraulic actuators i.e. cylinders are presented and compared. These models are the truss-elementlike cylinder and bending flexible cylinder models. The bending flexible cylinder element is a super-element combining the geometrically exact Reissner-beam element, the C^1-continuous slide-spring element needed for the telescopc movement and the hydraulic fluid field. Both models are embeded with a friction model based on a bristle approach. The models are implemented in a finite element enviroment. In time the coupled stiff differential equation system is integrated using the L-stable Rosenbrock method.

General information

Publication status: Published
MoE publication type: A3 Part of a book or another research book
Organisations: Department of Civil Engineering, Research group: Structural Mechanics, Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, FS Dynamics Finland Oy Ab
Contributors: Ylinen, A., Mäkinen, J., Kouhia, R.
Number of pages: 31
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Publication date: 2016

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Publisher: Springer
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ISSN (Print): 1871-3033
ASJC Scopus subject areas: Computational Mathematics, Modelling and Simulation, Fluid Flow and Transfer Processes, Computer Science Applications, Civil and Structural Engineering, Electrical and Electronic Engineering, Biomedical Engineering
DOIs:

10.1007/978-3-319-27996-1_17

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JUFOID=79940
EXT="Ylinen, Antti"
Source: Scopus
Source ID: 84964233721
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Functional model for organisational and safety culture

Cultures are usually defined as shared values, attitudes and behaviour of certain group. The core of culture is inside person's mind. Only through behaviour or other actions of persons the culture becomes visible and shareable. Cultural artefacts and all other perceptible signs of culture are formed through action. From this perspective culture requires functionality. It does not exist nor spread without activity of individuals. In systems theory there is a methodological distinction between theoretical system and empirical system. Theoretical system "is a complex of concepts, suppositions, and propositions having both logical integration and empirical reference". Empirical system is "a set of phenomena in the observable world that is amenable to description and analysis by means of a theoretical system". However, in cultural context, theoretical models usually describe only properties of the empirical system. Usually the functionality of the culture is left undefined. Therefore theoretical models may have flaws in their ability to describe the functionality of the culture, which is essential part of the culture. In this paper we use a novel functional model to explore the functionality of the most commonly used culture models. We inspect Schein's organizational culture model, Cooper's reciprocal safety culture model and Johnson's cultural web. We study them and their functionality with our own functional model, which integrates person to sociotechnical system and shows person-sociotechnical system interaction. This study clearly shows that if culture's basis is in shared mental models, then the question whether organization is or has culture is absurd. As Antonsen has pointed out certain mandatory organizational features are clearly structural and not cultural. We also emphasize the behavioural aspect when defining cultural issues. The shared mental model alone is not sufficient requirement to define a feature as a cultural artefact, nor is the behaviour all employees share. Behaviour or action is cultural artefact only when the members of the culture have truly free will to choose their behaviour.

General information

Publication status: Published
MoE publication type: A3 Part of a book or another research book
Organisations: Pori Department
Contributors: Porkka, P. L.
Number of pages: 6
Pages: 907-912
Publication date: 2016

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Publisher: Italian Association of Chemical Engineering AIDIC
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Name: Chemical Engineering Transactions
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DOIs:

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Bibliographical note
JUFOID=70222
Source: Scopus
Source ID: 84976878615
Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

Enhancing CT 3D Images by Independent Component Analysis of Projection Images
Computed tomography (CT) is an imaging modality producing 3D images from sets of 2D X-ray images taken around the object. The images are noisy by nature, and segmentation of the 3D images is tedious. Also, detection of low contrast objects may be difficult, if not impossible. Here, we propose an independent component analysis (ICA) based method to process sets of 2D projection images prior to 3D reconstruction to remove noise, and to enhance objects for detection and segmentation. In this paper, a proof-of-concept is provided: the proposed method was able to separate noise and image components, as well as to make visible objects that were not observable in 3D images without processing. We demonstrate our method in object separation with 2D slice image processing simulations, and by enhancing a 3D image of a polymer sample taken with Xradia MicroXCT-400. The method is applicable in any CT tomography for which a number of project image sets with different contrasts can be taken, e.g., in multispectral fashion.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Research group: Computational Biophysics and Imaging Group, BioMediTech
Contributors: Hannula, M., Hyttinen, J. A., Tanskanen, J. M.
Number of pages: 9
Pages: 381-389
Publication date: 2020

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Publisher: Springer
Editors: Henriques, J., de Carvalho, P., Neves, N.
ISBN (Print): 9783030316341

Publication series
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ISSN (Electronic): 1433-9277
ASJC Scopus subject areas: Bioengineering, Biomedical Engineering
Keywords: 3D imaging, Computed tomography, CT, Image processing, Independent component analysis, Micro-CT, µCT
DOIs:

10.1007/978-3-030-31635-8_46

Bibliographical note
dupl=51710539

Source: Scopus
Source ID: 85075871982
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Ectopic Beat Detection from Wrist Optical Signals for Sinus Rhythm and Atrial Fibrillation Subjects

Ectopic beats are abnormal cardiac beats originating from a location different than the sino-atrial node and therefore not being controlled by the autonomous nervous system. Thus, correct heart rate variability analysis inevitably requires accurate ectopic beat detection. Furthermore, an accurate ectopic beat detection is crucial to differentiate irregular cardiac rhythm due to different types of pathological arrhythmias from those caused by isolated ectopic beats. In this paper, we present an algorithm for ectopic beat detection based on wrist plethysmographic (PPG) signals. The proposed algorithm relies on analyzing the inter-beat patterns while considering the heart-rhythm condition; whether sinus rhythm (SR) or atrial fibrillation (AF). We monitor 29 patients recovering from surgery in the post-anesthesia care unit. During the recordings, 15 patients had SR and 14 patients had AF. The proposed ectopic beat detection algorithm achieves a sensitivity of and a specificity of 2.12.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Research group: Sensor Technology and Biomeasurements (STB), PulseOn SA, Tampere University Hospital, Pulseon Oy, Tampere University
Contributors: Haddad, S., Harju, J., Tarniceriu, A., Halkola, T., Parak, J., Korhonen, I., Yli-Hankala, A., Vehkaoja, A.
Number of pages: 9
Pages: 150-158
Publication date: 2020

Host publication information

Title of host publication: 15th Mediterranean Conference on Medical and Biological Engineering and Computing – MEDICON 2019 - Proceedings of MEDICON 2019
Publisher: Springer
Editors: Henriques, J., de Carvalho, P., Neves, N.
ISBN (Print): 9783030316341

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ASJC Scopus subject areas: Bioengineering, Biomedical Engineering
Keywords: Atrial fibrillation, Ectopic beat detection, Heart rate variability, Photoplethysmography
DOIs:
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Bibliographical note

EXT="Parak, Jakub"
dupl=51710603
Source: Scopus
Source ID: 85075876200
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Deformability analysis and improvement in stretchable electronics systems through finite element analysis

Stretchable electronic systems employ a combination of extremely deformable substrates with electrically conductive inks printed on their surface, on which components are connected. The absence of solid metal as conductive material greatly enhances the deformability of these systems. However, although being able to sustain high deformation, the presence of rigid components heavily affects the achievable deformation levels due to strain concentrations near the interconnection area. In order to improve stretchability under these conditions, a combination of research on materials for conductive inks and optimization of the employed layout is needed. Especially for the latter, the use of Finite Element (FE) modeling is very useful, since it allows to locate critical regions for deformation behavior and to perform design optimization and instability analyses. In this work, the authors show the application of this strategy to improve mechano-electrical performance of the system under uniaxial tension by modelling and then modifying the overall stiffness of specific sample regions. Depending on the specific need, different strategies can be adopted to intervene on stiffness changes, such as material addition to specific regions. This work shows that, in particular, a simple technique such as laser cutting can be used to tailor the local material parameters at a deeper level, thus allowing decrease in stiffness gradients and a general enhancement of electrical performances under high levels of uniaxial deformation of the sample, as also predicted in the FE analyses.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Electrical Engineering, Research group: Plastics and Elastomer Technology, Research group: Laboratory for Future Electronics, Materials Science and Environmental Engineering
Contributors: Di Vito, D., Mosallaei, M., Vahed, B. K., Kanerva, M., Mäntysalo, M.
Number of pages: 9
Pages: 755-763
Publication date: 2020

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Publisher: Springer
Editors: Carcaterra, A., Graziani, G., Paolone, A.
ISBN (Print): 9783030410568
ISBN (Electronic): 978-3-030-41057-5

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ASJC Scopus subject areas: Automotive Engineering, Aerospace Engineering, Mechanical Engineering, Fluid Flow and Transfer Processes
Keywords: FEM, Optimization, Stretchable electronics
Electronic versions:

Deformability analysis and improvement in stretchable 2020. Embargo ended: 31/03/21
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URLs:

http://urn.fi/URN:NBN:fi:tuni-202008046388. Embargo ended: 31/03/21

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jufoid=79273
Source: Scopus
Source ID: 85083958324
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Moving Web and Dynamic Problem of Aerothermoelastic Vibrations and Instability
The paper is devoted to the analysis of the axially travelling web supported by a system of fixed rollers and submerged in axially flowing gas medium. In order to accurately model the dynamics and stability of a lightweight moving web, the interaction between it and the surrounding air is taken into account. The light weight of the moving web leads to the inertial contribution of the surrounding air to the acceleration of the material becoming significant. In the context of this paper we apply a Galerkin method for dynamic stability analysis of the moving web based on developed added-mass model.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Civil Engineering, Research group: Electromechanics, Russian Acad Sci, Russian Academy of Sciences, Kotelnikov Inst Radio Engn & Elect
Contributors: Banichuk, N., Ivanova, S., Jeronen, J.
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Pages: 66-71
Publication date: 2020

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Publisher: Springer
Editors: Indeitsev, D., Krivtsov, A.
ISBN (Print): 9783030498818
ISBN (Electronic): 978-3-030-49882-5

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ASJC Scopus subject areas: Automotive Engineering, Aerospace Engineering, Mechanical Engineering, Fluid Flow and Transfer Processes
Keywords: Aeroelastic vibrations, Instability, Moving web
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Bibliographical note
JUFOID=79273
Source: Scopus
Source ID: 85090672412
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Miniaturized stimulator for imaging of live cell responses to high frequency mechanical vibration
Cellular mechanobiology is highly important for tissue development and disease formation. However, lack of proper tools limit investigation of the cellular responses to different mechanical cues. High frequency (HF) vibration has already been applied in different cellular applications, but the knowledge of the stimulation effect on cells is limited. To meet this challenge, we designed a HF vibration stimulator for combined mechanical manipulation of live cells and high-resolution light-microscopy. Our system utilizes a commercial miniaturized speaker to vibrate a 3D printed sample vehicle horizontally. Technical tests demonstrated excellent performance at lower frequencies (30–60 Hz), enabling even high magnitude (HMHF, $G_{peak} \geq 1\ G_{peak}$) method. Real-time acceleration measurement and light-microscopy both revealed accurately and precisely produced low magnitude (LMHF, $G_{peak} < 1\ G_{peak}$) vibrations. With our system, we could observe cellular responses to the LMHF (0.2 G_{peak}, 30 Hz) vibration. In this paper, we introduce an inexpensive stimulation platform for the mechanobiology research of different cell applications.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Research group: Computational Biophysics and Imaging Group, BioMediTech
Contributors: Halonen, H. T., Hyttinen, J. A., Ihalainen, T. O.
Number of pages: 7
Pages: 21-27
Publication date: 11 May 2019

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Title of host publication: CMBEBIH 2019 - Proceedings of the International Conference on Medical and Biological Engineering
Publisher: Springer Verlag
Editors: Badnjevic, A., Gurbeta Pokvić, L., Škrbić, R., Badnjevic, A., Gurbeta Pokvić, L.
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ASJC Scopus subject areas: Bioengineering, Biomedical Engineering
Keywords: High frequency vibration, Live cell imaging, Mechanotransduction
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Miniaturized stimulator for imaging of live cell responses 2019
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http://urn.fi/URN:NBN:fi:tuni-202002061909

Bibliographical note
jufoid=58152
dupl=51710515
Source: Scopus
Source ID: 85066029834
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

The electrical conductivity of human cerebrospinal fluid in vivo
Cerebrospinal fluid (CSF) is a clear, highly conductive liquid. Due to its much higher electric conductivity compared to other intracranial tissues, its influence is significant, for example, on volume conductor models, current distribution and heat generation in RF surgery. It has already been shown previously that it is important to include CSF in models to

achieve more accurate results. Conductivity values measured in vitro are commonly used in modelling because in vivo values are not available. We have developed a method for taking calibrated in vivo human CSF conductivity measurements with a needle electrode. We used this method to take CSF conductivity measurements from four patients during brain surgeries that were conducted to remove tumours. The patients were selected so that the surgical path went through a ventricle to make sure that there was enough CSF volume to take the measurements. Two of the patients had meningiomas and the other two had gliomas. Measurements taken from clear CSF with our method resulted in conductivity values of 1.79–1.81 S/m. Impurities such as blood or the presence of cystic brain tumour decreased the measured electrical conductivity of CSF. Our results support the findings that the previously suggested conductivity value of 1.79 S/m for human CSF at 37 °C taken from in vitro measurements is applicable for modelling purposes.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Research group: Quantitative medical imaging, Faculty of Biomedical Sciences and Engineering
Contributors: Latikka, J., Eskola, H.
Number of pages: 4
Pages: 773-776
Publication date: 2019

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No.: 1
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ASJC Scopus subject areas: Bioengineering, Biomedical Engineering
Keywords: Brain tissue, Electrical properties, Measurements, Modelling
DOIs:

10.1007/978-981-10-9035-6_142

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INT=tut-bmt,"Latikka, Juha"
jufoid=58152
Source: Scopus
Source ID: 85048302965
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

μCT based characterization of biomaterial scaffold microstructure under compression
Scaffolds are often designed with progressive degradation to make way for cell proliferation of seeded cells for native tissue. The viability of the scaffold has been shown to depend on, among other things, the microstructure. Common parameters, that are used to describe microstructure, are porosity, material thickness, pore size and surface area. These properties quantify the suitability of the scaffold as a substrate for cell adhesion, fluid exchange and nutrient transfer. Bone and cartilage scaffolds are often placed or operated under loads (predominantly compression). This can alter the structural parameters depending on the stiffness of the scaffold and applied deformation. It is important to know, how scaffolds' parameters change under deformation. In this study, two scaffolds (PLCL-TCP and collagen-PLA) intended for use in bone and cartilage applications, were studied through micro computed tomography based imaging and in situ mechanical testing. The scaffolds were subjected to uniaxial compressive deformation up to 50% of the original size. The corresponding changes in the individual scaffold bulk characteristics were analyzed. Our results show an expected decrease in porosity with increasing deformation (with PLCL-TCP scaffold 52% deformation resulted in 56% decrease in porosity). Especially in the sandwich constructs of collagen-PLA, but also in PLCL-TCP composites, it was evident that different materials are affected differently which may be of significance in applications with mechanical loading. Our results are a step towards understanding the changes in the structure of these scaffolds under loading.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, Division of Biomedical Engineering, University of Cape Town, Faculty of Health Sciences
Contributors: Hannula, M., Narra, N., Paakinaho, K., Haaparanta, A., Kellomäki, M., Hyttinen, J.
Number of pages: 5
Pages: 165-169
Publication date: 2019

Host publication information
Title of host publication: World Congress on Medical Physics and Biomedical Engineering 2018
Publisher: Springer
ISBN (Electronic): 978-981-10-9023-3

Publication series
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Volume: 68
No.: 3
ISSN (Print): 1680-0737
ASJC Scopus subject areas: Bioengineering, Biomedical Engineering
Keywords: Biomaterials, Compression, In situ imaging, Porosity, X-ray microtomography
DOIs:
10.1007/978-981-10-9023-3_30
Source: Scopus
Source ID: 85048307904
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Electrical stimulation of eye blink in individuals with dry eye symptoms caused by chronic unilateral facial palsy

The aim was to validate the functionality and subjective experiences of timer-triggered electrical blink stimulation with participants (N = 6) suffering from dry eye symptoms caused by chronic unilateral facial palsy. In a stimulation condition, the muscles responsible for eye blinking were stimulated at fixed intervals while watching a video for about 120 min. In a control condition, the participants watched a video without stimulation. The participants rated their dry eye symptoms with a questionnaire before and after the both conditions. They also rated the levels of felt pain, discomfort and naturalness of the stimulated movement. Additionally, the magnitude of the stimulated eye blinks over time was evaluated. The results showed that the magnitude of the stimulated eye blink did not decrease significantly during the watching task. The stimulation was rated as painless, slightly uncomfortable, and fairly natural. The experienced eye dryness decreased significantly in the stimulation condition. Most participants got used to the stimulation, or even forgot it during the task. The findings are promising in respect to the use of timer-triggered blink stimulation.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Faculty of Medicine and Health Technology (Otorhinolaryngology), Department of Clinical Neurophysiology, Pirkanmaan sairaanhoitopiiri
Contributors: Lylykangas, J., Ilves, M., Venesvirta, H., Rantanen, V., Mäkelä, E., Vehkaoja, A., Verho, J., Lekkala, J., Rautiainen, M., Surakka, V.
Number of pages: 5
Pages: 7-11
Publication date: 2019

Host publication information
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Publisher: Springer Verlag
Editors: Badnjevic, A., Gurbeta Pokvić, L., Škrbić, R., Badnjevic, A., Gurbeta Pokvić, L.
ISBN (Print): 9783030179700

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Volume: 73
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ASJC Scopus subject areas: Bioengineering, Biomedical Engineering
Keywords: Dry eye disease, Dry eye symptoms, Electrical stimulation, Eye blink, Facial palsy
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10.1007/978-3-030-17971-7_2
URLs:
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Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85066049117
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nanocellulose and Polylactic Acid Based Multilayer Coatings for Barrier Applications

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science and Environmental Engineering, Research group: Paper Converting and Packaging
Contributors: Lahti, J.
Number of pages: 10
Pages: 446-455
Publication date: 2019

Host publication information
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Publisher: TAPPI Press
ISBN (Electronic): 9781510888012
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Media Technology, Materials Science(all)
Source: Scopus
Source ID: 85073782128
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Market implementation of active and intelligent packaging-opportunities from a socio-economic perspective

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science and Environmental Engineering, Research group: Paper Converting and Packaging
Contributors: Lahti, J.
Number of pages: 9
Pages: 419-427
Publication date: 2019

Host publication information
Title of host publication: 17th Biennial TAPPI European PLACE Conference 2019
Publisher: TAPPI Press
ISBN (Electronic): 9781510888012
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Media Technology, Materials Science(all)
Source: Scopus
Source ID: 85073779128
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Effect of polyolefin molecular structure on product properties in extrusion coating

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Materials Science and Environmental Engineering, Research group: Paper Converting and Packaging
Contributors: Suokas, E.
Number of pages: 10
Pages: 89-98
Publication date: 2019

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Title of host publication: 17th Biennial TAPPI European PLACE Conference 2019
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ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Media Technology, Materials Science(all)
Source: Scopus
Source ID: 85073771221
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Detection and assessment of sleep-disordered breathing with emfit mattress

Measuring respiratory effort during sleep is a demanding job. It needs intrathoracic pressure monitoring via nostril inserted catheter in the esophagus. Though the size and material of catheter are nowadays more comfortable than earlier, it is still quite invasive and cumbersome technique, and it does not suit for clinical use. It is known that mattress-type contactless sensors can be used to detect respiratory movements and overall cross-body movements. Beating heart produces mechanical activity called ballistocardiography (BCG), which can be assessed with Emfit (Electromechanical film transducer) mattress sensor too. These heart-related movements with increased breathing effort cause patterns called spiking in the mattress signal. We have studied esophageal pressure changes during this spiking and showed that this phenomenon appears when intrathoracic pressure decreases under -8 cmH2O. These increased breathing efforts quite often appeared together with loud snoring. That is why we have also studied the spectral content of Emfit signal using the power spectral density (PSD). Snoring epochs displayed a power increase in all frequency bands. This increase was best quantified using the power ratio between 60–100 Hz (BW3) and 16– 30 Hz (BW2). We have shown that this type of contactless sensors suits well for the screening of snoring, and the increased respiratory effort was visualized too. Mattress-type movement sensors are inexpensive and unobtrusive, and thus provide an interesting tool for sleep research.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, Research group: Physiological Measurement Systems and Methods Group, BioMediTech, Department of Clinical Neurophysiology, Pirkanmaan sairaanhoitopiiri, Department of Medical Physics, Tampere University Hospital
Contributors: Tenhunen, M., Hyttinen, J., Viik, J., Perez-Macias, J. M., Himanen, S. L.
Number of pages: 4
Pages: 173-176
Publication date: 2018

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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Breathing effort, Emfit sensor, Sleep, Sleep mattress, Sleep-disordered breathing
DOIs:
10.1007/978-981-10-5122-7_44

Bibliographical note

jufoid=58152
EXT="Tenhunen, Mirja"
Source: Scopus
Source ID: 85021745431
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Time characteristics of prolonged partial obstruction periods using an Emfit mattress

Prolonged partial obstruction (PPO) is a sleep disordered breathing (SDB) characterized by increased respiratory efforts for extended periods of time. In this research, we analyzed the time characteristics differences of the Emfit (Electromechanical film transducer) signal between PPO and normal breathing (NB) periods. An experienced neurophysiologist selected ten-minute periods of PPO and NB from a sample of 10 patients suffering from PPO using the esophageal pressure as a Gold reference. Time features were extracted to study the differences between the two types of breathing. Statistical differences of a set of time-related features were assessed with Mann-Whitney U–test. The individual diagnostic performance was determined using receiver operating characteristics (ROC) analysis. Additionally, the diagnostic performance of a subset of features was evaluated using a support vector machine (SVM) classifier. In the evaluation, average results over ten-fold Monte Carlo cross-validation with 80% training and 20% testing splits were reported. Sixteen features reached statistical significance. The classifier achieved sensitivity and specificity of 85±12%, 87±14%, respectively.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Physiological Measurement Systems and Methods Group, Research group: Sleep and Sensory Signal Analysis Group-SSSAG, Research group: Personal Health Informatics-PHI, Pirkanmaan sairaanhoitopiiri, Department of Medical Physics and Medical Imaging Centre
Contributors: Perez-Macias, J. M., Viik, J., Värri, A., Himanen, S., Tenhunen, M.
Number of pages: 4
Pages: 775-778
Publication date: 2018

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Publisher: Springer Verlag
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Name: IFMBE Proceedings
Volume: 65
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Emfit (Electromechanical film transducer) mattress, Increased respiratory resistance (IRR), Obstructive sleep apnea (OSA), Prolonged partial obstruction (PPO), Sleep, Sleep-disordered breathing (SDB)
DOIs:
10.1007/978-981-10-5122-7_194

Bibliographical note
jufoid=58152
EXT="Tenhunen, Mirja"
Source: Scopus
Source ID: 85021767481
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Auto-regression-driven, reallocative particle filtering approaches in PPG-based respiration rate estimation

Interest towards respiratory state assessment with non-obtrusive instrumentation has led to the design of novel algorithmic solutions. Notably, respiratory behavior has been observed to cause modulative changes in two discreetly measurable physiological signals, PPG and ECG. The potential to integrate respiratory rate measurements in widely used instrumentation with no additional cost has made the research of suitable signal processing methods attractive. We have studied and compared auto-regressive (AR) model order optimization and coefficient extraction methods combined with a reallocative particle filtering approach for respiration rate estimation from finger PPG signal. The evaluated coefficient extraction methods were Yule-Walker, Burg, and Least-square. Considered model order optimization methods were Akaike’s information criteria (AIC) and Minimum description length. Methods were evaluated with a publicly available dataset comprised of approximately 10-minute measurements from 39 healthy subjects at rest. From the evaluated AR model parameter extraction methods, Burg's method combined AIC performed the best. We obtained the mean absolute error of 2.7 and bias of -0.4 respirations per minute with this combination.

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MoE publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering, Research area: Dynamic Systems, Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech
Contributors: Pirhonen, M., Suominen, O., Vehkaoja, A.
Number of pages: 5
Pages: 1020-1024
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Autoregression, Particle filtering, Photoplethysmography, Respiration rate
Electronic versions:

Auto-regression-driven reallocative particle filtering approaches in PPG-based respiration rate estimation - post-print
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10.1007/978-981-10-5122-7_255
URLs:

http://urn.fi/URN:NBN:fi:tty-201809252336

Bibliographical note
INT=tut-bmt,"Pirhonen, Mikko"
jufoid=58152
Source: Scopus
Source ID: 85021724168
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Altered synaptic signaling due to β-amyloid interference in astrocytes: A modeling study
Astrocytes are active participants in brain physiology and a known target of pathological processes of several diseases. Using a mathematical model of a tripartite synapse, we investigated the effects of astrocyte intracellular β-amyloid 1-42 fragments on astrocyte Ca^{2+} signaling and synaptic signal transmission. Our results show that with this model, β-amyloid interference of astrocyte Ca^{2+} signaling can considerably alter signal transmission at the synapse, and even silence postsynaptic firing. We conclude that when disturbing astrocyte Ca^{2+} signaling, β-amyloid fragments can potentially contribute to changes in synaptic signaling.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Computational Neuro Science-CNS
Contributors: Havela, R., Manninen, T., Linne, M. L.
Number of pages: 4
Pages: 679-682
Publication date: 2018

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ISBN (Print): 9789811051210

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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Astrocytes, Biophysical modeling, Tripartite synapses, β-amyloid
DOIs:

10.1007/978-981-10-5122-7_170

Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021708806
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Performance analysis of novel flexible electrodes for wearable ECG/heart rate monitoring
The development of manufacturing methods has made it possible to add metal materials as flexible electrodes into wearables. This paper presents effective methods of manufacturing custom electrodes that give reliable ECG/HR signal and maintain textile comfort. Screen-printing, micro etching and electro plating have been used to make dry electrodes that are integrated into common types of heart rate straps. Each manufacturing method of dry electrodes is related to single electrode material. The effects of different materials on signal quality are investigated. Tested materials were platinum, silver ink and stainless steel. These heart rate straps were used during rest condition, cycling, walking and running. Ten users were included (7 male and 3 female) and were measured during physical activity. Electrode performance was measured and signals were compared simultaneously with silver/silver chloride gel electrodes. In this study, platinum has the smallest signal error; therefore, it is the most appropriate of the tested materials. Followed by Ag

ink, disposable Ag/AgCl and lastly stainless steel. The results obtained during exercise indicate that, all of the tested materials worked reliably with these activities and there is no statistical difference between them. The HR error % in all materials was below 20%, which was considered the limit for reliability. It can be concluded that their signal measurement reliability is adequate for sportswear and health care applications. These electrodes did not rub or the edges scratched the skin. The additional result is that they are reasonably comfortable to wear during exercising.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Electronics and Communications Engineering, Research group: Personal Electronics Group
Contributors: Kaappa, E. S., Joutsen, A. S., Vanhala, J.
Number of pages: 4
Pages: 237-240
Publication date: 2018

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Title of host publication: EMBEC and NBC 2017 - Joint Conference of the European Medical and Biological Engineering Conference EMBEC 2017 and the Nordic-Baltic Conference on Biomedical Engineering and Medical Physics, NBC 2017
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Name: IFMBE Proceedings
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Electro plating, Electrode, Micro etching, Screen print, Wearable
DOIs:
10.1007/978-981-10-5122-7_60

Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021752411
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Stimulation waveform selection to suppress functional electrical stimulation artifact from surface EMG signals
We present a simple method to suppress the artifact that functional electrical stimulation causes to surface electromyography signals. The method is based on selecting a high-frequency sinusoidal wavelet as the stimulation waveform to make the artifact frequencies easily removable from the measured signals, and combining it with simple filters in the hardware and as digital filters. Our theoretical computations demonstrate how the selected stimulus pulses attenuate significantly compared to commonly used square wave pulses already in a first-order low-pass filter used before the measurement amplifier. The experimental results with 8 participants show that the artifacts can be suppressed in our target application: facial pacing for unilateral facial paralysis. The method can be beneficial also for other neuroprosthetic applications that apply functional electrical stimulation in combination with electromyography measurements. More complex artifact suppression methods are unnecessary and the delays of the processing are caused only by the simple filters in the signal processing chain.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB)
Contributors: Rantanen, V., Vehkaoja, A., Verho, J.
Number of pages: 4
Pages: 422-425
Publication date: 2018

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Name: IFMBE Proceedings

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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Electromyography, Filtering, Functional electrical stimulation, Stimulation artifact
Electronic versions:

Stimulation Waveform Selection to Suppress Functional Electrical Stimulation Artifact from Surface EMG Signals.

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URLs:

http://urn.fi/URN:NBN:fi:tty-201708141679. Embargo ended: 6/06/18
Additional files:

Stimulation waveform selection to suppress functional electrical stimulation artifact from surface EMG signals - Presentation

Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021735117
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A case study of focal bayesian EEG inversion for whitney element source spaces: Mesh-based vs. cartesian orientations
This paper concentrates on the Bayesian detection of the neuronal current distributions in the electroencephalography (EEG) imaging of the brain activity. In particular, we focus on a hierarchical maximum a posteriori inversion technique applicable when the lead field matrix is constructed via the finite element method. We utilize the linear Whitney (Raviart-Thomas) basis functions as source currents. In the numerical experiments, the accuracy was investigated using two spherical head models. The results obtained suggest that the interpolation of the dipolar source space does not necessarily bring any advantage for FEM based inverse computations. Furthermore, the divergence conforming Whitney-type sources were found to be sufficient for precise and highly focal Bayesian modeling of dipole-like currents.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Mathematics, Research group: Inverse Problems
Contributors: Miinalainen, T., Pursiainen, S.
Number of pages: 4
Pages: 1065-1068
Publication date: 2018

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Volume: 65
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Electroencephalography (EEG), Finite element method (FEM), Hierarchical Bayesian inverse model, Whitney elements
DOIs:

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Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021711207
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Pathwalue: Pathways with value
This work proposes a tool called PathWalue, that aims to identify commercially interesting reaction routes for bio-production. PathWalue evaluates large sets of pathways using stoichiometric data, pathway properties such as

compounds involved and estimates of market information. The public databases Rhea, ChEBI and IntEnz were utilized in this work for reaction, compound and enzyme data, respectively. Data were handled using Python whereas the PathWalue tool was implemented as a JavaScript-based web application. The tool generates, filters and evaluates biochemical pathways. The functioning of the framework was assessed by querying pathways for ethanol and isoprene production and measuring the similarity of the generated pathways to known reference pathways. PathWalue is freely available at http://www.tut.fi/ pathw/.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy
Contributors: Losoi, P., Aho, T.
Number of pages: 4
Pages: 583-586
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Commercial interest, Pathway identification, Reaction networks
DOIs:
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Bibliographical note
jufoid=58152
INT=keb,"Losoi, Pauli"
Source: Scopus
Source ID: 85021772763
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Temperature effect on the baseline noise in MEA measurements
It is a well known fact that increasing temperature increases noise in all kind of electronics, which applies also to cell and tissue measurements by microelectrode arrays (MEAs). We show that ambient temperature may have a surprisingly big role in the noise level of MEA measurements. To study that we measured the baseline noise when the MEA amplifier was subject to temperature variations, either in a temperature chamber or by preventing amplifier unit’s normal heat exchange. Around room temperature (+24°C) the RMS value of the baseline noise was found to increase approximately 0.14 μV/°C, which is a huge variation as the default RMS noise at that temperature with our setup was only around 5.5 μV. Additional cooling of the MEA amplifier could thus be a clever way to decrease the noise level at very sensitive measurements and on the other hand, one should not interfere the amplifier’s normal heat exchange to the ambient air in order to avoid additional warming and thus increasing the noise level.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech
Contributors: Ryynänen, T., Lekkala, J.
Number of pages: 4
Pages: 5-8
Publication date: 2018

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Publication series

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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: MEA, Microelectrode array, Noise, Temperature
Electronic versions:

Temperature effect on the baseline noise in MEA measurements. Embargo ended: 13/06/18
DOIs:

10.1007/978-981-10-5122-7_2
URLs:

http://urn.fi/URN:NBN:fi:tty-201712202449. Embargo ended: 13/06/19

Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021743235
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Dry electrode sizes in recording ECG and heart rate in wearable applications
The rise of wearable electronics is paving the way for textile integrated sensor applications. ECG and heart rate monitoring are common in health care and consumer applications, respectively. In short term monitoring Ag/AgCl, conductive polymer or fabric electrodes can be used. In long term monitoring the electrolyte and adhesives may cause skin irritation, therefore textile integrated skin friendly dry electrodes may be a solution. The electrodes need to be cost-effective, easy to integrate, need no special care from the user and perform well. Conductive polymer and textile used in sports applications perform poorly when used without electrolyte. Stainless steel is common, affordable, easy to process, biocompatible (selected alloys), and provides adequate ECG quality. In this paper, we study different size stainless steel dry electrodes in ECG and heart rate monitoring and compare those with commercial disposable Ag/AgCl electrodes. The results show that stainless steel dry electrodes performed well throughout the tested activities if the circular electrode diameter was 20 mm or larger.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Electronics and Communications Engineering
Contributors: Joutsen, A. S., Kaappa, E. S., Karinsalo, T. J., Vanhala, J.
Number of pages: 4
Pages: 735-738
Publication date: 2018

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Name: IFMBE Proceedings
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Dry electrodes, ECG, Electrode size, Heart rate, Stainless steel
DOIs:

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Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021723087
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

High resolution E-jet printed temperature sensor on artificial skin
Skin-conformable electronics research field has grown rapidly during the recent years. Body monitoring systems are shrinking in size and integrating more seamlessly with the human skin. To make these monitoring systems feasible options, new suitable materials and manufacturing processes needs to be studied. This paper presents materials and a simple fabrication process for skin-conformable, E-jet printed silver temperature sensors. Utilizing printing processes and

biodegradable substrate materials, the skin-conformable electronics may become attractive for disposable systems by decreasing the manufacturing costs and reducing the amount of waste materials. In this study, the temperature sensors are fabricated with E-jet printed silver nanoparticle ink and the printing is done on a bacterial nanocellulose substrate. During the characterization, the silver temperature sensors were able to reach more than 0.06 % resistance change per degree Celsius sensitivity and they exhibited positive temperature dependence.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Electronics and Communications Engineering, Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Research group: Laboratory for Future Electronics
Contributors: Vuorinen, T., Laurila, M. M., Mangayil, R., Karp, M., Mäntysalo, M.
Number of pages: 4
Pages: 839-842
Publication date: 2018

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Identification of feasible pathway information for c-di-GMP binding proteins in cellulose production
In this paper, we utilize a machine learning approach to identify the significant pathways for c-di-GMP signaling proteins. The dataset involves gene counts from 12 pathways and 5 essential c-di-GMP binding domains for 1024 bacterial genomes. Two novel approaches, Least absolute shrinkage and selection operator (Lasso) and Random forests, have been applied for analyzing and modeling the dataset. Both approaches show that bacterial chemotaxis is the most essential pathway for c-di-GMP encoding domains. Though popular for feature selection, the strong regularization of Lasso method fails to associate any pathway to MshE domain. Results from the analysis may help to understand and emphasis to the supporting pathways involved in bacterial cellulose production. These findings demonstrate the need for a chassis to restrict the behavior or functionality by deactivating the selective pathways in cellulose production.

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Systems Biology, Chemistry and Bioengineering, BioMediTech
Contributors: Hassan, S. S., Mangayil, R., Aho, T., Yli-Harja, O., Karp, M.
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jufoid=58152
Source: Scopus
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nocturnal use of light compression garments and recovery
The aim of the study was to investigate nocturnal effect of wearing whole-body light compression garments on post-exercise recovery. HRV analysis was used to evaluate the recovery. The study involved sixteen female Finnish baseball players for four three-day-periods. The participants wore light compression garments every other three-day period and kept record of daily events. The analyzed period was 4 hours starting from the moment subjects fell asleep. The HRV analysis was performed for the time domain, frequency domain and nonlinear measurements. There were no statistical differences in HRV parameters between nights when subjects used or did not use light compression garments. This indicates that whole-body light compression garments had no benefits on the post-exercise recovery during the night.

General information
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MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Physiological Measurement Systems and Methods Group, BioMediTech
Contributors: Jokinen, V., Korpela, J., Lehtinen, E., Perttunen, J., Viik, J.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Human activity recognition using a single optical heart rate monitoring wristband equipped with triaxial accelerometer
This paper investigates activity monitoring using a single wrist-worn optical heart rate monitoring sensor that is equipped with a triaxial accelerometer. Wearing accelerometers on the wrist provides more convenience and therefore improved wear-time compliance compared to other measurement sites. Reliability of wrist acceleration for activity monitoring has been addressed in former research. However, integration of wrist acceleration with physiological signals has not been comprehensively explored yet. We investigated a variety of home-specific activities (sitting, standing, household, and stationary cycling) performed by 20 male participants. Random Forest (RF) and Support Vector Machines (SVM) were applied for activity classification. Various features calculated from acceleration, heart rate (HR), and heart rate variability

(HRV) were used as classified inputs. Results of leave-one-subject-out cross-validation showed 89.2% and 85.6% average recognition accuracies for RF and SVM, respectively. HR and HRV features improved the classification rates of high-intensity cycling by 8% for RF and 7% for SVM.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Personal Health Informatics-PHI, BioMediTech, College of Computer & Information Science and Bouv College of Health Sciences, Northeastern University
Contributors: Mehrang, S., Pietilä, J., Tolonen, J., Helander, E., Jimison, H., Pavel, M., Korhonen, I.
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Context awareness, Human activity recognition, Machine learning, Optical heart rate monitoring wristband, Wearable sensors
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EXT="Jimison, Holly"
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Reproducible preparation method of hydrogels for cell culture applications – Case study with spermidine crosslinked gellan gum
Hydrogels are promising materials to culture cells in 3D environment. Their mechanical properties are decisive, as cells understand the stiffness of their surroundings. Herein, a method is presented to produce ionically crosslinked hydrogel matrices. A reproducible method is needed, because conventional methods cause inconsistent properties. The investigated material is gellan gum, crosslinked with the bioamine spermidine. Samples were prepared with the more conventional ‘pipetting’ technique and with self-developed ‘uniform mixing’ technique. The two preparation techniques are described in detail and the obtained hydrogels are compared. The mechanical properties are analyzed with compression testing. The obtained results show that samples by the so-called ‘uniform mixing’ method have more uniform dimensions and higher compression modulus. A preliminary stability test in cell culture medium was also carried out.

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Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Biomaterials and Tissue Engineering Group
Contributors: Gering, C., Koivisto, J. T., Parraga, J. E., Kellomäki, M.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Computational model for multifocal imaging in optical projection tomography and numerical analysis of all-in-focus fusion in tomographic image reconstruction
Optical projection tomography (OPT) is a noninvasive 3D imaging method that has been used to study small biological samples. In OPT samples can be mounted in hydrogel scaffold mimicking real life extracellular matrix, and hence grown in all natural dimensions. In optical imaging systems, focusing lenses are required for image acquisition. Due to these lenses, particles at a certain distance from objectives — in the focal plane of the lens — are captured accurately and the further a particle is from the focal plane the blurrier it is captured in the resulting image. To compensate this limitation, multifocal OPT is implemented, where images from each angle are taken with multiple focal planes at different distances. From these images, parts in focus are detected and combined into a single image using all-in-focus fusion algorithm. In this work we present computational way of modeling multifocal imaging and use the presented model to assess the performance of two different all-in-focus fusion methods.

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MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Mathematics, Research group: Inverse Problems, Research group: Computational Biophysics and Imaging Group, BioMediTech, International Iberian Nanotechnology Laboratory
Contributors: Koskela, O., Pursiainen, S., Belay, B., Montonen, T., Figueiras, E., Hyttinen, J.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Multiresolution MAPEM method for 3D reconstruction of symmetrical particles with electron microscopy
The resolution and accuracy of the 3D images obtained with single particle reconstruction (SPR) highly depend on the number and signal to noise ratio of the particle images. The maximum a posteriori probability expectation maximization

(MAPEM) reconstruction methods have been successful in suppressing noise and compensating for the limited angular sampling. This paper presents a multiresolution MAPEM (mMAPEM) method to improve the resolution and accuracy of the 3D images of the symmetrical particles reconstructed using SPR. The method utilizes the median root prior and the symmetry information about the reconstructed structure in the image domain. The method was compared with the conventional Fourier Reconstruction (FR) method using phantom and experimental datasets for different noise levels and projection angle sampling conditions. The numerical and visual assessment of the reconstruction results demonstrate that the mMAPEM method provides more accurate results than FR.

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Organisations: Signal Processing, Research group: M2oBSI, UC Davis
Contributors: Acar, E., Baikoghli, M. A., Stark, M., Peltonen, S., Ruotsalainen, U., Cheng, R. H.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Twelve years follow-up of ballistocardiography
The purpose of this work is to study the effect of long term alterations of ballistocardiography during 12 years time recorded in sitting position by using EMFi (Electromechanical Film) sensors. ECG, BCG, ankle pulse signal and carotid pulse (CP) signal from the neck near the carotid artery were recorded from a single person and duration of the signal components according to R spike of the ECG and amplitudes of the signals were studied. The time domain properties of BCG, CP and ankle pulse signals at different times (time interval around 1 year during 12 years time) remained rather stable within the same person. The BCG signal stability endured during 12 years time showing that no major changes happened in the condition of the heart-vasculature system.

General information
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Contributors: Alametsä, J., Viik, J.
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EXT="Alametsä, J."
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Predicting gene expression levels from histone modification signals with convolutional recurrent neural networks

In this paper we study how a Convolutional Recurrent Neural Network performs for predicting the gene expression levels from histone modification signals. Moreover, we consider two simplified variants of the Convolutional Recurrent Neural Network: Convolutional Neural Network and Recurrent Neural Network. The performance of the methods is evaluated with histone modification signal and gene expression data derived from Roadmap Epigenomics Mapping Consortium database, and compared against the state of the art method: the DeepChrome. It is shown that the proposed models give a statistically significant improvement over the baseline.

General information

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Organisations: Signal Processing, Research group: Vision, University of Tampere
Contributors: Zhu, L., Kesseli, J., Nykter, M., Huttunen, H.
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EXT="Kesseli, Juha"
EXT="Nykter, Matti"
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Characterization of chloride channels in human embryonic stem cell derived retinal pigment epithelium

Retinal pigment epithelium (RPE) is vital for vision. Its ion channels play important roles in the various functions of RPE that are critical for retinal welfare. These functions are often disrupted in degenerative eye diseases leading to visual impairment and even blindness. New treatments are currently being developed and transplantation of human embryonic stem cell (hESC)-derived RPE is showing great promise. For the success of these therapies, functionality of the transplantable cells needs to be verified. Presence of ion channels in hESC-derived RPE remains poorly known, particularly regarding the various chloride (Cl^-) channels. We addressed this issue by investigating the Cl^- conductivity of hESC-derived RPE by whole-cell patch clamp recordings followed by immunolabeling of the Cl^- channels typical to RPE. Our recordings showed a diverse pattern of slowly inactivating currents characteristic to voltage-dependent Cl^- channels (ClC) previously reported for RPE. Some of the identified currents were modulated by changes in intracellular calcium concentration. This data, together with the immunolabeling, demonstrated the presence of bestrophin-1, cystic fibrosis

transmembrane regulator (CFTR) and ClC-2 channels in hESC-derived RPE thus indicating their capability to mimic native Cl^- physiology.

General information
Publication status: Published
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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech
Contributors: Korkka, I., Johansson, J. K., Skottman, H., Hyttinen, J., Nymark, S.
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DOIs:

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Source: Scopus
Source ID: 85021731884
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Evaluating different shapes of cranial fixation mini-plates using finite element method
Medical grade 3D printing offers the possibility to manufacture patient-specific implants to treat cranial defects. The performance of the implant assembly depends on many factors, such as material, thickness, size and manufacturing accuracy. A significant factor in the stability and success of the assembly is the fixation method. Cranial implants are usually fixed to the skull by means of mini-plates. Biomechanical assessment of fixing the implant to the skull might be helpful not only for mini-plate design but might be beneficial also for the surgeons. In this study, four different mini-plate designs were analyzed and compared based on the stress-strain analysis of one cranial implant fixed at three locations by mini-plates. Computational simulations were done using Finite Element Method.

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech, Brno University of Technology
Contributors: Chamrad, J., Marcián, P., Narra, N., Borák, L.
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Source: Scopus
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A strategy for dissecting the kinetics of transcription repression mechanisms
Promoters in Escherichia coli include an ‘OFF’ state, during which transcription is halted. Here, we propose a novel empirical method for assessing the time-length spent by promoters in this state. It relies on direct measurements of RNA production kinetics at the single molecule level at different induction levels, followed by an estimation of the RNA production rate under infinite induction, which is then compared to this rate under real, maximum induction. We apply it to the LacO3O1 promoter and infer that, under full induction, on average, 15% of the time between successful transcription events is spent in the OFF state. We verify this result by comparing the kinetics of a mutant strain lacking repressor molecules with that of the inferred rate under infinite induction. We expect this strategy of dissecting the kinetics of transcription repression to be applicable to a wide number of promoters in E. coli.

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Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Laboratory of Biosystem Dynamics-LBD, Universidade Nova de Lisboa
Contributors: Palma, C. S., Startceva, S., Neeli-Venkata, R., Zare, M., Goncalves, N. S., Fonseca, J. M., Oliveira, S. M., Ribeiro, A. S.
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jufoid=58152
INT=tut-bmt,"Zare, Marzieh"
Source: Scopus
Source ID: 85021725472
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nonlinear local projection filter for impedance pneumography
The ability of impedance pneumography (IP) for recording tidal flow during long periods of free breathing make it a promising tool for assessing temporal complexity of respiration. However, techniques quantifying complexity may be sensitive to the noise in the IP signal resulting from the current processing method. A nonlinear local projection filter (NLPF) is presented as the solution to the current linear processing method, failing to reduce noise without distorting the flow signal. Current and proposed NLPF methods were applied to and existing data set of raw IP recorded in 21 infants during a methacholine challenge test. Methods’ performance was compared in a battery of test using mouth flow as a reference. NLPF achieved lower sample-by-sample error, and higher frequency attenuation, while linearity with mouth flow was maintained. Therefore, we concluded that NLPF superiorly reduces noise without distorting respiratory information.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Physiological Measurement Systems and Methods Group, BioMediTech, Helsinki University Central Hospital
Contributors: Gracia, J., Seppä, V. P., Pelkonen, A., Kotaniemi-Syrjänen, A., Mäkelä, M., Malmberg, P., Viik, J.
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Evaluation of the accuracy and reliability for photoplethysmography based heart rate and beat-to-beat detection during daily activities
With the advances in sensor technology and the emergence of new sensor systems, it is important to assess the accuracy of these devices. In this paper, we describe an evaluation study for two wrist-worn devices, namely PulseOn (PO) and Empatica E4 (E4), measuring photoplethysmography – based heart rate (PPG HR) and inter-beat intervals (IBIs). The accuracy and reliability of PPG HR and beat-to-beat detection are evaluated with respect to electrocardiography (ECG) – based HR and IBIs during different daily activities, such as sitting, standing, household work and cycling. The evaluation study employed data from twenty male subjects. The absolute difference of PPG and ECG HR was less than 10 bpm for 90-99% and 81-97% of time for PO and E4, respectively. The accuracy and reliability of the devices were decreased during household work due to the excess hand movements. On average, the mean absolute error in HR was 2.5 bpm higher in PO and 3.7 bpm higher in E4 during household work than during sitting. The percentage of correctly detected heartbeats was 89% for PO and 68% for E4 during sitting but 76% for PO and only 9% for E4 during household work. PO showed better beat-to-beat detection accuracy than E4 in all activities. The errors in heart rate variability measure (HRV) of root mean square of successive inter-beat interval differences were 3.5 ± 3.9 ms for PO and 10.2 ± 6.7 ms for E4 during sitting, but 18.0 ± 10.9 ms for PO and 48.7 ± 21.8 ms for E4 during cycling. As a conclusion, PPG – based wrist-worn devices are accurate and reliable for HR and beat-to-beat detection when the amount of hand movements is not excess but HRV can be estimated from PPG IBI data reliably only during resting conditions. Moreover, there were significant differences in accuracy between different devices.

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MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Personal Health Informatics-PHI, College of Computer & Information Science, Northeastern University
Contributors: Pietilä, J., Mehrang, S., Tolonen, J., Helander, E., Jimison, H., Pavel, M., Korhonen, I.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Wearable RFID perspiration sensor tags for well-being applications – From laboratory to field use

RFID technology has proven to have many possibilities in sensing applications. Smart sensor solutions would be especially helpful in the health and well-being sectors. There is already research on wearable RFID-based sensors, but most are only tested in controlled laboratory environments. The emphasis of this paper is 1) to analyze the performance of two moisture sensor textile tags in realistic field use and through this 2) to discuss their application possibilities. Based on the measurement results, different kinds of textile tags were differently affected by moisture. Especially with embroidered tags the presence of moisture could be detected, including in field conditions. Many applications were also found for the tags. The results indicate potential of RFID-based sensing also in field use, but the actual use environment must be carefully taken into account when implementing the technology.

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Wireless Identification and Sensing Systems Research Group, Mathematics, Research group: Inverse Problems, BioMediTech, Satakunta University of Applied Sciences, Satakunta University of Applied Sciences
Contributors: Mulholland, K., Virkki, J., Raumonen, P., Merilampi, S.
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jufoid=58152
EXT="Merilampi, S."
Source: Scopus
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Impacts of laminin and polyethyleneimine surface coatings on morphology of differentiating human SH-SY5Y cells and networks

The viability and morphological differentiation of the neuronal cells are often enhanced by attachment on surface coating proteins or polymers. Laminin is a basal membrane protein and one of the matrix components in the nervous system. Polyethyleneimine is a positively charged polymer widely used for improving attachment of cell cultures. The aim of this study was to find a favorable surface coating for cultures of differentiating human SH-SY5Y cells in order to promote

homogenous cell adhesion, neurite sprouting and formation of the complete network structure. Two surface coatings were examined; laminin and polyethyleneimine alone or when used together. The impacts of the coatings on morphology of undifferentiated or retinoic-acid and cholesterol differentiated human SH-SY5Y cells and networks were then assessed. In addition, the influence of coatings on the number of cell nuclei at 10 days in vitro was quantified. The morphological analysis of the study shows that laminin enables homogenous attachment and oval cell nuclei formation, whereas polyethyleneimine induces clusters of cells in form of multicellular spheroids. Furthermore, laminin supports branching of long neurites and neuronal network formation, whereas polyethyleneimine induces straight neurite bundles between the spheroids of differentiated human cells.

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Contributors: Teppola, H., Sarkanen, J. R., Jalonen, T. O., Linne, M. L.
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jufoid=58152
INT=tut-bmt,"Jalonen, T. O."
Source: Scopus
Source ID: 85021717153
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Artificial eye blink pacemaker - A first investigation into the blink production using constant-interval electrical stimulation
Facial paralysis due to damage of the facial nerve affects the function of facial muscles, including the muscles responsible for eye blinking. The absence of the eye blink can lead to severe and permanent corneal damage as the protection and lubrication of the eye is decreased. Thus, it would be highly important to provide an aid to sustain the eye health. The present aim was to study the effects of long-term electrical eye blink stimulation using a facial stimulation prototype. Five healthy participants watched a movie for 78 minutes, while the eye blinks were produced to their left eye by pre-programmed, timer-triggered blink stimulation at fixed intervals. We analyzed the functionality of the stimulation prototype, potential changes in the quality of the produced blinks, and the ratings of experiences in terms of pain, discomfort, and naturalness. We also analyzed the acuity of vision before and after the stimulation. The results showed that the stimulated eye blink was rated as not painful, somewhat uncomfortable, and slightly unnatural. With three participants the stimulation evoked a full eye closure throughout the study, and with two participants, the stimulation evoked partial blink after some time. Further, on four of the cases, the vision of the stimulated eye was better after the movie than before it. The participants told that the stimulation did not disturb the movie watching. As the findings were promising, the next steps include more comprehensive tests both with intact participants and with persons having an acute facial paralysis.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech, Faculty of Medicine and Life Sciences (Otorhinolaryngology),, Department of Clinical Neurophysiology, Pirkanmaan sairaanhoitopiiri
Contributors: Lylykangas, J., Ilves, M., Venesvirta, H., Rantanen, V., Mäkelä, E., Vehkaoja, A., Verho, J., Lekkala, J., Rautiainen, M., Surakka, V.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Connectivity analysis of full montage EEG in traumatic brain injury patients in the ICU

Long-term full montage (19 channels) electroencephalographic (EEG) recordings of 6 patients, treated in the Intensive Care Unit (ICU) for severe Traumatic Brain Injury (TBI), were analyzed using the methodology of connectivity analysis. Two connectivity measures, Coherence and Cross Frequency Coupling (CFC) were calculated for each pair of channels in two frequency bands, 8−13 Hz and 13−35 Hz. In the case of CFC, frequencies below 2 Hz were considered as the modulating rhythm. The ability of the measures to indicate the outcome of treatment was evaluated using the Mann-Whitney U-test. The results indicate that CFC values tend to be higher in good outcome patients for (modulating) frontal EEG channels. For the Coherence measure, U-statistic values close to 0.9 were obtained for some channel pairs, however, no clear pattern could be observed.

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Organisations: Signal Processing, GE Healthcare Finland, Turku University Hospital
Contributors: Lipping, T., Erkintalo, N., Särkelä, M., Takala, R. S., Katila, A., Frantzén, J., Posti, J. P., Müller, M., Tenovuo, O.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Electric field of eeg during anesthesia

Electroencephalogram (EEG) has been clinically used to estimate the level of consciousness during anesthesia, but its physiology and biophysics are poorly understood in anesthe-siological literature. The electrical sources of EEG are in cortical structures. EEG currents create closed-loops, which flow from the surface of the cortex and then return to the inside of the hemispheres. In the case of widespread synchronous activity like physiological sleep or anesthesia, the currents return through the base of brain and skull. Here we show with a typical EEG pattern of anesthesia, burst-suppression, that due to those currents EEG is recordable outside of scalp area. We also present the sensitivity field of electrodes located submentally, as well as the electrodes used for anesthesia monitoring, calculated from a realistic head model of the potential distribution and currents of EEG. Our results show that anesthesia EEG can be recorded with a pair of electrodes anywhere on the surface of head, as well as inside of head and brain, because the EEG current loops produce recordable voltage gradients in the whole head. A pair of electrodes submentally is most sensitive to basal parts of the brain. The typical electrodes used in anesthesia monitoring are most sensitive to basal surface of frontal lobes as well as frontal and mesial parts of temporal lobes.

General information

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Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Seinäjoki Central Hospital, Central Hospital of Seinäjoki, Aalto University, Aalto University, Tampere University Hospital
Contributors: Jäntti, V., Subramaniyam, N. P., Kamata, K., Ylinen, T., Yli-Hankala, A., Kauppinen, P., Väisänen, O.
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Learned vs. hand-designed features for ECG beat classification: A comprehensive study

In this study, in order to find out the best ECG classification performance we realized comparative evaluations among the state-of-the-art classifiers such as Convolutional Neural Networks (CNNs), multi-layer perceptrons (MLPs) and Support Vector Machines (SVMs). Furthermore, we compared the performance of the learned features from the last convolutional layer of trained 1-D CNN classifier against the handcrafted features that are extracted by Principal Component Analysis, Hermite Transform and Dyadic Wavelet Transform. Experimental results over the MIT-BIH arrhythmia benchmark database demonstrate that the single channel (raw ECG data based) shallow 1D CNN classifier over the learned features in general achieves the highest classification accuracy and computational efficiency. Finally, it is observed that the use of the learned features on either SVM or MLP classifiers does not yield any performance improvement.

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Organisations: Signal Processing, Research group: Video, Research group: Multimedia Research Group - MRG, Qatar University, Izmir University of Economics
Contributors: Ince, T., Zabihi, M., Kiranyaz, S., Gabbouj, M.

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EXT="Kiranyaz, S."
EXT="Ince, T."
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Optical projection tomography imaging of single cells in 3D gellan gum hydrogel
3D cell culturing has become attractive in biology and tissue engineering laboratories as it mimics the natural environment for the cells to grow, differentiate and interact in all directions. To study cells and cellular interactions within 3D, cell culture requires a non-invasive, non-toxic, and high resolution imaging technique. The existing imaging techniques face challenges to image cells in 3D macro-scale environment because of the sample size, photo-bleaching or resolution requirements. Optical projection tomography (OPT) is a non-invasive 3D imaging technique for samples in the range of 1-10 mm. It works in both emission and transmission modes for fluorescence and bright-field imaging, respectively. Here, we demonstrate the use of OPT for imaging of cells and cellular materials in 3D gellan gum hydrogel. Fluorescence projection images showed alive and dead human lung fibroblast cells encapsulated in hydrogel. The mineralized extracellular matrix secreted by the human adipose stem cells in the hydrogel was evenly distributed throughout the sample and analyzable in 3D volume.

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Contributors: Belay, B., Koivisto, J. T., Vuornos, K., Montonen, T., Koskela, O., Lehti-Polojärvi, M., Miettinen, S., Kellomäki, M., Figueiras, E., Hyttinen, J.
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jufoid=58152
EXT="Vuornos, K."
Source: Scopus
Source ID: 85021747989
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Texture-property relations of bioamine crosslinked gellan gum hydrogels
Gellan gum is a hydrogel with potential for soft tissue engineering but a quick and thorough method is needed for screening of different possible compositions for more extensive studies. Here optical projection tomography in bright field mode was used to image nearly transparent hydrogels to record their optical texture in 3D. The gained Haralick's textural features were then analyzed with multiple discriminant analysis and combined with data from mechanical testing and neuronal cell culturing. We show the usefulness of optical texture analysis in screening of hydrogel compositions when aiming for tissue engineering applications.

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Contributors: Koivisto, J., Koskela, O., Montonen, T., Parraga, J. E., Joki, T., Ylä-Outinen, L., Narkilahti, S., Figueiras, E., Hyttinen, J., Kellomäki, M.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Low-latency EMG onset and termination detection for facial pacing
An adaptive method for reliable and fast detection of muscle activity from surface electromyographic (sEMG) signals is introduced. The aim of this research was to minimize the delay of the onset and termination detection, while still retaining the reliability and simplicity of the detection algorithm. The proposed algorithm is based on a double-threshold detector. The algorithm applies the same principles as a constant false alarm rate (CFAR) processor that is often used to distinguish events from noisy environments with dynamic noise characteristics. The algorithm was tested with different noise conditions and frequencies. For each condition, a set of 1000 computer-simulated EMG signals were processed multiple times with different processing parameters in order to find the optimal settings for reliable muscle activity detection. The results for the detection delays were comparable to previously published results, and for low-noise

conditions the detection worked without errors. The performance of the algorithm was verified using real sEMG signals. Performance in termination detection that has often been neglected in prior studies, is also reported. The results show that the method could be applied in the targeted real-time application: facial pacing.

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Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), Department of Clinical Neurophysiology, Pirkanmaan sairaanhoitopiiri, Faculty of Medicine and Life Sciences (Otorhinolaryngology),
Contributors: Kontunen, A., Rantanen, V., Vehkaoja, A., Ilves, M., Lylykangas, J., Mäkelä, E., Rautiainen, M., Surakka, V., Lekkala, J.
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Source: Scopus
Source ID: 85021753090
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Linearity of simultaneously recorded impedance pneumography and direct pneumotachography in thoracic surgery patients
Current assessment of postoperative lung function of thoracic surgery patients based on spirometry requires patient's mechanical effort. Non-invasive impedance pneumography (IP) has the potential to evaluate postoperative patients while alleviating their effort. The objective of this study was to assess the agreement of IP and pneumotachography (PNT) of adult cardiac and pulmonary surgery patients before and after surgery. IP was measured simultaneously with the flow signal from the mouth for one minute. Pearson correlation coefficient and linearity test were used to evaluate the agreement. 324 measurements had $r \geq 0.7$ and 23 measurements had $r<0.7$. Linearity studies revealed that the average deviation from the linearity and sample-by-sample difference were similar between the surgery groups. The visualization shows that there is more deviation from the linearity in the lung resection group than in the cardiac surgery group during inspiration. The linearity was similar perioperatively, thus the surgery did not affect the agreement of IP and PNT. The results indicate that IP is potential to be used for evaluation of postoperative lung functions of cardiac and pulmonary patients.

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Contributors: Jauhiainen, M., Gracia, J., Seppä, V. P., Mahrberg, H., Tuomisto, L., Laurikka, J., Viik, J.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Automated pipeline for brain ROI analysis with results comparable to previous freehand measures in clinical settings

Diffusion tensor imaging (DTI) has become a relatively common MR imaging technique in only 10 years. DTI can provide important information of brain microstructure in vivo. Many quantitative DTI analysis methods utilize either region of interest (ROI) or voxel-wise whole-brain methods. ROI methods do not require potentially bias-inducing image data altering, e.g., resampling and smoothing, and are the preferred method in clinical settings. We present an automated pipeline for quantitative ROI analysis of brain DTI data. The pipeline includes pre-processing, registrations, and calculation of mean (and SD) DTI scalar values from the automated ROIs. In addition to atlas regions, the pipeline accepts freehand ROIs, as long as the frame of reference is also provided. By the uniquely designed pipeline, we ensure that the results can be retrospectively compared to previously conducted manual freehand ROI measurement results, if desired. We validated the feasibility of the pipeline by comparing manual freehand ROI measurement results from 40 subjects against the results obtained from automated ROIs. A single set of freehand ROIs (drawn similarly to the original freehand manual ROIs in the population) was input to the pipeline, and the resulting scalar values from the automated ROIs were compared to the manual freehand ROIs' data. Adopting a limit for goodness of fit of $z = \pm 1.6$ resulted in 94 % success rate for the pipeline's automated ROI registrations in the whole population. The pipeline can reduce the time taken in clinical ROI measurements.

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Quantitative medical imaging, BioMediTech, BioMediTech Institute, Department of Radiology, Pirkanmaan sairaanhoitopiiri
Contributors: Ilvesmäki, T., Hakulinen, U., Eskola, H.
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Bibliographical note
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Correlation of depth of anesthesia indexes with MAC in volatile anesthesia

The aim of this study is to investigate the effectiveness of the commercial EEG-based indexes (BIS, SE/RE, AEP) and the sample entropy measure in assessing the depth of anesthesia in case of different agents (isoflurane, desflurane and sevoflurane) and induction protocols (propofol, VIMA, VCRII). The relationships between the indexes and the anesthetic concentration were quantified in 82 orthopedic patients using the linear Pearsons correlation coefficient and the Spearmans rank correlation coefficient. The highest Spearman's rank correlation coefficient was observed for the SE in sevoflurane, and for RE in isoflurane and desflurane anesthesia. If the linear Pearson's correlation coefficient is considered, BIS gives better correlation in isoflurane and desflurane, and SE in sevoflurane anesthesia.

General information

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Organisations: Signal Processing, Polish Academy of Sciences, Medical University of Silesia
Contributors: Olejarczyk, E., Lipping, T., Marciniak, R.
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Bibliographical note

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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Physical characteristics of collimators for dual-isotope imaging with ^{99m}Tc and ^{123}I

The purpose of this study was to compare the physical characteristics of Low Energy High Resolution (LEHR), Low Energy Ultra High Resolution (LEUHR) and Medium Energy Low Penetration (MELP) collimators for simultaneous ^{99m}Tc and ^{123}I imaging. MELP collimator performed well with ^{123}I high-energy gamma photons, but low resolution makes it unsuitable to use for acquisition of small structures such as parathyroid adenomas. LEUHR collimators optimized for ^{99m}Tc have highest resolution, but the differences in septal penetration and sensitivity in favor of LEHR collimator needs to be tested with specific parathyroid phantoms.

General information

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Quantitative medical imaging, Satakunta Central Hospital, Helsinki University Central Hospital, Department of Radiology, Tampere University Hospital
Contributors: Tunninen, V., Kauppinen, T., Eskola, H.
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EXT="Tunninen, V."
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Optimization of ^{99m}Tc-sestamibi/^{123}I subtraction SPECT/CT protocol for parathyroid scintigraphy

The purpose of this study was to optimize effective, but technically challenging ^{99m}Tc-sestamibi/^{123}I subtraction SPECT/CT protocol for parathyroid scintigraphy. An anthropomorphic parathyroid phantom was set up using a small sphere, a thyroid phantom and a thorax phantom with clinical range of activities of ^{123}I and ^{99m}Tc. SPECT/CT acquisitions were performed using three collimators (Low Energy High Resolution (LEHR), Low Energy Ultra High Resolution (LEUHR) and Medium Energy Low Penetration (MELP)) and two energy window settings. Images were reconstructed with a combination of four different numbers of iterations and with or without scatter correction. Images were subjected to visual and quantitative evaluation. The effect of collimator, energy window selection and reconstruction parameters had a significant effect on visual appearance and adenoma contrast in parathyroid ^{99m}Tc-sestamibi/^{123}I subtraction SPECT/CT. Symmetrical energy windows and ultra-high resolution collimator yielded best results with some improvement with scatter correction.

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Contributors: Tunninen, V., Kauppinen, T., Eskola, H.
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Source: Scopus
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Nonlinear dynamics of heart rate variability in children with asthmatic symptoms

Asthma is a chronic lung disease that is prone to start during chilhood. Although symptoms can be usually controlled with medication, early diagnosis is crucial to reduce the risk of permanent airway obstruction. Despite the fact that origin of asthma is still uncertain, abnormal parasympathetic nervous system (PNS) activity has been pointed out to play a major role in its pathogenesis. In this work the use of nonlinear heart rate variability (HRV) indexes is proposed in order to look for differences between children classified as high- or low-risk of suffering from asthma in the future. PNS activity is

assessed trough a filtered HRV signal. Correlation dimension analysis showed statistically significant differences distinguishing high-and low-risk. Decreased complexity observed in high-risk group suggests that abnormal PNS activity might be related with increased risk of developing asthma.

General information

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Contributors: Milagro, J., Gil, E., Bolea, J., Seppä, V. P., Malmberg, L. P., Pelkonen, A. S., Kotaniemi-Syrjänen, A., Mäkelä, M. J., Viik, J., Bailón, R.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Comparison of linear and non-linear heart rate variability indices between preterm infants at their theoretical term age and full term newborns

Heart rate variability (HRV) enables non-invasive evaluation of cardiac autonomic activity. Preterm infants are known to have altered HRV characteristics that remain even when reaching their term age. Little is known about non-linear HRV measures between full term and preterm babies close to their theoretical full term. In this study, we calculated sample entropy, shape-describing parameters (skewness and kurtosis) and detrended fluctuation analysis coefficients α1 and α2 from RR time series of 16 very preterm babies (37 weeks, “FT group”) infants. Compared to the FT group, smaller values of sample entropy and lower values of α1 were found in the PT group. No difference in α2, kurtosis, or skewness was found. This indicates decrease in overall complexity of HR dynamics in the PT group. When various HRV indices, that included also non-linear indices, were projected to the principal component analysis space obtained from the FT group, a good separation between the PT and FT groups was found. The study was limited by a small sample but the results were in line with literature. The combinations of several HRV parameters can be of interest for future studies on the degree of ANS maturity.

General information

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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Coronary artery disease diagnosis by means of heart rate variability analysis using respiratory information

Heart rate variability (HRV) analysis during exercise has been used to evaluate cardiovascular response to the stress of exercise, which may offer additional value than in rest condition. To properly analyze HRV during exercise, several challenges need to be addressed, such as including respiratory information and removing the dependance with the mean heart rate (HR) level. The objective of this work is to extract parameters from HRV analysis and respiratory information during exercise to evaluate their capability of diagnose coronary artery disease (CAD). Significant differences in mean HR were found due to medication effect in patients with CAD. By correcting the HRV parameters by mean HR, this effect is minimized. Power related to high frequency, when guided by respiration, results to have the best diagnosis capability (AUC > 0.7).

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Physiological Measurement Systems and Methods Group, BioMediTech, CIBER, Imec, Department of Internal Medicine, University of Helsinki, Tampere University Hospital
Contributors: Hernando, D., Kähönen, M., Lázaro, J., Lehtinen, R., Nieminen, T., Nikus, K., Lehtimäki, T., Bailón, R., Viik, J.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Finite element mapping for efficient image reconstruction in rotational electrical impedance tomography

Electrical impedance tomography (EIT) is a label free harmless imaging method capable of imaging differences in electrical conductivity of a sample. In EIT, a low frequency current is injected into the sample, voltage differences on sample surface are measured, and from these measurements, interior conductivity distribution is reconstructed. To

increase the accuracy of reconstruction, rotational EIT (rEIT) has been proposed where independent measurements are taken from multiple rotational positions around the sample. However, the benefit of conventional electrode configurations are limited to small number of rotational positions. We have presented an approach called Limited Angle Full Revolution rEIT (LAFR-rEIT) that uses a small number of electrodes and large number of rotational measurement position measurements over 360°. The results are comparable to previous rotational EIT implementations, and furthermore, the limited EIT boundary access provides space for simultaneous attachment of other measurement modalities. On the other hand, the increased number of measurement positions cause an increase in computational complexity, and optimization is required until 3D applications are feasible. This work presents modifications into finite element mesh presentation of the imaging domain and outlines an optimization, that enables sufficiently light rotation for 3D LAFR-rEIT computations.

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Contributors: Koskela, O., Lehti-Polojärvi, M., Seppänen, A., Figueiras, E., Hyttinen, J.
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Atrial fibrillation detection from wrist photoplethysmography data using artificial neural networks

Atrial fibrillation (AF) can be detected by analysis of the rhythm of heartbeats. The development of photoplethysmography (PPG) technology has enabled comfortable and unobtrusive physiological monitoring of heart rate with a wrist-worn device. Therefore, it is important to examine the possibility of using PPG signal to detect AF episodes in real-world situations. The aim of this paper is to evaluate an AF detection method based on artificial neural networks (ANN) from PPG-derived beat-to-beat interval data used for primary screening or monitoring purposes. The proposed classifier is able to distinguish between AF and sinus rhythms (SR). In total 30 patients (15 with AF, 15 with SR, mean age 71.5 years) with multiple comorbidities were monitored during routine postoperative treatment. The monitoring included standard ECG and a wrist-worn PPG monitor with green and infrared light sources. The input features of the ANN are based on the information obtained from inter-beat interval (IBI) sequences of 30 consecutive PPG pulses. One of the main concerns about the PPG signals is their susceptibility to be corrupted by noise and artifacts mostly caused by subject movement. Therefore, in the proposed method the IBI reliability is automatically evaluated beforehand. The amount of uncertainty due to unreliable beats was 15.42%. The achieved sensitivity and specificity of AF detection for 30 beats sequences were 99.20 ± 1.3 and 99.54 ± 0.64, respectively. Based on these results, the ANN algorithm demonstrated excellent performance at recognizing AF from SR using wrist PPG data.

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Contributors: Rezaei Yousefi, Z., Parak, J., Tarniceriu, A., Harju, J., Yli-Hankala, A., Korhonen, I., Vehkaoja, A.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Effects of nitroglycerin to ballistocardiography by EMFi
The purpose of this work was to study the effect of nitroglycerin (glyceryl trinitrate) to ballistocardiographic signal (BCG) recorded in sitting position by using Electromechanical Film (EMFi) sensors. ECG, BCG, ankle pulse signal and carotid pulse (CP) signal from the neck near the carotid artery were recorded from a single person and duration of the signal components according to R wave of the ECG and amplitudes of the signals were studied. In the first study the effect of 1 nitroglycerin pill was studied and in the second study the effect of exercise and the intake of 2 nitroglycerin pills were examined. The time domain properties of BCG, CP and ankle pulse signals stayed somewhat stable due to nitroglycerin intake. Noticeable increase was seen in some systolic signal amplitudes. Diastolic signal amplitudes mainly decreased. Signal traces became smoother and the fluctuation of the ballistic signals decreased. Nitroglycerin intake had a major but temporary effect on the heart-vasculature system due to increased aortic elasticity.

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Contributors: Alametsä, J., Viik, J.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A neural network strategy for learning of nonlinearities toward feed-forward control of pressure-compensated hydraulic valves with a significant dead zone

A velocity feed-forward-based strategy is an effective means for controlling a heavy-duty hydraulic manipulator; in particular, a typical valve-controlled hydraulic manipulator, to compensate for valve dead-zone and other hydraulic valve nonlinearities. Based on our previous work on the adaptive learning of valve velocity feed-forwards, manually labelling and identifying the dead-zones and the other nonlinearities in the velocity feedforward curves of pressure-compensated hydraulic valves can be avoided. Nevertheless, it may take two to three minutes or more per actuator to identify a pressure-compensated valve's highly nonlinear velocity feed-forward in real-time with an adaptive approach, which should be reduced for realistic applications. In this paper, inspired by brain signal analysis technologies, we propose a new method based on deep convolutional neural networks comparing with the previous method to significantly reduce this online learning process with the strong nonlinearities of pressurecompensated hydraulic valves. We present simulation results to demonstrate the effectiveness of the deep learning-based learning method compared to the previous results with an adaptive control-based learning.

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Contributors: Nurmi, J., Aref, M. M., Mattila, J.
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Floating frame of reference formulation for a flexible manipulator with hydraulic actuation - Modelling and experimental validation

One of the current and future trends in robotics is to reduce the weight of a robotic manipulator by using lightweight materials, such as ultra-high-strength steel or composites. The reduction in weight results in material and fuel savings, which are highly relevant for heavy-duty, off-highway manipulators found in excavators, truck-mounted cranes, and forestry machines. Due to the highly demanding working conditions of such manipulators, hydraulic actuation is mainly used. Automated and accurate control of these manipulators is very challenging due to the nonlinearities present in the system. Recent studies indicate that nonlinear model-based control (NMBC) methods can provide the most advanced control performance in the case of hydraulic robotic manipulators. An accurate model capturing the dynamics of the physical system is required for effective NMBC design. The present study proposes a hybrid rigid-flexible model for a flexible manipulator combined with a hydraulic actuator, implemented with the help of the floating frame of reference formulation (FFRF). The designed model is validated by comparing simulations with experimental reference data obtained from an OptiTrack motion-capture system and other sensors. The comparative results demonstrate that the model is able to capture the system's dynamics accurately, which motivates further research on developing NMBC methods using the FFRF.

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Bilateral teleoperation of a hydraulic robotic manipulator in contact with physical and virtual constraints
Teleoperated robotic manipulators can be used to remotely operate within hazardous, hard to reach or dangerous environments. In tasks requiring handling of heavy objects with high forces, hydraulic manipulators have remained the most practical solution. Contrary to the previous research on teleoperation of hydraulic manipulators based on linearization and linear control theory, the present study proposes a full-dynamics-based bilateral force-reflected teleoperation, designed between a multiple degrees-of-freedom (n-DOF) electrical master manipulator and an n-DOF hydraulic slave manipulator. The used teleoperation method allows arbitrary motion and force scaling between the n-DOF manipulators, effectively enabling the use of two greatly dissimilar manipulators. The proposed teleoperation system is demonstrated with a full-scale two-DOF hydraulic slave manipulator (having 475 kg payload attached to the tip) in a free-space motion task, and in a constrained motion task including both real and virtual constraints in the environment. Despite the inherent highly nonlinear dynamic behaviour of hydraulic systems and challenges in realizing a bilateral teleoperation, the experimental results demonstrate that the proposed controller for fulldynamics- based teleoperation 1) can rigorously address the system nonlinearities, 2) can realize a high-performance bilateral teleoperation with hydraulic slave manipulators, and 3) is capable to operate in constrained motion with the environment having both real and virtual (i.e., artificially rendered) constraints.

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Model-based control of a digital hydraulic transformer-based hybrid actuator
Energy-efficient motion control of hydraulic actuators is a challenging task. Throttle-free solutions have the potential for high efficiency. The main throttle-free approaches are pumpcontrolled systems, transformer-based solutions, and digital hydraulic solutions, such as switching transformers, multichamber cylinder and multi-pressure systems. This paper presents a novel solution based on a so-called digital hydraulic power management system (DHPMS). The DHPMS is freely rotating and a hydraulic accumulator is used for energy storage. In contrast to existing approaches, each actuator has its own DHPMS and a small accumulator to locally handle the power peaks. Only an average amount of power is needed from the hydraulic grid, radically reducing the size of the supply pump and the hydraulic piping and hosing. Pump flow is only 12.5% of the peak flow of the actuator in the case studied. Control of this type of system is challenging, and the model-based approach is used. The controller uses a simplified model and functionality is verified by using a detailed simulation model of the system. The results show that the approach is feasible but is demanding on the control valves. The system delay is also relatively long, which reduces the control performance in high-end systems. Nevertheless, this approach has potential in mobile machines, for example.

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Effect of driver and work cycle on losses of a loader
Improving the energy efficiency of mobile machines requires information about the initial state of the machine. This information includes knowledge of the systems and their components and of course, measurement data that is acquired during typical operation. Machine manufacturers and research institutes have carried out extensive measurement programs during the last decade. Usually, the published studies concentrated on one work cycle, the machines studied were operated by humans, and it is shown that productivity and fuel consumption are dependent on the machine design, work cycle and operator. This study concentrates on a detailed analysis of the energy consumption of a municipal loader during measured work tasks. The goal was to find out how much the driver and work cycle affect the machine's energy consumption and energy distribution. To evaluate the real fuel consumption and energy distribution, the measurements consisted of two different work cycles that were driven by two drivers with different skill levels. The first cycle was the classic short wheel loader loading cycle, the Y-cycle. In this task, the loader was equipped with a bucket, and a pile of gravel was moved from pile A to pile B in a Y-pattern. The second cycle was the load and carry cycle in which the driver picked up a load with the forklift attachment and carried the load over a predefined distance. The major finding was that the impact of the driver and the work cycle is considerable in fuel consumption. The difference is also seen in the energy distribution in the hydraulic system and in losses and how the losses are divided. Therefore, it can be stated that test results with one driver or one cycle should not be generalized without concern and judgement of novel concepts requires several tests with different drivers and work cycles.

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Direct position control of electro-hydraulic excavator
Position measurement in the electro-hydraulic systems is feasible via the utilization of physical sensors. An improvement in technology has led to the manufacturing of high accurate position sensors for direct position control. This paper proposes utilization of direct position control in an electro-hydraulic system with a new hydraulic zonal system architecture implemented with Direct Driven Hydraulics. It was mentioned in early study that this hydraulic system architecture as a replacement for the traditional valve-based hydraulic systems, has higher energy efficiency rate. In this study, the simulation implementation and experimental verification of Direct Driven Hydraulics (DDH) will be investigated for a micro excavator test case from position control point of view. Results demonstrated that the implementation of DDH in an excavator case will lead to maximum 5 cm error in a single-cycle movement.

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Contributors: Danaee, S., Nurmi, J., Minav, T., Mattila, J., Pietola, M.
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Addressing closed-chain dynamics for high-precision control of hydraulic cylinder actuated manipulators
Nonlinear model-based (NMB) control methods have been shown (both in theory and in practice) to provide the most advanced control performance for highly nonlinear hydraulic manipulators. In these methods, the inverse dynamics of a system are used to proactively generate the system actuation forces from the desired motion dynamics. To model the inverse dynamics in articulated systems, the Lagrange dynamics and the Newton- Euler dynamics are the most common methods. In hydraulic cylinder actuated manipulators, a linear motion of the cylinder can be converted to a rotational joint motion between two links, creating closed-chain structures in the system. In Lagrange-dynamics-based control methods, the closed-chain structures are typically treated as an open-chain structure, which may raise the question of inaccurate system modeling. Contrary, the virtual decomposition control (VDC) approach is the first rigorous NMB control method to take full advantage of Newton- Euler dynamics, allowing to address the system nonlinear dynamics without imposing additional approximations. In VDC, the actuated closed-chain structures can be virtually decomposed to open chain structures. To address the dynamics between the decomposed open chains, three specific terms (namely two load distribution factors and an internal force vector) need to be addressed. However, analytical solutions for these terms cannot be found in the literature. This paper provides the detailed solutions for these terms, which are further needed in a high-precision control of hydraulic robotic manipulators.

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Contributors: Koivumäki, J., Zhu, W. H., Mattila, J.
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Novel equipment to simulate hot air heat sealability of packaging materials

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MoE publication type: A4 Article in a conference publication
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Contributors: Lahti, J., Kuusipalo, J., Auvinen, S.
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Effect of air gap on the adhesion of PET layer on cardboard substrate in extrusion coating

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Novel bio-based materials for active and intelligent packaging

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Electrode comparison for textile-integrated electrocardiogram and impedance pneumography measurement

Wearable electronics is a quickly broadening category in sports, wellbeing and entertainment products. Also, fully textile-integrated electronics is used increasingly to improve user experience. Medical industry is interested in exploiting, especially the latter sub-category of wearable electronics in long-term home care. In this study, we report a textile-integrated electrocardiography (ECG) and impedance pneumography (IP) measurement system. The performance of the system is evaluated by comparing the measurement accuracy for heart rate and respiration rate obtained with different electrode types and different measurement methods. Three electrode types: disposable, textile, and printed electrodes, are investigated and both, bipolar and tetrapolar measurement methods are compared by using a modified commercial evaluation board. Disposable electrodes provide the least noisy signal and the most stable results. However, the skin irritation caused by these electrodes prevents their use in long-term monitoring. The textile and printed electrodes did not seem to cause similar skin irritation. From the two measuring techniques, tetrapolar measuring method had higher noise levels, but heart rate and breathing were estimated with better accuracy compared to bipolar measuring method.

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MoE publication type: A4 Article in a conference publication
Organisations: BioMediTech, Electronics and Communications Engineering, Faculty of Biomedical Sciences and Engineering, Research group: Sensor Technology and Biomeasurements (STB), Research group: Personal Electronics Group, Research group: Physiological Measurement Systems and Methods Group, Research group: Laboratory for Future Electronics
Contributors: Tuohimäki, K., Mahdiani, S., Jeyhani, V., Vehkaoja, A., Iso-Ketola, P., Vanhala, J., Viik, J., Mäntysalo, M.
Number of pages: 4
Pages: 302-305
Publication date: 2017

Host publication information

Title of host publication: EMBEC and NBC 2017 - Joint Conference of the European Medical and Biological Engineering Conference EMBEC 2017 and the Nordic-Baltic Conference on Biomedical Engineering and Medical Physics, NBC 2017
Volume: 65
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Publication series

Name: IFMBE Proceedings
Volume: 65
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Electrocardiogram, Impedance pneumography, Medical analog front-end, Textile-integrated electronics
Electronic versions:

Electrode Comparison for Textile-Integrated Electrocardiogram and Impedance
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http://urn.fi/URN:NBN:fi:tty-201708141672

Bibliographical note

jufoid=58152
INT=TUT-BMT,"Mahdiani, S."
Source: Scopus
Source ID: 85021707351
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Day-to-day repeatability of the results of the finger-toe-plot analysis

Non-invasive arterial pulse wave (PW) measurement provides valuable information on the vascular health. The aim of the study is to characterize the between-visit or day-to-day repeatability of combined finger and toe photoplethysmographic

(PPG) signal analysis method called finger-toe plot (FT-plot) and compare it with the repeatability of other methods proposed for vascular characterization. Ten 22–36-year-old subjects were examined on 3 different days in order to find out the day-to-day repeatability of the results. The repeatability of the extracted parameters was analyzed by means of intra-class correlation coefficients (ICC) and free-marginal multirater κ agreement. ICCs varied widely from below 0.2 to almost 0.9, but κ coefficients higher than 0.7 were achieved for most of the results. Based on the presented results, the FT-plot analysis has at least sufficient day-to-day repeatability. However, further studies with real patients and different stages of cardiovascular diseases are required for confirming the findings.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech
Contributors: Peltokangas, M., Telembeci, A., Verho, J., Lekkala, J., Vehkaoja, A., Oksala, N.
Number of pages: 4
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Publication series
Name: IFMBE Proceedings
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
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DOIs:

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URLs:

http://urn.fi/URN:NBN:fi:tty-201708311859. Embargo ended: 13/06/18

Bibliographical note
JUFOID=58152
INT=tut-bmt,"Telembeci, A.A."
Source: Scopus
Source ID: 85021772278
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Short-term stability of combined finger and toe photoplethysmogram analysis
Arterial pulse waves (PWs) provide information on the vascular health and could be utilized in the early detection of atherosclerosis. The aim of the study is to characterize the short-term repeatability of combined finger and toe photoplethysmographic (PPG) signal analysis method which we call finger-toe plot (FT-plot) and compare it with other methods proposed for vascular characterization. PPG signals were recorded from 24 atherosclerotic and 47 control subjects from finger and toe. The repeatability of the method was analyzed by means of intra-class correlation coefficients (ICC) and free-marginal multirater κ agreement. The metrics were computed for individual PWs as well as for averages based on 10–100 PWs. The ICCs increased with number of PWs utilized — ICCs and κ agreements higher than ≥ 0.90 were widely achieved based on the averages of ≥ 20 PWs, depending on the parameter or study group. Based on the present results, the FT-plot based detection of atherosclerotic changes has at least equal repeatability compared with a current clinical standard, ankle-to-brachial pressure index. However, further studies should validate the findings before the method is ready for the screening of atherosclerotic changes.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech, Univ of Oulu, Oulu University Hospital
Contributors: Peltokangas, M., Huotari, M., Verho, J., Mattila, V. M., Röning, J., Romsi, P., Lekkala, J., Vehkaoja, A., Oksala, N.
Number of pages: 4

Pages: 342-345
Publication date: 2017

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Name: IFMBE Proceedings
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ISSN (Print): 1680-0737
ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Atherosclerosis, Photoplethysmography
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Bibliographical note
jufoid=58152
Source: Scopus
Source ID: 85021722258
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

X-ray microtomography of collagen and polylactide samples in liquids
Methods to image and assess the microstructure of polymer based biomaterials in liquid phase, for example cell culture medium, are well warranted. X-ray microtomography could provide a mean to visualize and analyze such structures. However, the density of such polymers is close to that of water and hence the inherent X-ray contrast is poor. The material can provide good contrast when dry, however, if the materials contain cells and are dried, the cell morphology may be distorted. Moreover the entire structure of these water containing materials are deformed in the drying process. In this paper we tested phosphotungstic acid (PTA) staining to improve the contrast. We imaged collagen and PLA samples, as well as collagen-PLA composites with μCT in air, water and alcohol. The methods were compared visually and with contrast to noise ratio calculated from the images. Our results demonstrate that with alcohol the PLA can be imaged also in liquid phase. PTA staining seems to be a good method to increase the contrast for collagen in μCT imaging.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, Research group: Computational Biophysics and Imaging Group
Contributors: Hannula, M., Haaparanta, A. M., Tamminen, I., Aula, A., Kellomäki, M., Hyttinen, J.
Number of pages: 5
Pages: 420-424
Publication date: 2016

Host publication information
Title of host publication: XIV Mediterranean Conference on Medical and Biological Engineering and Computing 2016 : MEDICON 2016, March 31st–April 2nd 2016, Paphos, Cyprus
Publisher: Springer Verlag
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Publication series
Name: IFMBE Proceedings
Volume: 57
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Collagen, Polylactide, Staining, μCT imaging
DOIs:

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Bibliographical note

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Source: Scopus
Source ID: 84968645247
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A novel generic algorithm for robust physiological signal classification

The last decade has witnessed a significant interest in widespread usage of wearable monitoring devices that could provide continuous measurements of physiological parameters. The design and development of these devices has attracted lots of attention in industry and scientific associations. Advanced and miniaturized electronics with signal acquisition technologies provide a possibility for designing only one device for several physiological measurement purposes. Therefore for designing such an automatic system, a simple generic algorithm for physiological signal classification is required. In this paper, a novel generic algorithm for robust physiological signal classification is presented. The architecture of the proposed system includes preprocessing, feature extraction and a neural network method. Our generic algorithm was able to distinguish different physiological signals such as electrocardiogram (ECG), respiratory signal, seismocardiogram (SCG), electromyogram (EMG) and photoplethysmogram with 100% accuracy. The algorithm was also evaluated by noisy signals with 10 and 20 dB levels of added noise and the same results were achieved. The algorithm could be implemented in healthcare monitoring systems and it can provide the possibility of monitoring various physiological signals with only one device.

General information

Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Physiological Measurement Systems and Methods Group
Contributors: Mahdiani, S., Vanhala, J., Viik, J.
Number of pages: 6
Pages: 1038-1043
Publication date: 2016

Host publication information

Title of host publication: XIV Mediterranean Conference on Medical and Biological Engineering and Computing 2016 : MEDICON 2016, March 31st–April 2nd 2016, Paphos, Cyprus
Publisher: Springer Verlag
ISBN (Print): 978-3-319-32701-3
ISBN (Electronic): 978-3-319-32703-7

Publication series

Name: IFMBE Proceedings
Volume: 57
ISSN (Print): 1680-0737
ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Classifier, Generic algorithm, Neural network, Physiological signals, Wearable devices
DOIs:

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Bibliographical note

INT=elt,"Mahdiani, Shadi"
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Source: Scopus
Source ID: 84968662326
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A review of transient suppression methods of IIR notch filters used for power-line interference rejection in ECG measurement

Bioelectric signals are often corrupted by noise. The most common form of noise is power-line interference and its harmonics. A convenient way for eliminating these unwanted components is to use a single or multiple notch filters. One of the problems about this approach is the effect of transient response of the filter at the beginning of its output in short time measurements. In this work, three initialization methods, which can be used to reduce/overcome this problem are reviewed and their performance and computational complexity are evaluated using ECG as an example signal. These methods are projection initialization, pole radius-varying filtering and vector projection. Additionally, some implementation variations and memory usage considerations are discussed. Our study shows that, pole radius-varying method is computationally cheap but introduces longer transient than the others. On the other hand, vector projection provides a more accurate reconstruction of the signal in the transient part of the output but with a more expensive computation. There are also two drawbacks about vector projection. One is its computational complexity dependency to the sampling frequency of the signal and the other is the fact that it cannot provide the results in real-time.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Automation Science and Engineering, Research area: Microsystems, Research area: Measurement Technology and Process Control
Contributors: Mahdiani, S., Jeyhani, V., Vehkaoja, A.
Number of pages: 6
Pages: 151-156
Publication date: 2016

Host publication information
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Publication series
Name: IFMBE Proceedings
ISSN (Print): 1680-0737
ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: ECG, Filter, IIR, Initialization, Transient
Electronic versions:

A Review of Transient Suppression Methods of IIR Notch Filters Used for Power-line Interference Rejection in ECG Measurement
DOIs:

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http://urn.fi/URN:NBN:fi:tty-201809252337

Bibliographical note
INT=ase,"Jeyhani, Vala"
INT=elt,"Mahdiani, Shadi"
Source: Scopus
Source ID: 84968571748
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

A tool for geometrical measurements of orthognathic surgery changes using cone beam computed tomography
Cone Beam Computed Tomography has become quite popular in craniofacial imaging. Tools for analyzing the volumetric data however have not caught up with the recent industry demands. Most of the analysis in 3D is primarily based on techniques used in 2D format, thus adding some limitations to the post diagnostic capabilities of the imaging modality. We have developed a technique to measure the geometry of the CBCT volumes and find the changes in the facial structures after the surgery, all in a technically non-intensive and reproducible way.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Quantative medical imaging , Medical Imaging Center, Tampere University Hospital
Contributors: Prakash, M., Peltomäki, T., Eskola, H.
Number of pages: 4
Pages: 430-433
Publication date: 2016

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Title of host publication: XIV Mediterranean Conference on Medical and Biological Engineering and Computing 2016 : MEDICON 2016, March 31st–April 2nd 2016, Paphos, Cyprus
Publisher: Springer Verlag
ISBN (Print): 978-3-319-32701-3
ISBN (Electronic): 978-3-319-32703-7

Publication series
Name: IFMBE Proceedings
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ISSN (Print): 1680-0737
ASJC Scopus subject areas: Biomedical Engineering, Bioengineering

Keywords: CBCT, Image registration, Landmark setting, Orthognathic surgery
DOIs:

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Bibliographical note
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Source ID: 84968616757
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Optimal short distance electrode locations for impedance pneumography measurement from the frontal thoracic area

Electrical impedance pneumography signal is a valuable tool in qualifying better the person's health condition. It can be used in monitoring of respiration rate, rhythm and tidal volume. Impedance pneumography has also the potential in ambulatory physiological monitoring systems that are increasingly often implemented using plaster-like on-body devices. In such cases, the area of electrode substrate may be limited and therefore, the electrode configuration, which is able to provide both a clinically valuable electrocardiogram signal and accurate pulmonary information, is an issue. EAS is a useful small area electrode configuration that can be used for electrocardiogram measurements. In this work, different two-electrode bipolar pairs of EAS system are tested for impedance pneumography measurements. Two additional electrodes are also considered in these tests. Our results show that the electrode pair S-A provides the most accurate respiration cycle length and is least affected by movement artifact. Additionally, the results show that this electrode pair produces the signals with highest amplitude.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Electronics and Communications Engineering, Research group: Laboratory for Future Electronics, Department of Automation Science and Engineering, Research area: Microsystems, Research area: Measurement Technology and Process Control, University of Oulu
Contributors: Jeyhani, V., Vuorinen, T., Noponen, K., Mäntysalo, M., Vehkaoja, A.
Number of pages: 6
Pages: 1138-1143
Publication date: 2016

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Name: IFMBE Proceedings
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ASJC Scopus subject areas: Biomedical Engineering, Bioengineering
Keywords: Electrode, Impedance, Location, Pneumography, Respiration
Electronic versions:

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URLs:

http://urn.fi/URN:NBN:fi:tty-201809252334

Bibliographical note
INT=ase,"Jeyhani, Vala"
JUFOID=58152
Source: Scopus
Source ID: 84968593202
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nanoscale barrier coating on BOPP packaging film by ALD

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication

Organisations: Department of Materials Science, Research group: Paper Converting and Packaging
Contributors: Lahti, J.
Number of pages: 13
Pages: 493-505
Publication date: 2016

Host publication information
Title of host publication: TAPPI PLACE Conference 2016: Exploring New Frontiers
Publisher: TAPPI Press
ISBN (Electronic): 9781510823563
ASJC Scopus subject areas: Media Technology, Mechanical Engineering, Materials Science(all), Chemistry(all), Chemical Engineering(all)
Source: Scopus
Source ID: 84981736600
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Roll-to-roll application of photocatalytic TiO_2 nanoparticles for printed functionality
In this work ultraviolet A (UVA) light controlled photocatalytic activity of TiO_2 nanoparticles is utilized on paper, paperboard, and plastic films for controlled wetting and oxygen sensors for modified atmosphere packages (MAPs). A liquid flame spray (LFS) process is used for a large-area TiO_2 nanoparticle deposition on natural fibre based substrates such as paperboard that results in a superhydrophobic surface. Controlled wettability is achieved using an UVA light activation that converts the surface to hydrophilic whereas an oven heat treatment recovers the initial superhydrophobicity. On the other hand, a TiO_2 nanoparticles with methylene blue (MB) dye is used to detect the presence of oxygen in modified atmosphere packages. We believe that photocatalytically active surfaces with tailorable properties will find many applications in the near future, for example, with printed functional devices.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, Center for Functional Materials at Biological Interfaces (FUNMAT), Abo Akad Univ, Abo Akademi University, Dept Phys, Omya International AG, AGH University of Science and Technology, Aerosol Physics Laboratory
Contributors: Saarinen, J. J., Valtakari, D., Bollström, R., Stepien, M., Haapanen, J., Mäkelä, J. M., Toivakka, M.
Number of pages: 4
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Publication date: 2016

Host publication information
Title of host publication: Advanced Manufacturing, Electronics and Microsystems : TechConnect Briefs 2016
Volume: 4
Publisher: TechConnect
ISBN (Electronic): 9780997511734
ASJC Scopus subject areas: Fluid Flow and Transfer Processes, Biotechnology, Surfaces, Coatings and Films, Fuel Technology
Keywords: Controlled wetting, Nanoparticles, O sensor, Photocatalysis, TiO
URLs:
http://www.techconnect.org/proceedings/paper.html?volume=TCB2016v4&chapter=1&paper=785
URLs:
http://www.scopus.com/inward/record.url?scp=84988974879&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84988974879
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

'miSimBa' - A simulator of synthetic time-lapsed microscopy images of bacterial cells
Escherichia coli is a model organism for the study of multiple biological processes, including gene expression and cellular aging. Recently, these studies started to rely on temporal single cell imaging. To support these efforts, available automated image analysis methods should be improved. One important step is their validation. Ideally, the 'ground truth' of the images should be known, which is possible only in synthetic images. To simulate artificial images of E. coli cells, we are developing the 'miSimBa' tool (Microscopy Image Simulator of Bacterial Cells). 'miSimBa' simulates images that reproduce the spatial and temporal bacterial organization by modelling realistically cell morphology (shape, size and spatial arrangement), cell growth and division, cell motility and some internal functions and intracellular structures, namely, the nucleoid. This tool also incorporates image acquisition parameters that simulate illumination and the primary sources of noise.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Research group: Laboratory of Biosystem Dynamics-LBD, Department of Signal Processing, Multi-scaled biodata analysis and modelling (MultiBAM), Universidade de Lisboa, CA3, UNINOVA - Centre of Technology and Systems , Faculdade de Ciências e Tecnologia da Universidade Nova
Contributors: Martins, L., Fonseca, J., Ribeiro, A.
Publication date: 17 Apr 2015

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Title of host publication: Proceedings - 2015 IEEE 4th Portuguese Meeting on Bioengineering, ENBENG 2015
Publisher: The Institute of Electrical and Electronics Engineers, Inc.
Article number: 7088854
ISBN (Print): 9781479982691
ASJC Scopus subject areas: Bioengineering
Keywords: Microscopy imaging, Synthetic image simulation, Time-lapse simulation
DOIs:
10.1109/ENBENG.2015.7088854
Source: Scopus
Source ID: 84929250520
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Fungal treatment of landfill mining fine fraction to increase its stability and end-use potential
Landfill mining, i.e. extraction, processing, treatment and recovery of landfilled materials, is conducted to prevent pollution and to recover materials and energy from waste (Krook et al., 2012). On average, half of landfilled waste is material resembling soil, i.e. its fine fraction (FF, < 20 mm) (Kaartinen et al., 2013). The end-use potential of the FF is limited due to its organic matter content, a possible presence of harmful contaminants as well as its stability. The aim of this study was to evaluate if fungal treatment stabilises FF and removes organic contaminants thus allowing an end-use of FF as soil-like material. Basidiomycetous fungi were obtained and maintained according to Valentin et al. (2008) prior to experiments and were screened for their potential to grow in FF originally landfilled between 1967 – 1989. Screening experiments and previous experiences with contaminated soil (Valentin et al. 2008) led to the selection of Phanerochaete velutina for fungal treatment experiments, which were carried out at room temperature for 58 days. Two acryl columns (height 600 mm, radius 75 mm) were filled with 1 – 2 cm layer of gravel at the bottom and 5.8 kg of FF on the top as well as 500 mL of tap water. The fungal column was amended with fungal bark inoculum to the middle of the column. Two ports at the bottom of the columns were used to collect leachate and aerate columns with humidified air at 0.1 L/min, respectively. Carbon dioxide (CO_2) production was followed during the experiment with gas chromatography. The columns were covered with aluminium foil to stop germination of seeds present in FF. Total solids and volatile solids (VS) were analysed from FF according to standard SFS 3008. Organic contaminants mentioned in criteria for landfilling were analysed from FF in an accredited laboratory. Aerobic stability of FF was determined by the Oxitop method and anaerobic stability of FF was determined as biochemical methane potential. In less than one month, fungal mycelium was observed throughout the FF in the column inoculated with Phanerochaete velutina while no mycelium was observed in the control column. At this stage the experiment was continued in order to allow fungal mycelium to degrade and produce CO_2. Concentrations of mineral oils (C10-C40) and organic matter, measured as VS, were higher in FF than in waste that can be placed to landfills. Mineral oil concentrations exceeded Finnish criteria set for contaminated soil. The aerobic stability of FF was high even initially and it did not increase in control or fungal treatments. Fungal treatment reduced organic matter content of FF and reduced mineral oil concentrations, although the criteria set in legislation could not be met in these experiments.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Research group: Industrial Bioengineering and Applied Organic Chemistry, Department of Chemistry and Bioengineering, University of Helsinki, Department of Food and Environmental Sciences
Contributors: Palmroth, M. R. T., Mönkäre, T. J., Steffen, K. T.
Pages: 47
Publication date: 2015

Host publication information
Title of host publication: Book of abstracts of the 6th European Bioremediation Conference
Editors: Kalogerakis, N., Fava, F., Manousaki, E.
Article number: 169
ISBN (Print): 978-960-8475-23-6
ASJC Scopus subject areas: Bioengineering, Geotechnical Engineering and Engineering Geology, Environmental Engineering
Keywords: bioremediation

Bibliographical note

xabstract
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Improving the effect of nanoscale barrier coating on BOPP film properties: Influence of substrate contamination, web handling and pretreatments

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Paper Converting and Packaging, Engineering materials science and solutions (EMASS), Lappeenranta University of Technology, ASTRaL, Miktech Oy, Masaryk Univ, Masaryk University Brno, R&D Ctr Low Cost Plasma & Nanotechnol Surface Mod
Contributors: Lahti, J., Johansson, P., Lahtinen, K., Cameron, D. C., Seppänen, T.
Number of pages: 23
Pages: 1039-1061
Publication date: 2014

Host publication information
Title of host publication: TAPPI PLACE Conference 2014
Volume: 2
Publisher: TAPPI Press
ISBN (Print): 9781510801271
ASJC Scopus subject areas: Materials Science(all), Chemistry(all), Mechanical Engineering, Media Technology, Chemical Engineering(all)
URLs:

http://www.tappi.org/Bookstore/Technical-Papers/Conference-Papers/2014/14PLACE/14pla34.aspx
Source: Scopus
Source ID: 84939521131
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Improving the effect of a nanoscale barrier coating on BOPP film properties by surface pretreatments

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), Lappeenranta University of Technology, Paper Converting and Packaging Technology
Contributors: Lahtinen, K., Lahti, J., Johansson, P., Seppänen, T., Cameron, D. C.
Number of pages: 25
Pages: 469-493
Publication date: 2013

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Title of host publication: 14th European PLACE Conference 2013
Volume: 1
Publisher: TAPPI Press
ISBN (Electronic): 9781510815568
ASJC Scopus subject areas: Media Technology, Chemical Engineering(all), Chemistry(all), Mechanical Engineering, Materials Science(all)
URLs:

http://www.scopus.com/inward/record.url?scp=84962833172&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84962833172
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Conductive layers on surface modified natural fibre based substrates for printed functionality
Formation of conductive surfaces by flexographical printing has been studied using an IGT test printer with PEDOT-PSS and Ag conductive inks on coated papers. Printability of multilayer coated paper and TiO_2 nanoparticle coating generated by the liquid flame spray process are compared to commercial plastic film used in printed electronics applications. The wettability of TiO_2 nanoparticle coating can be altered between superhydrophobic and superhydrophilic states by ultraviolet light. It is observed that superhydrophobicity induced by TiO_2 nanoparticles results in poorer ink setting and hence lower conductivities with water-based PEDOT:PSS ink. Therefore, we observe conductivity only after several successive prints. On contrary, we observe several orders of magnitude better conductivities when using a silver ink in flexography. It is believed that sustainable natural fibre based substrates will find more applications in printed electronics application in the future.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Department of Physics, Engineering materials science and solutions (EMASS), Abo Akad Univ, Abo Akademi University, Dept Phys, Paper Converting and Packaging Technology, Aerosol Physics Laboratory, Hokkai-Gakuen University
Contributors: Valtakari, D., Bollström, R., Tuominen, M., Teisala, H., Aromaa, M., Toivakka, M., Kuusipalo, J., Mäkelä, J. M., Uozumi, J., Saarinen, J. J.
Publication date: 2012

Host publication information
Title of host publication: AIChE 2012 - 2012 AIChE Annual Meeting, Conference Proceedings
ISBN (Print): 9780816910731
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all)
URLs:

http://www.scopus.com/inward/record.url?scp=84871794294&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84871794294
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Nanoparticle deposition on packaging materials by the liquid flame spray

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Department of Physics, Research area: Aerosol Physics, Department of Software Systems, Engineering materials science and solutions (EMASS), Paper Converting and Packaging Technology, Aerosol Physics Laboratory, Abo Akad Univ, Abo Akademi University, Dept Phys, Center for Functional Materials at Biological Interfaces (FUNMAT)
Contributors: Teisala, H., Tuominen, M., Aromaa, M., Mäkelä, J. M., Stepien, M., Saarinen, J. J., Toivakka, M., Kuusipalo, J.
Number of pages: 2
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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Effect of pre-treatments on barrier properties of layers applied by atomic layer deposition onto polymer-coated substrates

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Organisations: Department of Materials Science, Department of Materials Science, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland
Contributors: Vähä-Nissi, M., Hirvikorpi, T., Sievänen, J., Salo, E., Harlin, A., Johansson, P., Kuusipalo, J.
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The effects of corona and flame treatment: Part 2. PE-HD and PP coated papers

The most important function of a packaging material is to shield the product inside the package. Extrusion coated papers and paperboards are generally used in various consumer packages like food, medical and cosmetic packages. Extrusion coatings give a barrier against water, water vapour, aroma, grease, oxygen, etc. In addition to barrier properties, heat sealability and printability are important properties in packaging applications. From the point of view of printing, the dense and impervious structure of extrusion coatings is challenging: printing inks and toners do not penetrate into the coatings. The durability of the printed image is significant, because the image must withstand various converting operations when the package is constructed. The most common method for obtaining good ink or toner adhesion is to oxidise the surface. Surface treatments are used to change the chemical composition, increase surface energy, modify surface morphology and topography, or remove contaminants and weak boundary layers. Two widely used methods are corona discharge treatment and flame treatment. These processes generally cause physical and chemical changes in a thin surface layer without affecting the bulk properties. Treatments will increase surface energy and also provide polar molecular groups necessary for good bonds between ink/toner and polymer molecules. In addition to printability, surface treatments also affect the sealing properties, i.e. initial heat sealing temperature, initial hot tack temperature, sealing window and seal strength of extrusion coatings. Both the sealability of packaging material and the tightness of the seal are critical points in the manufacturing process of packages and of the final package. The printability must be obtained without losing the sealability properties. In the first part of this research (TAPPI European PLACE 2007), surface energy, printability and sealability of low density polyethylene (PE-LD) coated paperboard after flame and corona treatments were studied. In this second part of the study, the research is extended to other polyolefins, i.e. high-density polyethylene (PE-HD) and polypropylene (PP). The surface chemistry is evaluated with contact angle measurements and X-ray photoelectron spectroscopy (XPS) measurements. Scanning electron microscopy (SEM) and optical profilometry are used to study the topographical and morphological changes on the surfaces. Furthermore, the heat sealing and hot tack properties, and water vapour barrier properties of the extrusion coatings are evaluated. The aim of this study is also to evaluate the printability of the extrusion coatings and to map out the role of surface modification in print quality formation. This study has concentrated on digital printing, particularly on the dry toner-based electrophotographic printing process. Flame treatment decreases the contact angle of water on PE-LD, PE-HD and PP coated papers more than corona treatment, but the lowest contact angle is obtained when the treatments are used simultaneously (i.e. co-effect of the treatments). Flame treatment deteriorates the sealability properties of PE-LD coated paper, whereas corona treatment improves sealability for example by decreasing the minimum heat sealing temperature. The sealability properties of PE-HD and PP coated papers are improved not only by corona treatment, but also by flame treatment. Flame treatment significantly improves the water vapour barrier of PEs. Where printability is concerned, it can be noticed that all the treatments improve rub-off resistance with PEs. With PE-LD flame is the most effective, and with PE-HD corona. With PP, the co-treatment gives the best result. Morphological changes in micro- and nano- scale were most observed on the flame treated PE-LD surface, whereas the electret phenomenon was observed on PE-LD, PE-HD and PP surfaces only after corona treatment.

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Statistical modeling of water vapor transmission rates for extrusion-coated papers

The testing of water vapor transmission rates (WVTR) for extrusion-coated papers can be a time-consuming task for laboratories. This study introduces a prediction model that provides an effective and helpful option to laboratory measurements. In practice, the WVTR of an extrusion-coated paper is affected by three main factors: coating weight (or

squared mass) of the polymer concerned, the temperature and moisture content of the immediate surroundings. The prediction model determines mathematical connections between the WVTR and these variables covering the detected region of experimental WVTR results with a continuous estimation. By using mixing ratio as a variable of humidity, the model was found to provide accurate estimation across the field of experiments. As a result of this study, a practical computer program, which predicts the WVTR of a multilayer extrusion-coated paper as a function of user-defined temperature and relative humidity values and the layer structure of the coating, was developed. APPLICATION STATEMENT: This work shows how WVTR of a multilayer extrusion-coated paper can be estimated with the help of a statistical prediction model.

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EMBEC & NBC 2017: Joint Conference of the European Medical and Biological Engineering Conference (EMBEC) and the Nordic-Baltic Conference on Biomedical Engineering and Medical Physics (NBC), Tampere, Finland, June 2017
This volume presents the proceedings of the joint conference of the European Medical and Biological Engineering Conference (EMBEC) and the Nordic-Baltic Conference on Biomedical Engineering and Medical Physics (NBC), held in Tampere, Finland, in June 2017.

The proceedings present all traditional biomedical engineering areas, but also highlight new emerging fields, such as tissue engineering, bioinformatics, biosensing, neurotechnology, additive manufacturing technologies for medicine and biology, and bioimaging, to name a few. Moreover, it emphasizes the role of education, translational research, and commercialization.

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Designing of Elastomer Nanocomposites: From Theory to Application

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Modular Instrumentation for Controlling and Monitoring In-Vitro Cultivation Environment and Image-based Functionality Measurements of Human Stem Cells

Artificial animal cell culture was successfully developed by Ross Harrison in 1907. But it was not until the 1940's and 1950's that several developments occurred, which expedited the cell culturing *in-vitro (C-Vitro)* to be a consistent and reproducible technique to study isolated living-cells in a controlled environment. Currently, *CVitro*is one of the major tools in cellular and molecular biology both in the academia and industry. They are extensively utilised to study the cellular physiology/biochemistry, to screen drugs/therapeutic compounds, to understand the effects of drugs/toxic compounds and also to identify the pathways of carcinogenesis/mutagenesis. It is also used in large scale manufacturing of vaccines and therapeutic proteins. In any experimental setup, it is important that the *C-Vitro* model should represent the physiological phenomena of interest with reasonable accuracy so that all experimental results are statistically consistent and reproducible. In this direction, sensors and measurement systems play important roles in *in-situ* detection and/or control/manipulation of cells/tissues/environment. This thesis aimed to develop new technology for tailored cell culturing and integrated measurements. Firstly, design and assembly of a portable Invert-upright microscope interchangeable modular cell culturing platform (iuCMP) was envisioned. In contrast to conventional methods, micro-scaled systems mimic the cells' natural microenvironment more precisely, facilitating accurate and tractable models. The iuCMP integrates modular measurement schemes with a mini culture chamber using biocompatible cell-friendly materials, automated environment-control (temperature and gas concentrations), oxygen sensing and simultaneous functional measurements (electrophysiological and image-based). Time lapse microscopy is very useful in cell biology, but integration of advanced >i>in-vitro/device based biological systems (e.g. lab/organ/body-on-chips, or mini-bioreactors/microfluidic systems) into conventional microscopes can be challenging in several circumstances due to multiple reasons. But in iuCMP the main advantage is, the microscope can be switched either as an inverted or as an upright system and therefore can accommodate virtually any *in-vitro* device. It can capture images from regions that are otherwise inaccessible by conventional microscopes, for example, cells cultured on physical or biochemical sensor systems. The modular design also allows accommodating more sensor or measurement systems quite freely. We have demonstrated the system for video-based beating analysis of cardiomyocytes, cell orientation analysis on nanocellulose, and simultaneous long-term in-situ microscopy with oxygen and temperature sensing in hypoxia.

In an example application, the system was utilised for long-term temperature stressing and simultaneous mechanobiological analysis of human induced pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs). For this the iuCMP together with a temperature sensor plate (TSP) and a novel non-invasive beating analysis software (CMaN—cardiomyocyte function analysis tool, scripted as a subpart of this thesis), was applied for automated temperature response studies in hiPSC-CM cultures. *In-situ* temperature sensing is usually challenging with bulky external sensors, but TSPs solved this issue. In the temperature response study, we showed that the relationship between hiPSC-CM beating frequency and temperature is non-linear and measured the Q_{10}temperature coefficients. Moreover, we observed the hiPSC-CM contractile networking, including propagation of the action potential signal between dissociated clusters and their non-invasive measurements. It was the first case where these events were reported in hiPSC-CM clusters and their

noninvasive measurements by image processing.

The software CMaN comes with a user-friendly interface and, is equipped with features for batch processing, movement centre detection and cluster finding. It can extract six different signals of the contractile motion of cardiomyocytes (clusters or single cells) per processing. This ensures a minimum of one useful beating signal even in the cases of complex beating videos. On the processing end, compared to similar tools, CMaN is faster, more sensitive, and computationally less expensive and allows ROI based processing. In the case of healthy cells, the waveform of the signal from the CMaN resembles an ECG signal with positive and negative segments, allowing the computation of contraction and relaxation features separately.

In addition to iuCMP, a Modular optical pH measurement system (MO-pH) for 24/7 non-contact cell culture measurements was also developed. The MO-pH incorporates modular sterilisable optical parts and is used in phenol-red medium cell cultures. The modular assembly of MO-pH cassettes is unique and reusable. Measurements are carried out in a closed flow system without wasting any culture medium and requires no special manual attention or recalibrations during culture. Furthermore, a new absorption correction model was put forward that minimised errors caused e.g. by biolayers in spectrometric pH measurement, which improved the pH measurement accuracy. MO-pH has been applied in long-term human adipose stem cells (hASC) expansion cultures in CO_2 dependent and independent media. Additionally, the MO-pH was also utilised to comprehend the behaviour of pH, temperature and humidity in water jacked incubators as well as to record the pH response as a function of temperature in the presence and absence of CO_2 in the context of stem cell cultures. The resulting plots clearly showed the interplay between measured parameters indicating a few stress sources present all through the culture. Additionally, it provided an overall picture of behaviour of critical control parameters in an incubator and pointed out the need for bioprocess systems with automatic process monitoring and smart control for maximum yield, optimal growth and maintenance of the cells. Besides, we also integrated MO-pH into flasks with reclosable lids (RL-F) and tested its applicability in stem cell cultures. A standalone system around an RL-F flask was built by combining the cell culture, medium perfusion and optical measurements. The developed RL-F system has been successfully tested in ASC-differentiation cultures.

Finally, a few trial experiments for image-based pH estimation aimed for iuCMP have also been carried out. This includes tests with LCD illumination, optical projection tomography, and webcam systems. In reality, the pH is not distributed uniformly in tissues, and has shown a gradient of up to 1.0 pH unit within 1 cm distance. Therefore, producing reliable pH maps also in *in-vitro* can be important in understanding various common pathologies and location of lesions. A reliable and adequately developed long-term pH mapping method will be an important addition into the iuCMP.

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A simulation case study of production planning and control in printed wiring board manufacturing

Production planning and control in printed wiring board (PWB) manufacturing is becoming more difficult as PWB's technology is developing and the production routings become more complex. Simultaneously, the strategic importance of delivery accuracy, short delivery times, and production flexibility is increasing with the highly fluctuating demand and short product life cycles of end products. New principles, that minimize throughput time while guaranteering excellent customer service and adequate capacity utilization, are needed for production planning and control. Simulation is needed in order to develop the new principles and test their superiority. This paper presents an ongoing simulation product that aims at developing the production planning and control of a PWB manufacturer. In the project, a discrete event simulation model is built of a pilot case factory. The model is used for comparing the effect of scheduling, queuing rules, buffer policies, and lot sizes on customer service and cost efficiency.

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