Pyrolysed cellulose nanofibrils and dandelion pappus in supercapacitor application

Dandelion pappus and wood based nanocellulose fibrils were combined to form films that were subsequently pyrolyzed under low-pressure conditions in a carbon monoxide (CO) rich atmosphere to make supercapacitor electrode material. The electrodes were prepared from these materials and pyrolyzed under low-pressure conditions in a carbon monoxide-rich atmosphere. The electrode materials and assembled supercapacitors were electrically and structurally characterized. The assembled six supercapacitors showed specific capacitances per electrode ranging from 1 to 6 F/g and surface resistance of pyrolyzed electrodes ranging from 30 to 170 Ω. Finally, equivalent series resistance and leakage current measurements were conducted for three samples, resulting values from 125 to 500 Ω and from 0.5 to 5.5 μA, respectively.

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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Electronics and Communications Engineering, Materials Science, Research group: Plastics and Elastomer Technology, Research group: Plastics and Elastomer Technology, Research area: Measurement Technology and Process Control, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech, BioMediTech Institute and Faculty of Biomedical Sciences and Engineering
Authors: Virtanen, J., Pammo, A., Keskinen, J., Sarlin, E., Tuukkanen, S.
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Scopus rating (2014): SJR 1.071 SNIP 1.334 CiteScore 3.58
Scopus rating (2013): SJR 1.127 SNIP 1.48 CiteScore 3.83
Scopus rating (2012): SJR 1.179 SNIP 1.71 CiteScore 3.74
Scopus rating (2011): SJR 1.354 SNIP 1.795 CiteScore 3.99
Scopus rating (2010): SJR 0.873 SNIP 1.384
Scopus rating (2009): SJR 1.038 SNIP 1.219
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Scopus rating (2004): SJR 0.855 SNIP 1.072
Scopus rating (2003): SJR 0.81 SNIP 1.02
Scopus rating (2002): SJR 0.649 SNIP 0.689
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Bibliographical note
INT="Pammo, Arno"
Research output: Scientific - peer-review › Article

Engineering and Characterization of Bacterial Nanocellulose Films as Low Cost and Flexible Sensor Material

Some bacterial strains such as Komagataeibacter xylinus are able to produce cellulose as an extracellular matrix. In comparison to wood-based cellulose, bacterial cellulose (BC) holds interesting properties such as biodegradability, high purity, water-holding capacity, and superior mechanical and structural properties. Aiming toward improvement in BC production titer and tailored alterations to the BC film, we engineered K. xylinus to overexpress partial and complete bacterial cellulose synthase operon that encodes activities for BC production. The changes in cell growth, end metabolite, and BC production titers from the engineered strains were compared with the wild-type K. xylinus. Although there were no
significant differences between the growth of wild-type and engineered strains, the engineered K. xylinus strains demonstrated faster BC production, generating 2–4-fold higher production titer (the highest observed titer was obtained with K. xylinus-bcsABCD strain producing 4.3 ± 0.46 g/L BC in 4 days). The mechanical and structural characteristics of cellulose produced from the wild-type and engineered K. xylinus strains were analyzed with a stylus profilometer, in-house built tensile strength measurement system, a scanning electron microscope, and an X-ray diffractometer. Results from the profilometer indicated that the engineered K. xylinus strains produced thicker BC films (wild type, 5.1 μm, and engineered K. xylinus strains, 6.2–10.2 μm). Scanning electron microscope revealed no principal differences in the structure of the different type BC films. The crystallinity index of all films was high (from 88.6 to 97.5%). All BC films showed significant piezoelectric response (5.0–20 pC/N), indicating BC as a promising sensor material.

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Scopus rating (2013): SJR 1.979 SNIP 1.543 CiteScore 6.05
Scopus rating (2012): SJR 2.18 SNIP 1.309 CiteScore 4.94
Scopus rating (2011): SJR 2.017 SNIP 1.396 CiteScore 4.41
Scopus rating (2010): SJR 1.571 SNIP 0.931
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**Bibliographical note**
INT="Luo, Jin"
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Source: RIS
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Research output: Scientific · peer-review > Article

**Collagen-immobilized polyimide membranes for retinal pigment epithelial cell adherence and proliferation**
Degenerative retinal diseases are a leading cause of visual loss and irreversible blindness, particularly in the developed world. Retinal pigment cell (RPE) transplantation is nowadays considered the most promising therapeutic approach for certain retinal diseases, and the presence of a supportive scaffold has been considered essential to ensure the success of the implant. In this work, collagen IV was covalently immobilized to the surface of polyimide membranes, with the purpose of developing scaffold materials for RPE cell culture. The covalent modification method involved four steps: argon-plasma treatment, acrylic acid graft polymerization, surface activation, and finally immobilization of collagen type IV. Collagen-modified membranes did not become more rough but became significantly more hydrophilic than the unmodified and dip-coated controls. ARPE-19 cell morphology and attachment were studied by immunofluorescence staining and confocal microscopy. Covalently modified surfaces showed cell attachment and cell properties comparable to the uncoated and dip-coated controls. This work demonstrated the potential of collagen IV-immobilized polyimide membranes as substrates for the growth of ARPE-19 cells.

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Authors: Teymouri, S., Calejo, M. T., Hiltunen, M., Sorkio, A. E., Juuti-Uusitalo, K., Skottman, H., Kelломäki, M.
Collagen immobilized polyimide membranes for retinal pigment epithelial cell adherence and proliferation

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Research output: Scientific - peer-review › Article

Langmuir-Schaefer film deposition onto honeycomb porous films for retinal tissue engineering

Age-related macular degeneration (AMD) is the leading cause of vision loss in senior citizens in the developed world. The disease is characterised by the degeneration of a specific cell layer at the back of the eye – the retinal pigment epithelium (RPE), which is essential in retinal function. The most promising therapeutic option to restore the lost vision is considered to be RPE cell transplantation. This work focuses on the development of biodegradable biomaterials with similar properties to the native Bruch’s membrane as carriers for RPE cells. In particular, the breath figure (BF) method was used to create semi-permeable microporous films, which were thereafter used as the substrate for the consecutive Langmuir-Schaefer (LS) deposition of highly organised layers of collagen type I and collagen type IV. The newly developed biomaterials were further characterised in terms of surface porosity, roughness, hydrophilicity, collagen distribution, diffusion properties and hydrolytic stability. Human embryonic stem cell-derived RPE cells (hESC-RPE) cultured on the biomaterials showed good adhesion, spreading and morphology, as well as the expression of specific protein markers. Cell function was additionally confirmed by the assessment of the phagocytic capacity of hESC-RPE. Throughout the study, microporous films consistently showed better results as cell culture materials for hESC-RPE than dip-coated controls. This work demonstrates the potential of the BF-LS combined technologies to create biomimetic prosthetic Bruch’s membranes for hESC-RPE transplantation.
Roll-to-roll manufacturing of disposable surface-enhanced Raman scattering (SERS) sensors on paper based substrates

We present two cost-effective routes for roll-to-roll (R2R) manufacturing of silver nanoparticle based surface-enhanced Raman scattering (SERS) active substrates on paper utilizing either inkjet printing or liquid flame spray (LFS) nanoparticle deposition. Paper is cost-effective, renewable, recyclable, and biodegradable that can easily be disposed after the SERS analysis. Paper based substrates can have a strong luminescence that can overshadow the rather weak SERS signal. Two solutions are presented here that solve the luminescence issue of the base paper substrate. A full silver coverage by inkjet printing or alternatively a simple flexography carbon coating can suppress the background luminescence allowing a reliable SERS characterization. The detection limit of the sample analyte crystal violet was 100 nM corresponding to 100 fmol in a 1 µl sample volume. These approaches can provide a cost-effective route towards disposable, point-of-care SERS active substrates.

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Organisations: Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, Photonics, Research group: Nanophotonics, Laboratory of Paper Coating and Converting, Center for Functional Materials, Abo Akademi University, Turku, Center for Functional Materials at Biological Interfaces (FUNMAT), Faculty of Engineering, Hokkai-Gakuen University
Authors: Saarinen, J. J., Valtakari, D., Sänden, S., Haapanen, J., Salminen, T., Mäkelä, J., Uozumi, J.
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Scopus rating (2014): SJR 0.444 SNIP 0.823 CiteScore 0.99
Scopus rating (2013): SJR 0.389 SNIP 0.684 CiteScore 0.71
Scopus rating (2012): SJR 0.628 SNIP 1.281 CiteScore 1.13
Scopus rating (2011): SJR 0.582 SNIP 0.902 CiteScore 0.78
Scopus rating (2010): SJR 0.658 SNIP 0.764
Scopus rating (2009): SJR 1.167 SNIP 0.984
Scopus rating (2008): SJR 0.928 SNIP 0.857
Scopus rating (2007): SJR 2.018 SNIP 1.035
Scopus rating (2006): SJR 1.002 SNIP 0.951
Scopus rating (2005): SJR 1.181 SNIP 0.997
Scopus rating (2004): SJR 2.08 SNIP 1.354
Scopus rating (2003): SJR 2.952 SNIP 1.129
Scopus rating (2002): SJR 1.836 SNIP 1.145
Scopus rating (2001): SJR 1.12 SNIP 1.147
Scopus rating (2000): SJR 1.086 SNIP 1.154
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Original language: English
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Research output: Scientific - peer-review › Article

Improved antifouling properties and selective biofunctionalization of stainless steel by employing heterobifunctional silane-polyethylene glycol overlayers and avidin-biotin technology

A straightforward solution-based method to modify the biofunctionality of stainless steel (SS) using heterobifunctional silane-polyethylene glycol (silane-PEG) overlayers is reported. Reduced nonspecific biofouling of both proteins and bacteria onto SS and further selective biofunctionalization of the modified surface were achieved. According to
photoelectron spectroscopy analyses, the silane-PEGs formed less than 10 Å thick overlayers with close to 90% surface coverage and reproducible chemical compositions. Consequently, the surfaces also became more hydrophilic, and the observed non-specific biofouling of proteins was reduced by approximately 70%. In addition, the attachment of E. coli was reduced by more than 65%. Moreover, the potential of the overlayer to be further modified was demonstrated by successfully coupling biotinylated alkaline phosphatase (bAP) to a silane-PEG-biotin overlayer via avidin-biotin bridges. The activity of the immobilized enzyme was shown to be well preserved without compromising the achieved antifouling properties. Overall, the simple solution-based approach enables the tailoring of SS to enhance its activity for biomedical and biotechnological applications.

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Ministry of Education publication type: A1 Journal article-refereed
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- Scopus rating (2014): SJR 2.103 SNIP 1.544 CiteScore 4.75
- Scopus rating (2013): SJR 1.886 SNIP 1.51 CiteScore 4.06
- Scopus rating (2012): SJR 1.458 SNIP 0.896 CiteScore 2.44
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Research output: Scientific - peer-review › Article

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**Articular cartilage repair with recombinant human type II collagen/polyactide scaffold in a preliminary porcine study**
The purpose of this study was to investigate the potential of a novel recombinant human type II collagen/polyactide scaffold (rhCo-PLA) in the repair of full-thickness cartilage lesions with autologous chondrocyte implantation technique (ACI). The forming repair tissue was compared to spontaneous healing (spontaneous) and repair with a commercial porcine type I/III collagen membrane (pCo). Domestic pigs (4-month-old, n = 20) were randomized into three study groups and a circular full-thickness chondral lesion with a diameter of 8 mm was created in the right medial femoral condyle. After 3 weeks, the chondral lesions were repaired with either rhCo-PLA or pCo together with autologous chondrocytes, or the lesion was only debrided and left untreated for spontaneous repair. The repair tissue was evaluated 4 months after the second operation. Hyaline cartilage formed most frequently in the rhCo-PLA treatment group. Biomechanically, there was a trend that both treatment groups resulted in better repair tissue than spontaneous healing. Adverse subchondral bone reactions developed less frequently in the spontaneous group (40%) and the rhCo-PLA treated group (50%) than in the pCo control group (100%). However, no statistically significant differences were found between the groups. The novel rhCo-PLA biomaterial showed promising results in this proof-of-concept study, but further studies will be needed in order to determine its effectiveness in articular cartilage repair.

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Peer-reviewed: Yes
Dissolution behavior of the bioactive glass S53P4 when sodium is replaced by potassium, and calcium with magnesium or strontium

The initial dissolution behavior of glasses based on bioactive glass S53P4 was studied with a dynamic measurement setup in a Tris-buffered solution. The glass composition was modified systematically on a molar basis by replacing sodium oxide with potassium oxide (0-100% K) and calcium oxide with magnesium (0-18% Mg) or strontium oxide (0-100% Sr). The concentrations of the ions dissolving from the glasses were measured continuously on-line in the fluid flow for 15 to 25 min using an inductively coupled plasma emission optical spectrometer. This method enabled attainment of detailed information on the initial dissolution mechanisms without the, for bioactive glasses typical, interference of apatite layer formation. The results showed that initial dissolutions of sodium and potassium were markedly higher from the mixed alkali oxide glasses than from the compositions containing only one alkali oxide. Introducing MgO in S53P4 caused a minor decrease in the dissolution rates of all ions. The glass containing 3 mol% of MgO showed the best chemical durability. In contrast, replacing CaO gradually with SrO increased the dissolution rates of all ions. The glasses with the highest replacement of CaO with SrO showed rapid release of both Sr and Na ions. The results corroborate the overall knowledge of glass durability and can be utilized to design bioactive glasses with controlled ion release rate for tissue engineering applications.
Functionalizing Surface Electrical Potential of Hydroxyapatite Coatings

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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science, Research group: Surface Engineering, Riga Technical University, University of Adelaide
Authors: Pluduma, L., Freimanis, E., Gross, K., Koivuluoto, H., Algate, K., Haynes, D., Vuoristo, P.
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Research output: Scientific - peer-review › Conference contribution

Machine-coated starch-based dispersion coatings prevent mineral oil migration from paperboard
Mineral oil migration through paperboard presents a safety risk in modern food packaging. This study aimed to enhance the safety of fiber-based packaging by utilizing a bio-based composite barrier layer to protect against mineral oil. Starch-clay composite coatings on paperboard were created via dispersion coating. Thermal analysis of the coating components and field emission scanning electron microscopy imaging were performed to ascertain the physicochemical properties and morphology of the coatings. Coating functionality was evaluated using contact angles and transmission rate (water and
oxygen) measurements. The packaging safety focus was implemented by measuring the gas phase migration of heptane and analyzing the migration of liquid mineral oil through the coated paperboards with FTIR. The functional properties of the coated paperboards were maintained or improved. The studied coatings were effective barriers against the migration of mineral oil and could hence improve the barrier properties and safety of fiber-based primary food packaging.

Uniform and electrically conductive biopolymer-doped polypyrrole coating for fibrous PLA

Three-dimensional, fibrous scaffolds can be easily fabricated from polylactide (PLA) using melt spinning and textile techniques. However, the surface properties of PLA scaffolds are not ideal for tissue engineering purposes. Furthermore, electrically conducting scaffolds are required to deliver electrical stimulation to cells. In this study, uniform, electrically conducting polypyrrole (PPy) coatings were fabricated on biodegradable PLA fibers. Biopolymer dopants-hyaluronic acid (HA) and chondroitin sulfate (CS)—were compared, and a PPy/CS composition was analyzed further. The effect of the oxidative polymerization conditions on the PLA fibers and CS counterion was studied. Furthermore, the initial molecular weight of CS and its degree of polymerization were determined. Our experiments showed that the molecular weight of CS decreases under oxidizing conditions but that the decay is not significant with the short polymerization process we used. The coating process was transferred to nonwoven PLA fabrics, and the stability of PPy/CS coating was studied during in vitro incubation in phosphate buffer solution at physiological temperature. The conductivity and surface roughness of the coating decayed during the 20-day incubation. The mechanical strength, however, remained at the initial level. Thus, the fabricated structures are suitable for short-term electrical stimulation adequate to promote cell functions in specific cases.
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.
Processing and characterization of phosphate glasses containing CaAl2O4:Eu2+,Nd3+ and SrAl2O4:Eu2+,Dy3+ microparticles

In this paper, phosphate based glasses with persistent luminescence properties were processed using standard melting process in air by adding SrAl2O4:Eu2+,Dy3+ or CaAl2O4:Eu2+,Nd3+ in the glass batch before melting. All produced glasses were characterized using SEM/EDXA, Raman spectroscopy and photoluminescence. We discuss the effect of melting conditions (temperature and duration of the melting) on the persistent luminescence properties of the microparticles containing glasses. It is demonstrated that the melting in air allows for the preparation of glasses with persistent luminescence if the melting conditions are carefully controlled.

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Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, Frontier Photonics, Integrated Technologies for Tissue Engineering Research (ITTE), Turun Yliopisto/Turun Biomateriaalikeskus, Johan Gadolin Process Chemistry Centre, Åbo Akademi University, University of Turku, Institute of Low Temperature and Structure Research Polish Academy of Sciences, Wroclaw, Poland, Turku University Centre for Materials and Surfaces (MatSurf), Turku, Finland
Authors: Massera, J., Gaussiran, M., Gluchowski, P., Lastusaari, M., Hupa, L., Petit, L.
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Erbium-doped borosilicate glasses containing various amounts of P2O5 and Al2O3: Influence of the silica content on the structure and thermal, physical, optical and luminescence properties
Strontium- and calcium-containing, titanium-stabilised phosphate-based glasses with prolonged degradation for orthopaedic tissue engineering
Er3+-Al2O3 nanoparticles doping of borosilicate glass

Novel borosilicate glasses were developed by adding in the glass batch Er3+-Al2O3 nanoparticles synthetized by using a soft chemical method. A similar nanoparticle doping with modified chemical vapour deposition (MCVD) process was developed to increase the efficiency of the amplifying silica fibre in comparison to using MCVD and solution doping. It was shown that with the melt quench technique, a Er3+-Al2O3 nanoparticle doping neither leads to an increase in the Er3+ luminescence properties nor allows one to control the rare-earth chemical environment in a borosilicate glass. The site of Er3+ in the Er3+-Al2O3 nanoparticle containing glass seems to be similar as in glasses with the same composition prepared using standard raw materials. We suspect the Er3+ ions to diffuse from the nanoparticles into the glass matrix. There was no clear evidence of the presence of Al2O3 nanoparticles in the glasses after melting.
Abstract Bone tissue engineering requires highly porous three-dimensional (3D) scaffolds with preferable osteoconductive properties, controlled degradation, and good dimensional stability. In this study, highly porous 3D poly(d,l-lactide-co-glycolide) (PLGA) - bioactive glass (BG) composites (PLGA/BG) were manufactured by combining highly porous 3D fibrous BG mesh skeleton with porous PLGA in a freeze-drying process. The 3D structure of the scaffolds was investigated as well as in vitro hydrolytic degradation for 10 weeks. The effect of BG on the dimensional stability, scaffold composition, pore structure, and degradation behaviour of the scaffolds was evaluated. The composites showed superior pore structure as the BG fibres inhibited shrinkage of the scaffolds. The BG was also shown to buffer the acidic degradation products of PLGA. These results demonstrate the potential of these PLGA/BG composites for bone tissue engineering, but the ability of this kind of PLGA/BG composites to promote bone regeneration will be studied in forthcoming in vivo studies.
Bioactive glass ions as strong enhancers of osteogenic differentiation in human adipose stem cells

Bioactive glasses are known for their ability to induce osteogenic differentiation of stem cells. To elucidate the mechanism of the osteoinductivity in more detail, we studied whether ionic extracts prepared from a commercial glass S53P4 and from three experimental glasses (2-06, 1-06 and 3-06) are alone sufficient to induce osteogenic differentiation of human adipose stem cells. Cells were cultured using basic medium or osteogenic medium as extract basis. Our results indicate that cells stay viable in all the glass extracts for the whole culturing period, 14 days. At 14 days the mineralization in osteogenic medium extracts was excessive compared to the control. Parallel to the increased mineralization we observed a decrease in the cell amount. Raman and Laser Induced Breakdown Spectroscopy analyses confirmed that the mineral consisted of calcium phosphates. Consistently, the osteogenic medium extracts also increased osteocalcin production and collagen Type-I accumulation in the extracellular matrix at 13 days. Of the four osteogenic medium extracts, 2-06 and 3-06 induced the best responses of osteogenesis. However, regardless of the enhanced mineral formation, alkaline phosphatase activity was not promoted by the extracts. The osteogenic medium extracts could potentially provide a fast and effective way to differentiate human adipose stem cells in vitro.
Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), Tampere University Hospital, BioMediTech, University of Jyväskylä, Pirkanmaa Hospital District and School of Health Sciences, Adult Stem Cell Research Group, Regenerative Medicine, Adult Stem Cell Group, Johan Gadolin Process Chemistry Centre, Åbo Akademi University

Authors: Ojansivu, M., Vanhatupa, S., Björkvik, L., Häkkänen, H., Kellomäki, M., Autio, R., Ihalainen, J. A., Hupa, L., Miettinen, S.

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Scopus rating (2015): SJR 1.997 SNIP 1.99 CiteScore 6.58
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Scopus rating (2013): SJR 1.963 SNIP 2.269 CiteScore 6.41
Scopus rating (2012): SJR 1.904 SNIP 2.125 CiteScore 5.51
Scopus rating (2011): SJR 1.808 SNIP 1.91 CiteScore 5.15
Scopus rating (2010): SJR 1.794 SNIP 1.964
Scopus rating (2009): SJR 1.399 SNIP 1.662
Scopus rating (2008): SJR 1.404 SNIP 1.981
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EXT="Autio, Reija"
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Research output: Scientific - peer-review › Article

Application of Biopolymer Doped Polypyrroles in Biomedical Implants and Electrical Stimulation Devices

Organic conductive polymers are emerging new materials for biomedical engineering. They offer surface properties which are attractive for many biomedical applications, such as surface coatings on metallic or biodegradable polymeric implants, tissue engineering scaffolds, implantable electronic tissue stimulation devices and microelectromechanical systems for the manipulation of single living cells in vitro, for example. Owing to the proven compatibility with tissues and cells, conductive polypyrrole (PPy) has been intensively investigated for bone and neural stimulation applications. A salient feature of PPy is its easy modification with bioactive molecules and macromolecules, such as the extracellular matrix (ECM) components of animal tissues. This work assessed the ECM components hyaluronic acid (HA) and chondroitin sulfate (CS) as dopants, which we incorporated into the PPy during the syntheses by electrochemical and oxidative chemical polymerization.

Biopolymer doped PPy’s have been earlier reported to be good substrates for cell cultures. Furthermore, preceding implantation studies have shown promising results. However, considering clinical application and registration of PPy as a biomaterial in commercial cell culturing or tissue engineering products, there are still many practical aspects requiring more attention, such as the establishment of feasible synthetic routes, sterilizability, preservation of the electronic properties during storage and during the incubation in physiological conditions, possible biodegradation mechanisms, stability and biological elimination of the degradation products in vivo, for example. Mass spectroscopy of the hydrolysis products of polylactide (PLA) fibers coated with layer of PPy, suggested that the PPy was biostable in water at neutral pH. Electrical conductivity measurements and Raman spectroscopy showed that the PPy chain was prone to de-doping, and hence the lost its conductivity under biological conditions, but these effects were partly reversible by acid doping and positively biased electrochemical potential. The electrochemical redox activity and electromechanical actuation property of the biopolymer doped PPy’s was thoroughly studied. It was shown that the biopolymer doped PPy had significant and reversible redox activity, which could be potentially utilized in microelectromechanical stimulation of cells and implantable microscopic actuators.
Practical and reproducible polymerization protocols were developed during this work. We took novel approaches and suggested a relatively simple "one-pot" chemical polymerization scheme, avoiding the complications of biological functionalization using potentially toxic click-chemistry. The developed methods were successfully applied in the deposition of electrically conductive, biopolymer doped PPy coatings on polylactide (PLA) nonwoven tissue engineering scaffolds and commercial poly(lactide-co-glycolide)-β-tricalcium phosphate (PLGA-β-TCP) bone fixation screws.

The physical properties and cell response of HA and CS doped PPys (PPyHA and PPyCS) electrode coatings were investigated by atomic force microscopy (AFM) and electrochemical methods. Drastically different behaviour of adipose stem cells (hASC) was found on the different electrode coatings, highlighting the sensitivity of the hASCs on the nanoscopic and microscopic surface properties of the PPy substrate, such as surface roughness, elasticity and surface potential distribution, factors which could be engineered during the synthesis and affected by external stimuli during incubation in cell culture medium.

In conclusion, the results of this thesis supported the use of PPy coatings in bone tissue engineering. The electropolymerized films and also the chemically polymerized PPyHA and PPyCS coatings on bioabsorbable polymer were highly compatible with hASCs, supported cell adhesion and could be utilized in delivering direct electrical stimulation in vitro. There is also future potential in designing permanently implantable scaffolds and microstimulation devices, but still further insight into the biodegradation mechanism and biological elimination of PPy in vivo is needed.
Optimising polylactide melt spinning using real-time monitoring

Polylactide (PLA) is a synthetic biodegradable polyester and it is usually processed into fibres by two-step melt spinning, which comprises of (i) melting the raw material and pushing the melt through small orifices and (ii) stretching and heat treating the fibre to increase its mechanical properties. However, processing biodegradable polymers is challenging because the polymer degrades thermally which narrows the choice of the processing parameters. Real-time monitoring allows monitoring of the key properties of the material during the production of the fibre.

There were two objectives for this work: (i) upscaling the production of 4-filament PLA fibre with an updated set-up with real-time monitoring and (ii) studying the hydrolytic degradation of PLA fibres manufactured with the conventional set-up. The updated set-up comprised of high-speed spinning plants and a twin-screw extruder equipped with a slit die for later real-time monitoring of parameters related to thermal degradation of the polymer. The processing conditions of polylactide melt spinning were optimised by two sets of trials; initial trials with a packaging grade PLA and a second set of trials with GMP grade poly(L/D)lactide with an L/D ratio of 96/4.

The obtained fibres were characterised by tensile testing and the temperature-induced chain scission was evaluated by inherent viscosity (i.v.) measurements. Goal values were established to enable the post-processing of the fibres. Mechanically adequate fibre was produced in the initial trials regarding the material used and the filament diameters fulfilled the requirements. The packaging grade PLA did not degrade during extrusion but the i.v. of the GMP grade PLA was decreased by one third. The filament diameter and the strain values were at an acceptable level in half of the spools produced.
in the GMP grade trials. In the initial trials there was a problem with the fluctuation of the filament diameters but it was largely solved by a change of the feeding equipment in the GMP grade trials. There is a need for further optimisation of the mechanical properties. This should be done by increasing the draw ratio. However, the ultimate tensile strength of the fibre was close to the required value.

In addition a 48-week hydrolysis study was conducted on the fibre produced with the conventional set-up. The molecular, rheological, thermal and mechanical properties of gamma irradiated and non-irradiated fibres were measured. The molecular weights and inherent viscosities of both fibres decreased steadily, but the irradiated fibre degraded more prominently. The mechanical performance of the non-irradiated fibre showed no changes but the irradiated fibre could no longer be tested after 28 weeks. In conclusion, the results of the hydrolytic degradation studies were mainly in line with earlier studies. These results can be used as a reference for the future hydrolytic degradation studies for the fibre manufactured with the upgraded set-up.

Chitosan membranes in a rat model of full-thickness cutaneous wounds: Healing and IL-4 levels

Objective: The aim of this study was to examine the effect of chitosan membrane on wound healing. Method: The effect of chitosan membranes was evaluated in an experimental rat model. On day 0, circular full-thickness skin sections were excised from the scalps of rats. The wounds were then measured and the surrounding area tattooed. Rats were sacrificed either immediately after excision, or randomised into control and chitosan groups and followed up on day 3, 7, 14 or 21. Control group wounds were covered with Aquacel (wound dressing). Chitosan group wounds were covered with chitosan membranes and the wound dressing. Wounds and the distances between the tattooed marks were measured on follow-up, the wound sites were harvested and histologically examined, and serum interleukin (IL-4) levels were analysed.

Results: A total of 54 rats were examined and all time points included 6 control and 6 chitosan treated animals, except for day 0 which consisted of control animals only. On day 3, wounds in the chitosan group were significantly (p<0.05) smaller (60 ± 6% versus 78 ± 19% of the original wound area) than in the control group. Chitosan membranes were found to degrade at the wound sites between days 7 and 14. Leukocyte counts were lower in the chitosan group than in the control group on day seven (p<0.05). IL-4 levels were significantly higher on day 7 (p<0.001) and 14 (p<0.001) in the chitosan group. Conclusion: According to our results chitosan membrane may promote early wound healing, reduce inflammation and affect the IL-4 pathway, however, the membrane degrades at the wound site after day 7.
Bioabsorbable fabrics for musculoskeletal scaffolds

This chapter discusses how woven, braided, and knitted scaffolds have been used in bone, cartilage, tendon, and ligament tissue engineering (TE). First, we describe the different steps for manufacturing filaments, yams, and bioabsorbable textiles. Then we discuss issues related to the characterization and modelling of fabrics and scaffolds. In separate sections, we also consider four different applications of experimental TE using textile scaffolds, and we list currently available commercial products.

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The internet of Bio-Nano things
The Internet of Things (IoT) has become an important research topic in the last decade, where things refer to interconnected machines and objects with embedded computing capabilities employed to extend the Internet to many application domains. While research and development continue for general IoT devices, there are many application domains where very tiny, concealable, and non-intrusive Things are needed. The properties of recently studied nanomaterials, such as graphene, have inspired the concept of Internet of NanoThings (IoNT), based on the
interconnection of nanoscale devices. Despite being an enabler for many applications, the artificial nature of IoNT devices can be detrimental where the deployment of NanoThings could result in unwanted effects on health or pollution. The novel paradigm of the Internet of Bio-Nano Things (IoBNT) is introduced in this paper by stemming from synthetic biology and nanotechnology tools that allow the engineering of biological embedded computing devices. Based on biological cells, and their functionalities in the biochemical domain, Bio-NanoThings promise to enable applications such as intra-body sensing and actuation networks, and environmental control of toxic agents and pollution. The IoBNT stands as a paradigm-shifting concept for communication and network engineering, where novel challenges are faced to develop efficient and safe techniques for the exchange of information, interaction, and networking within the biochemical domain, while enabling an interface to the electrical domain of the Internet.

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Authors: Akyildiz, I. F., Pierobon, M., Balasubramaniam, S., Koucheryavy, Y.
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Scopus rating (2013): SJR 2.584 SNIP 5.643 CiteScore 6.08
Scopus rating (2012): SJR 2.867 SNIP 5.416 CiteScore 5.73
Scopus rating (2011): SJR 2.242 SNIP 5.121 CiteScore 4.97
Scopus rating (2010): SJR 2.29 SNIP 3.65
Scopus rating (2009): SJR 1.817 SNIP 3.976
Scopus rating (2008): SJR 1.893 SNIP 3.918
Scopus rating (2007): SJR 2.331 SNIP 4.411
Scopus rating (2006): SJR 2.085 SNIP 4.483
Scopus rating (2005): SJR 2.788 SNIP 5.649
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ASJC Scopus subject areas: Electrical and Electronic Engineering, Computer Science Applications, Computer Networks and Communications
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Research output: Scientific - peer-review › Article

Binary TiO2/SiO2 nanoparticle coating for controlling the wetting properties of paperboard
We introduce a flame based aerosol method to fabricate thin films consisting of binary TiO2/SiO2 nanoparticles deposited directly from the flame onto the paperboard. Nanocoatings were prepared with Liquid Flame Spray (LFS) in a roll-to-roll process with the line speed of 50 m/min. Surface wetting behavior of nanocoated paperboard was studied for different Ti/Si ratios in the precursor, affecting TiO2/ SiO2 ratio in the coating. Wettability could be adjusted to practically any water
contact angle between 10 and 160° by setting the Ti/Si ratio in the liquid precursor. Structure of the two component nanocoating was analysed with FE-SEM, TEM, EDS, XPS and XRD. The porous thin film coating was concluded to consist of ca. 10 nm sized mixed oxide nanoparticles with segregated TiO2 and SiO2 phases. Accumulation of carbonaceous compounds on the surface was seen to be almost linearly dependent on the Ti/Si ratio, indicating the species being exposed in corresponding amount. However, wetting of the surface was observed to follow merely an S-shaped curve, caused by the roughness of the nanocoated surface. Reasons for the observed superhydrophobicity and superhydrophilicity of these binary nanocoatings on paperboard are discussed. (C) 2014 Elsevier B.V. All rights reserved.

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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, Department of Materials Science, Research group: Paper Converting and Packaging, Engineering materials science and solutions (EMASS), Abo Akad Univ, Abo Akademi University, Lab Paper Coating & Converting, Univ Helsinki, University of Helsinki, Dept Chem, Inorganic Chem Lab
Authors: Haapanen, J., Aromaa, M., Teisala, H., Tuominen, M., Stepien, M., Saarinen, J. J., Heikkila, M., Toivakka, M., Kuusipalo, J., Mäkelä, J.
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Scopus rating (2013): SJR 0.818 SNIP 1.265 CiteScore 2.38
Scopus rating (2012): SJR 0.916 SNIP 1.445 CiteScore 2.41
Scopus rating (2011): SJR 0.95 SNIP 1.466 CiteScore 2.56
Scopus rating (2010): SJR 1.045 SNIP 1.273
Scopus rating (2009): SJR 0.986 SNIP 1.297
Scopus rating (2008): SJR 0.936 SNIP 1.311
Scopus rating (2007): SJR 1.007 SNIP 1.339
Scopus rating (2006): SJR 0.948 SNIP 1.334
Scopus rating (2005): SJR 0.782 SNIP 1.182
Scopus rating (2004): SJR 0.665 SNIP 0.936
Scopus rating (2003): SJR 0.64 SNIP 1.15
Scopus rating (2002): SJR 0.603 SNIP 0.8
Scopus rating (2001): SJR 0.497 SNIP 0.834
Scopus rating (2000): SJR 0.553 SNIP 0.77
Scopus rating (1999): SJR 0.373 SNIP 0.657
Original language: English
Keywords: Coatings, Composite materials, Nanostructures, Surfaces, Thin films, LIQUID FLAME SPRAY, SUPERHYDROPHOBIC SURFACES, WETTABILITY CONVERSION, AEROSOL SYNTHESIS, TITANIA, PYROLYSIS, SIO2/TIO2, DEPOSITS, POWDERS, OXIDES
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Research output: Scientific - peer-review › Article

Biodegradable passive resonance sensor: Fabrication and initial testing
Biodegradable resonance circuits were studied. The circuits have a novel two-layer resonator structure without galvanic through hole vias. A patterned magnesium layers were evaporated on biodegradable PLA sheets by using a 3D printed
mask. The circuits were assembled by heat sealing two magnesium patterned sheets together to encapsulate the circuit structure. An inductive link is used to wirelessly detect the resonance frequency of the circuit. The circuits were tested when immersed in de-ionised water and saline. According to the tests, the designed resonator structure can be measured in aqueous environment. The resonance of the tested circuit was observable at least for 51 hours. The concept still needs more development to extend degradation time and to increase the stability during immersion.

General information
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Authors: Salpavaara, T., Ellä, V., Kellomäki, M., Lekkala, J.
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ISBN (Print): 9789897580710
ASJC Scopus subject areas: Biomedical Engineering, Electrical and Electronic Engineering
Keywords: Biodegradable, Passive resonance sensor
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http://www.scopus.com/inward/record.url?scp=84936806627&partnerID=8YFLogxK (Link to publication in Scopus)

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ORG=elt,0.5
Source: Scopus
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Research output: Scientific - peer-review › Conference contribution

Miksi villalanka aiheuttaa allergiaa?

General information
State: Published
Ministry of Education publication type: E1 Popularised article, newspaper article
Organisations: Department of Materials Science, Research group: Fibre Materials
Authors: Rissanen, M.
Publication date: 2015
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Original language: Finnish
Research output: General public › Letter

Muraglitazar-Eluting Bioabsorbable Vascular Stent Inhibits Neointimal Hyperplasia in Porcine Iliac Arteries
Purpose To evaluate the biocompatibility of a new muraglitazar-eluting polylactide copolymer stent and investigate its ability to prevent the formation of intimal hyperplasia.

Materials and Methods Ten self-expandable muraglitazar-eluting poly-96l/4d-lactic acid (PLA96) stents and 10 self-expandable control PLA96 stents were implanted into porcine common iliac arteries. After 28 days follow-up, all stent-implanted iliac arteries were harvested and prepared for quantitative histomorphometric analysis.

Results Angiographic analysis revealed that one control PLA96 stent had occluded and one had migrated. Histomorphometric analysis demonstrated that, with the control PLA96 stent, the luminal diameter and area were decreased versus the muraglitazar-eluting PLA96 stents (means ± standard error of the mean, 3.58 mm ± 0.34 vs 4.16 mm ± 0.14 and 9.83 mm² ± 2.41 vs 13.75 mm² ± 0.93, respectively). The control PLA96 stent induced more intimal hyperplasia than the bioactive muraglitazar-eluting PLA96 stent (557 μm ± 122 vs 361 μm ± 32). Vascular injury scores demonstrated only mild vascular trauma for both stents (muraglitazar-eluting, 0.68 ± 0.07; control, 0.75 ± 0.08).
Inflammation scores also showed mild inflammation for both stents (muraglitazar-eluting, 1.05 ± 0.17; control, 1.23 ± 0.19).

Conclusions This new muraglitazar-eluting PLA96 stent was shown to be biocompatible with a tendency for better patency and less intimal hyperplasia compared with the control PLA96 stents.

New alternative route for the preparation of phosphate glasses with persistent luminescence properties
In this paper, we investigate a new alternative route for the preparation of phosphate glasses with persistent luminescence properties. Phosphate glasses within the P2O5-Na2O-CaO and P2O5-Na2O-SrO systems were prepared by a standard melting process in air by adding Sr4Al14O25:Eu2+,Dy3+ microparticles in the glass batch before melting. We found that all the investigated glasses show persistent luminescence. It is clearly shown that conventional melting in air of Sr4Al14O25:Eu2+,Dy3+ microparticles in phosphate glass batch can be a new technique to prepare phosphate glasses with persistent luminescence properties.
New routes from cellulose to textile fiber and ready products

General information
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Organisations: Department of Materials Science, Research group: Fibre Materials, Aalto University, VTT Tech Res Ctr Finland, VTT Technical Research Center Finland
Authors: Nousiainen, P., Rissanen, M., Michud, A., Sixta, H., Hummel, M., Setälä, H.
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Processing and characterization of novel borophosphate glasses and fibers for medical applications

General information
Ultrathin Polyimide Membrane as Cell Carrier for Subretinal Transplantation of Human Embryonic Stem Cell Derived Retinal Pigment Epithelium

**General information**
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Nanofabrication and Adsorption Studies of Organic Molecules on Metal and Metal Alloy Surfaces as Templates for Biofunctional Applications

The nanofabrication of organic layers on metal and metal alloy surfaces was studied in this thesis by employing photoelectron spectroscopy (PES) as the main analysis method. The motivation for this research is to introduce new properties to metal and metal alloy surfaces via self-assembly driven adsorption processes of organic molecules. Trimesic acid (TMA) and glycine adsorption on single crystal Cu(100) surface was investigated with PES and scanning tunnelling microscopy (STM). TMA on Cu(100) exhibits coverage dependent surface phases with drastic changes in the molecular orientation. The mobile TMA molecules at low coverage transform into Cu atom coordinated TMA networks and finally into carboxyl (COOH) functionalized, densely packed TMA monolayers. This is enabled due to three equivalent COOH groups symmetrically around a rigid benzene ring. Homo- and heterochiral surface phases of achiral glycine on Cu(100) were observed, and a new structural model for glycine bonding on Cu(100) based on STM and density functional theory calculations is presented. The coadsorption of aminopropyl trimethoxysilane (APS) and mercaptopropyl trimethoxysilane (MPS) on stainless steel was studied with an aim to incorporate MPS in APS matrix with tuneable distribution. In addition to the determination of elemental and chemical states at the surface, PES data was also used to determine the surface morphology by employing inelastic electron energy-loss background analysis. Synchrotron radiation mediated PES enabled the study of the in-depth distribution of the chemical states in non-destructive manner. The functionality of the APS/MPS overlayers on stainless steel was studied with chemical derivatization. The studies of TMA and glycine on Cu(100) provide important knowledge of the adsorption behaviour of small molecules on surfaces, which is crucial for understanding the adsorption phenomena of larger molecules, such as proteins on more complex substrates. The fabricated surface structures may also be applicable to molecular electronics or catalytic surfaces. The bifunctional silanization of stainless steel, on the other hand, is directly transferrable to industrial scale processes. The bifunctional APS/MPS nanomolecular layer on stainless steel works as a template, to which biomolecules can be covalently coupled with tuneable distribution. Hence, the stainless steel surface can be biofunctionalized for a range of applications, depending on the properties of the biomolecules.
Development of chip-surface stimulus electrode array for fully-implantable subretinal prosthesis chip

In this study, we have developed a chip-surface stimulus electrode array for fully-implantable subretinal prosthesis chip. To realize visual restoration with high resolution, stimulus electrodes should be miniaturized and arrayed with high density. When we miniaturize them, however, their electrochemical impedances become higher and their amount of charge injection become smaller. Additionally, as the number of electrodes increases, it becomes difficult to make electrical connection to each pixel of the retinal prosthesis chip and each electrode by electrical wiring. To overcome these problems, we have developed the stimulus electrodes that have low electrochemical impedances and large charge injection capacities, and established a fabrication process of chip-surface stimulus electrode array. We fabricated the stimulus electrodes made of extremely porous platinum which had large-surface-area compared with conventional Pt. We also fabricated the chip-surface stimulus electrodes array on the subretinal prosthesis chip which surface was rough and covered with insulator film.

General information
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Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), International Graduate School in Biomedical Engineering and Medical Physics (Ministry of Education in Finland), Graduate School of Engineering, Tohoku University
Authors: Sasaki, Y., Suzuki, T., Iwagami, T., Tani, T., Naganuma, H., Kino, H., Hyttinen, J., Kellomäki, M., Tanaka, T.
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Development of Si neural probe module with adjustable gain amplifier for neuronal signal recording
In recent years, lots of research on biomedical technologies directly using bio-signals such as BMI (Brain Machine Interface) have been performed intensively. Among bio-signals, ECoG (Electrocorticogram), LFP (Local Field Potential), and AP (Action Potential) are usually recorded especially for diagnosis, treatment, and prevention of brain diseases. These bio-signals have different amplitudes and frequency bandwidths, and the signal intensities vary accordingly with recording electrode conditions and individual variation. Therefore, a multiple bio-signals recording system having adjustable gain and bandwidth is strongly required. In this study, we designed the adjustable gain amplifier appropriate for the system, and fabricated the module composed of the amplifier and a Si neural probe for the multiple bio-signal recording in the deep brain. Additionally, we verified fundamental functions of the module by in vitro experiments.

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Authors: Tani, T., Naganuma, H., Harashima, T., Iwagami, T., Kino, H., Kiyoyama, K., Kellomäki, M., Hyttinen, J., Tanaka, T.
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Scopus rating (2011): SJR 0.104 SNIP 0.198 CiteScore 0.13
Scopus rating (2010): SJR 0.103 SNIP 0.193
Scopus rating (2006): SJR 0.101 SNIP 0.043
Scopus rating (2005): SJR 0.106 SNIP 0.126
Scopus rating (2004): SJR 0.103 SNIP 0.487
Scopus rating (2003): SJR 0.111 SNIP 0.167
Scopus rating (2002): SJR 0.112 SNIP 0.052
Switchable water absorption of paper via liquid flame spray nanoparticle coating

Surface wetting/anti-wetting and liquid absorption are relevant properties of many porous solids including paper and other cellulose-based materials. Here we demonstrate how surface wetting by water and water absorption of commercially available kraft paper can be altered by thin nanoparticle coatings fabricated by liquid flame spray in facile and continuous one-step process. Surface wettability and absorption properties of paper increased with silica and decreased with titania (TiO2) nanoparticle coatings. Moreover, the water-repellent (superhydrophobic) TiO2 nanoparticle coated paper could be switched to superhydrophilic and water absorbing by ultraviolet illumination. The experiments revealed that although surface wetting and liquid absorption of nanoparticle coated paper are strongly related to each other, they are two distinct phenomena which do not necessarily correlate. We propose wetting regimes on the nanoparticle coated paper samples on the basis of the experimental observations.

General information

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Authors: Teisala, H., Tuominen, M., Haapanen, J., Aromaa, M., Stepien, M., Mäkelä, J. M., Saarinen, J. J., Toivakka, M., Kuusipalo, J.
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Scopus rating (2012): SJR 1.179 SNIP 1.71 CiteScore 3.74
Scopus rating (2011): SJR 1.354 SNIP 1.795 CiteScore 3.99
Scopus rating (2010): SJR 0.873 SNIP 1.384
Scopus rating (2009): SJR 1.038 SNIP 1.219
Scopus rating (2008): SJR 0.926 SNIP 1.123
Scopus rating (2007): SJR 0.754 SNIP 1.034
Scopus rating (2006): SJR 0.699 SNIP 1.15
Scopus rating (2005): SJR 1.112 SNIP 1.318
Scopus rating (2004): SJR 0.855 SNIP 1.072
Scopus rating (2003): SJR 0.81 SNIP 1.02
Scopus rating (2002): SJR 0.649 SNIP 0.689
Scopus rating (2001): SJR 0.602 SNIP 0.785
Scopus rating (2000): SJR 0.583 SNIP 0.773
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Biofunctional hybrid materials: bimolecular organosilane monolayers on FeCr alloys

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Authors: Vuori, L., Leppiniemi, J., Hannula, M., Lahtonen, K., Hirsimäki, M., Nömmiste, E., Costelle, L., Hytönen, V. P., Valden, M.
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Scopus rating (2011): SJR 1.892 SNIP 1.461 CiteScore 3.86
Scopus rating (2010): SJR 1.844 SNIP 1.259
Scopus rating (2009): SJR 1.819 SNIP 1.28
Scopus rating (2008): SJR 1.875 SNIP 1.333
Scopus rating (2007): SJR 1.91 SNIP 1.36
Scopus rating (2006): SJR 1.934 SNIP 1.378
Scopus rating (2005): SJR 1.925 SNIP 1.445
Scopus rating (2004): SJR 1.849 SNIP 1.477
Scopus rating (2003): SJR 1.427 SNIP 1.371
Scopus rating (2002): SJR 0.962 SNIP 0.993
Scopus rating (2001): SJR 0.901 SNIP 0.94
Scopus rating (2000): SJR 0.881 SNIP 0.891
Comparison of Chondroitin Sulfate and Hyaluronic Acid Doped Conductive Polypyrrole Films for Adipose Stem Cells

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Björninen, M., Siljander, A., Pelto, J., Hyttinen, J., Kellomäki, M., Miettinen, S., Seppänen, R., Haimi, S.
Number of pages: 12
Pages: 1889-1900
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Annals of Biomedical Engineering
Volume: 42
Issue number: 9
ISSN (Print): 0090-6964
Ratings:
Scopus rating (2016): CiteScore 3.13 SJR 1.054 SNIP 1.221
Scopus rating (2015): SJR 1.179 SNIP 1.355 CiteScore 3.21
Scopus rating (2014): SJR 1.095 SNIP 1.521 CiteScore 3.29
Scopus rating (2013): SJR 1.257 SNIP 1.451 CiteScore 3.38
Scopus rating (2012): SJR 0.926 SNIP 1.242 CiteScore 2.77
Scopus rating (2011): SJR 0.863 SNIP 1.135 CiteScore 2.54
Scopus rating (2010): SJR 0.812 SNIP 1.266
Scopus rating (2009): SJR 0.892 SNIP 1.337
Scopus rating (2008): SJR 1.003 SNIP 1.268
Scopus rating (2007): SJR 1.073 SNIP 1.322
Scopus rating (2006): SJR 1.049 SNIP 1.283
Scopus rating (2005): SJR 0.802 SNIP 1.111
Scopus rating (2004): SJR 0.694 SNIP 1.214
Scopus rating (2003): SJR 0.355 SNIP 1.069
Scopus rating (2002): SJR 0.295 SNIP 0.911
Scopus rating (2001): SJR 0.282 SNIP 1.276
Scopus rating (2000): SJR 0.663 SNIP 0.956
Scopus rating (1999): SJR 0.524 SNIP 0.984
Original language: English
DOIs: 10.1007/s10439-014-1023-7

Bibliographical note
Contribution: organisation=elt,FACT1=1<br/>Portfolio EDEND: 2014-05-30<br/>Publisher name: Springer US
Source-ID: 172
Research output: Scientific - peer-review › Article

Controlling the synergetic effects in (3-aminopropyl) trimethoxysilane and (3-mercaptopropyl) trimethoxysilane coadsorption on stainless steel surfaces
Degradation mechanisms of bioresorbable polyesters. Part 1. Effects of random scission, end scission and autocatalysis

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Gleadall, A., Pan, J., Kruft, M., Kellomäki, M.
Number of pages: 10
Pages: 2223-2232
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Acta Biomaterialia
Volume: 10
Issue number: 5
Degradation mechanisms of bioresorbable polyesters. Part 2. Effects of initial molecular weight and residual monomer

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Gleadall, A., Pan, J., Kruft, M., Kellomäki, M.
Number of pages: 8
Pages: 2233-2240
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Acta Biomaterialia
Volume: 10
Issue number: 5
ISSN (Print): 1742-7061
Ratings:

Scopus rating (2016): CiteScore 6.66 SJR 1.789 SNIP 1.921
Scopus rating (2015): SJR 1.997 SNIP 1.99 CiteScore 6.58
Scopus rating (2014): SJR 1.814 SNIP 2.324 CiteScore 6.53
Scopus rating (2013): SJR 1.963 SNIP 2.269 CiteScore 6.41
Scopus rating (2012): SJR 1.904 SNIP 2.125 CiteScore 5.51
Scopus rating (2011): SJR 1.808 SNIP 1.91 CiteScore 5.15
Scopus rating (2010): SJR 1.794 SNIP 1.964
Scopus rating (2009): SJR 1.399 SNIP 1.662
Scopus rating (2008): SJR 1.404 SNIP 1.981
Scopus rating (2007): SJR 1.199 SNIP 1.493
Scopus rating (2006): SJR 0.837 SNIP 1.131
Original language: English
DOIs:
10.1016/j.actbio.2013.12.039

Bibliographical note
Contribution: organisation=elt,FACT1=1<br/>Portfolio EDEND: 2014-04-30<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 349
Research output: Scientific - peer-review › Article
Determination of the functionality of monolayers of aminopropyl trimethoxy silane and mercaptopropyl trimethoxy silane on stainless steel with SR-PES and chemical derivatization

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Vuori, L., Hannula, M., Hirsimäki, M., Tönisoo, A., Nömmiste, E., Valden, M.
Number of pages: 2
Pages: 1-2
Publication date: 2014

Host publication information
Place of publication: Lund, Sweden
Publisher: MAX-LAB
Links:
https://www.maxlab.lu.se/node/1913

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-12-15
Source: researchoutputwizard
Source-ID: 1771
Research output: Scientific » Chapter

Direct laser writing of microstructures for the growth guidance of human pluripotent stem cell derived neuronal cells

General information
State: Published
Ministry of Education 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)
Authors: Turunen, S., Käpylä, E., Lähteenmäki, M., Ylä-Outinen, L., Narkilahti, S., Kellomäki, M.
Number of pages: 8
Pages: 197-204
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Optics and Lasers in Engineering
Volume: 55
ISSN (Print): 0143-8166
Ratings:
Scopus rating (2016): CiteScore 3.06 SJR 0.959 SNIP 1.79
Scopus rating (2015): SJR 1.056 SNIP 1.872 CiteScore 2.53
Scopus rating (2014): SJR 0.975 SNIP 2.146 CiteScore 2.52
Scopus rating (2013): SJR 0.867 SNIP 1.901 CiteScore 2.4
Scopus rating (2012): SJR 0.863 SNIP 2.121 CiteScore 2.32
Scopus rating (2011): SJR 0.937 SNIP 2.331 CiteScore 2.28
Scopus rating (2010): SJR 0.764 SNIP 1.815
Scopus rating (2009): SJR 0.687 SNIP 1.518
Scopus rating (2008): SJR 0.584 SNIP 1.536
Scopus rating (2007): SJR 0.595 SNIP 1.386
Scopus rating (2006): SJR 0.512 SNIP 1.382
Scopus rating (2005): SJR 0.624 SNIP 1.447
Scopus rating (2004): SJR 0.702 SNIP 1.48
Scopus rating (2003): SJR 0.671 SNIP 1.396
Scopus rating (2002): SJR 0.457 SNIP 1.243
Direct laser writing of synthetic poly(amino acid) hydrogels and poly(ethylene glycol) diacrylates by two-photon polymerization

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Käpylä, E., Sedlacik, T., Aydogan, D. B., Viitanen, J., Rypacek, F., Kellomäki, M.
Number of pages: 10
Publication date: 2014
Publication information
Journal: Materials Science and Engineering C: Materials for Biological Applications
Volume: 43
ISSN (Print): 0928-4931
Ratings:
Scopus rating (2016): CiteScore 3.78 SJR 0.857 SNIP 1.176
Scopus rating (2015): SJR 1.312 SNIP 1.084 CiteScore 3.13
Scopus rating (2014): SJR 0.716 SNIP 1.196 CiteScore 2.88
Scopus rating (2013): SJR 0.755 SNIP 1.346 CiteScore 3.07
Scopus rating (2012): SJR 0.832 SNIP 1.471 CiteScore 2.78
Scopus rating (2011): SJR 0.849 SNIP 1.353 CiteScore 2.93
Scopus rating (2010): SJR 0.81 SNIP 1.083
Scopus rating (2009): SJR 0.753 SNIP 1.208
Scopus rating (2008): SJR 0.796 SNIP 1.08
Scopus rating (2007): SJR 0.682 SNIP 1.035
Scopus rating (2006): SJR 0.656 SNIP 0.976
Scopus rating (2005): SJR 0.747 SNIP 1.009
Scopus rating (2004): SJR 0.639 SNIP 0.843
Scopus rating (2003): SJR 0.609 SNIP 0.7
Scopus rating (2002): SJR 0.482 SNIP 0.67
Scopus rating (2001): SJR 0.467 SNIP 0.664
Scopus rating (2000): SJR 0.489 SNIP 0.394
Scopus rating (1999): SJR 0.251 SNIP 0.379
Original language: English
DOIs:
10.1016/j.msec.2014.07.027

Bibliographical note
Contribution: organisation=elt,FACT1=1<br/>Portfolio EDEND: 2014-08-30<br/>Publisher name: Elsevier S.A.
Source: researchoutputwizard
Source-ID: 658
Research output: Scientific - peer-review › Article
Flexor tendon healing within the tendon sheath using bioabsorbable poly-l/d-lactide 96/4 suture. A histological in vivo study with rabbits

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Viinikainen, A., Göransson, H., Taskinen, H., Röyttä, M., Kellomäki, M., Törmälä, P., Rokkanen, P.
Number of pages: 7
Pages: 1319-1325
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Journal of Materials Science: Materials in Medicine
Volume: 25
Issue number: 5
ISSN (Print): 0957-4530
Ratings:
Scopus rating (2016): SJR 0.533 SNIP 0.739 CiteScore 2.02
Scopus rating (2015): SJR 0.738 SNIP 0.952 CiteScore 2.46
Scopus rating (2014): SJR 0.739 SNIP 1.348 CiteScore 2.52
Scopus rating (2013): SJR 0.825 SNIP 1.349 CiteScore 3.02
Scopus rating (2012): SJR 0.861 SNIP 1.305 CiteScore 2.68
Scopus rating (2011): SJR 1.006 SNIP 1.228 CiteScore 2.8
Scopus rating (2010): SJR 0.949 SNIP 1.06
Scopus rating (2009): SJR 0.817 SNIP 0.996
Scopus rating (2008): SJR 0.686 SNIP 0.997
Scopus rating (2007): SJR 0.803 SNIP 0.979
Scopus rating (2006): SJR 0.724 SNIP 1.034
Scopus rating (2005): SJR 0.548 SNIP 1.046
Scopus rating (2004): SJR 0.465 SNIP 0.955
Scopus rating (2003): SJR 1.109 SNIP 0.808
Scopus rating (2002): SJR 0.923 SNIP 1.072
Scopus rating (2001): SJR 0.755 SNIP 1.378
Scopus rating (2000): SJR 0.707 SNIP 1.048
Scopus rating (1999): SJR 0.66 SNIP 1.078
Original language: English
DOIs:
10.1007/s10856-014-5160-1

Bibliographical note
Contribution: organisation=elt,FACT1=1<br/>Portfolio EDEND: 2014-04-30<br/>Publisher name: Springer New York
Source: researchoutputwizard
Source-ID: 1734
Research output: Scientific - peer-review › Article

In vitro bioluminescence used as a method for real-time inhibition zone testing for antibiotic-releasing composites

Aims: This study describes the potential of real-time bioluminescence imaging in evaluating the antibiotic efficiency of two cylinder-shaped bioabsorbable antibiotic-releasing composites by in vitro inhibition zone tests. The bacterial infections of bone tissue can cause extensive hard and soft tissue damage and decrease the efficiency of oral antibiotic therapy due to the poor blood circulation in the infected area. To overcome this problem, new, locally antibiotic-releasing biodegradable composites have been developed. Study Design & Methodology: The two composites evaluated in this study were composed of poly(L-lactide-co-ε-caprolactone) matrix, β-tricalcium phosphate ceramic and either ciprofloxacin or rifampicin antibiotic. The composites were tested with genetically modified model pathogens of osteomyelitis (Pseudomonas aeruginosa and Staphylococcus epidermidis) in vitro in inhibition zone tests using a method of real-time bioluminescence. Results: The first signs of the effect of the released ciprofloxacin or rifampicin became visible after four hours of incubation and were seen as changed bioluminescence around the composite pellet on a culture dish. Both of the composite types showed excellent effects against the sensor bacteria within the diffusion area. Bioluminescence
measurements suggested that no survivor bacteria capable of evolving resistant strains were left inside the inhibition zones. The S. epidermidis bacterial strain was an inhibition sensor and P. aeruginosa was a stress sensor. Conclusion: These results highlight the potential of the composite materials against the pathogens of osteomyelitis. The approach allows continuous visual inspection of the efficacy of the antibiotics against the bacteria.

**General information**

State: Published

**Ministry of Education publication type:** A1 Journal article-refereed

**Organisations:** Department of Electronics and Communications Engineering, Department of Chemistry and Bioengineering

**Authors:** Männistö, N. M., Ahola, N., Karp, M. T., Veiranto, M., Kellomäki, M.

**Number of pages:** 20

**Pages:** 235-254

**Publication date:** 2014

**Peer-reviewed:** Yes

**Publication information**

**Journal:** British Microbiology Research Journal

**Volume:** 4

**Issue number:** 2

**ISSN (Print):** 2231-0886

**Original language:** English

**Electronic versions:**

mannisto_in_vitro_bioluminescence_used_as_a_method.pdf

**DOIs:**

10.9734/BMRJ/2014/6661

**Links:**

http://urn.fi/URN:NBN:fi:tty-201401301069

**Bibliographical note**

Contribution: organisation=keb,FACT1=0.5<br/>
Contribution: organisation=elt,FACT2=0.5<br/>
Portfolio EDEND: 2014-02-15<br/>
Publisher name: Sciencedomain International

Source: researchoutputwizard

Source-ID: 1026

Research output: Scientific - peer-review › Article

**Mechanical and Thermal Characterization of Compression Moulded Polylactic Acid Natural Fiber Composites Reinforced with Hemp and Lyocell Fibers**

**General information**

State: Published

**Ministry of Education publication type:** A1 Journal article-refereed

**Organisations:** Department of Materials Science

**Authors:** Baghaei, B., Skrifvars, M., Rissanen, M., Ramamoorthy, S. K.

**Number of pages:** 10

**Pages:** 1-10

**Publication date:** 2014

**Peer-reviewed:** Yes

**Publication information**

**Journal:** Journal of Applied Polymer Science

**Volume:** 131

**Issue number:** 15

**ISSN (Print):** 0021-8995

**Ratings:**

Scopus rating (2016): CiteScore 1.73 SJR 0.532 SNIP 0.724

Scopus rating (2015): SJR 0.574 SNIP 0.827 CiteScore 1.74

Scopus rating (2014): SJR 0.658 SNIP 0.964 CiteScore 1.76

Scopus rating (2013): SJR 0.628 SNIP 1.085 CiteScore 1.71

Scopus rating (2012): SJR 0.658 SNIP 1.081 CiteScore 1.57

Scopus rating (2011): SJR 0.601 SNIP 0.965 CiteScore 1.45

Scopus rating (2010): SJR 0.679 SNIP 0.909

Scopus rating (2009): SJR 0.697 SNIP 0.825

Scopus rating (2008): SJR 0.647 SNIP 0.822
Scopus rating (2007): SJR 0.678 SNIP 0.931
Scopus rating (2006): SJR 0.782 SNIP 1.145
Scopus rating (2005): SJR 0.779 SNIP 0.912
Scopus rating (2004): SJR 0.774 SNIP 0.962
Scopus rating (2003): SJR 0.816 SNIP 1.067
Scopus rating (2002): SJR 0.866 SNIP 1.084
Scopus rating (2001): SJR 0.964 SNIP 1.157
Scopus rating (2000): SJR 0.864 SNIP 1.157
Scopus rating (1999): SJR 0.978 SNIP 1.277
Original language: English
DOIs:
10.1002/APP.40534

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-01<br/>Publisher name: Wiley
Source: researchoutputwizard
Source-ID: 135
Research output: Scientific - peer-review › Article

**Multifunctional superhydrophobic nanoparticle coatings for cellulose-based substrates by liquid flame spray**

**General information**
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science
Authors: Teisala, H.
Number of pages: 1
Pages: 59
Publication date: 2014
Peer-reviewed: Unknown

**Publication information**
Journal: Materia
Issue number: 1
ISSN (Print): 1459-9694
Original language: Finnish
Links:
http://www.vuorimiesyhdistys.fi/sites/default/files/materia/pdf/Materia%201-2014_0.pdf

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-05<br/>Publisher name: Vuorimiesyhdistys
Source: researchoutputwizard
Source-ID: 1608
Research output: Professional › Article

**Nanoparticle Depositon on Packaging Materials by Liquid Flame Spray: Generation of Superhydrophilic and Superhydrophobic Coatings**

**General information**
State: Published
Ministry of Education publication type: A3 Part of a book or another research book
Organisations: Department of Materials Science, Department of Physics
Authors: Teisala, H., Tuominen, M., Aromaa, M., Stepien, M., Mäkelä, J. M., Saarinen, J. J., Toivakka, M., Kuusipalo, J.
Number of pages: 13
Pages: 331-343
Publication date: 2014

**Host publication information**
Title of host publication: Recent Advances in Adhesion Science and Technology
Place of publication: Boca Raton
Publisher: CRC Press
Editors: Gutowski, W. (., Dodiuk, H.)
Optical projection tomography as a tool for 3D imaging of hydrogels

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Number of pages: 7
Pages: 3443-3449
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Biomedical Optics Express
Volume: 5
Issue number: 10
ISSN (Print): 2156-7085
Ratings:
Scopus rating (2016): CiteScore 3.8 SJR 1.315 SNIP 1.526
Scopus rating (2015): SJR 1.432 SNIP 1.647 CiteScore 4.07
Scopus rating (2014): SJR 1.754 SNIP 1.798 CiteScore 3.86
Scopus rating (2013): SJR 1.549 SNIP 1.827 CiteScore 3.98
Scopus rating (2012): SJR 1.301 SNIP 1.662 CiteScore 2.85
Scopus rating (2011): SJR 0.846 SNIP 1.757
Original language: English
DOIs:
10.1364/BOE.5.003443

Optical projection tomography can be used to investigate spatial distribution of chondrocytes in three-dimensional biomaterial scaffolds for cartilage tissue engineering

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Järvinen, E., Muhonen, V., Haaparanta, A., Kellomäki, M., Kiviranta, I.
Number of pages: 5
Pages: 1549-1553
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Bio-Medical Materials and Engineering
Ormocomp-Modified Glass Increases Collagen Binding and Promotes the Adherence and Maturation of Human Embryonic Stem Cell-Derived Retinal Pigment Epithelial Cells

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electronics and Communications Engineering, Optoelectronics Research Centre, Research group: Surface Science, Frontier Photonics, Integrated Technologies for Tissue Engineering Research (ITTE)
Authors: Käpylä, E., Sorkio, A., Teymouri, S., Lahtonen, K., Vuori, L., Valden, M., Skottman, H., Kellomäki, M., Juuti-Uusitalo, K.
Number of pages: 11
Pages: 1-11
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Langmuir
ISSN (Print): 0743-7463
Ratings:
Scopus rating (2016): CiteScore 3.99 SJR 1.55 SNIP 1.188
Scopus rating (2015): SJR 1.686 SNIP 1.308 CiteScore 4.33
Scopus rating (2014): SJR 1.816 SNIP 1.391 CiteScore 4.59
Scopus rating (2013): SJR 1.895 SNIP 1.356 CiteScore 4.55
Scopus rating (2012): SJR 2.177 SNIP 1.382 CiteScore 4.37
Scopus rating (2011): SJR 2.051 SNIP 1.357 CiteScore 4.42
Scopus rating (2010): SJR 2.148 SNIP 1.4
Scopus rating (2009): SJR 2.156 SNIP 1.351
Paper-based microfluidics: Fabrication technique and dynamics of capillary driven surface flow

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Department of Physics, Engineering materials science and solutions (EMASS)
Authors: Songok, J., Tuominen, M., Teisala, H., Haapanen, J., Mäkelä, J. M., Kuusipalo, J., Toivakka, M.
Number of pages: 7
Pages: 20060-20066
Publication date: 2014
Peer-reviewed: Yes

Publicaton information
Journal: ACS Applied Materials and Interfaces
Volume: 6
Issue number: 22
ISSN (Print): 1944-8244
Ratings:
Scopus rating (2016): CiteScore 7.6 SJR 2.524 SNIP 1.528
Scopus rating (2015): SJR 2.299 SNIP 1.568 CiteScore 7.38
Scopus rating (2014): SJR 2.126 SNIP 1.64 CiteScore 6.88
Scopus rating (2013): SJR 1.979 SNIP 1.543 CiteScore 6.05
Scopus rating (2012): SJR 2.18 SNIP 1.309 CiteScore 4.94
Scopus rating (2011): SJR 2.017 SNIP 1.396 CiteScore 4.41
Scopus rating (2010): SJR 1.571 SNIP 0.931
Original language: English
DOIs: 10.1021/am5055806

Bibliographical note
Contribution: organisation=elt,FACT1=0.7<br/>
Contribution: organisation=orc,FACT2=0.3<br/>
Portfolio EDEND: 2014-11-30<br/>
Publisher name: American Chemical Society
Source: researchoutputwizard
Source-ID: 659
Research output: Scientific - peer-review › Article

Physicochemical characterization of segmented polyurethanes prepared with glutamine or ascorbic acid as chain extenders and their hydroxyapatite composites
Review on Liquid Flame Spray in paper converting: Multifunctional superhydrophobic nanoparticle coatings

Wettability of a solid surface by a liquid plays an important role in several phenomena and applications, for example in adhesion, printing, and coating. Especially, wetting of rough surfaces has attracted a considerable scientific interest in recent decades. Superhydrophobic surfaces, which possess extraordinary water repellency properties due to their low surface energy chemistry and specific nano- and microscale roughness, are of particular interest due to the great variety of potential applications ranging from self-cleaning surfaces to microfluidic devices. Here we examine functional superhydrophobic and superhydrophilic nanoparticle coatings fabricated by liquid flame spray (LFS) on cellulose-based substrate materials. The article is a review of earlier papers with some new results and conclusions added. LFS has proved itself straightforward and versatile one-step method to fabricate broad range of functional nanoparticle coatings on various substrate materials in an atmospheric roll-to-roll process. It has established itself among the most potential candidates for large-scale production of superhydrophobic coatings on affordable cellulose-based substrates.
Silane-modified substratum improves cell attachment of human embryonic stem cell-derived retinal pigment epithelial cells

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Electronics and Communications Engineering, Research group: Biomaterials and Tissue Engineering Group, Optoelectronics Research Centre, Research group: Surface Science, Univ Tampere, University of Tampere, BioMediTech, BMT FM5, BioMediTech
Authors: Juuti-Uusitalo, K., Sorkio, A. E., Käpylä, E. M. K., Teymouri, S., Lahtonen, K. T., Vuori, A. M., Valden, M. O., Skottman, H., Kellomäki, M. A. E.
Pages: 3996
Publication date: 2014

Host publication information
Title of host publication: Investigative Ophthalmology & Visual Science
Volume: 55
Publisher: Association for Research in Vision and Ophthalmology
Edition: 13
Article number: 3996 - D0055
ISBN (Print): 0146-0404
ISBN (Electronic): 1552-5783
Links: http://iovs.arvojournals.org/article.aspx?articleid=2269472&resultClick=1

Bibliographical note
xabstract
Research output: Scientific › Conference contribution
An in vitro study of composites of poly(L-lactide-co-ε-caprolactone), β-tricalcium phosphate and ciprofloxacin intended for local treatment of osteomyelitis

Osteomyelitis is a bacterial disease that can become chronic, and treatment often includes a surgical operation to remove infected bone. The aim of this study was to develop and investigate in vitro bone filling composite materials that release ciprofloxacin to kill any remaining bacteria and contain bioceramic to help the bone to heal. Three composites of poly(L-lactide-co-ε-caprolactone), β-tricalcium phosphate and ciprofloxacin were compounded using twin-screw extrusion and sterilized by gamma irradiation. Drug release and degradation of the composites were investigated in vitro for 52 weeks. The composite with 50 wt% of β-TCP had the most promising ciprofloxacin release profile. The ceramic component accelerated the drug release that occurred in three phases obeying first-order kinetics. Inhibition zone testing using bioluminescence showed that the released ciprofloxacin had effect in eradicating a common osteomyelitis causing bacteria Pseudomonas aeruginosa. During the in vitro degradation test series, molar weight of the polymer matrix of the composites decreased rapidly. Additionally, 1H-NMR analysis showed that the polymer had blocky structure and the comonomer ratio changed during hydrolysis. The tested composites showed great potential to be developed into bone filler materials for the treatment of osteomyelitis or other bone related infections.
This thesis examines the chemical composition of a mixed silane thin film synthesized on electrochemically passivated AISI 316L stainless steel. Silane thin films can be used to enhance the biocompatibility of stainless steel and to create surface functionalities that promote adsorption of biomolecules. Such hybrid materials made of steel and organic coatings can be utilized in e.g. medical implants and tissue engineering.

The goal of this work was to develop deposition equipment needed for the synthesis of silane thin films in order to improve the rate and reproducibility of the sample preparation. The equipment was used to investigate the effect of silanization parameters such as the composition of the silane solution, the hydrolysis time and the silanization time on the structure of the self-assembled thin film. The silane molecules used in this study were amine terminated (3-aminopropyl)trimethoxysilane (APS) and thiol terminated (3-mercaptopropyl)trimethoxysilane (MPS).

The silanization process was conducted as a liquid phase deposition in atmospheric pressure, which enables the method to be easily adapted to commercial applications. On the other hand, the measurements were performed in ultra-high vacuum utilizing both synchrotron radiation induced and conventional X-ray photoelectron spectroscopy (XPS). The acquired spectra enabled conclusions to be made on the chemical composition and thickness of the silane films. They also provided information on the ratio and orientation of the functional groups.

According to the results, the employed silanization process enables the reproducible manufacturing of approximately one monolayer thick silane films. In addition, the amount of surface functionalities can be adjusted by modifying either the silane concentration in the hydrolysis solution or the silanization time. However, changing the hydrolysis time only affects the chemical bonding between the silane molecules and steel surface, not the total amount of functional groups. Based on the measurements with varying surface sensitivities, it was possible to conclude that the majority of functional groups point outwards. This is an important result considering the adsorption of biomolecules on the surface.
This study found that the hydrolysis rate of different silane species shows considerable variation despite the similar basic structure of the molecules. In the future, the hydrolysis behaviour should be investigated more carefully in the liquid phase. This might help to understand the hydrolysis reactions and also enhance the repeatability of the sample preparation.

**General information**
State: Published
Ministry of Education publication type: G2 Master's thesis, polytechnic Master's thesis
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Hannula, M.
Number of pages: 105
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