

A novel electrical charging condensing heat exchanger for efficient particle emission reduction in small wood boilers

Small-scale biomass combustion is an important source of fine particles in ambient air, causing adverse health and environmental effects. Thus, there is a clear need to develop efficient and feasible flue gas cleaning technologies for small-scale combustion appliances. In this study a novel electrical charging condensing heat exchanger (eCHX) for combined fine particle removal and efficient heat recovery from flue gases was demonstrated in a small biomass-fired boiler. The method is based on the combination of a shielded corona charger and a condensing heat exchanger, where fine particles are removed by the electrophoretic, thermophoretic and diffusiophoretic forces. The eCHX was found to decrease >80% of fine particle mass (PM₁) emissions and >40% of particle number emissions with simultaneous high thermal efficiency in the heat exchanger. The usage of the condensing heat exchanger without electrical charging resulted in 40% decrease in PM₁ emissions when compared to the usage of a traditional tube heat exchanger. The advantage of the eCHX system is that it replaces the conventional heat exchanger in boilers, making it a compact and inexpensive solution, when compared to additional flue gas cleaning devices installed after the boiler.

General information

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Organisations: Physics, University of Eastern Finland, Fine Particle and Aerosol Technology Laboratory, Tampere University of Applied Sciences

Contributors: Grigonytė-Lopez Rodriguez, J., Suhonen, H., Laitinen, A., Tissari, J., Kortelainen, M., Tiitta, P., Lähde, A., Keskinen, J., Jokiniemi, J., Sippula, O.

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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/m³, 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/m³), 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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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, Natl. University of Ireland, Galway, Indian Institute of Technology Hyderabad

Contributors: Dessi, P., Chatterjee, P., Mills, S., Kokko, M., Lakaniemi, A., Collins, G., Lens, P. N.

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Original language: English

ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: Attached community, Bioelectrochemical system, Electrogenic microorganisms, MFC, Microbial electrochemical technology, Planktonic community

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Building university-industry co-innovation networks in transnational innovation ecosystems: Towards a transdisciplinary approach of integrating social sciences and artificial intelligence

This paper presents a potential solution to fill a gap in both research and practice that there are few interactions between transnational industry cooperation (TIC) and transnational university cooperation (TUC) in transnational innovation ecosystems. To strengthen the synergies between TIC and TUC for innovation, the first step is to match suitable industrial firms from two countries for collaboration through their common connections to transnational university/academic partnerships. Our proposed matching solution is based on the integration of social science theories and specific artificial intelligence (AI) techniques. While the insights of social sciences, e.g., innovation studies and social network theory, have potential to answer the question of why TIC and TUC should be looked at as synergetic entities with elaborated conceptualization, the method of machine learning, as one specific technique of AI, can help answer the question of how to realize that synergy. On the way towards a transdisciplinary approach to TIC and TUC synergy building, or creating transnational university-industry co-innovation networks, the paper takes an initial step by examining what the supports and gaps of existing studies on the topic are, and using the context of EU-China science, technology and innovation cooperation as a testbed. This is followed by the introduction of our proposed approach and our suggestions for future research.

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Organisations: Research group: Automation and Systems Theory, Automation Technology and Mechanical Engineering

Contributors: Cai, Y., Ferrer, B. R., Lastra, J. L. M.

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The potential of biomethane in replacing fossil fuels in heavy transport-a case study on Finland

Electrification is a frequently discussed solution for reducing transport related carbon dioxide emissions. However, transport sectors such as aviation and heavy-duty vehicles remain dependent on on-board fuels. Here, biomethane is still a little exploited solution, and the case of heavy-duty vehicles is particularly underappreciated despite the recent technical advances and potentially notable emission reductions. This paper discusses the potential of biomethane in heavy-duty road transport in the case of Finland, where the utilization rate is low compared to the technical potential. To this end, the potential of biomethane production through both anaerobic digestion and gasification was calculated in three scenarios for the heavy-duty transport fleet, based on the literature values of biomethane potential and truck class fuel consumption.

The authors find that approximately half of the heavy-duty transport in Finland could be biomethane fueled by 2030. The estimated production costs for biomethane (81-190 €/MWh) would be competitive with the current consumer diesel price (152 €/MWh). Utilizing the total biomethane potential in heavy-duty transport would furthermore decrease the respective carbon dioxide emissions by 50%. To accelerate the transition in the heavy-duty transport sector, a more comprehensive political framework is needed, taking into account both production and consumption.

General information

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MoE publication type: A1 Journal article-refereed

Organisations: Research group: Bio- and Circular Economy, Materials Science and Environmental Engineering, MAB Powertec Oy, Tampere University

Contributors: Pääkkönen, A., Aro, K., Aalto, P., Konttinen, J., Kojo, M.

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Journal: Sustainability

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ASJC Scopus subject areas: Geography, Planning and Development, Renewable Energy, Sustainability and the Environment, Management, Monitoring, Policy and Law

Keywords: Anaerobic digestion, Biomethane, Carbon emission reduction, Finland, Heavy-duty transport, Renewable transport fuels, Transition, Wood gasification

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

Towards a circular economy by leveraging hazardous resources: A case study of Fortum HorsePower

The increasingly efficient use of scarce resources is a central theme in the gradual transition towards a circular economy. Hazardous materials represent a category of resources that is often difficult—and potentially risky—to transport, store, or neutralize. As a result, hazardous materials are rarely included in closed material loops. The present paper analyzes HorsePower, a business concept centered around an innovative way of utilizing horse manure. Horse manure is generated in millions of tons in horse-rich countries such as the UK, Germany, and France. It is a hazardous resource, as it may spread diseases, and cannot be disposed of or landfilled economically. The content analysis of 21 semi-structured interviews carried out with different business actors participating in the HorsePower business network reveals that the success of HorsePower stems from its ability to combine the complementary capabilities and material needs of a relatively complex network of business actors including stables, sawmills, logistical service providers, and heat and power plants. Each actor receives added value; the benefits from participation are greater than the sacrifices of participation. Furthermore, the findings show that certain types of hazardous resources, when combined with resources produced by another actor, may be burned efficiently and safely in specific power plants, reducing the need for other types of fuel. The observations imply that novel approaches for effectively sharing ideas and resource needs across organizational boundaries are needed to facilitate the development of additional innovative CE business concepts, leveraging both actor-specific capabilities and intra-actor resource dependencies.

General information

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MoE publication type: A1 Journal article-refereed

Organisations: Industrial Engineering and Management, Research group: Center for Research on Operations Projects and Services, Research group: Center for Research on Project and Service Business (CROPS), Lappeenranta University of Technology

Contributors: Tura, N., Ahola, T.

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Photovoltaic properties of low-bandgap (0.7–0.9eV) lattice-matched GaInNAsSb solar junctions grown by molecular beam epitaxy on GaAs

We demonstrate single junction GaInNAsSb solar cells with high nitrogen content, i.e. in the range of 5–8%, and bandgap energies close to 0.7 eV grown by molecular beam epitaxy. A good crystalline quality is demonstrated for the entire range of N concentrations. An average external quantum efficiency of 0.45 is demonstrated for GaInNAsSb solar cell with 6.2% N exhibiting a bandgap of 0.78 eV (no antireflection coatings has been applied). The internal quantum efficiency for the cell is 0.65 at $E_g + 0.2$ eV. The solar cells exhibited bandgap-voltage offsets between 0.55 V (for N = 5.3%) and 0.66 V (for N = 7.9%). When used in a six-junction solar cell architecture under AM1.5D illumination, the estimated short-circuit current density corresponding to the 0.78 eV cell is 8.2 mA/cm^2 . Furthermore, using the parameters obtained for the GaInNAsSb junction with 6.2% N, we have estimated that such six-junction solar cell architecture could realistically attain an efficiency of over 50% at 1000 suns concentration.

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Organisations: Physics, Research group: ORC, Research group: Nanophotonics, Microscopy Center

Contributors: Isoaho, R., Aho, A., Tukiainen, A., Aho, T., Raappana, M., Salminen, T., Reuna, J., Guina, M.

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

Impact of Different Concrete Types on Radio Propagation: Fundamentals and Practical RF Measurements

By the 1960's, European countries faced a massive housing shortage due to changes in social structure and migration from rural areas to towns. This led to a rapid growth of suburban areas in the 1960's and 1970's. Concrete, as a building material became popular as the prefabrication techniques of precast concrete structures developed rapidly during this era, and these trends continue even today. In the near future, the number of frequency bands used by mobile wireless communication systems will increase and, in general, the trend is towards higher frequencies. This paper presents the results of measurements in which the RF attenuations of several different concrete types were determined on the basis of the permittivity of the material samples. The frequency ranges used in the measurements were 4.5 to 19 GHz and 26 to 40 GHz. In particular, at higher frequencies, the attenuation of various concrete grades is very different, and the level of RF attenuation of the outer wall cannot be predicted without knowing the age of the building and the concrete quality used in the element.

General information

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MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Tampere University, VTT Technical Research Centre of Finland

Contributors: Asp, A., Hentilä, T., Valkama, M., Pikkuvirta, J., Hujanen, A., Huhtinen, I.

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ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Instrumentation, Energy Engineering and Power Technology, Renewable Energy, Sustainability and the Environment

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INT=ceng,"Pikkuvirta, Jussa"

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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Pre-Grant Signaling for Energy-Efficient 5G and Beyond Mobile Devices: Method and Analysis

Due to the severely limited battery capacities, the energy efficiency of mobile devices plays an important role in their usability. In general, the cellular subsystem is one of the major contributors to the energy consumption of a mobile device, thus improving its energy efficiency is of paramount importance. In this paper, a new concept of pre-grant message together with associated control plane signaling is introduced, aiming to reduce the energy consumption of the cellular subsystem in the downlink, without notable increase in the buffering delay or latency. The proposed method is fully independent of the ordinary discontinuous reception (DRX) principle, which means that both methods can co-exist and act together to efficiently reduce the energy consumption of the user equipment. The performance of the proposed scheme in terms of the false alarm and misdetection rates are investigated and evaluated, in both additive white Gaussian noise and Rayleigh fading channels. The obtained numerical results show that the pre-grant message signaling can be decoded very reliably and can reduce the system power consumption, relative to an ordinary DRX-only reference system, by up to 70%, 68%, and 62% for FTP traffic, video streaming and VoIP, respectively, at the cost of negligible increase in the signaling overhead. The proposed method is also compared in terms of the energy consumption and energy efficiency against another state-of-the-art power-saving mechanism, namely the wake-up radio-based approach. The obtained results show that the pre-grant approach outperforms the wake-up-based system under broad range of traffic characteristics.

General information

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MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, Helsinki R and D Center, Huawei Technologies Oy (Finland). Co. Ltd.

Contributors: Rostami, S., Heiska, K., Puchko, O., Leppanen, K., Valkama, M.

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GIS-data related route optimization, hierarchical clustering, location optimization, and kernel density methods are useful for promoting distributed bioenergy plant planning in rural areas

Currently, geographic information system (GIS) models are popular for studying location-allocation-related questions concerning bioenergy plants. The aim of this study was to develop a model to investigate optimal locations for two different types of bioenergy plants, for farm and centralized biogas plants, and for wood terminals in rural areas based on minimizing transportation distances. The optimal locations of biogas plants were determined using location optimization tools in R software, and the optimal locations of wood terminals were determined using kernel density tools in ArcGIS. The present case study showed that the utilized GIS tools are useful for bioenergy-related decision-making to identify potential bioenergy areas and to optimize biomass transportation, and help to plan power plant sizing when candidate bioenergy plant locations have not been defined in advance. In the study area, it was possible to find logistically viable locations for 13 farm biogas plants (>100 kW) and for 8 centralized biogas plants (>300 kW) using a 10-km threshold for feedstock supply. In the case of wood terminals, the results identified the most intensive wood reserves near the highest road classes, and two potential locations were determined.

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, University of Jyväskylä, Seinäjoki University of Applied Sciences

Contributors: Laasasenaho, K., Lensu, A., Lauhanen, R., Rintala, J.

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ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology

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Energy Detection-Based Spectrum Sensing over Fisher-Snedecor F Fading Channels

This paper investigates the performance of energy detection-based spectrum sensing over Fisher-Snedecor F fading channels. To this end, an analytical expression for the corresponding average detection probability is firstly derived and then this is extended to account for collaborative spectrum sensing. The complementary receiver operating characteristics (ROC) are analyzed for different conditions of the average signal-to-noise ratio (SNR), time-bandwidth product, multipath fading, shadowing and number of collaborating users. It is shown that the energy detection performance is strongly linked to the severity of the multipath fading and amount of shadowing, whereby even small variations in either of these physical phenomena significantly impact the detection probability. Also, the versatile modeling capability of the Fisher-Snedecor F distribution is verified in the context of energy detection based spectrum sensing as it provides considerably more accurate characterization than the conventional Rayleigh fading model. To confirm the validity of the analytical results presented in this paper, we compare them with the results of some simulations.

General information

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Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, Queen's University, Belfast, Northern Ireland, Centre for Wireless Innovation, Khalifa University, Department of Chemistry and Bioengineering, University of Surrey, German Jordanian University, Aristotle University of Thessaloniki

Contributors: Yoo, S. K., Cotton, S. L., Sofotasios, P. C., Muhaidat, S., Badarneh, O. S., Karagiannidis, G. K.
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Improved Session Continuity in 5G NR with Joint Use of Multi-Connectivity and Guard Bandwidth

The intermittent millimeter-wave radio links as a result of human-body blockage are an inherent feature of the 5G New Radio (NR) technology by 3GPP. To improve session continuity in these emerging systems, two mechanisms have recently been proposed, namely, multi-connectivity and guard bandwidth. The former allows to establish multiple spatially-diverse connections and switch between them dynamically, while the latter reserves a fraction of system bandwidth for sessions changing their state from non-blocked to blocked, which ensures that the ongoing sessions have priority over the new ones. In this paper, we assess the joint performance of these two schemes for the user- and system-centric metrics of interest. Our numerical results reveal that the multi-connectivity operation alone may not suffice to increase the ongoing session drop probability considerably. On the other hand, the use of guard bandwidth significantly improves session continuity by somewhat compromising new session drop probability and system resource utilization. Surprisingly, the 5G NR system implementing both these techniques inherits their drawbacks. However, complementing it with an initial AP selection procedure effectively alleviates these limitations by maximizing the system resource utilization, while still providing sufficient flexibility to enable the desired trade-off between new and ongoing session drop probabilities.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Department of Chemistry and Bioengineering, Peoples' Friendship University of Russia

Contributors: Kovalchukov, R., Moltchanov, D., Begishev, V., Samuylov, A., Andreev, S., Koucheryavy, Y., Samouylov, K.

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Impedance-based interactions in grid-tied three-phase inverters in renewable energy applications

Impedance-ratio-based interaction analyses in terms of stability and performance of DC-DC converters is well established. Similar methods are applied to grid-connected three-phase converters as well, but the multivariable nature of the converters and the grid makes these analyses very complex. This paper surveys the state of the interaction analyses in the grid-connected three-phase converters, which are used in renewable-energy applications. The surveys show clearly that the impedance-ratio-based stability assessment are usually performed neglecting the cross-couplings between the impedance elements for reducing the complexity of the analyses. In addition, the interactions, which affect the transient performance, are not treated usually at all due to the missing of the corresponding analytic formulations. This paper introduces the missing formulations as well as explicitly showing that the cross-couplings of the impedance elements have to be taken into account for the stability assessment to be valid. In addition, this paper shows that the most accurate stability information can be obtained by means of the determinant related to the associated multivariable impedance ratio. The theoretical findings are also validated by extensive experimental measurements.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, Research group: Power electronics, Research area: Power engineering, Automation Technology and Mechanical Engineering, Research group: Automation and Systems Theory, Aalto University

Contributors: Suntio, T., Messo, T., Berg, M., Alenius, H., Reinikka, T., Luhtala, R., Zenger, K.

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Peer-reviewed: Yes

Publication information

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Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Energy (miscellaneous), Control and Optimization, Electrical and Electronic Engineering

Keywords: Grid synchronization, Power electronics, Power grid, Source and load impedance, Stability, Transient dynamics

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

Direct fixed-step maximum power point tracking algorithms with adaptive perturbation frequency

Owing to the good trade-off between implementation and performance, fixed-step direct maximum power point tracking techniques (e.g., perturb and observe and incremental conductance algorithms) have gained popularity over the years. In order to optimize their performance, perturbation frequency and perturbation step size are usually determined a priori. While the first mentioned design parameter is typically dictated by the worst-case settling time of the combined energy conversion system, the latter must be high enough to both differentiate the system response from that caused by irradiation variation and match the finite resolution of the analog-to-digital converter in case of digital implementation. Well-established design guidelines, however, aim to optimize steady-state algorithm performance while leaving transients nearly untreated. To improve transient behavior while keeping the steady-state operation unaltered, variable step direct maximum power point tracking algorithms based on adaptive perturbation step size were proposed. This paper proposes a concept of utilizing adaptive perturbation frequency rather than variable step size, based on recently revised guidelines for designing fixed-step direct maximum power point tracking techniques. Preliminary results demonstrate the superiority of the proposed method over adaptive perturbation step size operation during transients, without compromising the steady state performance.

General information

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MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, Research group: Power electronics, Ben-Gurion University of the Negev

Contributors: Amer, E., Kuperman, A., Suntio, T.

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Journal: Energies

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ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Energy (miscellaneous), Control and Optimization, Electrical and Electronic Engineering

Keywords: Maximum power point tracking, Perturbation frequency, Photovoltaic generators, Step size

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

The economics of renewable CaC₂ and C₂H₂ production from biomass and CaO

This article presents the economics of a bio-based CaC₂/C₂H₂ production concept plant. The aim of the research was to study if renewable CaC₂/C₂H₂ production could be competitive in comparison with current technologies. The starting point was to integrate a wood char production unit into a combined heat and power (CHP) plant with a bubbling fluidized bed (BFB) boiler. The wood char was reacted with CaO in an electric arc furnace (EAF). The production costs of the CaC₂ were determined based on the wood char production costs as well as the EAF electric power consumption. The results showed that the C₂H₂ yield (18%) is similar to the current fossil-based production. However, the production costs proved to be even higher than the current selling prices of CaC₂ and C₂H₂. With the chosen basic feedstock (20 €/MWh) and electricity prices (45 €/MWh) the production costs of CaC₂ were calculated to be 725 €/t and for C₂H₂ 1805 €/t. The cost effectiveness of the concept plant was determined using the payback time method including the time value of money. The break even selling prices were 747–920 €/t for the CaC₂ and 1940–3015 €/t for C₂H₂ depending on the desired payback time (4–30 years). The key factors in the production costs of CaC₂ and C₂H₂ are the price of electricity and the electrical efficiency of the EAF. The results also showed that recycling the Ca at the site could save up to 48% in fresh Ca material costs.

General information

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Organisations: Chemistry and Bioengineering, Test Rig Finland, Inc.

Contributors: Pääkkönen, A., Tolvanen, H., Kokko, L.

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ASJC Scopus subject areas: Forestry, Renewable Energy, Sustainability and the Environment, Agronomy and Crop Science, Waste Management and Disposal

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Source ID: 85056214971

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

Why social sustainability counts: The impact of corporate social sustainability culture on financial success

Awareness is growing in European companies of the importance of managing all aspects of sustainability. However, the elusive social aspect of sustainability and its influence on successful business has been under-investigated in corporate culture literature so far. The aim of this paper is to examine whether a correlation can be found between corporate social sustainability culture (expressed as explicit "items" of corporate values and practices emphasizing employee and societal well-being) and the financial success of a company. This is examined through a multiple regression analysis of two contrasting European polls, examining items indicating corporate social sustainability culture, and financial outcomes. The empirical results show that four specific success-related social sustainability dimensions of corporate culture are predictors of a company being classified as financially successful. These are: Sustainability strategy and leadership; Mission, communication and learning; Social care and work life; and Loyalty and identification. The paper contributes to the understanding of how to manage corporate social sustainability culture whilst supporting companies' financial performance, and provides evidence-grounded recommendations to business managers and stakeholders aiming to manage social sustainability proactively by undertaking cultural change and development initiatives.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Mechanical Engineering and Industrial Systems, Deep White GmbH, Chalmers University of Technology, Politecnico di Milano, Festo AG & Co. KG, Panepistimion Patron

Contributors: Schönborn, G., Berlin, C., Pinzone, M., Hanisch, C., Georgoulas, K., Lanz, M.
Number of pages: 10
Pages: 1-10
Publication date: 1 Jan 2019
Peer-reviewed: Yes

Publication information

Journal: Sustainable Production and Consumption

Volume: 17

ISSN (Print): 2352-5509

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Renewable Energy, Sustainability and the Environment, Industrial and Manufacturing Engineering

Keywords: Corporate culture, Corporate sustainability, Financial performance, Social sustainability, Success factors, Sustainability

DOIs:

10.1016/j.spc.2018.08.008

Source: Scopus

Source ID: 85053411172

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

Charge carrier dynamics in tantalum oxide overlayered and tantalum doped hematite photoanodes

We employ atomic layer deposition to prepare 50 nm thick hematite photoanodes followed by passivating them with a 0.5 nm thick Ta₂O₅-overlayer and compare them with samples uniformly doped with the same amount of tantalum. We observe a three-fold improvement in photocurrent with the same onset voltage using Ta-overlayer hematite photoanodes, while electrochemical impedance spectroscopy under visible light irradiation shows a decreased amount of surface states under water splitting conditions. The Ta-doped samples have an even higher increase in photocurrent along with a 0.15 V cathodic shift in the onset voltage and decreased resistivity. However, the surface state capacitance for the Ta-doped sample is twice that of the reference photoanode, which implies a larger amount of surface hole accumulation. We further utilize transient absorption spectroscopy in the sub-millisecond to second timescale under operating conditions to show that electron trapping in both Ta₂O₅-passivated and Ta-doped samples is markedly reduced. Ultrafast transient absorption spectroscopy in the sub-picosecond to nanosecond timescale shows faster charge carrier dynamics and reduced recombination in the Ta-doped hematite photoanode resulting in the increased photoelectrochemical performance when compared with the Ta₂O₅-overlayer sample. Our results show that passivation does not affect the poor charge carrier dynamics intrinsic to hematite based photoanodes. The Ta-doping strategy results in more efficient electron extraction, solving the electron trapping issue and leading to increased performance over the surface passivation strategy.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Chemistry & Advanced Materials, Materials Science and Environmental Engineering, Physics, Research group: Surface Science

Contributors: Ruoko, T., Hiltunen, A., Iivonen, T., Ulkuniemi, R., Lahtonen, K., Ali-Löytty, H., Mizohata, K., Valden, M., Leskelä, M., Tkachenko, N. V.

Number of pages: 10

Pages: 3206-3215

Publication date: Jan 2019

Peer-reviewed: Yes

Publication information

Journal: Journal of Materials Chemistry A

Volume: 7

Issue number: 7

ISSN (Print): 2050-7488

Original language: English

ASJC Scopus subject areas: Chemistry(all), Renewable Energy, Sustainability and the Environment, Materials Science(all)

Electronic versions:

c8ta09501a

DOIs:

10.1039/C8TA09501A

URLs:

<http://urn.fi/URN:NBN:fi:tty-201905141602>

Bibliographical note

INT=phys,"Ulkuniemi, Riina"

Source: Scopus

Source ID: 85061474749

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

Bio-hydrogen Production from Sewage Sludge: Screening for Pretreatments and Semi-continuous Reactor Operation

Abstract: The high volumes of sewage sludge produced have raised interests for simultaneous treatment and clean energy production, e.g. in the form of hydrogen. Pretreatment of sewage sludge is required to enhance microbial degradation and in turn hydrogen yield from sewage sludge. The potential of five substrate pretreatments, individually and in combinations, to increase biohydrogen production from mixed primary and secondary sewage sludge at four incubation pH (5, 7, 9, and 11) was studied in batch assays. Alkali + ultrasonication pretreatment increased the hydrogen production almost seven times ($0.35 \text{ mmol H}_2/\text{g VS}$) compared to untreated sewage sludge at initial pH 11. In general, higher hydrogen yields and lower acetate concentrations were obtained under alkaline conditions (pH 9 and 11), being more favorable for protein degradation and not favorable for hydrogen consumption via homoacetogenesis. Subsequently, fermentation of alkali + ultrasonication pretreated sewage sludge in a semi-continuous stirred tank reactor (CSTR) produced a maximum hydrogen yield of $0.1 \text{ mmol H}_2/\text{g VS}$, three times higher than the yield obtained from alkali pretreated sludge. The gas produced in the CSTRs contained a low concentration of CO_2 ($< 5\%$), and is thus easily upgradable to biohydrogen. Graphic Abstract: [Figure not available: see fulltext].

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science and Environmental Engineering, Water Pollution Research Department, National Research Centre, Indian Institute of Technology Hyderabad, Natl. University of Ireland, Galway, Ain Shams University

Contributors: El-Qelish, M., Chatterjee, P., Dessì, P., Kokko, M., El-Gohary, F., Abo-Aly, M., Rintala, J.

Publication date: 2019

Peer-reviewed: Yes

Publication information

Journal: Waste and Biomass Valorization

ISSN (Print): 1877-2641

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: Alkali treatment, Continuously stirred tank reactor (CSTR), Dark fermentation, Pretreatment, Sewage sludge, Ultrasonication

DOIs:

10.1007/s12649-019-00743-5

Source: Scopus

Source ID: 85069208392

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

Combined experimental and theoretical study of acetylene semi-hydrogenation over $\text{Pd}/\text{Al}_2\text{O}_3$

The semi-hydrogenation of acetylene ($\text{C}_2\text{H}_2 + \text{H}_2 = \text{C}_2\text{H}_4$, $\Delta H = -172 \text{ kJ mol}^{-1}$) is a well-studied reaction that is important for purification of ethylene, C_2H_4 , feed used in polyethylene production. Pd-based catalysts are most commonly used to remove acetylene from ethylene feed prior to Ziegler–Natta polymerization because acetylene is a poison for Ziegler–Natta catalysts. New applications of the analogous catalytic processes, with similar requirements for the conversion and selectivity, are considered for the storage of H_2 within the context of the H_2 economy. Here, a combination of experimental and theoretical studies was employed to explore the performance of synthesized Pd nanoparticles and the feasibility of using computational modelling for predicting their catalytic properties. Specifically, a model 5%Pd/ Al_2O_3 nanocatalyst was successfully synthesized using high-throughput flame spray pyrolysis (FSP) method. As a catalyst for acetylene semi-hydrogenation, the material shows high conversion of 97%, a modest selectivity of 62%, and a turnover frequency of ethylene formation of 5 s^{-1} . The experimental data were further supported by computational modelling of catalytic properties. Results of microkinetic simulations, based on parameters obtained from DFT calculations, over a Pd₃₀/ Al_2O_3 (100) model system were correlated with experiments. The insights from this direct comparison of theory and experiments provide indications for future improvements of the theoretical predictions and for novel types of materials with improved catalytic properties.

General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Materials and Molecular Modeling, Research area: Computational Physics, Physics, INL - International Iberian Nanotechnology, Universidade do Porto, Tethis S.p.A., Forschungszentrum Jülich (FZJ), Iowa State University, Ames Laboratory, Norwegian Univ. of Sci. and Technol.

Contributors: Gonçalves, L. P., Wang, J., Vinati, S., Barborini, E., Wei, X. K., Heggen, M., Franco, M., Sousa, J. P., Petrovykh, D. Y., Soares, O. S. G., Kovnir, K., Akola, J., Kolen'ko, Y. V.
Publication date: 2019
Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy
ISSN (Print): 0360-3199
Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology
Keywords: DFT, Heterogeneous catalysis, Hydrogenation, Kinetics, Modelling, Nanoclusters
DOIs:
10.1016/j.ijhydene.2019.04.086
Source: Scopus
Source ID: 85065260706
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.
Number of pages: 19
Pages: 104-122
Publication date: 2019
Peer-reviewed: Yes
Early online date: 15 Mar 2018

Publication information

Journal: International Journal of Sustainable Energy
Volume: 38
Issue number: 2
ISSN (Print): 1478-6451
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
DOIs:
10.1080/14786451.2018.1448398
Source: Scopus
Source ID: 85043677926
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 retrofiting 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.

Publication date: 2019

Peer-reviewed: Yes

Publication information

Journal: International Journal of Sustainable Energy

ISSN (Print): 1478-6451

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, district heating, energy performance, Energy retrofits, greenhouse gas emissions, power demand

DOIs:

10.1080/14786451.2019.1613992

Source: Scopus

Source ID: 85065643393

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

Identification of three-phase grid impedance in the presence of parallel converters

Grid impedance is an important parameter which affects the control performance of grid-connected power converters. Several methods already exist for optimizing the converter control system based on knowledge of grid impedance value. Grid impedance may change rapidly due to fault or disconnection of a transmission line. Therefore, online grid identification methods have been recently proposed to have up-to-date information about the grid impedance value. This is usually done by perturbing the converter output current and measuring the response in output voltage. However, any parallel converters connected to the same interface point will cause errors, since the measured current differs from the current that is flowing through the grid interface point. This paper points out challenges and errors in grid impedance identification, caused by parallel converters and their internal control functions, such as grid-voltage support. Experimental grid-impedance measurements are shown from the power hardware-in-the-loop setup developed at DNV-GL Flexible Power Grid Lab.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation Technology and Mechanical Engineering, Research group: Automation and Systems Theory, Research group: Power electronics, Electrical Engineering, Eindhoven University of Technology, DNV-GL

Contributors: Luhtala, R., Messo, T., Roinila, T., Alenius, H., Jong, E. D., Burstein, A., Fabian, A.

Publication date: 2019

Peer-reviewed: Yes

Publication information

Journal: Energies

Volume: 12

Issue number: 14

Article number: 2674

ISSN (Print): 1996-1073

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Energy (miscellaneous), Control and Optimization, Electrical and Electronic Engineering

Keywords: DC-AC power converters, Grid impedance identification, Power hardware-in-the-loop

Electronic versions:

energies-12-02674

DOIs:

10.3390/en12142674

URLs:

<http://urn.fi/URN:NBN:fi:ty-201909022052>

Source: Scopus

Source ID: 85068784950

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

Power electronics in renewable energy systems

General information

Publication status: Published

MoE publication type: B1 Article in a scientific magazine

Organisations: Electrical Engineering, Research group: Power electronics, Research area: Power engineering

Contributors: Suntio, T., Messo, T.

Publication date: 2019

Peer-reviewed: No

Publication information

Journal: Energies

Volume: 12

Issue number: 10

Article number: en12101852

ISSN (Print): 1996-1073

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Energy (miscellaneous), Control and Optimization, Electrical and Electronic Engineering

Electronic versions:

[energies-12-01852](#)

DOIs:

[10.3390/en12101852](http://urn.fi/URN:NBN:fi:ty-201906251908)

URLs:

<http://urn.fi/URN:NBN:fi:ty-201906251908>

Source: Scopus

Source ID: 85066827333

Research output: Contribution to journal > Editorial > Scientific

Sustainability of bioenergy in finland and globally – fact check

The sustainability of bioenergy has attracted recently a lot of debate and there has been critical arguments for and against the use of bioenergy. This presentation examines six international publications dealing with the use of bioenergy and collects systematically the allegations of bioenergy, as well as arguments for defending and restricting bioenergy use in the publications. Some of the most controversial arguments are analyzed more thoroughly and they are subjected to fact checking by comparing arguments with sources in scientific literature. At the same time, the preconditions, restrictions, and assumptions that can be used to modify the claims to favor desired arguments are identified. The study finds that there are several problems that can be criticized towards the arguments. Arguments can be justified, among others, by looking at the situation over different time periods or by emphasizing the maximization of short-term or long-term climate benefits. Different values can be selected from initial data, whereupon their own argument can be confirmed.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Materials Science and Environmental Engineering, Lappeenranta University of Technology, Tampere University

Contributors: Vakkilainen, E., Kontinen, J., Orasuo, V., Aalto, P.

Number of pages: 2

Pages: 1634-1635

Publication date: 2019

Host publication information

Title of host publication: 27th European Biomass Conference and Exhibition, EUBCE 2019

Publisher: ETA-Florence Renewable Energies

Publication series

Name: European Biomass Conference and Exhibition Proceedings

ISSN (Print): 2282-5819

ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
Keywords: Bioenergy, Carbon neutrality, Carbon sinks, Climate change, Fact check, Forest Biomass, Sustainability

Bibliographical note

jufoid=71903

Source: Scopus

Source ID: 85071067879

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Technology valuation method for supporting knowledge management in technology decisions to gain sustainability

New technologies have major effects on the profitability of companies and the economic growth of society. If appropriate technologies can be routinely selected, then it is possible to achieve sustainability at a company level. Knowledge management (KM) can be used to support technology decision making and give an understanding of the potential of particular technologies in a specific business environment. In this study, the design research methodology (DRM) is used with three case studies in an industry environment to develop and evaluate a novel technology valuation method (TVM). The proposed six-step TVM focuses on the acquisition, modeling, and validation of product-related knowledge to support KM related to technology decisions. The contribution of this research is to use distinctions between product properties and behaviors with a disposition toward understanding the potential of technology. During the process, tacit knowledge is made visible and documented, which supports the reliability of technology decisions and enables companies to gain sustainability.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation Technology and Mechanical Engineering, Sandvik Mining and Construction Oyj

Contributors: Mämmelä, J., Juuti, T., Julkunen, P.

Publication date: 2019

Peer-reviewed: Yes

Publication information

Journal: Sustainability (Switzerland)

Volume: 11

Issue number: 12

Article number: 3410

ISSN (Print): 2071-1050

Original language: English

ASJC Scopus subject areas: Geography, Planning and Development, Renewable Energy, Sustainability and the Environment, Management, Monitoring, Policy and Law

Keywords: Knowledge management, Manufacturing industry, Sustainability, Technology, Technology decision, Technology valuation

Electronic versions:

sustainability-11-03410

DOIs:

10.3390/su11123410

URLs:

<http://urn.fi/URN:NBN:fi:tty-201909092079>

Bibliographical note

EXT="Julkunen, Pasi"

Source: Scopus

Source ID: 85069775222

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 €/m², respectively.

General information

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.
Publication date: 2019
Peer-reviewed: Yes
Early online date: 2018

Publication information

Journal: International Journal of Sustainable Energy
Volume: 38
Issue number: 7
ISSN (Print): 1478-6451
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:
10.1080/14786451.2018.1559164
Source: Scopus
Source ID: 85058681434
Research output: Contribution to journal › Article › Scientific › peer-review

How and why does willow biochar increase a clay soil water retention capacity?

Addition of biochar into a soil changes its water retention properties by modifying soil textural and structural properties. In addition, internal micrometer-scale porosity that is able to directly store readily plant available water affects soil water retention properties. This study shows how precise knowledge of the internal micrometer-scale pore size distribution of biochar can deepen the understanding of the biochar-water interactions in soils. The micrometer-scale porosity of willow biochar was quantitatively and qualitatively characterized using X-ray tomography, 3D image analysis and Helium ion microscopy. The effect of biochar application on clay soil water retention was studied by conventional water retention curve approach. The results indicate that the internal pores of biochar, with sizes of at 50 and 10 μm (equivalent pore diameter), increased soil porosity and the amount of readily plant available water. After biochar addition, changes in soil porosity were detected at pore size regimes 5–10 and 25 μm , i.e. biochar pore sizes multiplied by factor 0.5. The detected pore size distribution of biochar does not predict directly (1:1 compatibility) the changes observed in the soil moisture characteristics. It is likely that biochar chemistry and pore morphology affect biochar-water interactions via e.g. surface roughness and contact angle. In addition, biochar induced changes in soil structure and texture affected soil moisture characteristics. However, the approach presented is an attractive pathway to more generalized understanding on how and why biochar internal porosity affects soil moisture characteristics.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, Natural Resources Institute Finland (Luke), Jyväskylän yliopisto
Contributors: Rasa, K., Heikkinen, J., Hannula, M., Arstila, K., Kulju, S., Hyväluoma, J.
Number of pages: 8
Pages: 346-353
Publication date: 1 Dec 2018
Peer-reviewed: Yes

Publication information

Journal: Biomass and Bioenergy
Volume: 119
ISSN (Print): 0961-9534
Ratings:
Scopus rating (2018): CiteScore 3.96 SJR 1.072 SNIP 1.26
Original language: English
ASJC Scopus subject areas: Forestry, Renewable Energy, Sustainability and the Environment, Agronomy and Crop Science, Waste Management and Disposal
Keywords: 3D image analysis, Biochar, Helium ion microscopy, Plant available water, Soil water retention, X-ray tomography
Electronic versions:
1-s2.0-S0961953418302708-main

DOIs:

10.1016/j.biombioe.2018.10.004

URLs:

<http://urn.fi/URN:NBN:fi:tty-201811012524>

Bibliographical note

EXT="Kulju, Sampo"

Source: Scopus

Source ID: 85054557305

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

Energiatohokkaan arkkitehtisuunnittelun ohjekortisto

General information

Publication status: Published

MoE publication type: D5 Text book, professional manual or guide or a dictionary

Organisations: Architecture, Research group: ASUTUT

Contributors: Moisio, M., Kaasalainen, T., Lehtinen, T., Hedman, M.

Number of pages: 142

Publication date: Dec 2018

Publication information

Publisher: Tampereen teknillinen yliopisto. Arkkitehtuurin laboratorio

ISBN (Print): 978-952-15-4284-8

ISBN (Electronic): 978-952-15-4285-5

Original language: Finnish

Publication series

Name: Tampereen teknillinen yliopisto. Arkkitehtuurin laboratorio. Asuntosuunnittelu. Julkaisu

Volume: 32

ISSN (Print): 2242-4598

ASJC Scopus subject areas: Architecture , Renewable Energy, Sustainability and the Environment

Keywords: Energy efficiency, Architectural design, Service buildings, Building simulation

Electronic versions:

Moisio et al. 2018. Energiatohokkaan arkkitehtisuunnittelun ohjekortisto

URLs:

<http://urn.fi/URN:NBN:fi:tty-201901221135>

Research output: Book/Report › Book › Professional

Peruskoulut ja energiatohokkuus: Tilallisista ja toiminnallisista suunnitteluperiaatteista

General information

Publication status: Published

MoE publication type: D5 Text book, professional manual or guide or a dictionary

Organisations: Architecture, Research group: ASUTUT

Contributors: Lehtinen, T., Papinsaari, A., Kaasalainen, T., Moisio, M., Hedman, M.

Number of pages: 86

Publication date: Dec 2018

Publication information

Publisher: Tampereen teknillinen yliopisto. Arkkitehtuurin laboratorio

ISBN (Electronic): 978-952-15-4287-9

Original language: Finnish

Publication series

Name: Tampereen teknillinen yliopisto. Arkkitehtuurin laboratorio. Asuntosuunnittelu. Julkaisu

Volume: 34

ISSN (Print): 2242-4598

ASJC Scopus subject areas: Architecture , Renewable Energy, Sustainability and the Environment

Keywords: Energy efficiency, Architectural design, School building, Service buildings

Electronic versions:

Lehtinen et al. 2018. Peruskoulut ja energiatohokkuus

URLs:

<http://urn.fi/URN:ISBN:978-952-15-4287-9>

Creating value in the circular economy: A structured multiple-case analysis of business models

The circular economy (CE) has gained traction as a pathway towards more sustainable economic growth. The main actions leading towards a CE have been identified as the 3R principles of reduce, reuse, and recycle. However, understanding is lacking regarding how the adoption of CE using the 3R principles generates value and revenue in a business context. Thus, this study structurally examines business models used by CE-driven firms utilizing the fundamental business model components of value proposition, value creation/delivery, and value capture. By developing a detailed framework of business model components, acknowledging the particular features of CE implementation, and conducting a multiple-case study combining the business model approach with the 3R principles, this study analyzes feasible CE business models from multiple industries in Europe, the US, and China. The following five research propositions are derived from the findings of the explorative case analysis: 1) the cost-efficiency of circular operations is the key proponent to successful CE business, 2) take-back services enable the acquisition of particular wastes as resources, but they need to be incentivized through reductions in customers' total waste management costs, 3) circular business models require the focal firm to separately manage multiple positions in the value chain, 4) the take-back system for gaining value through CE can be implemented successfully in multiple ways, and 5) recycling is easier to implement than reducing or reusing due to a smaller impact on the business. These propositions contribute to the circular business model literature by showing how economic value is generated by CE initiatives and providing foundations for theory-testing future research. The propositions also provide guidance for policymakers and managers on supporting and implementing circular business.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Industrial and Information Management, Research group: Center for Innovation and Technology Research

Contributors: Ranta, V., Aarikka-Stenroos, L., Mäkinen, S. J.

Number of pages: 13

Pages: 988-1000

Publication date: 10 Nov 2018

Peer-reviewed: Yes

Publication information

Journal: Journal of Cleaner Production

Volume: 201

ISSN (Print): 0959-6526

Ratings:

Scopus rating (2018): CiteScore 7.32 SJR 1.62 SNIP 2.308

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Environmental Science(all), Strategy and Management, Industrial and Manufacturing Engineering

Keywords: 3R principles, Business model, Circular economy, Value capture, Value creation, Value proposition

DOIs:

10.1016/j.jclepro.2018.08.072

Source: Scopus

Source ID: 85053080716

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

Quantification of bio-anode capacitance in bioelectrochemical systems using Electrochemical Impedance Spectroscopy

Understanding the electrochemical properties of bio-anodes is essential to improve performance of bioelectrochemical systems. Electrochemical Impedance Spectroscopy (EIS) is often used to study these properties in detail. Analysis of the EIS response, however, is challenging due to the interfering effect of the large capacitance of typically used graphite and carbon-based electrodes. In this study, we used flat electrodes made of conductive Fluorine-doped Tin Oxide (FTO) as anode, and monitored bio-anode performance. We show that with this configuration, it is possible to accurately separate the distinct contributions to the electrical response of the bio-anodes: charge transfer, biofilm and diffusion resistances, and biofilm capacitance. We observed that the capacitance of the biofilm increased from $2 \mu\text{F cm}^{-2}$ to $450 \mu\text{F cm}^{-2}$ during biofilm growth, showing a relationship with current and total produced charge. These results suggest that biofilm capacitance is a measure for the amount of active biomass in bioelectrochemical systems. At the end of the experiment, the biofilm was harvested from the FTO electrode and an average yield of $0.55 \text{ g COD biomass/mol e}^-$ was determined.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Wageningen University and Research Centre, Wetsus, Centre for Sustainable Water Technology, Universitat Jaume I

Contributors: Heijne, A. T., Liu, D., Sulonen, M., Sleutels, T., Fabregat-Santiago, F.
Number of pages: 6
Pages: 533-538
Publication date: 1 Oct 2018
Peer-reviewed: Yes

Publication information

Journal: Journal of Power Sources

Volume: 400

ISSN (Print): 0378-7753

Ratings:

Scopus rating (2018): CiteScore 7.19 SJR 1.947 SNIP 1.433

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Physical and Theoretical Chemistry, Electrical and Electronic Engineering

Keywords: BES, Bioanode, Biomass yield, Capacitance, Electrochemical Impedance Spectroscopy, MET, Microbial fuel cell

Electronic versions:

1-s2.0-S0378775318308620-main

DOIs:

10.1016/j.jpowsour.2018.08.003

URLs:

<http://urn.fi/URN:NBN:fi:ty-201809212323>

Source: Scopus

Source ID: 85052096235

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

Alternative Power-Based Pricing Schemes for Distribution Network Tariff of Small Customers

The development of electricity distribution pricing is becoming an increasingly relevant topic due to various factors. The Distribution System Operators (DSO) face challenges regarding their tariffs of small customers when the customers invest in energy efficiency and small-scale energy production. Thus, the DSOs must evaluate their pricing practices to maintain a profitable and sustainable business. To respond to changes in the operational environment, transitioning toward power-based pricing is seen as a potential development direction. In this paper, we study various power-based distribution tariff (PBTD) structures and evaluate them from different viewpoints. To support the analysis, we provide a study where alternative tariff structures are analyzed based on data from two Finnish DSOs to investigate the impacts of the tariffs on the distribution fees of the customers and on the turnover of the DSO.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Helen Electricity Network Ltd., Elenia Ltd., Helen Electricity Network Ltd.

Contributors: Lummi, K., Rautiainen, A., Jarventausta, P., Heine, P., Lehtinen, J., Hyvarinen, M., Salo, J.

Number of pages: 6

Pages: 581-586

Publication date: 18 Sep 2018

Host publication information

Title of host publication: International Conference on Innovative Smart Grid Technologies, ISGT Asia 2018

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781538642917

ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Energy Engineering and Power Technology, Renewable Energy, Sustainability and the Environment, Electrical and Electronic Engineering

Keywords: Demand response, Demand tariff, Distribution network business, Network tariff, Power-based pricing

DOIs:

10.1109/ISGT-Asia.2018.8467793

Bibliographical note

EXT="Lehtinen, Jouni"

Source: Scopus

Source ID: 85055529338

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > 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 ($2.5\text{--}30\text{ g/m}^3\cdot\text{h}$) 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 $21\text{ g/m}^3\cdot\text{h}$. 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

Publication date: 1 Sep 2018

Peer-reviewed: Yes

Publication information

Journal: Bioresource Technology

Volume: 263

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2018): CiteScore 7.08 SJR 2.157 SNIP 1.824

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](#)

A distributed automation architecture for distribution networks, from design to implementation

With the current increase of distributed generation in distribution networks, line congestions and PQ issues are expected to increase. The smart grid may effectively coordinate DER, only when supported by a comprehensive architecture for automation. In IDE4L project such architecture is designed based on monitoring, control and business use cases. The IDE4L instance of SGAM architecture is derived and explained in details. The automation actor are specified in terms of interfaces, database and functions. The division in these three layers boosted the implementation phase as dedicated interfaces, databases or application has been developed in a modular way and can be installed in different HW/SW. Some implementation instances are presented and the main output of the architecture is discussed with regards to some indexes as communication traffic and level of distribution of automation functions.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research area: Power engineering, RWTH Aachen University, Surface and Corrosion Science, Catalonia Institute for Energy Research IREC, S.p.A., VTT Technical Research Centre of Finland

Contributors: Angioni, A., Lu, S., Hooshyar, H., Cairo, I., Repo, S., Ponci, F., Della Giustina, D., Kulmala, A., Dedè, A., Monti, A., Del Rosario, G., Vanfretti, L., Garcia, C. C.

Pages: 3-13

Publication date: Sep 2018

Peer-reviewed: Yes

Early online date: 27 Apr 2017

Publication information

Journal: Sustainable Energy, Grids and Networks

Volume: 15

ISSN (Print): 2352-4677

Ratings:

Scopus rating (2018): CiteScore 4.25 SJR 0.99 SNIP 1.083

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Architecture, Distribution system, Smart grid

DOIs:

10.1016/j.segan.2017.04.001

Bibliographical note

EXT="Kulmala, Anna"

Source: Scopus

Source ID: 85020176163

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

Dilute nitride triple junction solar cells for space applications: Progress towards highest AM0 efficiency

We report a detailed performance assessment of triple junction dilute nitride solar cells fabricated by a combined molecular beam epitaxy-metal organic chemical vapor deposition process and designed for space applications. The experimental sample exhibits an efficiency level of 30.8% under AM0 illumination. Analyses of the isotype single junction dilute nitride bottom cells reveal a band gap voltage offset of 0.49 V at one sun illumination and a value as low as 0.47 V for full spectrum excitation without filter layers. The analyses point out the limitation of the design in terms of current balancing. With optimized design, an efficiency of 32.1% is possible, revealing the maturity reached by dilute nitride technology in the quest for improving the efficiency of lattice-matched multijunction solar cells.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC, CESI S.p.A.

Contributors: Aho, A., Isoaho, R., Tukiainen, A., Gori, G., Campesato, R., Guina, M.

Number of pages: 5

Pages: 740-744

Publication date: Sep 2018

Peer-reviewed: Yes

Early online date: Apr 2018

Publication information

Journal: Progress in Photovoltaics: Research and Applications

Volume: 26

Issue number: 19

ISSN (Print): 1062-7995

Ratings:

Scopus rating (2018): CiteScore 6.68 SJR 1.942 SNIP 2.413

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Renewable Energy, Sustainability and the Environment, Condensed Matter Physics, Electrical and Electronic Engineering

Electronic versions:

Dilute Nitride Triple Junction Solar Cells for Space Applications Progress Towards Highest AM0 Efficiency_ AuthorVersion

DOIs:

10.1002/pip.3011

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910183934>

Source: Scopus

Source ID: 85045098254

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

Lessons learnt from real-time monitoring of the low voltage distribution network

Up to now, the evolution of the distribution network toward the smart grid model has been essentially focused on two non-intersecting areas: medium voltage network automation and smart metering. The former one is mainly focused on improving the quality of service, studying and deploying fault location, isolation and service restoration systems, while the latter has been addressed to improve the customer relationship management, promote the customer awareness and enable new smart home services. In most cases a deep investigation of the low voltage network has been left disregarded, even if it represents the asset bridging the medium voltage level up to final customers. This network segment is probably the most affected by regulatory actions promoting intermittent renewable generations, distributed storage, heat pumps and the growing diffusion of electric vehicles utilization. The paper describes a field demonstrator of the FP7 European project IDE4L, where an extensive analysis of the low voltage network has been performed by means of an innovative use of smart meters and the installation of sensors on the medium-to-low voltage substation.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research area: Power engineering, Research group: Power systems

Contributors: Barbato, A., Dedè, A., Della Giustina, D., Massa, G., Angioni, A., Lipari, G., Ponci, F., Repo, S.

Pages: 76-85

Publication date: Sep 2018

Peer-reviewed: Yes

Publication information

Journal: Sustainable Energy, Grids and Networks

Volume: 15

ISSN (Print): 2352-4677

Ratings:

Scopus rating (2018): CiteScore 4.25 SJR 0.99 SNIP 1.083

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Distributed measurement system, Low voltage network, Smart grid, Smart metering

DOIs:

10.1016/j.segan.2017.05.002

Source: Scopus

Source ID: 85021196165

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

Production of alkanes from CO₂ by engineered bacteria

Background: Microbial biosynthesis of alkanes is considered a promising method for the sustainable production of drop-in fuels and chemicals. Carbon dioxide would be an ideal carbon source for these production systems, but efficient production of long carbon chains from CO₂ is difficult to achieve in a single organism. A potential solution is to employ acetogenic bacteria for the reduction of CO₂ to acetate, and engineer a second organism to convert the acetate into long-chain hydrocarbons. Results: In this study, we demonstrate alkane production from CO₂ by a system combining the acetogen *Acetobacterium woodii* and a non-native alkane producer *Acinetobacter baylyi* ADP1 engineered for alkane production. Nine synthetic two-step alkane biosynthesis pathways consisting of different aldehyde- and alkane-producing enzymes were combinatorically constructed and expressed in *A. baylyi*. The aldehyde-producing enzymes studied were AAR from *Synechococcus elongatus*, Acr1 from *A. baylyi*, and a putative dehydrogenase from *Nevskia ramosa*. The alkane-producing enzymes were ADOs from *S. elongatus* and *Nostoc punctiforme*, and CER1 from *Arabidopsis thaliana*. The performance of the pathways was evaluated with a twin-layer biosensor, which allowed the monitoring of both the intermediate (fatty aldehyde), and end product (alkane) formation. The highest alkane production, as indicated by the biosensor, was achieved with a pathway consisting of AAR and ADO from *S. elongatus*. The performance of this pathway was further improved by balancing the relative expression levels of the enzymes to limit the accumulation of the intermediate fatty aldehyde. Finally, the acetogen *A. woodii* was used to produce acetate from CO₂ and H₂, and the acetate was used for alkane production by the engineered *A. baylyi*, thereby leading to the net production of long-chain alkanes from CO₂. Conclusions: A modular system for the production of drop-in liquid fuels from CO₂ was demonstrated. Among the studied synthetic pathways, the combination of ADO and AAR from *S. elongatus* was found to be the most efficient in heterologous alkane production in *A. baylyi*. Furthermore, limiting the accumulation of the fatty aldehyde intermediate was found to be beneficial for the alkane production. Nevertheless, the alkane productivity of the system remained low, representing a major challenge for future research.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy

Contributors: Lehtinen, T., Virtanen, H., Santala, S., Santala, V.

Publication date: 21 Aug 2018

Peer-reviewed: Yes

Publication information

Journal: Biotechnology for Biofuels

Volume: 11

Article number: 228

ISSN (Print): 1754-6834

Ratings:

Scopus rating (2018): CiteScore 5.84 SJR 1.762 SNIP 1.451

Original language: English

ASJC Scopus subject areas: Biotechnology, Applied Microbiology and Biotechnology, Renewable Energy, Sustainability and the Environment, Energy(all), Management, Monitoring, Policy and Law

Keywords: Acetate, Acetogen, Acinetobacter baylyi ADP1, Aldehyde, Alkane, Biofuel, Biosensor, Carbon dioxide, CO, Drop in
DOIs:

10.1186/s13068-018-1229-2

Bibliographical note

INT=keb,"Virtanen, Henri"

Source: Scopus

Source ID: 85052519319

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 10 days at pH 7.0 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 $68 \mu\text{mol Se cm}^{-2}$ 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 (> 0.6 mm), 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.

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, Montana State University (MSU), Bhabha Atomic Research Centre, UPEM

Contributors: Tan, L. C., Espinosa-Ortiz, E. J., Nancharaiyah, Y. V., van Hullebusch, E. D., Gerlach, R., Lens, P. N.

Pages: 2380-2389

Publication date: Aug 2018

Peer-reviewed: Yes

Early online date: 1 Jan 2018

Publication information

Journal: Journal of Chemical Technology and Biotechnology

Volume: 93

Issue number: 8

ISSN (Print): 0268-2575

Ratings:

Scopus rating (2018): CiteScore 2.88 SJR 0.715 SNIP 0.883

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:

10.1002/jctb.5586

Source: Scopus

Source ID: 85043713774

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

Design aspects of all atomic layer deposited TiO₂-Fe₂O₃ scaffold-absorber photoanodes for water splitting

Iron and titanium oxides have attracted substantial attention in photoelectrochemical water splitting applications. However, both materials suffer from intrinsic limitations that constrain the final device performance. In order to overcome the limitations of the two materials alone, their combination has been proposed as a solution to the problems. Here we report on the fabrication of an atomic layer deposited (ALD) Fe₂O₃ coating on porous ALD-TiO₂. Our results show that successful implementation requires complete mixing of the TiO₂ and Fe₂O₃ layers via annealing resulting in the formation of a photoactive iron titanium oxide on the surface. Moreover, we found that incomplete mixing leads to crystallization of Fe₂O₃ to hematite that is detrimental to the photoelectrochemical performance. IPCE and transient photocurrent measurements performed using UV and visible light excitation confirmed that the iron titanium oxide extends the photocurrent generation to the visible range. These measurements were complemented by transient absorption spectroscopy (TAS), which revealed a new band absent in pristine hematite or anatase TiO₂ that we assign to charge

transfer within the structure. Taken together, these results provide design guidelines to be considered when aiming to combine TiO₂ and Fe₂O₃ for photoelectrochemical applications.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, Research group: Surface Science, Photonics, Materials Science, Research group: Plastics and Elastomer Technology

Contributors: Hiltunen, A., Ruoko, T., Iivonen, T., Lahtonen, K., Ali-Löytty, H., Sarlin, E., Valden, M., Leskelä, M., Tkachenko, N.

Pages: 2124-2130

Publication date: 31 Jul 2018

Peer-reviewed: Yes

Publication information

Journal: Sustainable Energy & Fuels

Volume: 2

Issue number: 9

ISSN (Print): 2398-4902

Ratings:

Scopus rating (2018): CiteScore 4.94 SNIP 0.841

Original language: English

ASJC Scopus subject areas: Electrochemistry, Renewable Energy, Sustainability and the Environment, Surfaces, Coatings and Films

Keywords: Water splitting, Atomic layer deposition (ALD), Titanium dioxide, Hematite, Cellulose, Template

DOIs:

10.1039/C8SE00252E

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

Metabolic pairing of aerobic and anaerobic production in a one-pot batch cultivation

Background: The versatility of microbial metabolic pathways enables their utilization in vast number of applications.

However, the electron and carbon recovery rates, essentially constrained by limitations of cell energetics, are often too low in terms of process feasibility. Cocultivation of divergent microbial species in a single process broadens the metabolic landscape, and thus, the possibilities for more complete carbon and energy utilization. Results: In this study, we integrated the metabolisms of two bacteria, an obligate anaerobe *Clostridium butyricum* and an obligate aerobe *Acinetobacter baylyi* ADP1. In the process, a glucose-negative mutant of *A. baylyi* ADP1 first deoxidized the culture allowing *C. butyricum* to grow and produce hydrogen from glucose. In the next phase, ADP1 produced long chain alkyl esters (wax esters) utilizing the by-products of *C. butyricum*, namely acetate and butyrate. The coculture produced 24.5 ± 0.8 mmol/l hydrogen (1.7 ± 0.1 mol/mol glucose) and 28 mg/l wax esters (10.8 mg/g glucose). Conclusions: The cocultivation of strictly anaerobic and aerobic bacteria allowed the production of both hydrogen gas and long-chain alkyl esters in a simple one-pot batch process. The study demonstrates the potential of 'metabolic pairing' using designed microbial consortia for more optimal electron and carbon recovery.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering

Contributors: Salmela, M., Lehtinen, T., Efimova, E., Santala, S., Mangayil, R.

Publication date: 3 Jul 2018

Peer-reviewed: Yes

Publication information

Journal: Biotechnology for Biofuels

Volume: 11

Issue number: 1

Article number: 187

ISSN (Print): 1754-6834

Ratings:

Scopus rating (2018): CiteScore 5.84 SJR 1.762 SNIP 1.451

Original language: English

ASJC Scopus subject areas: Biotechnology, Applied Microbiology and Biotechnology, Renewable Energy, Sustainability and the Environment, Energy(all), Management, Monitoring, Policy and Law

Keywords: Hydrogen production, Integrated metabolism, Metabolic pairing, Synthetic microbial consortia, Wax esters

Electronic versions:

full text

DOIs:

10.1186/s13068-018-1186-9

URLs:

<http://urn.fi/URN:NBN:fi:ty-201808072056>

Source: Scopus

Source ID: 85049884043

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

Online dynamic conductance estimation based maximum power point tracking of photovoltaic generators

In this paper, a novel method of maximum power point tracking of renewable energy generators is proposed, utilizing the sum of dynamic and static conductance as maximum power point tracking loop variable. This allows to formulate the maximum power point tracking problem as a typical closed-loop stabilization task of non-linear static plant with zero reference. Consequently, a simple integrative controller is shown to be sufficient to ensure zero steady-state maximum power point tracking error with easily determinable nominal dynamics. A recently revealed method of online photovoltaic generator dynamic conductance estimation allowing robust terminal voltage control is utilized. Moreover, it is revealed that the resulting maximum power point tracking loop plant is piecewise linear around the maximum power point, i.e. for given environmental conditions two different convergence rates are expected, depending on the relative value of operating voltage to maximum power point voltage. Presented analytical outcomes are verified by application of the proposed maximum power point tracking structure to a grid-connected photovoltaic generator system under robust voltage control.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Ariel University Center of Samaria, Ben-Gurion University of the Negev

Contributors: Sitbon, M., Lineykin, S., Schacham, S., Suntio, T., Kuperman, A.

Number of pages: 10

Pages: 687-696

Publication date: 15 Jun 2018

Peer-reviewed: Yes

Publication information

Journal: Energy Conversion and Management

Volume: 166

ISSN (Print): 0196-8904

Ratings:

Scopus rating (2018): CiteScore 7.87 SJR 2.73 SNIP 2.151

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Nuclear Energy and Engineering, Fuel Technology, Energy Engineering and Power Technology

Keywords: Dynamic conductance, Maximum power point tracking, Renewable energy generators

DOIs:

10.1016/j.enconman.2018.04.053

Source: Scopus

Source ID: 85046490026

Research output: [Contribution to journal](#) › [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 7.08 SJR 2.157 SNIP 1.824

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

Role of Oxide Defects in ALD grown TiO₂ Coatings on Performance as Photoanode Protection Layer

Photoelectrochemical (PEC) water splitting is one of the potential methods of utilizing solar energy. A major issue for the method and for renewable energy production is the development of an efficient, chemically stable and cost-effective semiconductor photoanode. Recently, titanium dioxide (TiO₂) coatings grown by atomic layer deposition (ALD) have appeared to be a promising approach to stabilize semiconductor photoanodes under PEC conditions. In particular, amorphous ALD grown TiO₂ has shown exceptional charge transfer properties compared to its crystalline form that are not properly understood yet. Therefore, we target to gain better understanding on the defect structure of ALD grown TiO₂ and utilize the information in the development of optimal photoanode protection layer for efficient solar water splitting.

In this work, structural, optical and photoelectrochemical properties of the ALD grown TiO₂ films were studied in as-deposited condition and after annealing in air at 500 °C. TiO₂ films were grown on n-type phosphorus-doped silicon and fused quartz by ALD at 200 °C using tetrakis(dimethylamido)titanium (TDMAT) and deionized water as precursors. The properties of TiO₂ were investigated by X-ray photoelectron spectroscopy (XPS), ellipsometry and UV/Vis/NIR spectrophotometry. In addition, results from X-ray diffraction (XRD), Raman spectroscopy and photoelectrochemical (PEC) cell are discussed.

Based on the results, as-deposited TiO₂ is amorphous and absorbs visible light as "black" TiO₂. After annealing in air at 500 °C TiO₂ crystallizes as rutile and becomes "white" TiO₂ that absorbs light only in the UV region. As-deposited TiO₂ contains significant amount of Ti^{3+/2+} oxygen vacancies that are oxidized as Ti⁴⁺ upon annealing in air. In addition, nitrogen is found only in as-deposited titanium dioxide. As-deposited TiO₂ is not chemically stable under PEC conditions. In contrast, the annealed TiO₂ is chemically stable and showed 0.20 % ABPE efficiency for water splitting reaction.

As a conclusion, Ti³⁺ defects induce photocorrosion of ALD TiO₂ under PEC conditions. After annealing in air at 500 °C ALD TiO₂ is chemically stable and it can be used as a photoanode protection layer. In the future, research will be focused on optimizing the properties of ALD TiO₂/Si interface and studying the structure of the surface after deposition of nickel electrocatalysts on TiO₂/Si photoanode.

General information

Publication status: Published

Organisations: Photonics, Research group: Surface Science

Contributors: Saari, J., Ali-Löytty, H., Valden, M.

Publication date: 29 May 2018

Peer-reviewed: Unknown

Event: Paper presented at Optics & Photonics Days 2018, Jyväskylä, Finland.

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Surfaces, Coatings and Films

Keywords: Atomic layer deposition, Titanium dioxide, Photoelectrochemical water splitting

Research output: Other conference contribution > Paper, poster or abstract > Scientific

Inoculum pretreatment differentially affects the active microbial community performing mesophilic and thermophilic dark fermentation of xylose

The influence of different inoculum pretreatments (pH and temperature shocks) on mesophilic (37 °C) and thermophilic (55 °C) dark fermentative H₂ production from xylose (50 mM) and, for the first time, on the composition of the active microbial community was evaluated. At 37 °C, an acidic shock (pH 3, 24 h) resulted in the highest yield of 0.8 mol H₂ mol

mol^{-1} xylose. The H_2 and butyrate yield correlated with the relative abundance of Clostridiaceae in the mesophilic active microbial community, whereas Lactobacillaceae were the most abundant non-hydrogenic competitors according to RNA-based analysis. At 55 °C, Clostridium and Thermoanaerobacterium were linked to H_2 production, but only an alkaline shock (pH 10, 24 h) repressed lactate production, resulting in the highest yield of $1.2 \text{ mol H}_2 \text{ mol}^{-1}$ xylose. This study showed that pretreatments differentially affect the structure and productivity of the active mesophilic and thermophilic microbial community developed from an inoculum.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Natl. University of Ireland, Galway, ENEA/CREATE/Università Degli Studi Napoli Federico II, University of Cassino and Southern Lazio, Institute for Water Education, UNESCO-IHE

Contributors: Dessi, P., Porca, E., Frunzo, L., Lakaniemi, A., Collins, G., Esposito, G., Lens, P. N.

Pages: 9233-9245

Publication date: 10 May 2018

Peer-reviewed: Yes

Early online date: 1 Jan 2018

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 43

Issue number: 19

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2018): CiteScore 4.16 SJR 1.1 SNIP 1.128

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology

Keywords: Biohydrogen, Clostridium, Lactobacillus, MiSeq, pH shock, Temperature shock

Electronic versions:

Inoculum pretreatment differentially affects the active microbial community

DOIs:

[10.1016/j.ijhydene.2018.03.117](https://doi.org/10.1016/j.ijhydene.2018.03.117)

URLs:

<http://urn.fi/URN:NBN:fi:tty-201901231146>

Source: Scopus

Source ID: 85045538153

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

Dynamic modeling and analysis of PCM-controlled DCM-operating buck converters-A reexamination

Peak-current-mode (PCM) control was proposed in 1978. The observed peculiar behavior caused by the application of PCM-control in the behavior of a switched-mode converter, which operates in continuous conduction mode (CCM), has led to a multitude of attempts to capture the dynamics associated to it. Only a few similar models have been published for a PCM-controlled converter, which operates in discontinuous conduction mode (DCM). PCM modeling is actually an extension of the modeling of direct-duty-ratio (DDR) or voltage-mode (VM) control, where the perturbed duty ratio is replaced by proper duty-ratio constraints. The modeling technique, which produces accurate PCM models in DCM, is developed in early 2000s. The given small-signal models are, however, load-resistor affected, which hides the real dynamic behavior of the associated converter. The objectives of this paper are as follows: (i) proving the accuracy of the modeling method published in 2001, (ii) performing a comprehensive dynamic analysis in order to reveal the real dynamics of the buck converter under PCM control in DCM, (iii) providing a method to improve the high-frequency accuracy of the small-signal models, and (iv) developing control-engineering-type block diagrams to facilitate the development of generalized transfer functions, which are applicable for PCM-controlled DCM-operated buck, boost, and buck-boost converters.

General information

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Electrical Energy Engineering, Research group: Power electronics, Research area: Power engineering

Contributors: Suntio, T.

Number of pages: 18

Pages: 1-18

Publication date: 2018

Peer-reviewed: Yes

Early online date: 15 May 2018

Publication information

Journal: Energies

Volume: 11

Issue number: 5

Article number: en11051267

ISSN (Print): 1996-1073

Ratings:

Scopus rating (2018): CiteScore 3.18 SJR 0.612 SNIP 1.156

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Energy (miscellaneous), Control and Optimization, Electrical and Electronic Engineering

Keywords: Discontinuous conduction mode, Duty-ratio constraints, Dynamic modeling, Peak-current-mode control

Electronic versions:

energies-11-01267-v2

DOIs:

10.3390/en11051267

URLs:

<http://urn.fi/URN:NBN:fi:ty-201811282777>

Source: Scopus

Source ID: 85054989951

Research output: Contribution to journal > Review Article > Scientific > peer-review

Improved Light Trapping in Quantum Dot Solar Cells Using Double-sided Nanostructuring

We investigate light trapping in thin-film quantum dot solar cells employing front and back side nanostructuring for antireflection and diffraction, respectively. Simulation results demonstrate a large improvement of the effective quantum dot optical absorption.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Photonics, Research group: ORC, Politecnico di Torino

Contributors: Elsehrawy, F., Aho, T., Niemi, T., Guina, M., Cappelluti, F.

Number of pages: 2

Publication date: 2018

Host publication information

Title of host publication: Optics and Photonics for Energy and the Environment 2018

Publisher: OSA - The Optical Society

ISBN (Electronic): 978-1-943580-47-7

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

DOIs:

10.1364/EE.2018.JM4A.5

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Light-trapping enhanced thin-film III-V quantum dot solar cells fabricated by epitaxial lift-off

We report thin-film InAs/GaAs quantum dot (QD) solar cells with n-i-p+ deep junction structure and planar back reflector fabricated by epitaxial lift-off (ELO) of full 3-in wafers. External quantum efficiency measurements demonstrate twofold enhancement of the QD photocurrent in the ELO QD cell compared to the wafer-based QD cell. In the GaAs wavelength range, the ELO QD cell perfectly preserves the current collection efficiency of the baseline single-junction ELO cell. We demonstrate by full-wave optical simulations that integrating a micro-patterned diffraction grating in the ELO cell rear side provides more than tenfold enhancement of the near-infrared light harvesting by QDs. Experimental results are thoroughly discussed with the help of physics-based simulations to single out the impact of QD dynamics and defects on the cell photovoltaic behavior. It is demonstrated that non radiative recombination in the QD stack is the bottleneck for the open circuit voltage (V_{oc}) of the reported devices. More important, our theoretical calculations demonstrate that the V_{oc} offset of 0.3 V from the QD ground state identified by Tanabe et al., 2012, from a collection of experimental data of high quality III-V QD solar cells is a reliable - albeit conservative - metric to gauge the attainable V_{oc} and to quantify the scope for improvement by reducing non radiative recombination. Provided that material quality issues are solved, we demonstrate - by transport and rigorous electromagnetic simulations - that light-trapping enhanced thin-film cells with twenty InAs/GaAs QD layers reach efficiency higher than 28% under unconcentrated light, ambient temperature. If photon recycling can be fully exploited, 30% efficiency is deemed to be feasible.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: ORC, Research group: Nanophotonics, Politecnico di Torino, Department of Applied Health Research, Radboud University Nijmegen, tf2 devices B.V.

Contributors: Cappelluti, F., Kim, D., van Eerden, M., Cédola, A. P., Aho, T., Bissels, G., Elsehrawy, F., Wu, J., Liu, H., Mulder, P., Bauhuis, G., Schermer, J., Niemi, T., Guina, M.

Pages: 83-92

Publication date: 2018

Peer-reviewed: Yes

Publication information

Journal: Solar Energy Materials and Solar Cells

Volume: 181

ISSN (Print): 0927-0248

Ratings:

Scopus rating (2018): CiteScore 5.94 SJR 1.62 SNIP 1.669

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Renewable Energy, Sustainability and the Environment, Surfaces, Coatings and Films

Keywords: Epitaxial lift-off, Light-trapping, Quantum dot, Solar cell, Thin-film

DOIs:

10.1016/j.solmat.2017.12.014

Source: Scopus

Source ID: 85039853836

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

Thermophilic versus mesophilic dark fermentation in xylose-fed fluidised bed reactors: Biohydrogen production and active microbial community

Dark fermentative biohydrogen production in a thermophilic, xylose-fed (50 mM) fluidised bed reactor (FBR) was evaluated in the temperature range 55-70 °C with 5-degree increments and compared with a mesophilic FBR operated constantly at 37 °C. A significantly higher ($p = 0.05$) H_2 yield was obtained in the thermophilic FBR, which stabilised at about $1.2 \text{ mol } H_2 \text{ mol}^{-1}$ xylose (36% of the theoretical maximum) at 55 and 70 °C, and at $0.8 \text{ mol } H_2 \text{ mol}^{-1}$ xylose at 60 and 65 °C, compared to the mesophilic FBR ($0.5 \text{ mol } H_2 \text{ mol}^{-1}$ xylose). High-throughput sequencing of the reverse-transcribed 16S rRNA, done for the first time on biohydrogen producing reactors, indicated that *Thermoanaerobacterium* was the prevalent active microorganism in the thermophilic FBR, regardless of the operating temperature. The active microbial community in the mesophilic FBR was mainly composed of *Clostridium* and *Ruminiclostridium* at 37 °C. Thermophilic dark fermentation was shown to be suitable for treatment of high temperature, xylose-containing wastewaters, as it resulted in a higher energy output compared to the mesophilic counterpart.

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, The James Hutton Institute, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education

Contributors: Dessi, P., Porca, E., Waters, N. R., Lakaniemi, A., Collins, G., Lens, P. N.

Pages: 5473-5485

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2018

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 43

Issue number: 11

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2018): CiteScore 4.16 SJR 1.1 SNIP 1.128

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology

Keywords: Active community, Biohydrogen, FBR, MiSeq, *Thermoanaerobacterium*, Thermophilic

Electronic versions:

Thermophilic versus mesophilic dark fermentation in xylose-fed fluidised bed reactors

DOIs:

10.1016/j.ijhydene.2018.01.158

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201901231143>

Source: Scopus

Source ID: 85042365131

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

Effect of hydraulic retention time on continuous electricity production from xylose in up-flow microbial fuel cell

Aerobic wastewater management is energy intensive and thus anaerobic processes are of interest. In this study, a microbial fuel cell was used to produce electricity from xylose which is an important constituent of lignocellulosic waste. Hydraulic retention time (HRT) was optimized for the maximum power density by gradually decreasing the HRT from 3.5 d to 0.17 d. The highest power density (430 mW/m²) was obtained at 1 d HRT. Coulombic efficiency decreased from 30% to 0.6% with HRTs of 3.5 d and 0.17 d, respectively. Microbial community analysis revealed that anode biofilm contained known exoelectrogens, including *Geobacter* sp. and fermentative organisms were present in both anolyte and the anode biofilm. The peak power densities were obtained at 1-1.7 d HRTs and xylose degraded almost completely even with the lowest HRT of 0.17 d, which demonstrates the efficiency of up-flow MFC for treating synthetic wastewater containing xylose.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Feng Chia University

Contributors: Haavisto, J. M., Kokko, M. E., Lay, C., Puhakka, J. A.

Pages: 27494-27502

Publication date: 1 Nov 2017

Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 42

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2017): CiteScore 4.1 SJR 1.116 SNIP 1.292

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology

Keywords: Continuous operation, Hydraulic retention time, Microbial community, Microbial fuel cell, Up-flow, Xylose

Electronic versions:

Effect of hydraulic retention time on continuous electricity production from xylose in up-flow microbial fuel cell. Embargo ended: 2/11/19

DOIs:

10.1016/j.ijhydene.2017.05.068

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201907151963>. Embargo ended: 2/11/19

Bibliographical note

EXT="Lay, Chyi-How"

Source: Scopus

Source ID: 85019734862

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

A demand-based nutrient utilization approach to urban biogas plant investment based on regional crop fertilization

This study aimed to develop a regional nutrient demand-based approach to assess the potential use of digestate nutrients from a planned biogas plant investment as a part of a regional circular economy concept. The assumed biogas plant is expected to treat urban wastes; biowastes (23,500 t/y) and sewage sludges (120,000 t/y) from the Tampere region, Finland (total population of 500,000). The calculation of the regional nutrient balance was based on the fertilizable crop areas, fertilization regimes and biomass nutrient amounts, with an assumption that livestock manures were primarily utilized in crop production. Subsequently, a Geographic Information System (GIS)-based methodology was applied to evaluate the transportation distances of nutrients from the biogas plant to the closest crop fields. As a result from the presented approach, livestock manure covered 41% and 12% of the phosphorus (P) and soluble nitrogen (N) need of the studied region. There was a residual potential for the regional utilization of biogas plant nutrients, which together with the livestock manure accounted for 50% of P and 15% of soluble-N need. Transportation of nutrients up to 40 km from the biogas plant is necessary if all nearby fields receive the waste-based nutrients, while the distance increased to 66 km if 30% of the local farmers are willing to use the nutrients. The approach presented in this study acts as a tool for planning nutrient cycles, which can be used to sustainably manage the regional nutrient flows when planning a new biogas plant investment.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Natural Resources Institute Finland (Luke)

Contributors: Tampio, E., Lehtonen, E., Kinnunen, V., Mönkäre, T., Ervasti, S., Kettunen, R., Rasi, S., Rintala, J.

Number of pages: 11

Pages: 19-29

Publication date: 15 Oct 2017

Peer-reviewed: Yes

Publication information

Journal: Journal of Cleaner Production

Volume: 164

ISSN (Print): 0959-6526

Ratings:

Scopus rating (2017): CiteScore 5.79 SJR 1.467 SNIP 2.339

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Environmental Science(all), Strategy and Management, Industrial and Manufacturing Engineering

Keywords: Biogas plant, Biowaste, Digestate, Livestock manure, Nutrient recycling, Sewage sludge

DOIs:

10.1016/j.jclepro.2017.06.172

Bibliographical note

EXT="Tampio, Elina"

Source: Scopus

Source ID: 85027488845

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

Atomikerroskasvatusmenetelmällä kasvatetun titaanidioksidikalvon ominaisuudet valosähkökemiallisessa veden hajottamisessa

Photoelectrochemical water splitting is one of the potential ways of utilizing solar energy. A major issue for the method and for renewable energy production would be the development of an efficient and a cost-effective semiconductor photoanode. In this Master of Science Thesis properties of atomic layer deposited (ALD) titanium dioxide film (TiO_2), such as a chemical composition, a crystal structure and the ability to absorb sunlight, are studied in as-deposited conditions and after oxidative annealing. By understanding thoroughly the properties of atomic layer deposited titanium dioxide and the effects of post-annealing in air, titanium dioxide can be better utilized in semiconductor photoanodes used in photoelectrochemical water splitting.

Titanium dioxide films examined in this study were grown on n-type phosphorus-doped silicon (n-Si(100)(P)) and fused quartz used as substrates by atomic layer deposition at 200 °C using tetrakis(dimethylamido)titanium (TDMAT) and deionized water as precursors. The annealing of some of the samples at 500 °C in air was made in a tube furnace. The concentrations of the elements and chemical states of the atomic layer deposited titanium dioxide films were studied by X-ray photoelectron spectroscopy (XPS). The film thickness and refractive index were determined by ellipsometer and the absorption properties of the titanium dioxide film were measured by UV/Vis/NIR spectrophotometer. In addition, crystallographic results from X-ray diffraction (XRD) and Raman spectroscopy were also utilized, as well as the results of the photoelectrochemical cell and solar simulator on titanium dioxide photoanode performance.

Based on the results, at 200 °C atomic layer deposited titanium dioxide is amorphous and absorbs visible light as "black" TiO_2 . At the oxidative annealing at 500 °C titanium dioxide crystallizes into rutile and becomes "white" TiO_2 that absorbs less visible light. Both titanium dioxide films contain the lower $\text{Ti}^{3+/2+}$ oxidation states of titanium that may indicate oxygen vacancies. Nitrogen is found only in as-deposited titanium dioxide. The annealed titanium dioxide is stable in electrolyte, achieving 0.20 % ABPE for water splitting reaction.

General information

Publication status: Published

MoE publication type: G2 Master's thesis, polytechnic Master's thesis

Organisations: Photonics, Research group: Surface Science

Contributors: Saari, J.

Number of pages: 74

Publication date: 4 Oct 2017

Publication information

Original language: Finnish

ASJC Scopus subject areas: Surfaces, Coatings and Films, Renewable Energy, Sustainability and the Environment

Keywords: Photoelectrochemical water splitting, Titanium dioxide, ALD, Atomic layer deposition, XPS, X-ray photoelectron spectroscopy, Ellipsometry, UV/Vis/NIR spectrophotometry

URLs:

<http://URN.fi/URN:NBN:fi:tyy-201709201911>

Research output: Book/Report › Master's Thesis › Scientific

Electropolymerized polyazulene as active material in flexible supercapacitors

We report the capacitive behavior of electrochemically polymerized polyazulene films in different ionic liquids. The ionic liquids in this study represent conventional imidazolium based ionic liquids with tetrafluoroborate and bis(trifluoromethylsulfonyl)imide anions as well as an unconventional choline based ionic liquid. The effect of different ionic liquids on the polymerization and capacitive performance of polyazulene films is demonstrated by cyclic voltammetry and electrochemical impedance spectroscopy in a 3-electrode cell configuration. The films exhibit the highest capacitances in the lowest viscosity ionic liquid (92 mF cm^{-2}), while synthesis in high viscosity ionic liquid shortens the conjugation length and results in lower electroactivity (25 mF cm^{-2}). The obtained films also show good cycling stabilities retaining over 90% of their initial capacitance over 1200 p-doping cycles. We also demonstrate, for the first time, flexible polyazulene supercapacitors of symmetric and asymmetric configurations using the choline based ionic liquid as electrolyte. In asymmetric configuration, capacitance of 55 mF (27 mF cm^{-2}) with an equivalent series resistance of 19Ω is obtained at operating voltage of 1.5 V . Upon increasing the operating voltage up to 2.4 V , the capacitance increases to 72 mF (36 mF cm^{-2}).

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research area: Measurement Technology and Process Control, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech, Turun Yliopisto/Turun Biomateriaalikeskus

Contributors: Suominen, M., Lehtimäki, S., Yewale, R., Damlin, P., Tuukkanen, S., Kvarnström, C.

Number of pages: 10

Pages: 181-190

Publication date: 15 Jul 2017

Peer-reviewed: Yes

Publication information

Journal: Journal of Power Sources

Volume: 356

ISSN (Print): 0378-7753

Ratings:

Scopus rating (2017): CiteScore 7 SJR 2.202 SNIP 1.557

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Energy Engineering and Power Technology, Physical and Theoretical Chemistry, Electrical and Electronic Engineering

Keywords: Choline, Electropolymerization, Flexible supercapacitor, Ionic liquid, Polyazulene

Electronic versions:

Suominen_2017_Revised_Manuscript. Embargo ended: 15/07/19

Suominen_2017_Supplementary_information. Embargo ended: 15/07/19

DOIs:

[10.1016/j.jpowsour.2017.04.082](https://doi.org/10.1016/j.jpowsour.2017.04.082)

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201706021571>. Embargo ended: 15/07/19

URLs:

<http://www.scopus.com/inward/record.url?scp=85019024216&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85019024216

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

Hafnium oxide thin films as a barrier against copper diffusion in solar absorbers

The thermal stability of copper substrate material used in solar thermal collectors was investigated with and without atomic layer deposited (ALD) hafnium oxide barrier films at temperatures of $200\text{--}400 \text{ }^\circ\text{C}$. HfO_2 films were studied as barriers against thermal diffusion of copper substrate atoms. The ALD HfO_2 thin films were deposited in a thermal process at $200 \text{ }^\circ\text{C}$ using Tetrakis(Dimethylamido)Hafnium ($\text{Hf}(\text{NMe}_2)_4$) and H_2O precursors, with 200, 400, and 600 cycles. The Cu substrates with and without HfO_2 thin films were aged by means of heat treatment in air. The influence of the HfO_2 barriers was determined by optical, microstructural, and morphological analyses before and after the ageing procedures. The optical performance of the HfO_2 barriers as a part of solar absorber stack was modelled with CODE Coating Designer. The copper surface without a HfO_2 barrier thin film oxidized significantly, which increased thermal emittance

and surface roughness. 200 cycles of HfO_2 deposition did not result in a completely continuous coating and only provided a little protection against oxidation. Films of 200 and 400 cycles gave continuous coverage and the thickest HfO_2 thin film studied, which was deposited from 600 ALD cycles and had a thickness ~ 50 nm, prevented Cu oxidation and diffusion processes after 2 h heat treatment in air at 300 °C, and retained low thermal emissivity. At 400 °C, diffusion and formation of copper oxide hillocks were observed but the HfO_2 thin film significantly retarded the degradation when compared to a Cu substrate without and with thinner barrier layers.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Research group: Surface Engineering, R&D Center for Low-Cost Plasma and Nanotechnology Surface Modifications (CEPLANT), Masaryk University

Contributors: Kotilainen, M., Krumpolec, R., Franta, D., Souček, P., Homola, T., Cameron, D. C., Vuoristo, P.

Number of pages: 7

Pages: 140-146

Publication date: 1 Jul 2017

Peer-reviewed: Yes

Publication information

Journal: Solar Energy Materials and Solar Cells

Volume: 166

ISSN (Print): 0927-0248

Ratings:

Scopus rating (2017): CiteScore 4.83 SJR 1.459 SNIP 1.532

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Renewable Energy, Sustainability and the Environment, Surfaces, Coatings and Films

Keywords: Copper diffusion, Diffusion barrier, HfO thin film, Solar absorber, Thermal ageing

DOIs:

10.1016/j.solmat.2017.02.033

Source: Scopus

Source ID: 85016025672

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

On the Efficient Calculation of the Periodic Steady-State Response of Grid-Connected Wind Parks - Part I

This paper presents a new power systems simulation environment suitable for the swift calculation of the periodic steady-state response of large power networks with large wind parks. In order to achieve the greatest computational efficiency and solution reliability, the wind generator model uses the state-of-the-art voltage-behind-reactance model of the induction generator; in this first part of the paper, the fixed-speed wind generator model is presented. The overall solving environment for the nonlinear system of differential equations representing the power system is the so-called Poincare map method. A rather useful feature to reduce further the calculation times is the availability of an equivalent wind farm model based on multiple wakes. The Poincare acceleration yields a vastly improved numerical solution compared to existing models of fixed-speed wind parks. The application of equivalent wind farm models yields a staggering reduction in the elapsed time to only 1.16% of the time demanded by the detailed model, while retaining a good approximation of the response of the wind farm. Full comparisons of the detailed and equivalent wind park models with PSCAD/EMTDC, are carried out and the agreement of the results is excellent. In this paper the emphasis is on harmonic generation.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research area: Power engineering, Univ. Michoacana

Contributors: Garcia, N., Acha, E.

Number of pages: 10

Pages: 458-467

Publication date: 1 Apr 2017

Peer-reviewed: Yes

Publication information

Journal: IEEE Transactions on Sustainable Energy

Volume: 8

Issue number: 2

ISSN (Print): 1949-3029

Ratings:

Scopus rating (2017): CiteScore 7.42 SJR 2.318 SNIP 2.468

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Induction machine, periodic steady-state, Poincaré map method, voltage behind reactance model, wind farm
DOIs:

10.1109/TSTE.2016.2606352

Source: Scopus

Source ID: 85027504357

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

Effects of PV array layout, electrical configuration and geographic orientation on mismatch losses caused by moving clouds

The mismatch losses of photovoltaic (PV) systems are mainly caused by partial shading and the largest mismatch losses are caused by sharp shadows. However, in large scale PV plants majority of shading events is caused by moving clouds which lead to gentle irradiance transitions causing typically only minor irradiance differences between adjacent PV modules. Irradiance transitions caused by the edges of cloud shadows have an average length of almost 150 m meaning that even the largest PV power plants are widely affected by them. In addition of mismatch losses, these irradiance transitions can lead to failures in maximum power point tracking and cause significant fluctuations in the output power of PV systems. In this paper, the effects of PV array shape, electrical configuration and orientation on mismatch losses caused by moving clouds were studied based on apparent velocity and other measured characteristics of roughly 27,000 irradiance transitions. The study was conducted using a mathematical model and parametrisation method of irradiance transitions and an experimentally verified simulation model of a PV module based on the well-known one-diode model of a PV cell. The studied electrical PV array configurations were series-parallel, total-cross-tied and multi-string. The results of this study confirmed a prior conclusion, namely, that the mismatch losses decrease with decreasing PV string length. It was also found that the array orientation has a considerable effect on the mismatch losses of the studied array layouts. The mismatch losses were the smallest when the dominant direction of movement of the shadow edges was perpendicular to the PV strings. The differences in the mismatch losses between the studied electrical array configurations were very small. The results indicated that the mismatch losses caused by moving clouds have only a minor effect on the overall efficiency of PV arrays.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research area: Power engineering

Contributors: Lappalainen, K., Valkealahti, S.

Number of pages: 8

Pages: 548-555

Publication date: 1 Mar 2017

Peer-reviewed: Yes

Publication information

Journal: Solar Energy

Volume: 144

ISSN (Print): 0038-092X

Ratings:

Scopus rating (2017): CiteScore 4.89 SJR 1.615 SNIP 1.781

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Materials Science(all)

Keywords: Irradiance transition, Mismatch losses, Partial shading, Photovoltaic power generation

DOIs:

10.1016/j.solener.2017.01.066

Source: Scopus

Source ID: 85011675458

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 CH₄ 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

Publication status: Published
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.
Number of pages: 8
Pages: 706-713
Publication date: 2017
Peer-reviewed: Yes

Publication information

Journal: Bioresource Technology
Volume: 245
Issue number: A
ISSN (Print): 0960-8524
Ratings:
Scopus rating (2017): CiteScore 6.28 SJR 2.029 SNIP 1.823
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
Keywords: Digestate characteristics, Microalgal growth, Nutrient recovery, Pulp and paper industry, Wastewater treatment
Electronic versions:
Cultivation of *Scenedesmus acuminatus* in different liquid digestates from anaerobic digestion of pulp and paper industry biosludge
Cultivation of *Scenedesmus acuminatus* in different liquid digestates from anaerobic digestion of pulp and paper industry biosludge. Embargo ended: 14/09/19
DOIs:
10.1016/j.biortech.2017.08.218
URLs:
<http://urn.fi/URN:NBN:fi:tty-201812052814>
Source: Scopus
Source ID: 85029373417
Research output: Contribution to journal › Article › Scientific › peer-review

Design of a 25 MWe Solar Thermal Power Plant in Iran with Using Parabolic Trough Collectors and a Two-Tank Molten Salt Storage System

Nowadays, parabolic trough solar thermal plants are prevalent around the world. In different areas concerning the amount of solar radiation, their standard size is approximately between 20 and 100 MWe. Certainly, the right size of the solar field is the first selection with regard to nominal electrical power. A vast area will be economically unreasonable whereas a small area will mainly cause the power plant to operate at the part-load condition. This paper presents an economic modeling of a solar parabolic trough plant, operating at 25 MWe in Yazd, Iran. The varying types of collector dimensions have been investigated; then, by selecting autumnal equinox (22 September) at 12:00 PM as the design point, thermal performance of the solar power plant has been featured annually, in all conditions. The total operating time of the power plant is about 1726 hours (1248 hours in full-load condition). In the end, the effect of thermal storage tanks has been analyzed to save extra solar heat and use it at nights in hot months. By implementing a storage system, the total operating time will be increased to 3169 hours (2785 in full-load condition). Moreover, 7974 GJ useful thermal energy can be obtained from the solar field and storage system.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering, University of Guilan
Contributors: Kordmahaleh, A. A., Naghashzadegan, M., Javaherdeh, K., Khoshgoftar, M.
Publication date: 2017
Peer-reviewed: Yes

Publication information

Journal: International Journal of Photoenergy
Volume: 2017
Article number: 4210184
ISSN (Print): 1110-662X
Ratings:
Scopus rating (2017): CiteScore 1.18 SJR 0.341 SNIP 0.605

Original language: English

ASJC Scopus subject areas: Chemistry(all), Atomic and Molecular Physics, and Optics, Renewable Energy, Sustainability and the Environment, Materials Science(all)

Electronic versions:

4210184

DOIs:

10.1155/2017/4210184

URLs:

<http://urn.fi/URN:NBN:fi:tty-201801081036>

Bibliographical note

INT=aut,"Kordmahaleh, Aidin Alinezhad"

Source: Scopus

Source ID: 85038904387

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

Thermal Modification of ALD Grown Titanium Oxide Ultra Thin Film for Photoanode Applications

General information

Publication status: Published

Organisations: Optoelectronics Research Centre, Research group: Surface Science

Contributors: Hannula, M. K., Lahtonen, K. T., Isotalo, T. J., Saari, J. S., Valden, M. O.

Publication date: 15 Dec 2016

Peer-reviewed: Unknown

Event: Paper presented at Symposium on Future Prospects for Photonics, Tampere, Finland.

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Surfaces, Coatings and Films, Surfaces and Interfaces, Atomic and Molecular Physics, and Optics

Keywords: Titanium dioxide, titanium silicide, Atomic layer deposition (ALD), photoemission electron microscopy, PEEM, hydrogen energy

Research output: [Other conference contribution](#) > [Paper, poster or abstract](#) > [Scientific](#)

Apparent velocity of shadow edges caused by moving clouds

Even the largest photovoltaic (PV) power plants are widely affected by overpassing cloud shadows which have several harmful effects on the operation of PV systems. Irradiance transitions caused by edges of cloud shadows can be very steep and large and might lead to situations where the grid inverter is not able to follow the global maximum power point. Further, partial shading of PV systems causes mismatch losses and fast fluctuations of the power fed to the electric grid can cause power balance and quality problems. In this paper, a method to determine apparent shadow edge velocity from measured data of three irradiance sensors is presented. A total of around 43,000 irradiance transitions were first identified in 15 months of data measured with one of the sensors around midsummer in 2011–2014. Out of those about 27,000 transitions were identified by all the three irradiance sensors and their apparent shadow edge velocity, length, etc. were analysed. The apparent shadow edge speed varies greatly with an average value of around 9 m/s. The lengths of irradiance transitions caused by edges of moving clouds are typically around 100 m, which is large enough to affect the operation of PV power plants of all sizes.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electrical Engineering, Research area: Power engineering

Contributors: Lappalainen, K., Valkealahti, S.

Number of pages: 6

Pages: 47-52

Publication date: 15 Nov 2016

Peer-reviewed: Yes

Publication information

Journal: Solar Energy

Volume: 138

ISSN (Print): 0038-092X

Ratings:

Scopus rating (2016): CiteScore 4.52 SJR 1.504 SNIP 1.741

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Materials Science(all)

Keywords: Apparent shadow edge velocity, Irradiance transition, Partial shading, Solar radiation

DOIs:

10.1016/j.solener.2016.09.008

Source: Scopus

Source ID: 84987875834

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

Analysis of shading periods caused by moving clouds

Fast variability of solar radiation is the main cause of fluctuating photovoltaic power production. Shadows caused by moving clouds are the main reason of such variability. Irradiance transitions caused by edges of cloud shadows can be very steep and large and might lead to failures in maximum power point tracking causing extra losses. Further, fast fluctuations of the power fed to the electric grid can cause power balance and quality problems for the grid. This paper presents a method to identify shading periods caused by moving clouds in measured irradiance data. A total of around 12,000 shading periods were identified in a measured data of 15 months around midsummer in 2011-2014 and their shading strength, duration, time of occurrence etc. were analysed. It was found that the duration of shading periods varies a lot from about four seconds up to almost 1.5 h with an average duration of around 60 s. Furthermore, the Linear Cloud Edge method was used to determine the velocity of shadows and their speed, direction of movement, length etc. were analysed. The determination of velocity was conducted by two different ways based directly on measured irradiance values and on the curve fits of a mathematical model of irradiance transitions. The use of curve fits mitigates the effects of irregularities present on shadow edges. The speed of shadows varies greatly with an average value of around 13 m/s.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electrical Engineering, Research area: Power engineering

Contributors: Lappalainen, K., Valkealahti, S.

Number of pages: 9

Pages: 188-196

Publication date: 1 Oct 2016

Peer-reviewed: Yes

Publication information

Journal: Solar Energy

Volume: 135

ISSN (Print): 0038-092X

Ratings:

Scopus rating (2016): CiteScore 4.52 SJR 1.504 SNIP 1.741

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Materials Science(all)

Keywords: Partial shading, Shading period, Shadow velocity, Solar radiation

DOIs:

10.1016/j.solener.2016.05.050

Source: Scopus

Source ID: 84971664094

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

Exposure to biological and chemical agents at biomass power plants

The increasing use and production of bioenergy means that the number of employees working in this area will inevitably grow, making it ever more important to know the health and safety issues involved in the biomass supply chain. Our aim was to determine the exposure of employees to biological and chemical agents during various work tasks at different biomass-fuelled power plants in Finland. The study included technical surveys on biomass operations and occupational measurements at three CHP plants. Workers' main health risks were bacteria and fungi, which were easily spread to the air during heavy biomass processes. The exposure levels of actinobacteria, bacterial endotoxins and fungi were high, especially during the unloading of peat and wood chips. In addition, workers were exposed to mechanical irritation caused by organic dust, and chemical irritation caused by volatile organic compounds and components of diesel exhausts. Multiple exposures to these agents may simultaneously have synergistic health effects on workers' lower and upper respiratory tracts. During operations, workers were also exposed to endotoxins, actinobacteria and fungi, especially during the cleaning and handling of wood chips in silos and while working near screens or crushers. The measured concentrations exceeded the limit values proposed for these agents. The highest concentration of volatile organic compounds was found near conveyors. On the basis of these measurements, we suggested best practices for the power plants. The levels of biological agents in outdoor measurements reflected only low spreading of contaminants from power plants to the environment.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Environmental Health, Työterveyslaitos, VTT Technical Research Centre of Finland, Finnish Institute of Occupational Health, University of Eastern Finland

Contributors: Laitinen, S., Laitinen, J., Fagernäs, L., Korpijärvi, K., Korpinen, L., Ojanen, K., Aatamila, M., Jumpponen, M., Koponen, H., Jokiniemi, J.

Number of pages: 9

Pages: 78-86

Publication date: 1 Oct 2016

Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy

Volume: 93

ISSN (Print): 0961-9534

Ratings:

Scopus rating (2016): CiteScore 3.71 SJR 1.198 SNIP 1.385

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: Bioenergy, Biological agents, Chemical compounds, Exposure, Occupational hygiene, Power plants

Electronic versions:

Exposure to biological and chemical agents at biomass power plants

DOIs:

10.1016/j.biombioe.2016.06.025

URLs:

<http://urn.fi/URN:NBN:fi:tty-201608154410>

Source: Scopus

Source ID: 84977492787

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

Comparison of photovoltaic and wind generators as dynamic input sources to power processing interfaces

The paper reveals that while the equivalent circuit, representing the load side reflected low-frequency dynamics of a wind turbine generator, is similar to the electrical equivalent circuit of a photovoltaic generator, their dynamic resistances possess different behavior. While the incremental conductance of a photovoltaic generator does not change sign with terminal voltage variations, zero-crossing dynamic conductance characterizes wind turbine generator. The findings point out the complications arising during interfacing a wind turbine generator by different power processing interfaces.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Research area: Power engineering, Ariel University Center of Samaria

Contributors: Kolesnik, S., Sitbon, M., Agranovich, G., Kuperman, A., Suntio, T.

Publication date: 25 Jul 2016

Host publication information

Title of host publication: 2016 2nd International Conference on Intelligent Energy and Power Systems, IEPS 2016 - Conference Proceedings

Publisher: IEEE

ISBN (Electronic): 9781509017690

ASJC Scopus subject areas: Energy Engineering and Power Technology, Renewable Energy, Sustainability and the Environment, Control and Systems Engineering, Electrical and Electronic Engineering

Keywords: dynamic resistance, equivalent electrical circuit, Photovoltaic generator, wind turbine

DOIs:

10.1109/IEPS.2016.7521859

Source: Scopus

Source ID: 84983341165

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Liquid fertilizer products from anaerobic digestion of food waste: Mass, nutrient and energy balance of four digestate liquid treatment systems

This study compared four different digestate liquid treatment systems of a theoretical anaerobic digestion plant in order to facilitate the utilization of municipal food waste nutrients in agriculture. The mass, nutrient and energy balances of a theoretical plant digesting 60 kt/y of food waste were used to evaluate the feasibility of the treatments to concentrate nutrients into liquid fertilizer products. The studied technologies for digestate liquid treatment were ammonia stripping,

ammonia stripping combined with reverse osmosis (RO), evaporation combined with RO, and stripping combined with both evaporation and RO. As a result, processing of digestate into concentrated fertilizer products consumed less than 10% of the produced energy from food wastes and was also sufficient for the heat-demanding digestate liquid treatments, evaporation and stripping. The digestate liquid treatment systems were considered as nitrogen and potassium concentration methods which were able to concentrate up to 67% of the feedstock nitrogen into transportable fertilizer products with low mass. Of the studied digestate systems evaporation combined with RO was evaluated as the most efficient nutrient recovery technology for the production of transportable fertilizer products due to the high concentration of nutrients and nutrient availability as well as low product mass and energy consumption. Overall, the selection of the treatment technology is dependent on the location of the anaerobic digestion plant relative to the agricultural land and the type of fertilizer products needed.

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, Natural Resources Institute Finland (Luke)

Contributors: Tampio, E., Martinen, S., Rintala, J.

Number of pages: 11

Pages: 22–32

Publication date: Jul 2016

Peer-reviewed: Yes

Publication information

Journal: Journal of Cleaner Production

Volume: 125

ISSN (Print): 0959-6526

Ratings:

Scopus rating (2016): CiteScore 5.83 SJR 1.659 SNIP 2.53

Original language: English

ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Renewable Energy, Sustainability and the Environment, Environmental Science(all), Strategy and Management

Keywords: Anaerobic digestion, Digestate liquid treatment, Evaporation, Food waste, Reverse osmosis, Stripping

DOIs:

10.1016/j.jclepro.2016.03.127

Source: Scopus

Source ID: 84963538041

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

Power quality in distribution networks with electric vehicle charging - A research methodology based on field tests and real data

In this paper power quality measurement results of electric vehicle (EV) battery charging are presented. The power quality issues of EV charging are a rising concern among power utilities, as a rapid penetration of EVs on automotive markets is expected to happen in a few years to come. For evaluating the impact of EV charging a series of field measurements are conducted and harmonic current profiles based on the measurements were created. Paper also discusses the calculation methodology of harmonic current flow in distribution networks using the harmonic profiles. For this purpose an OpenDSS based calculation tool is developed and preliminary simulation results are presented.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Research area: Power engineering

Contributors: Supponen, A., Rautiainen, A., Markkula, J., Mäkinen, A., Järventausta, P., Repo, S.

Publication date: 20 May 2016

Host publication information

Title of host publication: 2016 11th International Conference on Ecological Vehicles and Renewable Energies, EVER 2016

Publisher: IEEE

ISBN (Print): 9781509024643

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Automotive Engineering

Keywords: Distribution Network Analysis, Electric Vehicles, Harmonic currents, OpenDSS, Power Quality

DOIs:

10.1109/EVER.2016.7476376

Bibliographical note

INT=dee,"Supponen, Antti"

Source: Scopus

Source ID: 84974530660

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Influence of As/group-III flux ratio on defects formation and photovoltaic performance of GaInNAs solar cells

The correlation between the As to group III flux ratio and photovoltaic performance of GaIn_{0.1}N_{0.03}As solar cells fabricated by molecular beam epitaxy is systematically investigated. The results show that flux ratio has a remarkable influence on the formation of defect traps. Furthermore, the formation of defects at different flux ratios is correlating with the variation of the background doping level and the photovoltaic performance. In particular, this study reveals a linear dependency between current generation, dark saturation current, defect densities, photoluminescence peak intensity and the flux ratio. A significant increase in solar cell performance, exhibiting maximum external quantum efficiency of 90%, is obtained when As/group-III ratio is decreased close to the stoichiometric limit. For optimized growth condition, the 1 eV GaIn_{0.1}N_{0.03}As solar cell exhibits a short circuit current density as high as 17.9 mA/cm² calculated from the external quantum efficiency data (AM0 conditions) with 870 nm high-pass filter. This value reflects the potential of the GaInNAs cell for current matching and power generation in high efficiency solar cells incorporating three- or four- junctions.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications

Contributors: Polojärvi, V., Aho, A., Tukiainen, A., Raappana, M., Aho, T., Schramm, A., Guina, M.

Number of pages: 8

Pages: 213-220

Publication date: 1 May 2016

Peer-reviewed: Yes

Publication information

Journal: Solar Energy Materials and Solar Cells

Volume: 149

ISSN (Print): 0927-0248

Ratings:

Scopus rating (2016): CiteScore 4.97 SJR 1.599 SNIP 1.697

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films

Keywords: Defects, Dilute nitrides, III-V semiconductors, Material characterization, Molecular beam epitaxy, Multijunction solar cells

DOIs:

10.1016/j.solmat.2016.01.024

Source: Scopus

Source ID: 84957536411

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

Antireflection composite coatings for organic solar cells

Experimental studies on increasing the transmittance of a light-receiving element (LRE) by applying an antireflection coating were carried out. As an antireflection coating on the solar furnace, the fluoride composite material MgF₂-CaF₂ was synthesized. Transmission spectra of the LRE without the antireflection coating and with the antireflection coating were measured. The effect of translucence (increase of transmittance) of the LRE after applying the antireflection coating is observed in the spectral region of 0.4–1.1 μm.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Academy of Sciences of the Republic of Uzbekistan, Ohio State University

Contributors: Suleimanov, S. K., Berger, P., Dyskin, V. G., Dzhanklich, M. U., Bugakov, A. G., Dudko, O. A., Kulagina, N. A., Kim, M.

Number of pages: 2

Pages: 157-158

Publication date: 1 Apr 2016

Peer-reviewed: Yes

Publication information

Journal: Applied Solar Energy (English translation of Geliotekhnika)

Volume: 52

Issue number: 2
ISSN (Print): 0003-701X
Ratings:

Scopus rating (2016): CiteScore 0.53 SJR 0.238 SNIP 0.742
Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment
DOIs:

10.3103/S0003701X1602016X

Source: Scopus

Source ID: 84988345161

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

Planning land use for biogas energy crop production: The potential of cutaway peat production lands

Each year, thousands of hectares of peatland that had been harvested are being released in Finland, which can offer an opportunity to increase energy crops and attain the bioenergy targets for non-agriculture lands. In this study, the Geographic Information System (GIS) method was used to improve the assessment of decentralized renewable energy resources. The amount of peat production lands and future cutaway areas for energy crop production was calculated as a case study by using ArcGIS and the Finnish Topographic database. There are almost 1000 km² of peat production lands in Finland, and theoretically, approximately 300 km² of cutaway peatlands could be used for energy crops after 30 years. The dry biomass yield of reed canary grass (*Phalaris arundinacea*) or timothy-fescue grass (mix of *Phleum pratense* and *Festuca pratensis*) could be higher than 100 Gg a⁻¹ in these lands indicating methane potential of approximately 300 GWh. The exhausted peat production areas in the western region of Finland have significant potential for use for energy crops; North and South Ostrobothnia account for almost 45% of the total peat production land. A future goal could be to use the cutaway peat production lands more efficiently for bioenergy to mitigate climate change. Since the use of wastelands (including peatlands) are being considered in Europe as a way to avoid competition with food production, the GIS method used in the study to identify suitable peat lands could be applicable to biomass resource studies being conducted in many countries.

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, University of Jyväskylä

Contributors: Laasasenaho, K., Lensu, A., Rintala, J.

Number of pages: 8

Pages: 355-362

Publication date: 1 Feb 2016

Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy

Volume: 85

ISSN (Print): 0961-9534

Ratings:

Scopus rating (2016): CiteScore 3.71 SJR 1.198 SNIP 1.385

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: Bioenergy, *Festuca pratensis*, GIS, *Phalaris arundinacea*, *Phleum pratense*, Wasteland

DOIs:

10.1016/j.biombioe.2015.12.030

Bibliographical note

EXT="Laasasenaho, Kari"

Source: Scopus

Source ID: 84953292007

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

Microbial electrochemical technologies with the perspective of harnessing bioenergy: Maneuvering towards upscaling

Microbial electrochemical technologies have gained much attention in the recent years during which basic research has been carried out to provide proof of concept by utilizing microorganisms for generating bioenergy in an electro redox active environment. However, these bio-electrocatalyzed systems pose significant challenges towards up-scaling and practical applications. Various parameters viz., electrodes, materials, configuration, biocatalyst, reaction kinetics, fabrication and operational costs, resistance for electron transfer etc. will critically govern the performance of microbial catalyzed electrochemical systems. Majorly, the surface area of electrode materials, biofilm coverage on the electrode surface,

enrichment of electrochemically active electrode respiring bacteria and reduction reactions at cathode will aid in increasing the reaction kinetics towards the upscaling of microbial electrochemical technologies. Enrichment of electroactive microbial community on anode electrode can be promoted with electrode pretreatment, controlled anode potential or electrical current, external resistance, optimal operation temperature, chemical additions and bioaugmentation. Inhibition of the growth of methanogens also increases the coulombic efficiency, an essential parameter that determines the efficacy of bioelectricity generation. Considering the practical implementation of these microbial electrochemical technologies, the current review addresses the challenges and strategies to improve the performance of bio-electrocatalyzed systems with respect to the operational, physico-chemical and biological factors towards scale up. Besides, the feasibility for long term operation, the scope for future research along with the operational and maintenance costs are discussed to provide a broad spectrum on the role of the system components for the implementation of these bio-electrochemical technologies for practical utility.

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, CSIR-Indian Institute of Chemical Technology, Indian Institute of Technology, Delhi, India, Department of Environmental Engineering, Yildiz Technical University, Department of Chemical Engineering, Bioengineering and Environmental Sciences (BEES), CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Sustainable Energy Research Laboratory (SERL), Indian Institute of Technology Delhi

Contributors: Butti, S. K., Velvizhi, G., Sulonen, M. L. K., Haavisto, J. M., Oguz Koroglu, E., Yusuf Cetinkaya, A., Singh, S., Arya, D., Annie Modestra, J., Vamsi Krishna, K., Verma, A., Ozkaya, B., Lakaniemi, A., Puhakka, J. A., Venkata Mohan, S.

Pages: 462-476

Publication date: Jan 2016

Peer-reviewed: Yes

Publication information

Journal: Renewable and Sustainable Energy Reviews

Volume: 53

ISSN (Print): 1364-0321

Ratings:

Scopus rating (2016): CiteScore 9.52 SJR 2.998 SNIP 3.526

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Biocatalyst, Bioelectrochemical system, Electrode materials, Fuel cell design, Microbial fuel cell

DOIs:

10.1016/j.rser.2015.08.058

Source: Scopus

Source ID: 84942275042

Research output: Contribution to journal > Review Article > Scientific > peer-review

Influence of temperature-induced copper diffusion on degradation of selective chromium oxy-nitride solar absorber coatings

Temperature-induced copper diffusion process and its influences on optical degradation and long-term stability of solar absorber coatings on copper substrates were investigated at intermediate temperatures of 248-500. °C. The studied absorbers were sputtered chromium oxy-nitride absorbers having tin oxide anti-reflection coatings. The absorbers were aged by means of thermal accelerated ageing studies and short-period heat treatments up to 500. °C for two hours. Ageing mechanisms and degradation of the absorbers were analysed before and after the ageing studies by optical measurements (solar absorptance with a UV/Vis/NIR spectrophotometer and thermal emittance by FTIR spectrophotometry), microstructural analysis using a field-emission scanning electron microscope (FESEM) equipped with an energy dispersive X-ray spectrometer (EDS) and a transmission electron microscope (TEM) with an EDS, composition by time-of-flight elastic recoil detection analysis (TOF-ERDA) and an X-ray photoelectron spectroscopy (XPS), and adhesion by tensile test. The relation between optical degradation and diffusion mechanisms was studied using optical modelling and simulation. The results clearly revealed the mechanism of outward copper diffusion: diffusion of copper substrate atoms into the coating and through the coating to the surface, formation of copper oxide islands on the surface of the coating, and formation of voids in the substrate surface. The relation between the diffusion mechanisms and increase in thermal emittance of the absorber surface was demonstrated.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Surface Engineering, Research group: Materials Characterization, University of Helsinki

Contributors: Kotilainen, M., Honkanen, M., Mizohata, K., Vuoristo, P.

Number of pages: 10
Pages: 323-332
Publication date: 2016
Peer-reviewed: Yes

Publication information

Journal: Solar Energy Materials and Solar Cells
Volume: 145
ISSN (Print): 0927-0248
Ratings:

Scopus rating (2016): CiteScore 4.97 SJR 1.599 SNIP 1.697

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films

Keywords: Coating, Copper, Diffusion mechanisms, Solar absorber, Thermal diffusion, Void growth
DOIs:

10.1016/j.solmat.2015.10.034

Source: Scopus

Source ID: 84949090386

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

Metabolic engineering of *Acinetobacter baylyi* ADP1 for removal of *Clostridium butyricum* growth inhibitors produced from lignocellulosic hydrolysates

Background: Pretreatment of lignocellulosic biomass can produce inhibitory compounds that are harmful for microorganisms used in the production of biofuels and other chemicals from lignocellulosic sugars. Selective inhibitor removal can be achieved with biotransformation where microorganisms catabolize the inhibitors without consuming the sugars. We engineered the strictly aerobic *Acinetobacter baylyi* ADP1 for detoxification of lignocellulosic hydrolysates by removing the gene for glucose dehydrogenase, *gcd*, which catalyzes the first step in its glucose catabolism. Results: The engineered *A. baylyi* ADP1 strain was shown to be incapable of consuming the main sugar components of lignocellulosic hydrolysates, i.e., glucose, xylose, and arabinose, but rapidly utilized acetate and formate. Formate was consumed during growth on acetate and by stationary phase cells, and this was enhanced in the presence of a common aromatic inhibitor of lignocellulosic hydrolysates, 4-hydroxybenzoate. The engineered strain tolerated glucose well up to 70 g/l, and the consumption of glucose, xylose, or arabinose was not observed in prolonged cultivations. The engineered strain was applied in removal of oxygen, a gaseous inhibitor of anaerobic fermentations. Co-cultivation with the *A. baylyi* ADP1 *gcd* knockout strain under initially aerobic conditions allowed the strictly anaerobic *Clostridium butyricum* to grow and produce hydrogen (H_2) from sugars of the enzymatic rice straw hydrolysate. Conclusions: We demonstrated that the model organism of bacterial genetics and metabolism, *A. baylyi* ADP1, could be engineered to be an efficient biotransformation strain of lignocellulosic hydrolysates. Only one gene knockout was required to completely eliminate sugar consumption and the strain could be used in production of anaerobic conditions for the strictly anaerobic hydrogen producer, *C. butyricum*. Because of these encouraging results, we believe that *A. baylyi* ADP1 is a promising candidate for the detoxification of lignocellulosic hydrolysates for bioprocesses.

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), Rhodes University

Contributors: Kannisto, M. S., Mangayil, R. K., Shrivastava-Bhattacharya, A., Pletschke, B. I., Karp, M. T., Santala, V. P.

Publication date: 1 Dec 2015

Peer-reviewed: Yes

Publication information

Journal: Biotechnology for Biofuels

Volume: 8

Issue number: 1

Article number: 198

ISSN (Print): 1754-6834

Ratings:

Scopus rating (2015): CiteScore 6.79 SJR 2.487 SNIP 1.957

Original language: English

ASJC Scopus subject areas: Energy(all), Management, Monitoring, Policy and Law, Biotechnology, Applied Microbiology and Biotechnology, Renewable Energy, Sustainability and the Environment

Keywords: *Acinetobacter baylyi*, Biotransformation, Biohydrogen, *Clostridium butyricum*, Metabolic engineering, Rice straw hydrolysate

DOIs:

10.1186/s13068-015-0389-6

Source: Scopus

Source ID: 84956930091

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

Single-source multibattery solar charger: Case study and implementation issues

In this paper, design process and functionality of a portable single-panel dual-battery solar charger prototype are presented, achieving energy density of 571Whkg^{-1} during a typical 3-day infantry mission. The device may instantaneously charge up to two Li-ion MR-2791 batteries, supporting plug-and-play operation. The system consists of a lightweight custom solar panel, based on 20% efficient monocrystalline photovoltaics, and an intelligent power processing module. The panel contains eight transparent polymer-encapsulated and camouflaged series-connected six solar cell packs with antiparallel diodes, allowing partial shading operation. The power processing module consists of two synchronous current-mode-controlled buck converters, digital signal processor, and a microcontroller, supporting both maximum power point tracking of the solar panel with partial shading detection and multimode charging of Li-ion packs while instantaneously communicating with the batteries. Power management algorithmic design is presented, based on ensuring system stability while supporting the required operation modes. System implementation stages and underlying issues are thoroughly discussed, and utilized hardware components are presented in detail. Experimental results of system testing under real outdoor conditions are presented to demonstrate the device functionality and energy yield capabilities.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES), Hybrid Energy Sources Laboratory

Contributors: Gadelovits, S., Sitbon, M., Suntio, T., Kuperman, A.

Number of pages: 13

Pages: 1916-1928

Publication date: 25 Nov 2015

Peer-reviewed: Yes

Publication information

Journal: Progress in Photovoltaics: Research and Applications

Volume: 23

Issue number: 12

ISSN (Print): 1062-7995

Ratings:

Scopus rating (2015): CiteScore 7.31 SJR 2.724 SNIP 3.396

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Condensed Matter Physics

Keywords: Energy density, Li-ion battery, Partial shading, Portable system, Solar charger

DOIs:

10.1002/pip.2591

URLs:

<http://www.scopus.com/inward/record.url?scp=84922287176&partnerID=8YFLogxK> (Link to publication in Scopus)

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

Synthesis and study of electrochemical and optical properties of substituted perylenemonoimides in solutions and on solid surfaces

A new and efficient methodology towards the synthesis of 7-pyrrolidinyl and 7,12-bispyrrolidinyl perylenemonoimide monoanhydrides (PMI monoanhydrides) and their corresponding dicarboxylic acids is devised. The high yields (70-96%) and facile synthesis of PMI monoanhydrides, as compared to traditional methodologies, make the method attractive and versatile. The reported 7,12-bispyrrolidinyl PMI monoanhydrides are a new family of peryleneimides, where both the bay-substituents are located towards the anhydride cycle. The electrochemical and optical properties of target molecules and their precursors were investigated using UV-Vis spectroscopy and differential pulse voltammetry. Atomic charges and electronic properties were calculated using density functional theory (DFT). In addition, self-assembling monolayers of the PMI monoanhydrides and their corresponding diacids were successfully formed over ZnO and TiO₂ films. The results of the current study indicate that these molecules are potentially good candidates for various applications in the fields of organic electronics and solar cells.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics
Contributors: Ahmed, Z., George, L., Hiltunen, A., Lemmetyinen, H., Hukka, T., Efimov, A.
Number of pages: 8
Pages: 13332-13339
Publication date: 7 Jul 2015
Peer-reviewed: Yes

Publication information

Journal: Journal of Materials Chemistry A
Volume: 3
Issue number: 25
ISSN (Print): 2050-7488
Ratings:
Scopus rating (2015): CiteScore 8.36 SJR 2.62 SNIP 1.63
Original language: English
ASJC Scopus subject areas: Chemistry(all), Renewable Energy, Sustainability and the Environment, Materials Science(all)
DOIs:
10.1039/c5ta02241j
URLs:
<http://www.scopus.com/inward/record.url?scp=84934958229&partnerID=8YFLogxK> (Link to publication in Scopus)
Source: Scopus
Source ID: 84934958229
Research output: Contribution to journal › Article › Scientific › peer-review

Improved adaptive input voltage control of a solar array interfacing current mode controlled boost power stage

Nonlinear characteristics of photovoltaic generators were recently shown to significantly influence the dynamics of interfacing power stages. Moreover, since the dynamic resistance of photovoltaic generators is both operating point and environmental variables dependent, the combined dynamics exhibits these dependencies as well, burdening control challenge. Typically, linear time invariant input voltage loop controllers (e.g. Proportional-Integrative-Derivative) are utilized in photovoltaic applications, designed according to nominal operating conditions. Nevertheless, since actual dynamics is seldom nominal, closed loop performance of such systems varies as well. In this paper, adaptive control method is proposed, allowing to estimate photovoltaic generator resistance online and utilize it to modify the controller parameters such that closed loop performance remains nominal throughout the whole operation range. Unlike previously proposed method, utilizing double-grid-frequency component for estimation purposes and suffering from various drawbacks such as operation point dependence and applicability to single-phase grid connected systems only, the proposed method is based on harmonic current injection and is independent on operating point and system topology.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES), Dept. of Electrical Engineering and Electronics, Ariel University
Contributors: Sitbon, M., Schacham, S., Suntio, T., Kuperman, A.
Number of pages: 7
Pages: 369-375
Publication date: 1 Jul 2015
Peer-reviewed: Yes

Publication information

Journal: Energy Conversion and Management
Volume: 98
ISSN (Print): 0196-8904
Ratings:
Scopus rating (2015): CiteScore 5.24 SJR 2.023 SNIP 2.057
Original language: English
ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology, Nuclear Energy and Engineering, Renewable Energy, Sustainability and the Environment
Keywords: Adaptive control, Dynamic resistance, Photovoltaic generators
DOIs:
10.1016/j.enconman.2015.03.100
Source: Scopus
Source ID: 84927949172
Research output: Contribution to journal › Article › Scientific › peer-review

Characteristics and agronomic usability of digestates from laboratory digesters treating food waste and autoclaved food waste

Digestate characteristics such as organic and nutrient content, hygienic quality and stability are valuable measures when evaluating the use of food waste (FW) digestate as organic fertiliser. This study compared the characteristics of FW and autoclaved (160 °C, 6.2 bar) FW and their digestates from laboratory-scale reactors. Decreased ammonification and low ammonium nitrogen content were observed in the digestate from an autoclaved FW reactor due to autoclave treatment of FW, which affected the nitrogen-containing molecules by formation of Maillard compounds. The methane potential of autoclaved FW and its digestate was decreased by 40% due to reduced microbial activity as microbes were not able to adapt to the conditions within a reactor fed with autoclaved FW. Both studied materials were suitable for agricultural use in terms of their nutrient content, hygienic quality and stability, and thus the decrease in ammonium nitrogen in digestate from an autoclaved FW reactor supported the use of digestate as soil amendment rather than fertiliser.

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), Natural Resources Institute Finland (Luke)

Contributors: Tampio, E., Ervasti, S., Rintala, J.

Number of pages: 7

Pages: 86-92

Publication date: 1 May 2015

Peer-reviewed: Yes

Publication information

Journal: Journal of Cleaner Production

Volume: 94

ISSN (Print): 0959-6526

Ratings:

Scopus rating (2015): CiteScore 5.57 SJR 1.635 SNIP 2.373

Original language: English

ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Renewable Energy, Sustainability and the Environment, Environmental Science(all), Strategy and Management

Keywords: Ammonium nitrogen, Autoclave treatment, Characterisation, Digestate, Fertiliser, Food waste

DOIs:

10.1016/j.jclepro.2015.01.086

URLs:

<http://www.scopus.com/inward/record.url?scp=84928768890&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

EXT="Tampio, Elina"

Source: Scopus

Source ID: 84928768890

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

Engineered nanomaterials reduce but do not resolve life cycle environmental impacts of power capacitors

Abstract Engineered nanomaterials are used to improve the properties of products. Often this results in size reduction or increased functionality, which may result in reduced environmental impacts. At the same time the manufacturing and disposal of the nanomaterials increases the life cycle impacts of the product. In this study the effects of using nano-silica polymers in power capacitors were investigated through life cycle assessment (LCA). The analysis was based on existing production technology which was modified to represent a prototype using nanomaterials. Based on the results, the nanomaterials would reduce impacts by c.a. 20% in the most relevant environmental life cycle impact categories. The main impact categories of the power capacitors were in metal depletion, land transformation and ecotoxicity. Although the nanomaterial based capacitor had slightly lower impacts, it did not resolve the main problems in these categories. Contribution analysis revealed that most of the impact is caused by only a few processes in the life cycle, especially raw materials supply for tin solders and waste treatment of insulating oil. Ecodesign alternatives for targeting the identified environmental hotspots are discussed.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electrical Engineering, Tampere University of Technology, Finnish Environment Institute

Contributors: Alaviitala, T., Mattila, T. J.

Number of pages: 7

Pages: 347-353
Publication date: 15 Apr 2015
Peer-reviewed: Yes

Publication information

Journal: Journal of Cleaner Production

Volume: 93

ISSN (Print): 0959-6526

Ratings:

Scopus rating (2015): CiteScore 5.57 SJR 1.635 SNIP 2.373

Original language: English

ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Renewable Energy, Sustainability and the Environment, Environmental Science(all), Strategy and Management

Keywords: Ecodesign, Electronics, Life cycle assessment, Nanotechnology, Power capacitors

DOIs:

10.1016/j.jclepro.2015.01.036

Bibliographical note

INT=dee,"Alaviitala, Tiina"

Source: Scopus

Source ID: 84926155646

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

Fermentative metabolism of an anaerobic, thermophilic consortium on plant polymers and commercial paper samples

The purpose of the study was to examine the feasibility and capacity of a thermophilic microbial consortium to produce fermentative metabolites from plant polymers. The consortium comprised of cellulolytic anaerobes that were originally enriched from a compost pile using cellulose as the substrate. Fermentative metabolism was examined with monosaccharides, disaccharides, hemicellulose, starch, pectin, chitin, and eight commercial paper samples without further enrichment of the culture to each specific substrate. In general, H₂, CH₄, CO₂, and organic acids were the main metabolites on all substrates but the metabolite profiles varied with the substrate. Similar H₂ yields of 2-3 mol mol⁻¹ substrate at 48h were obtained with all monosaccharides and disaccharides. The CO₂ yields were higher with disaccharides than with monosaccharides, 4.5 vs 2 mol mol⁻¹ substrate. Metabolite yields were relatively low with glyceraldehyde, glycerol, and arabinose. Paper samples containing high amounts of chemical pulp produced the highest metabolite yields, and biodegradation accounted for ≤74% of total dry weight loss. The fermentative metabolism of the paper samples varied with the pulp composition and the amount of inorganic material. Bacterial community analysis using pyrosequencing analysis of 16S rRNA gene showed a predominance of members of the order Clostridiales, including members of genera Clostridium and Lutispora, which contain known cellulolytic organisms. Most differences among the samples were attributed to small taxonomic groups represented by ≤10% of total sequences.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Department of Animal Science, Ohio State University

Contributors: Carver, S. M., Nelson, M. C., Yu, Z., Tuovinen, O. H.

Number of pages: 12

Pages: 11-22

Publication date: 1 Apr 2015

Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy

Volume: 75

ISSN (Print): 0961-9534

Ratings:

Scopus rating (2015): CiteScore 4.03 SJR 1.51 SNIP 1.587

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: Anaerobic biodegradation, Biohydrogen, Cellulose biodegradation, Fermentation, Plant polymers

DOIs:

10.1016/j.biombioe.2015.02.005

URLs:

<http://www.scopus.com/inward/record.url?scp=84923621284&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84923621284

Improved bioconversion of crude glycerol to hydrogen by statistical optimization of media components

Bioconversion of crude glycerol to hydrogen has gained importance as it addresses both sustainable energy production and waste disposal issues. Until recently, statistical optimizations of crude glycerol bioconversion to hydrogen have been greatly focused on pure strains. In this study, biohydrogen production from crude glycerol by an enriched microbial culture (predominated with *Clostridium* species) was improved by statistical optimization of media components. Plackett-Burman design identified $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ and KCl with negative effect on hydrogen production and selected NH_4Cl , K_2HPO_4 and KH_2PO_4 as significant variables. Box-Behnken design indicated the optimal region beyond design area and studies were continued by ridge analysis. Central composite face centered design envisaged a maximal hydrogen yield of $1.41 \text{ mol-H}_2 / \text{mol-glycerol consumed}$ at concentrations 4.40 g/L and 2.27 g/L for NH_4Cl and KH_2PO_4 respectively. Confirmation experiment with the optimized media (NH_4Cl , 4.40 g/L ; K_2HPO_4 , 1.6 g/L ; KH_2PO_4 , 2.27 g/L ; $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$, 1.0 g/L ; KCl, 1.0 g/L ; Na-acetate $\cdot 3\text{H}_2\text{O}$, 1.0 g/L and tryptone, 2.0 g/L) revealed an excellent correlation between predicted and experimental hydrogen yield. Optimization of media components by design of experiments enhanced hydrogen yield by 29%.

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, Tampere University of Technology, Department of Signal Processing, Urban circular bioeconomy (UrCirBio)

Contributors: Mangayil, R., Aho, T., Karp, M., Santala, V.

Number of pages: 7

Pages: 583-589

Publication date: 1 Mar 2015

Peer-reviewed: Yes

Publication information

Journal: Renewable Energy

Volume: 75

ISSN (Print): 0960-1481

Ratings:

Scopus rating (2015): CiteScore 4.51 SJR 1.767 SNIP 2.071

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Biohydrogen, Crude glycerol, Optimization, Response surface methodology

DOIs:

10.1016/j.renene.2014.10.051

URLs:

<http://www.scopus.com/inward/record.url?scp=84910051633&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

Available online 3 November 2014 : Volume 75, March 2015, Pages 583-589

Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2014-12-12
Publisher name: Pergamon; The World Renewable Energy Network

Source: researchoutputwizard

Source ID: 1020

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

Driving pattern analysis of Nordic region based on National Travel Surveys for electric vehicle integration

Electric vehicles (EVs) show great potential to cope with the intermittency of renewable energy sources (RES) and provide demand side flexibility required by the smart grid. Furthermore, EVs will increase the electricity consumption. Large scale integration of EVs will probably have substantial impacts on power systems. This paper presents a methodology to transform driving behavior of person into one of the cars in order to analyze the driving pattern of EVs based on the National Travel Surveys. In the proposed methodology, a statistical process is used to obtain the driving behavior of cars by grouping the survey respondents according to the driving license number and car number, and mapping the households with similar characteristics. The proposed methodology was used to carry out the driving pattern analysis in the Nordic region. The detailed driving requirements and charging/discharging availability of vehicles along the day were obtained. Two types of EV availabilities were studied in this paper considering different charging/discharging conditions of EVs for the power system integration, i.e. EV availability all day and EV availability at home. The results show that the daily driving requirements of the Nordic region are not very intensive. The driving patterns of vehicles in the Nordic region vary on weekdays and weekends. The two types of EV availabilities are quite different from each other.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES), Danmarks Tekniske Universitet, DTU Informatik, State Grid

Contributors: Liu, Z., Wu, Q., Christensen, L., Rautiainen, A., Xue, Y.

Number of pages: 10

Pages: 180-189

Publication date: 1 Jan 2015

Peer-reviewed: Yes

Publication information

Journal: Journal of Modern Power Systems and Clean Energy

Volume: 3

Issue number: 2

ISSN (Print): 2196-5420

Ratings:

Scopus rating (2015): CiteScore 2.45 SJR 0.898 SNIP 1.412

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Renewable Energy, Sustainability and the Environment

Keywords: Driving pattern, Electric vehicles (EVs), EV availability, Nordic, Power system integration

DOIs:

10.1007/s40565-015-0127-x

URLs:

<http://www.scopus.com/inward/record.url?scp=84945363932&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84945363932

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

Interfacing renewable energy sources for maximum power transfer-Part II: Dynamics

The manuscript reveals combined source-converter-load dynamics of interfacing renewable energy generators by means of terminal voltage control, aimed to track a Maximum Power Line. Control-to-input voltage transfer functions are calculated for three basic DC-DC converters based power electronic interfaces operating in both current and voltage control modes; respective stability assessment is performed as well for each arrangement. In order to generalize the derived dynamics, it is shown that photovoltaic and wind generators may be represented by similar electrical equivalent circuits, possessing comparable small-signal dynamics. It is exposed that dynamic impedance of renewable energy generators is both operating point and environmental conditions dependent and hence plays a crucial role in the combined source-converter-load dynamics from affecting system damping to causing open-loop instability in particular arrangements. Consequently, special care must be taken when designing power electronic interface intended to operate as a renewable energy generator power processor while at the same time the controller must be robust enough to ensure system stability for all expected environmental conditions. In addition, in case fixed closed-loop behavior is required through the whole operating range of the system, some kind of adaptive mechanism is required to estimate the dynamic impedance online. Several particular case examples of the proposed method presented in the literature are reviewed.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research area: Power engineering, Department of Electrical Engineering, Smart Energy Systems (SES), Ariel University Center of Samaria

Contributors: Kolesnik, S., Sitbon, M., Gadelovits, S., Suntio, T., Kuperman, A.

Number of pages: 13

Pages: 1771-1783

Publication date: 2015

Peer-reviewed: Yes

Publication information

Journal: Renewable and Sustainable Energy Reviews

Volume: 51

ISSN (Print): 1364-0321

Ratings:

Scopus rating (2015): CiteScore 8.35 SJR 2.921 SNIP 3.35

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Dynamics, Power processing, Renewable energy, Stability

DOIs:

10.1016/j.rser.2015.04.043

URLs:

<http://www.scopus.com/inward/record.url?scp=84928180032&partnerID=8YFLogxK> (Link to publication in Scopus)

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

Composition dependent growth dynamics in molecular beam epitaxy of GaInNAs solar cells

We have investigated the role of the nitrogen content, the growth parameters, and the annealing processes involved in molecular beam epitaxy of GaInNAs solar cells lattice-matched to GaAs. The nitrogen composition was varied between 1% and 5%. The influence of the growth temperature was assessed by performing photoluminescence, atomic force microscopy, X-ray diffraction, reflection high-energy electron diffraction, quantum efficiency and light-biased current-voltage measurements. The growth temperature ensuring the best cell parameters was found to be 440 C. At this temperature we were able to incorporate up to 4% of nitrogen and achieve a good material quality. Further increase of the N composition to 5% led to phase separation. For the lattice matched samples grown within the optimal temperature range, we have identified a clear (1×3) surface reconstruction. Using the optimized growth we have demonstrated a GaInNAs p-i-n solar cell structure containing 4% nitrogen, that exhibited a short-circuit current density as high as 33.8 mA/cm² in respect to effective area illuminated. These measurements have been performed under real sun AM1.5 (~1000 W/m²) illumination. © 2014 Elsevier B.V.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Frontier Photonics, Department of Physics and Astronomy, University of Turku, Turun Yliopisto/Turun Biomateriaalikeskus

Contributors: Aho, A., Polojärvi, V., Korpjärvi, V. M., Salmi, J., Tukiainen, A., Laukkanen, P., Guina, M.

Number of pages: 9

Pages: 150-158

Publication date: May 2014

Peer-reviewed: Yes

Publication information

Journal: Solar Energy Materials and Solar Cells

Volume: 124

ISSN (Print): 0927-0248

Ratings:

Scopus rating (2014): CiteScore 5.87 SJR 2.19 SNIP 2.357

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films

Keywords: Concentrated photovoltaics, Dilute nitrides, GaInNAs, Multi-junction solar cells, Plasma-assisted molecular beam epitaxy

DOIs:

10.1016/j.solmat.2014.01.044

URLs:

<http://www.scopus.com/inward/record.url?scp=84894584078&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

Contribution: organisation=orc,FACT1=1
Portfolio EDEND: 2014-04-29
Publisher name: Elsevier

Source: researchoutputwizard

Source ID: 58

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

Inhibitory effects of substrate and soluble end products on biohydrogen production of the alkalithermophile *Caloramator celer*: Kinetic, metabolic and transcription analyses

In this study the tolerance of the alkalithermophile *Caloramator celer* towards substrate (glucose) and soluble end product (acetate, formate and ethanol) inhibition was assessed employing nonlinear inhibition models. In addition, the effects of subinhibitory concentrations of end products on fermentative metabolism and regulation of 12 key genes involved in pyruvate catabolism were studied. Optimal growth and H₂ production were found at 50 mM of glucose and the critical substrate concentration was observed at 290-360 mM. Two inhibition models revealed that ethanol had a higher inhibitory effect on growth rate, whereas H₂ production kinetics was more sensitive towards increasing concentrations of acetate and formate. Acetate, the main soluble metabolite of the fermentation, inhibited the H₂ production by increasing the ionic strength in the medium. Subinhibitory concentrations of soluble end products induced changes in the metabolite profile of *C. celer*, specifically exogenous acetate (80 mM) and ethanol (40 mM) slightly increased the H₂ yield by 4 and 7%, respectively. However, despite the observed metabolic shifts, gene regulation was minimal and not always in agreement with the measured product yields. Overall, the results suggest that further optimization of the H₂ production process from

C. celer should focus on methods to evolve adapted osmotolerant strains and/or remove soluble metabolites, especially acetate, from the culture. Copyright © 2014, Hydrogen Energy Publications, LLC. Published by Elsevier Ltd. All rights reserved.

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)

Contributors: Ciranna, A., Ferrari, R., Santala, V., Karp, M.

Number of pages: 11

Pages: 6391-6401

Publication date: 15 Apr 2014

Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 39

Issue number: 12

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2014): CiteScore 3.54 SJR 1.207 SNIP 1.484

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology

Keywords: Acetate, Dark fermentation, End product inhibition, Gene expression, Kinetic model, Substrate inhibition

DOIs:

10.1016/j.ijhydene.2014.02.047

URLs:

<http://www.scopus.com/inward/record.url?scp=84897389272&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2014-04-29
Publisher name: Elsevier Ltd; International Association for Hydrogen Energy

Source: researchoutputwizard

Source ID: 235

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

Design driven world of cellulose-from bulk to luxury?

Tekes-the Finnish Funding Agency for Innovation has granted funding 4,5 million funding for a project targeting on new approaches for use of wood-based cellulose. Project "Design Driven Value Chains in The World of Cellulose" (DWoC) launched by VTT Technical Research Centre of Finland, Aalto University and Tampere University of Technology integrates design and design processes into the strategic development of businesses operating in the field. The aim is to create a business ecosystem to serve both existing industry and a new, growing cellulose-based industry, and to brand Finland as a producer of refined, cellulose-based products. This manuscript summarises the future visions and background aspects and facts that have led to the initiation of the project. The presentation based on the manuscript also presents some of the first demonstrator processes and products developed during the first operational year of the project. These demonstrators include: Fibre yarn process that produces yarn from cellulose pulp fibres without traditional spinning process using novel wet extrusion technique (figure on right). Foam forming method for manufacturing well-formed foamed structures for new product applications 3D-printing technology enabling customisable on demand production of fibre structures and components using modified cellulosic raw materials.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland, Aalto University

Contributors: Qvintus, P., Kataja, K., Heikkilä, P., Salmela, J., Lehmonen, J., Ketoja, J., Hänninen, T., Harlin, A., Härkäsalmi, T., Vuorinen, J., Vuorinen, T.

Number of pages: 8

Pages: 67-74

Publication date: 2014

Host publication information

Title of host publication: Fibre Value Chain Conference and Expo 2014: Pulp and Paper Bioenergy Bioproducts

Publisher: Appita Inc.

ISBN (Print): 9780987168443

ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Energy Engineering and Power Technology, Renewable Energy, Sustainability and the Environment

Keywords: Cellulose, Design, Design driven research, Ecodesign, New business, New cellulose technologies

URLs:

<http://www.scopus.com/inward/record.url?scp=84923271599&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

EXT="Harlin, Ali"

EXT="Heikkilä, Pirjo"

Source: Scopus

Source ID: 84923271599

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Nanocellulose aerogel membranes for optimal electrolyte filling in dye solar cells

A new method for depositing electrolyte in dye solar cells (DSCs) is introduced: a nanocellulose hydrogel membrane is screen printed on the counter electrode and further freeze-dried to form a highly porous nanocellulose aerogel, which acts as an absorbing sponge for the liquid electrolyte. When the nanoporous dye-sensitized TiO₂ photoelectrode film is pressed against the wetted aerogel, it becomes filled with the electrolyte. The electrolyte flows inside the TiO₂ film only about ten micrometers (i.e. the TiO₂ film thickness) whereas in the conventional filling method, where the electrolyte is pumped through the cell, it flows about 1000-times longer distance, which is known to cause uneven distribution of the electrolyte components due to a molecular filtering effect. Furthermore, with the new method there is no need for electrolyte filling holes which simplifies significantly the sealing of the cells and eliminates one common pathway for leakage. Photovoltaic analysis showed that addition of the nanocellulose aerogel membrane did not have a statistically significant effect on cell efficiency, diffusion in the electrolyte or charge transfer at the counter electrode. There was, however, a clear difference in the short circuit current density and open circuit voltage between the cells filled with the aerogel method and in the reference cells filled with the conventional method, which appeared to be caused by the differences in the electrolyte filling instead of the nanocellulose itself. Moreover, accelerated aging tests at 1 Sun 40°C for 1000h showed that the nanocellulose cells were as stable as the conventional DSCs. The nanocellulose aerogel membranes thus appear inert with respect to both performance and stability of the cells, which is an important criterion for any electrolyte solidifying filler material.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Aalto University, COMP Centre of Excellence, Department of Applied Physics, Aalto University, Département de Chimie, VTT Technical Research Centre of Finland

Contributors: Miettunen, K., Vapaavuori, J., Tiihonen, A., Poskela, A., Lahtinen, P., Halme, J., Lund, P.

Number of pages: 8

Pages: 95-102

Publication date: 2014

Peer-reviewed: Yes

Publication information

Journal: NANO ENERGY

Volume: 8

ISSN (Print): 2211-2855

Ratings:

Scopus rating (2014): CiteScore 9.74 SJR 3.558 SNIP 2.323

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Materials Science(all), Electrical and Electronic Engineering

Keywords: Dye-sensitized solar cell, Gel electrolyte, Nanocellulose, Semi-solid electrolyte, Spatial distribution

DOIs:

10.1016/j.nanoen.2014.05.013

URLs:

<http://www.scopus.com/inward/record.url?scp=84902988799&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84902988799

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

Scanner abdominal: Étude comparative de l'exposition patient en routine clinique sur des appareils avec et sans reconstruction itérative

Objective: compare the dose delivered to patients and image quality in clinical routine to perform an abdominal CT scan with no iterative reconstruction techniques (IR) relative to an examination conducted on a scanner with IR. Materials and methods: this is a retrospective study of 30 patients who underwent two abdominal examinations: one on a 40-slice scanner (TDM40) without IR and another one on a 256-slice scanner with IR (TDM256). The patients, on medical follow-up for a chronic abdominal disease, had an exam on each scanner using the same protocol comprising an abdominopelvic time portal phase. The length of acquisition, the effective dose and the dose length product (DLP) as well as quantitative and qualitative assessments of the image were compared. Results: the average effective dose per examination was 17.3 mSv with the TDM40 (PDL: 1019 mGy.cm) against 11.1 mSv with the TDM256 (PDL: 654 mGy.cm), hence a reduction of 35.8% ($p < 0.001$). The length of acquisition and quantification were comparable in both groups. The qualitative assessment was slightly higher on the TDM40 but no examination was considered suboptimal. Conclusion: using a scanner equipped with IR significantly reduces the effective dose while maintaining image quality.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Lille University Hospital - CHRU, Univ Lille Nord de France

Contributors: Gomes, M., Leroy, C., Lemaire, S., Marmin, C., Mordon, S., Ernst, O.

Number of pages: 7

Pages: 35-41

Publication date: 2014

Peer-reviewed: Yes

Publication information

Journal: Radioprotection

Volume: 49

Issue number: 1

ISSN (Print): 0033-8451

Ratings:

Scopus rating (2014): CiteScore 0.3 SJR 0.231 SNIP 0.332

Original language: French

ASJC Scopus subject areas: Nuclear Energy and Engineering, Renewable Energy, Sustainability and the Environment, Public Health, Environmental and Occupational Health, Waste Management and Disposal, Health, Toxicology and Mutagenesis, Safety, Risk, Reliability and Quality

Keywords: As low as reasonably achievable (ALARA), Computed tomography, Low doses, Patient dose, Radiation dose DOIs:

10.1051/radiopro/2013078

URLs:

<http://www.scopus.com/inward/record.url?scp=84905261404&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84905261404

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

Software design for simulating microbial bioprocesses in bioreactor

UML based software design use is presented to implement a simulation environment. Simulation environment will be a software application which will provide a playground for researchers to simulate bioreactor experiments involving microbial species and predict the products of the experiment. Four subsystems namely: Feed system, Bioreactor system, Microbial system and Products system were identified and are presented as four major classes. The implementation of the system is left open at this stage and simulation environment can be implemented using object oriented programming languages like C++, JAVA and platforms like MATLAB (Simulink).

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Chemistry and Bioengineering, President, Research group: Industrial Bioengineering and Applied Organic Chemistry, Department of Signal Processing, Research area: Information Technology for Biology and Health, Research area: Intelligence in Machines, Research group: MMDM, Research area: Signal and Information Processing, Prostate cancer research center (PCRC), Urban circular bioeconomy (UrCirBio), Tampere University of Technology, Institute of Signal Processing

Contributors: Nikhil, Puhakka, J. A., Visa, A., Yli-Harja, O.

Publication date: 2014

Host publication information

Title of host publication: 6th International Conference on Environmental Informatics, ISEIS 2007

Publisher: International Society for Environmental Information Sciences

Article number: 60700018

ASJC Scopus subject areas: Environmental Engineering, Renewable Energy, Sustainability and the Environment, Management, Monitoring, Policy and Law, Water Science and Technology

Keywords: Bioreactor, Microbial bioprocess, Simulation environment, Software design, UML

URLs:

<http://www.scopus.com/inward/record.url?scp=84915751131&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84915751131

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Non-sterile process for biohydrogen and 1,3-propanediol production from raw glycerol

Raw glycerol is a tempting substrate for fermentations, but contains impurities that can be inhibitory for organisms. In this study, raw glycerol tolerance and contamination risk of pure bacterial culture at hypersaline process conditions were evaluated. The inhibitory effect of raw glycerol was similar to a halophilic (*Halanaerobium saccharolyticum*) and a non-halophilic (*Clostridium butyricum*) bacterium implying the inhibition originating from methanol or other impurities rather than salt. The hypersaline process conditions decreased efficiently contaminations and no growth of contaminants was observed at and above 125 g/l NaCl. Halophilic H₂ and 1,3-PD production from raw glycerol were studied separately as 1-stage processes and jointly as 2-stage process in non-sterile conditions. Non-sterile conditions were successfully applied and the highest production yields obtained were 3.0 mol H₂/mol glycerol and 0.66 mol 1,3-PD/mol glycerol (1-stage processes), whereas the highest cumulative production was 74 mmol H₂/l culture and 31 mmol 1,3-PD/l culture (2-stage process). © 2013, Hydrogen Energy Publications, LLC. Published by Elsevier Ltd. All rights reserved.

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, Tampere University of Technology, Urban circular bioeconomy (UrCirBio)

Contributors: Kivistö, A., Santala, V., Karp, M.

Number of pages: 7

Pages: 11749-11755

Publication date: 10 Sep 2013

Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 38

Issue number: 27

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2013): CiteScore 3.38 SJR 1.265 SNIP 1.442

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology

Keywords: Biodiesel by-product, Clostridium, Contamination risk, Halanaerobium, Halophilic fermentation, Raw glycerol tolerance

DOIs:

10.1016/j.ijhydene.2013.06.119

URLs:

<http://www.scopus.com/inward/record.url?scp=84882722439&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2013-09-29
Publisher name: Elsevier Ltd

Source: researchoutputwizard

Source ID: 2576

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

Prospecting hydrogen production of Escherichia coli by metabolic network modeling

Genome-scale model was applied to analyze the anaerobic metabolism of *Escherichia coli*. Three different methods were used to find deletions affecting fermentative hydrogen production: flux balance analysis (FBA), algorithm for blocking competing pathways (ABCP), and manual selection. Based on these methods, 81 *E. coli* mutants possessing one gene deletion were selected and cultivated in batch experiments. Experimental results of H₂ and biomass production were compared against the results of FBA. Several gene deletions enhancing H₂ production were found. Correctness of gene essentiality predictions of FBA for the selected genes was 78% and 77% in glucose and galactose media, respectively. 33% of the mutations that were predicted by FBA to increase H₂ production had a positive effect in experiments. Batch cultivation is a simple and straightforward experimental way to screen improvements in H₂ production. However, the ability of FBA to predict the H₂ production rate cannot be evaluated by batch experiments. Metabolic network models provide a

method for gaining broader understanding of the complicated metabolic system of a cell and can aid in prospecting suitable gene deletions for enhancing H₂ production. © 2013, Hydrogen Energy Publications, LLC. Published by Elsevier Ltd. All rights.

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, Tampere University of Technology, Department of Signal Processing, Prostate cancer research center (PCRC), Urban circular bioeconomy (UrCirBio), Aalto University

Contributors: Seppälä, J. J., Larjo, A., Aho, T., Yli-Harja, O., Karp, M. T., Santala, V.

Number of pages: 10

Pages: 11780-11789

Publication date: 10 Sep 2013

Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 38

Issue number: 27

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2013): CiteScore 3.38 SJR 1.265 SNIP 1.442

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology

Keywords: Escherichia coli, Flux balance analysis, Hydrogen production, Metabolic engineering, Metabolic network modeling

DOIs:

10.1016/j.ijhydene.2013.07.002

URLs:

<http://www.scopus.com/inward/record.url?scp=84882724445&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

Contribution: organisation=keb,FACT1=0.5
Contribution: organisation=sgn,FACT2=0.5
Portfolio EDEND: 2013-09-29
Publisher name: Elsevier Ltd

Source: researchoutputwizard

Source ID: 3397

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

Renewable vs. traditional energy management solutions - A Finnish hospital facility case

This article discusses the current price situation in the Finnish energy market. The aim of the study was to calculate the life-cycle costs (LCC) of 12 energy management systems and compare the prices. Surprisingly, the most polluting and commonly used solution, combination of district heating and grid electricity, was also the most expensive solution. The main reason for this is the increase in energy prices in Finland in the twenty-first century. According to the calculations, when considering a facility the size of the Espoo Hospital, the most affordable solutions were biogas energy, wood chip heating and ground source heating. The differences were relatively small between all solutions other than biogas. Biogas energy is by far the most affordable solution. However, it is only suitable for large-scale projects and some uncertainty risk has to be added because the system is not yet commonly used. Regarding the other unorthodox systems, solar electricity was the most expensive method; similar to the situation with snow storage cooling, which needs to entail certain societal benefits for it to be cost-effective. A sensitivity analysis was also conducted using four variations; however, significant differences to the original calculations were not discovered.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto University

Contributors: Kantola, M., Saari, A.

Number of pages: 7

Pages: 539-545

Publication date: Sep 2013

Peer-reviewed: Yes

Publication information

Journal: Renewable Energy

Volume: 57
ISSN (Print): 0960-1481
Ratings:

Scopus rating (2013): CiteScore 4.63 SJR 1.989 SNIP 2.699

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Economical comparison, Energy management, Life-cycle cost, Renewable energy

DOIs:

10.1016/j.renene.2013.02.023

URLs:

<http://www.scopus.com/inward/record.url?scp=84875293452&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84875293452

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

Attitude-behaviour gap in energy issues: Case study of three different Finnish residential areas

To mitigate climate change technical advances must be accompanied by greater ecological commitment from consumers, i.e. households. This study aims to determine whether there are differences in energy attitudes and energy behaviour between residents living in three different types of residential districts. To gain an understanding of attitudes, the study investigated the participants' concerns about climate change, their position on energy issues and their perceptions of their own energy behaviour. To gain an understanding of actual energy behaviour the study investigated the participants' carbon footprints. The results indicate that there is a gap between people's energy attitudes and their actual energy behaviour. There seems to be a discernible 'ecologisation', a greening of attitudes, in Finnish society, but actual energy behaviour is changing more slowly. People know how to reduce their energy use but are e.g. too comfort-loving or indifferent to make any changes to their energy use. Due to the attitudes are not becoming more environment friendly and no environmental action is happening. Regarding further research this gap need to be investigated specifically and filled because it could otherwise prove a significant stumbling block to achieving the desired rate of progress towards the country's environmental goals.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto University, School of Engineering, Aalto University

Contributors: Valkila, N., Saari, A.

Number of pages: 11

Pages: 24-34

Publication date: Feb 2013

Peer-reviewed: Yes

Publication information

Journal: ENERGY FOR SUSTAINABLE DEVELOPMENT

Volume: 17

Issue number: 1

ISSN (Print): 0973-0826

Ratings:

Scopus rating (2013): CiteScore 3.32 SJR 1.651 SNIP 2.061

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Geography, Planning and Development, Management, Monitoring, Policy and Law

Keywords: Carbon footprint, Energy attitudes, Energy behaviour, Finland, Greenhouse gas emissions

DOIs:

10.1016/j.esd.2012.10.001

URLs:

<http://www.scopus.com/inward/record.url?scp=84871966946&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84871966946

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

Roll-to-roll atomic layer deposition for flexible substrates

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

Contributors: Lahtinen, K., Maydannik, P., Kääriäinen, T., Seppänen, T., Cameron, D. C., Johansson, P., Kraft, M., Kuusipalo, J.

Number of pages: 14

Pages: 726-739

Publication date: 2013

Host publication information

Title of host publication: TAPPI International Conference on Nanotechnology 2013

Publisher: TAPPI Press

ISBN (Electronic): 9781510815681

ASJC Scopus subject areas: Biomaterials, Biotechnology, Renewable Energy, Sustainability and the Environment

URLs:

<http://www.scopus.com/inward/record.url?scp=84966539214&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84966539214

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Wear resistance of nanoparticle coatings on paperboard

• LFS-deposited TiO₂ and SiO₂ nanoparticles create superhydro-phobic and hydrophilic paper surface, • Abrasive damage of surface structure influences only slightly the wettability of superhydrophobic TiO₂ and hydrophilic SiO₂ coatings, • A more severe abrasive action will remove some of the nanoparticle coating, but the hydrophobic/hydrophilic properties of the surface are maintained, • SiO₂ nanoparticle coated surface is more resistant to abrasion than the TiO₂ coating, which indicates a stronger inter-particle and particle to surface adhesion of the former, • Investigation of nanoparticle loss from the paper surface is challenging, due to the small total mass of nanoparticles in the coating, mixed together with pigment particles and fiber debris removed during abrasion experiment.

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 and Fibre Research Institute (PFI), Paper Converting and Packaging Technology, Division of Chemistry and Chemical Engineering, California Institute of Technology, Aerosol Physics Laboratory

Contributors: Stepien, M., Chinga-Carrasco, G., Saarinen, J. J., Teisala, H., Tuominen, M., Aromaa, M., Haapanen, J., Kuusipalo, J., Mäkelä, J. M., Toivakka, M.

Number of pages: 9

Pages: 821-829

Publication date: 2013

Host publication information

Title of host publication: TAPPI International Conference on Nanotechnology 2013

Publisher: TAPPI Press

ISBN (Electronic): 9781510815681

ASJC Scopus subject areas: Biomaterials, Biotechnology, Renewable Energy, Sustainability and the Environment

URLs:

<http://www.scopus.com/inward/record.url?scp=84966648395&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84966648395

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Methane production from maize in Finland - Screening for different maize varieties and plant parts

The objective of the study was to determine how the harvest time and maize variety (12 varieties) affects the methane yield and dry matter yield per hectare in southern Finland (Piikkiö) and in Central Finland (Laukaa). The specific methane yields and methane yields per hectare were also determined for different plant parts (stem, leaves and cobs). The methane yield per hectare varied from 2130 to 9170 m³ ha⁻¹. The methane yields per hectare were ~50% lower in Laukaa than in Piikkiö due to a shorter growing season and lower total solid (TS) yields. TS yields were on average 16.7 and 15.5 Mg ha⁻¹ in Piikkiö and 8.7 and 6.8 Mg ha⁻¹ in Laukaa in 2007 and 2008, respectively. The specific methane yields varied from 366 to 491 dm³ kg⁻¹ volatile solid (VS) in 2007 and from 296 to 373 dm³ kg⁻¹ VS in 2008. The harvest time and sowing time did not affect the specific methane yields (p > 0.05). Whole maize crops produced more methane in batch assays than stem (372 dm³ kg⁻¹ VS), leaves (334 dm³ kg⁻¹ VS) and cobs (421 dm³ kg⁻¹ VS) alone, and also the specific methane yields per hectare were higher than the methane yield per hectare calculated for the various plant parts. Maize cultivation for biogas production appears to be feasible only in southern Finland. © 2012

Elsevier Ltd.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Tampere University of Technology, Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, MTT Agrifood Research Finland, Plant Production Research Horticulture, University of Jyväskylä, Department of Chemistry and Bioengineering

Contributors: Seppälä, M., Pyykkönen, V., Laine, A., Rintala, J.

Number of pages: 9

Pages: 282-290

Publication date: Nov 2012

Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy

Volume: 46

Issue number: November

ISSN (Print): 0961-9534

Ratings:

Scopus rating (2012): CiteScore 3.66 SJR 1.516 SNIP 1.725

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: Biogas, Biomass, Maize, Methane production, Plant parts

DOIs:

10.1016/j.biombioe.2012.08.016

URLs:

<http://www.scopus.com/inward/record.url?scp=84868502703&partnerID=8YFLogxK> (Link to publication in Scopus)

Bibliographical note

International Conference on Lignocellulosic ethanol
Contribution: organisation=keb bio,FACT1=1

Source: researchoutputwizard

Source ID: 5303

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

Consumer panel on the readiness of finns to behave in a more pro-environmental manner

Due to climate change, there is an urgent need to take measures toward reducing greenhouse gases and energy consumption. It is therefore vital to examine peoples' attitudes and the potential for a more pro-environmental readiness. Consumer panels were used in the gathering of data, even with such small subsamples, statistical significance of difference cannot be assessed. The research subjects participating were randomly selected from two different residential areas and three different age groups. The consumer panels examined the environmental attitudes of the research subjects as well as their readiness to adopt a more pro-environmental lifestyle under four theme headings: Urban structure, household energy consumption, mobility and lifestyle. The results suggest that all the research subjects are very much ready to reduce their consumption, but not quite ready to invest in expensive, but environmentally-friendly equipment. Young and elderly research subjects seemed more prepared to make pro-environmental changes than middle-aged subjects. Place of residence also seemed to have an impact on the adoption threshold: Research subjects living in more densely populated suburbs seemed to be more willing to give up driving, whereas those living in sparsely populated areas seemed to be more willing to invest in expensive, but environmentally-friendly equipment and give up flying for vacations.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto Univ, Aalto University, Sch Engn, Dept Civil & Struct Engr

Contributors: Valkila, N., Saari, A.

Number of pages: 19

Pages: 1561-1579

Publication date: Jul 2012

Peer-reviewed: Yes

Publication information

Journal: Sustainability

Volume: 4

Issue number: 7

ISSN (Print): 2071-1050

Ratings:

Scopus rating (2012): CiteScore 1.18 SJR 0.463 SNIP 0.774

Original language: English

ASJC Scopus subject areas: Management, Monitoring, Policy and Law, Renewable Energy, Sustainability and the Environment, Geography, Planning and Development

Keywords: consumer panel, environmental-friendliness, behavioral readiness, urban structure, sustainable consumption, GREENHOUSE-GAS EMISSIONS, ENERGY

DOIs:

10.3390/su4071561

URLs:

<http://www.scopus.com/inward/record.url?scp=84864474855&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84864474855

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

Publication status: Published

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.

Number of pages: 5

Pages: 209-213

Publication date: Apr 2012

Peer-reviewed: Yes

Publication information

Journal: Journal of Biobased Materials and Bioenergy

Volume: 6

Issue number: 2

ISSN (Print): 1556-6560

Ratings:

Scopus rating (2012): CiteScore 1.24 SJR 0.458 SNIP 0.664

Original language: English

ASJC Scopus subject areas: Biomaterials, Bioengineering, Renewable Energy, Sustainability and the Environment

Keywords: Biodiesel, FAME Production, Lipid Extraction, Nitrogen Starvation, *Stigeoclonium*

DOIs:

10.1166/jbmb.2012.1200

Source: Scopus

Source ID: 84865034973

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

Influence of nutrient deprivations on lipid accumulation in a dominant indigenous microalga *Chlorella* sp., BUM11008: Evaluation for biodiesel production

Microalgae are a potential source of biodiesel. The urgent need for an alternative and sustainable energy has created renewed interest to analyze the microalgae for biodiesel production. In this study, a dominant indigenous freshwater unicellular microalgal strain *Chlorella* sp., BUM11008, was examined for its efficiency towards biodiesel production. The organism was evaluated for ability to yield high of biomass and lipid productivity under normal and various nutrient-deprived conditions (nitrogen, phosphate-potassium, iron, and all three combined). Under normal conditions, after 20 days of cultivation in Chu10 medium, the organism yielded a biomass of 2.58 ± 0.07 g/L, with lipid content of 312.16 ± 2.38 mg/g. In a two-phase culturing system upon nutrition deprivation, the organism was able to respond with different levels of lipid accumulation. Among the various post-harvest treatments, nitrogen deprivation yielded the highest lipid productivity of 53.96 ± 0.63 mg/Ld, followed by the combined deprivation condition (49.16 ± 1.36 mg/Ld). FAME profiles of the isolate were found to meet the requirements of international standards for biodiesel. The study leads to the conclusion that the two-

phase culturing system with nitrogen starvation as post-harvest treatment would be suitable for gaining maximum biomass productivity, and lipid content of high quality fatty acids. Thus, it is proposed that *Chlorella* sp., BUM11008, would be a promising candidate for sustainable biodiesel production.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Bharathidasan University, King Saud University

Contributors: Praveenkumar, R., Shameera, K., Mahalakshmi, G., Akbarsha, M. A., Thajuddin, N.

Number of pages: 7

Pages: 60-66

Publication date: Feb 2012

Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy

Volume: 37

ISSN (Print): 0961-9534

Ratings:

Scopus rating (2012): CiteScore 3.66 SJR 1.516 SNIP 1.725

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal

Keywords: *Chlorella* sp., FAME profiles, Microalgal biodiesel, Nitrogen deprivation, Nutrient deprivation

DOIs:

10.1016/j.biombioe.2011.12.035

Source: Scopus

Source ID: 84856231118

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

High temperature oxidation behaviour of MnCo₂O₄ coating on crofer 22 APU manufactured by a novel solution precursor plasma spray process (SPPS)

MnCo₂O₄ spinel coatings are designed to be used on metallic interconnectors in SOFC devices to decrease oxidation rate of the metallic interconnect and to prevent the evaporation of harmful CrO₃ and Cr₂(OH)₂ compounds. These Cr-compounds degrade the long-term performance of the SOFC by migrating to the triple phase barrier (TPB) of the cathode and reduce back to Cr₂O₃. MnCo₂O₄ spinel coatings, used in this study, were manufactured by using a novel solution precursor plasma spray (SPPS) process and heat treated in oxidizing environment. Deionized water based solutions of Mn(NO₃)₃·4H₂O and Co(NO₃)₂·6H₂O were used as a feedstock material. Concentration of the metal cations in the solutions was adjusted to 3 M. Ferritic stainless grade Crofer 22 APU with the thickness of 0.5 mm and surface roughness of R_a < 0.5 μm was used as a substrate material. The coatings were manufactured using a Sulzer Metco A3000S plasma spray system with F4-MB plasma gun with modified solution feeding hardware. Coatings with different microstructures were sprayed using different spraying parameters, e.g. the type of plasma gases used. The as-sprayed coatings were aged at 700 °C for 500 h in oxidizing environment, in order to study the stability of the coating, the growth of the Cr-scale and the Cr-transport through the spinel coatings. The microstructural characterization for the as-sprayed and the oxidized coatings were done using a field-emission scanning electron microscopy (FESEM) with SE-mode. The quantitative analyses were executed with energy dispersive spectroscopy (EDS), and in addition X-ray diffraction (XRD) was used for qualitative studies. The coatings with various microstructures were sprayed. The densest microstructure was sprayed using Ar-He plasma gas. Also the crystallographic equivalence for MnCo₂O₄ was achieved when Ar-He plasma was used with 40 mm spraying distance. Ageing caused the increase in structural porosity. On the interface between the coating and the interconnect, a dense spinel layer was formed which effectively prevented the Cr-transport forming approximately 500 nm thick Cr-rich sub-scale.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Facilities and Infrastructure, Department of Materials Science, Engineering materials science and solutions (EMASS)

Contributors: Puranen, J., Laakso, J., Hyvärinen, L., Kylmälahti, M., Vuoristo, P.

Number of pages: 6

Pages: 213-218

Publication date: 2012

Host publication information

Title of host publication: ASME 2012 10th International Conference on Fuel Cell Science, Engineering and Technology Collocated with the ASME 2012 6th International Conference on Energy Sustainability, FUELCELL 2012

Publisher: The American Society of Mechanical Engineers ASME

ISBN (Print): 9780791844823

ASJC Scopus subject areas: Fuel Technology, Renewable Energy, Sustainability and the Environment

DOIs:

10.1115/FuelCell2012-91385

URLs:

<http://www.scopus.com/inward/record.url?scp=84892634592&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84892634592

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Hydrogen and methane yields of untreated, water-extracted and acid (HCl) treated maize in one- and two-stage batch assays

In the present study, two-stage H₂ and CH₄ production was compared with one-stage CH₄ production from maize subjected to water extraction and acid (HCl) treatment. In addition, the effect of duration (2 and 14 days) of the first-stage H₂ process on the H₂ yields and subsequent CH₄ yields from the second-stage was also investigated. Results showed that the average H₂ yields from untreated maize were 5.6 and 9.9 ml/g volatile solids added (VS_{added}) after 2 and 14 days, respectively. On the other hand, H₂ yields from water-extracted and HCl-treated maize were 18.0 and 20.5 ml/gVS_{added} (14 d), respectively. On comparison to one-stage CH₄ assays, the average increase in CH₄ yields from two-stage assays with 2 d H₂ stage were 7, 9 and 27% for untreated, water-extracted and HCl-treated maize, respectively.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä

Contributors: Pakarinen, O. M., Kaparaju, P. L. N., Rintala, J. A.

Number of pages: 7

Pages: 14401-14407

Publication date: Nov 2011

Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 36

Issue number: 22

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2011): CiteScore 4.42 SJR 1.443 SNIP 1.828

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter

Physics, Energy Engineering and Power Technology

Keywords: Anaerobic digestion, Hydrogen, Maize, Methane, Pre-treatment, Two-stage

DOIs:

10.1016/j.ijhydene.2011.08.028

Source: Scopus

Source ID: 80054013006

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

Trace compounds affecting biogas energy utilisation - A review

This paper investigates the trace compounds affecting energy utilisation in biogas that come from different production sites. With biogas being more widely used in different energy applications more interest has arisen for the specific composition of biogas. In traditional energy applications, methane and hydrogen sulphide contents have had the most influence when energy utilisation application has been considered. With more advanced processes also the quantity and quality of trace compounds is more important. In regards to trace compounds, it was found that the concentrations and the variations of volatile organic compounds (VOCs) can be high in different landfills, especially, with compounds originating from the biological degradation process (like aromatics and terpenes) as seasonal variations affect the biological degradation. Trace compounds produced by direct volatilisation (halogenated and silicon compounds) show a smaller seasonal variation. Halogenated compounds are rarely present in high concentrations in waste water treatment plant (WWTP) biogas, but the concentrations of organic silicon compounds and their variation is high. Organic silicon compounds are usually detected only in low concentrations in co-digestion plant biogas, when no WWTP sludge is used as a raw material.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed
Organisations: Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä
Contributors: Rasi, S., Läntelä, J., Rintala, J.
Number of pages: 7
Pages: 3369-3375
Publication date: Nov 2011
Peer-reviewed: Yes

Publication information

Journal: Energy Conversion and Management

Volume: 52

Issue number: 12

ISSN (Print): 0196-8904

Ratings:

Scopus rating (2011): CiteScore 3.03 SJR 1.24 SNIP 1.82

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology, Nuclear Energy and Engineering, Renewable Energy, Sustainability and the Environment

Keywords: Biogas, Biogas production sites, Biomethane, Energy utilisation, Organic silicon compounds, Trace compounds removal

DOIs:

10.1016/j.enconman.2011.07.005

Source: Scopus

Source ID: 80052255401

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

Mitigation of greenhouse gas emissions by adopting anaerobic digestion technology on dairy, sow and pig farms in Finland

The impact of anaerobic digestion (AD) technology on mitigating greenhouse gas (GHG) emissions from manure management on typical dairy, sow and pig farms in Finland was compared. Firstly, the total annual GHG emissions from the farms were calculated using IPCC guidelines for a similar slurry type manure management system. Secondly, laboratory-scale experiments were conducted to estimate methane (CH₄) potentials and process parameters for semi-continuous digestion of manures. Finally, the obtained experimental data were used to evaluate the potential renewable energy production and subsequently, the possible GHG emissions that could be avoided through adoption of AD technology on the studied farms. Results showed that enteric fermentation (CH₄) and manure management (CH₄ and N₂O) accounted for 231.3, 32.3 and 18.3Mg of CO₂ eq.yr⁻¹ on dairy, sow and pig farms, respectively. With the existing farm data and experimental methane yields, an estimated renewable energy of 115.2, 36.3 and 79.5MWh of heatyr⁻¹ and 62.8, 21.8 and 47.7MWh of electricityyr⁻¹ could be generated in a CHP plant on these farms respectively. The total GHG emissions that could be offset on the studied dairy cow, sow and pig farms were 177, 87.7 and 125.6Mg of CO₂ eq.yr⁻¹, respectively. The impact of AD technology on mitigating GHG emissions was mainly through replaced fossil fuel consumption followed by reduced emissions due to reduced fertilizer use and production, and from manure management.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä

Contributors: Kaparaju, P., Rintala, J.

Number of pages: 11

Pages: 31-41

Publication date: Jan 2011

Peer-reviewed: Yes

Publication information

Journal: Renewable Energy

Volume: 36

Issue number: 1

ISSN (Print): 0960-1481

Ratings:

Scopus rating (2011): CiteScore 3.9 SJR 1.634 SNIP 2.349

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Biogas, Carbon trade, Greenhouse gases, Livestock manures, Mesophilic digestion, Renewable energy

DOIs:

10.1016/j.renene.2010.05.016

Source: Scopus

Source ID: 79955470119

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

Environmental and economic evaluation of solar thermal panels using exergy and dimensional analysis

Environmental considerations must now be taken into account more and more during the development of products and processes. As the decisions made during the early phases of development influence a large part of the final structure and cost, a quick and efficient way of evaluating environmental impact is crucial to give solid bases to the decisions. This article presents a framework for an environmental and economic evaluation that uses exergy and dimensional analysis, aimed for these early stages of design. The proposed framework is illustrated through a case study on flat solar thermal panels.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: LISMMA - SupMeca Toulon, Aalto Univ, Aalto University, Aalto Univ Finland, Dept Engn Design & Prod, Sch Engn, School of Engineering

Contributors: Medyna, G., Coatanea, E., Millet, D.

Number of pages: 5

Pages: 647-651

Publication date: 2011

Host publication information

Title of host publication: Glocalized Solutions for Sustainability in Manufacturing - Proceedings of the 18th CIRP International Conference on Life Cycle Engineering

ISBN (Print): 9783642196911

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Industrial and Manufacturing Engineering

Keywords: Dimensional analysis, Environmental evaluation, Exergy, Flat solar thermal panels

DOIs:

10.1007/978-3-642-19692-8_112

URLs:

<http://www.scopus.com/inward/record.url?scp=80052135169&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80052135169

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Manganese-cobalt spinel coatings for SOFC metallic interconnects manufactured by conventional plasma spraying (PS) and suspension plasma spraying (SPS)

Protective coatings are used on ferritic stainless steel interconnects of solid oxide fuel cells (SOFCs) to prevent the oxidation and evaporation of volatile chromium compounds. Oxide scale is formed of chromium oxide (Cr_2O_3) which tends to react with the oxygen and water, forming chromium trioxide (Cr_2O_3) and chromium hydroxides ($\text{Cr}_2(\text{OH})_2$). These compounds will migrate to the triple phase barrier (TPB) of a cathode and reduce back to Cr_2O_3 . This reaction pathway is a notable reason for the degradation phenomena of the cell. Plasma spraying (PS) and suspension plasma spraying (SPS) were studied as possible manufacturing processes for thin Mn-Co-(Fe) spinel coatings. Powder for PS was manufactured by using a solid state reaction method from carbonates and oxide to form a $\text{MnCo}_{1.8}\text{Fe}_{0.2}\text{O}_4$ and powder for SPS by co-precipitation process from nitrates to form a MnCo_2O_4 spinel structure. Using PS, coatings with thin and relatively dense structures were obtained. The composition of the coatings was homogeneous although, the decomposition of the spinel structure was noticed. The crystal structures of the PS coatings were partially restored by a separate annealing process. The spray parameters had a strong influence on the coating structure and the composition when SPS was used. The most homogenous coating structure was formed when low energy spraying parameters were used, whereas high energy parameters formed a columnar structure with larger cobalt rich areas. The decomposed spinel structure of the SPS coatings were fully restored by the annealing treatment. In SPS, more process optimization is needed to improve the coating quality and especially denseness.

General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Materials Science, Facilities and Infrastructure, Materials Science, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland

Contributors: Puranen, J., Hyvärinen, L., Lagerbom, J., Kylvälähti, M., Koivuluoto, H., Vuoristo, P.

Number of pages: 8

Pages: 237-244

Publication date: 2011

Host publication information

Title of host publication: ASME 2011 9th International Conference on Fuel Cell Science, Engineering and Technology.
Collocated with ASME 2011 5th International Conference on Energy Sustainability, FUELCELL 2011
ISBN (Print): 9780791854693

ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology, Renewable Energy, Sustainability and the Environment

DOIs:

10.1115/FuelCell2011-54750

URLs:

<http://www.scopus.com/inward/record.url?scp=84881649302&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84881649302

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

Determination of organic silicon compounds in biogas from wastewater treatments plants, landfills, and co-digestion plants

The study determined the organic silicon compounds in biogases from landfills, wastewater treatment plants (WWTPs), and biogas plants processing different organic material. The aim was to provide information for gas utilisation applications, as siloxanes are reported to shorten the life time of engines when biogas is used for energy production. In total, 48 samples were measured. The total concentration of organic silicon compounds in landfill and WWTP gases varied from 77 to 2460 $\mu\text{g}/\text{m}^3$ while the concentrations in biogases from biogas plants varied from 24 to 820 $\mu\text{g}/\text{m}^3$. The total concentration of organic silicon compounds was lowest (24 $\mu\text{g}/\text{m}^3$) in the biogas plant processing grass and maize, and highest (2460 $\mu\text{g}/\text{m}^3$) in one of the studied WWTP. The most common compounds in WWTPs and in biogas plants processing also sewage sludge were D4 and D5 while in landfills the most common compounds were D4 and L2 followed by trimethyl silanol. The effect of condensation of biogas on concentrations of organic silicon compounds was studied in one of the landfills and a negligible effect on concentrations was detected.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Rasi, S., Lehtinen, J., Rintala, J.

Number of pages: 8

Pages: 2666-2673

Publication date: Dec 2010

Peer-reviewed: Yes

Publication information

Journal: Renewable Energy

Volume: 35

Issue number: 12

ISSN (Print): 0960-1481

Ratings:

Scopus rating (2010): SJR 1.459 SNIP 2.202

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment

Keywords: Biogas, Biogas utilisation, Methane, Organic silicon compounds, Siloxanes

DOIs:

10.1016/j.renene.2010.04.012

Source: Scopus

Source ID: 77954310205

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

One-stage H₂ and CH₄ and two-stage H₂ + CH₄ production from grass silage and from solid and liquid fractions of NaOH pre-treated grass silage

In the present study, mesophilic CH₄ production from grass silage in a one-stage process was compared with the combined thermophilic H₂ and mesophilic CH₄ production in a two-stage process. In addition, solid and liquid fractions separated from NaOH pre-treated grass silage were also used as substrates. Results showed that higher CH₄ yield was obtained from grass silage in a two-stage process (467 ml g⁻¹ volatile solids (VS)_{original}) compared with a one-stage process (431 ml g⁻¹ VS_{original}). Similarly, CH₄ yield from solid fraction increased from 252 to 413 ml g⁻¹ VS_{original} whereas CH₄ yield from liquid fraction decreased from 82 to 60 ml g⁻¹ VS_{original} in a two-stage compared to a one-stage process. NaOH pre-treatment increased combined H₂ yield by 15% (from 5.54 to 6.46 ml g⁻¹ VS_{original}). In contrast, NaOH pre-treatment decreased the combined CH₄ yield by 23%. Compared to the energy value of CH₄ yield obtained, the energy value of H₂ yield remained low. According to this study, highest CH₄ yield (495 ml g⁻¹ VS_{original}) could be obtained, if grass silage was first pre-treated with NaOH, and the separated solid fraction was digested in a two-stage (thermophilic H₂ and mesophilic CH₄) process while the liquid fraction could be treated directly in a one-stage CH₄

process.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Pakarinen, O. M., Tähti, H. P., Rintala, J. A.
Number of pages: 9
Pages: 1419-1427
Publication date: Oct 2009
Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy
Volume: 33
Issue number: 10
ISSN (Print): 0961-9534
Ratings:
Scopus rating (2009): SJR 1.728 SNIP 2.183
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
Keywords: Alkaline treatment, Dark fermentation, Grass silage, Hydrogen, Methane, Two-stage
DOIs:
10.1016/j.biombioe.2009.06.006
Source: Scopus
Source ID: 69449103697
Research output: Contribution to journal > Article > Scientific > peer-review

Screening boreal energy crops and crop residues for methane biofuel production

The purpose of the study was to screen potential boreal energy crops and crop residues for their suitability in methane production and to investigate the effect of harvest time on the methane production potential of different crops. The specific methane yields of crops, determined in 100-200 d methane potential assays, varied from 0.17 to 0.49 m³ CH₄ kg⁻¹ VS added (volatile solids added) and from 25 to 260 m³ CH₄ t_{ww}⁻¹ (tonnes of wet weight). Jerusalem artichoke, timothy-clover grass and reed canary grass gave the highest potential methane yields of 2900-5400 m³ CH₄ ha⁻¹, corresponding to a gross energy yield of 28-53 MWh ha⁻¹ and ca. 40,000-60,000 km ha⁻¹ in passenger car transport. The effect of harvest time on specific methane yields per VS of crops varied a lot, whereas the specific methane yields per t_{ww} increased with most crops as the crops matured.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Jyväskylän yliopisto, University of Jyväskylä
Contributors: Lehtomäki, A., Viinikainen, T. A., Rintala, J. A.
Number of pages: 10
Pages: 541-550
Publication date: Jun 2008
Peer-reviewed: Yes

Publication information

Journal: Biomass & Bioenergy
Volume: 32
Issue number: 6
ISSN (Print): 0961-9534
Ratings:
Scopus rating (2008): SJR 1.614 SNIP 2.137
Original language: English
ASJC Scopus subject areas: Agronomy and Crop Science, Forestry, Renewable Energy, Sustainability and the Environment
Keywords: Anaerobic digestion, Crop residues, Energy crops, Harvest time, Maturity stage, Methane production
DOIs:
10.1016/j.biombioe.2007.11.013
Source: Scopus
Source ID: 44249103064
Research output: Contribution to journal > Article > Scientific > peer-review

Batch dark fermentative hydrogen production from grass silage: The effect of inoculum, pH, temperature and VS ratio

The potential for fermentative hydrogen (H_2) production from grass silage was evaluated in laboratory batch assays. First, two different inocula (from a dairy farm digester and digested sewage sludge) were studied with and without prior heat treatment and pH adjustment. Only the inoculum from the dairy farm digester produced H_2 from grass silage. Without heat treatment, methane (CH_4) was mainly produced, but heat treatment efficiently inhibited CH_4 production. pH adjustment to 6 further increased H_2 production. The effects of initial pH (4, 5 and 6), temperature (35, 55 and 70 °C) and the substrate to inoculum volatile solids (VS) ratio (henceforth VS ratio) (1:1; 1.5:1 and 2:1) on H_2 production from grass silage were evaluated with heat-treated dairy farm digester sludge as inoculum. Optimal pH was found to be between 5 and 6, while at pH 4 no H_2 was formed. The highest H_2 yield was achieved at 70 °C. H_2 production also increased when the VS ratio was increased. However, the overall energy value of H_2 compared to that of CH_4 production remained low.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Pakarinen, O., Lehtomäki, A., Rintala, J.

Number of pages: 8

Pages: 594-601

Publication date: Jan 2008

Peer-reviewed: Yes

Publication information

Journal: International Journal of Hydrogen Energy

Volume: 33

Issue number: 2

ISSN (Print): 0360-3199

Ratings:

Scopus rating (2008): SJR 1.389 SNIP 2.1

Original language: English

ASJC Scopus subject areas: Electrochemistry, Fuel Technology, Renewable Energy, Sustainability and the Environment

Keywords: Fermentative hydrogen production, Grass silage, Heat treatment, pH, Temperature, VS ratio

DOIs:

10.1016/j.ijhydene.2007.10.008

Source: Scopus

Source ID: 39049172869

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

Laboratory investigations on co-digestion of energy crops and crop residues with cow manure for methane production:

Effect of crop to manure ratio

Anaerobic co-digestion of grass silage, sugar beet tops and oat straw with cow manure was evaluated in semi-continuously fed laboratory continuously stirred tank reactors (CSTRs). Co-digestion of manure and crops was shown to be feasible with feedstock volatile solids (VS) containing up to 40% of crops. The highest specific methane yields of 268, 229 and 213 l CH_4 kg^{-1} VS_{added} in co-digestion of cow manure with grass, sugar beet tops and straw, respectively, were obtained with 30% of crop in the feedstock, corresponding to 85-105% of the methane potential in the substrates as determined by batch assays. Including 30% of crop in the feedstock increased methane production per digester volume by 16-65% above that obtained from digestion of manure alone. Increasing the proportion of crops further to 40% decreased the specific methane yields by 4-12%, while doubling the loading rate from 2 to 4 kg VS m^{-3} day^{-1} decreased the specific methane yields by 16-26%. The post-methanation potential of the digestates corresponded to 0.9-2.5 m^3 CH_4 t^{-1} wet weight of digestate and up to 12-31% of total methane production in northern climatic conditions, being highest after co-digestion of manure with straw.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Lehtomäki, A., Huttunen, S., Rintala, J. A.

Number of pages: 19

Pages: 591-609

Publication date: Sep 2007

Peer-reviewed: Yes

Publication information

Journal: Resources Conservation and Recycling

Volume: 51

Issue number: 3

ISSN (Print): 0921-3449

Ratings:

Scopus rating (2007): SJR 0.715 SNIP 1.676

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Management, Monitoring, Policy and Law, Waste Management and Disposal, Economics and Econometrics

Keywords: Anaerobic digestion, Biogas, Co-digestion, Cow manure, Crop residues, CSTR, Energy crop digestion testing, Energy crops, Methane potential, Methane production

DOIs:

10.1016/j.resconrec.2006.11.004

Source: Scopus

Source ID: 34250321725

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

Trace compounds of biogas from different biogas production plants

Biogas composition and variation in three different biogas production plants were studied to provide information pertaining to its potential use as biofuel. Methane, carbon dioxide, oxygen, nitrogen, volatile organic compounds (VOCs) and sulphur compounds were measured in samples of biogases from a landfill, sewage treatment plant sludge digester and farm biogas plant. Methane content ranged from 48% to 65%, carbon dioxide from 36% to 41% and nitrogen from <1% to 17%. Oxygen content in all three gases was <1%. The highest methane content occurred in the gas from the sewage digester while the lowest methane and highest nitrogen contents were found in the landfill gas during winter. The amount of total volatile organic compounds (TVOCs) varied from 5 to 268 mg m⁻³, and was lowest in the biogas from the farm biogas plant. Hydrogen sulphide and other sulphur compounds occurred in landfill gas and farm biogas and in smaller amounts in the sewage digester gas. Organic silicon compounds were also found in the landfill and sewage digester gases. To conclude, the biogases in the different production plants varied, especially in trace compound content. This should be taken into account when planning uses for biogas.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Rasi, S., Veijanen, A., Rintala, J.

Number of pages: 6

Pages: 1375-1380

Publication date: Aug 2007

Peer-reviewed: Yes

Publication information

Journal: Energy

Volume: 32

Issue number: 8

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2007): SJR 0.902 SNIP 1.339

Original language: English

ASJC Scopus subject areas: Energy(all), Energy Engineering and Power Technology, Fuel Technology, Nuclear Energy and Engineering, Renewable Energy, Sustainability and the Environment

Keywords: Biogas plant, Landfill, Methane, Sewage treatment plant, Volatile organic compounds

DOIs:

10.1016/j.energy.2006.10.018

Source: Scopus

Source ID: 34247160816

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

Anaerobic co-digestion of potato tuber and its industrial by-products with pig manure

The possible use of potato tuber and its industrial by-products (potato stillage and potato peels) on farm-scale co-digestion with pig manure was evaluated in a laboratory study. The methane yields (m³ kg⁻¹ volatile solids (VS) added waste⁻¹) achieved on semi-continuous co-digestion at loading rate of 2 kg VS m⁻³ day⁻¹ in continuously stirred tank reactors at 35°C were 0.13-0.15 at 100:0 (VS% pig manure to VS% potato co-substrate), 0.21-0.24 at 85:15 and 0.30-0.33 at 80:20 feed ratio. Increasing the loading rate from 2 to 3 kg VS m⁻³ day⁻¹ at a feed VS ratio of 80:20 (pig manure to potato waste) produced methane yields of 0.28-0.30 m³ kg⁻¹ VS added waste⁻¹. Post-digestion (60 days) of the digested materials in batches produced 0.12-0.15 m³ kg⁻¹ VS added waste⁻¹ of methane at 35°C. The results suggest that

successful digester operation can be achieved with feed containing potato material up to 15-20% of the feed VS and that under similar feed VS, loading rate, retention time and feed VS ratio, the methane yields and process performance for potato tuber would be similar to that of its industrial residues. Thus, co-digestion of potatoes and/or its industrial by-products with manures on a farm-scale level would generate renewable energy and provide a means of waste treatment for industry.

General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Kaparaju, P., Rintala, J.

Number of pages: 14

Pages: 175-188

Publication date: Jan 2005

Peer-reviewed: Yes

Publication information

Journal: Resources Conservation and Recycling

Volume: 43

Issue number: 2

ISSN (Print): 0921-3449

Ratings:

Scopus rating (2005): SJR 0.725 SNIP 1.42

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Management, Monitoring, Policy and Law, Waste Management and Disposal

Keywords: Agro-industrial waste, Ammonia, Anaerobic digestion, Co-digestion, Methane, Pig manure, Potato peel, Potato stillage, Potato tuber

DOIs:

10.1016/j.resconrec.2004.06.001

Source: Scopus

Source ID: 7744243028

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