

### **Estimation of the largest expected photovoltaic power ramp rates**

Photovoltaic (PV) systems are prone to irradiance variation caused by cloud shadows leading to fluctuations in generated power. Since these fluctuations can be harmful to the operation of power grids, there is a need to restrict the largest PV power ramp rates (RR). This article proposes a method to estimate the largest expected PV power RRs. The only inputs of the method are the minimum PV system dimension and the measurements of point irradiance and cloud shadow velocity. Since cloud shadows cause the largest power RRs for well-designed large-scale PV power plants, the relation between the largest RRs in irradiance and power during partial cloud shading events was studied based on irradiance measurements. The largest RRs in PV power are estimated from RRs in the average irradiance across the PV system. The proposed method was validated using measured data of 57 days from two PV systems. It showed superior performance compared to an existing method enveloping the RR in the measured power over 99.99% of the time. The method can be used in design and component sizing of PV power plants.

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Organisations: Electrical Engineering, Research group: Power systems, Research area: Power engineering, University of California

Contributors: Lappalainen, K., Wang, G. C., Kleissl, J.

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### **Tuning electricity generation throughout the year with PV module technology**

Currently, photovoltaic (PV) installations target a maximization of annual energy yield. However, as the grid penetration of PV is increasing, PV electricity generation will need to match better with local load profiles. Especially the seasonal variabilities remain challenging. While wind and PV tend to have complementary seasonal variability, wind turbine installation faces limitations especially in densely populated areas. In this paper, we discuss how this challenge may be addressed with climate- and consumption-specific PV module technology. In particular, we demonstrate how the temperature coefficient of a PV system can impact the energy yield throughout the year. In colder climates, higher temperature coefficients allow for a better energy balance, favoring production in colder seasons without a significant reduction of yearly energy yield. Simulations for locations at high latitude, and colder climates, indicate that higher temperature coefficients and improved low-light behavior not only enable a higher energy yield in cold seasons, but also negligible losses in the overall yearly energy yield compared to lower temperature coefficients and slightly better low-light behavior. Simulations show that these results can be obtained using commercial PV modules. More broadly, they indicate how PV module technology may be optimized depending on the location and climate.

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Organisations: Electrical Engineering, Research group: Power systems, Research area: Power engineering, Imec, EnergyVille, KU Leuven, College of Engineering and Petroleum Kuwait, Carleton University, Hasselt University

Contributors: Manganiello, P., Govaerts, J., Horvath, I. T., Chowdhury, M. G., Yordanov, G. H., Goverde, H., Aldalali, B., Beausoleil-Morrison, I., Valkealahti, S., Lappalainen, K., Poortmans, J.

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### How consumers' respect for nature and environmental self-assets influence their car brand experiences

This paper provides a novel perspective on sustainability research by exploring how two pro-environmental characteristics of consumers – respect for nature and environmental self-assets – influence their brand experiences. The study uses survey data collected on a car brand that incorporated eco-friendly advances. The results show that respect for nature has an impact on how respondents experience the eco-friendliness of brands and that eco-friendly brand experiences in turn influence general brand experiences. The findings also suggest that the effects of the two pro-environmental characteristics depend on the education level of the consumer: eco-friendly brand experiences of highly educated consumers are affected by their respect for nature, whereas those of consumers with lower education levels are affected by environmental self-assets.

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Organisations: Industrial Engineering and Management, Research group: Center for Innovation and Technology Research, Jönköping International Business School, University of Graz, Radboud University Nijmegen, Nyenrode Business Universiteit

Contributors: Saari, U. A., Mäkinen, S. J., Baumgartner, R. J., Hillebrand, B., Driessen, P. H.

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

Keywords: Automotive industry, Brand experience, Car brand, Eco-friendliness, Partial least squares structural equation modeling, Pro-environmental characteristics

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### Comprehensive assessment brings out shortcomings in almost every school building

Consideration of the big picture is needed when evaluating aspects of the building with relevance for reporting of poor indoor air quality or symptoms. Even the most accurate longitudinal measurements do not remove the need for expertise and broad understanding of the different possible sources and causes of indoor air exposures. Finnish Institute for Health and Welfare (THL), in collaboration with Tampere University (TAU), studies the association between school buildings of Helsinki and pupil reported health symptoms. The present paper focuses on introducing the methods and classifications as well as presenting the results about the condition of the buildings. Characteristics of 53 school buildings have been assessed by visiting the buildings and by going through the previous building investigation reports. Visits relied mainly on visual inspections with an extensive checklist and some non-intrusive momentary measurements about the dampness, pressure difference, and indoor air quality (IAQ). The major strength of the study is that all the possible school buildings in certain areas were inspected and assessed using the same methods, irrespective if the building had a long history of indoor air problems or not. That makes it possible to evaluate the general prevalence of the problems in school buildings,

which has been highlighted as an open question by the National Indoor Air and Health Program 2018-2028, coordinated by THL. The first results indicate that every school building has its shortcomings. However, none of the studied buildings was in a very bad condition either. The results indicate that it is not possible to draw a clear line between the buildings with 'good' or 'poor' IAQ.

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MoE publication type: A1 Journal article-refereed

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Contributors: Marttila, T., Lahdensivu, J., Pekkanen, J.

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Source ID: 85088449337

Research output: Contribution to journal > Conference article > Scientific > peer-review

#### **Laboratory tests and modelling of mineral wool insulated steel sandwich panels**

This study presents results from laboratory measurements of mineral wool insulated steel sandwich panels. The purpose of the work was to have a better understanding on the heat and moisture conditions inside sandwich panels and to study how the structure behaves in water leakage situation. The tests were done by sealing the structure from all sides and regulating the temperature on one side of the test structure while measuring the temperature and relative humidity conditions inside the structure. Water leakages were created by injecting liquid water onto the insulation layer. According to the results, water vapour pressure differences stayed relatively small both in stationary and dynamic conditions. This implies that the limiting factor for moisture source was the evaporation rate from the water leakage and that the vapour pressure throughout the insulation layer is determined strongly by the vapour pressure at the possible condensation layer. The paper discusses also the determination of sensor accuracy and impacts of a thermal bridge from the probe itself. Also, measurement results from a new radio wave monitoring method are presented.

#### **General information**

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Organisations: Civil Engineering, Research group: Building Physics, Tallinn University of Technology, SSAB, Smart City Center of Excellence (Finest Twins)

Contributors: Laukkarinen, A., Vinha, J., Kalbe, K., Kesti, J., Kalamees, T., Honkakoski, E.

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#### **Bibliographical note**

EXT="Kalamees, Targo"

Source: Scopus

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#### **Ministry of the Environment announces a Guide on Renovation and Repair of Buildings with Moisture and Microbial Damage - From theory to practice**

In 2015, the Ministry of the Environment in Finland renewed the legislation and the National Building Code of Finland. It released completely new legislation concerning repair design. This was due to widely known issues relating to the indoor air quality of private and public buildings. In the autumn of 2019, the Ministry of the Environment in Finland published a guide concerning the repairs of moisture and microbial damage. It is available in Finnish and Swedish. This guide is a follow-up of the Environmental Guide "Building Moisture and Indoor Air Quality Assessment", published 2016. It completes the series of guides for the execution of a project repairing indoor air quality issues, from a condition assessment to the completion of repairs and the implementation of the building. These guides lead through common practices and how these issues shall be dealt with in Finland.

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Organisations: Civil Engineering, Research group: Service Life Engineering of Structures, Ramboll Finland Ltd., Aalto University

Contributors: Weijo, I., Turunen, T., Lahdensivu, J., Sistonen, E., Annila, P.

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#### **Bibliographical note**

EXT="Weijo, Inari"

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Research output: Contribution to journal > Conference article > Scientific > peer-review

#### **Reliability of the detection of moisture and mould damage in visual inspections**

Moisture and mould damage are common in Finnish public buildings. Due to the possible health hazards of such damage, more efficient detection methods and protocols are needed to examine it. The aim of this study is to examine the reliability of visual inspection in the detection of moisture and mould damage. The study points out that the reliability of all the research material is 70%. The highest reliability values concentrate on those structures where the repair need is highest. However, the range of reliability values is wide: from 0% to 100% depending on the age of building or structure. Reliability is highest in the most simplified structures and lowest in structures consisting of multiple layers of different building materials.

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Contributors: Annala, P. J., Lahdensivu, J.  
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Research output: Contribution to journal > Conference article > Scientific > peer-review

#### Current collectors for low resistance aqueous flexible printed supercapacitors

In this paper we propose various current collector alternatives to be used in flexible supercapacitors with aqueous electrolyte when low equivalent series resistance (ESR) is required. The current collector material should be corrosion resistant when in contact with the saline electrolyte. Simultaneously it should have high electrical conductivity. In addition, environmental and cost aspects must be taken into account. We report supercapacitors with current collectors made of two different thicknesses of graphite foil (25  $\mu\text{m}$  and 150  $\mu\text{m}$ ) and aluminium coated with graphite inks. These disposable and non-toxic supercapacitors show remarkable improvements in ESR compared with values obtained for similar components with current collectors made of graphite ink. When graphite foil or aluminium is used as current collector, the ESR can be decreased by more than 80 % compared to using graphite ink alone. Supercapacitors using a dense graphite protective layer on top of aluminium showed no sign of corrosion and their performance was not significantly reduced after ageing for 950 days. With graphite foils, comparable ESR values can be obtained as with aluminium. The graphite foil is an interesting alternative if metal materials should be avoided, e.g. to facilitate incineration of the supercapacitors together with regular household waste. Especially with non-porous graphite foil, we obtained properties suitable for practical applications.

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Organisations: Electrical Engineering, Research group: Laboratory for Future Electronics, Materials Science and Environmental Engineering, Abo Akad Univ, Abo Akademi University, Dept Phys, Microscopy Center  
Contributors: Arvani, M., Keskinen, J., Lupo, D., Honkanen, M.  
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### **Operation of a PV power plant during overpower events caused by the cloud enhancement phenomenon**

Partly cloudy days possess two characteristics that can significantly increase the photovoltaic (PV) generator power: the operating temperature of the PV panels can cool down during the shade periods, and the irradiance can be enhanced due to the cloud enhancement phenomenon. If an overirradiance event is preceded by a long shade period, the maximum power of a PV generator can occasionally be much higher than the nominal nameplate power. During the overpower events, the inverter is operating in power-limiting mode whereby the operating voltage is increased to decrease the power of the PV generator. We created a simulation model of a 31.9 kW PV generator and used 12 months of irradiance and PV panel temperature measurement data to analyze its operation. We analyzed the PV generator power during the overirradiance events and applied various static power limits to calculate the operating voltage ranges in case of power curtailment. During the observation period, the maximum power produced by the PV generator was 1.42 times its nominal power. The duration of the overpower events was up to several minutes, but the typical duration was only some tens of seconds. The strongest overpower events occur seldom and their duration is only some seconds. Due to the overpower events, the operating voltage may receive high values, especially if the DC-to-AC power ratio is large.

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

Contributors: Järvelä, M., Valkealahti, S.

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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: Cloud enhancement, Operating voltage, Overirradiance, PV cell temperature, PV generator

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### **Assessing and comparing short term load forecasting performance**

When identifying and comparing forecasting models, there may be a risk that poorly selected criteria could lead to wrong conclusions. Thus, it is important to know how sensitive the results are to the selection of criteria. This contribution aims to study the sensitivity of the identification and comparison results to the choice of criteria. It compares typically applied criteria for tuning and performance assessment of load forecasting methods with estimated costs caused by the forecasting errors. The focus is on short-term forecasting of the loads of energy systems. The estimated costs comprise electricity market costs and network costs. We estimate the electricity market costs by assuming that the forecasting errors cause balancing errors and consequently balancing costs to the market actors. The forecasting errors cause network costs by overloading network components thus increasing losses and reducing the component lifetime or alternatively increase operational margins to avoid those overloads. The lifetime loss of insulators, and thus also the components, is caused by heating according to the law of Arrhenius. We also study consumer costs. The results support the assumption that there is a need to develop and use additional and case-specific performance criteria for electricity load forecasting.

#### **General information**

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Organisations: Electrical Engineering, Research group: Power systems, Research area: Power engineering, VTT Technical Research Centre of Finland, University of Eastern Finland

Contributors: Koponen, P., Ikäheimo, J., Koskela, J., Brester, C., Niska, H.  
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Source: Scopus  
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Research output: Contribution to journal > Article > Scientific > peer-review

#### Practical implementation of adaptive SRF-PLL for three-phase inverters based on sensitivity function and real-time grid-impedance measurements

Rapidly increasing demand for renewable energy has created a need for the photovoltaic and wind farms to be placed in various locations that have diverse and possibly time-variant grid conditions. A mismatch between the grid impedance and output admittance of an inverter causes impedance-based stability issues, which appear as power quality problems and poor transient performance. Grid synchronization with phase-locked loop (PLL) introduces a negative-resistance-like behavior to inverter output admittance. High control bandwidth of the PLL makes the system sensitive to impedance-based stability issues when the inverter is connected to a weak grid that has high impedance. However, very conservative tunings lead to overly damped dynamic responses in strong grids, where the control performance and power quality can be improved by applying higher PLL control bandwidths. Continuous evaluation of grid conditions makes it possible to avoid the risk of instability and poor dynamic responses, as the inverter output admittance can be re-shaped online to continuously match the grid conditions. The present work proposes method for adaptive control of the PLL based on the real-time measurements of the grid impedance, applying pseudo-random binary sequence (PRBS) injections. The method limits the PLL bandwidth in weak grids to avoid stability issues and increases the control bandwidth in strong grids to improve voltage-tracking, and thus overall control performance. The method is verified through simulations and experimental laboratory tests in a kW-scale system. The results show that optimizing the PLL bandwidth with respect to the grid conditions is highly beneficial for system performance and stability.

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Contributors: Luhtala, R., Alenius, H., Roinila, T.  
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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  
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Research output: Contribution to journal › Article › Scientific › peer-review

### **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 diffusio-phoretic forces. The eCHX was found to decrease >80% of fine particle mass ( $PM_{10}$ ) 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  $PM_{10}$  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.

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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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### **Acid and ferric sulfate bioleaching of uranium ores: A review**

This review examines the acid and ferric sulfate bioleaching of uranium from low grade ores. The review traces back the progression of the technology from the time the role of microorganisms was recognized in the 1950's and 1960's. Some past and present uranium mining operations with active or potential microbial contribution are summarized. Experimental techniques and laboratory bioleaching experiments are described. Choice microorganisms have been iron- and sulfur-oxidizing acidophiles, comprising bacteria and archaea with mesophilic and thermophilic temperature ranges. Uranium is bioleached from ores in acidic ferric sulfate lixiviant. Ferric iron oxidizes tetravalent uranium to the hexavalent form and is thereby reduced to ferrous iron in this redox reaction. Microorganisms in the bioleaching process oxidize ferrous iron to the ferric form and thus regenerate ferric sulfate. Iron oxidation requires oxygen as the electron acceptor in the leach solution. Acidity ensures that ferric iron is soluble in the lixiviant and protons increase the solubilization of the oxidized, hexavalent uranium. Ancillary sulfide minerals such as pyrite enhance the bioleaching because their oxidation releases ferrous iron and reduced sulfur compounds for biological ferric iron and sulfuric acid generation. The main mining engineering approaches used for uranium leaching are heap, dump, stope, in situ, and in-place leaching. The efficiency of uranium bioleaching is affected by a number of mineralogical, physicochemical, microbial and process factors. Bioinformatics and synthetic biology are progressing the research on bioleaching microorganisms but these developments have not been materialized in the industrial practice of uranium mining. New applications of uranium bioleaching may focus increasingly on deposits where other products such as rare earth elements or base metals can be recovered in addition to uranium.

#### **General information**

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Organisations: Materials Science and Environmental Engineering, CSIRO Land and Water, University of Western Australia, Ohio State University

Contributors: Kaksonen, A. H., Lakaniemi, A., Tuovinen, O. H.  
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EXT="Tuovinen, Olli H."  
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#### Autonomous reactive power support for smart photovoltaic inverter based on real-time grid-impedance measurements of a weak grid

A large share of renewable energy production is connected to a weak grid with significant grid impedance. The transmission impedance causes unintended flow of reactive power to grid, coupling the grid reactive power to the active power fed from the inverter. The reactive power causes transmission losses, strains the grid with reactive power requirements, and can even compromise system stability. Requirements on reactive power support were recently imposed on new photovoltaic inverters, which are often implemented with proportional power factor control or droop control for local voltage regulation. The present work proposes a method for real-time compensation of the unintended reactive power, which decouples the reactive power from the active power of a photovoltaic inverter. Based on real-time measurement of the grid impedance, the unintended reactive power is estimated and autonomously compensated in the inverter. The method removes the fluctuating reactive power component, while still permitting unrestricted manual control of the reactive power. Unlike conventional methods, the proposed method requires no prior knowledge on grid impedance values or delicate tuning. The method outperforms conventional power factor control even when the conventional method is tuned optimally with known grid inductance. The method is validated with simulations and experiments on three-phase photovoltaic inverter connected to a weak grid.

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

### **Censor-Based Cooperative Multi-Antenna Spectrum Sensing with Imperfect Reporting Channels**

The present contribution proposes a spectrally efficient censor-based cooperative spectrum sensing (C-CSS) approach in a sustainable cognitive radio network that consists of multiple antenna nodes and experiences imperfect sensing and reporting channels. In this context, exact analytic expressions are first derived for the corresponding probability of detection, probability of false alarm, and secondary throughput, assuming that each secondary user (SU) sends its detection outcome to a fusion center only when it has detected a primary signal. Capitalizing on the findings of the analysis, the effects of critical measures, such as the detection threshold, the number of SUs, and the number of employed antennas, on the overall system performance are also quantified. In addition, the optimal detection threshold for each antenna based on the Neyman-Pearson criterion is derived and useful insights are developed on how to maximize the system throughput with a reduced number of SUs. It is shown that the C-CSS approach provides two distinct benefits compared with the conventional sensing approach, i.e., without censoring: i) the sensing tail problem, which exists in imperfect sensing environments, can be mitigated; and ii) less SUs are ultimately required to obtain higher secondary throughput, rendering the system more sustainable.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, Taiyuan University of Science and Technology, University of Waterloo, Khalifa University, University of Surrey, University of London, Simon Fraser University

Contributors: Li, M., Alhussein, O., Sofotasios, P. C., Muhaidat, S., Yoo, P. D., Liang, J., Wang, A.

Number of pages: 13

Pages: 48-60

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Transactions on Sustainable Computing

Volume: 5

Issue number: 1

ISSN (Print): 2377-3782

Original language: English

ASJC Scopus subject areas: Computational Theory and Mathematics, Hardware and Architecture, Software, Renewable Energy, Sustainability and the Environment, Control and Optimization

Keywords: censoring, cooperative spectrum sensing, energy detection, energy efficiency, imperfect reporting channels, multi-antenna systems, Sustainable computing

DOIs:

10.1109/TSUSC.2019.2896667

Source: Scopus

Source ID: 85081759371

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

### **Charge transfer characteristics of fullerene-free polymer solar cells via multi-state electronic coupling treatment**

Recently, non-fullerene (NF) polymer solar cells (PSCs), where new electron acceptor (eA) materials are blended with a donor-acceptor (D-A) copolymer as an electron donor (eD), have shown promising power conversion efficiencies up to 18%. Some of the best-performing NF PSCs use the eD copolymers PBDT-TzBI, PDTB-EF-T, and PBDB-T-2F, and either a D-A copolymer P(NDI2OD-T2) or small molecule acceptors (SMAs) ITIC-4F and ITIC-2Cl as the NF eA compounds. Here we investigate these systems with density functional theory methods and extend our previous study of the multi-state fragment charge difference (FCD) electronic coupling scheme by applying it to the calculations of charge transfer (CT) rates for exciton dissociation and charge recombination (CR) processes at local eD-eA interfaces. Despite similar backbone structures and optical properties, the studied eD copolymers have different conformational, ionization, excitation, and CT characteristics. The electronic couplings and CT rates depend strongly on the relative positioning of the eD and eA compounds in the eD-eA complexes. While the main CT path is from eD to the eA compound, CT from eA to the eD compound is also predicted in the polymer-polymer PBDT-TzBI-P(NDI2OD-T2) system. The multi-state FCD electronic couplings are independent of the number of the excited states included in the calculations when using a dispersion-corrected optimally tuned long-range corrected functional. The calculated CR rates are slower in the polymer-SMA systems than in the polymer-polymer system, which could partly account for their higher experimentally observed efficiencies in devices.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Kastinen, T., Hukka, T. I.

Number of pages: 21

Pages: 4137-4157

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Sustainable Energy and Fuels

Volume: 4

Issue number: 8

ISSN (Print): 2398-4902

Original language: English

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

Electronic versions:

Charge transfer characteristics 2020

DOIs:

10.1039/d0se00306a

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008246612>

Source: Scopus

Source ID: 85089201008

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

### Charlie and the CryptoFactory: Towards Secure and Trusted Manufacturing Environments

The modernization that stems from Industry 4.0 started populating the manufacturing sector with networked devices, complex sensors, and a significant proportion of physical actuation components. However, new capabilities in networked cyber-physical systems demand more complex infrastructure and algorithms and often lead to new security flaws and operational risks that increase the attack surface area exponentially. The interconnected nature of Industry 4.0-driven operations and the pace of digital transformation mean that cyberattacks can have far more extensive effects than ever before. Based on that, the core ideas of this paper are driven by the observation that cybersecurity is one of the key enablers of Industry 4.0. Having this in mind, we propose CryptoFactory - a forward-looking design of a layered-based architecture that can be used as a starting point for building secure and privacy-preserving smart factories. CryptoFactory aims to change the security outlook in smart manufacturing by discussing a set of fundamental requirements and functionality that modern factories should support in order to be resistant to both internal and external attacks. To this end, CryptoFactory first focuses on how to build trust relationships between the hardware devices in the factory. Then, we look on how to use several cryptographic approaches to allow IoT devices to securely collect, store and share their data while we also touch upon the emerging topic of secure and privacy-preserving communication and collaboration between manufacturing environments and value chains. Finally, we look into the problem of how to perform privacy-preserving analytics by leveraging Trusted Execution Environments and the promising concept of Functional Encryption.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, University of Westminster

Contributors: Michalas, A., Kiss, T.

Number of pages: 6

Pages: 141-146

Publication date: 2020

### Host publication information

Title of host publication: 20th IEEE Mediterranean Electrotechnical Conference, MELECON 2020 : Proceedings

Publisher: IEEE

ISBN (Print): 978-1-7281-5201-1

ISBN (Electronic): 9781728152004

### Publication series

Name: IEEE Mediterranean Electrotechnical Conference

Publisher: Institute of Electrical and Electronics Engineers

ISSN (Print): 2158-8473

ISSN (Electronic): 2158-8481

ASJC Scopus subject areas: Control and Systems Engineering, Electrical and Electronic Engineering, Control and Optimization, Information Systems and Management, Energy Engineering and Power Technology

Keywords: Industry 4.0, Privacy, Security, Smart Factories

DOIs:

10.1109/MELECON48756.2020.9140712

#### **Bibliographical note**

JUF0ID=72875

Source: Scopus

Source ID: 85089274465

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

#### **Distributed small loads as fast frequency reserves: Impact on system performance**

This paper discusses the concept of using AMR (automatic meter reading) connected distributed loads as fast frequency reserves (ACFRs). The paper presents high-level analysis on power system response when considerable amount of directly grid-connected rotational reserves are replaced by AMR meter connected loads. In the study, the amount of ACFRs and their response time (i.e. very fast and fast) are varied together with different rotational kinetic reserves of power generation participating in frequency control. For the studies, a general power system and load models for EMT-type software have been established. The results show that ACFR could in principle replace effectively rotating reserves provided that frequency measurement and the coordination of the ACFRs are robust. The studied load shedding patterns and parametrization have less than expected influence on frequency minimum and system response.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Research group: Power systems, Fingrid Oyj

Contributors: Peltonen, L., Järventausta, P., Repo, S., Rauhala, T.

Number of pages: 6

Pages: 114-119

Publication date: 2020

#### **Host publication information**

Title of host publication: 2020 IEEE Texas Power and Energy Conference, TPEC 2020

Publisher: IEEE

ISBN (Electronic): 9781728144368

ASJC Scopus subject areas: Computer Networks and Communications, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Safety, Risk, Reliability and Quality

Keywords: AMR, Distributed load, Fast frequency reserves, Measurement, Power system

DOIs:

10.1109/TPEC48276.2020.9042522

#### **Bibliographical note**

EXT="Rauhala, Tuomas"

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

#### **Enhancement of EQE for MBE grown InAs/GaAs Quantum Dot Solar Cell with Back Reflector**

We report on molecular beam epitaxy grown InAs/GaAs quantum dot solar cells incorporating thin-film configuration with back surface reflectors. External quantum efficiency measurements reveal two times higher current generation for the quantum dots with the thin-film solar cell with the back reflector compared to a standard reference solar cell without back reflector. A high open-circuit voltage of 0.884 V is demonstrated. Furthermore, the benefits of using more advanced designs for a back reflector employing pyramidal diffraction gratings are discussed.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

Contributors: Aho, T., Tukiainen, A., Ranta, S., Elsehrawy, F., Raappana, M., Isoaho, R., Aho, A., Cappelluti, F., Guina, M.

Number of pages: 4

Pages: 2593-2596

Publication date: 2020

#### **Host publication information**

Title of host publication: 2019 IEEE 46th Photovoltaic Specialists Conference (PVSC)

Publisher: IEEE

ISBN (Electronic): 978-1-7281-0494-2

#### **Publication series**

Name: Conference record of the IEEE Photovoltaic Specialists Conference

ISSN (Print): 0160-8371

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

Keywords: Solar Cell, Semiconducting III-V Materials

DOIs:

10.1109/PVSC40753.2019.8981170

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

### **Enhancing thermophilic dark fermentative hydrogen production at high glucose concentrations via bioaugmentation with *Thermotoga neapolitana***

The aim of the present study was to investigate the effect of gradually increasing glucose concentrations (from 5.6 to 111 mmol L<sup>-1</sup>) on the fermentative H<sub>2</sub> production with and without bioaugmentation. A stirred tank reactor (STR) was operated at 70 °C and inoculated with a hyperthermophilic mixed culture or a hyperthermophilic mixed culture bioaugmented with *Thermotoga neapolitana*. With both the unaugmented (control) and augmented cultures, the H<sub>2</sub> production rate was improved when the initial glucose concentration was increased. In contrast, the highest H<sub>2</sub> yield (1.68 mol H<sub>2</sub> mol<sup>-1</sup> glucose consumed) was obtained with the augmented culture at the lowest glucose concentration of 5.6 mmol L<sup>-1</sup> and was 37.5% higher than that obtained with the unaugmented culture at the same feed glucose concentration. Overall, H<sub>2</sub> production rates and yields were higher in the bioaugmented cultures than in the unaugmented cultures whatever the glucose concentration. Quantitative polymerase chain reaction targeting *T. neapolitana* *hydA* gene and MiSeq sequencing proved that *Thermotoga* was not only present in the augmented cultures but also the most abundant at the highest glucose concentrations.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Bio- and Circular Economy, Materials Science and Environmental Engineering, ENEA/CREATE/Università Degli Studi Napoli Federico II, INRA

Contributors: Okonkwo, O., Papirio, S., Trably, E., Escudie, R., Lakaniemi, A., Esposito, G.

Number of pages: 9

Pages: 17241-17249

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Hydrogen Energy

Volume: 45

Issue number: 35

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: Biohydrogen, Dark fermentation, Metabolic pathways, Microbial dynamics

DOIs:

10.1016/j.ijhydene.2020.04.231

#### **Bibliographical note**

EXT="Papirio, Stefano"

Source: Scopus

Source ID: 85085051125

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

### **Hematite Surface Modification toward Efficient Sunlight-Driven Water Splitting Activity: The Role of Gold Nanoparticle Addition**

Localized surface plasmon resonance has been investigated to enhance light harvesting in hematite-based photoelectrodes modified with gold nanoparticles (AuNPs); meanwhile, an extensive understanding about the different processes involved in the hematite-AuNP system remains unclear. This work addresses a majority of effects associated with AuNP addition by comparing charge transfer, catalytic and light harvesting efficiencies. The obtained results revealed that the lower AuNP amount leads to a higher photocurrent response of 1.20 mA cm<sup>-2</sup> at 1.23 V<sub>RHE</sub> in comparison with all photoelectrodes designed here. X-ray photoelectron data revealed that hematite photoelectrodes loaded with higher concentrations of AuNPs immersed in an alkaline electrolyte showed hydrated/oxidized gold phase formation at the electrode/electrolyte interface. This change on the semiconductor-metal interface may affect the conductivity impairing the photocatalytic performance because of the passivation layer on the AuNP surface, decreasing the efficiency of charge transfer. Notoriously, increasing AuNP amount supported on the hematite surface clearly promoted higher light absorption, which was surprisingly not followed by photoelectrochemical efficiency. This result suggests here that the plasmon effect is not a dominant phenomenon that drives the photoelectrode performance. In fact, a deeper analysis showed that the

loaded hematite photoelectrodes with low amounts of AuNPs provides a Schottky contact at the semiconductor-metal interface leading to Fermi level equilibration enhancing charge transport efficiency, which is classified as the predominant effect leading to higher photoresponse in the system.

#### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Universidade Federal do ABC, Microscopy Centre

Contributors: Tofanello, A., Freitas, A. L., Carvalho, W. M., Salminen, T., Niemi, T., Souza, F. L.

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

ISSN (Print): 1932-7447

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Physical and Theoretical Chemistry, Surfaces, Coatings and Films

DOIs:

10.1021/acs.jpcc.9b11966

Source: Scopus

Source ID: 85082009064

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

#### Local Mechanical Properties at the Dendrite Scale of Ni-Based Superalloys Studied by Advanced High Temperature Indentation Creep and Micropillar Compression Tests

Chemical inhomogeneities due to dendritic solidification of Ni-based superalloys result in different local microstructures with varying mechanical properties. New indentation creep test methods allow probing of the local creep properties at the dendrite scale at high temperatures. The as-cast single crystalline Ni-based superalloy ERBO1A (a derivative alloy of CMSX-4) was investigated and electron-probe microanalysis (EPMA) measurements revealed strong segregation of, e.g., Re and W in the dendritic region and, e.g., Ta in the interdendritic region. Indentation creep experiments at 750 °C and micropillar compression tests at 785 °C were conducted in both regions, and a higher creep strength was found in the dendritic region compared to the interdendritic region. Theoretical models for solid solution hardening as well as  $\gamma'$  precipitation hardening confirm these results, since they predict a higher strength in the dendritic region than in the interdendritic region. Compared with the fully heat treated state, a smaller difference in the local mechanical properties or even a reverse strength ratio of the dendritic and interdendritic region can be expected.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Materials Science and Environmental Engineering, Research group: Materials Characterization, Friedrich-Alexander-Universität Erlangen-Nürnberg, Swiss Federal Laboratories for Materials Science and Technology, Fraunhofer Institut für Keramische Technologien und Systeme

Contributors: Haußmann, L., Neumeier, S., Kolb, M., Ast, J., Mohanty, G., Michler, J., Göken, M.

Number of pages: 9

Pages: 273-281

Publication date: 2020

#### Host publication information

Title of host publication: Superalloys 2020 : Proceedings of the 14th International Symposium on Superalloys

Publisher: Springer

Editors: Tin, S., Hardy, M., Clews, J., Cormier, J., Feng, Q., Marcin, J., O'Brien, C., Suzuki, A.

ISBN (Print): 9783030518332

ISBN (Electronic): 978-3-030-51834-9

#### Publication series

Name: The Minerals, Metals and Materials Series

ISSN (Print): 2367-1181

ISSN (Electronic): 2367-1696

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy Engineering and Power Technology, Mechanics of Materials, Metals and Alloys, Materials Chemistry

Keywords: Dendritic segregations, Indentation creep, Micropillar compression, Ni-based superalloy

DOIs:

10.1007/978-3-030-51834-9\_26

#### Bibliographical note

JUFOID=86210

Source: Scopus

Source ID: 85091283715

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

### **Luminescent (Er,Ho)<sub>2</sub>O<sub>3</sub> thin films by ALD to enhance the performance of silicon solar cells**

We have fabricated luminescent (Er,Ho)<sub>2</sub>O<sub>3</sub> thin films by atomic layer deposition (ALD) and studied their capability to enhance the performance of state-of-the-art single-junction c-Si bifacial solar cells. The films convert IR photons (e.g. 1523 nm) by three- and two-photon upconversion process to emit visible-light in the 400–700 nm range. When the films were coupled with solar cells, ~3% improvement in the short-circuit current density ( $620 \pm 5$  to  $638 \pm 5$  mAcm<sup>-2</sup>) was recorded under a simulated solar excitation equivalent to 16 suns. These findings highlight a potential of ALD for the design and fabrication of luminescent coatings for practical solar cell devices.

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: ORC, Aalto University, University of Turku

Contributors: Ghazy, A., Safdar, M., Lastusaari, M., Aho, A., Tukiainen, A., Savin, H., Guina, M., Karppinen, M.

Number of pages: 5

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Solar Energy Materials and Solar Cells

Volume: 219

Article number: 110787

ISSN (Print): 0927-0248

Original language: English

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

Keywords: Atomic layer deposition, c-Si solar cell, Luminescence, Photonics, Upconversion

DOIs:

10.1016/j.solmat.2020.110787

Source: Scopus

Source ID: 85090731507

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

### **Mapping the types of business experimentation in creating sustainable value: A case study of cleantech start-ups**

In this study, business experimentation for sustainable value creation is explored through seven cleantech start-ups by applying the systemic combining approach. The findings reveal novel descriptions of six different business experimentation types. The study also advances our theoretical understanding of how the specific roles of learning, signaling, and convincing dominate each of the experimentation types differently and how each type of business experimentation has a distinct purpose. Furthermore, our findings propose how business experimentation types can be applied as a continuum as part of the cleantech start-ups' sustainable value creation process. Hence, our study contributes theoretically to our understanding of business experimentation for sustainable value creation and how the different types are applied in cleantech start-ups. We conclude our treatise with managerial implications and outline fruitful future research avenues.

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Industrial Engineering and Management, Research group: Center for Innovation and Technology Research, Aarhus Universitet, Jönköping International Business School

Contributors: Aagaard, A., Saari, U. A., Mäkinen, S. J.

Number of pages: 12

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Cleaner Production

Volume: 279

Article number: 123182

ISSN (Print): 0959-6526

Original language: English

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

Keywords: Business experimentation, Cleantech, Start-up, Sustainable entrepreneurship, Sustainable value creation

DOIs:

10.1016/j.jclepro.2020.123182

#### **Bibliographical note**

EXT="Saari, Ulla A."

Source: Scopus

Source ID: 85089808603

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

#### **Modification of Surface States of Hematite-Based Photoanodes by Submonolayer of TiO<sub>2</sub> for Enhanced Solar Water Splitting**

Surface states are inherently involved with photoelectrochemical (PEC) solar fuel production; some of them are beneficial and participate in the surface reactions, but some act as recombination centers and therefore limit the PEC efficiency. Surface treatments have been applied to modify the surface states, but interrelated effects of the treatments on both types of surface states have not been properly considered. This research examines the modification of the surface states on hematite-based photoanodes by atomic layer deposition of submonolayer amount of TiO<sub>2</sub> and by postannealing treatments. Our results show that the postannealing causes diffusion of Ti deeper into the hematite surface layers, which leads to an increased saturation photocurrent and an anodic shift in the photocurrent onset potential. Without postannealing, the separate TiO<sub>2</sub> phase on the hematite surface results in a second intermediate surface state and delayed charge carrier dynamics, i.e., passivation of the recombination surface states. It is evident by these results that the intermediate surface states observed with impedance spectroscopy in a PEC cell are directly involved in the surface reaction and not with the recombination surface states observed with ultrafast (picoseconds-nanoseconds) transient absorption spectroscopy in air. These results open new optimization strategies to control the beneficial and detrimental surface states independently.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Palmolahti, L., Ali-Löytty, H., Khan, R., Saari, J., Tkachenko, N. V., Valden, M.

Number of pages: 8

Pages: 13094-13101

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Physical Chemistry C

Volume: 124

Issue number: 24

ISSN (Print): 1932-7447

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Physical and Theoretical Chemistry, Surfaces, Coatings and Films

Electronic versions:

Modification of Surface States 2020

DOIs:

10.1021/acs.jpcc.0c00798

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008246609>

Source: Scopus

Source ID: 85088902594

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

#### **Numerical modeling of the tool-rock penetration process using FEM coupled with SPH technique**

The numerical simulation of penetration into rock is an important tool to gain insights into rock drilling mechanisms, since it can be exploited as an alternative to the expensive field testing. This research aims to present an innovative computer simulation of rock penetration process on the basis of the finite element method (FEM) coupled with smoothed particle hydrodynamics (SPH). An advanced material model, namely the Karagozian and Case Concrete (KCC) model, was employed for this purpose. The Punch Penetration test (PPT) was carried out on a medium strength sandstone for validating the numerical method. The comparison of the numerical and experimental results obtained concluded that the FEM coupled with SPH method in conjunction with the fully calibrated KCC material model is a reliable method for the study of rock penetration due to its ability to deal with large deformations and its realistic constitutive modeling. The modeling approach was finally applied to estimate the required force to penetrate an offshore reservoir rock block under

the in-situ confining pressure with a double conical tool up to 5 mm depth. The effective stresses in sedimentary basins of Agosta and Dosso Campus at a depth of 3000 m below the seabed are considered as the confining pressures of this study.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Structural Mechanics, Politecnico di Milano

Contributors: Mardalizad, A., Saksala, T., Manes, A., Giglio, M.

Number of pages: 14

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING

Volume: 189

Article number: 107008

ISSN (Print): 0920-4105

Original language: English

ASJC Scopus subject areas: Fuel Technology, Geotechnical Engineering and Engineering Geology

Keywords: Coupled FEM-SPH, Drilling, KCC, Punch penetration test (PPT)

DOIs:

10.1016/j.petrol.2020.107008

Source: Scopus

Source ID: 85078782491

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

#### Plant-Based Biodegradable Capacitive Tactile Pressure Sensor Using Flexible and Transparent Leaf Skeletons as Electrodes and Flower Petal as Dielectric Layer

In biomedical sciences, there is demand for electronic skins with highly sensitive tactile sensors, having applications in patient monitoring, human-machine interfaces, and on-body sensors. In clinical applications, it would be especially beneficial if the sensors would be disposable. Here, an all plant-material-based biodegradable capacitive tactile pressure sensor for disposable electronic skins is reported. Silver-nanowire-coated leaf skeletons are used as breathable and flexible electrodes while freeze-dried rose petals are used as the dielectric layer. The leaf skeleton electrodes have a rough fractal-like architecture, which provides good adhesion to the silver nanowires and maintains interconnections between the silver nanowires when the electrodes are bent. The electrodes display low constant resistance up to curvature of  $800 \text{ m}^{-1}$ . The rose petal dielectric layer has a multiscale 3D cell wall microstructure, which compresses elastically when subjected to pressure. The fabricated sensor can respond to pressures ranging from 0.007 to at least 60 kPa, with a maximum sensitivity of  $\approx 0.08 \text{ kPa}^{-1}$ . The signal is stable for at least 5000 pressure cycles, after an initial break-in period. Owing to the all biomaterial constituents, the sensor is biodegradable under aqueous conditions. The sensor is successfully applied as an e-skin in touch sensing and gesture monitoring.

#### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech

Contributors: Elsayes, A., Sharma, V., Yiannacou, K., Koivikko, A., Rasheed, A., Sariola, V.

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: Advanced Sustainable Systems

ISSN (Print): 2366-7486

Original language: English

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

Keywords: bioinspiration, capacitive sensors, electronic skins, leaf skeletons

Electronic versions:

adsu.202000056

DOIs:

10.1002/adsu.202000056

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202007026308>

Source: Scopus

Source ID: 85085072940

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

### **Structural Compatibility of Infrastructures Utilizing Alternative Earth Construction Materials**

This paper presents analysis of the structural behavior of road pavements in which alternative construction materials are replacing the traditional ones in some of the structural layers. The analysis is considered important since from the structural performance point of view many of the alternative materials have mechanical properties far different from those of the traditional road construction materials, especially unbound aggregates, and as a consequence of that, the empirically calibrated design rules applied and adjusted for the normally utilized pavements solutions are not valid any more. The analysis is exemplified by means of four different low volume road pavement structures that are in line with the existing design guidelines in Finland. The mechanical behavior of these structures is analyzed using three different approaches: semi-empirical Oedemark design approach, multi-layer linear elastic analysis and finite element analysis. The obtained calculation results indicate clearly that if a low volume road structure containing a high stiffness layer made e.g. of stabilized fly ash is resting on soft subgrade soil, tensile stresses up to 1 MPa may be developed. Therefore, the performance and respective distress mechanisms of the structure are likely to be very different from those of a traditional solution. As a key conclusion from the analysis, need for a new concept, structural compatibility, was identified. It would help in drawing due attention to the mechanical behavior of alternative materials when they are used in replacing the traditional ones in road structures exposed to repeated heavy traffic loads. Graphic Abstract: [Figure not available: see fulltext].

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Earth Constructions, Research area: Infrastructure Construction

Contributors: Kolisoja, P., Kalliainen, A.

Number of pages: 9

Publication date: 2020

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: Alternative material, Mechanical behavior, Road pavement, Structural compatibility

Electronic versions:

Kolisoja-Kalliainen2020\_Article\_StructuralCompatibilityOfnInfra

DOIs:

10.1007/s12649-020-01061-x

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202007016287>

Source: Scopus

Source ID: 85083433907

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

### **Urban housing density and infrastructure costs**

Urbanisation is one of the most significant global megatrends and, as a result, major cities are facing multiple challenges. In this study, we contribute to the sustainable urban development debate and examine the relation between housing density and infrastructure costs. The analysis is based on four hypothetical design prototypes and a consistent cost calculation framework. Based on the results, infrastructure costs per capita are the highest in low-density areas and the lowest in high-density areas, if parking is excluded. However, if also construction costs of parking structures are included, the costs per capita are the highest in high-density areas. Considering the notably high cost impact of parking structures and people's limited willingness to pay for parking, municipally zoned parking requirements in urban areas are likely to result in non-optimal land use. Furthermore, construction in poor soil conditions may only be considered feasible if the floor area ratio and residential densities are relatively high. Beyond the cost benefits, the number of residents that may be accommodated is crucial and higher density in central urban locations should be promoted. We also suggest the cost of urban greenness to be reasonable relative to its many reported benefits and conclude that denser urban structure should not be pursued at the expense of green spaces.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Responsible Construction

Contributors: Kurvinen, A., Saari, A.

Number of pages: 24

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Sustainability (Switzerland)

Volume: 12

Issue number: 2

Article number: 497

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: Floor area ratio, Green spaces, Infrastructure costs, Parking, Residential density, Urban housing density

Electronic versions:

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DOIs:

10.3390/su12020497

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202003202772>

Source: Scopus

Source ID: 85079605222

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

### Power production and microbial community composition in thermophilic acetate-fed up-flow and flow-through microbial fuel cells

The microbial communities developed from a mixed-species culture in up-flow and flow-through configurations of thermophilic (55 °C) microbial fuel cells (MFCs), and their power production from acetate, were investigated. The up-flow MFC was operated for 202 days, obtaining an average power density of 0.13 W/m<sup>3</sup>, and *Tepidiphilus* was the dominant transcriptionally-active microorganisms. The planktonic community developed in the up-flow MFC was used to inoculate a flow-through MFC resulting in the proliferation of *Ureibacillus*, whose relative abundance increased from 1 to 61% after 45 days. Despite the differences between the up-flow and flow-through MFCs, including the anode electrode, hydrodynamic conditions, and the predominant microorganism, similar ( $p = 0.05$ ) volumetric power (0.11–0.13 W/m<sup>3</sup>), 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

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

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

Publication date: 1 Dec 2019

Peer-reviewed: Yes

### Publication information

Journal: Bioresource Technology

Volume: 294

Article number: 122115

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2019): CiteScore 12.8 SJR 2.43 SNIP 2.012

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

DOIs:

10.1016/j.biortech.2019.122115

Source: Scopus

Source ID: 85072279751

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

### **Towards the EU emission targets of 2050: Cost-effective emission reduction in Finnish detached houses**

To mitigate the effects of climate change, the European Union calls for major carbon emission reductions in the building sector through a deep renovation of the existing building stock. This study examines the cost-effective energy retrofit measures in Finnish detached houses. The Finnish detached house building stock was divided into four age classes according to the building code in effect at the time of their construction. Multi-objective optimization with a genetic algorithm was used to minimize the life cycle cost and CO<sub>2</sub> emissions in each building type for five different main heating systems (district heating, wood/oil boiler, direct electric heating, and ground-source heat pump) by improving the building envelope and systems. Cost-effective emission reductions were possible with all heating systems, but especially with ground-source heat pumps. Replacing oil boilers with ground-source heat pumps (GSHPs), emissions could be reduced by 79% to 92% across all the studied detached houses and investment levels. With all the other heating systems, emission reductions of 20% to 75% were possible. The most cost-effective individual renovation measures were the installation of air-to-air heat pumps for auxiliary heating and improving the thermal insulation of external walls.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Responsible Construction, Aalto University

Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.

Number of pages: 29

Publication date: 19 Nov 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Energies

Volume: 12

Issue number: 22

Article number: 4395

ISSN (Print): 1996-1073

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.635 SNIP 1.154

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: Deep renovation, Detached house, Energy retrofit, Genetic algorithm, Greenhouse gas emissions, Heat pump, Multi-objective optimization

Electronic versions:

energies-12-04395

DOIs:

10.3390/en12224395

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001131194>

Source: Scopus

Source ID: 85076020206

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

### **Potential of renewable fuel to reduce diesel exhaust particle emissions**

The use of fossil fuels in traffic is a significant source of air pollutants and greenhouse gases in rapidly growing and densely populated cities. Diesel exhaust emissions including particle number concentration and size distribution along with the particles' chemical composition and NO<sub>x</sub> were investigated from a Euro 4 passenger car with a comprehensive set of high time-resolution instruments. The emissions were compared with three fuel standards – European diesel (EN590), Indian diesel (BS IV) and Finnish renewable diesel (Neste MY) – over the New European Driving Cycle (NEDC) and the Worldwide harmonized Light vehicles Test Cycle (WLTC). Fuel properties and driving conditions strongly affected exhaust emissions. The exhaust particulate mass emissions for all fuels consisted of BC (81–88%) with some contribution from organics (11–18%) and sulfate (0–3%). As aromatic-free fuel, the MY diesel produced around 20% lower black carbon (BC) emissions compared to the EN590 and 29–40% lower compared to the BS IV. High volatile nanoparticle concentrations at high WLTC speed conditions were observed with the BS IV and EN590 diesel, but not with the sulfur-free MY diesel. These nanoparticles were linked to sulfur-driven nucleation of new particles in cooling dilution of the exhaust. For all the fuels non-volatile nanoparticles in sub-10 nm particle sizes were observed during engine braking, and they were most likely formed from lubricant-oil-originated compounds. With all the fuels, the measured particulate and NO<sub>x</sub> emissions were significantly higher during the WLTC cycle compared to the NEDC cycle. This study demonstrated that renewable diesel fuels enable mitigations of particulate and climate-warming BC emissions of traffic, and will simultaneously help tackle urban air quality problems.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Department of Automotive and Mechanical Engineering, Metropolia University of Applied Sciences, Finnish Meteorological Institute, The Energy and Resources Institute India, Neste Oyj

Contributors: Pirjola, L., Kuuluvainen, H., Timonen, H., Saarikoski, S., Teinilä, K., Salo, L., Datta, A., Simonen, P., Karjalainen, P., Kulmala, K., Rönkkö, T.

Publication date: 15 Nov 2019

Peer-reviewed: Yes

### Publication information

Journal: Applied Energy

Volume: 254

Article number: 113636

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2019): CiteScore 16.4 SJR 3.607 SNIP 2.865

Original language: English

ASJC Scopus subject areas: Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law

Keywords: Black carbon, Combustion, New European Driving Cycle, Renewable fuel, Traffic emissions, Worldwide harmonized Light vehicles Test Cycle

Electronic versions:

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DOIs:

10.1016/j.apenergy.2019.113636

URLs:

<http://urn.fi/URN:NBN:fi:ty-201909092081>

### Bibliographical note

EXT="Pirjola, Liisa"

Source: Scopus

Source ID: 85070211798

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

### Maximum perturbation step size in MPP-Tracking control for ensuring predicted PV power settling behavior

The heuristic perturb-and-observe-based maximum-power-point tracking (MPPT) algorithm of photovoltaic (PV) generator is still the most popular technique in use, despite the broad spectrum of developed other MPPT algorithms. The correct direction of the next perturbation step requires that the previous perturbation is settled down properly and the applied perturbation step size is large enough to overcome the PV-power changes induced by the varying irradiation level and/or the power-grid-originated PV-voltage ripple. The requirements for the minimum perturbation step size are well defined in the available literature. The design equations to predict the PV-power settling time are derived by assuming that the PV-interfacing converter operates in continuous conduction mode (CCM). A large perturbation step size may drive the interfacing converter to enter into discontinuous conduction mode (DCM), which will delay the PV-power settling process and destroy the validity of the predicted settling times. In order to avoid confusing the MPPT process, the maximum perturbation step size has to be limited as well. This paper provides theoretical foundations for the proper design of the maximum step size based on the DC-DC interfacing-converter dynamic behavior. The theoretical findings are validated with experiments as well as by simulations by means of a boost-type DC-DC converter and real PV panel.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Suntio, T., Kuperman, A.

Number of pages: 19

Publication date: 19 Oct 2019

Peer-reviewed: Yes

### Publication information

Journal: Energies

Volume: 12

Issue number: 20

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ISSN (Print): 1996-1073

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.635 SNIP 1.154

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: MPP tracking, Perturbation step size, PV generator, Transient settling time

Electronic versions:

energies-12-03984

DOIs:

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URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912126795>

Source: Scopus

Source ID: 85075001066

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

### **Performance of Solar Cell Grids based on Ag, Au, and Al for Cost-Effective Manufacturing**

We report on the performance of contact grids based on Ag, Al, and Au applied to III-V multijunction solar cells. We compare their suitability as grid metals from different perspectives, including price, mass-to-conductivity ratio, and abundance. The grid functionality was evaluated by performing charge transport experiments under simulated sunlight. The best solar cell performance was obtained for Ag contacts. On the other hand, Al and Ag provide the most cost-effective approach: when compared to Au for equal conductivities, the cost for the grid material being only about 1.1% in the case of Ag, and 0.7% for Al.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Research group: ORC

Contributors: Raappana, M., Aho, A., Aho, T., Isoaho, R., Anttola, E., Kajas, N., Polojärvi, V., Tukiainen, A., Guina, M.

Publication date: Oct 2019

#### **Host publication information**

Title of host publication: 2019 European Space Power Conference (ESPC)

Publisher: IEEE

ISBN (Print): 978-1-7281-2127-7

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

Keywords: Solar Cell, Semiconducting III-V Materials

DOIs:

10.1109/ESPC.2019.8932002

#### **Bibliographical note**

INT=PHYS, "Anttola, Elina"

INT=PHYS, "Kajas, Ninja"

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

### **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.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Automation and Systems Theory, Automation Technology and Mechanical Engineering  
Contributors: Cai, Y., Ferrer, B. R., Lastra, J. L. M.  
Publication date: 1 Sep 2019  
Peer-reviewed: Yes

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Article number: 4633  
ISSN (Print): 2071-1050  
Ratings:

Scopus rating (2019): CiteScore 3.2 SJR 0.581 SNIP 1.165

Original language: English

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

Keywords: Artificial intelligence, EU-China, Machine learning, Science, technology and innovation cooperation, Transdisciplinary approach, Transnational industry cooperation, Transnational innovation ecosystem, Transnational university cooperation

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URLs:

<http://urn.fi/URN:NBN:fi:tuni-201909193416>

Source: Scopus

Source ID: 85071972293

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

#### 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

Publication status: Published

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., Kontinen, J., Kojo, M.

Publication date: 1 Sep 2019

Peer-reviewed: Yes

#### Publication information

Journal: Sustainability  
Volume: 11  
Issue number: 17  
Article number: 4750  
ISSN (Print): 2071-1050  
Ratings:

Scopus rating (2019): CiteScore 3.2 SJR 0.581 SNIP 1.165

Original language: English

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

Electronic versions:

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DOIs:

10.3390/su11174750

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201909193417>

Source: Scopus

Source ID: 85071977101

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**

Publication status: Published

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.

Number of pages: 9

Pages: 518-526

Publication date: 1 Sep 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Cleaner Production

Volume: 230

ISSN (Print): 0959-6526

Ratings:

Scopus rating (2019): CiteScore 10.9 SJR 1.886 SNIP 2.394

Original language: English

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

Keywords: Business models, Business networks, Circular economy, Hazardous resources, Value creation

DOIs:

10.1016/j.jclepro.2019.05.121

Source: Scopus

Source ID: 85066124307

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

### **Cost optimal energy performance renovation measures in a municipal service building in a cold climate**

The energy saving potential of existing buildings is significant compared to new buildings in the EU region. To reduce significantly the CO<sub>2</sub> emissions of buildings, energy efficiency of old buildings need to be improved. Aim of this study is to determine cost-optimal solutions for energy renovation and renewable energy production systems for an old existing service building. The example building of this study is a residence for elderly people, which was built in 1955 and located in Finland. This study was carried out by a dynamic building simulation tool IDA-ICE and multi objective optimization tool MOBO. The cost-optimal renovation concepts were determined from over 2.6 billion renovation measure combinations to minimize both target energy consumption and life-cycle costs over 20 years. The results show that air-to-water heat pump is more cost effective heating system for the studied building than district heating from the building owner point of view. Improving thermal insulation level of the external walls from the original level is not the most cost-effective option to

improve the energy efficiency of the building. Instead of that, for example, installation of PV and solar thermal systems are recommended in all the cost-optimal solutions regardless of the target energy consumption level.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Civil Engineering, Aalto University, Finnish Environment Institute, Nanjing Tech University

Contributors: Jokisalo, J., Sankelo, P., Vinha, J., Sirén, K., Kosonen, R.

Publication date: 13 Aug 2019

#### Host publication information

Title of host publication: CLIMA 2019 Congress : Bucharest, Romania, May 26-29, 2019

Publisher: EDP Sciences

#### Publication series

Name: E3S Web of Conferences

Volume: 111

ISSN (Print): 2555-0403

ASJC Scopus subject areas: Environmental Science(all), Energy(all), Earth and Planetary Sciences(all)

Electronic versions:

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DOIs:

10.1051/e3sconf/201911103022

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911196066>

#### Bibliographical note

jufoid=86108

Source: Scopus

Source ID: 85071852938

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

#### Optimization of emission reducing energy retrofits in Finnish apartment buildings

This study examined the cost-optimality of energy renovation on Finnish apartment buildings of different ages, built according to different energy performance requirements. Multi-objective optimization was utilized to minimize both CO<sub>2</sub> emissions and life cycle cost (LCC). IDA-ICE simulations were performed to obtain the hourly heating demand of the buildings. Four building age classes and three heating systems (district heating, exhaust air heat pump and ground-source heat pump) were separately optimized. With district heating, it was possible to reduce emissions by 11%, while also reducing LCC. With heat pumps cost-savings could be achieved while reducing emissions by over 49%. With maximal (not cost-effective) investments, emissions could be reduced by more than 70% in all examined cases. In all cases, the cheapest solutions included solar electricity and sewage heat recovery. In old buildings, window upgrades and additional roof insulation were cost-effective. In new buildings, demand-based ventilation was included in all optimal solutions.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Civil Engineering, Aalto University

Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.

Publication date: 13 Aug 2019

#### Host publication information

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Publisher: EDP Sciences

Article number: 03002

#### Publication series

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ASJC Scopus subject areas: Environmental Science(all), Energy(all), Earth and Planetary Sciences(all)

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#### Bibliographical note

jufoid=86108

Source: Scopus

Source ID: 85071843244

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

### **Understanding tariff designs and consumer behaviour to employ electric vehicles for secondary purposes in the United Kingdom**

Electric Vehicle (EV) uptake has increased rapidly in the recent years. The rate of EV use is likely to increase in the future as well. At this point, the topic of using EVs for secondary purposes other than mobility and transport is getting more popular. This paper outlines the importance of tariff designs and EV consumer behaviour in achieving the business models such as Vehicle-to-Grid (V2G) and Vehicle-to-Home (V2H). We took the United Kingdom (UK) as a case study country to demonstrate how crucial electricity tariffs and consumer behaviour are.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Industrial Engineering and Management, University of Cambridge

Contributors: Küfeoğlu, S., Melchiorre, D. A., Kotilainen, K.

Number of pages: 6

Pages: 1-6

Publication date: 1 Jul 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: ELECTRICITY JOURNAL

Volume: 32

Issue number: 6

ISSN (Print): 1040-6190

Ratings:

Scopus rating (2019): CiteScore 2.7 SJR 0.616 SNIP 0.825

Original language: English

ASJC Scopus subject areas: Business and International Management, Energy (miscellaneous), Management of Technology and Innovation, Law

Keywords: Electric vehicle, Tariff, V2G, V2H

DOIs:

10.1016/j.tej.2019.05.011

Source: Scopus

Source ID: 85066131134

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

### **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  $8.2 \text{ mA/cm}^2$ . 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.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

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.

Number of pages: 6

Pages: 198-203

Publication date: 15 Jun 2019

Peer-reviewed: Yes

#### **Publication information**

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Volume: 195

ISSN (Print): 0927-0248

Ratings:

Scopus rating (2019): CiteScore 11.6 SJR 1.827 SNIP 1.799

Original language: English

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

Keywords: Dilute nitrides, GaInNAsSb, Molecular beam epitaxy, Multijunction solar cells

Electronic versions:

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DOIs:

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URLs:

<http://www.scopus.com/inward/record.url?scp=85062810786&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85062810786

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**

Publication status: Published

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.

Publication date: 1 Jun 2019

#### **Host publication information**

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Publisher: IEEE

Editors: Rodrigues, J. J., Solic, P., Perkovic, T., Vukojevic, K., Rodrigues, J. J., Patrono, L., Nizetic, S.

ISBN (Electronic): 9789532900910

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

Keywords: energy-efficient buildings, outdoor-To-indoor propagation, penetration loss, plastering net, Radiowave propagation, RF measurements

DOIs:

10.23919/SpliTech.2019.8783022

#### **Bibliographical note**

INT=ceng,"Pikkuvirta, Jussa"

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

Publication status: Published

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.

Number of pages: 15

Pages: 418-432

Publication date: 1 Jun 2019

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Green Communications and Networking

Volume: 3

Issue number: 2

Article number: 8616818

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Ratings:

Scopus rating (2019): CiteScore 5.5 SJR 1.18 SNIP 1.804

Original language: English

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

Keywords: 5G, discontinuous reception, energy efficiency, microsleep, power saving, signaling, UE, wake-up scheme

DOIs:

10.1109/TGCN.2019.2893504

#### Bibliographical note

EXT="Rostami, Soheil"

Source: Scopus

Source ID: 85066002345

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

#### Artificial intelligence yesterday, today and tomorrow

Artificial Intelligence (AI) is one of the current emerging technologies. In the history of computing AI has been in the similar role earlier - almost every decade since the 1950s, when the programming language Lisp was invented and used to implement self-modifying applications. The second time that AI was described as one of the frontier technologies was in the 1970s, when Expert Systems (ES) were developed. A decade later AI was again at the forefront when the Japanese government initiated its research and development effort to develop an AI-based computer architecture called the Fifth Generation Computer System (FGCS). Currently in the 2010s, AI is again on the frontier in the form of (self-)learning systems manifesting in robot applications, smart hubs, intelligent data analytics, etc. What is the reason for the cyclic reincarnation of AI? This paper gives a brief description of the history of AI and also answers the question above. The current AI "cycle" has the capability to change the world in many ways. In the context of the CE conference, it is important to understand the changes it will cause in education, the skills expected in different professions, and in society at large.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Tallinn University of Technology, University of Lapland, Computer Science Institute

Contributors: Jaakkola, H., Henno, J., Mäkelä, J., Thalheim, B.

Number of pages: 8

Pages: 860-867

Publication date: 1 May 2019

#### Host publication information

Title of host publication: 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2019 - Proceedings

Publisher: IEEE

Editors: Skala, K., Car, Z., Pale, P., Huljenic, D., Janjic, M., Koracic, M., Sruk, V., Ribaric, S., Grbac, T. G., Butkovic, Z., Cicin-Sain, M., Skvorc, D., Mauher, M., Babic, S., Gros, S., Vrdoljak, B., Tijan, E.

ISBN (Electronic): 9789532330984

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Information Systems, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials

Keywords: Artificial Intelligence, Computer, Computer-supported decision-making, Deep learning, Education, Emerging technology, Expert Systems, Fifth Generation Computer, Frontier technology, Learning, Lisp, Prolog

DOIs:

10.23919/MIPRO.2019.8756913

URLs:

[http://docs.mipro-proceedings.com/proceedings/mipro\\_2019\\_proceedings.pdf](http://docs.mipro-proceedings.com/proceedings/mipro_2019_proceedings.pdf)

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

### **Intelligent data service for farmers**

The agricultural sector in Finland has been lagging behind in digital development. Development has long been based on increasing production by investing in larger machines. Over the past decade, change has begun to take place in the direction of digitalization. One of the challenges is that different manufacturers are trying to get farmers' data on their own closed cloud services. In the worst case, farmers may lose an overall view of their farms and opportunities for deeper data analysis because their data is located in different services. The goals and previously studied challenges of the 'MIKÄ DATA' project are described in this research. This project will build an intelligent data service for farmers, which is based on the Oskari platform. In the 'Peltodata' service, farmers can see their own field data and many other data sources layer by layer. The project is focused on the study of machine learning techniques to develop harvest yield prediction and find out the correlation between many data sources. The 'Peltodata' service will be ready at the end of 2019.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences

Contributors: Linna, P., Narra, N., Grönman, J.

Number of pages: 4

Pages: 1072-1075

Publication date: 1 May 2019

### **Host publication information**

Title of host publication: 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2019 - Proceedings

Publisher: IEEE

Editors: Skala, K., Car, Z., Pale, P., Huljenic, D., Janjic, M., Koricic, M., Sruk, V., Ribaric, S., Grbac, T. G., Butkovic, Z., Cicin-Sain, M., Skvorc, D., Mauher, M., Babic, S., Gros, S., Vrdoljak, B., Tijan, E.

ISBN (Electronic): 9789532330984

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Information Systems, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials

Keywords: Agriculture, Artificial intelligence, Platform

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[http://docs.mipro-proceedings.com/proceedings/mipro\\_2019\\_proceedings.pdf](http://docs.mipro-proceedings.com/proceedings/mipro_2019_proceedings.pdf)

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

### **Teaching for virtual work**

Universities are still mainly preparing students for the world, where 'do something useful', i.e. 'do something with your hands' was the main principle and work was done during strictly regulated time. But world has changed and traditional areas of human activity (what also are the main target in University courses) are rapidly diminishing. More important have become virtual products - computer programs, mobile apps, social networks, new types of digital currencies, IOT (voice in your bathroom suggesting to buy the next model of Alexa), video games, interactive TV, virtual reality etc. Most of these new areas are not present in current curricula and there are problems with involving them in curricula - (working) students know (some aspects of) these areas better than many of university teachers, since corresponding knowledge is not yet present in textbooks - it is present only on Internet. The Internet strongly influences both what we teach and how we teach.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Tallinn University of Technology, University of Lapland

Contributors: Henno, J., Jaakkola, H., Mäkelä, J.

Number of pages: 9

Pages: 818-826

Publication date: 1 May 2019

### Host publication information

Title of host publication: 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2019 - Proceedings

Publisher: IEEE

Editors: Skala, K., Car, Z., Pale, P., Huljenic, D., Janjic, M., Koracic, M., Sruk, V., Ribaric, S., Grbac, T. G., Butkovic, Z., Cicin-Sain, M., Skvorc, D., Mauher, M., Babic, S., Gros, S., Vrdoljak, B., Tijan, E.

ISBN (Electronic): 9789532330984

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Information Systems, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials

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[http://docs.mipro-proceedings.com/proceedings/mipro\\_2019\\_proceedings.pdf](http://docs.mipro-proceedings.com/proceedings/mipro_2019_proceedings.pdf)

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

### 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

Publication status: Published

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.

Number of pages: 11

Pages: 47-57

Publication date: 1 Apr 2019

Peer-reviewed: Yes

### Publication information

Journal: Sustainable Energy Technologies and Assessments

Volume: 32

ISSN (Print): 2213-1388

Ratings:

Scopus rating (2019): CiteScore 5.4 SJR 1.165 SNIP 1.294

Original language: English

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

Keywords: Biogas, Circular economy, Location-allocation, Network analysis, Wood terminal

Electronic versions:

laasasenaho\_gis-data\_related\_route. Embargo ended: 7/02/21

DOIs:

10.1016/j.seta.2019.01.006

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910033674>. Embargo ended: 7/02/21

Source: Scopus

Source ID: 85061098980

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

### 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

Publication status: Published

MoE publication type: A4 Article in a conference publication

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.

Publication date: 20 Feb 2019

#### Host publication information

Title of host publication: 2018 IEEE Global Communications Conference

Publisher: IEEE

Article number: 8647778

ISBN (Electronic): 9781538647271

ASJC Scopus subject areas: Information Systems and Management, Renewable Energy, Sustainability and the Environment, Safety, Risk, Reliability and Quality, Signal Processing, Modelling and Simulation, Instrumentation, Computer Networks and Communications

DOIs:

10.1109/GLOCOM.2018.8647778

Source: Scopus

Source ID: 85063500863

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

#### 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.

Publication date: 20 Feb 2019

#### Host publication information

Title of host publication: 2018 IEEE Global Communications Conference, GLOBECOM 2018

Publisher: IEEE

ISBN (Electronic): 9781538647271

ASJC Scopus subject areas: Information Systems and Management, Renewable Energy, Sustainability and the Environment, Safety, Risk, Reliability and Quality, Signal Processing, Modelling and Simulation, Instrumentation, Computer Networks and Communications

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<http://urn.fi/URN:NBN:fi:tuni-202001281600>

Source: Scopus

Source ID: 85063532495

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

### **The potential of electric trucks – An international commodity-level analysis**

Development of battery technology is making battery electric heavy duty trucks technically and commercially viable and several manufacturers have introduced battery electric trucks recently. However, the national and sectoral differences in freight transport operations affect the viability of electric trucks. The aim of this paper is to develop a methodology for estimating the potential of electric trucks and demonstrate the results in Switzerland and Finland. Commodity-level analysis of the continuous road freight survey data were carried out in both countries. As much as 71% of Swiss road freight transport tonne-kilometers may be electrified using battery electric trucks but Finland has very limited potential of 35%, due to the use of long and heavy truck-trailer combinations. Within both countries the electrification potential varies considerably between commodities, although in Finland more so than in Switzerland. Commodities which are constrained by payload volume rather than weight and are to large extent carried using medium duty or <26t rigid trucks seem to provide high potential for electrification even with the current technology. Electric trucks increase the annual electricity consumption by only 1–3%, but truck charging is likely to have a large impact on local grids near logistics centres and rest stations along major roads. A spatial analysis by routing the trips reported in the datasets used in this study should be carried out. Future research should also include comparison between the alternate ways of electrifying road freight transport, i.e. batteries with charging, batteries with battery swapping and electrified road systems.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Transport Research Centre Verne, Civil Engineering, HCl e 486.1

Contributors: Liimatainen, H., van Vliet, O., Aplyn, D.

Number of pages: 11

Pages: 804-814

Publication date: 15 Feb 2019

Peer-reviewed: Yes

Early online date: 14 Dec 2018

#### **Publication information**

Journal: Applied Energy

Volume: 236

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2019): CiteScore 16.4 SJR 3.607 SNIP 2.865

Original language: English

ASJC Scopus subject areas: Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law

Keywords: Charging infrastructure, Electric trucks, Logistics, Road freight transport

Electronic versions:

1-s2.0-S0306261918318361-main

DOIs:

10.1016/j.apenergy.2018.12.017

URLs:

<http://urn.fi/URN:NBN:fi:tty-201901081024>

Source: Scopus

Source ID: 85058374379

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

### **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: A2 Review article in a scientific journal

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.

Publication date: 31 Jan 2019

Peer-reviewed: Yes

### Publication information

Journal: Energies

Volume: 12

Issue number: 3

Article number: 464

ISSN (Print): 1996-1073

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.635 SNIP 1.154

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

DOIs:

10.3390/en12030464

URLs:

<http://www.scopus.com/inward/record.url?scp=85060952873&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85060952873

Research output: Contribution to journal > Review 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

Publication status: Published

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.

Publication date: 27 Jan 2019

Peer-reviewed: Yes

### Publication information

Journal: Energies

Volume: 12

Issue number: 3

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ISSN (Print): 1996-1073

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.635 SNIP 1.154

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

Electronic versions:

energies-12-00399-v2

DOIs:

10.3390/en12030399

URLs:

<http://urn.fi/URN:NBN:fi:tty-201905021455>

Source: Scopus

Source ID: 85060911593

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

### **The economics of renewable CaC<sub>2</sub> and C<sub>2</sub>H<sub>2</sub> production from biomass and CaO**

This article presents the economics of a bio-based CaC<sub>2</sub>/C<sub>2</sub>H<sub>2</sub> production concept plant. The aim of the research was to study if renewable CaC<sub>2</sub>/C<sub>2</sub>H<sub>2</sub> 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 CaC<sub>2</sub> were determined based on the wood char production costs as well as the EAF electric power consumption. The results showed that the C<sub>2</sub>H<sub>2</sub> 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 CaC<sub>2</sub> and C<sub>2</sub>H<sub>2</sub>. With the chosen basic feedstock (20 €/MWh) and electricity prices (45 €/MWh) the production costs of CaC<sub>2</sub> were calculated to be 725 €/t and for C<sub>2</sub>H<sub>2</sub> 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 CaC<sub>2</sub> and 1940–3015 €/t for C<sub>2</sub>H<sub>2</sub> depending on the desired payback time (4–30 years). The key factors in the production costs of CaC<sub>2</sub> and C<sub>2</sub>H<sub>2</sub> 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**

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

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

Number of pages: 9

Pages: 40–48

Publication date: 1 Jan 2019

Peer-reviewed: Yes

Early online date: 10 Nov 2018

#### **Publication information**

Journal: Biomass and Bioenergy

Volume: 120

ISSN (Print): 0961-9534

Ratings:

Scopus rating (2019): CiteScore 6.6 SJR 1.11 SNIP 1.415

Original language: English

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

Keywords: /C, H, Poly-generation, Renewable CaC, Renewable chemicals, Techno-economic evaluation

DOIs:

10.1016/j.biombioe.2018.10.020

Source: Scopus

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

Ratings:

Scopus rating (2019): CiteScore 5.1 SJR 0.973 SNIP 1.307

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 overlayers 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 Ta<sub>2</sub>O<sub>5</sub>-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 Ta<sub>2</sub>O<sub>5</sub>-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 Ta<sub>2</sub>O<sub>5</sub>-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

Ratings:

Scopus rating (2019): CiteScore 17.1 SJR 3.432 SNIP 1.683

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

### Back Reflector with Diffractive Gratings for Light-Trapping in Thin-Film III-V Solar Cells

We report on the development of light-trapping architectures applied to thin-film solar cells. In particular, we focus on enhancing the absorption at 1-eV spectral range for dilute nitride and quantum dot materials and report on the influence of planar back reflectors on the photovoltaic properties. Moreover, we discuss the properties of polymer diffraction gratings with enhanced light-trapping capability pointing to advantageous properties of pyramidal gratings. In order to understand the suitability of these polymer grating architectures for space applications, we have performed an electron irradiation study (1 MeV) revealing the absence of reflectance changes up to doses of  $1 \times 10^{15} \text{ e}^-/\text{cm}^2$ .

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

Contributors: Aho, T., Tukiainen, A., Elsehrawy, F., Ranta, S., Raappana, M., Aho, A., Isoaho, R., Cappelluti, F., Guina, M.

Number of pages: 4

Publication date: 2019

### Host publication information

Title of host publication: 2019 European Space Power Conference (ESPC)

Publisher: IEEE

ISBN (Print): 978-1-7281-2127-7

ISBN (Electronic): 978-1-7281-2126-0

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

Keywords: Solar Cell, Semiconducting III-V Materials

DOIs:

10.1109/ESPC47532.2019.9049262

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > 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  $\text{CO}_2$  (< 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., Dessi, 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

Ratings:

Scopus rating (2019): CiteScore 3.6 SJR 0.569 SNIP 1.035

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 Pd/Al<sub>2</sub>O<sub>3</sub>

The semi-hydrogenation of acetylene ( $C_2H_2 + H_2 = C_2H_4$ ,  $\Delta H = -172 \text{ kJ mol}^{-1}$ ) 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<sub>2</sub>O<sub>3</sub> 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  $5 \text{ s}^{-1}$ . 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 Pd<sub>30</sub>/Al<sub>2</sub>O<sub>3</sub>(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

Ratings:

Scopus rating (2019): CiteScore 8 SJR 1.141 SNIP 1.377

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

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes

Keywords: Building simulation, daycare building, life-cycle cost, multi-objective optimisation, simulation-based optimisation, target energy use

Electronic versions:

Jokisalo - Cost-optimal energy performance measures in a new daycare building in cold climate. Embargo ended: 14/03/19

DOIs:

10.1080/14786451.2018.1448398

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911186054>. Embargo ended: 14/03/19

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

### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Aalto University, Nanjing Tech University

Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.

Publication date: 2019

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Sustainable Energy

ISSN (Print): 1478-6451

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes

Keywords: apartment building, 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

### Guest editorial joint special section on power conversion & control in photovoltaic power plants

#### General information

Publication status: Published

MoE publication type: B1 Article in a scientific magazine

Organisations: Electrical Engineering, Research group: Power electronics, University of Washington Seattle, University of New Brunswick, Crop and Soil Sciences, Cornell Univ., University of Memphis, Fraunhofer IWES, National Taiwan University, University of Texas at Arlington, University of Minnesota Twin Cities, Clemson University, Sandia National Laboratories, New Mexico, University of Wollongong, Technical University of Crete, University of Alberta, Computer Science Institute, University of Cambridge, Temple University, Universita degli Studi di Padova, Italy, Universitat Politècnica de Catalunya, Nanjing University of Aeronautics and Astronautics, Aalborg University, Huazhong University of Science and Technology, Ryerson University, Khalifa University, University of Technology Sydney

Contributors: Johnson, B., Chang, L., Afridi, K., Ali, M. H., Von Appen, J., Chen, Y. M., Davoudi, A., Dhople, S., Enslin, J. H., Flicker, J., Islam, M. R., Koutroulis, E., Kim, K. A., Li, Y., Liserre, M., Long, T., Lu, X., Mattavelli, P., Rodriguez, P., Ruan, X., Suntio, T., Wang, H., Xu, D., Xu, W., Yazdani, A., Zeineldin, H., Zhu, J.

Number of pages: 2

Pages: 159-160

Publication date: 2019

Peer-reviewed: No

#### Publication information

Journal: IEEE Transactions on Energy Conversion

Volume: 34

Issue number: 1

ISSN (Print): 0885-8969

Ratings:

Scopus rating (2019): CiteScore 9.3 SJR 1.776 SNIP 1.965

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1109/TEC.2019.2895778

Source: Scopus

Source ID: 85062840015

Research output: Contribution to journal › Editorial › Scientific

### 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

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.635 SNIP 1.154

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:tty-201909022052>

Source: Scopus

Source ID: 85068784950

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

### Narrow Bandgap Dilute Nitride Materials for 6-junction Space Solar Cells

Narrow bandgap p-i-n dilute nitride GaInNAsSb junctions, for use as bottom cell in 6-junction solar cells, are reported. In particular, we demonstrate a high optical quality for GaInNAsSb junction with a bandgap  $\sim 0.78$  eV, corresponding to a N content of 6.2%. Under AM0 illumination, such cell exhibits a photocurrent of 36.6 mA/cm<sup>2</sup>. By extracting the parameters of the experimental cell, we estimate the the AM0 efficiency of a 6-junction multijunction solar cell employing the GaInNAsSb junction, to attain a value of 33%. Further improvements are discussed towards achieving the full potential of the 6-junction design.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

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

Number of pages: 3

Publication date: 2019

### Host publication information

Title of host publication: 2019 European Space Power Conference (ESPC)

Publisher: IEEE

ISBN (Print): 978-1-7281-2127-7

ISBN (Electronic): 978-1-7281-2126-0

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

Keywords: Solar cell, dilute nitride semiconductors, III-V semiconductor

Electronic versions:

Narrow Bandgap Dilute Nitride Materials 2019

DOIs:

10.1109/ESPC47532.2019.9049263

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009106949>

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > 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

Ratings:

Scopus rating (2019): CiteScore 3.8 SJR 0.635 SNIP 1.154

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

URLs:

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

Source: Scopus

Source ID: 85066827333

Research output: Contribution to journal > Editorial > Scientific

## Remote diagnostics application software for remote handling equipment

The ITER Remote Handling Control System (RHCS) controllers provide measurement and diagnostics data about the remote handling equipment and tools they control. This paper presents the Remote Diagnostics Application (RDA) software for the analysis and archiving of the RHCS diagnostics data. The RDA provides a basic set of diagnostics tools, including trends, spectra, histograms, scatter plots, cross-correlation plots, as well as archiving and retrieval of history data. The ITER RH operators can extend diagnostics capabilities for specific RH equipment needs by incorporating custom diagnostics functions. To facilitate customization, RDA implements an architecture with three nested levels: the RDA Framework, its Diagnostics Workbenches and their Diagnostics Primitives. The RDA Framework has a user interface that can load one or several special diagnostics cases implemented as custom Diagnostics Workbenches with custom or default Diagnostics Primitives, such as rules, analysis functions and filters. As a result, the RDA features a diagnostics framework to execute complex and dedicated diagnostics and prognostics for the RH experts to monitor performance data, to run diagnostics tests and rules on equipment systems and to analyse historical data. The RDA helps the RH operators reduce downtime of the Remote Handling systems by exposing failure conditions and maintenance needs.

### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Automation Technology and Mechanical Engineering, VTT Technical Research Centre of Finland, Fusion For Energy (F4E)

Contributors: Alanen, J., Ruiz Morales, E., Muhammad, A., Saarinen, H., Minkkinen, J.

Publication date: 2019

Peer-reviewed: Yes

### Publication information

Journal: Fusion Engineering and Design

ISSN (Print): 0920-3796

Ratings:

Scopus rating (2019): CiteScore 2.7 SJR 0.558 SNIP 1.049

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Nuclear Energy and Engineering, Materials Science(all), Mechanical Engineering

Keywords: Control system, Diagnostics, Prognostics, Remote handling, Software

DOIs:

10.1016/j.fusengdes.2019.01.125

#### **Bibliographical note**

EXT="Saarinen, Hannu"

Source: Scopus

Source ID: 85060619368

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

#### **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., Konttinen, 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

Ratings:

Scopus rating (2019): CiteScore 3.2 SJR 0.581 SNIP 1.165

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 €/m<sup>2</sup>, 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

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes

Keywords: apartment building, Cost-optimal renovation, energy performance, greenhouse gas emissions, multi-objective optimisation

DOIs:

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  $\mu\text{m}$  (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  $\mu\text{m}$ , 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 6.5 SJR 1.072 SNIP 1.275

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

### Energiatehokkaan 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. Energiatehokkaan arkkitehtisuunnittelun ohjekortisto  
URLs:  
<http://urn.fi/URN:NBN:fi:tty-201901221135>  
Research output: Book/Report › Book › Professional

#### Peruskoulut ja energiatehokkuus: 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 energiatehokkuus  
URLs:  
<http://urn.fi/URN:ISBN:978-952-15-4287-9>  
Research output: Book/Report › Book › Professional

#### 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 8.7 SJR 1.62 SNIP 2.317

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

### Flux-Weakening Control for IPMSM Employing Model Order Reduction

The variation of magnetic parameters due to the magnetic saturation and cross coupling can affect the efficiency and the stability of the control system in electrical machines, especially at high-speed operation. This paper presents an approach independent of the magnetic model parameters to control synchronous motors at the flux-weakening region. In this approach, a model order reduction technique is applied to reduce the finite element model of a synchronous machine. The stator current components and the flux linkage components are the inputs and the outputs of the reduced model, respectively. The reduced model and its inversion are employed to calculate the current reference components from the reference torque. Field oriented control scheme is utilized to implement the overall control system. The proposed control system is validated by means of simulation and experiment on a 2.2 kW permanent magnet synchronous machine.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Aalto University, Tallinn University of Technology

Contributors: Far, M. F., Mustafa, B., Martin, F., Rasilo, P., Belahcen, A.

Number of pages: 7

Pages: 1510-1516

Publication date: 24 Oct 2018

### Host publication information

Title of host publication: 2018 23rd International Conference on Electrical Machines, ICEM 2018

Publisher: IEEE

ISBN (Electronic): 9781538624777

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering, Mechanical Engineering

Keywords: Flux weakening, Interior permanent magnet synchronous motor, Model order reduction, Orthogonal interpolation method, Vector control

Electronic versions:

Flux-Weakening Control for IPMSM Employing Model Order Reduction

DOIs:

10.1109/ICELMACH.2018.8506693

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910023644>

Source: Scopus

Source ID: 85057179831

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

### Model Order Reduction of Bearingless Reluctance Motor Including Eccentricity

Eccentricity in a bearingless motor may occur during different operating states of the machine. This rises challenges in designing robust control for the machine with a lumped parameter model, due to the cross coupling of the windings with respect to the eccentric position of the rotor, the saturation of the ferromagnetic material, and spatial complexity. The non-

linearity of the ferromagnetic material and the spatial harmonics can be considered in a finite element model of the machine, although applying it in a real time system is unreasonable. We propose a novel method based on orthogonal interpolation to reduce the order of the 2D finite element model of a bearingless synchronous reluctance motor, suitable for implementation in a real-time system. The winding currents and the eccentricity are given as inputs to the reduced model and the nodal values of the magnetic vector potential is obtained as the output, wherefrom the flux linkages, torque, and forces can be computed easily.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Aalto University, Tallinn University of Technology

Contributors: Far, M. F., Mukherjee, V., Martin, F., Rasilo, P., Belahcen, A.

Number of pages: 7

Pages: 2243-2249

Publication date: 24 Oct 2018

#### **Host publication information**

Title of host publication: 2018 23rd International Conference on Electrical Machines, ICEM 2018

Publisher: IEEE

ISBN (Electronic): 9781538624777

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering, Mechanical Engineering

Keywords: Bearingless synchronous reluctance motor, Eccentricity, Finite element analysis, Model order reduction, Orthogonal interpolation method

Electronic versions:

Model Order Reduction of Bearingless Reluctance Motor Including Eccentricity

DOIs:

10.1109/ICELMACH.2018.8506758

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910023643>

Source: Scopus

Source ID: 85057162208

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

#### **A comparative analysis of global datasets and initiatives for urban health and sustainability**

Globally, urban populations are growing rapidly, and in most cases their demands for resources are beyond current limits of sustainability. Cities are therefore critical for achieving national and international sustainability objectives, such as greenhouse gas reduction. Improving sustainability may also provide opportunities for urban population health co-benefits by reducing unhealthy exposures and behaviours. However, there is currently sparse empirical evidence on the degree to which city characteristics are associated with variations in health-related exposures, behaviours and sustainability. This paper examines the feasibility of aggregating empirical data relating to sustainability and health for global cities. An initial scoping review of existing English-language datasets and networks is performed. Resulting datasets are analysed for data types, collection method, and the distribution of contributing cities across climates, population sizes, and wealth. The review indicates datasets are populated using inconsistent methodologies and metrics and have poor overlap of cities between them. Data and organisations tend to be biased towards larger and wealthier cities, and concentrated in Europe and North America. Therefore, despite vast amounts of available data, limitations of reliability, representativeness, and disparate sources mean researchers are faced with significant obstacles when aggregating data to analyse the sustainability and health of globally representative samples of cities.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, London School of Hygiene and Tropical Medicine, The Energy and Resources Institute India, Fiocruz Bahia

Contributors: Taylor, J., Haines, A., Milner, J., Davies, M., Wilkinson, P., Sehgal, M., Singh, K. N., Barreto, M., Vianna, N., Teles, C.

Publication date: 11 Oct 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Sustainability (Switzerland)

Volume: 10

Issue number: 10

Article number: 3636

ISSN (Print): 2071-1050

Ratings:

Scopus rating (2018): CiteScore 2.8 SJR 0.549 SNIP 1.201

Original language: English

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

Keywords: Data, Health, Organizations, Sustainability, Urban

DOIs:

10.3390/su10103636

URLs:

<http://www.scopus.com/inward/record.url?scp=85054722697&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85054722697

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 13.8 SJR 1.947 SNIP 1.484

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:tty-201809212323>

Source: Scopus

Source ID: 85052096235

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

### **Cloud Enhancement Phenomenon and its Effect on PV Generators**

Due to the cloud enhancement (CE) phenomenon, global horizontal irradiance can exceed the clear sky irradiance value. Enhanced irradiance areas are formed when photons are scattering from the water droplets in clouds near the direct irradiance path. The CE is well-known as a phenomenon, but its effect on photovoltaic (PV) generators has not been thoroughly studied. Output power of a PV generator is almost directly proportional to the irradiance. Therefore, due to the CE phenomenon, output power of a PV generator can exceed the nominal power, which affects the requirements set to

the inverter. We used irradiance measurement data of 440 days from an array of pyranometers to calculate the speeds and movement directions of cloud shadows to deduce the diameters of enhancement areas. During the CE events, the irradiance values were occasionally more than 150% of the expected clear sky irradiance value. We discovered that the diameters of these extreme irradiance areas are tens of meters and, therefore, they can have a full effect on residential or commercial scale PV systems. Utility scale PV generators are in practice affected more by less extreme CE events with larger diameters, since spatial smoothing by the large generator area decreases the effects of the extreme events.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Electrical Energy Engineering  
Contributors: Järvelä, M., Lappalainen, K., Valkealahti, S.  
Pages: 1964-1968  
Publication date: 25 Sep 2018

#### Host publication information

Title of host publication: 35th European Photovoltaic Solar Energy Conference and Exhibition (35th EU PVSEC), 24–28 September, 2018, Brussels, Belgium  
ISBN (Electronic): 3-936338-50-7  
ASJC Scopus subject areas: Energy(all)  
DOIs:  
10.4229/35thEUPVSEC20182018-6CV.2.30  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Automatic Meter Infrastructure (AMI) as a part of flexibility market

This paper gives an overview, how Automatic Meter Infrastructure (AMI) enable possibilities to participate flexibility markets. Paper introduces the current situation in Finnish electricity market and role of AMI for demand response. Flexibility market places available today in Finland are introduced with their technical specifications. Possibilities and development needs in AMI in respect to these requirements are discussed. These aspects need to be evaluated when planning new AMI projects. The paper proposes a novel AMI solution and business model based on requirements of flexibility market to realize large-scale demand response of small distributed energy resources. AMI-based demand response could be one of the solutions to activate customers and seems to be an interesting option to bring small scale resources in the flexibility market in cost-efficient manner.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Electrical Energy Engineering, Research group: Power systems, Research area: Power engineering, Elenia Oy  
Contributors: Repo, S., Pylvänäinen, J., Kauppinen, M., Repo, S., Jarventausta, P.  
Number of pages: 5  
Publication date: 20 Sep 2018

#### Host publication information

Title of host publication: 15th International Conference on the European Energy Market, EEM 2018  
Volume: 2018-June  
Publisher: IEEE COMPUTER SOCIETY PRESS  
Article number: 8469765  
ISBN (Electronic): 9781538614884

#### Publication series

Name: International Conference on the European Energy Market  
ISSN (Electronic): 2165-4093  
ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology  
Keywords: Demand-side management, Power distribution, Power system management, Smart grids  
DOIs:  
10.1109/EEM.2018.8469765

#### Bibliographical note

EXT="Repo, Sirpa"  
EXT="Kauppinen, Markku"  
jufoid=70631  
Source: Scopus  
Source ID: 85055486329  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Comparison of innovation policies for electric vehicle business ecosystems**

Shift away from fossil fuel-based transportation is challenging countries to develop strategies for electric vehicle deployment. The transition offers countries also strategic opportunities in growing markets. Policy incentives are commonly used to help sustainability enhancing technologies to succeed in their journey from labs to markets. Electric vehicles are not standalone but require an ecosystem of related products, services and infrastructure and cannot be considered only from the transportation sector point of view. This paper compares electric vehicle innovation policies in four Nordic countries. The results show how different positions in the electric vehicle ecosystem these countries have chosen and how their choices reflect their economies.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Industrial and Information Management, Electrical Energy Engineering, Research group: Power systems,

Research area: Power engineering, University of Tampere

Contributors: Valta, J., Makinen, S., Kotilainen, K., Rautiainen, A., Järventausta, P.

Number of pages: 5

Publication date: 20 Sep 2018

#### **Host publication information**

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Volume: 2018-June

Publisher: IEEE COMPUTER SOCIETY PRESS

Article number: 8469785

ISBN (Electronic): 9781538614884

#### **Publication series**

Name: International Conference on the European Energy Market

ISSN (Electronic): 2165-4093

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Business ecosystems, Electric vehicle, Innovation policy

Electronic versions:

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DOIs:

10.1109/EEM.2018.8469785

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911186004>

#### **Bibliographical note**

EXT="Kotilainen, Kirsi"

Source: Scopus

Source ID: 85055507417

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

### **Effects of electric vehicles and heat pumps on long-term electricity consumption scenarios for rural areas in the nordic environment**

Electrical energy consumption is undergoing major changes driven by several factors. Trends in electric vehicle (EV) purchases and heating system conversion indicate that changes in electricity demand can be significant between today and year 2030. For instance in Finland, the target for EVs is 250 000 passenger cars by 2030. At the same time, a significant number of heat pumps (HPs) will be installed in detached houses replacing old heating systems such as oil-fired boilers. In this paper, the effects of EVs and HPs on electricity consumption in Finnish rural areas are modeled and analyzed.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

Lappeenranta University of Technology, University of Eastern Finland

Contributors: Haakana, J., Haapaniemi, J., Lassila, J., Partanen, J., Niska, H., Rautiainen, A.

Number of pages: 5

Publication date: 20 Sep 2018

#### **Host publication information**

Title of host publication: 15th International Conference on the European Energy Market, EEM 2018

Volume: 2018-June  
Publisher: IEEE COMPUTER SOCIETY PRESS  
Article number: 8469937  
ISBN (Electronic): 9781538614884

#### Publication series

Name: International Conference on the European Energy Market  
ISSN (Electronic): 2165-4093  
ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology  
Keywords: Electric vehicles, Energy consumption, Heat pumps, Load modelling  
Electronic versions:  
effects\_of\_electric\_vehicles\_2018  
DOIs:  
10.1109/EEM.2018.8469937  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-201911186012>  
Source: Scopus  
Source ID: 85055573281  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Microgrids as part of electrical energy system - Pricing scheme for network tariff of DSO

In the Smart Grid environment, one novel concept is the microgrid, which can be either a very small entity or a larger one. For example, the microgrid can consist of resources of an individual small customer or of several customers each with their own energy resources inside a low-voltage network. The microgrid can also consist of a large area with various energy resources and a connection to the distribution grid. Especially, when the number of these large-scale microgrids increases, a central question is what kind of network tariff structure should be applied to them. The network tariffs can affect whether the microgrids will have a connection to the distribution grid. In this paper, a novel tariff structure for a large-scale microgrid is proposed. The results show that the benefits of the microgrid can be shared more fairly between it and the distribution system by applying a novel network tariff.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Electrical Energy Engineering, Research group: Power systems, Research area: Power engineering, Lempäälän Energia Ltd., Laboratory of Electrical Energy Engineering  
Contributors: Lummi, K., Rautiainen, A., Peltonen, L., Repo, S., Järventausta, P., Rintala, J.  
Number of pages: 5  
Publication date: 20 Sep 2018

#### Host publication information

Title of host publication: 15th International Conference on the European Energy Market, EEM 2018  
Volume: 2018-June  
Publisher: IEEE COMPUTER SOCIETY PRESS  
Article number: 8469965  
ISBN (Electronic): 9781538614884

#### Publication series

Name: International Conference on the European Energy Market  
ISSN (Electronic): 2165-4093  
ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology  
Keywords: Distribution network tariff, Microgrid, Regulation  
Electronic versions:  
microgrids\_as\_part\_of\_electrical\_energy\_2028  
DOIs:  
10.1109/EEM.2018.8469965  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-201911186027>  
Source: Scopus  
Source ID: 85055564419  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Use case description of real-time control of microgrid flexibility

Increasing amount of distributed energy resources necessitates more flexibility at the distribution network level. One option to attain this flexibility is by aggregation of these resources within microgrids and further supervisory control of the

latter in active network management. Among other reasons preventing their realization, these flexibility services lack standardized information and communication technology solution. This study assesses the required communication, information, and functional competences for such services and describes them by means of a use case modeling on smart grid architecture model planes. Specifically, the paper focuses on an information exchange built on the basis of web application programming interface called Smart API. The results of the study present a smart grid architecture that would enable real-time control of microgrid resources in active network management through flexibility market services.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Research group: Power systems, Research area: Power engineering, Lappeenranta University of Technology, VTT Technical Research Centre of Finland

Contributors: Mashlakov, A., Tikka, V., Honkapuro, S., Partanen, J., Repo, S., Järventausta, P., Kulmala, A., Abdurafikov, R., Keski-Koukkari, A., Aro, M.

Number of pages: 5

Publication date: 20 Sep 2018

#### Host publication information

Title of host publication: 15th International Conference on the European Energy Market, EEM 2018

Volume: 2018-June

Publisher: IEEE COMPUTER SOCIETY PRESS

Article number: 8469218

ISBN (Electronic): 9781538614884

#### Publication series

Name: International Conference on the European Energy Market

ISSN (Electronic): 2165-4093

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Flexibility services, Information exchange interface, Microgrid flexibility, Real-time control, Smart grid architecture

DOIs:

10.1109/EEM.2018.8469218

#### Bibliographical note

EXT="Kulmala, Anna"

jufoid=70631

Source: Scopus

Source ID: 85055476487

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > 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 (PBDT) 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

Electronic versions:

alternative\_power\_based\_pricing\_2018

DOIs:

10.1109/ISGT-Asia.2018.8467793

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911186003>

### Bibliographical note

EXT="Lehtinen, Jouni"

Source: Scopus

Source ID: 85055529338

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

### Constrained Long-Horizon Direct Model Predictive Control for Synchronous Reluctance Motor Drives

A finite control set model predictive control strategy for the control of the stator currents of a synchronous reluctance motor driven by a three-level neutral point clamped inverter is presented in this paper. The presented algorithm minimizes the stator current distortions while operating the drive system at switching frequencies of a few hundred Hertz. Moreover, the power electronic converter is protected by overcurrents and/or overvoltages owing to a hard constraint imposed on the stator currents. To efficiently solve the underlying integer nonlinear optimization problem a sphere decoding algorithm serves as optimizer. To this end, a numerical calculation of the unconstrained solution of the optimization problem is proposed, along with modifications in the algorithm proposed in [1] so as to meet the above-mentioned control objectives. Simulation results show the effectiveness of the proposed control algorithm.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Research group: Power electronics, Universita degli Studi di Padova, Italy, Technische Universitat Munchen

Contributors: Ortombina, L., Liegmann, E., Karamanakos, P., Tinazzi, F., Zigliotto, M., Kennel, R.

Number of pages: 8

Publication date: 10 Sep 2018

### Host publication information

Title of host publication: 2018 IEEE 19th Workshop on Control and Modeling for Power Electronics, COMPEL 2018

Publisher: IEEE

Article number: 8460173

ISBN (Print): 9781538655412

ASJC Scopus subject areas: Modelling and Simulation, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Control and Optimization

DOIs:

10.1109/COMPEL.2018.8460173

### Bibliographical note

JUFID=79370

Source: Scopus

Source ID: 85054503298

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 ( $1000\text{ mg/L}$ ) 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,  $\text{H}_2\text{S}$  and volatile fatty acids (VFA) was monitored and a maximum of  $2500\text{ mg/L}$  of acetate,  $200\text{ mg/L}$  of propionate,  $150\text{ mg/L}$  of isovalerate and  $100\text{ mg/L}$  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 11.1 SJR 2.157 SNIP 1.858

Original language: English

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

Keywords: Anaerobic, Biotrickling filter (BTF), Gas-phase methanol, Steady and intermittent BTF operation, Thiosulphate reduction, Volatile fatty acid

DOIs:

10.1016/j.biortech.2018.04.095

Source: Scopus

Source ID: 85047081553

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

#### 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 5.2 SJR 0.99 SNIP 1.138

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

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ISSN (Print): 1062-7995

Ratings:

Scopus rating (2018): CiteScore 16.5 SJR 1.942 SNIP 2.42

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 5.2 SJR 0.99 SNIP 1.138

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 CO<sub>2</sub> 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 CO<sub>2</sub> is difficult to achieve in a single organism. A potential solution is to employ acetogenic bacteria for the reduction of CO<sub>2</sub> to acetate, and engineer a second organism to convert the acetate into long-chain hydrocarbons. **Results:** In this study, we demonstrate alkane production from CO<sub>2</sub> 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 CO<sub>2</sub> and H<sub>2</sub>, and the acetate was used for alkane production by the engineered *A. baylyi*, thereby leading to the net production of long-chain alkanes from CO<sub>2</sub>. **Conclusions:** A modular system for the production of drop-in liquid fuels from CO<sub>2</sub> 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 8.4 SJR 1.762 SNIP 1.468

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

### Energy consumption of Finnish schools and daycare centers and the correlation to regulatory building permit values

The national building codes set requirements for building energy efficiency in many countries. The purpose of this study was to improve understanding on the measured and calculated energy efficiency of Finnish schools and daycare centers. The study analyzed the energy consumption of 134 schools and 71 daycare centers and compared the regulatory building permit calculations to measured values for 18 case buildings. According to the results, the specific electricity consumption ( $\text{kWh}/(\text{m}^2 \text{ a})$ ) has increased in schools but not in daycare centers. The heating energy consumption was lower in schools, but this might be explained by that they had clearly larger gross floor area than daycare centers. When compared to the technical requirements in the building code, the actual heating energy consumption has decreased less than what the changes in the building code would suggest. The building energy consumption calculated for building permits with the monthly calculation method and standard use clearly underestimated the measured building energy consumption. The differences were larger in heating energy than in electricity consumption. In conclusion, different regulatory limit values should be considered for the two building types. The calculation methods and input data should be analyzed to ensure that they truly guide towards cost-optimal design choices.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Ruusala, A., Laukkarinen, A., Vinha, J.  
Number of pages: 13  
Pages: 183-195  
Publication date: 1 Aug 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Energy Policy  
Volume: 119  
ISSN (Print): 0301-4215  
Ratings:  
Scopus rating (2018): CiteScore 7.2 SJR 1.988 SNIP 1.825  
Original language: English  
ASJC Scopus subject areas: Energy(all), Management, Monitoring, Policy and Law, Building and Construction, Energy (miscellaneous)  
Keywords: Building permit, Daycare center, Measured building energy consumption, Monthly calculation method, School building, Standard use  
Electronic versions:  
Ruusala et al 2018 Energy consumption - Preprint  
DOIs:  
10.1016/j.enpol.2018.04.029  
URLs:  
<http://urn.fi/URN:NBN:fi:ty-201808062052>  
Source: Scopus  
Source ID: 85046336515  
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 ( $\text{NO}_3^-$ ) and sulfate ( $\text{SO}_4^{2-}$ ), can influence selenate ( $\text{SeO}_4^{2-}$ ) reduction and impact the efficiency of biological treatment systems. **RESULTS:**  $\text{SeO}_4^{2-}$  removal by biofilms formed from an anaerobic sludge inoculum was investigated in the presence of  $\text{NO}_3^-$  and  $\text{SO}_4^{2-}$  using drip flow reactors operated continuously for 10 days at pH 7.0 and 30°C. The highest total Se (~60%) and  $\text{SeO}_4^{2-}$  (~80%) removal efficiencies were observed when the artificial wastewater contained  $\text{SO}_4^{2-}$ . A maximum amount of  $68 \mu\text{mol Se cm}^{-2}$  was recovered from the biofilm matrix in  $\text{SO}_4^{2-} + \text{SeO}_4^{2-}$  exposed biofilms and biofilm mass was 2.7-fold increased for biofilms grown in the presence of  $\text{SO}_4^{2-}$ . When  $\text{SeO}_4^{2-}$  was the only electron acceptor, biofilms were thin and compact. In the simultaneous presence of  $\text{NO}_3^-$  or  $\text{SO}_4^{2-}$ , biofilms were thicker (> 0.6 mm), less compact and exhibited gas pockets. **CONCLUSION:** The presence of  $\text{SO}_4^{2-}$  had a beneficial effect on biofilm growth and the  $\text{SeO}_4^{2-}$  removal efficiency, while the presence of  $\text{NO}_3^-$  did not have a significant effect on  $\text{SeO}_4^{2-}$  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., Nancharaiah, 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 4.8 SJR 0.715 SNIP 0.891

Original language: English

ASJC Scopus subject areas: Biotechnology, Chemical Engineering(all), Renewable Energy, Sustainability and the Environment, Fuel Technology, Waste Management and Disposal, Pollution, Organic Chemistry, Inorganic Chemistry  
Keywords: Biofilm, Biofilm characterization, Co-electron acceptors, Nitrate, Selenate, Selenium removal, Sulfate  
DOIs:

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 TiO<sub>2</sub>-Fe<sub>2</sub>O<sub>3</sub> 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) Fe<sub>2</sub>O<sub>3</sub> coating on porous ALD-TiO<sub>2</sub>. Our results show that successful implementation requires complete mixing of the TiO<sub>2</sub> and Fe<sub>2</sub>O<sub>3</sub> 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 Fe<sub>2</sub>O<sub>3</sub> 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 TiO<sub>2</sub> that we assign to charge transfer within the structure. Taken together, these results provide design guidelines to be considered when aiming to combine TiO<sub>2</sub> and Fe<sub>2</sub>O<sub>3</sub> 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 3.1 SNIP 0.85

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

### **Efficient method for the real-time contingency analysis of meshed HVDC power grids fed by VSC stations**

An efficient method for the real-time contingency analysis of meshed high-voltage direct current (HVDC) power grids fed by voltage source converter (VSC) stations is introduced here. A linearised AC/DC grid model is initially determined considering the control strategies of the various VSC units. This lays the foundations for the determination of linear sensitivity factors with which the contingency analysis is carried out to evaluate the real-time N-1 criterion in AC/DC grids, as demanded by system control centres. Distribution and power-injection factors are subsequently derived for efficiently assessing the impact of AC/DC transmission line outages and load/generator disconnections on the HVDC grid. Conversion factors are also derived to estimate the impact of the loss of VSC stations on the AC/DC network, this being another inherent contribution of this work. The efficiency and validity of this timely approach, which finds practical applicability to the real-time operation of HVDC power grids, is confirmed using a meshed DC network fed by three VSC stations. The disconnection of AC and DC transmission lines, generators, and VSC stations are dynamically simulated using Simulink and their post-disturbance steady-state conditions are compared against those computed by the introduced method where it is confirmed that both solutions concur very well with each other.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Department of Electrical Engineering

Contributors: Castro, L. M., Acha, E., Rodriguez-Rodriguez, J. R.

Number of pages: 9

Pages: 3158-3166

Publication date: 31 Jul 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: IET Generation, Transmission and Distribution

Volume: 12

Issue number: 13

ISSN (Print): 1751-8687

Ratings:

Scopus rating (2018): CiteScore 5.3 SJR 1.099 SNIP 1.512

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1049/iet-gtd.2017.1104

Source: Scopus

Source ID: 85050235242

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

### **Mechanical stress analysis during a quench in CLIQ protected 16 T dipole magnets designed for the future circular collider**

Protecting the magnets in case of a quench is a challenge for the 16 T superconducting dipole magnets presently designed for the 100 TeV: Future Circular Collider (FCC). These magnets are driven to the foreseen technological limits in terms of critical current, mechanical strength and quench protection. The magnets are protected with CLIQ (Coupling-Loss Induced Quench) system, which is a recently developed quench protection method based on discharging a capacitor bank across part of the winding. The oscillation of the magnet currents and the dissipation of the high stored energy into the windings cause electrodynamic forces and thermal stresses, which may need to be considered in the magnet mechanical design. This paper focuses on mechanical stress analysis during a quench of the 16 T cos- $\theta$  and block type dipole magnets. A finite element model allowed studying the stress due to the non-uniform temperature and current distribution in the superconducting coils. Two different CLIQ configurations were considered for the cos- $\theta$  design and one for the block type magnet. The analyses of the mechanical behavior of two magnets during a quench without or with hot spot turn were separately carried out. The simulation results show that the stress related to a quench should be considered when designing a high field magnet.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research group: Modelling and superconductivity, Lanzhou University, European Organization for Nuclear Research, Laboratorio Accelatori e Superconduttività Applicata, French Atomic Energy Commission (CEA) Saclay, Università degli Studi di Milano

Contributors: Zhao, J., Prioli, M., Stenvall, A., Salmi, T., Gao, Y., Caiffi, B., Lorin, C., Marinozzi, V., Farinon, S., Sorbi, M.

Number of pages: 8

Pages: 27-34

Publication date: 15 Jul 2018

Peer-reviewed: Yes

### Publication information

Journal: Physica C: Superconductivity and its Applications

Volume: 550

ISSN (Print): 0921-4534

Ratings:

Scopus rating (2018): CiteScore 2.7 SJR 0.463 SNIP 0.922

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Condensed Matter Physics, Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Accelerator magnet, CLIQ protection system, Finite element analysis, Lorentz forces, Quench, Thermal stress  
DOIs:

10.1016/j.physc.2018.04.003

Source: Scopus

Source ID: 85045717268

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  $24.5 \pm 0.8$  mmol/l hydrogen ( $1.7 \pm 0.1$  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 8.4 SJR 1.762 SNIP 1.468

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:tty-201808072056>

Source: Scopus

Source ID: 85049884043

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

### **Cross-impact analysis of Finnish electricity system with increased renewables: Long-run energy policy challenges in balancing supply and consumption**

Climate change and global economic pressures are strong drivers for energy economies to transition towards climate-neutrality, low-carbon economy and better energy and resource efficiencies. The response to these pressures, namely the increased use of renewable energy, creates a set of new challenges related to supply-demand balance for energy policy and electricity system planning. This study analyses the emergent problems resulting from the renewable energy response. These complex aspects of change in the electricity system are analysed with a cross-impact model based on an expert-driven modeling process, consisting of workshops, panel evaluations and individual expert work. The model is then analysed using a novel computational cross-impact technique, EXIT. The objective of the study is to map the important direct drivers of change in the period 2017–2030 in electricity consumption and production in Finland, construct a cross-impact model from this basis, and discover the emergent and systemic dynamics of the modeled system by analysis of this model.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Automation and Hydraulic Engineering

Contributors: Panula-Ontto, J., Luukkanen, J., Kaivo-oja, J., O'Mahony, T., Vehmas, J., Valkealahti, S., Björkqvist, T., Korpela, T., Järventausta, P., Majanne, Y., Kojo, M., Aalto, P., Harsia, P., Kallioharju, K., Holttinen, H., Repo, S.

Number of pages: 10

Pages: 504-513

Publication date: 1 Jul 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Energy Policy

Volume: 118

ISSN (Print): 0301-4215

Ratings:

Scopus rating (2018): CiteScore 7.2 SJR 1.988 SNIP 1.825

Original language: English

ASJC Scopus subject areas: Energy(all), Management, Monitoring, Policy and Law

Keywords: Cross-impact analysis, Electricity system, Low-carbon, Renewables, Transition

Electronic versions:

1-s2.0-S0301421518302246-main

DOIs:

10.1016/j.enpol.2018.04.009

URLs:

<http://urn.fi/URN:NBN:fi:tty-201805031589>

Source: Scopus

Source ID: 85045762685

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

### **Improved modelling of electric loads for enabling demand response by applying physical and data-driven models: Project Response**

Accurate load and response forecasts are a critical enabler for high demand response penetrations and optimization of responses and market actions. Project RESPONSE studies and develops methods to improve the forecasts. Its objectives are to improve 1) load and response forecast and optimization models based on both data-driven and physical modelling, and their hybrid models, 2) utilization of various data sources such as smart metering data, weather data, measurements from substations etc., and 3) performance criteria of load forecasting. The project applies, develops, compares, and integrates various modelling approaches including partly physical models, machine learning, modern load profiling, autoregressive models, and Kalman-filtering. It also applies non-linear constrained optimization to load responses. This paper gives an overview of the project and the results achieved so far.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Research group: Power systems, Research area: Information Systems in Automation, Automation and Hydraulic Engineering, VTT Technical Research Centre of Finland, University of Eastern Finland

Contributors: Koponen, P., Hanninen, S., Mutanen, A., Koskela, J., Rautiainen, A., Järventausta, P., Niska, H., Kolehmainen, M., Koivisto, H.

Number of pages: 6

Pages: 1-6

Publication date: 27 Jun 2018

### Host publication information

Title of host publication: 2018 IEEE International Energy Conference, ENERGYCON 2018

Publisher: IEEE

ISBN (Electronic): 9781538636695

ASJC Scopus subject areas: Artificial Intelligence, Energy Engineering and Power Technology, Control and Optimization

Keywords: Active demand, Forecasting, Hybrid models, Machine learning, Optimization, Physically based models

Electronic versions:

Koponen-ENERGYCON2018-final

DOIs:

10.1109/ENERGYCON.2018.8398794

URLs:

<http://urn.fi/URN:NBN:fi:tty-201808172164>

Source: Scopus

Source ID: 85050244199

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > 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 12.4 SJR 2.73 SNIP 2.181

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

### Sustainable electric vehicle - Prosumer framework and policy mix

Electric vehicles have pro-environmental advantages compared to traditional automobiles, or even hybrids: they can help reducing pollution and noise levels locally, and greenhouse gas emissions globally. However, there are still many challenges that the electric vehicles must overcome before reaching level of diffusion that can have significant impact on sustainability. This paper evaluates combined sustainability of electric vehicle and small-scale energy production. We propose a framework for sustainable electric vehicle - energy prosumer integration and outline a policy mix that is needed to support adoption of both renewable energy technologies and electric vehicles.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication  
Organisations: Industrial and Information Management, School of Management Politics  
Contributors: Kotilainen, K., Mäkinen, S. J., Valta, J.  
Number of pages: 6  
Pages: 1-6  
Publication date: 8 Jun 2018

#### Host publication information

Title of host publication: 2017 IEEE Innovative Smart Grid Technologies - Asia : Smart Grid for Smart Community, ISGT-Asia 2017  
Publisher: IEEE  
ISBN (Electronic): 9781538649503  
ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Control and Optimization, Safety, Risk, Reliability and Quality  
Keywords: Electric vehicle, Policy, Prosumer, Renewable energy, Sustainable  
DOIs:  
10.1109/ISGT-Asia.2017.8378406

#### Bibliographical note

EXT="Kotilainen, Kirsi"  
Source: Scopus  
Source ID: 85050005345  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Effects of wastewater constituents and operational conditions on the composition and dynamics of anodic microbial communities in bioelectrochemical systems

Over the last decade, there has been an ever-growing interest in bioelectrochemical systems (BES) as a sustainable technology enabling simultaneous wastewater treatment and biological production of, e.g. electricity, hydrogen, and further commodities. A key component of any BES degrading organic matter is the anode where electric current is biologically generated from the oxidation of organic compounds. The performance of BES depends on the interactions of the anodic microbial communities. To optimize the operational parameters and process design of BES a better comprehension of the microbial community dynamics and interactions at the anode is required. This paper reviews the abundance of different microorganisms in anodic biofilms and discusses their roles and possible side reactions with respect to their implications on the performance of BES utilizing wastewaters. The most important operational parameters affecting anodic microbial communities grown with wastewaters are highlighted and guidelines for controlling the composition of microbial communities are given.

#### General information

Publication status: Published  
MoE publication type: A2 Review article in a scientific journal  
Organisations: Chemistry and Bioengineering, Laboratory for MEMS Applications, Universitat Freiburg im Breisgau, Karlsruhe Institute of Technology, Insitute for Technical Physics, Germany, University of Bremen  
Contributors: Kokko, M., Epple, S., Gescher, J., Kerzenmacher, S.  
Number of pages: 14  
Pages: 376-389  
Publication date: 1 Jun 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 258  
ISSN (Print): 0960-8524  
Ratings:  
Scopus rating (2018): CiteScore 11.1 SJR 2.157 SNIP 1.858  
Original language: English  
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal  
Keywords: Bioelectrochemical system, Exoelectrogen, Microbial community, Wastewater  
DOIs:  
10.1016/j.biortech.2018.01.090  
Source: Scopus  
Source ID: 85043472557  
Research output: Contribution to journal > Review Article > Scientific > peer-review

### Role of Oxide Defects in ALD grown TiO<sub>2</sub> 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 (TiO<sub>2</sub>) 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 TiO<sub>2</sub> 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 TiO<sub>2</sub> 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 TiO<sub>2</sub> films were studied in as-deposited condition and after annealing in air at 500 °C. TiO<sub>2</sub> 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 TiO<sub>2</sub> 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 TiO<sub>2</sub> is amorphous and absorbs visible light as "black" TiO<sub>2</sub>. After annealing in air at 500 °C TiO<sub>2</sub> crystallizes as rutile and becomes "white" TiO<sub>2</sub> that absorbs light only in the UV region. As-deposited TiO<sub>2</sub> contains significant amount of Ti<sup>3+/2+</sup> oxygen vacancies that are oxidized as Ti<sup>4+</sup> upon annealing in air. In addition, nitrogen is found only in as-deposited titanium dioxide. As-deposited TiO<sub>2</sub> is not chemically stable under PEC conditions. In contrast, the annealed TiO<sub>2</sub> is chemically stable and showed 0.20 % ABPE efficiency for water splitting reaction.

As a conclusion, Ti<sup>3+</sup> defects induce photocorrosion of ALD TiO<sub>2</sub> under PEC conditions. After annealing in air at 500 °C ALD TiO<sub>2</sub> 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 TiO<sub>2</sub>/Si interface and studying the structure of the surface after deposition of nickel electrocatalysts on TiO<sub>2</sub>/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 H<sub>2</sub> 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 H<sub>2</sub> mol<sup>-1</sup> xylose. The H<sub>2</sub> 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<sub>2</sub> production, but only an alkaline shock (pH 10, 24 h) repressed lactate production, resulting in the highest yield of 1.2 mol H<sub>2</sub> mol<sup>-1</sup> 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: Dessì, 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 6.8 SJR 1.1 SNIP 1.166

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

Dessi et al. 2018 - Inoculum pretreatment for dark fermentation. Embargo ended: 26/04/20

DOIs:

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

### **Investigating the kinetics and biofuel properties of *Alstonia congensis* and *Ceiba pentandra* via torrefaction**

*Alstonia congensis* (Ahun) and *Ceiba pentandra* (Araba) were chosen as representations of tropical wood in this study. The use of untreated wood for energy recovery could lead to a high loss in efficiency. One way of circumventing this in a developing country such as Nigeria is by exposing the fuel materials to a pre-treatment, such as torrefaction, prior to deployment. Attempts were made to improve the combustion properties of these resources and also to investigate their torrefaction kinetics. Derivations of kinetic parameters using Coats-Redfern method were discontinued due to inconsistent results. A non-linear regression method was then employed and the results compared to the average value obtained by the FWO method, which was considered more viable than the Coats-Redfern method. The kinetic parameters ( $E_a$ ,  $A$  and  $n$ ) derived by the regression method are 134.45 kJ/mol,  $1.83E+13 \text{ min}^{-1}$  and 2.15, respectively, for Araba and 143.38 kJ/mol,  $1.90E+10 \text{ min}^{-1}$  and 2.28, respectively, for Ahun. The thermal behaviour of the samples showed that a lower mass yield resulted in a lower energy yield, while the heating values increased with the temperature of torrefaction. The results obtained in this study affirm the possibility of obtaining an optimum conversion of these resources for energy recovery.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, University of Borås, Laboratory of Chemistry and Bioengineering

Contributors: Oluoti, K., Doddapaneni, T. R. K., Richards, T.

Number of pages: 8

Pages: 134-141

Publication date: 1 May 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Energy

Volume: 150

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2018): CiteScore 8.5 SJR 2.048 SNIP 1.842

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Pollution, Energy(all), Mechanical Engineering, Industrial and Manufacturing Engineering, Electrical and Electronic Engineering

Keywords: *Alstonia congensis*, *Ceiba pentandra*, Energy densification, Kinetic parameters, Mini-grid, Torrefaction

DOIs:

10.1016/j.energy.2018.02.086

Source: Scopus

Source ID: 85042679330

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

### **Coordinated voltage control as a replacement for passive network reinforcements-A case study**

The paper presents the results of a case study conducted on a real-life distribution system, in which an active network management solution is compared against passive network reinforcements. A methodology for assessing the hosting capacity of medium voltage network for distributed generation is presented and results of two calculation cases (Active Network Management and equivalent passive investment) are compared from investment cost-benefit perspective. The results of the paper show significant economic benefits in Active Network Management based solutions against passive

reinforcements.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, VTT Technical Research Centre of Finland

Contributors: Supponen, A., Repo, S., Kulmala, A.

Number of pages: 6

Pages: 326-331

Publication date: 17 Apr 2018

#### Host publication information

Title of host publication: 2017 IEEE International Conference on Smart Grid Communications, SmartGridComm 2017

Publisher: IEEE

ISBN (Electronic): 9781538640555

ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Energy Engineering and Power Technology, Safety, Risk, Reliability and Quality

Keywords: Active Network Management, Coordinated Voltage Control, Distributed Generation, Hosting Capacity Assessment

DOIs:

10.1109/SmartGridComm.2017.8340714

#### Bibliographical note

INT=eee,"Supponen, Antti"

EXT="Kulmala, Anna"

Source: Scopus

Source ID: 85050893763

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

#### Policy Influence on Consumers' Evolution into Prosumers—Empirical Findings from an Exploratory Survey in Europe

The energy sector is in transition to a flexible and sustainable energy system based on renewable energy sources. This complex transition is affecting multiple levels in the sociotechnical system. One driver of the transition is climate change that enforces the policy push from the macro level to change the way energy is produced, delivered, and used. As part of the energy system evolution, the role of the end user in the energy sector is undergoing profound changes, and consumers are increasingly being empowered to participate actively in the production and use of energy. This article investigates how policies might affect consumers' interests in becoming prosumers of energy. We explore consumers' attitudes toward using renewable energy technologies (RET) by means of an empirical consumer survey that was conducted in five European countries. The partial least squares structural equation modeling (PLS-SEM) method was utilized to analyze the survey results. Our findings suggest that both economic and non-economic policies affect consumer attitudes toward using renewable energy technologies. We conclude that policies have different effects on consumers and prosumers, who have already made the decision to adopt renewable energy solutions. Based on the findings, we propose a set of policy and managerial implications.

#### 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, University of Lausanne

Contributors: Kotilainen, K., Saari, U. A.

Number of pages: 22

Publication date: 13 Jan 2018

Peer-reviewed: Yes

#### Publication information

Journal: Sustainability

Volume: 2018

Issue number: 10

Article number: 186

ISSN (Print): 2071-1050

Ratings:

Scopus rating (2018): CiteScore 2.8 SJR 0.549 SNIP 1.201

Original language: English

ASJC Scopus subject areas: Management Science and Operations Research, Management of Technology and Innovation, Environmental Science(all), Energy(all)

Keywords: energy policy, PLS-SEM, diffusion, Technology Acceptance, prosumer, consumer, renewable energy technology

Electronic versions:

sustainability-10-00186

DOIs:

10.3390/su10010186

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201803011327>

URLs:

<http://www.mdpi.com/2071-1050/10/1/186>

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

### **A new method to assess the contribution of VSC-HVDC connected wind farms to the primary frequency control of power networks**

This paper introduces a new method to assess the contribution of VSC-HVDC connected wind farms to the primary frequency control (PFC) of power networks. This is a formulation that enables the estimation of the post-disturbance conditions of the power system, including its electrical frequency, after the incidence of power imbalances, where various VSC-HVDC connected wind farms may be simultaneously simulated. As opposed to a full dynamic simulation, which may be time-consuming, the developed method resorts to modelling all power system components for the PFC time frame by using enhanced steady-state power-flow models which are solved for a power system operating point that agrees well with the operating conditions of the network after the action of the PFC. Therefore, models of DFIG and PMSG are first derived by following a proposed procedure for the determination of the frequency regulation of the wind turbines, often called statorism, whose value varies with the wind speed, as opposed to that of conventional power plants which is constant. Because the power reserve of the wind generators is used to counteract the frequency deviations in the AC power network, a VSC-HVDC link model is also developed which enables a free power transfer to conform to the output power of the wind farm. The proposed method is validated using a 9-bus power system comprising a 120-MW VSC-HVDC connected wind farm and whose results are compared against those computed by a full time-domain dynamic simulation, obtaining a very good agreement between the two quite distinct approaches where, for instance, the post-disturbance system frequency computed by the proposed method only differs by 0.092% with respect to that obtained by the full dynamic simulation. The IEEE 57-bus test system, slightly modified to incorporate two VSC-HVDC connected wind farms, is also simulated to show that the impact of the frequency regulation of the wind farms on the PFC may be assessed in a very quick, effective manner.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Department of Electrical Engineering

Contributors: Castro, L. M., Acha, E.

Number of pages: 11

Pages: 48-58

Publication date: 2018

Peer-reviewed: Yes

Early online date: 1 Sep 2017

#### **Publication information**

Journal: Electric Power Systems Research

Volume: 154

ISSN (Print): 0378-7796

Ratings:

Scopus rating (2018): CiteScore 6.4 SJR 1.037 SNIP 1.444

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: DFIG, Newton–Raphson method, PMSG, Post-disturbance conditions, Power imbalances, Primary frequency control, Variable speed wind turbines, VSC-HVDC links, Wind farms

DOIs:

10.1016/j.epsr.2017.08.011

Source: Scopus

Source ID: 85028060536

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

### **A novel strategy for optimal placement of locally controlled voltage regulators in traditional distribution systems**

In this paper, an approach for placement of voltage regulators (VRs) in traditional distribution systems by considering a local controller model is presented. The main aims of this paper are controlling the voltage level in its permitted range and decreasing the costs imposed to the distribution system companies, such as costs that stem from power losses, VRs' investment and maintenance. Genetic algorithm (GA) has been used as a tool to determine the number, location and rated power of VRs. Since in traditional distribution systems, tap position determination of VRs is achieved by local controllers,

local controller model is established to determine tap operations. A 70-bus distribution system is considered to prove the value of the presented approach. Effectiveness of the proposed approach and ineffectiveness and infeasibility of conventional approaches are presented in numerical studies. The presented approach allowed to eliminate voltage violation in all load conditions and a reduction of power losses of about 6% for the maximum load level.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Iran University of Science and Technology, University of Birjand, Università di Salerno

Contributors: Attar, M., Homaei, O., Falaghi, H., Siano, P.

Number of pages: 12

Pages: 11-22

Publication date: 2018

Peer-reviewed: Yes

Early online date: 29 Sep 2017

#### Publication information

Journal: International Journal of Electrical Power and Energy Systems

Volume: 96

ISSN (Print): 0142-0615

Ratings:

Scopus rating (2018): CiteScore 9.4 SJR 1.26 SNIP 2.058

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Distribution systems planning, Genetic algorithm, Local controller, Set point, Tap position, Voltage regulator DOIs:

10.1016/j.ijepes.2017.09.028

Source: Scopus

Source ID: 85030472698

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 3.3 SJR 0.612 SNIP 1.186

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:tty-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 rearside 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 (Voc) of the reported devices. More important, our theoretical calculations demonstrate that the Voc 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 Voc 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 10.2 SJR 1.62 SNIP 1.681

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

### Techno-economic evaluation of integrating torrefaction with anaerobic digestion

In recent days, the interest on torrefaction is increasing owing to its ability to improve biomass properties to a level of competing with coal. However, its techno-economic feasibility still need to be optimized. Integrating torrefaction with other thermochemical and biochemical processes could be a feasible option to improve the performance of the torrefaction process. In that regard, this study evaluates the techno-economic feasibility of integrating the torrefaction with anaerobic digestion (AD). In addition, new process configurations were studied to identify the possible heat energy recovery options. Technical feasibility was tested through mass and energy balance at each process unit. The economic indicators such as net present value (€), minimum selling price and internal rate on return (%) were used to evaluate the economic performance. At 10 t/h of torrefied biomass pellets production capacity, the estimated bio-methane production from AD was 369 m<sup>3</sup>/h. The economic evaluation shows that the minimum selling price of the torrefied biomass to reach the breakeven could be reduced from 199 €/t for standalone torrefaction to 185 €/t in case of torrefaction integrated with AD. The sensitivity analysis shows that feedstock and total capital investment were the most sensitive input parameters. This study shows that integrating the torrefaction with AD has better technical and economic feasibility than standalone torrefaction.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Doddapaneni, T. R. K. C., Praveenkumar, R., Tolvanen, H., Rintala, J., Kontinen, J.

Number of pages: 13

Pages: 272-284

Publication date: 2018

Peer-reviewed: Yes

Early online date: Jan 2018

### Publication information

Journal: Applied Energy

Volume: 213

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2018): CiteScore 14.3 SJR 3.455 SNIP 2.649

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law

Keywords: Energy recovery, Minimum selling price, Process integration, Techno-economic analysis, Torrefaction – anaerobic digestion, Torrefied pellets

DOIs:

10.1016/j.apenergy.2018.01.045

Source: Scopus

Source ID: 85041461877

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<sub>2</sub> yield was obtained in the thermophilic FBR, which stabilised at about 1.2 mol H<sub>2</sub> mol<sup>-1</sup> xylose (36% of the theoretical maximum) at 55 and 70 °C, and at 0.8 mol H<sub>2</sub> mol<sup>-1</sup> xylose at 60

and 65 °C, compared to the mesophilic FBR (0.5 mol H<sub>2</sub> mol<sup>-1</sup> 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 6.8 SJR 1.1 SNIP 1.166

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

Dessi et al 2018 - Thermophilic versus mesophilic dark fermentation. Embargo ended: 13/03/20

DOIs:

10.1016/j.ijhydene.2018.01.158

URLs:

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

Source: Scopus

Source ID: 85042365131

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

#### Carbazole-based small molecule electron donors: Syntheses, characterization, and material properties

Efficient synthetic methods for carbazole-based small molecule electron donors with donor-acceptor (D-A) and A-D-A type structures were developed. In order to study the relation between chemical structures and material properties, the prepared compounds were characterized in detail using absorption spectroscopy, differential pulse voltammetry, and computational methods. In addition, symmetrical A-D-A type compounds were tested as an active layer component in bulk heterojunction based organic solar cell (OSC) devices with conventional structure. The results show that the two compound types have many similar properties. However, the extended molecular structure of A-D-A type compounds offer better film forming properties and higher molar absorption coefficients compared with the D-A type materials. Furthermore, the attachment of fluoro substituents in the A units has a positive effect on all solar cell device parameters. Moreover, the computational studies revealed that the molecular structures are twisted between the central carbazole D unit and  $\pi$ -bridge which may result in inefficient intramolecular charge transfer and, also, relatively limited short-circuit currents in OSC devices.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Research group:

Chemistry & Advanced Materials, Research Unit of Sustainable Chemistry, IMEC PV Department

Contributors: Sippola, R. J., Hadipour, A., Kastinen, T., Vivo, P., Hukka, T. I., Aernouts, T., Heiskanen, J. P.

Number of pages: 10

Pages: 79-88

Publication date: 8 Nov 2017

Peer-reviewed: Yes

Early online date: 8 Nov 2017

### Publication information

Journal: Dyes and Pigments

Volume: 150

Article number: j.dyepig.2017.11.014

ISSN (Print): 0143-7208

Ratings:

Scopus rating (2017): CiteScore 5.6 SJR 0.819 SNIP 1.009

Original language: English

ASJC Scopus subject areas: Chemistry(all), Energy(all)

Keywords: Absorption, DFT, Electron donor, Organic solar cell, Suzuki-Miyaura, Synthesis

Electronic versions:

Carbazole-based small molecule electron donors 2017. Embargo ended: 8/11/19

DOIs:

10.1016/j.dyepig.2017.11.014

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002132062>. Embargo ended: 8/11/19

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 ( $430 \text{ mW/m}^2$ ) 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 6.3 SJR 1.116 SNIP 1.322

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:tty-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

## Koulujen ja päiväkotien laskettu ja toteutunut energiankulutus

### General information

Publication status: Published  
MoE publication type: B3 Non-refereed article in conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Ruusala, A., Vinha, J.  
Number of pages: 8  
Pages: 267-274  
Publication date: 24 Oct 2017

### Host publication information

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24.-26.10.2017, Tampere  
Volume: 1  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka  
Editors: Vinha, J., Kivioja, H.  
ISBN (Print): 978-952-15-4022-6

### Publication series

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.

ASJC Scopus subject areas: Engineering(all), Energy(all)

URLs:

[http://www.tut.fi/cs/groups/public\\_news/@l102/@web/@p/documents/liit/x229241.pdf](http://www.tut.fi/cs/groups/public_news/@l102/@web/@p/documents/liit/x229241.pdf)

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

## Kustannusoptimaaliset energiakorjaus- ja uusiutuvan energian tuotannon ratkaisut kunnallisissa palvelurakennuksissa

### General information

Publication status: Published  
MoE publication type: B3 Non-refereed article in conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics, Aalto Univ, Aalto University, Sch Engrn, Dept Energy Technol, Equa Simulation Finland Oy  
Contributors: Jokisalo, J., Sankelo, P., Sirén, K., Vinha, J.  
Number of pages: 6  
Pages: 287-292  
Publication date: 24 Oct 2017

### Host publication information

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24.-26.10.2017, Tampere  
Volume: 1  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka  
Editors: Vinha, J., Kivioja, H.  
ISBN (Print): 978-952-15-4022-6

ASJC Scopus subject areas: Engineering(all), Energy(all)

URLs:

[http://www.tut.fi/cs/groups/public\\_news/@l102/@web/@p/documents/liit/x229238.pdf](http://www.tut.fi/cs/groups/public_news/@l102/@web/@p/documents/liit/x229238.pdf)

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

## 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 7.7 SJR 1.467 SNIP 2.383

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 ( $\text{TiO}_2$ ), 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"  $\text{TiO}_2$ . At the oxidative annealing at 500 °C titanium dioxide crystallizes into rutile and becomes "white"  $\text{TiO}_2$  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:ty:201709201911>

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

### **Real-time hardware- and software-in-the-loop simulation of decentralised distribution network control architecture**

This study introduces a laboratory test set up developed to evaluate the functionality of a novel decentralised distribution automation architecture. The demonstration system consists of a simulated distribution network in real-time simulation environment including simulated monitoring and control devices as well as physical devices interfaced with the simulator as hardware-in-the-loop test devices. System involves also substation automation units for real-time monitoring and control that are interfaced with the simulator and physical devices. The operating principle of the system is demonstrated with an example simulation case. The main goal for this system was to test the functionality of the decentralised distribution automation architecture and track out any potential interfacing issues of automation system before implementing the concept to actual field demonstrations. Based on the tests executed with the system described in this study, the proper functionality of all the features of the automation architecture was verified and successfully deployed at the field test sites.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research group: Power systems, VTT Technical Research Centre of Finland

Contributors: Tuominen, V., Reponen, H., Kulmala, A., Lu, S., Repo, S.

Number of pages: 8

Pages: 3057-3064

Publication date: 24 Aug 2017

Peer-reviewed: Yes

### **Publication information**

Journal: IET Generation, Transmission and Distribution

Volume: 11

Issue number: 12

ISSN (Print): 1751-8687

Ratings:

Scopus rating (2017): CiteScore 4 SJR 0.907 SNIP 1.355

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1049/iet-gtd.2016.1570

### **Bibliographical note**

EXT="Kulmala, Anna"

Source: Scopus

Source ID: 85029745746

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

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

Exhaust emissions emitted by a non-road mobile machine were studied chasing a tractor in real-world conditions and repeating the same transient tests with a similar engine on an engine dynamometer where additionally, non-road steady state tests were carried out. The engines were equipped with an oxidation catalyst (DOC) and a selective catalytic reduction (SCR) system, and they were fuelled by fossil diesel fuel with ultra-low sulphur content and hydrotreated vegetable oil (HVO). By substituting diesel fuel with HVO the on-road emissions of nitrogen oxides ( $\text{NO}_x$ ) reduced 20% and particle number 44%, the emission factors being  $\text{EF}_{\text{NO}_x} = 1.62 \pm 0.04 \text{ g/kWh}$  and  $\text{EF}_N = (28.2 \pm 7.8) \times 10^{13} \text{ \#kWh}$ . Similar trend was observed for  $\text{NO}_x$  at laboratory although the emissions were somewhat smaller than on-road. In contrast to real-world, in the laboratory experiment the  $\text{EF}_N$  was only 2% smaller with HVO than with diesel, and these emission factors were almost one order of magnitude smaller than observed on-road. The number size distribution and volatility measurements showed that in real-world experiments small nucleation mode particles were formed during uphill and during downhill in engine braking conditions. These were not observed at laboratory. However, nucleation mode particles were observed in the laboratory experiments at high load steady driving conditions. At steady state tests the emissions strongly depended on engine load and engine speed with both fuels.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, University of Helsinki, Turku University of Applied Sciences

Contributors: Pirjola, L., Rönkkö, T., Saukko, E., Parviainen, H., Malinen, A., Alanen, J., Saveljeff, H.

Number of pages: 11

Pages: 154-164

Publication date: 15 Aug 2017

Peer-reviewed: Yes

### Publication information

Journal: Fuel

Volume: 202

ISSN (Print): 0016-2361

Ratings:

Scopus rating (2017): CiteScore 8.8 SJR 1.891 SNIP 2.127

Original language: English

ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry

Keywords: Diesel engine, Exhaust emissions, HVO, NO, Particle size distribution, Real-world emissions, Tractor

Electronic versions:

Fuel\_Pirjola\_rev2\_TUTCRIS. Embargo ended: 13/04/19

DOIs:

10.1016/j.fuel.2017.04.029

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712192400>. Embargo ended: 13/04/19

Additional files:

Appendix A\_Pirjola\_rev\_TUTCRIS

Source: Scopus

Source ID: 85017566506

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

### 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 ( $92 \text{ mF cm}^{-2}$ ), while synthesis in high viscosity ionic liquid shortens the conjugation length and results in lower electroactivity ( $25 \text{ mF cm}^{-2}$ ). 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  $55 \text{ mF}$  ( $27 \text{ mF cm}^{-2}$ ) with an equivalent series resistance of  $19 \Omega$  is obtained at operating voltage of  $1.5 \text{ V}$ . Upon increasing the operating voltage up to  $2.4 \text{ V}$ , the capacitance increases to  $72 \text{ mF}$  ( $36 \text{ mF cm}^{-2}$ ).

### 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 13.6 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

URLs:

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

### **Aspects of advancement of distribution tariffs for small consumers in Finland**

This paper discusses the development of distribution tariffs of small consumers in Finland. Changes in the electricity sector have created pressures for the Distribution System Operators (DSO) to develop their pricing practices in order to better reflect their cost structures. In this context, power-based distribution tariffs (PBDT) have been seen as a potential direction for development. This paper analyses the EU and Finnish legal framework for distribution tariffs with an aim to identify potential regulatory barriers and incentives for developing PBDTs in Finland. To support this analysis, the paper also provides results of a survey conducted in Finland in 2016 in the EL-TRAN project, reflecting the will of Finnish consumers to improve their ability to affect the distribution fees. The results indicate that the consumers are interested in having this opportunity.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Ita-Suomen yliopisto, School of Management (JKK)

Contributors: Lummi, K., Rautiainen, A., Järventausta, P., Huhta, K., Talus, K., Kojo, M.

Publication date: 14 Jul 2017

#### **Host publication information**

Title of host publication: 2017 14th International Conference on the European Energy Market, EEM 2017

Publisher: IEEE

ISBN (Electronic): 9781509054992

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Electricity distribution pricing, Energy efficiency, Legislation, Power-based distribution tariff

Electronic versions:

aspects\_of\_advancement\_of\_distribution\_2017

DOIs:

10.1109/EEM.2017.7981937

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911115870>

#### **Bibliographical note**

jufoid=70631

Source: Scopus

Source ID: 85027141816

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

### **Attractiveness of demand response in the Nordic electricity market - Present state and future prospects**

During the past few years demand response (DR) has appeared in the spotlight in a new way. This is due to general technological advancement, development of electricity infrastructure, especially roll-out of smart meters, and rapidly increasing amount of renewable intermittent energy sources. This paper analyzes the attractiveness of DR in the Nordic electricity market. The results show that in many market places the attractiveness of DR is improving in the long term, although variations between different years exist. Two case studies presented in the papers show that DR has economic potential for some of the customers, especially for medium to large actors, but in a large scope, number of obstacles still hinder a wide scale deployment of DR solutions.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Research area: Power engineering, Research group: Power systems, VTT Technical Research Centre of Finland

Contributors: Rautiainen, A., Koskela, J., Vilppo, O., Supponen, A., Kojo, M., Toivanen, P., Rinne, E., Järventausta, P.

Publication date: 14 Jul 2017

### Host publication information

Title of host publication: 2017 14th International Conference on the European Energy Market, EEM 2017

Publisher: IEEE

ISBN (Electronic): 9781509054992

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Demand response, Electricity market

Electronic versions:

Attractiveness of demand response in the Nordic electricity market

DOIs:

10.1109/EEM.2017.7981925

URLs:

<http://urn.fi/URN:NBN:fi:tty-201802141219>

### Bibliographical note

INT=eee,"Supponen, A."

EXT="Rinne, E."

jufoid=70631

Source: Scopus

Source ID: 85027168719

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

### Development options for distribution tariff structures in Finland

In this paper, we study the development options of tariff structures in electricity distribution in Finland. We compare the impacts of three different tariffs from the viewpoints of customers, distribution system operator (DSO), electricity supplier, and society. Analyzed tariffs are (1) energy oriented tariff, which is currently in use, (2) power limit tariff, and (3) power tariff. Based on the analyses, it seems that it is justified to include power based price component in distribution tariff. Generally, the impacts of both analyzed power based tariffs are quite similar. However, it seems that power tariff is a bit stronger candidate. Nevertheless, it should be noted that the benefits of the power-oriented pricing, illustrated in the paper, could be achieved only by well-designed tariff system. Although analyses are based on Finnish case, most of the results are generalizable to other countries also.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Lappeenranta University of Technology

Contributors: Honkapuro, S., Haapaniemi, J., Haakana, J., Lassila, J., Belonogova, N., Partanen, J., Lummi, K., Rautiainen, A., Supponen, A., Repo, S., Järventausta, P.

Publication date: 14 Jul 2017

### Host publication information

Title of host publication: 2017 14th International Conference on the European Energy Market, EEM 2017

Publisher: IEEE

ISBN (Electronic): 9781509054992

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Demand response, Distribution tariffs

Electronic versions:

Development options for distribution tariff structures in Finland

DOIs:

10.1109/EEM.2017.7981930

URLs:

<http://urn.fi/URN:NBN:fi:tty-201802141220>

### Bibliographical note

jufoid=70631

INT=eee,"Supponen, Antti"

Source: Scopus

Source ID: 85027133346

### **Understanding consumers' renewable energy behaviour beyond 'homo economicus': An exploratory survey in four European countries**

Climate change is putting global pressure for energy consumption and production to move towards sustainable solutions based on clean energy sources. Rapid advancements in technology make energy generation and storage solutions available and affordable for consumers and enable them to become relevant actors in the energy process. The actual success of sustainable energy solutions is however not so much dependent on technological readiness, which is already in place to large extent, but rather on influencing consumer adoption in an impactful way. This article explores consumers' behavioral drivers for the adoption of renewable energy solutions by comparing the economic, ecologic and social preferences of consumers in four European countries.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Industrial and Information Management, Electrical Energy Engineering

Contributors: Kotilainen, K., Valta, J., Mäkinen, S. J., Järventausta, P.

Publication date: 14 Jul 2017

#### **Host publication information**

Title of host publication: 2017 14th International Conference on the European Energy Market, EEM 2017

Publisher: IEEE

ISBN (Electronic): 9781509054992

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Consumer, Incentives, Policy, Prosumer, Renewable energy

DOIs:

10.1109/EEM.2017.7981932

#### **Bibliographical note**

jufoid=70631

Source: Scopus

Source ID: 85027150084

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › 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 200–400 °C. HfO<sub>2</sub> films were studied as barriers against thermal diffusion of copper substrate atoms. The ALD HfO<sub>2</sub> thin films were deposited in a thermal process at 200 °C using Tetrakis(Dimethylamido)Hafnium(Hf(NMe<sub>2</sub>)<sub>4</sub>) and H<sub>2</sub>O precursors, with 200, 400, and 600 cycles. The Cu substrates with and without HfO<sub>2</sub> thin films were aged by means of heat treatment in air. The influence of the HfO<sub>2</sub> barriers was determined by optical, microstructural, and morphological analyses before and after the ageing procedures. The optical performance of the HfO<sub>2</sub> barriers as a part of solar absorber stack was modelled with CODE Coating Designer. The copper surface without a HfO<sub>2</sub> barrier thin film oxidized significantly, which increased thermal emittance and surface roughness. 200 cycles of HfO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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 9.2 SJR 1.459 SNIP 1.537

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

### Long-Range Observation of Exciplex Formation and Decay Mediated by One-Dimensional Bridges

We report herein unprecedented long-range observation of both formation and decay of the exciplex state in donor (D)-bridge (B)-acceptor (A) linked systems. Zinc porphyrins (ZnP) as a donor were tethered to single-walled carbon nanotube (SWNT) as an acceptor through oligo(p-phenylene)s (ZnP-ph<sub>n</sub>-SWNT) or oligo(p-xylene)s (ZnP-xy<sub>n-1</sub>-ph<sub>1</sub>-SWNT) with systematically varied lengths (n = 1-5) to address the issue. Exponential dependencies of rate constants for the exciplex formation (k<sub>FEX</sub>) and decay (k<sub>DEX</sub>) on the edge-to-edge separation distance between ZnP and SWNT through the bridges were unambiguously derived from time-resolved spectroscopies. Distance dependencies (i.e., attenuation factor, β) of k<sub>FEX</sub> and k<sub>DEX</sub> in ZnP-ph<sub>n</sub>-SWNT were found to be considerably small (β = 0.10 for k<sub>FEX</sub> and 0.12 Å<sup>-1</sup> for k<sub>DEX</sub>) compared to those for charge separation and recombination (0.2-0.8 Å<sup>-1</sup>) in D-B-A systems with the same oligo(p-phenylene) bridges. The small β values may be associated with the exciplex state with mixed characters of charge-transfer and excited states. In parallel, the substantially nonconjugated bridge of oligo(p-xylene)s exhibited larger attenuation values (β = 0.12 for k<sub>FEX</sub> and 0.14 Å<sup>-1</sup> for k<sub>DEX</sub>). These results provide deep insight into the unique photodynamics of electronically strongly coupled D-B-A systems involving exciplex.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, Kyoto Women's University

Contributors: Baek, J., Umeyama, T., Stranius, K., Yamada, H., Tkachenko, N. V., Imahori, H.

Number of pages: 10

Pages: 13952-13961

Publication date: 29 Jun 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 121

Issue number: 25

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2017): CiteScore 7.9 SJR 2.135 SNIP 1.133

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Surfaces, Coatings and Films, Physical and Theoretical Chemistry

DOIs:

10.1021/acs.jpcc.7b04483

Source: Scopus

Source ID: 85022231305

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

### CFD based reactivity parameter determination for biomass particles of multiple size ranges in high heating rate devolatilization

This work presents a methodology that combines experimental measurements and Computational Fluid Dynamics (CFD) modeling to determine the global reaction kinetics of high heating rate biomass devolatilization. Three particle size ranges of woody biomass are analyzed: small (SF), medium (MF) and large (LF) fractions. Devolatilization mass loss is measured for each fraction in a laminar Drop-Tube Reactor (DTR) in nitrogen atmosphere, using two nominal reactor temperatures of 873 and 1173 K. Single First Order Reaction (SFOR) kinetics are determined by coupling an optimization routine with CFD models of the DTR. The global pre-exponential factors and activation energies for the SF, MF and LF particles are 5880 1/s and 42.7 kJ/mol, 48.1 1/s and 20.2 kJ/mol, and 102 1/s and 24.8 kJ/mol, respectively. These parameters are optimized for the isothermal heat transfer model available in CFD programs, and it is recommended that the specific heat capacity that was used in the optimization (1500 J/kgK) is used together with the parameters. Using the SF kinetics for small wood particles and either of the MF or LF kinetics for large particles, it is expected that more accurate

devolatilization predictions can be obtained for the whole fuel size distribution in large scale CFD simulations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Valmet Technologies Oy

Contributors: Niemelä, N. P., Tolvanen, H., Saarinen, T., Leppänen, A., Joronen, T.

Number of pages: 12

Pages: 676-687

Publication date: 1 Jun 2017

Peer-reviewed: Yes

#### Publication information

Journal: Energy

Volume: 128

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2017): CiteScore 8.1 SJR 1.99 SNIP 1.946

Original language: English

ASJC Scopus subject areas: Pollution, Energy(all)

Keywords: Biomass, Computational Fluid Dynamics (CFD), Devolatilization, High heating rate, Pyrolysis, Single First Order Reaction (SFOR)

DOIs:

10.1016/j.energy.2017.04.023

Source: Scopus

Source ID: 85018474683

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

#### Catalytic Activity of AuCu Clusters on MgO(100): Effect of Alloy Composition for CO Oxidation

Density functional simulations have been performed for Au<sub>7</sub>Cu<sub>23</sub> and Au<sub>23</sub>Cu<sub>7</sub> clusters on MgO(100) supports to probe their catalytic activity for CO oxidation. The adsorption of reactants, O<sub>2</sub> and CO, and potential O<sub>2</sub> dissociation have been investigated in detail by tuning the location of vacancies (F-center, V-center) in MgO(100). The total charge on Au<sub>7</sub>Cu<sub>23</sub> and Au<sub>23</sub>Cu<sub>7</sub> is negative on all supports, regardless of the presence of vacancies, but the effect is significantly amplified on the F-center. Au<sub>7</sub>Cu<sub>23</sub>/MgO(100) and Au<sub>23</sub>Cu<sub>7</sub>/MgO(100) with an F-center are the only systems to bind O<sub>2</sub> more strongly than CO. In each case, O<sub>2</sub> can be effectively activated upon adsorption and dissociated to 2 × O atoms. The different reaction paths based on the Langmuir-Hinshelwood (LH) and Eley-Rideal (ER) mechanisms for CO oxidation have been explored on the Au<sub>7</sub>Cu<sub>23</sub> and Au<sub>23</sub>Cu<sub>7</sub> clusters on F-centers, and the results are compared with the previous findings for Au<sub>15</sub>Cu<sub>15</sub>. Overall, the reaction barriers are small, but the changes in the Au:Cu ratio tune the reactant adsorption energies and sites considerably, showing also varying selectivity for CO and O<sub>2</sub>. The microkinetic model built on the basis of the above results shows a pronounced CO<sub>2</sub> production rate at low temperature for the clusters on F-centers.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Materials and Molecular Modeling, COMP Centre of Excellence, Department of Applied Physics, Aalto University, Aalto University, Norwegian Univ. of Sci. and Technol.

Contributors: Ma, L., Laasonen, K., Akola, J.

Number of pages: 11

Pages: 10876-10886

Publication date: 25 May 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 121

Issue number: 20

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2017): CiteScore 7.9 SJR 2.135 SNIP 1.133

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Surfaces, Coatings and Films, Physical and Theoretical Chemistry

Electronic versions:

Catalytic Activity of AuCu Clusters on MgO(100) Effect of Alloy Composition for CO Oxidation. Embargo ended: 17/02/18

DOIs:

10.1021/acs.jpcc.6b12054

URLs:

<http://urn.fi/URN:NBN:fi:ty-201905021452>. Embargo ended: 17/02/18

Source: Scopus

Source ID: 85020757142

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

### Geometric Structure and Chemical Ordering of Large AuCu Clusters: A Computational Study

Understanding the structure and composition of nanosized gold-copper (AuCu) clusters is crucial for designing an effective AuCu catalyst. Global optimization of AuCu clusters using atomistic force fields is a viable solution for clusters with at least a few nm sizes, because of its fast computation. Here we develop an atomistic many-body potential for AuCu on the basis of the second-moment approximation to the tight-binding model. We show that our potential is in good agreement with density-functional theory calculations, and use it to study the structure and chemical ordering of clusters of sizes up to ~4 nm by means of global optimization searches. We show that the clusters present a surface enrichment in Au, while subsurface and central sites are enriched in Cu. Surface enrichment in Au and center enrichment in Cu are stronger in icosahedra. Surface Cu atoms prefer terrace sites on (111) facets. Both atomistic and DFT calculations show that L1<sub>0</sub> and L1<sub>2</sub> ordered phases are not favorable, even at their ideal compositions for these sizes, because of the tendency of Au to surface segregation. The stability range of icosahedral structures is wider in AuCu nanoalloys than in Au and Cu pure clusters.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, COMP Centre of Excellence, Department of Applied Physics, Aalto University, Aalto University, Università di Genova

Contributors: Goh, J., Akola, J., Ferrando, R.

Number of pages: 8

Pages: 10809-10816

Publication date: 25 May 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 121

Issue number: 20

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2017): CiteScore 7.9 SJR 2.135 SNIP 1.133

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Physical and Theoretical Chemistry, Surfaces, Coatings and Films

DOIs:

10.1021/acs.jpcc.6b11958

Source: Scopus

Source ID: 85016919329

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

### The effects of calcium and potassium on CO<sub>2</sub> gasification of birch wood in a fluidized bed

Birch wood was leached of its naturally occurring ash forming elements and doped with three concentrations of calcium or potassium before being gasified in a laboratory bubbling fluidized bed reactor. The wood samples were pelletized and inserted into a fluidized bed reactor where they were first pyrolyzed with N<sub>2</sub> and then gasified with CO<sub>2</sub>. In addition to tracking the gas concentration of the exit gas, char samples were taken from the fluidized bed and analyzed to study the char properties. The presence of potassium in the biomass was found to have a significant influence on the structure of the resulting char, however potassium did not have an observable catalytic effect on the overall gasification reaction rate with CO<sub>2</sub> due to the formation of a unreactive coke layer on the char surface. In contrast, calcium did increase the char conversion rate and is likely the primary active catalyst in gasification of birch wood with CO<sub>2</sub>.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Industrial Bioengineering and Applied Organic Chemistry, Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Universidad de Sevilla, Johan Gadolin Process Chemistry Centre, Abo Akademi University, Univ of Oulu

Contributors: Kramb, J., Gómez-Barea, A., DeMartini, N., Romar, H., Doddapaneni, T. R. K. C., Kontinen, J.  
Number of pages: 10  
Pages: 398-407  
Publication date: 15 May 2017  
Peer-reviewed: Yes

#### Publication information

Journal: Fuel  
Volume: 196  
ISSN (Print): 0016-2361  
Ratings:

Scopus rating (2017): CiteScore 8.8 SJR 1.891 SNIP 2.127

Original language: English

ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry

Keywords: Biomass, Catalysts, Char, Fluidized bed, Gasification

DOIs:

10.1016/j.fuel.2017.01.101

Source: Scopus

Source ID: 85012050856

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

#### Photoinduced Electron Injection from Zinc Phthalocyanines into Zinc Oxide Nanorods: Aggregation Effects

Phthalocyanines (Pc) are well-known light-harvesting compounds. However, despite the tremendous efforts on phthalocyanine synthesis, the achieved energy conversion efficiencies for Pc-based dye-sensitized solar cells are moderate. To cast light on the factors reducing the conversion efficiency, we have undertaken a time-resolved spectroscopy study of the primary photoinduced reactions at a semiconductor-Pc interface. ZnO nanorods were chosen as a model semiconductor substrate with enhanced specific surface area. The use of a nanostructured oxide surface allows to extend the semiconductor-dye interface with a hole transporting layer (spiro-MeOTAD) in a controlled way, making the studied system closer to a solid-state dye-sensitized solar cell. Four zinc phthalocyanines are compared in this study. The compounds are equipped with bulky peripheral groups designed to reduce the self-aggregation of the Pcs. Almost no signs of aggregation can be observed from the absorption spectra of the Pcs assembled on a ZnO surface. Nevertheless, the time-resolved spectroscopy indicates that there are inter-Pc charge separation-recombination processes in the time frame of 1-100 ps. This may reduce the electron injection efficiency into the ZnO by more than 50%, pointing out to a remaining aggregation effect. Surprisingly, the electron injection time does not correlate with the length of the linker connecting the Pc to ZnO. A correlation between the electron injection time and the "bulkiness" of the peripheral groups was observed. This correlation is further discussed with the use of computational modeling of the Pc arrangements on the ZnO surface. (Figure Presented).

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, Instituto Madrileño de Estudios Avanzados (IMDEA)-Nanociencia, Universidad Autónoma de Madrid, Mersin University, South-Ukrainian National Pedagogical University

Contributors: Virkki, K., Hakola, H., Urbani, M., Tejerina, L., Ince, M., Martínez-Díaz, M. V., Torres, T., Golovanova, V., Golovanov, V., Tkachenko, N. V.

Number of pages: 12

Pages: 9594-9605

Publication date: 4 May 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 121

Issue number: 17

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2017): CiteScore 7.9 SJR 2.135 SNIP 1.133

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Surfaces, Coatings and Films, Physical and Theoretical Chemistry

DOIs:

10.1021/acs.jpcc.7b01562

Source: Scopus

Source ID: 85020915273

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

### **The IDE4L Project: Defining, Designing, and Demonstrating the Ideal Grid for All**

The Purpose of the IDE4L project was to define, design, and demonstrate the ideal grid for all, with an active distribution network that integrates renewable energy sources (RESs) and new loads and guarantees the reliability of classical distribution networks. The active distribution network consists of the infrastructure of power delivery, active resources, and active network management (ANM) and combines passive infrastructure with active resources, ANM functionalities, and distribution automation information and communication technology infrastructure. Active distributed energy resources (DERs) include distributed generation (DG), demand, response, and storage. The concept of a commercial aggregator offering flexibility services is also integrated in an ANM.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research area: Power engineering, Research group: Power systems, RWTH Aachen University, Unareti SpA, Schneider Electric, Catalonia Institute for Energy Research (IREC), Danish Energy Association (Dansk Energi), Universidad Carlos III de Madrid, VTT Technical Research Centre of Finland

Contributors: Repo, S., Ponci, F., Della Giustina, D., Alvarez, A., Corchero Garcia, C., Al-Jassim, Z., Amaris, H., Kulmala, A.

Number of pages: 11

Pages: 41-51

Publication date: 1 May 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE POWER AND ENERGY MAGAZINE

Volume: 15

Issue number: 3

ISSN (Print): 1540-7977

Ratings:

Scopus rating (2017): CiteScore 4 SJR 0.942 SNIP 1.356

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1109/MPE.2017.2662329

#### **Bibliographical note**

EXT="Kulmala, Anna"

Source: Scopus

Source ID: 85018954673

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 11.4 SJR 2.318 SNIP 2.496

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

### A New Miniaturized Sensor for Ultra-Fast On-Board Soot Concentration Measurements

In this article we present a design of a new miniaturized sensor with the capacity to measure exhaust particle concentrations on board vehicles and engines. The sensor is characterized by ultra-fast response time, high sensitivity, and a wide dynamic range. In addition, the physical dimensions of the sensor enable its placement along the exhaust line. The concentration response and temporal performance of a prototype sensor are discussed and characterized with aerosol laboratory test measurements. The sensor performance was also tested with actual engine exhaust in both chassis and engine dynamometer measurements. These measurements demonstrate that the sensor has the potential to meet and even exceed any requirements around the world in terms of on-board diagnostic (OBD) sensitivity and frequency of monitoring. Further to potential OBD applications, this has the capacity to be used as an engine and combustion diagnostics sensor, for example to detect misfiring, cylinder combustion variability, exhaust gas recirculation flowrate, etc.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Optics, Aristotle University of Thessaloniki, Finnish Meteorological Institute, Pegasor Oy

Contributors: Rostedt, A., Ntziachristos, L. D., Simonen, P., Rönkkö, T., Samaras, Z. C., Hillamo, R., Janka, K., Keskinen, J.

Number of pages: 7

Publication date: 28 Mar 2017

Peer-reviewed: Yes

### Publication information

Journal: SAE International Journal of Engines

Volume: 10

Issue number: 4

ISSN (Print): 1946-3936

Ratings:

Scopus rating (2017): CiteScore 3.9 SJR 1.455 SNIP 1.636

Original language: English

ASJC Scopus subject areas: Automotive Engineering, Fuel Technology

Electronic versions:

a\_new\_miniaturized\_sensor\_2017

DOIs:

10.4271/2017-01-1008

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910234036>

Source: Scopus

Source ID: 85018274264

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

### **Output power variation of different PV array configurations during irradiance transitions caused by moving clouds**

This paper presents a study of the output power variation of different photovoltaic (PV) array configurations during irradiance transitions caused by moving clouds. The study was based on velocity and other characteristics of roughly 27,000 irradiance transitions identified in measured irradiance data and conducted using a mathematical model of irradiance transitions and an experimentally verified simulation model of a PV module. The studied electrical PV array configurations were series-parallel, total-cross-tied and multi-string. The different PV array orientations and layouts (physical shapes) of the configurations were also studied. The average rate of change of the power of these studied PV array configurations during the irradiance transitions was around 3%/s and the maximum instantaneous rates of change of the power were around 75%/s. Half of the time during the studied transitions, the rate of change in the power was over 1.2%/s, and most of the time during the transitions, it exceeded typical PV power ramp rate limits set by grid operators. The average rate of change of PV array power decreased with an increasing maximum array dimension and it was observed to be the largest when the shorter dimension of the array was parallel to the dominant movement direction of the shadow edges. The results of this study are relevant especially in terms of PV array design, maximum power point tracking algorithm development and energy storage systems sizing.

#### **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: 9

Pages: 902-910

Publication date: 15 Mar 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Applied Energy

Volume: 190

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2017): CiteScore 12.9 SJR 3.162 SNIP 2.79

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Energy(all)

Keywords: Irradiance transition, Partial shading, Photovoltaic power generation, Power variation, PV array

DOIs:

10.1016/j.apenergy.2017.01.013

URLs:

<http://www.scopus.com/inward/record.url?scp=85009223592&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85009223592

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 6.9 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

#### Determining maximum MPP-tracking sampling frequency for input-voltage-controlled PV-interfacing converter

A maximum-power-point tracking (MPPT) algorithm is essential in all controllers of solar power electronic converters due to the nonlinear current-voltage characteristics of a photovoltaic generator. One of the most widely utilized algorithms are perturbative MPPT techniques such as perturb and observe and incremental conductance methods due to their simple implementation with relatively good tracking performance. However, in order to optimize the performance of such algorithms, the design parameters - sampling frequency and perturbation step size - need to be designed in respect to interfaced power electronic converter. Recent studies have provided state-of-art MPP-tracking design rules for single and two-stage grid-connected PV systems. Unfortunately, the analysis of those studies does not provide analytical results for PV power transient response under feedback-controlled converters. This paper provides reduced-order transfer functions for the converters equipped with either I-type or PID-type controllers in order to approximate the maximum sampling or perturbation frequency for MPP-tracking algorithms. The analysis reveals the factors affecting the transient behavior similarly as in open-loop converter providing valuable tools for optimizing MPP-tracking perturbation frequency design.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Energy Engineering, Research area: Power engineering, Ariel University

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

Publication date: 13 Feb 2017

#### Host publication information

Title of host publication: 8th Annual IEEE Energy Conversion Congress & Exposition (ECCE 2016)

Publisher: IEEE

ISBN (Electronic): 9781509007370

ASJC Scopus subject areas: Control and Systems Engineering, Electrical and Electronic Engineering, Energy Engineering and Power Technology, Control and Optimization

Electronic versions:

Determining maximum MPP-tracking sampling frequency for input-voltage-controlled PV-interfacing converter

DOIs:

10.1109/ECCE.2016.7855036

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201802141221>

Source: Scopus

Source ID: 85015446286

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

#### Cavitation erosion, slurry erosion and solid particle erosion performance of metal matrix composite (MMC) coatings sprayed with modern high velocity thermal spray processes

Thermally sprayed metal-matrix composite (MMC) coatings are widely used to protect components and surfaces against wear in various applications. Hard and wear resistant coatings increase the component lifetime and allow the refurbishment of the worn components. This produces significant savings and promotes ecological manufacturing. The current state-of-the-art coatings are produced with high velocity oxygen-fuel (HVOF) spray processes, while modern high velocity air-fuel (HVOF) spray process has become increasingly available in production and research. The current study

focuses on the performance of tungsten carbide (WC-10Co4Cr) and chromium carbide ( $\text{Cr}_3\text{C}_2$ -25NiCr) based MMC coatings sprayed with gaseous and liquid fuelled HVOF processes and a modern HVOF spray process. Two powder feedstock types, i.e. dense particles with fine carbides and porous particles with coarse carbides, were selected for both compositions. The results show significant improvements especially for WC-10Co4Cr coatings sprayed with HVOF when compared to HVOF sprayed coatings. In addition,  $\text{Cr}_3\text{C}_2$ -25NiCr coatings sprayed from the dense powder resulted in improved wear resistance compared to conventional feedstock powder.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Materials Science, Research group: Surface Engineering, Research group: Materials Characterization, VZÚ Pízeň, University of West Bohemia

Contributors: Matikainen, V., Rubio, S., Ojala, N., Koivuluoto, H., Schubert, J., Houdková, S., Vuoristo, P.

Number of pages: 3

Pages: 1161-1163

Publication date: 1 Jan 2017

#### Host publication information

Title of host publication: Materials Science and Technology Conference and Exhibition 2017, MS and T 2017 : October 8-12, 2017, Pittsburgh, Pennsylvania USA

Volume: 2

Publisher: Association for Iron and Steel Technology, AISTECH

ISBN (Electronic): 9781510850583

ASJC Scopus subject areas: Mechanics of Materials, Materials Science (miscellaneous), Energy Engineering and Power Technology

Keywords: Cavitation erosion, Coating, Metal matrix composite, Slurry erosion, Thermal spray

URLs:

<http://toc.proceedings.com/36807webtoc.pdf>

Source: Scopus

Source ID: 85047650405

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

#### Chasing measurements for real-world emissions of city buses

##### General information

Publication status: Published

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Atmospheric Composition Research, Finnish Meteorological Institute, Helsinki Region Environmental Services Authority (HSY), Department of Environmental Sciences, Helsinki University

Contributors: Järvinen, A., Karjalainen, P., Bloss, M., Potila, O., Simonen, P., Kuuluvainen, H., Timonen, H., Saarikoski, S., Niemi, J. V., Keskinen, J., Rönkkö, T.

Publication date: 2017

Peer-reviewed: Unknown

Event: Paper presented at European Aerosol Conference 2017, Zürich, Switzerland.

ASJC Scopus subject areas: Automotive Engineering, Pollution, Energy (miscellaneous)

Keywords: Exhaust emissions, bus emissions, Air quality

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

#### Controlling emissions of natural gas engines

Different selective catalytic reduction (SCR) and oxidation catalyst systems were assessed to study the effects of these catalysts on the  $\text{NO}_x$ , the hydrocarbon and the particle emissions from natural gas engines. High  $\text{NO}_x$  reductions were observed at low ammonia slips. A separate oxidation catalyst was used downstream of the SCR. The  $\text{NO}_x$  reduction efficiency was found to depend on the exhaust gas temperature. The efficiency of a catalyst reactor to remove hydrocarbons was found to depend on the hydrocarbon species, the exhaust temperature as well as the exhaust flow. The total measured PM mass was lower downstream of the catalyst than in the engine exhaust at all temperatures studied. Catalyst systems were found to have significant effects on particulate emissions.

##### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, VTT Technical Research Centre of Finland, Finnish Meteorological Institute, Dinex Ecocat, Wärtsilä Finland Oy

Contributors: Lehtoranta, K., Murtonen, T., Vesala, H., Koponen, P., Alanen, J., Kuittinen, N., Simonen, P., Rönkkö, T., Saarikoski, S., Timonen, H., Maunula, T., Kallinen, K., Korhonen, S.

Publication date: 2017

### Host publication information

Title of host publication: Proceedings of the Air and Waste Management Association's Annual Conference and Exhibition, AWMA2017

Publisher: Air and Waste Management Association

ASJC Scopus subject areas: Environmental Science(all), Energy(all)

Source: Scopus

Source ID: 85039150198

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › 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):  $10.2 \pm 2.2$  and  $10.8 \pm 1.2$  g L<sup>-1</sup>, respectively) than in pretreated mesophilic digestates ( $7.8 \pm 0.3$  g L<sup>-1</sup>), likely due to differences in concentration of sulfate, iron, and/or other minor nutrients. *S. acuminatus* removed over 97.4% of ammonium and 99.9% of phosphate and sulfate from the digestates. Color (74–80%) and soluble COD (29–39%) of the digestates were partially removed. Different AD processes resulted in different methane yields (18–126 L CH<sub>4</sub> kg<sup>-1</sup> 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 10 SJR 2.029 SNIP 1.84

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 2.8 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

#### **Numerical simulation and measurements of drying of Finnish concrete grades**

A numerical simulation model is presented to predict drying of concrete slabs of certain Finnish concrete grades. The coupled equations of heat and moisture transport in porous materials including the hydration phenomenon are incorporated in the model. The simulation model and its parameters were calibrated according to long-term measurements that were performed in a laboratory for test pieces of different concrete grades. As the material properties for quantities governing moisture transport were insufficient, parameters of the functions describing the material properties were fitted to the experimental data by employing the optimization analysis coupled to the simulation. A reasonable agreement was found and the unknown material parameters were solved, the values of which can be used in further simulations of real concrete structures.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Vahanen Building Physics Ltd, Comsol Oy

Contributors: Sekki, P., Karvinen, T.

Number of pages: 6

Pages: 729-734

Publication date: 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Energy Procedia

Volume: 132

Issue number: October

ISSN (Print): 1876-6102

Ratings:

Scopus rating (2017): CiteScore 1.7 SJR 0.495 SNIP 0.823

Original language: English

ASJC Scopus subject areas: Energy(all)

Keywords: Drying of concrete, early-age concrete, moisture diffusivity, numerical simulation, self-desiccation

DOIs:

10.1016/j.egypro.2017.10.015

URLs:

<http://www.scopus.com/inward/record.url?scp=85033375327&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Karvinen, Timo"

Source: Scopus

Source ID: 85033375327

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

#### **Photophysical properties of porphyrin dimer-single-walled carbon nanotube linked systems**

Porphyrin dimers were covalently grafted onto electron-accepting single-walled carbon nanotube (SWNT) sidewalls by direct aryl radical addition reaction with an m-or p-phenylene linker with the help of p-p interaction between the porphyrins. A splitting of the porphyrin Soret band and DFT calculations supported the selective formation of the porphyrin dimers on the sidewall of SWNTs. Photoexcitation of the porphyrin dimers on the SWNT resulted in the formation of the exciplex state, which directly decayed to the ground state without yielding the complete charge-separated state. Lifetimes of the porphyrin dimer-SWNT exciplex were longer than that of a porphyrin monomer-SWNT exciplex due to the stabilization by p-electron interaction over two porphyrin rings. In addition, the weaker electronic coupling through the meta-linkage than the para-one may be responsible for the exciplex lifetime of the porphyrin dimer-SWNT with the m-phenylene linker (49 ps) longer than that with the p-phenylene one (24 ps). The results obtained here provide the basic information on the effect of the donor dimerization on the photodynamic behavior of the exciplex state in donor-acceptor linked systems. [Figure presented]

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, Kyoto Women's University

Contributors: Baek, J., Umeyama, T., Mizuno, S., Tkachenko, N. V., Imahori, H.

Publication date: 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Physical Chemistry C

Volume: 121

Issue number: 39

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2017): CiteScore 7.9 SJR 2.135 SNIP 1.133

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Energy(all), Physical and Theoretical Chemistry, Surfaces, Coatings and Films

DOIs:

10.1021/acs.jpcc.7b08594

Source: Scopus

Source ID: 85032629899

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

#### **Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut: 24.-26.10.2017, Tampere. Seminaarijulkaisu 5 - Osa 1**

#### **General information**

Publication status: Published

MoE publication type: D6 Edited professional books

Organisations: Civil Engineering, Research group: Building Physics

Contributors: Vinha, J. (ed.), Kivioja, H. (ed.)

Number of pages: 370

Publication date: 2017

### Publication information

Place of publication: Tampere

Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka

Volume: 1

ISBN (Print): 978-952-15-4022-6

Original language: Finnish

ASJC Scopus subject areas: Engineering(all), Energy(all), Materials Science(all)

Electronic versions:

2017\_osa 1

URLs:

<http://urn.fi/URN:ISBN:978-952-15-4022-6>

Research output: Book/Report > Anthology > Professional

### Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut: 24.-26.10.2017, Tampere. Seminaarijulkaisu 5 - Osa 2

#### General information

Publication status: Published

MoE publication type: D6 Edited professional books

Organisations: Civil Engineering, Research group: Building Physics

Contributors: Vinha, J. (ed.), Kivioja, H. (ed.)

Number of pages: 256

Publication date: 2017

#### Publication information

Place of publication: Tampere

Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka

Volume: 2

ISBN (Print): 978-952-15-4023-3

Original language: Finnish

ASJC Scopus subject areas: Engineering(all), Energy(all), Materials Science(all)

Electronic versions:

2017\_osa 2

URLs:

<http://urn.fi/URN:ISBN:978-952-15-4023-3>

Research output: Book/Report > Anthology > Professional

### Rakennusten rakennusfysikaalisen suunnittelun ja toteutuksen periaatteet

#### General information

Publication status: Published

MoE publication type: D2 Article in professional manuals or guides or professional information systems or text book material

Organisations: Civil Engineering, Research group: Building Physics

Contributors: Vinha, J.

Number of pages: 60

Pages: 117-176

Publication date: 2017

#### Host publication information

Title of host publication: Rakentajain kalenteri 2018

Publisher: Rakennustieto Oy

Editors: Koskenvesa, A., Lyytinen, J., Laine, S.

#### Publication series

Name: Rakentajain kalenteri

Volume: 102

ISSN (Print): 0355-550X

ASJC Scopus subject areas: Engineering(all), Energy(all)

Research output: Chapter in Book/Report/Conference proceeding > Chapter > Professional

### Release of Potassium during Devolatilization of Spruce Bark

The spruce bark with different particle sizes were devolatilized under various final temperatures and heating rates. The char yield and potassium release from the spruce bark at studied conditions were quantified. Lower char yields realized

from the smaller fuel particles at high temperature and heating rate. It is mainly attributed to shorter residence time of volatiles in the fuel/char particles and less intensive secondary reaction of volatiles consequently. The devolatilization temperature has the most significant effects on alkali release from the studied spruce bark. At 600°C, less than 5% of alkali released from the both small and large particles regardless of heating rate. However, at 850°C, release of potassium from the small spruce bark particles sharply increased from 2.63% and 4.71% to 12.87% and 17.89%, as they were heated under heating rate of 50 K/min and 500 K/min, respectively. Large fraction of alkali released from studied fuel particles as they were devolatilized under a high heating rate. Additionally, more potassium release from small particles (125 <d<180 µm) than the larger ones (500 <d<600 µm) and this tendency increased with devolatilization temperature. In brief, intensive devolatilization conditions may limit secondary reactions of potassium containing compounds in the volatiles and thereby formation of more stable phases. The results obtained in the present work are of importance for understanding of potassium release during thermal conversion of spruce bark and proposing measures for mitigating potassium related operational problems.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, SINTEF Energy Research, Andritz AG

Contributors: Wang, L., Moilanen, A., Lehtinen, J., Konttinen, J., Matas, B. G.

Number of pages: 7

Pages: 1295-1301

Publication date: 2017

Peer-reviewed: Yes

### Publication information

Journal: Energy Procedia

Volume: 105

ISSN (Print): 1876-6102

Ratings:

Scopus rating (2017): CiteScore 1.7 SJR 0.495 SNIP 0.823

Original language: English

ASJC Scopus subject areas: Energy(all)

Keywords: char, devolatilization, ICP-OES, potassium, SEM-EDX, Spruce bark

Electronic versions:

Release of Potassium During Devolatilization of Spruce Bark

DOIs:

[10.1016/j.egypro.2017.03.463](https://doi.org/10.1016/j.egypro.2017.03.463)

URLs:

<http://urn.fi/URN:NBN:fi:tty-201708011639>

Source: Scopus

Source ID: 85020700355

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

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

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

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Aerosol Physics Laboratory, VTT Technical Research Centre of Finland, Finnish Meteorological Institute

Contributors: Ntziachristos, L., Saukko, E., Lehtoranta, K., Rönkkö, T., Timonen, H., Simonen, P., Karjalainen, P., Keskinen, J.

Number of pages: 10  
Pages: 456-465  
Publication date: 15 Dec 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Fuel  
Volume: 186  
ISSN (Print): 0016-2361  
Ratings:

Scopus rating (2016): CiteScore 7.8 SJR 1.736 SNIP 2.206

Original language: English

ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry

Keywords: Heavy fuel oil, Light fuel oil, Marine emissions, Particle emissions, Soot particles

DOIs:

10.1016/j.fuel.2016.08.091

Source: Scopus

Source ID: 84984817885

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

### Optimal control of pump rotational speed in filling and emptying a reservoir: minimum energy consumption with fixed time

An effective way to save energy in pumping systems with low static head is to control the pump's rotational speed with a variable-speed drive (VSD), which allows changing of the rotational speed when necessary. VSDs can be utilized to control batch transfer systems, for example, in filling or emptying a tank or a reservoir. In the literature, such processes have been optimized only with respect to energy consumption, but the time limit has been ignored. This means that pumping time can be very long. Our paper deals with this optimization problem and considers both pumping time and energy demand, which are often conflicting criteria. We derived a general optimal control law for rotational speed, which can easily be implemented in existing VSDs in the market. Minimum energy and minimum time schemes are special cases of this general new scheme. A constant flow rate scheme, suggested in the literature, is verified to give an optimum solution if the efficiency of the pump remains constant during operation. In addition to energy consumption, rotational speed control can have a favorable effect on the pump's lifetime, as pointed out in the paper.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Mechanical Engineering and Industrial Systems, FS Dynamics Finland Oy Ab

Contributors: Lindstedt, M., Karvinen, R.

Number of pages: 14

Pages: 1461-1474

Publication date: Dec 2016

Peer-reviewed: Yes

Early online date: 12 Mar 2016

#### Publication information

Journal: Energy Efficiency

Volume: 9

Issue number: 6

ISSN (Print): 1570-646X

Ratings:

Scopus rating (2016): CiteScore 2.5 SJR 0.744 SNIP 0.871

Original language: English

ASJC Scopus subject areas: Energy(all)

Keywords: Energy efficiency, Process control, Pumps, Variable-speed drives

DOIs:

10.1007/s12053-016-9434-y

### **Bibliographical note**

EXT="Lindstedt, Matti"

Source: Scopus

Source ID: 84960430781

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

### **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 6.4 SJR 1.504 SNIP 1.752

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

### **Multicriteria selection in concept design of a divertor remote maintenance port in the EU DEMO reactor using an AHP participative approach**

The work behind this paper took place in the Eurofusion remote maintenance system project (WPRM) for the EU Demonstration Fusion Power Reactor (DEMO). Following ITER, the aim of DEMO is to demonstrate the capability of generating several hundreds of MW of net electricity by 2050. The main objective of this paper was the study of the most efficient design of the maintenance port for replacing the divertor cassettes in a Remote Handling (RH) point of view. In DEMO overall design, one important consideration is the availability and short down time operations. The inclination of the divertor port has a very important impact on all the RH tasks such as the design of the divertor mover, the divertor locking systems and the end effectors. The current reference scenario of the EU DEMO foresees a 45° inclined port for the remote maintenance (RM) of the divertor in the lower part of the reactor. Nevertheless, in the optic of the systems engineering (SE) approach, in early concept design phase, all possible configurations shall be taken into account. Even the solutions which seem not feasible at all need to be investigated, because they could lead to new and innovative engineering proposals. The different solutions were compared using an approach based on the Analytic Hierarchy

Process (AHP). The technique is a multi-criteria decision making approach in which the factors that are important in making a decision are arranged in a hierarchic structure. The results of these studies show how the application of the AHP improved and focused the selection on the concept which is closer to the requirements arose from technical meetings with the experts of the RH field.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, ENEA/CREATE/Università Degli Studi Napoli Federico II, VTT Technical Research Centre of Finland, ENEA Brasimone

Contributors: Carfora, D., Gironimo, G. D., Esposito, G., Huhtala, K., Määttä, T., Mäkinen, H., Micciché, G., Mozzillo, R.

Number of pages: 8

Pages: 324-331

Publication date: 15 Nov 2016

Peer-reviewed: Yes

#### Publication information

Journal: Fusion Engineering and Design

Volume: 112

ISSN (Print): 0920-3796

Ratings:

Scopus rating (2016): CiteScore 2.3 SJR 0.579 SNIP 1.022

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Materials Science(all), Nuclear Energy and Engineering, Mechanical Engineering

Keywords: AHP, Concept design, DEMO, Remote handling, Systems engineering

DOIs:

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<http://www.scopus.com/inward/record.url?scp=84994060921&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84994060921

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

#### A Unified Modeling Approach of Multi-Terminal VSC-HVDC Links for Dynamic Simulations of Large-Scale Power Systems

This paper introduces a new and general frame-of-reference for dynamic solutions of multi-terminal VSC-HVDC systems using the Newton-Raphson method. Three VSC dynamic models are derived to conform to each pairing AC sub-network- the slack converter whose aim is to control its DC voltage, the scheduled-power converter which injects a scheduled amount of power and the passive converter which is connected to an AC network with no frequency control equipment. Each VSC unit makes provisions for the phase reactor, AC filter, DC capacitor, DC smoothing inductor and LTC transformer. The VSC itself is a positive-sequence lumped-type model whose core elements are a phase-shifting transformer and an equivalent shunt susceptance which account for the phase-shifting and scaling nature of the PWM control. In turn, the DC side of each pairing VSC unit is linked to a DC system of an arbitrary configuration. All this enables the assembly of any number of VSCs, giving rise to a comprehensive formulation of multi-terminal VSC-HVDC systems. The prowess of the proposed multi-terminal dynamic model is demonstrated by carrying out a comparison against the widely-used EMT-type package Simulink, using a three terminal VSC-HVDC system, with very good results. Furthermore, a six-terminal VSC-HVDC system forming a DC ring is used to show the applicability of the proposed unified approach when solving multi-terminal VSC-HVDC links for system-wide dynamic studies.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electrical Engineering, Research area: Power engineering, National Autonomous University of Mexico

Contributors: Castro, L. M., Acha, E.

Number of pages: 10

Pages: 5051-5060

Publication date: 1 Nov 2016

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Power Systems

Volume: 31

Issue number: 6

ISSN (Print): 0885-8950

Ratings:

Scopus rating (2016): CiteScore 12.1 SJR 3.368 SNIP 3.597

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Multi-terminal VSC-HVDC systems, Newton-Raphson method, VSC-HVDC dynamic modeling

DOIs:

10.1109/TPWRS.2016.2527498

Source: Scopus

Source ID: 84959422989

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 6.4 SJR 1.504 SNIP 1.752

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

### **Elimination of arsenic-containing emissions from gasification of chromated copper arsenate wood**

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

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Energy Technology and Thermal Process Chemistry, Gasification Technologies Inc., Gas Technology Institute

Contributors: Kramb, J., Konttinen, J., Backman, R., Salo, K., Roberts, M.

Number of pages: 6  
Pages: 319-324  
Publication date: 1 Oct 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Fuel  
Volume: 181  
ISSN (Print): 0016-2361  
Ratings:

Scopus rating (2016): CiteScore 7.8 SJR 1.736 SNIP 2.206

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry

Keywords: Arsenic, CCA wood, Equilibrium modeling, Gasification

DOIs:

10.1016/j.fuel.2016.04.109

Source: Scopus

Source ID: 84965081806

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 6.4 SJR 1.198 SNIP 1.411

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](#)

### **Power flow solutions of AC/DC micro-grid structures**

This paper presents a new and general frame-of-reference for the unified, power flow solution of AC and DC micro-grids using the Newton-Raphson method, where the quadratic convergence towards the solution is preserved. The cornerstone of this modeling development in power flow theory is the so-called multi-terminal VSC-HVDC system. In this frame-of-reference, an AC micro-grid of arbitrary configuration is connected to the high-voltage side of the LTC transformer of a VSC station. In turn, the DC side of each VSC is linked to a DC system of arbitrary configuration. Any number of AC micro-grids may exist and the DC system may contain single load or generation points such as a PV installation. Each VSC model takes into account, in aggregated form, the phase-shifting and scaling nature of the PWM control. It also accounts for the VSC current design limits, PWM limits within the linear range, switching losses and ohmic losses.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Research area: Power engineering, National Autonomous University of Mexico

Contributors: Acha, E., Rubbrecht, T., Castro, L. M.

Publication date: 10 Aug 2016

### **Host publication information**

Title of host publication: 19th Power Systems Computation Conference, PSCC 2016

Publisher: IEEE

ISBN (Print): 978-1-4673-8151-2

ASJC Scopus subject areas: Computer Networks and Communications, Energy Engineering and Power Technology

Keywords: Micro-grids, multi-terminal HVDC systems, Newton-Raphson method, power flows, VSC modeling

DOIs:

10.1109/PSCC.2016.7540815

Source: Scopus

Source ID: 84986550301

Research output: [Chapter in Book/Report/Conference proceeding](#) > [Conference contribution](#) > [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 points 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](#)

### **Cost-causation based approach in forming power-based distribution network tariff for small customers**

This paper discusses the development of electricity distribution network tariffs. In the paper, the present state of distribution network tariffs of small customers is discussed together with key future challenges of the distribution network business. As a potential solution to these challenges, power-based tariffs of the small customers are discussed and preliminary results of a case study are presented where tariffs are formed by applying data of one Finnish Distribution System Operator (DSO).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Research area: Power engineering, Helen Ltd.

Contributors: Lummi, K., Rautiainen, A., Järventausta, P., Heine, P., Lehtinen, J., Hyvärinen, M.

Publication date: 25 Jul 2016

#### **Host publication information**

Title of host publication: 2016 13th International Conference on the European Energy Market, EEM 2016

Publisher: IEEE COMPUTER SOCIETY PRESS

ISBN (Electronic): 9781509012978

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Electricity distribution business, electricity distribution network tariff, power-based distribution tariff

DOIs:

10.1109/EEM.2016.7521251

Source: Scopus

Source ID: 84983343584

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

### **Network impacts of distribution power tariff schemes with active customers**

In this paper we study the network impacts of power based distribution tariff which has been widely discussed in Finland as a future electricity distribution tariff also for small customers. The abundance of smart meters in Finland has enabled new forms of electricity pricing schemes, most notably hourly based energy pricing utilized by many Finnish retailers presently. However, the distribution pricing schemes are currently virtually same as during pre-deregulation and before the automatic meter reading (AMR) infrastructure. The paper presents the network impacts (voltage and current violations) of proposed tariff scheme based on load flow simulation of large-scale real-life distribution network from Finland. Simulations include the impact of both the retail and the distribution tariffs. Customers having large enough energy consumption (electric heating customers) are simulated to have a home automation for energy management. The results show that customer energy optimization can cause significant investment needs to the network and that power based distribution tariff can mitigate these issues.

#### **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., Lummi, K., Järventausta, P., Repo, S.

Publication date: 25 Jul 2016

#### **Host publication information**

Title of host publication: 2016 13th International Conference on the European Energy Market, EEM 2016

Publisher: IEEE COMPUTER SOCIETY PRESS

ISBN (Electronic): 9781509012978

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: Electricity Distribution Pricing, Energy management/optimization, Network Impacts, Power Tariff

DOIs:

10.1109/EEM.2016.7521237

#### **Bibliographical note**

AUX=DEE,"Supponen, Antti"

Source: Scopus

Source ID: 84983371980

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

### **The role of residential prosumers initiating the energy innovation ecosystem to future flexible energy system**

This paper explores prosumer role in Smart Grid innovation ecosystem as part of the energy market transition from traditional energy system to future flexible energy ecosystem based on renewable energy sources. This transition is facilitated by international agendas and government actions to slow down climate change globally and technological

advancements in multiple areas like consumer electronics (e.g. smart appliances) and Information and Communication Technologies (ICT). These developments render industries to converge and traditional structures are changing. Despite the technology developments and top-down policy push, the Smart Grid innovation ecosystem diffusion has not reached mass-market adoption yet. We review theoretical basis for energy system transition based on which we suggest a series of exploratory propositions for prosumer role in initiating the Smart Grid innovation ecosystem.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Industrial Management, Research group: Center for Innovation and Technology Research, Department of Electrical Engineering, Research area: Power engineering

Contributors: Kotilainen, K., Mäkinen, S. J., Järventausta, P., Rautiainen, A., Markkula, J.

Publication date: 25 Jul 2016

#### Host publication information

Title of host publication: 2016 13th International Conference on the European Energy Market, EEM 2016

Publisher: IEEE COMPUTER SOCIETY PRESS

ISBN (Electronic): 9781509012978

ASJC Scopus subject areas: Marketing, Energy Engineering and Power Technology, Fuel Technology

Keywords: demand response, diffusion of innovation, Flexible electrical energy system, innovation ecosystem, prosumer, Smart Grid

DOIs:

10.1109/EEM.2016.7521325

Source: Scopus

Source ID: 84983320429

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

#### A generalized frame of reference for the incorporation of, multi-terminal VSC-HVDC systems in power flow solutions

This paper introduces a new and general frame-of-reference for true unified, iterative solutions of AC/DC power flows using the Newton-Raphson method. The emphasis is placed on the so-called multi-terminal VSC-HVDC systems. This frame-of-reference accommodates quite naturally any number of AC/DC sub-networks generated by an arbitrary number of VSC converters. Besides, each AC sub-network may contain any number of FACTS devices. The modeling approach adopted for the multi-terminal VSC-HVDC systems is incremental in nature. An AC system of arbitrary configuration is connected to the high-voltage side of the VSC's LTC transformer. In turn, the DC side of each pairing VSC is linked to a DC system of arbitrary configuration. The new model represents a paradigm shift in the way the fundamental frequency, positive sequence modeling of VSC-HVDC links are modeled, where the VSCs are not treated as idealized, controllable voltage sources but rather as compound transformer devices with which key control properties of the PWM-based converters are linked. In contrast to other contemporary approaches, the power flow iterative solutions carried out using the reference frame put forward in this paper exhibits a true quadratic convergence characteristic - in most credible cases, convergence to a tight power mismatch tolerance of  $e^{-12}$  would be achieved in five or less iterations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Acha, E., Castro, L. M.

Number of pages: 10

Pages: 415-424

Publication date: 1 Jul 2016

Peer-reviewed: Yes

#### Publication information

Journal: Electric Power Systems Research

Volume: 136

ISSN (Print): 0378-7796

Ratings:

Scopus rating (2016): CiteScore 4.6 SJR 1.032 SNIP 1.517

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: MT-HVDC systems, Newton-Raphson method, Power flows, VSC-HVDC modeling

DOIs:

10.1016/j.epsr.2016.03.009

Source: Scopus

Source ID: 84962658013

### **Modeling of the catalytic effects of potassium and calcium on spruce wood gasification in CO<sub>2</sub>**

Using previously reported thermogravimetric analysis measurements, the effects of calcium and potassium on the char gasification rate of spruce wood were modeled. Spruce wood was leached of inorganic ash elements and doped with measured amounts of potassium and calcium. The wood was gasified in an isothermal thermogravimetric analysis device in CO<sub>2</sub> where the devolatilization of the wood, char formation and char gasification all occurred inside the preheated reactor. A new method for separating the effects of devolatilization and char gasification is presented. Kinetic models were evaluated for their ability to describe the observed catalytic effects of potassium and calcium on the gasification rate. Two modified versions of the random pore model were able to accurately describe the measured conversion rates and the parameters of the kinetic models were found to be dependent on the calcium and potassium concentrations. Empirical correlations were developed to predict the char conversion rate from only the potassium and calcium concentration of the sample.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Johan Gadolin Process Chemistry Centre, Abo Akademi University, VTT Technical Research Centre of Finland

Contributors: Kramb, J., DeMartini, N., Perander, M., Moilanen, A., Konttinen, J.

Number of pages: 10

Pages: 50-59

Publication date: 1 Jul 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Fuel Processing Technology

Volume: 148

ISSN (Print): 0378-3820

Ratings:

Scopus rating (2016): CiteScore 6.8 SJR 1.397 SNIP 1.769

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all)

Keywords: Biomass, Gasification, Modeling, Reaction kinetics

DOIs:

10.1016/j.fuproc.2016.01.031

#### **Bibliographical note**

EXT="Moilanen, Antero"

Source: Scopus

Source ID: 84959431503

Research output: Contribution to journal > Article > 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., Marttinen, 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 7.4 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

#### Stand-Off Radioluminescence Mapping of Alpha Emitters under Bright Lighting

Remote detection of alpha emitters is achieved by measuring the secondary radioluminescence light (air fluorescence) that is induced by alpha particles when absorbed in air. A telescope was used to collect the radioluminescence photons to a photomultiplier tube, which is operated in the photon counting mode. Careful matching of photocathode response and filter pass-band allows the sensing of a faint radioluminescence emission in a brightly illuminated environment, which is essential for operative use. A minimum detectable alpha activity of 4 kBq was reached at 1 m distance in 10 s time, when ultraviolet-free lighting is present, and 800 kBq under bright fluorescent lighting. These sensitivities are realized using an ultra-bialkali and cesium-telluride photocathodes in the aforementioned environments respectively. The presented approach is a robust and affordable solution to remotely detect and localize moderate alpha activities in a field environment, providing a means for automated alpha contamination mapping. Moreover, it is shown that a signal increase of more than two orders of magnitude (150–420) can be achieved in deep ultraviolet (close to 260 nm), if nitrogen or argon purge are used to enhance the detection.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics, STUK - Radiation and Nuclear Safety Authority, European Commission Joint Research Centre, Institute for Transuranium Elements Karlsruhe, HT Nuclear Ltd

Contributors: Sand, J., Nicholl, A., Hrneck, E., Toivonen, H., Toivonen, J., Peräjrv, K.

Number of pages: 7

Pages: 1777–1783

Publication date: 1 Jun 2016

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Nuclear Science

Volume: 63

Issue number: 3

ISSN (Print): 0018-9499

Ratings:

Scopus rating (2016): CiteScore 3.1 SJR 0.566 SNIP 1.048

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Nuclear Energy and Engineering, Nuclear and High Energy Physics

Keywords: air fluorescence, alpha particle detectors, optical devices, radioluminescence

DOIs:

10.1109/TNS.2016.2562359

#### Bibliographical note

EXT="Sand, Johan"

Source: Scopus

Source ID: 84979017346

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

### **Correlation of wear and work in dual pivoted jaw crusher tests**

A laboratory sized jaw crusher with uniform movement of the jaws, the Dual Pivoted Jaw Crusher (DPJC), was used to determine the relationship between wear and work. Wear was concentrated on the jaw plates opposing each other and was measured as mass loss of the specimens. Work was measured directly from the force and the displacement of the instrumented jaw, which allowed work to accumulate only from the actual crushing events. The tests were conducted with several jaw geometries and with two motional settings, where the relation of compressive and sliding motion between the jaws was varied.

The comminution of rock is presumed to be irreversible, meaning that the energy used for crack formation in the rock particles eventually results in the fracture of the particles. Therefore, the amount of energy needed to comminute rock particles should be roughly constant and not dependent on the loading conditions, if the speed of the loading contact is not changed. The DPJC test method allows the separation of work components into comminution specific work and sliding specific work. The results can be used to compare the crushability of minerals without the influence of the used test geometry or the selected jaw plate materials. The sliding work can be used for the comparison of the wear of the jaw plate materials

### **General information**

Publication status: Published

MoE publication type: D3 Professional conference proceedings

Organisations: Materials Science, Research group: Materials Characterization, Research group: Materials Characterization, Metso Minerals, Inc.

Contributors: Terva, J., Valtonen, K., Siitonen, P., Kuokkala, V.

Publication date: Jun 2016

### **Host publication information**

Title of host publication: The 17th Nordic Symposium on Tribology - NORDTRIB 2016

ASJC Scopus subject areas: Materials Science(all), Engineering (miscellaneous), Energy (miscellaneous)

Keywords: Jaw crusher, Comminution, Work, Wear, Abrasive wear

Electronic versions:

nordtrib\_2016\_215

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201708141675>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

### **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<sub>0.1</sub>N<sub>0.03</sub>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<sub>0.1</sub>N<sub>0.03</sub>As solar cell exhibits a short circuit current density as high as 17.9 mA/cm<sup>2</sup> 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 8.8 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

### **Effect of Hole Transporting Material on Charge Transfer Processes in Zinc Phthalocyanine Sensitized ZnO Nanorods**

The photoinduced electron transfer processes were studied for hybrid systems consisting of self-assembled monolayer of zinc phthalocyanine (ZnPc) assembled on ZnO nanorods and a film of organic hole transporting material (HTM) atop. Polythiophene (P3HT) or Spiro-OMeTAD were used as HTM. The study was carried out by ultrafast transient absorption spectroscopy technique with selective excitation of ZnPc at 680 nm or P3HT at 500 nm. Data analysis revealed that photoexcitation of ZnPc in the structure ZnO|ZnPc|P3HT results in a fast (1.8 ps) electron transfer from ZnPc to ZnO, which is followed by a hole transfer from the ZnPc cation to P3HT roughly in 30 ps. However, in the case of ZnO|ZnPc|Spiro-OMeTAD structure, the primary reaction upon excitation of ZnPc is a fast (0.5 ps) hole transfer from ZnPc to Spiro-OMeTAD, and the second step is electron injection from the ZnPc anion to ZnO in roughly 120 ps. Thus, we demonstrate two structurally very similar hybrid architectures that implement two different mechanisms for photoinduced charge separation found in dye-sensitized or in organic solar cells.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry

Contributors: Hakola, H., Sariola-Leikas, E., Efimov, A., Tkachenko, N. V.

Number of pages: 8

Pages: 7044-7051

Publication date: 21 Apr 2016

Peer-reviewed: Yes

### Publication information

Journal: Journal of Physical Chemistry C

Volume: 120

Issue number: 13

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2016): CiteScore 7.9 SJR 1.964 SNIP 1.189

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/acs.jpcc.6b01583

Source: Scopus

Source ID: 84964529902

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  $\text{MgF}_2\text{-CaF}_2$  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  $\mu\text{m}$ .

### 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 0.8 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

### Ambient-Pressure XPS Study of a Ni-Fe Electrocatalyst for the Oxygen Evolution Reaction

Chemical analysis of solid-liquid interfaces under electrochemical conditions has recently become feasible due to the development of new synchrotron radiation techniques. Here we report the use of "tender" X-ray ambient-pressure X-ray photoelectron spectroscopy (APXPS) to characterize a thin film of Ni-Fe oxyhydroxide electrodeposited on Au as the working electrode at different applied potentials in 0.1 M KOH as the electrolyte. Our results show that the as-prepared 7 nm thick Ni-Fe (50% Fe) film contains Fe and Ni in both their metallic as well as oxidized states, and undergoes further oxidation when the sample is subjected to electrochemical oxidation-reduction cycles. Metallic Fe is oxidized to  $\text{Fe}^{3+}$  and metallic Ni to  $\text{Ni}^{2+/3+}$ . This work shows that it is possible to monitor the chemical nature of the Ni-Fe catalyst as a function of potential when the corresponding current densities are small. This allows for operando measurements just above the onset of OER; however, current densities as they are desired in photoelectrochemical devices ( $\sim 1\text{-}10\text{ mA cm}^{-2}$ ) could not be achieved in this work, due to ohmic losses in the thin electrolyte film. We use a two-dimensional model to describe the spatial distribution of the electrochemical potential, current density, and pH as a function of the position above the electrolyte meniscus, to provide guidance toward enabling the acquisition of operando APXPS at high current density. The shifts in binding energy of water with applied potential predicted by the model are in good agreement with the experimental values.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Surface Science, SUNCAT Center for Interface Science and Catalysis, SLAC National Accelerator Laboratory, Department of Chemical and Biomolecular Engineering, Berkeley, Materials Sciences Division, Lawrence Berkeley National Laboratory, Materials and Corrosion Engineering, Exponent, Inc., Polymer Science and Materials Chemistry

Contributors: Ali-Löytty, H., Louie, M. W., Singh, M. R., Li, L., Sanchez Casalongue, H. G., Ogasawara, H., Crumlin, E. J., Liu, Z., Bell, A. T., Nilsson, A., Friebel, D.

Number of pages: 7

Pages: 2247-2253

Publication date: 4 Feb 2016

Peer-reviewed: Yes

### Publication information

Journal: Journal of Physical Chemistry C

Volume: 120

Issue number: 4

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2016): CiteScore 7.9 SJR 1.964 SNIP 1.189

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

Electronic versions:

MS+SI(post-print). Embargo ended: 4/01/17

DOIs:

10.1021/acs.jpcc.5b10931

URLs:

<http://urn.fi/URN:NBN:fi:tty-201606034213>. Embargo ended: 4/01/17

Source: Scopus

Source ID: 84957588014

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 km<sup>2</sup> of peat production lands in Finland, and theoretically, approximately 300 km<sup>2</sup> 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<sup>-1</sup> 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 6.4 SJR 1.198 SNIP 1.411

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 12.9 SJR 2.998 SNIP 3.543

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

### High efficiency dilute nitride solar cells: Simulations meet experiments

Parameter extraction procedure and simulation of dilute nitride solar cells are reported. Using PC1D simulation and fitting to experimental current-voltage and external quantum efficiency data, we retrieve the phenomenological material parameters for GaInNAs solar cells. Based on these, we have constructed a model that can explain the changes in short circuit current and open circuit voltage of n-i-p solar cells subjected to rapid thermal annealing. The model reveals that non-annealed MBE-grown GaInNAs material has an n-type doping that evolves to p-type upon rapid thermal annealing. The change of doping type and the shift of the physical location of the pn-junction were confirmed by Kelvin-probe force microscopy. The PC1D modelling was found to work well also for GaInNAs p-i-n solar cells with opposite polarity. It was also found that the GaInNAs lower doping levels in p-i-n solar cells grown at lowered As/III flux ratios were associated with increased carrier lifetimes.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Tukiainen, A., Aho, A., Polojärvi, V., Ahorinta, R., Guina, M.

Number of pages: 20

Pages: 113-132

Publication date: 2016

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Green Engineering

Volume: 5

Issue number: 3-4

Article number: 8

ISSN (Print): 1904-4720

Ratings:

Scopus rating (2016): CiteScore 0.7 SJR 0.132 SNIP 0.294

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Energy(all), Physics and Astronomy(all), Materials Science(all)

DOIs:

10.13052/jge1904-4720.5348

URLs:

<http://www.scopus.com/inward/record.url?scp=84983050025&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84983050025

Research output: Contribution to journal > 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 spectroscope (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 8.8 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

#### Roll-to-roll application of photocatalytic TiO<sub>2</sub> nanoparticles for printed functionality

In this work ultraviolet A (UVA) light controlled photocatalytic activity of TiO<sub>2</sub> nanoparticles is utilized on paper, paperboard, and plastic films for controlled wetting and oxygen sensors for modified atmosphere packages (MAPs). A liquid flame spray (LFS) process is used for a large-area TiO<sub>2</sub> nanoparticle deposition on natural fibre based substrates such as paperboard that results in a superhydrophobic surface. Controlled wettability is achieved using an UVA light activation that converts the surface to hydrophilic whereas an oven heat treatment recovers the initial superhydrophobicity. On the other hand, a TiO<sub>2</sub> nanoparticles with methylene blue (MB) dye is used to detect the presence of oxygen in modified atmosphere packages. We believe that photocatalytically active surfaces with tailorable properties will find many applications in the near future, for example, with printed functional devices.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, Center for Functional Materials at Biological Interfaces (FUNMAT), Abo Akad Univ, Abo Akademi University, Dept Phys, Omya International AG, AGH University of Science and Technology, Aerosol Physics Laboratory

Contributors: Saarinen, J. J., Valtakari, D., Bollström, R., Stepien, M., Haapanen, J., Mäkelä, J. M., Toivakka, M.

Number of pages: 4

Pages: 47-50

Publication date: 2016

#### Host publication information

Title of host publication: Advanced Manufacturing, Electronics and Microsystems : TechConnect Briefs 2016

Volume: 4

Publisher: TechConnect

ISBN (Electronic): 9780997511734

ASJC Scopus subject areas: Fluid Flow and Transfer Processes, Biotechnology, Surfaces, Coatings and Films, Fuel Technology

Keywords: Controlled wetting, Nanoparticles, O sensor, Photocatalysis, TiO

URLs:

<http://www.techconnect.org/proceedings/paper.html?volume=TCB2016v4&chapter=1&paper=785>

URLs:

<http://www.scopus.com/inward/record.url?scp=84988974879&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84988974879

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

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

Natural gas engine particle emissions were studied using an old gasoline engine modified to run with natural gas. The tests were steady-state tests performed on two different low loads in an engine dynamometer. Exhaust particle number concentration, size distribution, volatility and electric charge were measured. Exhaust particles were observed to have peak diameters below 10 nm. To get the full picture of particle emissions from natural gas engines, size range 1-5 nm is relevant and important to take into consideration. A particle size magnifier (PSM) was used in this engine application for measuring particles smaller than 3 nm and it proved to be a useful instrument when measuring natural gas engine exhaust particles. It is concluded that the detected particles probably originated from the engine cylinders or their vicinity and grew

to detectable sizes in the sampling process because a small fraction of the particles were observed to carry electric charge and the particles did not evaporate totally at 265°C.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Engineering materials science and solutions (EMASS), Urban circular bioeconomy (UrCirBio), Atmospheric Composition Research, VTT Technical Research Centre of Finland, Finnish Meteorological Institute

Contributors: Alanen, J., Saukko, E., Lehtoranta, K., Murtonen, T., Timonen, H., Hillamo, R., Karjalainen, P., Kuuluvainen, H., Harra, J., Keskinen, J., Rönkkö, T.

Number of pages: 7

Pages: 155-161

Publication date: 15 Dec 2015

Peer-reviewed: Yes

#### Publication information

Journal: Fuel

Volume: 162

ISSN (Print): 0016-2361

Ratings:

Scopus rating (2015): CiteScore 6.9 SJR 1.781 SNIP 2.111

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry

Keywords: Fine particle emission, Internal combustion engine, Natural gas, Particle formation

DOIs:

10.1016/j.fuel.2015.09.003

URLs:

<http://www.scopus.com/inward/record.url?scp=84941782885&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84941782885

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<sub>2</sub>) 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 8.8 SJR 2.487 SNIP 1.993

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, Biodetoxification, 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  $571 \text{Whkg}^{-1}$  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 15.3 SJR 2.724 SNIP 3.409

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

### **Power generation in fed-batch and continuous up-flow microbial fuel cell from synthetic wastewater**

Up-flow bioreactors have the advantages of retaining very high cell density and having high mass transfer efficiency. The recirculation rate could improve the up-flow rate in up-flow bioreactor. A two-chamber UFMFC (up-flow microbial fuel cell) is constructed with flat graphite electrodes and anion exchange membrane for electricity generation. The anode chamber is seeded with compost culture enriched on xylose and operated on synthetic wastewater with 0.5 g/L xylose, external resistance of 100  $\Omega$ , at pH 7.0 and 37 °C in fed-batch mode. The cathode chamber in the top of the UFMFC is filled with potassium ferricyanide (pH 7.0) as the electron acceptor. The effects of different recirculation rates of 1.2, 2.4, 4.8 and 7.2 RV (reactor-volumes)/h to increase the mass transfer and electricity production are determined in fed-batch mode. At a recirculation rate of 4.8 RV/h, a power density of  $356 \pm 24 \text{ mW/m}^2$  with CE (coulombic efficiency) of  $21.3 \pm 1.0\%$  is obtained. Decreasing HRT (hydraulic retention time) could improve the electricity production performance of UFMFC in continuous mode. The power generation is increased to  $372 \pm 20 \text{ mW/m}^2$ , while CE remains at  $13.4 \pm 0.5\%$  with HRT of 1.7 d and optimum recirculation rate of 4.8 RV/h on continuous mode. Microbial communities were characterized with PCR (polymerase chain reaction) - DGGE (denaturing gradient gel electrophoresis). In the end of the experiment, the biofilm contained both fermenting and exoelectrogenic bacteria, while fermenting and nitrate-reducing bacteria were mainly present in the anodic solutions. Moreover, some changes occurred in the microbial communities of the anodic solutions when the MFCs were switched from fed-batch to continuous mode, while the differences were minor between different recirculation rates in fed-batch mode.

#### **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: Lay, C., Kokko, M. E., Puhakka, J. A.

Number of pages: 7

Pages: 235-241

Publication date: 1 Nov 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Energy

Volume: 91

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2015): CiteScore 7.4 SJR 2.22 SNIP 2.027

Original language: English

ASJC Scopus subject areas: Energy(all), Pollution

Keywords: Continuous mode, Microbial fuel cell, Recirculation rate, Two chamber, Up-flow, Xylose

DOIs:

10.1016/j.energy.2015.08.029

URLs:

<http://www.scopus.com/inward/record.url?scp=84946031190&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84946031190

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

### **Suboptimal search strategies with bounded computational complexity to solve long-horizon direct model predictive control problems**

Search algorithms that reduce the time to solve the direct model predictive control (MPC) problem are proposed in this paper. By allowing for suboptimal solutions, the computational complexity of the underlying optimization problem can be significantly reduced, albeit by sacrificing (to a certain degree) optimality. Two approaches are presented and discussed. The first approach requires quadratic time, making it a very efficient candidate for solving the examined problem. Thanks to the second approach, a preset upper limit on the operations performed in real time is not exceeded, thus guaranteeing realtime termination in all runs. To highlight the effectiveness of the introduced strategies, a variable speed drive system with a three-level voltage source inverter is used as an illustrative example.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Smart Energy Systems (SES), Institute for Electrical Drive Systems and Power Electronics, Technische Universität München, ABB Corporate Research Center - Switzerland

Contributors: Karamanakos, P., Geyer, T., Kennel, R.

Number of pages: 8

Pages: 334-341

Publication date: 21 Sep 2015

### Host publication information

Title of host publication: 2015 IEEE Energy Conversion Congress and Exposition, ECCE 2015

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781467371506

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Electronic versions:

Suboptimal search strategies with bounded computational complexity 2015

DOIs:

10.1109/ECCE.2015.7309707

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004153261>

Source: Scopus

Source ID: 84963626563

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

### Construction of an Interconnected Nanostructured Carbon Black Network: Development of Highly Stretchable and Robust Elastomeric Conductors

In the present work, a strong filler-filler network of conductive carbon black was strategically established in an elastomer matrix, which leads to a unique combination of electrical and mechanical properties. The novelty of our composites was the development of a strong percolated morphology of nanostructured conducting carbon black particles by the incorporation of relatively large nonreinforcing spherical silica particles, inside the soft elastomer matrix. This technique allowed us to fabricate solution styrene butadiene rubber (S-SBR) composites with outstanding electrical conductivity of 40 S/m, tensile strength ~10 MPa, and extensibility up to 200%. Furthermore, the electrical conductivity was strain-independent up to 50% elongation strain. The electrical conductivity was found to be unaltered after 2000 loading-unloading cycles. This is the first ever report of a robust elastomeric system with such high electrical conductivity where all the basic ingredients used were selected from well-known commercially available raw materials of rubber industry. This work directly manifests an industrially viable method for preparing high-performance elastic conductors that can be utilized in robust and flexible applications.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), Leibniz-Institut für Polymerforschung Dresden E.V., Technische Universität Dresden, Institut für Werkstoffwissenschaft, Institut für Polymerwerkstoffe E.V., Elkem AS, Silicon Materials

Contributors: Bhagavatheswaran, E. S., Parsekar, M., Das, A., Le, H. H., Wiessner, S., Stöckelhuber, K. W., Schmaucks, G., Heinrich, G.

Number of pages: 9

Pages: 21723-21731

Publication date: 17 Sep 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Physical Chemistry C

Volume: 119

Issue number: 37

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2015): CiteScore 7.9 SJR 1.886 SNIP 1.246

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/acs.jpcc.5b06629

URLs:

<http://www.scopus.com/inward/record.url?scp=84941928016&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84941928016

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

### Compensation of PV generator output power fluctuations with energy storage systems

Photovoltaic generators (PVG) suffer from short-term intermittency of output power. With significant penetration of PV this intermittency can lead to power systems instability and power quality problems. Energy storage systems (ESS) can be used to compensate PV power fluctuations in order to mitigate these problems. In this paper ESS behavior, control and

sizing have been investigated to mitigate instabilities caused by PV power plants operating in Northern European conditions through simulations that utilize measurements from the Tampere University of Technology (TUT) Solar PV power station research plant. Continuous synchronized measurements have been recorded with the irradiance and PV module temperature sensor network with a 10 Hz sampling frequency since June 2011. The ESS capacity and power requirements are derived from the simulations for different PVG sizes and PV power ramp rate (RR) limits. The results show how both capacity and power requirements decrease as functions of the RR limit and the PVG size. Also, interesting differences have been noticed compared to similar studies done in Southern European climate, which indicate that the operational climate of the PVG can have an effect on ESS sizing.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Research area: Power engineering, Tampere University of Technology

Contributors: Schnabel, J., Valkealahti, S.

Number of pages: 5

Pages: 2177-2181

Publication date: 14 Sep 2015

#### Host publication information

Title of host publication: 31st European Photovoltaic Solar Energy Conference and Exhibition (31st EU PVSEC), 14– 18 September, 2015, Hamburg, Germany

ISBN (Print): 3-936338-39-6

ASJC Scopus subject areas: Energy(all)

DOIs:

10.4229/EUPVSEC20152015-5BV.2.6

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

#### Recognition of shading events caused by moving clouds and determination of shadow velocity from solar radiation measurements

Fast variability of solar radiation is the main cause of fluctuating photovoltaic (PV) power production and shadows caused by overpassing clouds are the main reason of such variability. Fast irradiance transitions caused by the edges of shadows can lead to situations where the grid inverter is not able to follow the global maximum power point (MPP) causing extra losses. Further, fast fluctuations of the power fed to the electric grid can cause, for example, power balance and quality problems. This paper presents a method to recognize shading events caused by moving clouds from measured irradiance data. The developed recognition method has been used to analyse shading events from 15 months of full-time irradiance recordings and the results of the analysis are presented. Further, the Linear Cloud Edge (LCE) method has been used to determinate velocities of the shadows.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

Contributors: Lappalainen, K., Valkealahti, S.

Number of pages: 6

Pages: 1568-1573

Publication date: 14 Sep 2015

#### Host publication information

Title of host publication: 31st European Photovoltaic Solar Energy Conference and Exhibition (31st EU PVSEC), 14– 18 September, 2015, Hamburg, Germany

ISBN (Print): 3-936338-39-6

ASJC Scopus subject areas: Energy(all)

DOIs:

10.4229/EUPVSEC20152015-5AO.7.5

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

#### Superatom Model for Ag-S Nanocluster with Delocalized Electrons

Several Ag-S nanoclusters where the cluster core comprises mixed metal (main component) and sulfur atoms show superatomic orbitals in the conduction band edge. However, there are no superatomic states, i.e., delocalized electrons, in the valence band, and the clusters in question can be labeled as “zerovalent”. We show here an example of an Ag-S cluster which fulfills the superatom model and has delocalized electrons: The recently synthesized and characterized  $[Ag_{62}S_{12}(StBu)_{32}]^{2+}$  cluster has four delocalized valence electrons based on a simple counting rule, and we compare it to the zerovalent cluster  $[Ag_{62}S_{13}(StBu)_{32}]^{4+}$ . Our electronic structure analysis confirms the existence of superatomic states in the valence and conduction bands, but the locations of these states do not agree completely with the

conventional prediction based on the spherical Jellium model.  $[\text{Ag}_{62}\text{S}_{12}(\text{StBu})_{32}]^{2+}$  displays the 1S<sub>2</sub> electronic shell closure at the Fermi energy instead of the 1S<sub>2</sub>1P<sub>2</sub> configuration as suggested by its electron count. This shift of energy levels and electron shell closing has been introduced by the core-shell structure of the cluster. Our optical absorption simulation can reproduce the features observed in the experiments, and we assign these features to the transitions involving superatomic states within the conduction band.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: Materials and Molecular Modeling, Computational Science X (CompX), COMP Centre of Excellence, Department of Applied Physics, Aalto University

Contributors: Goh, J. Q., Akola, J.

Number of pages: 8

Pages: 21165-21172

Publication date: 10 Sep 2015

Peer-reviewed: Yes

Early online date: 19 Aug 2015

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 119

Issue number: 36

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2015): CiteScore 7.9 SJR 1.886 SNIP 1.246

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/acs.jpcc.5b05824

URLs:

<http://www.scopus.com/inward/record.url?scp=84941254956&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84941254956

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

#### Searching for a robust strategy for minimizing alkali chlorides in fluidized bed boilers during burning of high SRF-energy-share fuel

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

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), University of Jyväskylä, Valmet Technologies Oy, VTT Technical Research Centre of Finland, Department of Chemistry, Renewable Natural Resources and Chemistry of Living Environment, Stora Enso

Contributors: Bajamundi, C. J. E., Vainikka, P., Hedman, M., Silvennoinen, J., Heinanen, T., Taipale, R., Konttinen, J.

Number of pages: 12

Pages: 25-36

Publication date: 1 Sep 2015

Peer-reviewed: Yes

## Publication information

Journal: Fuel

Volume: 155

ISSN (Print): 0016-2361

Ratings:

Scopus rating (2015): CiteScore 6.9 SJR 1.781 SNIP 2.111

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry

Keywords: Alkali chloride mitigation, Corrosion, SRF, Waste-to-energy

DOIs:

10.1016/j.fuel.2015.03.087

URLs:

<http://www.scopus.com/inward/record.url?scp=84928243284&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928243284

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

## Electrospun Black Titania Nanofibers: Influence of Hydrogen Plasma-Induced Disorder on the Electronic Structure and Photoelectrochemical Performance

This work encompasses a facile method for tailoring surface defects in electrospun TiO<sub>2</sub> nanofibers by employing hydrogen plasma treatments. This amiable processing method was proven with SQUID, EPR, and XPS to be highly effective in generating oxygen vacancies, accompanied by the reduction of Ti<sup>4+</sup> centers to Ti<sup>3+</sup>, resulting in the formation of black titania. The treatment temperature was found to affect the Ti<sup>3+</sup>/Ti<sup>4+</sup> ratios and surface valence, while preserving the original 1D morphology of the titania fibers. Ab initio DFT calculations showed that a high concentration of oxygen vacancies is highly efficient in producing midgap states that enhance the system absorption over the whole visible range, as observed with UV/vis/NIR diffuse reflectance spectroscopy. Pristine TiO<sub>2</sub> nanofibers produced a photocurrent density of similar to 0.02 mA/cm<sup>2</sup> at 1.23 V vs RHE, whereas the hydrogen plasma treatment resulted in up to a 10-fold increase in the photoelectrochemical performance.

## General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Universita degli Studi di Padova, Italy, Univ Cologne, University of Cologne, Dept Chem, Chair Inorgan & Mat Chem, Padova University, INSTM, J. Heyrovský Institute of Physical Chemistry, Academy of Sciences of the Czech Republic, Institute of Inorganic Chemistry, Catalonia Institute for Energy Research (IREC), Multiscale Materials Modelling and Tribo Simulation, CNR-IENI

Contributors: Lepcha, A., Maccato, C., Mettenböcker, A., Andreu, T., Mayrhofer, L., Walter, M., Olthof, S., Ruoko, T. P., Klein, A., Moseler, M., Meerholz, K., Morante, J. R., Barreca, D., Mathur, S.

Number of pages: 8

Pages: 18835-18842

Publication date: 20 Aug 2015

Peer-reviewed: Yes

## Publication information

Journal: Journal of Physical Chemistry C

Volume: 119

Issue number: 33

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2015): CiteScore 7.9 SJR 1.886 SNIP 1.246

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

Keywords: ROOM-TEMPERATURE, WATER, SURFACE, NANOSTRUCTURES, NANOPARTICLES, PHOTOCATALYSIS, INSULATORS, CONVERSION, DEFECTS, ARRAYS

Electronic versions:

Electrospun\_black\_titania\_nanofibers\_post-print

DOIs:

10.1021/acs.jpcc.5b02767

URLs:

<http://urn.fi/URN:NBN:fi:tty-201612094845>

URLs:

<http://www.scopus.com/inward/record.url?scp=84939825598&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939825598

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

### **Cascoded Power Stage With Automatic Dead Time Generation**

The paper presents a cascoded power stage with automatic dead time generation. The circuit is using the inter-transistor node voltages of the cascode configuration as feedback control signals to delay turning ON the power transistors. The circuit is designed as the output stage of a fully-integrated buck converter. The steady-state operation is described. The waveforms simulated on 45-nm CMOS process show that in steady-state operation the short-circuit path and body diode conductions are avoided while effective zero-voltage switching (ZVS) are provided both for ground and power supply line; the calculated dead times are in a good agreement with simulation results.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electronics and Communications Engineering, Research group: RF Integrated Circuits, University of Calgary, Alberta, Canada

Contributors: Filanovsky, I., Järvenhaara, J., Tchamov, N.

Number of pages: 4

Publication date: 2 Aug 2015

#### **Host publication information**

Title of host publication: IEEE 58th International Midwest Symposium on Circuits and Systems (MWSCAS), Fort Collins, CO, U.S.A, Aug. 2-5, 2015

Publisher: IEEE

ISBN (Print): 978-1-4673-6557-4

ASJC Scopus subject areas: Engineering(all), Energy(all)

Keywords: DC-DC converters, Buck converter, Cascoded Stage, Dead time auto-generation, ZVS

DOIs:

10.1109/MWSCAS.2015.7282019

Research output: [Chapter in Book/Report/Conference proceeding](#) › [Conference contribution](#) › [Scientific](#) › [peer-review](#)

### **Low-Voltage DC Distribution-Utilization Potential in a Large Distribution Network Company**

Low-voltage direct-current (LVDC) distribution is a promising solution whose benefits are large power transfer capacity with low voltage, high cost savings potential, and improvements to reliability and voltage quality. Tests by the pilot implementation in the distribution system operator (DSO) Elenia Oy have given promising results. The power transfer capacity of the system has been calculated in this paper using voltage drop and maximum load of cable as boundaries. The branches of the medium-voltage network that can be replaced by LVDC distribution are determined based on the calculations and mass computation of the entire distribution area of Elenia Oy. Based on the electrotechnical and customer outage costs (COC) analyses made, it can be inferred that LVDC distribution has good utilization potential. Based on the power transfer capacity calculations, it is technically possible to replace branch lines up to 8 km long by LVDC distribution which means about 20% of the total medium-voltage network length in the distribution area of Elenia Oy. This means also huge potential in improving the overall reliability of electricity supply and in reducing outage costs of customers which are these days taken into account in the regulation of network business.

#### **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), Elenia Oy

Contributors: Hakala, T., Lähdeaho, T., Järventausta, P.

Number of pages: 8

Pages: 1694-1701

Publication date: 1 Aug 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Transactions on Power Delivery

Volume: 30

Issue number: 4

ISSN (Print): 0885-8977

Ratings:

Scopus rating (2015): CiteScore 5.9 SJR 1.788 SNIP 2.564

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Energy Engineering and Power Technology

Keywords: Direct-current distribution, low-voltage direct current (LVDC), LVDC distribution system, power transfer capacity calculation

DOIs:

10.1109/TPWRD.2015.2398199

Source: Scopus

Source ID: 84937893206

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

### Photoinduced Electron Transfer in CdSe/ZnS Quantum Dot-Fullerene Hybrids

Photoinduced electron transfer (ET) in CdSe/ZnS core-shell quantum dot (QD) - fullerene (COOH-C<sub>60</sub>) hybrids was studied by the means of time-resolved emission and absorption spectroscopy techniques. A series of four QDs with emission in the range 540-630 nm was employed to investigate the dependence of the electron transfer rate on the QD size. Emission of the QDs is quenched upon hybrid formation, and the quenching mechanism is identified as photoinduced electron transfer from the QD to the fullerene moiety due to the fullerene anion signature observed in transient absorption. In order to obtain quantitative information on the ET reaction, several kinetic data analysis techniques were used, including a conventional multiexponential fitting and a maximum entropy method for emission decay analysis, as well as a distributed decay model based on the Poisson distribution of fullerenes in the hybrids. The latter gradually simplifies the interpretation of the transient absorption spectra and indicates that the spectra of QD cations are essentially similar to those of neutral QDs, differing only by a minor decrease in the intensity and broadening. Furthermore, only a minor decrease in the ET rate with the increasing QD size was observed, the time constants being in the range 100-200 ps for all studied QDs. The charge recombination is extended to 10 ns or longer for all hybrids.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry

Contributors: Virkki, K., Demir, S., Lemmetyinen, H., Tkachenko, N. V.

Number of pages: 12

Pages: 17561-17572

Publication date: 23 Jul 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Physical Chemistry C

Volume: 119

Issue number: 31

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2015): CiteScore 7.9 SJR 1.886 SNIP 1.246

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/acs.jpcc.5b04251

### Bibliographical note

INT=keb,"Demir, Sinem"

Source: Scopus

Source ID: 84938703282

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

### Divertor remote handling for DEMO: Concept design and preliminary FMECA studies

The paper describes a concept design of a remote handling (RH) system for replacing divertor cassettes and cooling pipes in future DEMO fusion power plant. In DEMO reactor design important considerations are the reactor availability and reliable maintenance operations. The proposed divertor mover is a hydraulic telescopic boom driven from the transportation cask through the maintenance tunnel of the reactor. The boom is divided in three sections and it is driving an end-effector in order to perform the scheduled operations of maintenance inside the vacuum vessel. Two alternative designs of the end effector to grip and manipulate the divertor cassette are presented in this work. Both concepts are hydraulically actuated, based on ITER previous studies. The divertor cassette end-effector consists of a lifting arm linked to the divertor mover, a tilting plate, a cantilever arm and a hook-plate. Taking advantage of the ITER RH background and experience, the proposed hydraulic RH system is compared with the rack and pinion system currently designed for ITER

and is an object of simulations at Divertor Test Platform (DTP2) in VTT's Labs of Tampere, Finland. Pros and cons will be put in evidence.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, Field robotics for efficient work sites (FIRE), VTT Technical Research Centre of Finland, ENEA/CREATE/Università Degli Studi Napoli Federico II

Contributors: Carfora, D., Di Gironimo, G., Järvenpää, J., Huhtala, K., Määttä, T., Siuko, M.

Number of pages: 5

Pages: 1437-1441

Publication date: 9 Jul 2015

Peer-reviewed: Yes

#### Publication information

Journal: Fusion Engineering and Design

Volume: 98-99

ISSN (Print): 0920-3796

Ratings:

Scopus rating (2015): CiteScore 2.1 SJR 0.682 SNIP 1.472

Original language: English

ASJC Scopus subject areas: Nuclear Energy and Engineering, Materials Science(all), Civil and Structural Engineering, Mechanical Engineering

Keywords: Concept design, DEMO, Divertor, Hydraulic telescopic boom, Remote handling

DOIs:

10.1016/j.fusengdes.2015.06.056

URLs:

<http://www.scopus.com/inward/record.url?scp=84942553949&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Siuko, M."

Source: Scopus

Source ID: 84942553949

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 TiO<sub>2</sub> 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 8.8 SJR 2.62 SNIP 1.639

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 6.7 SJR 2.023 SNIP 2.066

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

### **A real-time electrically controlled active matching circuit utilizing genetic algorithms for biomedical WPT applications**

In this research, the feasibility of a real-time active matching circuit for biomedical WPT applications is discussed. Also, the genetic-algorithm based matching circuit design method utilizing discrete circuit components is introduced and the practicality of active matching circuits for WPT is verified with preliminary measurement results featuring a maximum of 3 dB of improvement in transmission coefficient for a range of spanning a coil to coil distance of 10 to 12 cm, which was achieved by inserting the active matching circuit.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, School of Electrical and Computer Engineering

Contributors: Bito, J., Jeong, S., Tentzeris, M. M.  
Publication date: 29 Jun 2015

#### Host publication information

Title of host publication: 2015 IEEE Wireless Power Transfer Conference, WPTC 2015

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7140168

ISBN (Electronic): 9781467374477

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Impedance matching, Power transmission, Real-time systems

DOIs:

10.1109/WPT.2015.7140168

URLs:

<http://www.scopus.com/inward/record.url?scp=84942939382&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84942939382

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

#### Catalytic effect of Ca and K on CO<sub>2</sub> gasification of spruce wood char

Gasification is one route to produce chemicals and liquid fuels from biomass. The gasification of the char is catalyzed by alkali and alkaline earth metals in the biomass. In this work the catalytic effect of calcium (Ca) and potassium (K) on CO<sub>2</sub> gasification of spruce wood was studied using a thermo gravimetric analyzer (TGA). The ash-forming elements were first removed from the wood using an acid leaching method. Then, various concentrations of K and Ca were absorbed to the wood by ion-exchange to carboxylic and phenolic groups, impregnation of K<sub>2</sub>CO<sub>3</sub> or physically mixing of CaC<sub>2</sub>O<sub>4</sub>. The prepared spruce samples were placed in a mesh holder and gasified in the TGA at 850 °C in 100% CO<sub>2</sub>. The results demonstrate that the gasification rate of the char increased linearly with an increase in the concentration of Ca or K. Crystalline CaC<sub>2</sub>O<sub>4</sub> distributed only at the surface of the wood particles resulted in low catalytic activity. The catalytic activity of Ca was higher than K in the beginning of char gasification but the catalytic effect of Ca decreased earlier than the catalytic effect of potassium. Further, the char structure was investigated by SEM-EDX. The SEM analysis from interrupted gasification experiments showed the formation of CaCO<sub>3</sub> and K<sub>2</sub>CO<sub>3</sub> layer on the char surface. By adding corresponding levels of Ca and K as the original spruce to the acid washed sample, a similar gasification reactivity was obtained at 850 °C.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Abo Akademi University, Åbo Akademi University, University of Jyväskylä, Process Chemistry Center, VTT Technical Research Centre of Finland

Contributors: Perander, M., DeMartini, N., Brink, A., Kramb, J., Karlström, O., Hemming, J., Moilanen, A., Kontinen, J., Hupa, M.

Number of pages: 9

Pages: 464-472

Publication date: 15 Jun 2015

Peer-reviewed: Yes

#### Publication information

Journal: Fuel

Volume: 150

ISSN (Print): 0016-2361

Ratings:

Scopus rating (2015): CiteScore 6.9 SJR 1.781 SNIP 2.111

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry

Keywords: Biomass, Calcium, Char reactivity, CO, Gasification, Potassium

DOIs:

10.1016/j.fuel.2015.02.062

URLs:

<http://www.scopus.com/inward/record.url?scp=84924100908&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Kramb, J."

Source: Scopus

Source ID: 84924100908

### **Effect of Multilevel Inverter Supply on Core Losses in Magnetic Materials and Electrical Machines**

The effect of multilevel inverter supply on power losses in magnetic cores and electrical machines is studied. A dynamic numerical model for the hysteresis, eddy current, and excess losses in a core lamination is first developed. By both measurements and simulations for a ring-core inductor, we demonstrate how increasing the number of inverter voltage levels decreases the iron losses when compared with traditional two-level supply. Although the switching frequency has a significant impact on the iron losses in the case of a traditional two-level inverter, using three or five voltage levels makes the losses almost independent of the switching. Finally, finite-element simulations show that similar reductions are also possible for the core losses of 150-kVA and 12.5-MW wound-field synchronous machines, in which rather low switching frequencies are typically used. Calorimetric loss measurements are also presented for the 150-kVA machine in order to confirm the significant effect of switching frequency on the core losses with two-level inverter supply.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Smart Energy Systems (SES), Aalto University, Universiteit Gent, Ghent University, Zwijnaarde, Belgium, Cairo University

Contributors: Rasilo, P., Salem, A., Abdallah, A., De Belie, F., Dupré, L., Melkebeek, J. A.

Number of pages: 9

Pages: 736-744

Publication date: 1 Jun 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Transactions on Energy Conversion

Volume: 30

Issue number: 2

Article number: 6980114

ISSN (Print): 0885-8969

Ratings:

Scopus rating (2015): CiteScore 8.6 SJR 1.454 SNIP 2.609

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Energy Engineering and Power Technology

Keywords: Eddy currents, electrical machines, excess loss, finite-element analysis, iron loss, magnetic hysteresis, magnetic materials, multilevel converter, pulse width modulation

DOIs:

10.1109/TEC.2014.2372095

URLs:

<http://www.scopus.com/inward/record.url?scp=84930207311&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84930207311

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

### **A novel VSC-HVDC link model for dynamic power system simulations**

This paper introduces a new RMS model of the VSC-HVDC link. The model is useful for assessing the steady-state and dynamic responses of large power systems with embedded back-to-back and point-to-point VSC-HVDC links. The VSC-HVDC model comprises two voltage source converters (VSC) linked by a DC cable. Each VSC is modelled as an ideal phase-shifting transformer whose primary and secondary windings correspond, in a notional sense, to the AC and DC buses of the VSC. The magnitude and phase angle of the ideal phase-shifting transformer represent the amplitude modulation ratio and the phase shift that exists in a PWM converter to enable either generation or absorption of reactive power purely by electronic processing of the voltage and current waveforms within the VSC. The mathematical model is formulated in such a way that the back-to-back VSC-HVDC model is realized by simply setting the DC cable resistance to zero in the point-to-point VSC-HVDC model. The Newton-Raphson method is used to solve the nonlinear algebraic and discretised differential equations arising from the VSC-HVDC, synchronous generators and the power grid, in a unified frame-of-reference for efficient, iterative solutions at each time step. The dynamic response of the VSC-HVDC model is assessed thoroughly; it is validated against the response of a detailed EMT-type model using Simulink<sup>®</sup>. The solution of a relatively large power system shows the ability of the new dynamic model to carry out large-scale power system simulations with high efficiency.

#### **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), Universidad Michoacana de San Nicolás de Hidalgo

Contributors: Castro, L. M., Acha, E., Fuerte-Esquivel, C. R.  
Number of pages: 10  
Pages: 111-120  
Publication date: 30 May 2015  
Peer-reviewed: Yes

#### Publication information

Journal: Electric Power Systems Research

Volume: 126

ISSN (Print): 0378-7796

Ratings:

Scopus rating (2015): CiteScore 4.2 SJR 0.962 SNIP 1.59

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Dynamic power system simulations, FACTS, HVDC, Newton-Raphson method, VSC

DOIs:

10.1016/j.epsr.2015.05.003

Source: Scopus

Source ID: 84930658938

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 6.8 SJR 1.635 SNIP 2.396

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 6.8 SJR 1.635 SNIP 2.396

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, H<sub>2</sub>, CH<sub>4</sub>, CO<sub>2</sub>, and organic acids were the main metabolites on all substrates but the metabolite profiles varied with the substrate. Similar H<sub>2</sub> yields of 2-3 mol mol<sup>-1</sup> substrate at 48h were obtained with all monosaccharides and disaccharides. The CO<sub>2</sub> yields were higher with disaccharides than with monosaccharides, 4.5 vs 2 mol mol<sup>-1</sup> 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 6.8 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

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

#### 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  $MgCl_2 \cdot 6H_2O$  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 4.40g/L and 2.27g/L for  $NH_4Cl$  and  $KH_2PO_4$  respectively. Confirmation experiment with the optimized media ( $NH_4Cl$ , 4.40g/L;  $K_2HPO_4$ , 1.6g/L;  $KH_2PO_4$ , 2.27g/L;  $MgCl_2 \cdot 6H_2O$ , 1.0g/L; KCl, 1.0g/L; Na-acetate. $3H_2O$ , 1.0g/L and tryptone, 2.0g/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 7.2 SJR 1.767 SNIP 2.098

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

### Silver sulfide nanoclusters and the superatom model

The superatom model of electron-shell closings has been widely used to explain the stability of noble-metal nanoclusters of few nanometers, including thiolate-protected Au and Ag nanoclusters. The presence of core sulfur atoms in silver sulfide (Ag-S) nanoclusters renders them a class of clusters with distinctive properties as compared to typical noble-metal clusters. Here, it is natural to ask whether the superatom model is still applicable for the Ag-S nanoclusters with mixed metal and nonmetal core atoms. To address this question, we applied density functional simulations to analyze a series of Ag-S nanoclusters:  $\text{Ag}_{14}\text{S}(\text{SPh})_{12}(\text{PPh}_3)_8$ ,  $\text{Ag}_{14}(\text{SC}_6\text{H}_3\text{F}_2)_{12}(\text{PPh}_3)_8$ ,  $\text{Ag}_{70}\text{S}_{16}(\text{SPh})_{34}(\text{PhCO}_2)_4(\text{triphos})_4$ , and  $[\text{Ag}_{123}\text{S}_{35}(\text{StBu})_{50}]^{3+}$ . We observed that superatomic orbitals are still present in the conduction band of these Ag-S clusters where the cluster cores comprise mostly silver atoms. Our Bader charge analysis illustrates that thiolates play a significant role in withdrawing charge (electron density) from the core Ag atoms. The simulated optical absorption properties of the selected Ag-S clusters reflect the substantial band gaps associated with typical molecular orbitals on both sides. Apart from  $\text{Ag}_{14}\text{S}(\text{SPh})_{12}(\text{PPh}_3)_8$ , which has a central sulfur atom in the cluster core, superatomic orbitals of the Ag-S clusters can have contributions for individual transitions in the conduction band.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Physics, Research group: Materials and Molecular Modeling, Computational Science X (CompX), University of Jyväskylä, Departments of Physics and Chemistry  
Contributors: Goh, J., Malola, S., Häkkinen, H., Akola, J.  
Number of pages: 8  
Pages: 1583-1590  
Publication date: 22 Jan 2015  
Peer-reviewed: Yes

### Publication information

Journal: Journal of Physical Chemistry C  
Volume: 119  
Issue number: 3  
ISSN (Print): 1932-7447  
Ratings:  
Scopus rating (2015): CiteScore 7.9 SJR 1.886 SNIP 1.246  
Original language: English  
ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)  
DOIs:  
10.1021/jp511037x  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84921476515&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84921476515  
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 1.8 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

### Comparison of Detection Techniques for Multipath Propagation of Pseudolite Signals Used in Dense Industrial Environments

Modern industrial environments with automated production machinery often require special indoor positioning and localization techniques, due to the presence of objects and the infrastructure that may obstruct the line-of-sight propagation or interfere with the behaviour of electromagnetic waves. These challenges are difficult to overcome by the widely employed GNSS positioning system designed for use in outdoor areas. One of the existing indoor positioning systems are the pseudolites, which transmit positioning signals similar to the ones used by GNSS systems. One of the sources of errors for pseudolites is the multipath propagation. Our paper compares the performances of several multipath propagation detection techniques, using Binary Offset Carrier (BOC) navigation signal and determines that the error increases sharply when the receiver uses navigation signals that have multipath propagation. The techniques that we present improve the positioning accuracy, which leads to more precise industrial processes.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Wireless Communications and Positioning, Ministry of National Education, University Politehnica of Bucharest

Contributors: Alexandru, R., Lohan, E.

Number of pages: 7

Pages: 1294-1300

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Procedia Engineering

Volume: 100

Issue number: C

ISSN (Print): 1877-7058

Ratings:

Scopus rating (2015): CiteScore 0.9 SJR 0.239 SNIP 0.566

Original language: English

ASJC Scopus subject areas: Energy(all)

Keywords: Binary Offset Carrier, GNSS, Indoor positioning, Multipath propagation, Pseudolite

DOIs:

10.1016/j.proeng.2015.01.496

Source: Scopus

Source ID: 84925047361

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

### Driving forces of road freight CO<sub>2</sub> in 2030

**Purpose** - Road freight carbon dioxide (CO<sub>2</sub>) emissions are determined by a complex interaction between shippers and hauliers within the boundaries set by regulations and economic factors. It is necessary to gain understanding about the various driving forces and trends affecting these to promote low carbon future. The purpose of this paper is to find out what factors affect the long-term future development of road freight CO<sub>2</sub> emissions and whether the long-term emission targets will be achieved. **Design/methodology/approach** - An international comparison of similar Delphi surveys is carried out in Finland, Norway, and Sweden. **Findings** - The Delphi surveys indicate that the structural change of the economy, changes of consumer habits, concerns of energy and environment and changes in logistics practices and technology are the overarching trends shaping the future of the energy efficiency and CO<sub>2</sub> emissions of road freight transport. The expert forecasts for Finland and Sweden highlight that reaching the carbon emission target of 30 per cent reduction for the year 2030 is possible. However, the CO<sub>2</sub> emissions may also increase significantly even though the CO<sub>2</sub> intensity would decrease, as the Norwegian forecast shows. **Originality/value** - This study combined quantitative and qualitative analysis. The results confirmed that similar factors are seen to affect the future in all three countries, but with some national differences in the likely effects of the factors. Future research using the same methodology would enable wider analysis of the global significance of these driving forces.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Information Management and Logistics, Life Cycle Effectiveness of the Built Environment (LCE@BE)

Contributors: Liimatainen, H., Hovi, I. B., Arvidsson, N., Nykänen, L.

Number of pages: 26

Pages: 260-285

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Physical Distribution and Logistics Management

Volume: 45

Issue number: 3

ISSN (Print): 0960-0035

Ratings:

Scopus rating (2015): CiteScore 4.5 SJR 1.48 SNIP 1.389

Original language: English

ASJC Scopus subject areas: Energy(all)

Keywords: Forecasting, Road freight transport, CO<sub>2</sub> emissions, Delphi survey

DOIs:

10.1108/IJPDLM-10-2013-0255

URLs:

<http://www.emeraldinsight.com/doi/10.1108/IJPDLM-10-2013-0255>

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

### Enquête de la variabilité cycle-à-cycle du NO dans la combustion homogène

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

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

#### Publication information

Journal: OIL AND GAS SCIENCE AND TECHNOLOGY : REVUE DE L'INSTITUT FRANCAIS DU PETROLE  
Volume: 70  
Issue number: 1  
ISSN (Print): 1294-4475  
Ratings:

Scopus rating (2015): CiteScore 2.1 SJR 0.361 SNIP 0.733

Original language: French

ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology  
DOIs:

10.2516/ogst/2013199

URLs:

<http://www.scopus.com/inward/record.url?scp=84924341440&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84924341440

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

#### 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 11 SJR 2.921 SNIP 3.386

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)

## MBE GROWN GaInNAsSb MULTIJUNCTION SOLAR CELLS: PATH TOWARDS 50% EFFICIENCY

### General information

Publication status: Published

MoE publication type: D3 Professional conference proceedings

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

Contributors: Aho, A. J., Polojärvi, V. V., Aho, T. A., Raappana, M. J. S., Tukiainen, A. K., Guina, M. D.

Publication date: 2015

### Host publication information

Title of host publication: 18th European Molecular Beam Epitaxy Workshop. Canazei, Italy

ASJC Scopus subject areas: Energy(all)

URLs:

<http://web.nano.cnr.it/eurombe2015/wp-content/uploads/2014/03/Excerpt-program-01032015.pdf>

### Bibliographical note

xpresentation

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

### On the benefit of long-horizon direct model predictive control for drives with LC filters

Even though direct model predictive control (MPC) schemes almost exclusively use a prediction horizon of one in power electronics applications, the use of longer horizons offers significant performance benefits. This statement is underlined in this paper for a medium-voltage variable speed drive system, which consists of a three-level inverter, an LC filter and an induction machine. The proposed MPC controller simultaneously regulates the inverter current, capacitor voltage and stator current along given references, by manipulating the switch positions of the inverter. As will be shown, extending the prediction horizon significantly reduces the oscillations due to the filter resonance. For sufficiently long horizons, such as ten, low total harmonic distortions of the stator current can be achieved at low device switching frequencies. An additional active damping loop is not required, adding to the conceptual simplicity of the proposed control scheme.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Smart Energy Systems (SES), ABB Corporate Research Center - Switzerland, Technische Universität München

Contributors: Geyer, T., Karamanakos, P., Kennel, R.

Number of pages: 8

Pages: 3520-3527

Publication date: 15 Sep 2014

### Host publication information

Title of host publication: 2014 IEEE Energy Conversion Congress and Exposition, ECCE 2014

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781479956982

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology

Electronic versions:

On the benefit of long-horizon direct model 2014

DOIs:

[10.1109/ECCE.2014.6953879](https://doi.org/10.1109/ECCE.2014.6953879)

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004173333>

Source: Scopus

Source ID: 84934300239

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

### Reformulation of the long-horizon direct model predictive control problem to reduce the computational effort

For direct model predictive control schemes with current reference tracking, the underlying integer least-squares (ILS) problem is reformulated to reduce the computational complexity of the solution stage. This is achieved by exploiting the geometry of the ILS problem and by reducing the computations needed for its formulation and solution. A lattice reduction and a sphere decoding algorithm are implemented. A variable speed drive system with a three-level voltage source inverter serves as an illustrative example to demonstrate the effectiveness of the proposed algorithm.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Smart Energy Systems (SES), Technische Universitat Munchen, ABB Corporate Research Center - Switzerland

Contributors: Karamanakos, P., Geyer, T., Kennel, R.

Number of pages: 8

Pages: 3512-3519

Publication date: 15 Sep 2014

### Host publication information

Title of host publication: 2014 IEEE Energy Conversion Congress and Exposition, ECCE 2014

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781479956982

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology

Electronic versions:

Reformulation of the long-horizon direct model 2014

DOIs:

10.1109/ECCE.2014.6953878

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004173336>

Source: Scopus

Source ID: 84934300237

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

### Intrinsic momentum transport in up-down asymmetric tokamaks

Recent work has demonstrated that breaking the up-down symmetry of tokamak flux surfaces removes a constraint that limits intrinsic momentum transport, and hence toroidal rotation, to be small. We show, through MHD analysis, that ellipticity is most effective at introducing up-down asymmetry throughout the plasma. We detail an extension to GS2, a local  $\delta f$  gyrokinetic code that self-consistently calculates momentum transport, to permit up-down asymmetric configurations. Tokamaks with tilted elliptical poloidal cross-sections were simulated to determine nonlinear momentum transport. The results, which are consistent with the experiment in magnitude, suggest that a toroidal velocity gradient,  $(\partial u_{\phi} / \partial \rho) / v_{thi}$ , of 5% of the temperature gradient,  $(\partial T_i / \partial \rho) / T_i$ , is sustainable. Here  $v_{thi}$  is the ion thermal speed,  $u_{\phi}$  is the ion toroidal mean flow,  $\rho$  is the minor radial coordinate normalized to the tokamak minor radius, and  $T_i$  is the ion temperature. Though other known core intrinsic momentum transport mechanisms scale poorly to larger machines, these results indicate that up-down asymmetry may be a feasible method to generate the current experimentally measured rotation levels in reactor-sized devices.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Massachusetts Institute of Technology, University of Texas at Austin, University of Maryland, Princeton Plasma Physics Laboratory, Universidade de Lisboa

Contributors: Ball, J., Parra, F. I., Barnes, M., Dorland, W., Hammett, G. W., Rodrigues, P., Loureiro, N. F.

Publication date: 1 Sep 2014

Peer-reviewed: Yes

### Publication information

Journal: PLASMA PHYSICS AND CONTROLLED FUSION

Volume: 56

Issue number: 9

Article number: 095014

ISSN (Print): 0741-3335

Ratings:

Scopus rating (2014): CiteScore 4.7 SJR 1.542 SNIP 1.327

Original language: English

ASJC Scopus subject areas: Nuclear Energy and Engineering, Condensed Matter Physics

Keywords: gyrokinetics, intrinsic rotation, tokamaks, up-down asymmetry

DOIs:

10.1088/0741-3335/56/9/095014

URLs:

<http://www.scopus.com/inward/record.url?scp=84906539572&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84906539572

### Variable switching point predictive torque control of induction machines

This paper introduces an approach to include a variable switching time point into predictive torque control (PTC). In PTC, the switching frequency is limited by the sampling frequency; its theoretical maximum value is half the sampling frequency. However, in reality the switching frequency is lower than this value, and thus, high current and torque ripples occur compared with modulator-based control methods. In order to overcome this, an optimization problem is formulated and solved in real time. Thereby, apart from the regulation of the torque and the flux magnitude to their references, an additional control objective should be met: the minimization of the torque ripple. To do so, the time point at which the switches of the inverter should change state is calculated. Further advantages of the proposed method include the design flexibility and great performance during transients. Experimental results that verify the performance of the presented control strategy are included.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Smart Energy Systems (SES), Institute for Electrical Drive Systems and Power Electronics, Technische Universität München, National Technical University of Athens, University of Stellenbosch

Contributors: Karamanakos, P., Stolze, P., Kennel, R. M., Manias, S., Du Toit Mouton, H.

Number of pages: 11

Pages: 285-295

Publication date: Jun 2014

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Journal of Emerging and Selected Topics in Power Electronics

Volume: 2

Issue number: 2

ISSN (Print): 2168-6777

Ratings:

Scopus rating (2014): CiteScore 1.7 SJR 0.806 SNIP 2.193

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: AC motor drives, direct torque control (DTC), induction machines (IMs), low-voltage (LV) drives, model predictive control (MPC)

Electronic versions:

Variable switching point predictive torque control 2014

DOIs:

10.1109/JESTPE.2013.2296794

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004163280>

Source: Scopus

Source ID: 84922790918

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

### Bioprocessing of enhanced cellulase production from a mutant of *Trichoderma asperellum* RCK2011 and its application in hydrolysis of cellulose

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

#### 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), Department of Microbiology, University of Delhi South Campus, Lignocellulose Biotechnology Laboratory

Contributors: Raghuwanshi, S., Deswal, D., Karp, M., Kuhad, R. C.

Number of pages: 7

Pages: 183-189  
Publication date: 15 May 2014  
Peer-reviewed: Yes

#### Publication information

Journal: Fuel  
Volume: 124  
ISSN (Print): 0016-2361  
Ratings:

Scopus rating (2014): CiteScore 5.6 SJR 1.634 SNIP 2.29

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all), Organic Chemistry

Keywords: Alkaline cellulase, Catabolite repression, Saccharification, Solid state fermentation

DOIs:

10.1016/j.fuel.2014.01.107

URLs:

<http://www.scopus.com/inward/record.url?scp=84894571819&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

Contribution: organisation=keb,FACT1=1<br/>Portfolio EDEND: 2014-03-15

Source: researchoutputwizard

Source ID: 1327

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/cm<sup>2</sup> in respect to effective area illuminated. These measurements have been performed under real sun AM1.5 (~1000 W/m<sup>2</sup>) 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., Korpijärvi, 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 10.1 SJR 2.19 SNIP 2.368

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<br/>Portfolio EDEND: 2014-04-29<br/>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 H<sub>2</sub> 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 H<sub>2</sub> production kinetics was more sensitive towards increasing concentrations of acetate and formate. Acetate, the main soluble metabolite of the fermentation, inhibited the H<sub>2</sub> 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 H<sub>2</sub> 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 H<sub>2</sub> 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 5.6 SJR 1.207 SNIP 1.488

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<br/>Portfolio EDEND: 2014-04-29<br/>Publisher name: Elsevier Ltd;

International Association for Hydrogen Energy

Source: researchoutputwizard

Source ID: 235

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

### In-use vs. type-approval fuel consumption of current passenger cars in Europe

In-use fuel consumption data of 924 passenger cars (611 petrol, 313 diesel) were collected from various European sources and were evaluated in comparison to their corresponding type-approval values. The analysis indicated that the average in-use fuel consumption was higher than the type-approval one by 11% for petrol cars and 16% for diesel cars. Comparison of this dataset with the Travelcard database in the Netherlands showed that the deviation increased for late model years and in particular for cars with low type-approval values. The deviation was higher than 60% for vehicles registered in 2012 within the 90-100gCO<sub>2</sub>/km bin. Unrealistic vehicle resistances used in type-approval were identified as one of the prime reasons of the difference. A simplified linear model developed in the study may be used to predict in-use

fuel consumption based on data publicly available. The model utilizes the fuel consumption measured in type-approval, the mass, and the engine capacity to provide in-use fuel consumption. This may be either used to correct fuel consumption factors currently utilized by emission models (e.g. COPERT, HBEFA, VERSIT+, and others) or could be used independently to make projections on how fuel consumption may develop on the basis of changing future passenger cars characteristics.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, EMISIA SA, INFRAS, Graz University of Technology, TNO, STL Group, European Commission-JRC

Contributors: Ntziachristos, L., Mellios, G., Tsokolis, D., Keller, M., Hausberger, S., Ligterink, N. E., Dilara, P.

Number of pages: 9

Pages: 403-411

Publication date: Apr 2014

Peer-reviewed: Yes

#### Publication information

Journal: Energy Policy

Volume: 67

ISSN (Print): 0301-4215

Ratings:

Scopus rating (2014): CiteScore 6 SJR 2.143 SNIP 1.892

Original language: English

ASJC Scopus subject areas: Energy(all), Management, Monitoring, Policy and Law

Keywords: Fuel economy, Greenhouse gases, Road transport

DOIs:

10.1016/j.enpol.2013.12.013

URLs:

<http://www.scopus.com/inward/record.url?scp=84893819422&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893819422

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

#### Fabrication of ssDNA/oligo(ethylene glycol) monolayers by promoted exchange reaction with thiol and disulfide substituents

Biorepulsive oligo(ethylene glycol)-substituted alkanethiolate (OEG-AT) monolayers on gold can serve as primary templates for promoted (by electron irradiation) exchange reaction with thiolated ssDNA species, resulting in the formation of mixed OEG-AT/ssDNA monolayers of desired composition. Here we test the ability of alternative, disulfide precursors to serve as substituents in such a reaction. Two representative molecules, based on adenine-based homo-oligonucleotide (25-mer), were used, viz., asymmetric disulfide with a short second chain (A25SSOH) and symmetric disulfide (A25SSA25). The results were compared to the reference system of thiolated ssDNA (A25SH). Both disulfide precursors were found to be suitable for the reaction, further extending the types of commercially available compounds which can be used for this approach. A25SSOH exhibited quite high efficiency, similar to A25SH, while the efficiency of A25SSA25 was noticeably lower, especially at low irradiation doses (2). Also, the single component, A25SSA25-based ssDNA monolayer, was of lower quality as compared to the films prepared from the A25SH and A25SSOH precursors. The above observations were explained by the bulky character and conformational flexibility of A25SSA25, which hinder the proper assembly and efficient exchange reaction.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Universitat Heidelberg

Contributors: Khan, M. N., Zharnikov, M.

Number of pages: 9

Pages: 3093-3101

Publication date: 13 Feb 2014

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 118

Issue number: 6

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2014): CiteScore 8.4 SJR 2.032 SNIP 1.434

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/jp411353f

URLs:

<http://www.scopus.com/inward/record.url?scp=84894037828&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84894037828

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

### **Comparison of finite-element-based state-space models for PM synchronous machines**

An interior permanent-magnet (PM) motor is modeled by a combined analytical-numerical approach, in which the relationships between the stator currents and flux linkages are identified with static finite-element (FE) analysis. In addition to the previous approaches using the current space vector as the state variable, new models are also developed using the flux-linkage space vector, which leads to more convenient time-integration of the voltage equations. In order to account for the zero-sequence effects in delta connection, the models also include either the zero-sequence flux or current as an additional state variable. Finally, the possibilities of deriving the required quantities as partial derivatives of the magnetic field energy are discussed. The energy-based approaches avoid inaccuracies related to torque computation and thus allow better satisfying the power balance in the state-space model. We show the ability of the developed state-space models to predict the currents and torque equally to a nonlinear time-stepping FE model with much less computational burden. The results are validated by means of measurements for a prototype machine in both star and delta connections. In addition, we also demonstrate the effect of the zero-sequence current on the torque ripple in case of a delta-connected stator winding.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Smart Energy Systems (SES), Aalto University, Polytech Nantes

Contributors: Rasilo, P., Lemesle, M. A., Belahcen, A., Arkkio, A., Hinkkanen, M.

Number of pages: 9

Pages: 535-543

Publication date: 2014

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Transactions on Energy Conversion

Volume: 29

Issue number: 2

ISSN (Print): 0885-8969

Ratings:

Scopus rating (2014): CiteScore 8.3 SJR 1.471 SNIP 2.731

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Energy Engineering and Power Technology

Keywords: Field energy, finite-element methods, magnetic saturation, permanent-magnet (PM) machines, reluctance machines, state-space methods, torque ripple, variable-speed drives

DOIs:

10.1109/TEC.2014.2307472

Source: Scopus

Source ID: 84901470308

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 TiO<sub>2</sub> photoelectrode film is pressed against the wetted aerogel, it becomes filled with the electrolyte. The electrolyte flows inside the TiO<sub>2</sub> film only about ten micrometers (i.e. the TiO<sub>2</sub> 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 8.6 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

### **Nickel-based HVOF coatings promoting high temperature corrosion resistance of biomass-fired power plant boilers**

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

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland

Contributors: Oksa, M., Auerkari, P., Salonen, J., Varis, T.

Number of pages: 10

Pages: 236-245

Publication date: 2014

Peer-reviewed: Yes

#### **Publication information**

Journal: Fuel Processing Technology

Volume: 125

ISSN (Print): 0378-3820

Ratings:

Scopus rating (2014): CiteScore 5.9 SJR 1.612 SNIP 2.206

Original language: English

ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all)

Keywords: Biomass combustion, Chlorine induced corrosion, Corrosion protection, High temperature corrosion, HVOF, Thermal spray coating

DOIs:

10.1016/j.fuproc.2014.04.006

URLs:

<http://www.scopus.com/inward/record.url?scp=84899841098&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84899841098

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 0.5 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

### Direct model predictive current control strategy of dc-dc boost converters

A model predictive control (MPC) algorithm for DC-DC boost converters is proposed in this paper. The proposed control scheme is implemented as a current-mode controller. Two control loops are employed, with the inner loop being designed in the framework of MPC. Two different objective functions are formulated and investigated. The control objective, i.e., the

regulation of the current to its reference, is achieved by directly manipulating the switch, thus a modulator is not required. As a prediction model, a hybrid model of the converter is used, which captures precisely the continuous and the discontinuous conduction modes. The proposed control strategy achieves very fast current regulation, while exhibiting only a modest computational complexity. Simulation and experimental results substantiate the effectiveness of the proposed approach.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Smart Energy Systems (SES), Institute for Electrical Drive Systems and Power Electronics, Technische Universität München, ABB Corporate Research Center - Switzerland, National Technical University of Athens

Contributors: Karamanakos, P., Geyer, T., Manias, S.

Number of pages: 10

Pages: 337-346

Publication date: 1 Dec 2013

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Journal of Emerging and Selected Topics in Power Electronics

Volume: 1

Issue number: 4

ISSN (Print): 2168-6777

Ratings:

Scopus rating (2013): CiteScore 0.7

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: Current control, DC-DC converter, Hybrid system, Model predictive control (MPC), Optimal control

Electronic versions:

Direct model predictive current control strategy of dc-dc boost converters

DOIs:

10.1109/JESTPE.2013.2279855

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004294324>

Source: Scopus

Source ID: 84947231690

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

#### Fabrication of ssDNA/Oligo(ethylene glycol) monolayers and patterns by exchange reaction promoted by ultraviolet light irradiation

Using a representative test system, we present here a versatile approach to prepare mixed monolayers of thiolated single-stranded DNA (ssDNA) and oligo(ethylene glycol) substituted alkanethiols (OEG-AT) in a broad range of compositions as well as ssDNA/OEG-AT patterns of desired shape imbedded into a biorepulsive background. The procedure involves two steps. First, a primary, well-defined OEG-AT monolayer on a solid support is exposed to UV light in either homogeneous or lithographic fashion. Second, the exchange reaction between the damaged OEG-AT species in the film and ssDNA substituents in solution occurs, resulting in formation of ssDNA/OEG-AT monolayer or pattern. The above procedure relies on commercially available compounds and does not require vacuum, which simplifies its application in research and industrial laboratories. The composition of the mixed films or ssDNA/OEG-AT spots (lithography) can be precisely adjusted by UV dose in an almost entire composition range. It was demonstrated that the procedure can be performed with UV light of different wavelengths (254 or 365 nm), which opens new possibilities for lithography. Using advanced spectroscopic tools, it was shown that ssDNA molecules imbedded into the OEG-AT matrix maintain their identity and intact character as well as exhibit predominant upright orientation typical of one-component films of thiolated ssDNA. The OEG-AT constituents of the mixed monolayers were found to be intact as well, with all UV damaged OEG-AT species being exchanged for ssDNA. Finally, a representative ssDNA/OEG-AT pattern was fabricated.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Universität Heidelberg

Contributors: Khan, M. N., Zharnikov, M.

Number of pages: 11

Pages: 24883-24893

Publication date: 27 Nov 2013

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 117

Issue number: 47

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2013): CiteScore 8.3 SJR 2.143 SNIP 1.432

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/jp408819k

URLs:

<http://www.scopus.com/inward/record.url?scp=84889582340&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84889582340

Research output: Contribution to journal › Article › 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 on 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 H<sub>2</sub> 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 H<sub>2</sub>/mol glycerol and 0.66 mol 1,3-PD/mol glycerol (1-stage processes), whereas the highest cumulative production was 74 mmol H<sub>2</sub>/l culture and 31 mmol 1,3-PD/l culture (2-stage process). © 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, 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 6 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<br/>Portfolio EDEND: 2013-09-29<br/>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 H<sub>2</sub> and biomass production were compared against the results of FBA. Several gene deletions enhancing H<sub>2</sub> 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 H<sub>2</sub> production had a positive effect in experiments. Batch cultivation is a simple and straightforward experimental way to screen improvements in H<sub>2</sub> production. However, the ability of FBA to predict the H<sub>2</sub> 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 H<sub>2</sub> 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 6 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<br/>Contribution: organisation=sgn,FACT2=0.5<br/>Portfolio EDEND: 2013-09-29<br/>Publisher name: Elsevier Ltd

Source: researchoutputwizard

Source ID: 3397

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

### Model predictive control of the interleaved dc-dc boost converter with coupled inductors

This paper proposes a model predictive control (MPC) scheme for the interleaved dc-dc boost converter with coupled inductors. The main control objectives are the regulation of the output voltage to its reference value, despite changes in the input voltage and the load, and the equal sharing of the load current by the two circuit inductors. An inner control loop, using MPC, regulates the input current to its reference that is provided by the outer loop, which is based on a load observer. Simulation results are provided to highlight the performance of the proposed control scheme.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Smart Energy Systems (SES), National Technical University of Athens, ABB Corporate Research Center - Switzerland

Contributors: Karamanakos, P., Geyer, T., Manias, S.

Publication date: Sep 2013

### Host publication information

Title of host publication: 2013 15th European Conference on Power Electronics and Applications, EPE 2013

Article number: 6632006

ISBN (Print): 9781479901166

ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology, Electrical and Electronic Engineering

Keywords: Converter control, Non-linear control, Optimal control

Electronic versions:

Model predictive control of the interleaved 2013

DOIs:

10.1109/EPE.2013.6632006

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004294348>

Source: Scopus

Source ID: 84890168092

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › 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 6.5 SJR 1.989 SNIP 2.644

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

### Variable switching point predictive torque control for the three-level neutral point clamped inverter

In this paper the recently introduced control strategy referred as variable switching point predictive torque control (VSP<sup>2</sup> TC) is employed to control a three-level neutral point clamped (NPC) voltage source inverter driving an induction machine (IM). Based on a predictive torque control (PTC) scheme, the controller aims to reduce the high current and torque ripples that occur. In order to actualize this, a variable switching point is calculated based on an optimization problem formulated to reduce the torque ripple. At this switching point the switches of the inverter change their state to meet all the control objectives, i.e. minimization of the torque ripple, regulation of the torque and the flux magnitude to their references, and

balancing of the neutral point potential. Experimental results that verify the performance of the proposed control algorithm are presented.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Smart Energy Systems (SES), Technische Universitat Munchen, National Technical University of Athens, University of Stellenbosch

Contributors: Stolze, P., Karamanakos, P., Kennel, R., Manias, S., Mouton, T.

Publication date: Sep 2013

#### Host publication information

Title of host publication: 2013 15th European Conference on Power Electronics and Applications, EPE 2013

Article number: 6631894

ISBN (Print): 9781479901166

ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology, Electrical and Electronic Engineering

Keywords: Adjustable speed drive, Direct torque and flux control, Optimal control, Voltage Source Inverters (VSI)

Electronic versions:

Variable switching point predictive torque control for the three-level 2013

DOIs:

10.1109/EPE.2013.6631894

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004304765>

Source: Scopus

Source ID: 84890166712

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

#### Irradiation promoted exchange reaction with disulfide substituents

Exchange reaction between the primary self-assembled monolayer (SAM) on gold and potential molecular substituents capable of forming a SAM on the same substrate can be promoted by electron irradiation. Here we demonstrate that such a promoted reaction can be performed not only with thiols but with disulfides as substituents as well. This extends significantly the assortments of the suitable compounds, resulting in a broader variety of mixed SAMs and chemical patterns which can be fabricated by this technique. The kinetics of the promoted exchange reaction was studied in detail. The feasibility and practical usefulness of the approach were demonstrated by the experiments with a disulfide substituent bearing a tail group which can serve as an initiator for surface-initiated polymerization. A variety of complex polymer brush patterns was prepared using several representative polymers, relevant for biomedical research and applications, as test systems.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Universitat Heidelberg

Contributors: Khan, M. N., Zharnikov, M.

Number of pages: 10

Pages: 14534-14543

Publication date: 18 Jul 2013

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 117

Issue number: 28

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2013): CiteScore 8.3 SJR 2.143 SNIP 1.432

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/jp4006026

URLs:

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Source: Scopus

Source ID: 84880559790

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

### Organic silicon compounds in biogases produced from grass silage, grass and maize in laboratory batch assays

In the present study the occurrence of volatile organic silicon compounds in biogas produced from grass silage, grass and maize in laboratory batch assays was analyzed and methane potentials were determined. Inoculum from a mesophilic farm digester was used, and its effects were subtracted. Methane yields from grass silage, grass and maize were 0.38, 0.42 and 0.34 m<sup>3</sup>CH<sub>4</sub>/kg - volatile solids added (VS<sub>add</sub>), respectively. Trimethyl silanol, hexamethylcyclotrisiloxane (D3), octamethylcyclotetrasiloxane (D4) and decamethylcyclopentasiloxane (D5) were detected from all the biogases. Higher yields of volatile organic silicon compounds in the grass (from 21.8 to 37.6 µg/kgVS<sub>add</sub>) were detected than in grass silage or maize assays (from 14.7 to 20.4 and from 7.4 to 12.1 µg/kgVS<sub>add</sub>, respectively). Overall, it is important to consider silicon-containing compounds also in biogases in energy crop digestion as the number of biogas plants using energy crops as feeding material increases and some biogas applications are sensitive to organic silicon compounds. © 2013 Elsevier Ltd.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, Tampere University of Technology

Contributors: Rasi, S., Seppälä, M., Rintala, J.

Number of pages: 6

Pages: 137-142

Publication date: 1 Apr 2013

Peer-reviewed: Yes

#### Publication information

Journal: Energy

Volume: 52

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2013): CiteScore 7.2 SJR 2.458 SNIP 2.545

Original language: English

ASJC Scopus subject areas: Energy(all), Pollution

Keywords: Anaerobic digestion, Biogas, Energy crops, Methane, Siloxanes

DOIs:

10.1016/j.energy.2013.01.015

URLs:

<http://www.scopus.com/inward/record.url?scp=84875804553&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

Contribution: organisation=keb,FACT1=1<br/>Portfolio EDEND: 2013-06-29<br/>Publisher name: Elsevier Ltd.

Source: researchoutputwizard

Source ID: 3235

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

### Application of the Pegasor Particle Sensor for the Measurement of Mass and Particle Number Emissions

The Pegasor Particle Sensor (PPS) is a small and lightweight sensor that can be used directly in raw exhaust to provide the mass and number concentration of exhaust aerosol. Its operation principle is based on the electrical charging of exhaust aerosol and determination of particle concentration by measuring the charge accumulated on the particles. In this paper we have applied the PPS in a variety of vehicle exhaust configurations to evaluate its performance characteristics. First, the output signal of the instrument was calibrated with diesel exhaust to deliver either the mass or the number concentration of exhaust aerosol. Linear response with the soot mass concentration measured by a Photo Acoustic Soot Sensor and number concentration measured by an Electrical Low Pressure Impactor was established. Based on this calibration, the instrument was then used to measure particle concentrations at levels produced by a gasoline direct injection vehicle and diesel exhaust filtered by particle filters of variable efficiency. Hence, the complete range of concentrations and particle characteristics typically encountered in automotive exhaust has been examined. The results show that the PPS signal can provide a repeatable measurement of aerosol concentration in the exhaust of current vehicles, offering a very good correlation both to the mass and number of particles, as measured by existing techniques.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Pegasor Oyj

Contributors: Ntziachristos, L., Amanatidis, S., Samaras, Z., Janka, K., Tikkanen, J.  
Publication date: Apr 2013  
Peer-reviewed: Yes

#### Publication information

Journal: SAE International Journal of Fuels and Lubricants  
Volume: 6  
Issue number: 2  
ISSN (Print): 1946-3952  
Ratings:

Scopus rating (2013): CiteScore 2.8 SJR 1.202 SNIP 1.145

Original language: English

ASJC Scopus subject areas: Fuel Technology, Pollution

URLs:

<http://www.scopus.com/inward/record.url?scp=84876567866&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84876567866

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

#### Use of a Catalytic Stripper as an Alternative to the Original PMP Measurement Protocol

The Particle Measurement Programme (PMP) developed an exhaust particle number measurement protocol that has been adopted by current light duty vehicle emission regulations in Europe. This includes thermal treatment of the exhaust aerosol to isolate solid particles only and a number counting device with a lower cutpoint of 23 nm to avoid measurement of smaller particles that may affect the repeatability of the measurement. In this paper, we examine a potential alternative to the PMP system, where the thermal treatment is replaced by a catalytic stripper (CS). This offers oxidation and not just evaporation of the volatile components. Alternative sampling systems, either fulfilling the PMP recommendations or utilizing a CS, have been explored in terms of their volatile particle removal efficiency. Tests have been conducted on diesel exhaust, diesel equipped with DPF and gasoline direct injection emissions. The results showed that the CS offers similar performance characteristics to the PMP when tested on diesel exhaust. In tests with the gasoline vehicle, the CS has been shown of leading to lower particle concentrations than the PMP, indicating that a larger number of particles can be removed as volatiles. Moreover, steady speed tests at 120 kph revealed that the PMP protocol was not sufficient in removing particles below 10 nm, which were completely eliminated when the CS was positioned downstream of an evaporation tube. The results of the study once more confirm the robustness of the PMP protocol for diesel exhaust sampling but also suggest that more analysis is needed before extending the protocol to other vehicle types and/or particle sizes.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, AVL List GmbH

Contributors: Ntziachristos, L., Amanatidis, S., Samaras, Z., Giechaskiel, B., Bergmann, A.

Publication date: Apr 2013

Peer-reviewed: Yes

#### Publication information

Journal: SAE International Journal of Fuels and Lubricants  
Volume: 6  
Issue number: 2  
ISSN (Print): 1946-3952  
Ratings:

Scopus rating (2013): CiteScore 2.8 SJR 1.202 SNIP 1.145

Original language: English

ASJC Scopus subject areas: Fuel Technology, Pollution

URLs:

<http://www.scopus.com/inward/record.url?scp=84876549342&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84876549342

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 4.2 SJR 1.651 SNIP 2.045

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

#### Mismatch losses in PV power generators caused by partial shading due to clouds

Clouds cause spatial and temporal variability of solar radiation which is the main cause of fluctuating photovoltaic power fed into the grid. TUT solar PV power station research plant has been designed to enable systematic and thorough analysis of the dynamic phenomena in energy conversion processes of grid-connected solar PV power systems. Its climatic and electric measuring systems comprise an accurate weather station as well as an extensive mesh of solar radiation and module temperature measurements located through the PV facility. In this paper, we propose a method to generate a spatial irradiance map from an array of solar radiation measurements. Additionally, we utilize it as a tool to evaluate the mismatch losses in the operation of different PV generators due to partial shading caused by moving clouds.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

Contributors: Lobera, D. T., Valkealahti, S.

Publication date: 2013

#### Host publication information

Title of host publication: 2013 4th IEEE International Symposium on Power Electronics for Distributed Generation Systems, PEDG 2013 - Conference Proceedings

Publisher: IEEE COMPUTER SOCIETY PRESS

Article number: 6785587

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Keywords: maximum power point, mismatch losses, moving clouds, partial shading, PV power generator configurations

DOIs:

10.1109/PEDG.2013.6785587

URLs:

<http://www.scopus.com/inward/record.url?scp=84899443069&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84899443069

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

### **Orientation insensitive power transfer by magnetic resonance for mobile devices**

The efficiency of wireless power transfer (WPT) from an orientation insensitive system to a mobile device by strongly coupled magnetic resonance (SCMR) is reported here. This paper compares an optimal loop-based design in standard SCMR systems with misalignment insensitive system (3D and 3-loop structure), which exhibits higher efficiency than typical SCMR devices in several directions in a sphere.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense)

Contributors: Jonah, O., Georgakopoulos, S. V., Tentzeris, M. M.

Number of pages: 4

Pages: 5-8

Publication date: 2013

#### **Host publication information**

Title of host publication: 2013 IEEE Wireless Power Transfer, WPT 2013

Article number: 6556868

ISBN (Print): 9781467350082

ASJC Scopus subject areas: Computer Networks and Communications, Fuel Technology

Keywords: magnetic resonance, Misalignment insensitive, mobile devices

DOIs:

10.1109/WPT.2013.6556868

URLs:

<http://www.scopus.com/inward/record.url?scp=84881505514&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84881505514

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › 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 TiO<sub>2</sub> and SiO<sub>2</sub> nanoparticles create superhydro-phobic and hydrophilic paper surface,
- Abrasive damage of surface structure influences only slightly the wettability of superhydrophobic TiO<sub>2</sub> and hydrophilic SiO<sub>2</sub> coatings,
- A more severe abrasive action will remove some of the nanoparticle coating, but the hydrophobic/hydrophilic properties of the surface are maintained,
- SiO<sub>2</sub> nanoparticle coated surface is more resistant to abrasion than the TiO<sub>2</sub>

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

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<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 m<sup>3</sup> ha<sup>-1</sup>. 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<sup>-1</sup> in Piikkiö and 8.7 and 6.8 Mg ha<sup>-1</sup> in Laukaa in 2007 and 2008, respectively. The specific methane yields varied from 366 to 491 dm<sup>3</sup> kg<sup>-1</sup> volatile solid (VS) in 2007 and from 296 to 373 dm<sup>3</sup> kg<sup>-1</sup> VS in 2008. The harvest time and sowing time did not affect the specific methane yields ( $p \geq 0.05$ ). Whole maize crops produced more methane in batch assays than stem (372 dm<sup>3</sup> kg<sup>-1</sup> VS), leaves (334 dm<sup>3</sup> kg<sup>-1</sup> VS) and cobs (421 dm<sup>3</sup> kg<sup>-1</sup> 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 5.1 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<br/>Contribution: organisation=keb bio,FACT1=1

Source: researchoutputwizard

Source ID: 5303

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

### **Model predictive control of the internal voltages of a five-level active neutral point clamped converter**

In this paper, model predictive control (MPC) is introduced to control the internal voltages of an active neutral-point clamped five-level converter (ANPC-5L). The proposed control scheme aims to keep the neutral point and phase capacitors voltages of the converter within given hysteresis bounds while at the same time minimizing the switching frequency. An additional benefit of the controlled voltages is a reduced level of output current distortion. The large number of redundant states that exist in multi-level converters makes it possible for all the objectives to be achieved. A short horizon is employed in order to ensure a manageable level of complexity. At the same time extrapolation is used to bring the performance to the desired level. Simulation results that substantiate the effectiveness of the proposed approach are presented.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Smart Energy Systems (SES), ABB Corporate Research Center - Switzerland, Department of Electrical and Computer Engineering, National Technical University of Athens, ABB Switzerland

Contributors: Kieferndorf, F., Karamanakos, P., Bader, P., Oikonomou, N., Geyer, T.

Number of pages: 8

Pages: 1676-1683

Publication date: Sep 2012

### **Host publication information**

Title of host publication: 2012 IEEE Energy Conversion Congress and Exposition, ECCE 2012

ISBN (Print): 9781467308014

ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology

Keywords: five-level converter, model predictive control, neutral-point clamped

Electronic versions:

Model predictive control of the internal voltages of a five-level active neutral point clamped converter

DOIs:

10.1109/ECCE.2012.6342611

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202005115167>

Source: Scopus

Source ID: 84870932750

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

### **Model predictive pulse pattern control for the five-level active neutral point clamped inverter**

In this paper, the recently introduced control strategy referred to as model predictive pulse pattern control (MP<sup>3</sup>C) is adapted to the ACS 2000 five-level power converter of ABB. The drive consists of an induction machine and a five-level active neutral-point clamped (ANPC-5L) inverter. The power inverter is fed with optimized pulse patterns (OPPs) that produce minimum harmonic distortion in the stator winding of the ac machine. An optimal stator flux trajectory is calculated from these OPPs and a trajectory controller tracks it in real-time. In the proposed approach, trajectory tracking is based on model predictive control (MPC): a constrained optimal control problem is formulated and solved in real-time in a time-efficient manner. An event-based prediction horizon is employed in order to ensure fast tracking of the stator flux trajectory. The advantages of the proposed method are optimal steady-state behavior in terms of harmonic distortion and fast torque response. The method was tested on a pilot ACS 2000 power converter coupled to a general-purpose 1.21-MW induction machine. Experimental results were obtained from this industrial setup; they are presented in this paper to demonstrate the high performance of MP<sup>3</sup>C.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Smart Energy Systems (SES), ABB Corporate Research Center - Switzerland, ABB Switzerland, Department of Electrical and Computer Engineering, National Technical University of Athens

Contributors: Oikonomou, N., Gutscher, C., Karamanakos, P., Kieferndorf, F., Geyer, T.  
Number of pages: 8  
Pages: 129-136  
Publication date: Sep 2012

#### Host publication information

Title of host publication: 2012 IEEE Energy Conversion Congress and Exposition, ECCE 2012  
ISBN (Print): 9781467308014  
ASJC Scopus subject areas: Energy Engineering and Power Technology, Fuel Technology  
Keywords: AC drive, five-level active neutral point inverter, model predictive control, optimized pulse pattern  
Electronic versions:

Model predictive pulse pattern control 2012

DOIs:

10.1109/ECCE.2012.6342832

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202005135270>

Source: Scopus

Source ID: 84870916807

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

#### Impact of biodiesel application at various blending ratios on passenger cars of different fueling technologies

The effect of biodiesel on emissions of diesel passenger cars is a combination of the fuel properties, the blending ratio, and the vehicle technology. In this study, saturated and unsaturated biodiesel fuels were tested neat (B100) and in 30% blend with fossil diesel (B30) on two Euro 3 diesel passenger cars of different engine technologies, namely common rail and unit injector. The measured dataset is enlarged by introducing B10 results from an earlier study [15] in order to produce generalized conclusions over a wider range of blends. None of these vehicles was equipped with a particle filter and different conclusions might be reached for filter-equipped vehicles. The results indicate that the influence of biodiesel on pollutant emissions primarily depends on the blending ratio and secondly on the level of unsaturation and engine technology. Tailpipe CO<sub>2</sub>, NO<sub>x</sub> and PM emissions with biodiesel varied from -1% to +3%, -1% to 14%, and -18% to -35%, respectively, compared to fossil diesel. The difference over fossil diesel generally increased with an increasing blending ratio. CO and HC emissions increased over the fossil diesel but remained at low levels and did not threaten the compliance of the vehicles with their respective emission limits. Use of biodiesel on the common rail vehicle led to a smaller NO<sub>x</sub> increase and a higher PM reduction than in the unit-injector case. The unsaturated fuel generally led to higher NO<sub>x</sub> emissions from both engine technologies. However, the maximum blending ratio of saturated biodiesel is limited to around B30 due to cold-flow limitations. Hence, the saturated vs. unsaturated species ratio should be carefully designed in market fuels in order to optimize environmental and operational benefits. Overall, it appears that blends up to 10% v/v may be introduced with limited urban air quality implications.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Aristotle University of Thessaloniki, Laboratory of Applied Thermodynamics, European Commission-JRC

Contributors: Kousoulidou, M., Ntziachristos, L., Fontaras, G., Martini, G., Dilara, P., Samaras, Z.

Number of pages: 7

Pages: 88-94

Publication date: Aug 2012

Peer-reviewed: Yes

#### Publication information

Journal: Fuel

Volume: 98

ISSN (Print): 0016-2361

Ratings:

Scopus rating (2012): CiteScore 5.6 SJR 1.813 SNIP 2.387

Original language: English

ASJC Scopus subject areas: Chemical Engineering(all), Fuel Technology, Energy Engineering and Power Technology, Organic Chemistry

Keywords: Biodiesel, Fuel injection technology, Unsaturation level, Vehicle emissions

DOIs:

10.1016/j.fuel.2012.03.038

URLs:

<http://www.scopus.com/inward/record.url?scp=84861986728&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84861986728

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 Engn

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 1.4 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

### A first principles study of water adsorption on $\alpha$ -Pu (0 2 0) surface

Adsorptions of water in molecular ( $H_2O$ ) and dissociative ( $OH + H$ ,  $H + O + H$ ) configurations on the  $\alpha$ -Pu (0 2 0) surface have been studied using ab initio methods. The full-potential FP/LAPW + lo method has been used to calculate the adsorption energies at the scalar relativistic with no spin-orbit coupling (NSOC) and fully relativistic with spin-orbit coupling (SOC) theoretical levels. It is found that the SOC effect increases the adsorption energies by  $\sim 0.30$  eV for the two dissociative adsorptions. Weak physisorptions have been observed for the molecule  $H_2O$  on the  $\alpha$ -Pu (0 2 0) surface with primarily a covalent bonding, while the two dissociative adsorptions are chemisorptive with ionic bonding. The one-fold top site with an almost flat-lying orientation is found to be the most stable site for the adsorbed  $H_2O$  molecule. At the SOC level, the most stable adsorption energy is 0.58 eV, the corresponding values being 5.44 eV and 5.73 eV for the partial dissociation and complete dissociation cases, respectively. The analysis of the local projected density of states shows that the surface Pu-5f electrons remain primarily chemically inert in the molecular water adsorption process. Completely dissociative adsorption at a long bridge site for the dissociated O atom and two short bridge sites for the two dissociated H atoms is the most stable adsorption site. Hybridizations of O(2p)-H(1s)-Pu(5f)-Pu(6d) are observed for the two dissociative adsorptions, implying that some of the Pu-5f electrons become further delocalized and participate in chemical bonding. Work functions decrease for the molecular and the partial adsorption processes while it increases for complete dissociation.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computational Science X (CompX), University of Texas at Arlington  
Contributors: Wang, J., Ray, A. K.  
Number of pages: 8  
Pages: 138-145  
Publication date: May 2012  
Peer-reviewed: Yes

### Publication information

Journal: Journal of Nuclear Materials  
Volume: 424  
Issue number: 1-3  
ISSN (Print): 0022-3115  
Ratings:  
Scopus rating (2012): CiteScore 3.2 SJR 0.845 SNIP 1.189  
Original language: English  
ASJC Scopus subject areas: Nuclear and High Energy Physics, Materials Science(all), Nuclear Energy and Engineering  
DOIs:  
10.1016/j.jnucmat.2012.02.016  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84862814982&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84862814982  
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  $2.84 \pm 0.11$  g/l with lipid content  $138.21 \pm 9.82$  mg/g and lipid productivity  $15.07 \pm 0.67$  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  $2.798 \pm 0.18$  g/l with increased lipid content  $407.18 \pm 11.6$  mg/g at lipid productivity  $43.68 \pm 1.82$  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 1.8 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

### **Financial viability of energy-efficiency measures in a new detached house design in Finland**

This study analyses alternative energy-saving design concepts for a typical new detached house design in Finland. The impact of these design concepts on the construction costs and on the total delivered energy needs of the building were calculated, and the financial viability of the different concepts analysed. Different thermal insulation and airtightness properties of the building envelope and different ventilation's heat recovery efficiency assumptions were tested in the analysis work. Other variations modelled included the heating mode: direct electrical floor heating, or floor heating via an air or ground source heat pump. Among these alternatives, the estimated annual consumption of purchased energy for running the household varied extensively, in the range 57-182kWh/net floor m<sup>2</sup>. With the real interest rate set at 3%, the payback period was shortest for the air source heat pumps (9years). When a heat pump was installed in a house with higher energy consumption, the payback period was 7years, and if it was installed in the 'ultra low-energy' house designs, the payback period was over 13years. Investment to thick thermal insulation of envelope was unattractive in Finland. The results of this study can be generalized to similar climates and techno-economic environments.

#### **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, Department of Energy Technology, Department of Structural Design, Tallinn University of Technology, Finnish Innovative Fund

Contributors: Saari, A., Kalamees, T., Jokisalo, J., Michelsson, R., Alanne, K., Kurnitski, J.

Number of pages: 8

Pages: 76-83

Publication date: Apr 2012

Peer-reviewed: Yes

#### **Publication information**

Journal: Applied Energy

Volume: 92

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2012): CiteScore 8.1 SJR 2.778 SNIP 3.075

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Energy(all)

Keywords: Building simulations, Detached house, Energy efficiency, Financial viability, New construction

DOIs:

10.1016/j.apenergy.2011.10.029

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<http://www.scopus.com/inward/record.url?scp=82155186761&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

INT=rak,"Kalamees, Targo"

Source: Scopus

Source ID: 82155186761

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 20days of cultivation in Chu10 medium, the organism yielded a biomass of 2.58±0.07g/L, with lipid content of 312.16±2.38mg/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±0.63mg/Ld, followed by the combined deprivation condition (49.16±1.36mg/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 5.1 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

#### Surface-relief gratings and stable birefringence inscribed using light of broad spectral range in supramolecular polymer-bisazobenzene complexes

We report on phenol-pyridine hydrogen-bonded supramolecular polymer-azobenzene complexes made from a newly designed polar bisazobenzene chromophore. Because of the substitution with a polar nitro group, the chromophore possesses an extremely broad absorption band, spanning from near-UV up to 650 nm. Moreover, the inclusion of two methoxy groups to the central benzene ring prevents excessive chromophore-chromophore intermolecular interactions and provides advantageous size-related properties. Together, these features of the prepared photoresponsive polymer materials enable efficient inscription of (i) photoinduced birefringence with outstanding stability at various chromophore concentrations and (ii) surface-relief grating formation over a wide range of writing wavelengths from 405 to 633 nm. The photoresponsive behavior is compared to that of Disperse Yellow 7-based supramolecular complexes.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Department of Applied Physics, Aalto University, Tokyo Institute of Technology, University of Bristol

Contributors: Koskela, J. E., Vapaavuori, J., Hautala, J., Priimagi, A., Faul, C. F. J., Kaivola, M., Ras, R. H. A.

Number of pages: 8

Pages: 2363-2370

Publication date: 26 Jan 2012

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Physical Chemistry C

Volume: 116

Issue number: 3

ISSN (Print): 1932-7447

Ratings:

Scopus rating (2012): CiteScore 8 SJR 2.529 SNIP 1.461

Original language: English

ASJC Scopus subject areas: Physical and Theoretical Chemistry, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Energy(all)

DOIs:

10.1021/jp210706n

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<http://www.scopus.com/inward/record.url?scp=84856360260&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84856360260

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

## High temperature oxidation behaviour of MnCo<sub>2</sub>O<sub>4</sub> coating on Crofer 22 APU manufactured by a novel solution precursor plasma spray process (SPPS)

MnCo<sub>2</sub>O<sub>4</sub> 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 CrO<sub>3</sub> and Cr<sub>2</sub>(OH)<sub>2</sub> 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 Cr<sub>2</sub>O<sub>3</sub>. MnCo<sub>2</sub>O<sub>4</sub> 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(NO<sub>3</sub>)<sub>3</sub>·4H<sub>2</sub>O and Co(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O 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<sub>a</sub> < 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 MnCo<sub>2</sub>O<sub>4</sub> 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 H<sub>2</sub> and CH<sub>4</sub> production was compared with one-stage CH<sub>4</sub> 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 H<sub>2</sub> process on the H<sub>2</sub> yields and subsequent CH<sub>4</sub> yields from the second-stage was also investigated. Results showed that the average H<sub>2</sub> yields from untreated maize were 5.6 and 9.9 ml/g volatile solids added (VS<sub>added</sub>) after 2 and 14 days, respectively. On the other hand, H<sub>2</sub> yields from water-extracted and HCl-treated maize were 18.0 and 20.5 ml/gVS<sub>added</sub> (14 d), respectively. On comparison to one-stage CH<sub>4</sub> assays, the average increase in CH<sub>4</sub> yields from two-stage assays with 2 d H<sub>2</sub> 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 6 SJR 1.443 SNIP 1.841

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 4.6 SJR 1.24 SNIP 1.837

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

### Power flow initialisation of dynamic studies with induction motor loads

The initialisation of most power system stability studies is carried out with the outcome of a power flow solution using a constant power representation of the load that may contain voltage dependency. However, such an approach may not be

suitable when an important component of the system load is made up of induction motors because of a natural mismatch between the power flow scheduled power and the actual induction motor power, which is computed using the final converged value of the motor terminal bus voltage. To solve this problem, a method for incorporating the non-linear model of induction motors in Newton-Raphson power flow algorithm is put forward in this study. The prowess of the improved power flow algorithm is demonstrated using the Ward-Hale, the IEEE 30-bus and the New-England test systems in connection with industrial motor subsystems. The results show that the extended power flow algorithm provides the correct steady-state initialisation and still preserves the basic Newton-Raphson's quadratic convergence characteristics.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Smart Energy Systems (SES), Thammasat University, University of Glasgow  
Contributors: Aree, P., Acha, E.  
Number of pages: 8  
Pages: 417-424  
Publication date: Apr 2011  
Peer-reviewed: Yes

#### Publication information

Journal: IET Generation Transmission and Distribution  
Volume: 5  
Issue number: 4  
ISSN (Print): 1751-8687  
Ratings:  
Scopus rating (2011): CiteScore 3 SJR 0.766 SNIP 1.734  
Original language: English  
ASJC Scopus subject areas: Electrical and Electronic Engineering, Energy Engineering and Power Technology, Control and Systems Engineering  
DOIs:  
10.1049/iet-gtd.2010.0442  
URLs:  
<http://www.scopus.com/inward/record.url?scp=79956318336&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 79956318336  
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 (CH<sub>4</sub>) 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 (CH<sub>4</sub>) and manure management (CH<sub>4</sub> and N<sub>2</sub>O) accounted for 231.3, 32.3 and 18.3Mg of CO<sub>2</sub> eq.yr<sup>-1</sup> 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<sup>-1</sup> and 62.8, 21.8 and 47.7MWh of electricityyr<sup>-1</sup> 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 CO<sub>2</sub> eq.yr<sup>-1</sup>, 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 5.6 SJR 1.634 SNIP 2.38

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: Globalized 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 ( $\text{Cr}_2\text{O}_3$ ) which tends to react with the oxygen and water, forming chromium trioxide ( $\text{Cr}_2\text{O}_3$ ) 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  $\text{Cr}_2\text{O}_3$ . 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  $\text{MnCo}_2\text{O}_4$  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., Kylmälahti, 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 2.263

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

### Modeling the effect of inverter supply on eddy-current losses in synchronous machines

The effect of inverter supply on the eddy-current losses in the laminated core of a synchronous machine is studied. A 2D finite element model including a dynamic model for the eddy currents in the core laminations is applied to predict the

machine losses by numerical simulations. A synchronous extruder motor is simulated both with sinusoidal and pulse-width modulated voltage supplies in different operating points and the eddy-current losses both in the stator and the rotor are studied. The rotor additional inverter losses are found to be load-dependent while the stator additional losses remain constant independent of the loading.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Aalto University  
Contributors: Rasilo, P., Arkkio, A.  
Number of pages: 5  
Pages: 861-865  
Publication date: 2010

#### Host publication information

Title of host publication: SPEEDAM 2010 - International Symposium on Power Electronics, Electrical Drives, Automation and Motion  
ISBN (Print): 9781424449873  
ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering  
Keywords: Eddy currents, Finite element methods, Pulse width modulated inverters, Synchronous machines  
DOIs:  
10.1109/SPEEDAM.2010.5544811  
Source: Scopus  
Source ID: 77956596081  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### One-stage H<sub>2</sub> and CH<sub>4</sub> and two-stage H<sub>2</sub> + CH<sub>4</sub> production from grass silage and from solid and liquid fractions of NaOH pre-treated grass silage

In the present study, mesophilic CH<sub>4</sub> production from grass silage in a one-stage process was compared with the combined thermophilic H<sub>2</sub> and mesophilic CH<sub>4</sub> 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 CH<sub>4</sub> yield was obtained from grass silage in a two-stage process (467 ml g<sup>-1</sup> VS<sub>original</sub>) compared with a one-stage process (431 ml g<sup>-1</sup> VS<sub>original</sub>). Similarly, CH<sub>4</sub> yield from solid fraction increased from 252 to 413 ml g<sup>-1</sup> VS<sub>original</sub> whereas CH<sub>4</sub> yield from liquid fraction decreased from 82 to 60 ml g<sup>-1</sup> VS<sub>original</sub> in a two-stage compared to a one-stage process. NaOH pre-treatment increased combined H<sub>2</sub> yield by 15% (from 5.34 to 6.46 ml g<sup>-1</sup> VS<sub>original</sub>). In contrast, NaOH pre-treatment decreased the combined CH<sub>4</sub> yield by 23%. Compared to the energy value of CH<sub>4</sub> yield obtained, the energy value of H<sub>2</sub> yield remained low. According to this study, highest CH<sub>4</sub> yield (495 ml g<sup>-1</sup> VS<sub>original</sub>) could be obtained, if grass silage was first pre-treated with NaOH, and the separated solid fraction was digested in a two-stage (thermophilic H<sub>2</sub> and mesophilic CH<sub>4</sub>) process while the liquid fraction could be treated directly in a one-stage CH<sub>4</sub> 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 m<sup>3</sup> CH<sub>4</sub> kg<sup>-1</sup> VS added (volatile solids added) and from 25 to 260 m<sup>3</sup> CH<sub>4</sub> t<sub>ww</sub><sup>-1</sup> (tonnes of wet weight). Jerusalem artichoke, timothy-clover grass and reed canary grass gave the highest potential methane yields of 2900-5400 m<sup>3</sup> CH<sub>4</sub> ha<sup>-1</sup>, corresponding to a gross energy yield of 28-53 MWh ha<sup>-1</sup> and ca. 40,000-60,000 km ha<sup>-1</sup> 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<sub>ww</sub> 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<sub>2</sub>) 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<sub>2</sub> from grass silage. Without heat treatment, methane (CH<sub>4</sub>) was mainly produced, but heat treatment efficiently inhibited CH<sub>4</sub> production. pH adjustment to 6 further increased H<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> was formed. The highest H<sub>2</sub> yield was achieved at 70 °C. H<sub>2</sub> production also increased when the VS ratio was increased. However, the overall energy value of H<sub>2</sub> compared to that of CH<sub>4</sub> 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 2.109

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<sub>4</sub> kg<sup>-1</sup> VS<sub>added</sub> 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<sup>-3</sup> day<sup>-1</sup> decreased the specific methane yields by 16-26%. The post-methanation potential of the digestates corresponded to 0.9-2.5 m<sup>3</sup> CH<sub>4</sub> t<sup>-1</sup> 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<sup>-3</sup>, 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 1.348  
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

#### Statistical short-term network planning of distribution system and distributed generation

The paper presents improvements on the short-term network planning of a distribution system and distributed generation (DG) on the open electricity market. The interconnection of DG is currently based on worst case principle thus great savings in network investments can be achieved by applying a statistical planning approach. An idea for flexible interconnection is also introduced which further extends the advantages of a statistical planning approach. The approach is applied to an existing network information system (NIS) used for distribution network planning. The capability of the proposed approach is presented with a real life example and with a concept for voltage level management.

#### General information

Publication status: Published  
MoE publication type: Not Eligible  
Organisations: Sähkövoimatekniikka  
Contributors: Repo, S., Laaksonen, H., Järventausta, P.  
Publication date: 1 Jan 2005  
Peer-reviewed: Unknown  
Event: Paper presented at 15th Power Systems Computation Conference, PSCC 2005, Liege, Belgium.  
ASJC Scopus subject areas: Computer Networks and Communications, Computer Science Applications, Energy Engineering and Power Technology, Electrical and Electronic Engineering  
Keywords: Distributed generation, Distribution system, Network planning, Voltage level management  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84983164428&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84983164428  
Research output: Other conference contribution › Paper, poster or abstract › Scientific

#### 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 ( $\text{m}^3 \text{kg}^{-1} \text{VS}_{\text{added waste}}$ ) achieved on semi-continuous co-digestion at loading rate of  $2 \text{ kg VS m}^{-3} \text{ day}^{-1}$  in continuously stirred tank reactors at  $35^\circ\text{C}$  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  $3 \text{ kg VS m}^{-3} \text{ day}^{-1}$  at a feed VS ratio of 80:20 (pig manure to potato waste) produced methane yields of 0.28-0.30  $\text{m}^3 \text{kg}^{-1} \text{VS}_{\text{added waste}}$ . Post-digestion (60 days) of the digested materials in batches produced 0.12-0.15  $\text{m}^3 \text{kg}^{-1} \text{VS}_{\text{added waste}}$  of methane at  $35^\circ\text{C}$ . 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

#### Input Invariance as a Method to Reduce EMI Filter Interactions in Telecom DPS Systems

Distributed power supply (DPS) systems are extensively used to supply different electronic equipment and systems such as e.g. telecom switching systems where switched-mode converters are supplying other switched-mode converters. Stringent electromagnetic compatibility (EMC) requirements necessitate the use of input filters as an individual filter for a converter, and as a common filter for a group of converters in order to suppress the electromagnetic interference (EMI) to acceptable level. The ratio of input and output impedances of the associated subsystems known as minor-loop gain is typically used to define the stability and performance indices for the DPS systems. Even if certain design rules may be established for the ratio, the associated impedances may be difficult quantitatively to be defined. This may force the system designers to use conservative design in order to avoid instability and degrading of dynamic performance. This paper proposes methods by means of which the interactions between the subsystems may be significantly reduced making the converters invariant to input phenomena in small-signal sense. This means that the input filter stability would be the only concern, and may be ensured based on the input power of the associated converters.

#### General information

Publication status: Published  
MoE publication type: Not Eligible  
Organisations: University of Oulu  
Contributors: Suntio, T.  
Number of pages: 6  
Pages: 592-597  
Publication date: 1 Dec 2003  
Peer-reviewed: Yes

#### Publication information

Journal: INTELEC, International Telecommunications Energy Conference (Proceedings)  
ISSN (Print): 0275-0473  
Ratings:  
Scopus rating (2003): SJR 0.264 SNIP 0.244  
Original language: English  
ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering  
URLs:  
<http://www.scopus.com/inward/record.url?scp=1542330113&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 1542330113

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

### **The effects of intermittent charging on VRLA battery life expectancy in telecom applications**

A survey of a 2.5-year testing of VRLA batteries at elevated ambient temperature of 43°C is reported. The batteries were charged using float charging and standby charging or intermittent charging principles. The goal of the research was to verify the assumed adverse effects of continuous float charging in respect to intermittent charging. No clear correlation with the charging modes was noticed. The shorter than expected life of VRLA batteries may be addressed to the shortages in charging procedures rather than to continuous float charging. It was also noticed that the ineffective charging might be more harmful when using intermittent charging than when using continuous float charging.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: ABB Oy, Aalto University, University of Oulu

Contributors: Waltari, P., Suntio, T., Tenno, A., Tenno, R.

Number of pages: 7

Pages: 121-127

Publication date: 1 Dec 2002

Peer-reviewed: Yes

#### **Publication information**

Journal: INTELEC, International Telecommunications Energy Conference (Proceedings)

ISSN (Print): 0275-0473

Ratings:

Scopus rating (2002): SJR 0.549 SNIP 0.466

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Source: Scopus

Source ID: 0036907399

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

### **Use of unterminated two-port modeling technique in analysis of input filter interactions in telecom DPS systems**

A methodology to model and analyze input filter-interactions in Telecom distributed power system is presented based on the use of two-port unterminated modeling technique. Switched-mode converters and input filters are modeled using G-parameter representation where the input port is represented using Norton's equivalent circuit, and the output port using Thevenin's equivalent circuit. The used approach results in a unified model applicable to any converter regardless of topology, and the mode of operation or control. The two-port models are first defined as unterminated models where the effect of load is excluded but may be easily included using the developed reflection rules.

#### **General information**

Publication status: Published

MoE publication type: Not Eligible

Organisations: Aalto University, University of Oulu

Contributors: Suntio, T., Gadoura, I.

Number of pages: 6

Pages: 560-565

Publication date: 1 Dec 2002

Peer-reviewed: Yes

#### **Publication information**

Journal: INTELEC, International Telecommunications Energy Conference (Proceedings)

ISSN (Print): 0275-0473

Ratings:

Scopus rating (2002): SJR 0.549 SNIP 0.466

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

Source: Scopus

Source ID: 0036911643

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

### **Dynamics of a buck converter with a constant power load**

The dynamic properties of the buck converter with a constant power load are studied in this paper. The line-to-output and control-to-output transfer functions are derived, for voltage mode control and current mode control, in continuous conduction mode and discontinuous conduction mode. A comparison with the case of a resistive load is made in each case.

#### **General information**

Publication status: Published

MoE publication type: Not Eligible

Organisations: University Politehnica of Bucharest, Aalto University, Efore Oy

Contributors: Grigore, V., Hatonen, J., Kyyra, J., Suntio, T.

Number of pages: 7

Pages: 72-78

Publication date: 1 Jan 1998

#### **Host publication information**

Title of host publication: PESC 1998 - 29th Annual IEEE Power Electronics Specialists Conference

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 701881

ISBN (Print): 0780344898, 9780780344891

#### **Publication series**

Name: PESC Record - IEEE Annual Power Electronics Specialists Conference

Volume: 1

ISSN (Print): 0275-9306

ASJC Scopus subject areas: Modelling and Simulation, Condensed Matter Physics, Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1109/PESC.1998.701881

Source: Scopus

Source ID: 84880085186

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

### **DC UPS system's reliability performance: Facts and fiction**

Reliability performance of a DC UPS system having redundant (n+1) rectifiers and battery back-up can be naturally very high. Emergence of microcomputer based intelligent supervision and control system as well as low voltage disconnection (LVD) facilities can, however, drastically reduce or even totally destroy the naturally high reliability performance. This is quite worrying because high reliability performance is the basis for the quality of Telecom services. The reliability performance of a redundant rectifier system depends on the reliability of the individual rectifiers, on the ability of the supervision system to detect a failed unit and on the existence of common mode failure sources. The typical common mode failure sources are overvoltage protection, remote voltage control, remote shut down, internal short circuits at the output, unwise location and insufficient monitoring of LYD facilities. This paper describes the methodology to analyze the availability and reliability performance based on Markov chains. Methods and ways by which the reliability problem can be rectified are also addressed.

#### **General information**

Publication status: Published

MoE publication type: Not Eligible

Organisations: Efore Oy

Contributors: Suntio, T., Suur-Askola, S.

Number of pages: 7

Pages: 237-243

Publication date: 1 Jan 1997

#### **Host publication information**

Title of host publication: TELESCON 1997 - 2nd International Telecommunications Energy Special Conference

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9638111623, 9789638111623

#### **Publication series**

Name: TELESCON 1997 - 2nd International Telecommunications Energy Special Conference

ASJC Scopus subject areas: Computer Networks and Communications, Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1109/TELESC.1997.655721

Source: Scopus

Source ID: 85060689638

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

### **Shape of battery capacity-life curve as a decisive decision-making parameter**

The end of useful battery life is normally defined as the point at which battery capacity has reduced ca. 20 % from the nominal value. This aging is typically taken into account by multiplying the back-up time value by a factor of 1.25. The effect of capacity reduction on back-up time depends, however, on the length of the discharge time. If the discharge time is in the order of hours, then the 20 % reduction of capacity results in ca. 20 % reduction of back-up time. If the discharge time is in the order of 10 minutes then the effect could be ca. 50 % reduction of back-up time. This means that a 25 % increase in back-up time is not sufficient in this case. The shape of battery capacity-life curve is more important than people normally think. Their thinking is affected by the experience gained from the use of flooded batteries: The actual capacity of a battery is often higher than nominal after the use of 10 yrs and the reduction is very gradual even after this. In the case of VR-batteries the shape of capacity-life curve can be quite different from that of flooded batteries. The rate of capacity reduction can increase along the life and be very steep at the end of life. This raises a question whether the aging can be taken into account feasibly at all. It is also evident that the monitoring of battery condition will be more and more essential to be able to replace the batteries in time to avoid unexpected system shut downs. This paper discusses the matters referred above more in detail from the user's viewpoint and suggest actions to be taken to avoid fatal consequences.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Finlandia Interface Oy, Telecom Engineering

Contributors: Suntio, T., Waltari, P., Rajamäki, J.

Number of pages: 7

Pages: 113-119

Publication date: 1994

#### **Host publication information**

Title of host publication: TELESCON '94 - The First International Telecommunications Energy Special Conference

Publisher: IEEE

ASJC Scopus subject areas: Computer Networks and Communications, Energy Engineering and Power Technology, Electrical and Electronic Engineering, Safety, Risk, Reliability and Quality

DOIs:

10.1109/TELESC.1994.4794322

Source: Scopus

Source ID: 85060676990

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

### **Novel ways to improve rectifier performance from power systems' reliability viewpoint**

Technical advances are of no real relevance to a user, if they cannot offer benefits which can be measured in terms of money. The countable measures are such as improvements in equipment and system reliability, in efficiency resulting in lower internal temperature, in weight and need of space as well as in lower price. However, quite often the benefits are just marginal from the users' viewpoint. The reason is the overutilization of the obtained benefits and this can, for instance, be realized in lower reliability performance, higher price, etc. The main source of uncertainty is always public power i.e. the energy flow is not perfectly continuous. It is normally the level of voltage in public power lines which determines whether the energy is available (i.e. usable) or not. The number of outages and brownouts can be substantially reduced by means of a rectifier system which has a proper amount of filtering capacity and an adaptive (i.e. load power depending) undervoltage shut down feature. There are also other topics mainly related to system reliability from the rectifier viewpoint such as output overvoltage shut down, testing of batteries by discharging, rectifier failure detection, etc. which are discussed and solutions proposed.

#### **General information**

Publication status: Published

MoE publication type: Not Eligible

Organisations: UPS Agent Ky, Finlandia Interface Oy, Helsinki Telephone Company

Contributors: Suntio, T., Keränen, T., Tulkki, J.

Number of pages: 8

Pages: 40-47

Publication date: 1 Jan 1993

#### **Host publication information**

Title of host publication: Proceedings of Intelec 1993 : 15th International Telecommunications Energy Conference

Publisher: IEEE

ISBN (Electronic): 0780318420

### Publication series

Name: INTELEC, International Telecommunications Energy Conference (Proceedings)

Volume: 1

ISSN (Print): 0275-0473

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1109/INTLEC.1993.388471

Source: Scopus

Source ID: 85063547590

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

### AC-UPS reliability and availability performance: Comparison of available solutions

Uninterruptible power supply (AC-UPS) systems are studied from the reliability and availability (R&A) performance point of view. The objective is to find out the basic reason for using a UPS system as well as its impact on the optimal solution; and how the basic mission can be carried out in an optimal way. The alternatives are series power processing (also called true UPS) and parallel power processing (also called stand-by UPSW or line-interactive UPS). It is shown that the available UPS solutions are nearly equal from the R&A point of view and that if high reliability is of prime concern, optimal results can be obtained by means of line-interactive UPS.

### General information

Publication status: Published

MoE publication type: Not Eligible

Organisations: FISKARS OY AB Electron Power Syst, Fiskars Oy Ab

Contributors: Suntio, T., Uusitalo, J., Jonsson, L.

Publication date: 1 Dec 1989

Peer-reviewed: Yes

### Publication information

Journal: INTELEC, International Telecommunications Energy Conference (Proceedings)

ISSN (Print): 0275-0473

Original language: English

ASJC Scopus subject areas: Energy Engineering and Power Technology, Electrical and Electronic Engineering

DOIs:

10.1109/INTLEC.1989.88298

Source: Scopus

Source ID: 0024932058

Research output: Contribution to journal > Conference article > Scientific > peer-review

### Theoretical studies of structural properties of the high- $T_c$ superconductor $Y_1Ba_2Cu_3O_{7-x}$

Structural properties of the high temperature oxide superconductor  $Y_1Ba_2Cu_3O_{7-gc}$  have been studied by static lattice simulation methods. Empirical (ionic) potentials, derived on the basis of experimental data, are used to describe the basic structural properties of the superconductive oxides. Several potential models, with different location of the extra charge for the  $O_7$  compound, have been tested with respect to experimental lattice parameters. Fair parametrizations have been found in almost all cases, but they are usually valid only for a specific oxygen content. However, potential models, consistent both for  $O_6$  and  $O_7$ , have been found. We present the best of our ionic models, where, in  $O_7$ , two thirds of the holes are distributed in the sheet-site oxygens and one third in oxygens between the sheet and chain planes.

### General information

Publication status: Published

MoE publication type: Not Eligible

Organisations: Brookhaven National Laboratory

Contributors: Valkealahti, S., Welch, D. O.

Number of pages: 2

Pages: 540-541

Publication date: 1 Jan 1989

Peer-reviewed: Yes

### Publication information

Journal: Physica C: Superconductivity and its Applications

Volume: 162-164

Issue number: PART 1

ISSN (Print): 0921-4534

Original language: English

ASJC Scopus subject areas: **Electronic, Optical and Magnetic Materials, Condensed Matter Physics, Energy Engineering and Power Technology, Electrical and Electronic Engineering**

DOIs:

[10.1016/0921-4534\(89\)91145-3](https://doi.org/10.1016/0921-4534(89)91145-3)

Source: Scopus

Source ID: 0024887115

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