Passivation of surface states on hematite photoelectrode by ALD grown TiO₂ for efficient solar water splitting

General information
State: Published
Organisations: Photonics, Tampere Univ Technol, Tampere University of Technology
Authors: Ali-Löytty, H., Valden, M., Palmolahti, L.
Publication date: 4 Dec 2017
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Research output: Scientific ; Paper, poster or abstract

Photo-electrochemical and spectroscopic investigation of ALD grown TiO₂: Charge transfer characterization and effect of post annealing at different temperature
Inspired by the photo-electrochemical water oxidation system reported by Fujishima and Honda1, recent work has focused on functionalizing photoactive TiO₂ thin films on silicon (Si) semiconductor. Targeting to design an efficient photo-electrochemical device for solar fuel production, finding suitable protection layer material for semiconductors like Si, has recently gained significant attention.

In this work, TiO₂ thin films were deposited on highly doped Si substrate by atomic layer deposition (ALD) technique using tetrakis-dimethylamido titanium (TDMAT) and water as a precursors. In order to understand the influence of ALD parameters on TiO₂ film performance in photo-electrochemical cell, ALD growth temperature was varied from 150 °C to 225 °C and film thickness from 20 nm to 50 nm. Further efforts were made to analyze the effect of post-annealing treatment in air on ALD films and its influence on photo-electrochemical water oxidation reaction.

The highest applied bias photon-to-current efficiency for Solar Water Splitting (SWS) was obtained in 30 nm ALD TiO₂ film grown at 200 °C after post annealing at 475 °C. Annealing at higher temperatures decreased the photo-activity substantially. X-ray photoelectron spectroscopy analysis of TiO₂ (2 nm)/Si samples after annealing in air revealed the onset of interfacial SiO₂ formation at 450 °C. SiO₂ at the TiO₂/Si interface act as a charge transfer barrier with detrimental consequence on SWS on TiO₂/Si photo-anode.

Modeling of load-transient response of direct-duty-ratio-controlled buck converter
This paper provides a simple analytical model for the closed-loop output impedance of a direct-duty-ratio-controlled buck converter, which can be used to predict the behavior of the output voltage during a load-current transient. The modeling method utilizes standard control theory to obtain the model for the sensitivity function based on the crossover frequency and phase margin of the output-voltage feedback loop as well as on a clever estimate for the corresponding open-loop output impedance. The modeling method is validated by means of simulations and experimental tests.
Structured Metal/Polymer Back Reflectors for III-V Solar Cells
We report on fabrication of microstructured metal/polymer back reflectors for light trapping in III-V solar cells. The asymmetric triangular grating provided the highest diffraction of the light when compared to half sphere and cylinder reflectors.

General information
State: Published
Organisations: Photonics, Politecnico di Torino
Authors: Aho, T., Niemi, T., Cappelluti, F., Tukiainen, A., Elsehrawy, F., Guina, M.
Publication date: 6 Nov 2017
Peer-reviewed: Unknown
Research output: Scientific › Paper, poster or abstract

Photovoltaic mismatch losses caused by moving clouds
Mismatch losses is a major issue in the photovoltaic (PV) system and are mainly caused by partial shading; largest mismatch losses are caused by sharp shadows. These shadows are a typical problem for rooftop and residential installations. In large-scale PV plants, partial shading is mostly caused by moving clouds which produce gentle irradiance transitions causing typically only minor irradiance differences between adjacent PV modules.

This paper presents a study of the mismatch losses of PV arrays with various layouts and electrical configurations during around 27,000 irradiance transitions identified in measured irradiance data. The overall effect of the mismatch losses caused by moving clouds on the energy production of PV plants was also studied. The study was conducted using a mathematical model of irradiance transitions and an experimentally verified MATLAB/Simulink model of a PV module.

The relative mismatch losses during the identified irradiance transitions ranged from 1.4% to 4.0% depending on the electrical configuration and layout of the PV array. The overall effect of the mismatch losses caused by moving clouds on the total electricity production of PV arrays was about 0.5% for the PV array with strings of 28 PV modules and substantially smaller for arrays with shorter strings. The proportions of the total mismatch losses caused by very dark or highly transparent clouds were small. About 70% of the total mismatch losses were caused by shadow edges with shading strengths ranging between 40% and 80%. These results indicate that the mismatch losses caused by moving clouds are not a major problem for large-scale PV plants. An interesting finding from a practical point of view is that the mismatch losses increase the rate of power fluctuations compared to the rate of irradiance fluctuations.

General information
State: E-pub ahead of print
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Electrical Energy Engineering, Research group: Power systems
Authors: Lappalainen, K., Valkealahti, S.
Number of pages: 7
Pages: 455-461
Publication date: 14 Oct 2017
Peer-reviewed: Yes

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Scopus rating (2015): SJR 1.974 SNIP 2.143 CiteScore 4.61
Scopus rating (2014): SJR 2.014 SNIP 2.704 CiteScore 4.77
Scopus rating (2013): SJR 2.058 SNIP 2.92 CiteScore 4.44
Scopus rating (2012): SJR 1.655 SNIP 2.55 CiteScore 3.65
Scopus rating (2011): SJR 1.326 SNIP 2.223 CiteScore 3.19
Scopus rating (2010): SJR 1.419 SNIP 2.161
Scopus rating (2009): SJR 1.301 SNIP 2.158
Effect of natural convection and radiation inside of a hollow beam in a standard fire

In the design of steel structures, special attention must be paid on structural fire design in order to ensure a specified safe time period that the structure can withstand the fire without collapse. In the European design rules, the standard practise assumes uniform temperature for steel beam cross sections while the surrounding area is subjected to the so called standard fire. When the ambient temperature field is not uniform (e.g. at beam joint areas) neither will be the beam cross section temperature field. This paper studies the contribution of natural convection and cavity radiation to the temperature field of a hollow beam cross section in the case of non-uniform ambient temperature by using transient CFD-simulations.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Civil Engineering, Research group: Light-weight structures
Authors: Välikangas, T., Pajunen, S., Baczkiewicz, J., Singh, S., Sørensen, K.
Number of pages: 7
Pages: 121-127
Publication date: 27 Sep 2017

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Research output: Scientific - peer-review › Conference contribution
Passivation of GaInP and AlInP surfaces for III-V solar cells

General information
State: Published
Organisations: Photonics, Research group: ORC
Authors: Raappana, M., Polojärvi, V., Aho, T., Aho, A., Isoaho, R., Tukiainen, A., Guina, M.
Publication date: 27 Sep 2017
Peer-reviewed: Unknown
Research output: Scientific › Paper, poster or abstract

Nanocomposite Polypropylene For DC Cables And Capacitors: A New European Project
This paper presents the scientific background of a new European project, GRIDABLE, which was launched at the beginning of 2017 and has to deliver results in manufacturing and characterization of LV-MV capacitors and MV-HV cables for DC application. The innovation is in the development of nanostructured materials based on polypropylene and silica, and the relevant capacitor and cable manufacturing procedures. The initial results regarding the electrical properties of PP-SiO2 materials, which have brought to the proposal of this project, are presented in this paper, focusing on breakdown strength and space charge measurements performed on nanofilled PP films for capacitors.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering, Research area: Power engineering, Research group: High voltage engineering, University of Bologna, Italy, VTT Technical Research Centre of Finland
Authors: Montanari, G. C., Seri, P., Karttunen, M., Paajanen, M., Lahti, K., Rytöluoto, I.
Number of pages: 4
Pages: 433-436
Publication date: 15 Sep 2017

Resistive current waveform as a tool to identify degraded parts of polymeric surge arresters subjected to internal moisture

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering, University of São Paulo
Authors: Da Silva, D. A., Filho, J. P., Lahti, K.
Number of pages: 6
Publication date: 28 Aug 2017

Ideal operation of a photovoltaic power plant equipped with an energy storage system on electricity market
There is no natural inertia in a photovoltaic (PV) generator and changes in irradiation can be seen immediately at the output power. Moving cloud shadows are the dominant reason for fast PV power fluctuations taking place typically within a
minute between 20 to 100% of the clear sky value roughly 100 times a day, on average. Therefore, operating a utility scale grid connected PV power plant is challenging. Currently, in many regions, renewable energy sources such as solar and wind receive feed-in tariffs that ensure a certain price for the energy. On the other hand, electricity markets operate on a supply-demand principle and a typical imbalance settlement period is one hour. This paper presents the energy, power and corresponding requirements for an energy storage system in a solar PV power plant to feed the power to the grid meeting the electricity spot markets practices. An ideal PV energy production forecast is assumed to be available to define reference powers of the system for the studied imbalance settlement periods. The analysis is done for three different PV system sizes using the existing irradiance measurements of the Tampere University of Technology solar PV power station research plant.

### General information
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Authors: Järvelä, M., Valkealahti, S.
Number of pages: 13
Publication date: 23 Jul 2017
Peer-reviewed: Yes

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DOIs: 10.3390/app7070749
Research output: Scientific - peer-review › Article

### Enabling High-Efficiency InAs/GaAs Quantum Dot Solar Cells by Epitaxial Lift-Off and Light Management

### General information
State: Published
Organisations: Photonics, Politecnico di Torino, University College London
Publication date: 25 Jun 2017
Peer-reviewed: Unknown
Research output: Scientific › Paper, poster or abstract

### Analysis of Transition Steps Towards Power-based Distribution Tariff of Small Customers
This paper discusses the development of distribution tariffs of small customers. Future changes in the electricity sector challenge the present distribution tariff structures and instead of a passive approach, the Distribution System Operators (DSO) have the opportunity to respond to the challenges by applying novel tariff structures. The movement towards Power-based Distribution Tariffs (PBDT) has been seen as a very potential development direction. However, before implementing PBDTs, or any other novel tariff structures, it has to be ensured that the change will not cause unwanted outcomes such as too aggressive an impact on the distribution fees of the customers or on the total revenue of the DSO. The main focus of this paper is on the transition viewpoints from present tariffs towards one selected PBDT structure.

### General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering
Authors: Lummi, K., Rautiainen, A., Järventaula, P., Heine, P., Lehtinen, J., Apponen, R., Hyvärinen, M.
Publication date: 15 Jun 2017

### Host publication information
Title of host publication: 24th International Conference on Electricity Distribution, CIRED 2017
Cost-benefit Analysis for Using the Li-ion Batteries in Low-voltage Network for Decreasing the Outage Time Experienced by Customers

Battery energy storage (BES) installed in the low-voltage busbar of a secondary substation can prevent part of the customers' interruptions in a low voltage (LV) network that would happen due to failures in the supplying medium voltage (MV) network or rarely in the high voltage network (HV). In fact, over 80% of average customer outage time comes from the interruptions in the MV network [1]. One way to improve the network reliability for decreasing the interruption time of customers is to focus the investments on the MV network (e.g. network automation or cabling). The other option is to develop local solutions at LV network level by energy storages.

This study compares the life-time costs of Li-ion batteries against the benefits achieved by decreasing the customer interruption costs (CIC) defined by the Finnish network business regulation model. The analysis is done by using the interruption and network data of Elenia Oy consisting of 13,867 LV networks in rural areas. The results indicate profitability in the interruption prone LV networks.

Deveploment of Power-based Tariff Structure for Small Customers and Pathway for This Change

This paper discusses the development of alternative power-based tariff structures for small customers and presents a pathway for adapting one new structure. Development of new tariff structures are needed when actively responding to the future changes in the operating environment of the electricity distribution. In this paper, the studied tariff structures were a power-based tariff structure based on a cost-causation principle and a power-based tariff structure with power and time limits. The customer specific relative and absolute changes in the annual electricity distribution fees were analysed and by emphasizing the customer acceptance an acceptable pathway was created.
Earthing Systems Connected via Metallic Screens of the 20 kV Underground Cables in Non-urban Areas

Secondary substations’ earthing systems are connected to each other via metallic screens of the 20 kV underground cables also in suburban and rural areas nowadays. Topology is different from the earthing systems in city centers, where earthings are connected via multiple mesh connections forming a solid ground level. The standards EN 61936-1, EN 50522 and the Finnish SFS 6001 (High voltage installations) do not clearly consider the case of connected earthings. In 2015 studies were launched to investigate this issue. According to results of the studies, the connected earthings should be evaluated as a whole, and not separately as in the overhead networks. There is a need for renewing earthing network design principles because at the moment, the connections between the secondary substations are not systematically taken into account in the non-urban areas’ earthing design. Results show that the resulting impedance was typically 50-80% lower than the secondary substations’ individual earthing resistances. It means that there is great potential for savings in the earthing network without risking the safety. Furthermore, there is a need to develop earthing impedance measuring methods. Methods that are used for overhead network earthing measurements are not often suitable for cable network, where the earthings are connected. This paper brings out recommendations how the design and measurement principles could be developed and which possible changes in the relevant standards should be considered.

Field testing of a wideband monitoring concept at MV side of secondary substation

Smart grid concept substantially increases the need of monitoring devices in the future for efficient and flexible power delivery. Secondary substation is an ideal location for monitoring both LV and MV networks which can be used to improve the power grid resilience. This study presents the key features and practical experience gained from the deployment of novel wideband high-frequency current transformer sensors for monitoring power quality as well as partial discharges at MV side of the transformer. Additionally, a network simulation is carried out using real-time digital simulator to test the possibility of detecting an earth fault cost-effectively at MV side of secondary substation.
Generation Curtailment as a Means to Increase the Wind Power Hosting Capacity of a Real Regional Distribution Network
This paper represents how generation curtailment can be utilized to increase the wind power hosting capacity of an existing distribution network. The paper proposes a control algorithm that implements the curtailment and can be easily implemented as a part of the existing network management tools of the distribution system operator. The paper also presents how the amount of annual curtailment can be evaluated prior to wind farm construction.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering
Authors: Kulmala, A., Repo, S., Pylvänäinen, J.
Publication date: 15 Jun 2017

Reforming Distribution Tariffs of Small Customers: Targets, Challenges and Impacts of Implementing Novel Tariff Structures
The paper discusses the targets, challenges and impacts of novel distribution tariff structures, especially power based distribution tariffs. The paper summarizes the aims and preliminary results of an ongoing Finnish national research project in which distribution tariffs are being investigated together with multiple distribution system operators (DSO), research institutes and other actors of the field. The reformation of distribution tariffs has some clear motivational factors, but at the same time, the topic is very multifaceted, as changes in the pricing of electricity distribution have different effects on different actors of the field like customers, DSOs, electricity retailers and other third parties in the electricity sector (e.g. different kinds of service providers, device manufacturers) and society as a whole. These topics are discussed in a qualitative manner in the paper but also preliminary numerical results are presented to elaborate the customer impacts of novel tariffs.

General information
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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Electrical Energy Engineering
Publication date: 15 Jun 2017
The role of inorganics in modelling of biomass gasification

In this work, a summary of the research carried out about the role of inorganic elements in biomass gasification is presented. The research work has focused on the catalytic effects of alkali and alkaline earth metals in char gasification. The work has included gasification experiments using thermogravimetric analysis (TGA) and fluidized beds as well as modeling techniques. The results of the research presented in this paper indicate that the laboratory measured TGA reactivity numbers and correlations (including the effect of fuel ash inorganics) are possible to be converted to numbers predicting carbon conversion in a large scale fluidized bed gasification reactor. The model, called Carbon Conversion Predictor, is a relatively simple and transparent tool for the comparison of the gasification reactivity of different fuels in fluidized bed gasification.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Univ Seville, University of Seville, Chem & Environm Engn Dept, Bioenergy Grp, Escuela Super Ingenieros
Authors: Konttinen, J., Kramb, J., DeMartini, N., Gomez-Barea, A.
Number of pages: 5
Pages: 443-447
Publication date: 13 Jun 2017
Host publication information
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Publisher: ETA-Florence Renewable Energies
Editors: Ek, L., Ernrooth, H., Scarlat, N., Grassi, A., Helm, P.
Publication series
Name: European biomass conference and exhibition proceedings
Publisher: ETA Florence renewable energies
ISSN (Electronic): 2282-5819
DOIs:
10.5071/25thEUBCE2017-2BO.6.4
Research output: Scientific - peer-review › Conference contribution

Broadband Anti-reflective Coatings for Multi-junction Solar Cells
General information
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Organisations: Facilities and Infrastructure, Photonics, Research group: ORC
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Publication date: 29 May 2017
Peer-reviewed: Unknown
Event: Paper presented at Optics and Photonics days 2017, Oulu, Finland.
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics
Keywords: anti-reflective coating, thin films, multi-junction solar cell, material characterization
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Poster_for_OPD2017
Links:
http://urn.fi/URN:NBN:fi:ttv-201710312092

Bibliographical note
Poster and an abstract for Optics and Photonics days 2017.
Research output: Scientific › Paper, poster or abstract
Chlorine-Induced High Temperature Corrosion of Inconel 625 Sprayed Coatings Deposited with Different Thermal Spray Techniques

Ni-based coatings of the type Inconel 625 sprayed with high-kinetic spray processes are applied as protective coatings in many industrial fields where high corrosion resistance is required. Among the high-kinetic spray processes HVOF (High-Velocity Oxygen-Fuel) is an affirmed technology while HVAF (High-Velocity Air-Fuel) and cold spray are promising technologies for the deposition of thick and dense coatings, able to extend the service life of components subjected to harsh corrosive conditions. This study aims to assess the effect of the different high-kinetic spray technologies on the chlorine-induced high temperature corrosion behaviour of the coatings. The coatings were exposed to the test condition of 550°C in the presence of KCl salt deposits under air flow with 12 % of specific humidity for 168 h. The corrosion behaviour of the coatings was evaluated and compared with a reference wrought Inconel 625. Corrosion products and coatings were analysed and characterised in order to define the corrosion/oxidation mechanisms.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Research group: Surface Engineering, Valmet Technologies Oy
Authors: Fantozzi, D., Matikainen, V., Uusitalo, M., Koivuluoto, H., Vuoristo, P.
Number of pages: 11
Pages: 233-243
Publication date: 25 May 2017
Peer-reviewed: Yes

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Scopus rating (2016): CiteScore 2.56 SJR 0.874 SNIP 1.359
Scopus rating (2015): SJR 0.871 SNIP 1.415 CiteScore 2.46
Scopus rating (2014): SJR 0.998 SNIP 1.681 CiteScore 2.44
Scopus rating (2013): SJR 1.057 SNIP 1.859 CiteScore 2.58
Scopus rating (2012): SJR 1.049 SNIP 1.658 CiteScore 2.2
Scopus rating (2011): SJR 1.053 SNIP 1.851 CiteScore 2.38
Scopus rating (2010): SJR 1.155 SNIP 1.66
Scopus rating (2009): SJR 1.449 SNIP 1.526
Scopus rating (2008): SJR 1.479 SNIP 1.564
Scopus rating (2007): SJR 1.165 SNIP 1.509
Scopus rating (2006): SJR 1.276 SNIP 1.709
Scopus rating (2005): SJR 1.252 SNIP 1.666
Scopus rating (2004): SJR 1.269 SNIP 1.498
Scopus rating (2003): SJR 1.276 SNIP 1.516
Scopus rating (2002): SJR 1.208 SNIP 1.183
Scopus rating (2001): SJR 1.115 SNIP 1.181
Scopus rating (2000): SJR 0.981 SNIP 1.03
Scopus rating (1999): SJR 1.062 SNIP 1.167
Original language: English
Keywords: chlorine , high temperature corrosion, Thermal spray, HVOF, HVAF, cold spray, arc spray
DOIs: 10.1016/j.surfcoat.2016.12.086
Research output: Scientific - peer-review › Article

Pyrolysed cellulose nanofibrils and dandelion pappus in supercapacitor application
Dandelion pappus and wood based nanocellulose fibrils were combined to form films that were subsequently pyrolyzed under low-pressure conditions in a carbon monoxide (CO) rich atmosphere to make supercapacitor electrode material. The electrodes were prepared from these materials and pyrolysed under low-pressure conditions in a carbon monoxide-rich atmosphere. The electrode materials and assembled supercapacitors were electrically and structurally characterized. The assembled six supercapacitors showed specific capacitances per electrode ranging from 1 to 6 F/g and surface resistance of pyrolyzed electrodes ranging from 30 to 170 Ω/□. Finally, equivalent series resistance and leakage current measurements were conducted for three samples, resulting values from 125 to 500 Ω and from 0.5 to 5.5 µA, respectively.
General information
State: E-pub ahead of print
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Electronics and Communications Engineering, Materials Science, Research group: Plastics and Elastomer Technology, Research group: Plastics and Elastomer Technology, Research area: Measurement Technology and Process Control, Research group: Sensor Technology and Biomeasurements (STB), BioMediTech, BioMediTech Institute and Faculty of Biomedical Sciences and Engineering
Authors: Virtanen, J., Pammo, A., Keskinen, J., Sarlin, E., Tuukkanen, S.
Number of pages: 11
Publication date: 24 May 2017
Peer-reviewed: Yes

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Journal: Cellulose
ISSN (Print): 0969-0239
Ratings:
Scopus rating (2016): CiteScore 3.68 SJR 1.126 SNIP 1.144
Scopus rating (2015): SJR 1.153 SNIP 1.24 CiteScore 3.55
Scopus rating (2014): SJR 1.071 SNIP 1.334 CiteScore 3.58
Scopus rating (2013): SJR 1.127 SNIP 1.48 CiteScore 3.83
Scopus rating (2012): SJR 1.179 SNIP 1.71 CiteScore 3.74
Scopus rating (2011): SJR 1.354 SNIP 1.795 CiteScore 3.99
Scopus rating (2010): SJR 0.873 SNIP 1.384
Scopus rating (2009): SJR 1.038 SNIP 1.219
Scopus rating (2008): SJR 0.926 SNIP 1.123
Scopus rating (2007): SJR 0.754 SNIP 1.034
Scopus rating (2006): SJR 0.699 SNIP 1.15
Scopus rating (2005): SJR 1.112 SNIP 1.318
Scopus rating (2004): SJR 0.855 SNIP 1.072
Scopus rating (2003): SJR 0.81 SNIP 1.02
Scopus rating (2002): SJR 0.649 SNIP 0.689
Scopus rating (2001): SJR 0.602 SNIP 0.785
Scopus rating (2000): SJR 0.583 SNIP 0.773
Scopus rating (1999): SJR 0.67 SNIP 1.14
Original language: English
Keywords: Supercapacitor, Nanocellulose, Dandelion, Pyrolysis
DOIs:
10.1007/s10570-017-1332-8
Links:

Bibliographical note
INT="Pammo, Arno"
Research output: Scientific - peer-review > Article

Enhanced harvesting of thin-film quantum dot solar cells through light trapping techniques

General information
State: Published
Organisations: Photonics, Thales Alenia Space
Publication date: 26 Apr 2017
Peer-reviewed: Unknown
Research output: Scientific > Paper, poster or abstract

Aspects of moisture ingress in polymer housed surge arresters
Polymers have been extensively applied in the industry, especially in energy system e.g. due to their good processability and insulation properties. However, all polymers are permeable in different extent, which requires a good knowledge about
the process of permeation through these materials. In this study the moisture dynamics of four different surge arresters were studied in several ways,—at first by analysing the moisture diffusion properties of the housing polymers and finally by testing the full arrester structures against moisture ingress. Housing polymer composites were evaluated using thermogravimetric analysis and differential scanning calorimetry while the polymers' ability to withstand moisture diffusion was studied by water vapor transmission rate measurements. Moisture ingress behavior of the full surge arresters was examined by daily measurements of internal resistive leakage current along 30 days immersion test. Although correlations were found between the material composition and the diffusivity through the polymer, the moisture dynamic is deemed to be much more complex in the full surge arrester. Moisture permeation through separate housing material samples was typically high compared to internal leakage current formed in real arresters which highlights the main conclusion drawn,—internal structures and long term quality of interfaces are the key issues in preventing moisture induced degradation in metal oxide surge arresters.

**General information**

State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Electrical Energy Engineering, Research area: Power engineering, University of Campinas
Authors: Da Silva, D. A., Lahti, K., Buontempo, R. C., Filho, J. P.
Number of pages: 9
Pages: 162-170
Publication date: 6 Apr 2017
Peer-reviewed: Yes

**Publication Information**

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Scopus rating (2015): SJR 1.063 SNIP 1.663 CiteScore 2.74
Scopus rating (2014): SJR 1.129 SNIP 1.918 CiteScore 2.86
Scopus rating (2013): SJR 1.23 SNIP 1.941 CiteScore 2.92
Scopus rating (2012): SJR 1.211 SNIP 2.185 CiteScore 3.13
Scopus rating (2011): SJR 0.942 SNIP 2.157 CiteScore 2.97
Scopus rating (2010): SJR 1.004 SNIP 1.795
Scopus rating (2009): SJR 0.88 SNIP 1.561
Scopus rating (2008): SJR 0.574 SNIP 1.302
Scopus rating (2007): SJR 0.529 SNIP 1.281
Scopus rating (2006): SJR 0.535 SNIP 0.889
Scopus rating (2005): SJR 0.633 SNIP 1.136
Scopus rating (2004): SJR 0.38 SNIP 1.109
Scopus rating (2003): SJR 0.988 SNIP 0.894
Scopus rating (2002): SJR 0.678 SNIP 0.721
Scopus rating (2001): SJR 0.485 SNIP 0.414
Scopus rating (2000): SJR 0.271 SNIP 0.609
Scopus rating (1999): SJR 0.231 SNIP 0.446
Original language: English
ASJC Scopus subject areas: Electrical and Electronic Engineering
DOIs:
10.1016/j.epsr.2017.03.025
Research output: Scientific - peer-review › Article

**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**

State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Electrical Energy Engineering, Research area: Power engineering
Authors: Lappalainen, K., Valkealahti, S.
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Pages: 902-910
Publication date: 15 Mar 2017
Peer-reviewed: Yes

**Publication information**

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Scopus rating (2015): SJR 2.912 SNIP 2.61 CiteScore 6.4
Scopus rating (2014): SJR 3.254 SNIP 3.28 CiteScore 6.93
Scopus rating (2013): SJR 3.164 SNIP 3.377 CiteScore 6.59
Scopus rating (2012): SJR 2.854 SNIP 3.108 CiteScore 5.69
Scopus rating (2011): SJR 2.473 SNIP 2.84 CiteScore 5.5
Scopus rating (2010): SJR 1.516 SNIP 2.25
Scopus rating (2009): SJR 1.003 SNIP 1.781
Scopus rating (2008): SJR 0.974 SNIP 1.215
Scopus rating (2007): SJR 1.179 SNIP 1.709
Scopus rating (2006): SJR 0.979 SNIP 1.293
Scopus rating (2005): SJR 1.043 SNIP 0.996
Scopus rating (2004): SJR 0.643 SNIP 0.839
Scopus rating (2003): SJR 0.778 SNIP 0.797
Scopus rating (2002): SJR 0.577 SNIP 0.775
Scopus rating (2001): SJR 0.376 SNIP 0.578
Scopus rating (2000): SJR 0.352 SNIP 0.515
Scopus rating (1999): SJR 0.182 SNIP 0.45
Original language: English
Keywords: Irradiance transition, Partial shading, Photovoltaic power generation, Power variation, PV array
ASJC Scopus subject areas: Civil and Structural Engineering, Energy(all)
DOIs: 10.1016/j.apenergy.2017.01.013
Links: http://www.scopus.com/inward/record.url?scp=85009223592&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source-ID: 85009223592
Research output: Scientific - peer-review › Article

**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**

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Authors: Lappalainen, K., Valkealahti, S.
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- Scopus rating (2015): SJR 1.974 SNIP 2.143 CiteScore 4.61
- Scopus rating (2014): SJR 2.014 SNIP 2.704 CiteScore 4.77
- Scopus rating (2013): SJR 2.058 SNIP 2.92 CiteScore 4.44
- Scopus rating (2012): SJR 1.655 SNIP 2.55 CiteScore 3.65
- Scopus rating (2011): SJR 1.326 SNIP 2.223 CiteScore 3.19
- Scopus rating (2010): SJR 1.419 SNIP 2.161
- Scopus rating (2009): SJR 1.301 SNIP 2.158
- Scopus rating (2008): SJR 1.693 SNIP 2.007
- Scopus rating (2007): SJR 1.708 SNIP 2.101
- Scopus rating (2006): SJR 1.645 SNIP 2.278
- Scopus rating (2005): SJR 1.27 SNIP 1.577
- Scopus rating (2004): SJR 0.535 SNIP 1.675
- Scopus rating (2003): SJR 1.184 SNIP 1.421
- Scopus rating (2002): SJR 1.506 SNIP 1.593
- Scopus rating (2001): SJR 1.303 SNIP 1.291
- Scopus rating (2000): SJR 1.018 SNIP 1.053
- Scopus rating (1999): SJR 0.677 SNIP 1.275
Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Materials Science(all)
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DOIs:
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Source: Scopus
Source-ID: 85011675458
Research output: Scientific - peer-review › Article

**Utilization Possibilities of Electrical Energy Storages in Households’ Energy Management in Finland**

Electrical energy storage is one option for making the environmental impact of households’ energy usage smaller. A storage could improve the profitability of household level electricity production and could also decrease the load in the electricity networks. So far, poor profitability has been the greatest barrier to the use of storages. The battery systems prices have been high and the benefits difficult to predict. The benefit of the use of storage and the factors affecting to the benefits are studied in this paper. For this purpose, a simulator has been designed for modelling the energy storage as part of the household’s electricity grid. The control of the storage significantly affects to the amount of benefits. The developed control method of the simulator aims to maximize the benefits. The simulations took into account the variables that are not accurately known when the storage is controlled. For these variables, such as e.g. future consumption, various forecasts were formed.

**General information**

State: Published
Simulation Environment for Centralized Protection and Control applying dSPACE and RTDS with IEC 61850 9-2 Communication

The role of centralized protection and control system as a novel approach is important in terms of the protection of power networks. In centralized protection and control system, centralized computer receives the phase measurements from IEDs through the IEC 61850 9-2 sampled values. Based on these measurements, centralized computer instructs IEDs to perform necessary actions, according to the algorithms, to provide protection against faults. The aim of this paper is to describe the present centralized protection and control simulation environment at Tampere University of Technology. The present simulation environment has the ability to replay the pcap file and generate network traffic like real world traffic. In the present simulation environment, high resistance single phase to earth fault algorithm is implemented and successfully verified. In this simulation environment, dSPACE is used as centralized computer and real time digital simulator (RTDS) is used to simulate the network and IEDs in real time. The hardware of RTDS sends the measured data to the dSPACE IEC 61850 9-2 sampled values format. The simulation environment will enable researchers to test the protection algorithms in the real time e.g. their time performances.

31% European InGaP/GaAs/InGaNAs Solar Cells For Space Application

We report a triple junction InGaP/GaAs/InGaNAs solar cell with efficiency of ~31% at AM0, 25 °C fabricated using a combined molecular beam epitaxy (MBE) and metal-organic chemical vapour deposition (MOCVD) processes. The prototype cells comprise of InGaNAs (Indium Gallium Nitride Arsenide) bottom junction grown on a GaAs (Gallium
Arsenide) substrate by MBE and middle and top junctions deposited by MOCVD. Repeatable cell characteristics and uniform efficiency pattern over 4-inch wafers were obtained. Combining the advantages offered by MBE and MOCVD opens a new perspective for fabrication of high-efficiency space tandem solar cells with three or more junctions. Results of radiation resistance of the sub-cells are also presented and critically evaluated to achieve high efficiency in EOL conditions.
Development of Modern Phase Earthing System for Improving Quality of Supply in MV Network

This paper introduces the methods development of the modern phase earthing system. The target is reducing the harmful short interruptions experienced by the customers and electricity producers with temporary phase-to-earth faults of an MV system. Especially in neutral isolated MV networks the earth fault arc does not usually become extinct without an automatic reclosing function. It can be extinguished using shunt circuit-breaker to earth the faulty phase temporarily at the feeding primary substation. The functioning of the shunt-circuit breaker does not cause any voltage break to customers or DG units connected to the MV or LV system. An essential requirement enabling the applying of the phase earthing is that the residual current at the fault location must be determined reliably in order to evaluate fulfilling of the touch voltage regulations. The inexact information on the magnitude of the residual current has restricted the utilization of phase earthing. The main attention was paid to the modeling of the phase earthing system for developing the method for determining the residual phase-to-earth current. The developed novel algorithm was tested applying PSCAD simulation environment. The results show that the residual fault current can be calculated with the actual fault case (e.g. IED or Centralized Protection System, CPS). The prototype of shunt circuit-breaker has also been installed and tested with artificial earth faults.

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Ministry of Education publication type: A2 Review article in a scientific journal
Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES)
Authors: Nikander, A.
Number of pages: 8
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Peer-reviewed: Yes
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General information
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Ministry of Education publication type: D4 Published development or research report or study
Authors: Harsia, P., Penttinen, S., Järventaula, P., Sorri, J., Aalto, P., Kallioharju, K., Kaivo-oja, J., Kojo, M., Korpela, T., Ruostetsaari, I., Oksa, A. M.
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Energiatehokkuusinformaatio palvelurakennuksissa

General information
One of the key issues in the design and development of a satellite Photovoltaic Assembly (PVA) is the trade-off to be made between the available volume located to the PVA, its mass and the total amount of power that the solar panels have to guarantee to the spacecraft. The development of high-efficiency, flexible, lightweight solar cells is therefore instrumental to the design of future satellites providing enhanced missions and services. Based on the consolidated development of GaAs-based single junction and lattice matched triple-junction solar cells, several research efforts are being pursued worldwide to further increase the efficiency and reduce mass. Promising approaches include thin-film technologies such as Inverted Metamorphic and Epitaxial Lift-Off (ELO), and the use of nanostructures or highly mismatched alloys grown by MBE. We propose here an alternative path towards the development of lightweight GaAs-based solar cells with the potential to exceed the Shockley-Queisser (SQ) limit of single junction cells. Our approach is based on the synergistic combination of thin-film design, quantum dots (QDs) absorption, and photonic nanostructures. Challenges and opportunities offered by the use of QDs are discussed. A cost-effective and scalable fabrication process including ELO technology and nanoimprint lithography is outlined. Finally, a proof-of-concept design, based on rigorous electromagnetic and physics-based simulations, is presented. Efficiency higher than 30% and weight reduction close to 90% - owing to the substrate removal - makes the proposed device to rank record power-to-weight ratio, with the potential to become a cost-effective, attractive option for next generation space solar cells.
Performace of Dilute Nitride Triple Junction Space Solar Cell Grown by MBE
Dilute nitride arsenide antimonide compounds offer widely tailorable band-gaps, ranging from 0.8 eV to 1.4 eV, for the development of lattice-matched multijunction solar cells with three or more junctions. Here we report on the performance of GaInP/GaAs/GaInNAsSb solar cell grown by molecular beam epitaxy. An efficiency of 27% under AM0 conditions is demonstrated. In addition, the cell was measured at different temperatures. The short circuit current density exhibited a temperature coefficient of 0.006 mA/cm²/°C while the corresponding slope for the open circuit voltage was −6.8 mV/°C. Further efficiency improvement, up to 32%, is projected by better current balancing and structural optimization.

The role of (FeCrSi)2(MoNb)-type Laves phase on the formation of Mn-rich protective oxide scale on ferritic stainless steel
Microalloying of stainless steel with reactive elements increases oxidation resistance but makes the alloy prone to microstructural changes. XPS results reveal changes in the initial oxidation mechanism on Ti–Nb stabilized ferritic stainless steel (EN 1.4521) after 120 h heat treatment at 650 °C. Age-precipitation of (FeCrSi)2(MoNb)-type Laves phase resulted in less pronounced surface segregation and oxidation of microalloying elements. Si oxidizes preferentially at the Laves precipitate locations via outward diffusion forming diffusion barrier for the other scale forming elements. Most significantly the diffusion of Mn and the formation of low volatile (Mn,Cr)3O4 spinel oxide at the surface was strongly suppressed.
Enhancement of Photocurrent in GaInNAs Solar Cells using Ag/Cu Double-Layer Back Reflector

General information
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Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Research group: Nanophotonics
Authors: Ahonen, T., Aho, A., Tukiainen, A., Polojarvi, V., Salminen, T., Raappana, M., Guina, M.
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Scopus rating (2014): SJR 1.799 SNIP 1.462 CiteScore 3.25
Scopus rating (2013): SJR 2.149 SNIP 1.652 CiteScore 3.77
Scopus rating (2012): SJR 2.554 SNIP 1.754 CiteScore 3.76
Thermal Modification of ALD Grown Titanium Oxide Ultra Thin Film for Photoanode Applications

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Hannula, M. K., Lahtonen, K. T., Isotalo, T. J., Saari, J. S., Valden, M. O.
Publication date: 15 Dec 2016
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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: Scientific › Paper, poster or abstract

Ambient-Pressure XPS of Electrochemical Interfaces for Solar Fuel Production

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Ali-Löytty, H. J.
Publication date: 1 Dec 2016
Peer-reviewed: Unknown
Research output: Scientific › Paper, poster or abstract

Modeling and experimental verification of magneto-mechanical energy harvesting device based on construction steel

The concept of energy harvesting through ambient vibrations has seen significant rise in academic interest as it allows wireless or portable systems to be autonomous and self-sufficient in terms of energy requirement. Ambient sources of vibration involve vibrations from bridges, skyscrapers, rail tracks, machines, motors, shafts and body of cars or ships etc. Thus, the harvested energy depends on the nature and amplitude of vibration available.

The concept in discussion focuses on magneto-strictive energy harvesting technique due to its higher energy density as compared to piezoelectric. The project aims at the development of a stress dependent reluctance network model to determine the effect of mechanical stress on magnetization curves and for simulating the energy conversion process, as well as measurement of the power density obtainable from the test material. Construction steel has been utilized for energy harvesting application because of its practical applications in bridges, buildings and rail tracks etc.
Thermo-catalytic decomposition of methane: The effect of reaction parameters on process design and the utilization possibilities of the produced carbon

The study presents a path for selecting the reaction and reactor parameters of a process applying thermo-catalytic decomposition of methane (TDM). Temperature and catalyst are the main reaction parameters affecting the type of TDM carbon and defining the reaction's theoretical heat requirement. Secondly, the reaction parameters affect the reactor design including the selection of reactor type and heating source as well as the reactor dimensioning. The reactor dimensioning is discussed by highlighting the methane residence time requirement at different reaction conditions. Finally, the economic value of the TDM products is analyzed. According to the analyses, the reaction temperature and catalyst have a significant effect on reactor design and on the value and utilization possibilities of the TDM carbon. The prices of carbon products vary greatly as does the global demand of those. The utilization possibilities of carbon highly affect the overall viability of the TDM process and therefore should be carefully considered during process design.

General information
State: Published
Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology
Authors: Keipi, T., Tolvanen, K. E., Tolvanen, H., Konttinen, J.
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Keywords: Carbon capture, Process design, Natural gas, Methane decomposition, Hydrogen production
DOIs:
10.1016/j.enconman.2016.08.060
A comparative study between surge arrester monitoring through capacitive/resistive measurement bridge and digital decomposition

In order to improve the reliability of the energy system, a variety of techniques to access the condition monitoring of important equipment connected to the network have been developed in the past decades. However, it is important to choose the adequate method when evaluating the behavior of these devices. In this way, the current work aims to compare three techniques used to evaluate the condition of metal oxide surge arrester based on the decomposition of leakage current into its capacitive and resistive components. Each method was described in detail and their results compared.

Fabrication of topographically microstructured titanium silicide interface for advanced photonic applications

We present a widely scalable, high temperature post-growth annealing method for converting ultra-thin films of TiO2 grown by atomic layer deposition to topographically microstructured titanium silicide (TiSi). The photoemission electron microscopy results reveal that the transformation from TiO2 to TiSi at 950 °C proceeds via island formation. Inside the islands, TiO2 reduction and Si diffusion play important roles in the formation of the highly topographically microstructured TiSi interface with laterally nonuniform barrier height contact. This is advantageous for efficient charge transfer in Si-based heterostructures for photovoltaic and photoelectrochemical applications.
Optically Enhanced GaInNAs Solar Cell

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Authors: Aho, T. A., Aho, A., Tukiainen, A., Polojärvi, V., Raappana, M., Guina, M.
Publication date: 20 Jun 2016
Peer-reviewed: Unknown
Research output: Scientific - peer-review » Article

Improving Recovery Boiler Availability through Understanding Fume Behavior

Unexpected recovery boiler shutdowns are rare, but they can cost millions of dollars in lost income. Sometimes the inorganic compounds in black liquor can cause sudden fouling or plugging problems that could not be predicted beforehand. The ash particles can be divided into two main types and size classes: carryover and fume. This paper focuses on the smaller fume particles that form through the condensation of alkali metal vapors, and that deposit via different mechanisms than carryover. The location of fume deposition depends on several factors, such as flue gas and superheater temperatures, black liquor composition, and the flow field in the boiler.

This paper presents results obtained with a computational method that simulates fume formation in recovery boilers. The results in this paper focus on the effect of black liquor composition and elemental release on fume behavior, and the paper suggests how these observations should be taken into account when designing new boilers or retrofits. Moreover, the paper introduces the possible applications of the modeling method. These include, for example, troubleshooting of fouling problems in existing boilers, designing superheater configurations for new boilers, and positioning soot blowers.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Valmet Technologies Oy
Authors: Leppänen, A., Välimäki, E.
Pages: 187-193
Publication date: Mar 2016
Peer-reviewed: Yes
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 Fe$^{3+}$ and metallic Ni to 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 (∼1-10 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.
Color Bricks: Building Highly Organized and Strongly Absorbing Multicomponent Arrays of Terpyridyl Perylenes on Metal Oxide Surfaces

Terpyridine-substituted perylenes containing cyclic anhydrides in the peri position were synthesized. The anhydride group served as an anchor for assembly of the terpyridyl-crowned chromophores as monomolecular layers on metal oxide surfaces. Further coordination with Zn2+ ions allowed for layer-by-layer formation of supramolecular assemblies of perylene imides on the solid substrates. With properly selected anchor and linker molecules it was possible to build high quality structures of greater than ten successive layers by a simple and straightforward procedure. The prepared films were stable and had a broad spectral coverage and high absorbance. To demonstrate their potential use, the synthesized dyes were employed in solid-state dye-sensitized solar cells, and electron injection from the perylene antennas to titanium dioxide was observed.
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 cumbic 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
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Ministry of Education 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),
A study on raw, torrefied, and steam-exploded wood: Fine grinding, drop-tube reactor combustion tests in N₂/O₂ and CO₂/O₂ atmospheres, particle geometry analysis, and numerical kinetics modeling

The purpose of this study was to compare the fine grinding properties and combustion behavior of three wood pellet products: raw, torrefied, and steam-exploded wood. The energy required to fine grind the pellets was tested, and so was the geometry and size distribution of the resulting ground products. Out of all the samples the steam-exploded wood pellet required the most energy for grinding. However, it also produced more sphere-like particles compared to the other two types of samples. The combustion behavior of the samples was tested in a laminar drop-tube reactor (DTR). The samples were preground and the particles were sieved with vibration sieves with an opening of 112–125 μm. The pyrolysis process was examined separately at a temperature range of 973–1173 K. The combined pyrolysis and combustion tests were carried out at a reactor temperature of 1123 K. The O₂ concentrations used in the measurements were 3–21 vol-% in either N₂ or CO₂ atmospheres. The initial size distribution of the sample particles as well as their diameter evolution during pyrolysis and combustion was studied by using optical techniques. The surface temperature of the combusting particles was measured with a two-color pyrometer from within the DTR. The density, specific surface area, and pore diameter were measured from the ground samples with a mercury porosimeter. The chemical kinetic parameters, which describe the pyrolysis and char oxidation rates of the samples, were determined by using the data from the measurements.
Characterization of fine fraction mined from two Finnish landfills

A fine fraction (FF) was mined from two Finnish municipal solid waste (MSW) landfills in Kuopio (1- to 10-year-old, referred as new landfill) and Lohja (24- to 40-year-old, referred as old landfill) in order to characterize FF. In Kuopio the FF (<20mm) was on average 45±7% of the content of landfill and in Lohja 58±11%. Sieving showed that 86.5±5.7% of the FF was smaller than 11.2mm and the fraction resembled soil. The total solids (TS) content was 46-82%, being lower in the bottom layers compared to the middle layers. The organic matter content (measured as volatile solids, VS) and the biochemical methane potential (BMP) of FF were lower in the old landfill (VS/TS 12.8±7.1% and BMP 5.8±3.4m³ CH₄/t TS) than in the new landfill (VS/TS 21.3±4.3% and BMP 14.4±9.9m³ CH₄/t TS), and both were lower compared with fresh MSW. In the Kuopio landfill materials were also mechanically sieved in the full scale plant in two size fraction <30mm (VS/TS 31.1% and 32.9m³ CH₄/t TS) and 30-70mm (VS/TS 50.8% and BMP 78.5m³ CH₄/t TS). The nitrogen (3.5±2.0g/kg TS), phosphorus (<1.0-1.5g/kg TS) and soluble chemical oxygen demand (COD) (2.77±1.77kg/t TS) contents were low in all samples. Since FF is major fraction of the content of landfill, the characterization of FF is important to find possible methods for using or disposing FF mined from landfills.

General information

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Authors: Mönkäre, T. J., Palmroth, M. R. T., Rintala, J. A.
Number of pages: 6
Pages: 34-39
Publication date: 2016
Peer-reviewed: Yes
Detection of Subsynchronous Torsional Oscillation Frequencies Using Phasor Measurement

This paper presents a non-invasive and easy to implement technique using phasor measurement units for accurate estimation of subsynchronous torsional frequencies. This information is relevant for the optimal design of HVDC subsynchronous damping controllers that enhance the effect of HVDC on subsynchronous damping. The method is rigorously justified using mathematical proofs as well as thorough EMT simulations. The method was implemented in the Finnish transmission network and proved to be effective.

General information
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Organisations: Department of Electrical Engineering, Research area: Power engineering
Authors: Rauhala, T., Gole, A., Järventausta, P.
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Publication date: 2016
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Volume: 31
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Scopus rating (2015): SJR 1.967 SNIP 2.66 CiteScore 3.96
Scopus rating (2014): SJR 1.726 SNIP 2.693 CiteScore 3.4
Scopus rating (2013): SJR 1.64 SNIP 2.845 CiteScore 3.51
Scopus rating (2012): SJR 1.386 SNIP 2.688 CiteScore 3.28
Scopus rating (2011): SJR 1.117 SNIP 2.257 CiteScore 2.89
Scopus rating (2010): SJR 1.172 SNIP 2.068
Dilute Nitride Four-Junction Solar Cell

General information
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Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Optoelectronics Research Centre, Tampere University of Technology
Publication date: 2016
Peer-reviewed: Unknown
Event: Paper presented at Optics and Photonics days, Tampere, Finland.
Research output: Scientific › Paper, poster or abstract

Dilute Nitride Multijunction Cells: Recent progress and Future Outlook

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Publication date: 2016
Peer-reviewed: Unknown
Event: Paper presented at Optics and Photonics days, Tampere, Finland.
Research output: Scientific › Paper, poster or abstract

Dilute nitride solar cells fabricated by combined MBE-MOCVD epitaxy

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Publication date: 2016
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Event: Paper presented at 12th International Conference on Concentrator Photovoltaics (CPV-12), Freiburg, Germany.
Electronic versions:
CPV-12_Guina_MBE-MOCVD_update
Research output: Scientific › Paper, poster or abstract

Electrical isolation of dilute nitride solar cells by wet etching
Electrical isolation of high-efficiency dilute nitride multijunction solar cells

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Publication date: 2016
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Research output: Scientific → Paper, poster or abstract

HCl-based wet etching of III-V dilute nitride materials for multijunction solar cells

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Authors: Raappana, M., Poloijärvi, V., Aho, T., Aho, A., Tukiainen, A., Hytönen, L., Isoaho, R., Guina, M.
Publication date: 2016

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.

High efficiency dilute nitride solar cells: Simulations meet experiments

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High-efficiency III-V solar cells: From drawing board to real devices

The record solar cell conversion efficiency of 46% at concentrated sunlight has been demonstrated by direct bonding technique [1]. Regardless of the high efficiencies obtained using the direct wafer bonding technique, the conventional monolithic approach used in commercial solar cell production has several benefits, including production technology and cost-related factors. And yet, there is a high un-used potential, particularly in new materials that can be grown lattice-matched onto GaAs or Ge substrates. For example, by utilizing dilute nitride materials in multijunction solar cell structures with more than three junctions and by carefully optimizing structural elements and manufacturing technology, efficiencies exceeding 50% is a realistic target [2]. Here we review our theoretical and experimental work carried out on development of various parts of high-efficiency multijunction solar cells based on GaInNAsSb-based materials, i.e., dilute nitrides. First of all, we have developed a molecular beam epitaxy process for GaInNAsSb sub-junction with very high external quantum efficiency exceeding 90%. This building block is essential for achieving high conversion efficiency for GaInP/GaAs/GaInNAsSb triple-junction solar cells. Secondly, the use of a variety of electro-optical simulation tools such as Crosslight APSYS, Silvaco TCAD, PC1D, Essential MacLeod and semi-empirical analytical models combined with experimental work on numerous test samples have helped in fabricating ultra-low specific resistivity tunnel junctions and high-quality sub-junctions based on conventional III-V materials such as GaInP and GaAs to be integrated with the dilute nitride sub-junction. Thirdly, we have also extracted important material specific physical parameters such as carrier lifetimes, mobilities and concentrations for dilute nitrides by matching the simulations to experimental solar cell device characteristics [3]. The extracted parameters are used for refining the simulation models which provide deeper understanding of the device physics. The work done so far has led to a rapid increase in conversion efficiency of our GaInP/GaAs/GaInNAsSb triple-junction solar cells – at a pace of ~5 %points/year since 2012. High-efficiency solar cells with efficiencies of 29% and 31% at one sun (AM0 and AM1.5G, respectively) and 36–39% under concentrated sunlight (at ~70 suns) have already been demonstrated [4,5]. Additionally, the effects of various optical and structural design elements related to fabrication of real III-V multijunction solar cells will be critically reviewed. Especially, we will concentrate on the pros and cons of backside reflector structure architectures – including various planar reflector types and Lambertian scatterers – and nanostructured antireflection coatings [6] which are currently widely em-played for solar cell photon management. The consequences of adding such elements to the fabrication process and impact on improving the conversion efficiency towards >50% efficiency are as-sessed.
Increasing the quantum efficiency of GaInNAs solar cells by advanced optical design

Optimizing iron alloy catalyst materials for photoelectrochemical water splitting: Passivation of FeCr alloy surface by water vapour using near-ambient-pressure photoelectron spectroscopy
Revisiting cellulase production and redefining current strategies based on major challenges Article reference: RSER5103

Lignocellulosic biomass has been considered as an important and sustainable source of renewable energy. Cellulose constitutes the major component of the lignocellulosic biomass and also offers maximum recalcitrance towards its fullest utilization. The enzymatic breakdown of cellulose is achieved through cellulases. Diverse forms of microbes including fungi, bacteria, actinomycetes and yeast are known to produce cellulases that have found extensive application in various industries. Due to the current global political unrest over oil prices and the threat of global warming following combustion of fossil fuels, the paradigm of research is now focused on biofuel production from plant biomass. Conventional approaches have not been economically feasible for meeting the demands of the industry. This review provides an update regarding the status of present microbial cellulase production technologies and research with special reference to solid state fermentation and different molecular techniques such as mutagenesis, metabolic engineering and heterologous gene expression of cellulases from different microbial domains with improved catalytic and stability properties. Metagenomic and genomic studies for mining of novel cellulase genes in addition to screening of culturable strains using conventional methods have been advanced. In addition the bottlenecks associated with cellulase production and how the future research needs to be directed to provide a comprehensive technology for the production of cellulases with novel traits for application at an industrial level without economic constraints are discussed.
Techno-economic analysis of four concepts for thermal decomposition of methane: Reduction of CO₂ emissions in natural gas combustion

This paper presents a techno-economic analysis of four concepts that apply the thermal decomposition of methane (TDM) with the aim of reducing carbon dioxide emissions in natural gas combustion. Different technical solutions are applied to convert methane in natural gas to gaseous hydrogen, which is combusted to produce electricity with a steam power cycle, and solid carbon, which is assumed to be sold as carbon black. The cost of electricity production and the potential to reduce CO₂ emissions in each concept were evaluated and compared to the reference case of direct methane combustion. With a moderate emission allowance price (20 €/tCO₂) and product carbon price (500 €/tcarbon) the cost of electricity production in each concept was 12–58% higher than in the reference case. However, the price of product carbon had a significant effect on the feasibility of the concepts. Thus, the methane burner, which showed the best performance, produced 17% less CO₂ emissions per MWhₑ and had a smaller cost of electricity production than the reference case already with the carbon price of 600–700 €/tcarbon.

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Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, ÅF-Consult Oy
Authors: Keipi, T., Hankalin, V., Nummelin, J., Raiko, R.
Use of diluted urine for cultivation of Chlorella vulgaris

Our aim was to study the biomass growth of microalga Chlorella vulgaris using diluted human urine as a sole nutrient source. Batch cultivations (21 days) were conducted in five different urine dilutions (1:25-1:300), in 1:100-diluted urine as
such and with added trace elements, and as a reference, in artificial growth medium. The highest biomass density was obtained in 1:100-diluted urine with and without additional trace elements (0.73 and 0.60 g L⁻¹, respectively). Similar biomass growth trends and densities were obtained with 1:25- and 1:300-diluted urine (0.52 vs. 0.48 gVSS L⁻¹) indicating that urine at dilution 1:25 can be used to cultivate microalgal based biomass. Interestingly, even 1:300-diluted urine contained sufficiently nutrients and trace elements to support biomass growth. Biomass production was similar despite pH-variation from <5 to 9 in different incubations indicating robustness of the biomass growth. Ammonium formation did not inhibit overall biomass growth. At the beginning of cultivation, the majority of the biomass consisted of living algal cells, while towards the end, their share decreased and the estimated share of bacteria and cell debris increased.
Mesophilic anaerobic digestion of pulp and paper industry biosludge-long-term reactor performance and effects of thermal pretreatment

The pulp and paper industry wastewater treatment processes produce large volumes of biosludge. Limited anaerobic degradation of lignocellulose has hindered the utilization of biosludge, but the processing of biosludge using anaerobic digestion has recently regained interest. In this study, biosludge was used as a sole substrate in long-term (400 d) mesophilic laboratory reactor trials. Nine biosludge batches collected evenly over a period of one year from a pulp and paper industry wastewater treatment plant had different solid and nutrient (nitrogen, phosphorus, trace elements) characteristics. Nutrient characteristics may vary by a factor of 2-11, while biomethane potentials (BMPs) ranged from 89 to 102 NL CH$_4$ kg$^{-1}$ VS between batches. The BMPs were enhanced by 39-88% with thermal pretreatments at 105-134 °C. Despite varying biosludge properties, stable operation was achieved in reactor trials with a hydraulic retention time (HRT) of 14 d. Hydrolysis was the process limiting step, ceasing gas production when the HRT was shortened to 10 days. However, digestion with an HRT of 10 days was feasible after thermal pretreatment of the biosludge (20 min at 121 °C) due to enhanced hydrolysis. The methane yield was 78 NL CH$_4$ kg$^{-1}$ VS for untreated biosludge and was increased by 77% (138 NL CH$_4$ kg$^{-1}$ VS) after pretreatment.

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Scopus rating (2012): SJR 2.966 SNIP 2.456 CiteScore 5.15
Scopus rating (2011): SJR 2.867 SNIP 2.374 CiteScore 5.43
Scopus rating (2010): SJR 2.582 SNIP 2.196
Scopus rating (2009): SJR 2.319 SNIP 2.225
Scopus rating (2008): SJR 2.065 SNIP 2.19
Scopus rating (2007): SJR 1.994 SNIP 2.208
Scopus rating (2006): SJR 1.895 SNIP 2.214
Scopus rating (2005): SJR 2.114 SNIP 2.337
Scopus rating (2004): SJR 2.227 SNIP 2.106
Scopus rating (2003): SJR 1.696 SNIP 1.917
Scopus rating (2002): SJR 1.54 SNIP 1.775
Scopus rating (2001): SJR 1.321 SNIP 1.711
Scopus rating (2000): SJR 1.305 SNIP 1.688
Scopus rating (1999): SJR 1.456 SNIP 1.576
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DOIs:
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 Wh kg\(^{-1}\) 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.
Factors Affecting Efficiency of LVDC Distribution Network – Power Electronics Perspective

The power distribution network will be changed towards the future Smart Grid due to increased number of installed renewable power generation units to fulfill the tightened environmental regulation. The control of the future Smart Grid will be challenging due to increased number of renewable power generation units, which are variable in nature, and at the same time, the customers are highly dependent on uninterruptable, high quality power supply. The Smart Grid control is intensively studied. It can be concluded that the control might be simpler and the grid operation more reliable if the AC grid would be replaced by DC grid. However, the detailed energy efficiency analysis of the DC grid is not thoroughly studied. The efficiency and total lifetime costs are the key parameters when the network owners consider the future grid structure.

This thesis addresses the factors, which affect the energy efficiency of the low voltage DC (LVDC) distribution network from power electronics perspective. The power loss models for the converters and their AC filters are developed and verified by measurements. The impact on the converter topology, used power semiconductor switches, AC filter design and inductor core material, DC network configuration, customer behavior, the need of DC voltage balancing in the bipolar DC network as well as the grounding issues to fulfill the electrical safety standards are treated. For facilitating the design of cost effective LVDC distribution networks, the total power losses of the network with different configurations are evaluated and compared.

It is revealed that the used filter inductor core material has a significant impact on the power losses of the LVDC distribution network. The inductor core material having low high-frequency power loss characteristics, such as amorphous alloy, is recommended. The LVDC distribution network should be grounded to minimize the power losses whenever it is possible according to the local safety standardization and grounding conditions. The three-level NPC converters connected to 1500 VDC should be used to minimize the power losses. The grid-frequency isolation transformer is the main power loss source if the galvanic isolation is needed to isolate the ungrounded LVDC distribution network and the grounded customer electrical installations. In this case, the highest energy efficiency is achieved by using two- or three-level converters connected to 750 VDC if the DC cable length is less than 600 m. Otherwise, slightly higher energy efficiency is achieved by using three-level converters connected to 1500 VDC. Therefore, voltage transformation ratio of the isolation transformer must be 800V/400V instead of 400V/400V. Moreover, the efficiency of the power converters is increased by using SiC MOSFETs instead of conventional IGBTs as power semiconductor switches.
Dilute Nitride Multijunction Solar Cells Grown by Molecular Beam Epitaxy

Solar cells generate green energy directly from sunlight. The energy conversion efficiency of solar cells depends strongly on materials used as absorbers and the cell architecture. Currently, the best solar cells convert sunlight energy to electricity with an efficiency of up to 46%. This thesis focuses on the development of dilute-nitride materials and related solar cells, which are one of the most promising approaches for achieving even higher efficiencies. Applications for these cells include concentrated photovoltaic and space power systems. In particular, the thesis focuses on developing solar cell materials based on GaInNAsSb, which can provide efficient light absorption and energy conversion for a photon energy range of 0.8 eV-1 eV, typically challenging for conventional III-V semiconductors. The GaInNAsSb semiconductor materials were synthesized by molecular beam epitaxy.

The experimental work of this thesis explored the dependence of the fabrication parameters on the GaInNAsSb material and solar cell properties. It was observed that for many of the growth parameters even a slight change of the value can have a significant effect on the solar cell performance. A N incorporation model was developed to help the iteration process for growth parameter tuning. For optimized growth conditions, nearly ideal current generation for GaInNAsSb based material was achieved. Based on external quantum efficiency measurements it was possible to collect up to ~90% of the photons in the spectral range of the GaInNAsSb junction. In addition, an excellent fill factor of 0.7 and voltages in the range of 0.5 V for a 1 eV GaInNAsSb junction were measured.

Simulation based on a state-of-the-art GaInP/GaAs double junction cell, a commercial GaInP/GaAs/Ge triple junction cell and GaInNAsSb single junction cells studied in this thesis, revealed that a GaInP/GaAs/GaInNAsSb/Ge cell at the one sun concentration can have 1.7 percentage points higher efficiency than GaInP/GaAs/GaInNAsSb cell. In addition, the estimated efficiency of a four junction cell at 300 suns would be 3.6 percentage points higher than for a GaInP/GaAs/GaInNAsSb cell. The optimized single junction GaInNAsSb cell was experimentally tested into a GaInP/GaAs/GaInNAsSb cell in this work. The one sun efficiency of the cell under AM1.5G spectral conditions was 31% and the efficiency of the cell at 70 suns concentration was 37-39%. The one sun result is 91% of the projected efficiency. The results under concentrated conditions are expected to be improved by optimizing of the cell top grid design, layer structure and interfaces. As future concepts are concerned, a nanopatterned moth eye antireflection coating was fabricated on top of the GaInP/GaAs/GaInNAs cell, which was then compared to a cell that had a traditional two layer TiO2/SiO2 coating. The moth eye nanostructure had a low average reflection of 2% in the spectral range of 400-1700 nm, being less than half of the reflectance of the TiO2/SiO2 coating. For future work, the absorption loss for the nanostructure coating at wavelengths below 500 nm needs to be reduced.

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Research output: Collection of articles › Doctoral Thesis
Aspects of Electric Vehicles and Demand Response in Electricity Grids
The growing global energy demand combined with limited resources of fossil energy (especially crude oil), climate change and other environmental issues, the energy system has faced significant challenges. There is significant pressure to diversify the energy sources towards more sustainable choices and to increase energy efficiency. Shifting gradually from the use of fossil fuels to use of renewable energy sources is a long way to go, and to make it economically feasible requires a significant amount of will, effort and innovation.

This thesis deals with two parts of the energy system: the electrical energy system and the energy system of road transportation. A “smart” electrical energy system of the future includes the flexibility of electricity demand, i.e. demand response (DR), enabled by different types of incentives and offering many potential advantages. A road transportation system of the future can include significant amount of electric vehicles (full electric vehicles – full EVs and plug-in hybrid electric vehicles – PHEVs) as part of the vehicle fleet. These vehicles could also participate in the operation of an electrical power system. This thesis discusses electric vehicles and demand response in smart grid context.

The most important results and findings of the thesis are the following. In Finland, PHEVs could offer a significant proportion or even most of the benefits of EVs even with a quite modest charging infrastructure, and simultaneously the most severe obstacles of full EVs could be avoided or at least mitigated. In this thesis, a flexible methodology for modeling PHEV charging load using National Travel Survey data has been developed. Statistical PHEV charging load models, taking into account modeled statistical distributions of the loads, have been used by two different real DNOs in their network information systems to assess the impacts of EVs on distribution network planning in urban networks. It seems that high amounts of EVs fit well into Finnish distribution networks, but in certain cases demand response of electric vehicles would be reasonable. Electric vehicles, some DR actions and other changes in electricity use can increase peak powers in distribution networks. New distribution tariffs have been developed and simulated in a real distribution network with the purpose of encouraging small electricity customers towards peak load restriction. It seems that these kinds of tariffs would be efficient in restricting the increase of peak powers of spot price based DR, although it seems to be hard to decrease the present peak powers very much in the distribution networks. Different general DR and smart charging concepts have been sketched, and a practical local customer-site peak load control management algorithm of an EV charging station group has been developed as a tool to realize demand response of a group of electric vehicles.

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A Versatile Solution for Continuous On-line PD Monitoring
General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Electrical Engineering, Research area: Power engineering
Performance analysis of Q-f droop anti-islanding protection in the presence of mixed types of DG

This paper analyses the performance of a Q-f droop based anti-islanding protection (AIP) scheme when the islanded circuit contains both inverter based DG and directly connected synchronous generator (SG) based DG. It is found that the performance of the AIP method is significantly degraded when SG is present in the island. This is because frequency cannot be directly manipulated by injecting reactive power when SG is present. However, feeding reactive power still indirectly affects frequency and the Q-f droop based AIP scheme thus still facilitates islanding detection. The simulation results aim to bring awareness to which extent the presence of SG degrades the performance of the Q-f droop based AIP.

Smart Frequency Control in Power Transmission Systems Using a BESS

General information
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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Electrical Engineering, Research area: Power engineering
Authors: Servotte, J., Acha, E., Castro, L. M.
Publication date: Nov 2015
Methodology for Dynamic Stability and Robustness Analysis of Commercial-Power-Module-Based DC-Distributed Systems

The purpose of this thesis is to present dynamic small-signal stability and performance analysis methodology for dc-distributed systems consisting of commercial power modules. Furthermore, the objective is to introduce simple method to state the least conservative margins for robust stability as a single number. In addition, an index characterizing the overall system stability is obtained, based on which different dc-distributed systems can be compared in terms of robustness.

The interconnected systems are prone to impedance-based interactions which might lead to transient-performance degradation or even instability. These systems typically are constructed using commercial converters with unknown internal structure. Therefore, the analysis presented throughout this thesis is based on frequency responses measurable from the input and output terminals. The stability margins are stated utilizing a concept of maximum peak criteria, derived from the behavior of impedance-based sensitivity function that provides a single number to state robust stability. Using this concept, the stability information at every system interface is combined to a meaningful number to state the average robustness of the system. In addition, theoretical formulas are extracted to assess source and load side interactions in order to describe detailed couplings within the system. The presented theoretical analysis methodologies are experimentally validated throughout the thesis.

In this thesis, according to the presented analysis, the least conservative stability margins are provided as a single number guaranteeing robustness. It is also shown that within the interconnected system the robust stability is ensured only if the impedance-based minor-loop gain is determined at the very input or output of each subsystem. Moreover, a complete set of impedance-type internal parameters as well as the formulas according to which the interaction sensitivity can be fully explained and analyzed, is provided. The given formulation can be utilized equally either based on measured frequency responses, time-domain identified internal parameters or extracted analytic transfer functions.

Based on the analysis methodologies presented in this thesis, the stability and performance of interconnected systems consisting of converters with unknown internal structure, can be predicted. Moreover, the provided concept to assess the least conservative stability margins enables to obtain an index to state the overall robust stability of distributed power architecture and thus to compare different systems in terms of stability.

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Research output: Monograph › Doctoral Thesis

Partial discharge activity in distribution MOSAs due to internal moisture
In order to evaluate if metal oxide surge arrester present any partial discharge (PD) in case of internal moisture and how applicable it is as a condition monitoring diagnostic method, 8 distribution class (Ucov = 20 kV) metal oxide surge arresters (6 silicone housed and 2 Ethylen-Vinylacetate (EVA) housed) from four different manufacturers (A, B, C and D)
were submitted to an immersion test for 19 days. The partial discharge and leakage current levels were measured daily. Parameters like largest repeatedly occurring PD magnitude, discharge current and PD repetition rate were recorded for later comparison with power loss calculated from the leakage current. In some of the arresters internal moisture was noticed, however, partial discharge measurement was not as sensitive as power loss. For those samples identified with internal moisture, the partial discharge activity showed a special behavior keeping a limited amplitude itself but presenting a high repetition rate.

**General information**

State: Published

Ministry of Education publication type: A4 Article in a conference publication

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

Authors: Da Silva, D. A., De Jesus, R. C., Pissolato, J., Lahti, K.

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Research output: Scientific - peer-review › Conference contribution

**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**

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Authors: Schnabel, J., Valkealahti, S.

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Research output: Scientific - peer-review › Conference contribution

**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.

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Research output: Scientific - peer-review › Conference contribution

**Risk Assessment of Major Storm Situation in Distribution System**
Risk and reliability have a significant connection in meaning; both of them are the facts for one inference. High level of risk is resource of lower reliability. Risk management in power system has a variety of different subjects including models, methods and applications. Risk is a mixture of probability of disturbance event and the negative effect of that occurrence. Usually it counted for random accident which has harmful effect on people’s life and environment. In this paper risks study of storm situation modelled. Random failures in power system are the origin of risk and cannot control by staff. Monte-Carlo Simulation (MCS) has used to model the fault frequencies and outage time of customers. The two tools which use in financial studies to make investment decision and applicable in power systems are Value-at-Risk (VaR) and Conditional Value-at-Risk (CVaR) Result of study compared to the actual reliability which confirm the improvement in the reliability of system. It is not possible to predict the precise amount of load value, Concerns of power outage in local area and possibility of a general blackout.

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Authors: Dehghani, N., Supponen, A., Repo, S.
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Research output: Scientific - peer-review › Conference contribution

**Effects of thinning and heating for TiO2/AlInP junctions**
TiO2/AlInP junctions are used to construct the antireflection coatings for solar cells and to passivate III-V nanostructure surfaces. The thickness of AlInP epilayer affects light absorption and appropriate Al composition determining further the energy barrier for carriers. We report on reducing the AlInP thickness by dry etching down to 10 nm without introducing harmful defect states at TiO<sub>2</sub>/AlInP interface and AlInP/GalnP interface below, according to photoluminescence. Synchrotron-radiation photoelectron spectroscopy reveals that increased oxidation of phosphorus is not harmful to TiO<sub>2</sub>/AlInP and that post heating of the material enhances AlInP oxidation and group III element segregation resulting in decreased material homogeneity.

**General information**
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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Frontier Photonics, Department of Physics and Astronomy, University of Turku, University of Turku
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.
Lipid production by eukaryotic microorganisms isolated from palm oil mill effluent

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

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Authors: Sitbon, M., Schacham, S., Suntio, T., Kuperman, A.
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Pages: 369-375
Publication date: 1 Jul 2015
Peer-reviewed: Yes
Real-Time Low Voltage Network Monitoring - ICT Architecture and Field Test Experience

Traditionally, distribution network monitoring has been focused on primary substations (i.e., high voltage/medium voltage level), whereas low voltage (LV) network has not been monitored at all. With rapid growth and penetration of distributed energy resources in LV grids, there is growing interest in extending the real-time monitoring to LV level. The framework program FP7 European Project INTEGRIS proposes an integrated real-time LV network monitoring solution and implements it in a cost-efficient way. This solution integrates smart metering data with secondary substation measurements to get a more accurate and real-time view about LV grid, uses "decentralized" distribution management architecture to optimize data flow, and uses International Electrotechnical Commission 61850 Standard-based interfaces to improve interoperability. This paper focuses on information and communications technology perspective, explains the implementation details of this monitoring solution, and presents its functionality/performance testing results from two distribution system operator field trials and from real-time digital simulator laboratory.

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Change Detection of Electric Customer Behavior Based on AMR measurements

Smart Grids technology is emphasized a lot in the future power system worldwide. Nowadays, the widely used Automatic Meter Reading (AMR) technology in Finland makes it possible to collect customers' hourly load measurements and to use data analysis methods for customer clustering and load prediction purposes. This paper addresses the detection of possible changes in customers' behavior. This could for example be a result of changed habitation, heating solution change, installation of solar panels or other equipment. Basic classification and regression methods like K-means and Fuzzy C-means are utilized to analyze the electric customer behavior. The developed method successfully detects various obvious load pattern changes on different customer types. It also offers rough time information regarding at which week the change happens. This behavior change detection method can be applied in improving load modeling accuracy by considering the most recent consumption information after the change.

Monetary impact of dynamic pricing and demand response on households: The winners and losers

Smart grid paradigm is hailed as the Holy Grail to manage the future electricity consumption in a sustainable manner, and demand response (DR) is a fundamental component in the realization of smart grids. However, DR requires active household participation and in the previous studies monetary benefit is identified as the main motivation for the households to participate. In this paper, we analyze DR on households in terms of the monetary impact. Smart meter data together with data about properties of households are used from 669 households. Dynamic pricing schema and DR model are proposed and utilized in simulations. Self-Organizing Maps (SOM) are applied to identify the household segments that are monetarily affected in the simulations.
A communication based protection system for solving DG related protection challenges

This paper presents a communication based protection automation system which is designed for solving DG related protection problems. The system is able to tackle problems related protection blinding, nuisance tripping of feeders and generators and problems related to unintentional islanding. Moreover, the system can be configured to allow low voltage ride-through without compromising loss of mains protection. However, the system also has the potential of enhancing the reliability of electricity distribution service to DG units by automatically switching an alternative feeding path if the original feeding route is faulted.

Demonstration of the Inter-Organizational Situation Awareness System to Major Disturbances

There have been several problems in information exchange between organizations in the disturbances of the electricity supply. For instance, in Finland one municipality had problems to reach their local DSO (Distribution System Operator) during a disturbance in 2011. They had only the phone number of the DSO’s customer service, which was congested. Usually in disturbances, municipalities and authorities receive information from DSOs’ web pages, like transformer level maps or lists that show the outages and their duration, and by phone conversations. In general, it can be said that the inter-organizational situation awareness in disturbance situations is needed. After the storms in Finland in December 2011 the Finnish Electricity Market act was changed so that DSOs should participate in the formation of situation awareness and supply any information relevant to this purpose to the responsible authorities.

The paper presents a demonstration of the interorganizational situation awareness system developed in this research. The demonstration consists of an internet service which combines information about disturbances in the electricity supply from DSOs’ information systems and information from other actors. The demonstration illustrates how the exchange of information between actors can be executed by using a situation awareness system. It extends the integration of DMS (Distribution Management System) in an unusual direction by taking the other actors into account.
Implementation Possibilities of Power-based Distribution Tariff by Using Smart Metering Technology

This paper discusses on the implementation possibilities of distribution tariffs that include a separate demand (i.e. power) component for small customers by taking use of the present, and still developing, smart metering technology. Power-based distribution tariffs offer the customers effective price signals and better possibilities to affect to the size of their distribution fees through their own actions. The use of demand based components in the tariff structures also reflects the actual cost structure of the Distribution System Operator (DSO) and could make the pricing of the DSOs more just and transparent. In the paper, the possibility of limiting the yearly peak hourly power demand of the customer with the software fuse functionality of the smart meters is in a key role when different ways of implementing power based distribution tariff are studied. The paper also provides information about results of a questionnaire made to smart metering technology vendors about the present state and technological possibilities of the smart meters e.g. in the case of load control possibilities.

Modelling of simultaneous fault to reliability enhancement in distribution system

The main purpose of an electric power system is to provide electricity from the generation source to the customer point. Security and adequacy are the two most important requirements in power system reliability. As most of the faults that happen in a distribution network are experienced by the customers, improving the security of the distribution side can have a beneficial effect on the entire network. Faults can occur singly, but multiple faults can occur at the same time in many different places in the network. It is these simultaneous faults that can drastically affect the security of a network, and directly decrease its reliability. This paper studied the modelling of simultaneous faults by using the Monte-Carlo (MC) algorithm in a distribution network. This makes it possible to evaluate the effect of the repair time in different situations, and also to model various solutions to enhance the reliability of the network. A real overhead line feeder in a distribution network from a rural electricity distribution company was chosen for modelling the MC algorithm and to study the reliability procedures based on it. The calculations in our simulation model are based on number of the faults and the availability of maintenance and repair crews in the case of simultaneous faults. The algorithm can also be used for calculating the reliability indices in radial and mesh configurations with radially operated feeders.
Novel Sensor Solutions for On-Line PD Monitoring

The electric utility industry is going through significant changes caused by new regulation models, distributed generation, increased competition and requirements for continuous improvement in the quality of power supplied to the customers. To minimize outages and supply interruptions, utilities must be able to monitor and locate faults more quickly and to develop condition monitoring in a more preventive direction. On-line continuous partial discharge (PD) measurement is an excellent way to determine the overall health of the medium voltage (MV) cables. Essential parts of a PD monitoring system are the sensors for measuring the high frequency PD signal. The continuous on-line PD monitoring of MV cables is a problem, primarily because no adequate cost-effective sensor solution is available for permanent installation. The goal of this paper is to develop a low-cost, sensitive and robust sensor solution for continuous on-line PD monitoring of MV underground cable networks.

Practical Implementation of Demand Response in Finland

In this paper, we have studied the potential, incentives, and obstacles of the practical implementation of the demand response (DR) in Finland. We have discovered that there are remarkable amounts of the controllable loads, which can be controlled via smart meters. Furthermore, market places for DR already exists, and it is possible to gain economic benefits from DR. However, the roles and responsibilities of the stakeholders are unclear, and heterogeneity in systems and solutions hinder the actualization of the load controls. Furthermore, there may appear conflicting interests, as the sharing of the costs and benefits seem to be unequal in some cases, and contradicting needs for load controls between stakeholders may occur. As solutions to overcome the discovered obstacles, we suggest that more standardization to interfaces between stakeholders' ICT systems is needed, stakeholders' roles and responsibilities in the demand response process need to be clarified, and modifications in regulations are needed, to ease the problems concerning missing incentives and the conflict of interests.
Reserve Power – Alternative Solution to the Network Investments in Rural Area Networks?
The new legislative requirements and all the time tightening economic regulation cause a great pressure for Finnish distribution system operators to improve the security of power supply. Underground cabling has been seen in many cases basically the only but at the same time very expensive solution to solve this problem. This paper presents that with the help of reserve power solutions it is possible to fulfill the requirements especially in sparsely populated rural areas. The results show the profitability of utilizing reserve power generators instead of investing in the cabled network. In addition, the calculations support the fact that customers should at least consider purchasing own reserve power.
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\textsuperscript{®}. 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.
Demand Side Management in Open Electricity Markets from Retailer Viewpoint

In this paper, we have evaluated the incentives and obstacles of the demand side management (DSM) from the viewpoint of the electricity retailers. Research results are based on the questionnaires, workshops, and simulations. Based on our studies, it seems that there exist remarkable amount of controllable loads, and also market places for flexible resources have already been established in Finland. Furthermore, it seems that the economic profitability of the DSM is significantly higher, if resources are utilized in reserve or balancing power markets, instead of the day-ahead spot-markets. However, heterogeneity in stakeholders' solutions and systems hinder the possibility to control customers' loads based on the demands of the market places. Moreover, the roles of the stakeholders are unclear, and conflicts of interests seem to exist between the stakeholders.

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Product level accelerated reliability testing of motor drives with input power interruptions
Motor drives utilizing power semiconductors play an important role in modern day electric motor control. Although the reliability of power semiconductors is widely studied, the product level reliability of motor drives has been studied markedly less even though their more complex control and measuring electronics often make them more vulnerable to environmental stresses. In order to advance product level accelerated reliability testing, customized test methods with multiple simultaneous or sequential stresses can be used. However, the knowledge of combined effects of different
stresses is still largely unknown. In this research the reliability of a commercial motor drive was studied. Environmental
conditions used included an 85 °C constant temperature test and an 85 °C test with 85% relative humidity. Additionally,
input power interruptions were included to study the effect of sudden shortages of electricity. The results of the study
showed that the mean time to failure for the devices tested with the input power interruptions was notably shorter than that
for the test series without them. An especially clear effect of the input power interruptions was seen on the power
MOSFETs of the motor drives. Moreover, the humidity was found to play an important role in the reliability of the motor
drives.

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Scopus rating (2010): SJR 1.796 SNIP 2.89
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Research output: Scientific - peer-review › Article

Role of public regulators in demand response business ecosystem - Case New York State electric power market
This paper draws on business ecosystem research and concepts to study the structure and interdependencies of demand
response business network in New York State power market, with a particular focus in investigating the role of public
regulators in the business ecosystem. The analysis suggests that while demand response aggregators operatively lead
the ecosystem, the regulators hold a central role in both the birth and sustainability of the ecosystem through their
authority in setting market rules and performance requirements as well as in their control of the demand response program
funding mechanisms. Moreover, an analysis of the distribution of economic value generated by the ecosystem indicates
that only a minimal portion of the value surplus accumulates to the ecosystem's operative customers (NYISO and utilities),
which suggests that they may have only limited incentives to support the growth and sustainability of the business
Comprehensive dynamic analysis of photovoltaic generator interfacing DC-DC boost power stage

In transformer-less grid-connected renewable energy systems, interfacing of photovoltaic (PV) generators is typically implemented by means of DC-DC boost-power-stage converter, mainly because of its voltage-boosting capability. In order to track the maximum power point of a PV generator, input voltage of the converter is usually feedback controlled, forcing the converter to operate as a current-sourced rather than voltage-sourced converter. Nevertheless, PV generator interfacing power stage is commonly assumed to possess the same dynamic properties as corresponding voltage-sourced power stage. Investigations presented in this study reveal explicitly that the dynamics of PV generator interfacing DC-DC boost power stage resembles conventional buck power stage behaviour with duty-cycle independent resonance and additional right-half-plane zeros. In addition, the duty cycle has to be decreased for increasing the corresponding output variables (i.e. input voltage and output current). Extended experimental results are given to support the theoretical findings.
Matlab/Simulink modeling to study the effect of partially shaded condition on photovoltaic array's maximum power point

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A Finite Element Simulation Tool for Predicting Hysteresis Losses in Superconductors Using an H-Oriented Formulation with Cohomology Basis Functions

Currently, modelling hysteresis losses in superconductors is most often based on the H-formulation of the eddy current model (ECM) solved using the finite element method (FEM). In the H-formulation, the problem is expressed using the magnetic field intensity H and discretized using edge elements in the whole domain. Even though this approach is well established, it uses unnecessary degrees of freedom (DOFs) and introduces modelling error such as currents flowing in air regions due to finite air resistivity. In this paper, we present a modelling tool utilizing another H-oriented formulation of the ECM, making use of cohomology of the air regions. We constrain the net currents through the conductors by fixing the DOFs related to the so-called cohomology basis functions. As air regions will be truly non-conducting, DOFs and running times of these nonlinear simulations are reduced significantly as compared to the classical H-formulation. This fact is demonstrated through numerical simulations.

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Evolving Smart Meter Data Driven Model for Short-Term Forecasting of Electric loads

Short-term forecasting of electric loads is an essential function required by Smart Grids. Today increasing amount of smart metering data is available enabling the development of more accurate and adaptive data-driven models for short-term load forecasting. Until now, a plethora of models have been developed ranging from simple statistical regression models to more advanced models such as artificial neural networks (ANNs) and support vector machines (SVMs). Despite the relatively high accuracy obtained, data-driven models are still perceived to be highly complex and nontransparent, thus not allowing engineers and system operators to interpret and understand properly their behavior. Therefore it is important to develop optimization schemes, which can be used to facilitate the selection of appropriate data-driven model structure, and thus improve the acceptance of data-driven models in the domain. This study presents an optimization scheme based on multi-objective genetic algorithm (GA) for designing simple but accurate data-driven models for short-term forecasting of electric loads using smart metering data. The optimization scheme is demonstrated for an ANN model, and the performance of the resulting ANN model is assessed in terms of several performance indices.
Corrosion mechanisms of sintered Nd-Fe-B magnets in the presence of water as vapour, pressurised vapour and liquid

Corrosion behaviour of three commercial sintered Nd-Fe-B magnets exposed to environments containing water as vapour, pressurised vapour, and liquid was investigated in order to understand their overall corrosion performance under a range of conditions. Two types of heat humidity exposure tests, namely the 85/85 and pressure cooker test, and the immersion test combined with electrochemical measurements were used as corrosion tests. It was observed that varying the temperature, pressure, and the prevailing state of water in the exposure tests, different corrosion mechanisms were detected on the surface of Nd-Fe-B magnets. The surface finish of the magnet had an effect on the initiation of corrosion in mild heat-humidity exposure. Immersion in liquid water resulted in a corrosion topography where the Nd-rich grain-boundary phase did not corrode selectively as in the other accelerated corrosion tests but was retained intact while the matrix phase underwent corrosion. These results and the dominant corrosion mechanisms of sintered Nd-Fe-B magnets in different environments are presented and discussed in this paper.

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Scopus rating (2012): SJR 1.249 SNIP 1.584 CiteScore 2.43
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Scopus rating (2010): SJR 1.07 SNIP 1.221
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Dynamics of photovoltaic-generator-interfacing voltage-controlled buck power stage

This paper investigates the dynamic properties of the photovoltaic-generator-interfacing voltage-controlled buck power stage operating in both the maximum and limited power point tracking modes. The photovoltaic generator (PVG) is known to possess both current- and voltage-source properties with respect to its maximum power point. While voltage-fed operation is conventional, current-fed action is nontrivial and is thoroughly analyzed in this paper. The photovoltaic-generator-interfacing converter is formed by adding a capacitor at conventional voltage-fed converter input terminals, turning it into a current-fed power stage. During the maximum power point tracking phase, converter input voltage is regulated, possessing nontrivial dynamics. The situation is burdened further when output-voltage control should be alternatively realized to limit the voltage of the converter terminating the energy storage element. It is shown that both the photovoltaic generator and the terminating energy storage greatly affect the combined system dynamics. Parallel as well as cascaded control arrangements are proposed to support dual-mode system operation. Extended experimental results are shown to enforce presented theory and reveal nontrivial dynamics-related issues.

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 MgCl₂.6H₂O and KCl with negative effect on hydrogen production and selected NH₄Cl, K₂HPO₄ and KH₂PO₄ 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 mol-H₂/mol-glycerol consumed at concentrations 4.40 g/L and 2.27 g/L for NH₄Cl and KH₂PO₄ respectively. Confirmation experiment with the optimized media (NH₄Cl, 4.40 g/L; K₂HPO₄, 1.6 g/L; KH₂PO₄, 2.27 g/L; MgCl₂, 6H₂O, 1.0 g/L; Na-acetate, 3H₂O, 1.0 g/L and tryptone, 2.0 g/L) revealed an excellent correlation between predicted and experimental hydrogen yield. Optimization of media components by design of experiments enhanced hydrogen yield by 29%.
Halogen bonding, a noncovalent interaction possessing several unique features compared to the more familiar hydrogen bonding, is emerging as a powerful tool in functional materials design. Herein, we unambiguously show that one of these characteristic features, namely high directionality, renders halogen bonding the interaction of choice when developing azobenzene-containing supramolecular polymers for light-induced surface patterning. The study is conducted by using an extensive library of azobenzene molecules that differ only in terms of the bond-donor unit. We introduce a new tetrafluorophenol-containing azobenzene photoswitch capable of forming strong hydrogen bonds, and show that an iodoethynyl-containing azobenzene comes out on top of the supramolecular hierarchy to provide unprecedented photoinduced surface patterning efficiency. Specifically, the iodoethynyl motif seems highly promising in future development of polymeric optical and photoactive materials driven by halogen bonding.
Modeling Fume Particle Dynamics and Deposition with Alkali Metal Chemistry in Kraft Recovery Boilers

The kraft recovery boiler is the largest single unit in the pulp-making process, which makes its reliable operation important. However, the fuel of the recovery boiler, black liquor, contains large quantities of ash-forming elements that pose challenges to the efficient operation of the boiler. A fraction of these elements vaporizes in the recovery boiler and condenses to form submicron-sized particles, called fume. The fume particles may form fouling deposits on the heat transfer surfaces, cause plugging of the flue gas channels, and even expose the surfaces to corrosion. These problems often lead to unscheduled shutdowns of the boiler, which are expensive due to the large size of the modern pulp mills. Significant savings could be achieved if the behavior of the ash-forming elements could be better predicted. The objective of this thesis is to develop a CFD-based (computational fluid dynamics) model for the alkali metal chemistry, fume particles, and fume deposits in the kraft recovery boiler, and to use the model to simulate real recovery boilers. The model combines 3-dimensional CFD, fine particle dynamics, and equilibrium chemistry in a novel way, and solves the fume particle and deposit composition at different locations in the superheater area of the boiler. The model contains certain limitations, such as the steady-state approximation because a compromise has to be made between accuracy and computational cost, which is a significant factor when developing tools for industrial use. The model has been partially validated with measurements in an operating recovery boiler, and the modeling results are in good qualitative agreement with the measurements. Furthermore, the modeling results suggest that deposition through thermophoresis is the main mechanism of fume deposit formation in a recovery boiler, but also that the direct condensation of alkali chloride vapors to heat transfer surfaces can be significant if the black liquor chlorine content is high. According to the model sensitivity analysis, fume deposit growth seems to be a self-limiting process, since an increase in the deposit thickness lowers the rate of deposition by thermophoresis. Another important result is that chlorine enriches in the deposit layers closer to the tube surfaces, which is a result of the high temperature dependence of alkali chloride condensation. The CFD-based model developed here improves understanding of the fume formation mechanisms, shedding light on processes that would be difficult to investigate through experimental methods alone in the corrosive boiler environment. In particular, the model can simulate how certain operational changes, such as increasing boiler load or steam temperatures, affect the alkali metal and fume behavior. In the future, the model can be utilized in the industry to support the engineering of new recovery boilers, and minimize fouling, plugging, and corrosion problems.
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.
An accurate small-signal model of a three-phase VSI-based photovoltaic inverter with LCL-filter

Three-phase photovoltaic inverters are usually equipped with an LCL-type output filter to reduce cost and size of the converter compared to a simple L-type output filter. The LCL-filter has an inherent resonance which has to be damped by a passive or active method to avoid instability. This paper presents an accurate full-order small-signal model of the three-phase VSI-based photovoltaic inverter with LCL-type output filter. The model is developed in the dq-domain, where the steady-state operating point can be solved. The developed small-signal model has been verified by extracting frequency responses from a scaled-down prototype. The model is shown to give accurate predictions on the shape of inverter transfer functions such as control loop gains and output impedance. Thus, the model can be used for control design, impedance shaping and impedance-based stability analysis.

Appearance of a Drift Problem in Variable-step Perturbative MPPT Algorithms

Closure to Discussion on "Effect of Multilevel Inverter Supply on Core Losses in Magnetic Materials and Electrical Machines"
Designing Inter-Organizational SA System to Disturbances of Electricity Supply

There have been several problems in information exchange between actors in the disturbances of electricity supply. For example in storm 2011 in Finland, a municipality had problem to contact their local distribution system operator (DSO) because they had only the phone number of DSO’s customer service, which was congested.

At present, the situation awareness in disturbances of electricity supply is focused on every actor’s own perspective. In addition, present sources of SA are shattered.

In this research, the demonstration of inter-organizational situation awareness system to disturbances of electricity supply is developed. The design process has been iterative. The usability of the first version of the demonstration has been evaluated with Nielsen’s heuristic evaluation method. The needs of information exchange have been studied by user need interviews with one municipality and two fire and rescue service.

The theory of team SA is inadequate in case of disturbances of electricity supply. Different actors do not have common sub-goals. There is a need for extension of the team SA theory to cover cases where sub-goals are more likely linked to each other than common.

The designed demonstration improves information exchange between actors. In addition, it improves the resilience of society in disturbances by helping the authorities to focus their actions to sites that do not have electricity and or mobile network.

The main difference that the demonstration has to existing methods is that there is a criticality database where information about sites that are highly dependent on electricity is stored. In addition, the demonstration combines information from multiple different actors to same view.

In this research it was clarified that inter-organizational situation awareness system can change the thinking about how the restoration process of electricity distribution network in disturbances should be formed.

General information
State: Published
Dielectric Breakdown Strength of Thermally Sprayed Ceramic Coatings: Effects of Different Test Arrangements

Dielectric properties (e.g., DC resistivity and dielectric breakdown strength) of insulating thermally sprayed ceramic coatings differ depending on the form of electrical stress, ambient conditions, and aging of the coating, however, the test arrangements may also have a remarkable effect on the properties. In this paper, the breakdown strength of high velocity oxygen fuel-sprayed alumina coating was studied using six different test arrangements at room conditions in order to study the effects of different test and electrode arrangements on the breakdown behavior. In general, it was shown that test arrangements have a considerable influence on the results. Based on the results, the recommended testing method is to use embedded electrodes between the voltage electrode and the coating at least in DC tests to ensure a good contact with the surface. With and without embedded electrodes, the DBS was 31.7 and 41.8 V/µm, respectively. Under AC excitation, a rather good contact with the sample surface is, anyhow, in most cases acquired by a rather high partial discharge activity and no embedded electrodes are necessarily needed (DBS 29.2 V/µm). However, immersion of the sample in oil should strongly be avoided because the oil penetrates quickly into the coating affecting the DBS (81.2 V/µm).

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Scopus rating (2015): SJR 0.741 SNIP 0.949 CiteScore 1.61
Scopus rating (2014): SJR 0.848 SNIP 1.718 CiteScore 2.03
Scopus rating (2013): SJR 0.933 SNIP 1.394 CiteScore 1.78
Scopus rating (2012): SJR 0.962 SNIP 1.261 CiteScore 1.57
Scopus rating (2011): SJR 0.854 SNIP 1.382 CiteScore 2.06
Scopus rating (2010): SJR 0.872 SNIP 1.229
Scopus rating (2009): SJR 0.925 SNIP 0.69
Scopus rating (2008): SJR 0.793 SNIP 0.799
Scopus rating (2007): SJR 0.764 SNIP 0.958
Scopus rating (2006): SJR 0.928 SNIP 1.344
Scopus rating (2005): SJR 1.007 SNIP 1.23
Dynamic characteristics of three-phase Z-source-based photovoltaic inverter with asymmetric impedance network

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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES)
Authors: Jokipii, J., Suntio, T.
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Pages: 1976-1983
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10.1109/ICPE.2015.7168049
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Effect of active damping on the output impedance of PV inverter

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Authors: Aapro, A., Messo, T., Suntio, T.
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Harmonic and Imbalance Voltage Mitigation in Smart Grids: A DSTATCOM Based Solution

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Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES)
Authors: Roncer-Sanchez, P., Acha, E.
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III-N/Bu-V based high efficiency solar cells: recent developments and future prospects

General information
State: Published
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Authors: Guina, M.
Publication date: 2015
Peer-reviewed: Unknown

Improving Recovery Boiler Availability through Understanding Fume Behavior
Unexpected recovery boiler shutdowns are rare, but they can cost millions of dollars in lost income. Sometimes the inorganic compounds in black liquor can cause sudden fouling or plugging problems that could not be predicted beforehand. The ash particles can be divided into two main types and size classes: carryover and fume. This paper focuses on the smaller fume particles that form through the condensation of alkali metal vapors, and that deposit via different mechanisms than carryover. The location of fume deposition depends on several factors, such as flue gas and superheater temperatures, black liquor composition, and the flow field in the boiler.

This paper presents results obtained with a computational method that simulates fume formation in recovery boilers. The results in this paper focus on the effect of black liquor composition and elemental release on fume behavior, and the paper suggests how these observations should be taken into account when designing new boilers or retrofits. Moreover, the paper introduces the possible applications of the modeling method. These include, for example, troubleshooting of fouling problems in existing boilers, designing superheater configurations for new boilers, and positioning soot blowers.

Influence of Diffusion Barriers on Thermal Ageing Behaviour of Solar Absorber Coatings on Copper
The thermal stability of magnetron sputtered and electroplated solar absorber coatings were investigated at elevated temperatures of 200-500°C. Diffusion barriers of aluminium and nickel were studied towards thermal diffusion of copper substrate atoms.

The diffusion barriers studied were experimental magnetron sputtered Al layers and an industrial electroplated Ni layer between a Cu substrate and an absorber coating. The thicknesses of Al barriers were 0.1 µm and 0.5 µm, and a Ni barrier was 3 µm thick. As absorber coatings, magnetron sputtered chromium-based coatings and industrially electroplated black chromium coatings, were studied. The sputtered absorbers were a 3-layer stack of CrOx/Cr/CrOx with layer thicknesses of 0.05/0.03/0.06 µm, respectively. The electroplated black chromium coating had a thickness of 0.2 µm. Copper was used as a substrate for all of the absorbers studied.

The degradation of the absorber surfaces and influence of diffusion barriers were analysed by optical measurements (solar absorptance with a UV/Vis/NIR spectrophotometer and thermal emittance with a FTIR spectrophotometer), microstructural analyses were performed using a field-emission scanning electron microscope (FESEM). The absorbers
were aged by means of heat treatments in a circulating air furnace at 200, 300, 400 and 500°C for two hours. The experimental analyses were performed before and after the ageing studies.

The results showed that without a barrier coating copper substrate atoms can diffuse into the absorber coating and through the coating to the surface of the coating and form CuO islands on the surface. These phenomena degraded optical selectivity of the absorber surface. The diffusion can be prevented or retarded with a diffusion barrier layer between the Cu substrate and the absorber coating. The 3-µm-thick Ni barrier prevented Cu diffusion and retained optical selectivity up to 500°C for two hours and the 0.5-µm-thick Al layer up to 400°C.

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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 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.

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Scopus rating (2011): SJR 2.787 SNIP 3.901 CiteScore 7.39
Scopus rating (2010): SJR 2.374 SNIP 3.112
Scopus rating (2009): SJR 2.494 SNIP 3.6
Scopus rating (2008): SJR 2.447 SNIP 3.127
Scopus rating (2006): SJR 0.889 SNIP 1.758
Scopus rating (2005): SJR 0.956 SNIP 2.649
Scopus rating (2004): SJR 1.152 SNIP 2.268
Scopus rating (2003): SJR 0.813 SNIP 2.492
Scopus rating (2002): SJR 0.72 SNIP 2.152
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Konvergenssi ja divergenssi ongelmatyyppien luonnehtijoina: Esimerkkinä vesihuoltoinfrastruktuurin ikääntyminen

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Authors: Heino, O.
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Kysynnän jousto - Suomen soveltuvat käytännön ratkaisut ja vaikutukset verkkoyhtiöille (DR pooli): Loppuraportti


Ilmastonmuutoksen hillitseminen on taustalla myös uusissa rakentamiseen liittyvissä energiatehokkuusmääräyksissä, joiden tavoitteena on ohjata rakentamista yhä energiatehokkaampaan ja uuslutuvia energialähteitä hyödyntävään suuntaan. Energiathehokkuutta arvioidessa tulee joustoja tai esimerkkejä sen aikaisempaa tai ensimmäisiä huomioita myös hetkellisiin tehohuippujen ja käyttöprofiileihin. Kysynnän jousto tarve ja tavoitteet tulee nähdä myös tarpeellisena osana tulevissa lähes nollaenergia eli nZEB-rakentamisessa.
Kysynnän jousto sisältää laajan joukon erilaisia toimintoja, joiden merkitys, tarve ja ansaintalogiikka vaihtelevat toimijan näkökulmasta. Kysynnän joustolla voidaan ymmärtää välillinen esimerkiksi hinnottelurakenteilla toteutettava vaikuttaminen asiakkaan käyttäytymiseen, vaihtelevaan energian hintaan pohjautuvat suorat ohjaustoimenpiteet sekä siirto- ja jakeluverkon tarpeista tulevat ohjaukset, kuten, kuorman toiminnan kantaverkko-yhtiön reservinä tai yötariffin kytketyn kuorman porrastaminen. Seuraavassa on kuvattu lyhyesti kysynnän jouson mahdollisuuksia ja tarpeita eri toimijoiden näkökulmasta:

- Kantaverkko-yhtiöllä kysynnän jousto tarjoaa mahdollisuuksia tehotasapainon hallintaan ja taajuuden säätöön käyttö- ja häiriöreservien osalta sekä mahdollisesti myös joustavuutta tehopula-nilanteiden hallintaan.

- Sähkön vähittäismyyjä voi hyödyntää kysynnän joustoa sähkön hankinnan suunnittelussa, tasevastaavana oman taseensa hallinnassa muiden toimenpiteiden rinnalla, säätosähkömarkkinoille tarjouosissa sekä uusien tuotteiden ja oman liiketoiminnan kehittämisessä.

- Jakeluverkko-yhtiö voi hyödyntää kysynnän jouson mahdollisuuksia pitkän aikavälin verkon suunnittelussa verkon mitoitusvaiheen näkökulmasta sekä reaalialaikaisessa käyttötoiminnassa esim. poikkeusliitanteiden aikaisen huipputason hallinnassa.

- Sähkön loppukäyttäjän näkökulmasta kysynnän jousto mahdollistaa mm. sähkön käytön edullisen hinnan aikana, ostosähkön vähentämisen, oman pientuotannon täysimääräisen hyödyntämisen, huipputehojen pientämisen sekä mahdollisesti liittymäkoon rajoittaman.

- Laite- ja järjestelmatöimittajille sekä palvelun tarjoajille (esim. kuormia aggregoiva “jousto- operaattori”) kysynnän jousto tarjoaa uusia tuote- ja liiketoimintamahdollisuuksia.

Kysynnän jouston laajamittainen hyödyntäminen edellyttää eri toimijoiden välistä yhteistyötä. Etäluettavat energiamittarit (AMR, Automated Meter Reading), joiden osalta Suomi on edelläkävijä markkina- ja liiketoimintamerkivallassa, mahdollistavat todelliseen tunnikulutuksen pohjukunnan tasevaikeutukseen seänä oman taseselvityksen ja reaaliaikaisen käyttötoiminnan hallintaan sekä harjoittamaan tehoa ja sulautumista reaaliaikaisessa käyttötoiminnassa.

Kysynnän jousto potentiaalit kokoontuivat energian kulutuksen ja tyyppillisämpökäytöiden tarjoten ostokseen ja vuodenajalleen lähittymäksi. Vuodenajalla, vuorokauden ja vuorokauden sijaan riippuen potentiaalit vaihtelevat voimakkaasti. Suurimmat ohjaus potentialsit ovat lämmönsäädelyssä ja sähköverkon myyjänä ja pitkin saavutetun kannustelluuden kautta ohjattavissa olevien merkittävien tarjoten suurukset ja osuudet suuremmilla osuutuksilla sekä muilla omilla ohjauspotentiaaleilla. Tämä edellyttää kuitenkin suurempia infrastruktuurikohteita suurimpana osuutuksilla, kuten kasvihuoneita ja suuriin rakennuksiin.

Tehtyjen analyysien ja verkko-yhtiöille tehdyn kyselyn perusteella AMR-mittareiden ohjauspotentialin suurin osuus on tarjota mahdollisuuksia ja mankaltaa mahdollisuuksia kääntämään huomattavasti yhteen. Että ohjattava huomataan ja kannustetaan hyödyntämiseen, on tarjolla omat tekniikan merkitys ja tarve, jotta mahdollisuudet ja hyödyntämisalajärjestelyt voivat olla käytössä täydellisesti. Suurimmat mahdollisuudet ovat tarjolla omalla lähimmällä ja myös myöhemmällä kentällä, mutta myös oman liiketoiminnan kehittämisessä oman liiketoiminnan hallinnassa sekä myös muilla toimilla, joidenäkökulmasta mahdollisuudet ovat suurimmilla osuudilla.

Day-ahead ja intra-day markkinoiden merkittävimmän taloudellisen potentiaalin tarjoavat kamppailukohta, jossa käytätään erilaisten markkinamittauksien tuotantoa ja tarjotetaan mahdollisuus ohjattaa suuremmilla osuutuksilla. Kysynnän jousto on edellyttävissä tapauksissa hyödyntää mahdollisuuksia, joilla on mahdollisuus ohjattaa suuremmilla osuutuksilla.

Kysynnän jousto sisältää laajan joukon erilaisia toimintoja, joiden merkitys, tarve ja ansaintalogiikka vaihtelevat toimijan näkökulmasta. Kysynnän joustolla voidaan ymmärtää välillinen esimerkiksi hinnottelurakenteilla toteutettava vaikuttaminen asiakkailleen käyttäytymiseen, vaihtelevaan energian hintaan pohjautuvat suorat ohjaustoimenpiteet sekä siirto- ja jakeluverkon tarpeista tulevat ohjaukset, kuten, kuorman toiminnan kantaverkko-yhtiön reservinä tai yötariffin kytketyn kuorman porrastaminen. Seuraavassa on kuvattu lyhyesti kysynnän jouson mahdollisuuksia ja tarpeita eri toimijoiden näkökulmasta:

- Kantaverkko-yhtiöllä kysynnän jousto tarjoaa mahdollisuuksia tehotasapainon hallintaan ja taajuuden säätöön käyttö- ja häiriöreservien osalta sekä mahdollisesti myös joustavuutta tehopula-nilanteiden hallintaan.

- Sähkön vähittäismyyjä voi hyödyntää kysynnän joustoa sähkön hankinnan suunnittelussa, tasevastaavana oman taseensa hallinnassa muiden toimenpiteiden rinnalla, säätosähkömarkkinoille tarjouosissa sekä uusien tuotteiden ja oman liiketoiminnan kehittämisessä.

- Jakeluverkko-yhtiö voi hyödyntää kysynnän jouson mahdollisuuksia pitkän aikavälin verkon suunnittelussa verkon mitoitusvaiheen näkökulmasta sekä reaalialaikaisessa käyttötoiminnassa esim. poikkeusliitanteiden aikaisen huipputason hallinnassa.

- Sähkön loppukäyttäjän näkökulmasta kysynnän jousto mahdollistaa mm. sähkön käytön edullisen hinnan aikana, ostosähkön vähentämisen, oman pientuotannon täysimääräisen hyödyntämisen, huipputehojen pientämisen sekä mahdollisesti liittymäkoon rajoittaman.

- Laite- ja järjestelmatöimittajille sekä palvelun tarjoajille (esim. kuormia aggregoiva “jousto- operaattori”) kysynnän jousto tarjoaa uusia tuote- ja liiketoimintamahdollisuuksia.
infrastruktuuri on lähes valmiina. Mikäli kysyntäjoustotuotteen tarjoaa joku muu kuin asiakkaan sähkönmyyjä, tulee luoda menettely, jolla ratkaistaan tasevastuuseen liittyvät kysymykset.


Keskeistä kysynnän jouston laajamittaiselle hyödyntämisele on muodostaa kokonaisvaltainen näkemys kysynnän jouston toiminnallisuudesta ja eri toimijoiden mahdollisesti ristikäsiäistäkä rooleista, kaikkien toimijoiden liiketoimintaa tukevasta markkinamallista, tiedonsiirtorajapintojen yhteensovittamisesta sekä kysynnän joustoa edistävän lainsäädännön kehittämisestä. Erityisesti kysynnän joustoon ansaantalogiikka vaatii kehittämistä, asiakkaiden ymmärrystä tulee lisätä ja asiakkaille tulee tarjota kannusteita kysynnän joustoon osallistumiseen. Kuorman ohjauksen käyttöönotto edellyttää myös uusien ja uusittavien kiinteistöjen sähköverkon ja laitevalintojen suunnittelun tavoitellista ohjausta. Lainsäädäntöön liittyvien kysymysten lisäksi keskeisiä esteitä kysynnän joustoon toteutumisele yleisesti ovat hajanainen toimialakenttä (suuri määrä erilaisia toimijoita), standardoimattomat prosessit, tietojärjestelmiin rapina ja toimintavasteiden suuri hajonta, sekä asiakkaita kuormien ohjattavuustiedon puuttuminen.

Tutkimusprojektin lopputuloksena esitetään lukuisia joukoja toimenpiteitä, joilla voidaan edesauttaa laajamittaita kysynnän joustoon yleistymistä. Vastuu toimenpiteistä jakautuu laajasti toimialan yrityksille (mm. sähkön myyjät ja verkkoyhtiöt), toimialan järjestöjen edustajille sekä viranomaisille. Toimenpiteet liittyvät:

- kysynnän jouston tuotteistamiseen sähkön myyjän ja jakeluverkon kohdalle
- eri sidosryhmien informointiin ja koulutukseen
- toimintatapojen yhteistyöhön toimintaprosessien sekä teknisten järjestelmien osalta
- lainsäädännön, viranomaismääräysten ja ohjeiden kehittämiseen, joihin sisältyy erityisesti verkkoliiketoiminnan valvontamallin ja rakennusmääräysten kehittäminen.

Vaikka kysynnän joustoon laajamittainen käyttöönotto edellyttää vielä paljon erilaisia toimenpiteitä, niin olemassa oleva infrastruktuuri ja markkinapaikat sekä meneillään oleva kehitystyö luo uskoa kysynnän joustoon laajamittaisen toteutuksen käynnistymiseelle lähitulevaisuudessa.

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Links:
MBE GROWN GaInNAsSb MULTIJUNCTION SOLAR CELLS: PATH TOWARDS 50% EFFICIENCY

General information
State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications
Authors: 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)
Links:

Nano-graphite cold cathodes for electric solar wind sail

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering
Number of pages: 5
Pages: 132-136
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Peer-reviewed: Yes

Publication information
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ISSN (Print): 0008-6223
Ratings:
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Scopus rating (2015): SJR 2.042 SNIP 1.756 CiteScore 6.53
Scopus rating (2014): SJR 2.145 SNIP 2.014 CiteScore 6.62
Scopus rating (2013): SJR 2.292 SNIP 2.137 CiteScore 6.54
Scopus rating (2012): SJR 2.525 SNIP 2.135 CiteScore 5.95
Scopus rating (2011): SJR 2.174 SNIP 2.073 CiteScore 5.23
Scopus rating (2010): SJR 2.404 SNIP 2.055
Scopus rating (2009): SJR 2.132 SNIP 2.119
Scopus rating (2008): SJR 2.128 SNIP 1.96
Scopus rating (2007): SJR 1.845 SNIP 1.828
Scopus rating (2006): SJR 1.786 SNIP 1.862
Scopus rating (2005): SJR 1.426 SNIP 1.699
Scopus rating (2004): SJR 1.514 SNIP 1.906
Scopus rating (2003): SJR 1.595 SNIP 1.749
Scopus rating (2002): SJR 1.775 SNIP 1.813
Scopus rating (2001): SJR 1.304 SNIP 1.433
Scopus rating (2000): SJR 1.032 SNIP 1.342
Scopus rating (1999): SJR 1.099 SNIP 1.35
On the Provision of Frequency Regulation in Low Inertia AC Grids Using HVDC Systems

General information
State: E-pub ahead of print
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Electrical Engineering, Research area: Power engineering, Smart Energy Systems (SES), Universidad Nacional Autónoma de México
Authors: Castro Gonzalez, L. M., Acha Daza, E.
Number of pages: 12
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: IEEE Transactions on Smart Grids
ISSN (Print): 1949-3053
Ratings:
Scopus rating (2016): SJR 2.851 SNIP 2.58 CiteScore 7.73
Scopus rating (2015): SJR 3.785 SNIP 3.424 CiteScore 8.48
Scopus rating (2014): SJR 3.105 SNIP 3.799 CiteScore 7.77
Scopus rating (2013): SJR 3.175 SNIP 4.831 CiteScore 9.88
Scopus rating (2012): SJR 2.023 SNIP 6.821 CiteScore 13.33
Scopus rating (2011): SJR 0.902 SNIP 6.022 CiteScore 11.78
Original language: English
DOI: 10.1109/TSG.2015.2495243
Research output: Scientific - peer-review › Article

Optical properties and thermionic emission in solar cells with InAs quantum dots embedded within GaNAs and GaInNAs

The optical properties of p-i-n solar cells comprised of InAs quantum dots embedded within GaNAs and GaInNAs quantum wells are reported. Strain compensating and mediating GaNAs and GaInNAs layers shift the photoluminescence emission as well as absorption edge of the quantum dots to longer wavelengths. GaNAs and GaInNAs quantum wells contribute also to extending the absorption edge. In addition, the use of GaNAs and GaInNAs layers enhances the thermal escape of electrons from QDs by introducing steps for electrons to the GaAs conduction band.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Augmented Human Activities (AHA), Frontier Photonics, Faculty of Exact Sciences and Engineering, Hyperion University
Authors: Polojärvi, V., Pavelescu, E., Schramm, A., Tukiainen, A., Aho, A., Puustinen, J., Guina, M.
Number of pages: 4
Pages: 122-125
Publication date: 2015
Peer-reviewed: Yes
Early online date: 19 Jun 2015

Publication information
Journal: Scripta Materialia
Volume: 108
ISSN (Print): 1359-6462
Ratings:
Scopus rating (2016): SJR 1.901 SNIP 1.696 CiteScore 3.71
Principles of designing for situation awareness

High level of situation awareness is a key factor in many domains to ensure correct decision making and actions. Situation awareness has been studied extensively in the aviation and military domains but the research also applies to other domains e.g. power grid operations and managing disturbances of electricity supply. Based on the research design principles have been created in order to help system designers to create better user interfaces for systems used in operational activities. These principles have been applied when designing the situation awareness system concept for managing disturbances of electricity supply.

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Electrical Engineering, Research area: Power engineering
Authors: Haapanen, J.
Pages: 29-46
Publication date: 2015

Publication information
Place of publication: Tampere
Publisher: Maanpuolustuskorkeakoulu Sotatekniikan laitos

Publication series
Name: Situational awareness for critical infrastructure protection
Volume: 3
No.: 1
Research output: Professional › Working paper

Simulated and Experimental Performance of High Efficiency GaInNAsSb Solar Cells

General information
State: Published
Simulation of ash-forming compounds in the kraft recovery boiler

This paper presents a summary of the doctoral dissertation titled "Modeling Fume Particle Dynamics and Deposition with Alkali Metal Chemistry in Kraft Recovery Boilers". In the thesis, a computational model was developed and used to simulate the behavior of alkali metal compounds in kraft recovery boilers. The model combines, for the first time, the methods of CFD (Computational Fluid Dynamics), equilibrium chemistry, and fine particle dynamics to model the formation and deposition of fume particles. Fume particles are below 1 μm in diameter and form through the condensation of the alkali metal compounds. The model has been partially validated in an operating recovery boiler in terms of fume particle composition, but the modeling results also shed light on processes that cannot be investigated through experimental methods alone. For example, the modeling results indicate that thermophoresis is the main factor leading to fume deposit formation.
Smart Grids with Large-Scale Implementation of Automatic Meter Reading: Experiences from Finland

Finland is a forerunner in large-scale AMR (automated meter reading, known also as smart metering) roll-out worldwide, not only in coverage of installations, but also in functionality and utilization of AMR system in various business processes. In 2009, the Finnish Government passed a new act, which states that at least 80% of the customers of each distribution system operator (DSO) must have AMR implemented by 31 December 2013. In practice, almost all customers are provided by a new AMR meter. The law requires the AMR meter that features hourly energy measurement and registrations of quality of supply-and-demand response functionality. AMR system installation is not only energy remote reading, but it enables real-time two-way communication between customers and other actors and offers huge amount of data for developing new functions for smart grids. The use of AMR data in various functions increases cost effectiveness of AMR investments. AMR system with relating ICT (information and communications technology) systems and business processes forms a larger entity to create added value for customers, DSO, energy retailer, and service providers. AMR is an enabler of competition in electricity market for enhancing flexible change of energy retailer. Hourly measurements enable new kind of dynamic tariffs that support energy-efficient targets and operation of electricity market. Using hourly measurements, more accurate and even customer-specific load models can be created to support load estimation and forecasting. By integrating AMR system with SCADA (supervisory control and data acquisition) system and DMS (distribution management system), network management can be enlarged also to cover low voltage networks, for example, for automatic indication of burnt fuse. AMR system enables also new functions for customer service, for example, as web-based applications for the end customers. Household-level loads now in time-of-use control can also be dynamically controlled by electricity retailers via AMR systems.
Stabilization of fine fraction from landfill mining in anaerobic and aerobic laboratory leach bed reactors

Fine fraction (FF, <20mm) from mined landfill was stabilized in four laboratory-scale leach bed reactors (LBR) over 180 days. The aim was to study feasibility of biotechnological methods to treat FF and if further stabilization of FF is possible. Four different stabilization methods were compared and their effects upon quality of FF were evaluated. Also during the stabilization experiment, leachate quality as well as gas composition and quantity were analyzed. The methods studied included three anaerobic LBRs (one without water addition, one with water addition, and one with leachate recirculation) and one aerobic LBR (with water addition). During the experiment, the most methane was produced in anaerobic LBR without water addition (18.0 LCH$_4$/kgVS), while water addition and leachate recirculation depressed methane production slightly, to 16.1 and 16.4 LCH$_4$/kgVS, respectively. Organic matter was also removed via the leachate and was measured as chemical oxygen demand (COD). Calculated removal of organic matter in gas and leachate was highest in LBR with water addition (59gCOD/kgVS), compared with LBR without water addition or with leachate recirculation (51gCOD/kgVS). Concentrations of COD, ammonia nitrogen and anions in leachate decreased during the experiment, indicating washout mechanism caused by water additions. Aeration increased sulfate and nitrate concentrations in leachate due to oxidized sulfide and ammonium. Molecular weight distributions of leachates showed that all the size categories decreased, especially low molecular weight compounds, which were reduced the most. Aerobic stabilization resulted in the lowest final VS/TS (13.1%), lowest respiration activity (0.9-1.2 mgO$_2$/gTS), and lowest methane production after treatment (0.0-0.8 LCH$_4$/kgVS), with 29% of VS being removed from FF. Anaerobic stabilization methods also reduced organic matter by 9-20% compared with the initial amount. Stabilization reduced the quantity of soluble nitrogen in FF and did not alter concentration of soluble and insoluble phosphorus, and insoluble nitrogen. All four stabilization methods decreased organic matter and thus are possible stabilization methods for FF, but aerobic treatment was the most efficient in this study.
Temperature coefficients for GaInP/GaAs/GaInNAsSb solar cells

We report the temperature coefficients for MBE-grown GaInP/GaAs/GaInNAsSb multijunction solar cells and the corresponding single junction sub-cells. Temperature-dependent current-voltage measurements were carried out using a solar simulator equipped with a 1000W Xenon lamp and a three-band AM1.5D simulator. The triple-junction cell exhibited an efficiency of 31% at AM1.5G illumination and an efficiency of 37-39% at 70x real sun concentration. The external quantum efficiency was also measured at different temperatures. The temperature coefficients up to 80°C, for the open circuit voltage, the short circuit current density, and the conversion efficiency were determined to be -7.5mV/°C, 0.040mA/cm²/°C, and -0.09%/°C, respectively.
Rationally engineered synthetic coculture for improved biomass and product formation

In microbial ecosystems, bacteria are dependent on dynamic interspecific interactions related to carbon and energy flow. Substrates and end-metabolites are rapidly converted to other compounds, which protects the community from high concentrations of inhibitory molecules. In biotechnological applications, pure cultures are preferred because of the more straightforward metabolic engineering and bioprocess control. However, the accumulation of unwanted side products can limit the cell growth and process efficiency. In this study, a rationally engineered coculture with a carbon channeling system was constructed using two well-characterized model strains Escherichia coli K12 and Acinetobacter baylyi ADP1. The directed carbon flow resulted in efficient acetate removal, and the coculture showed symbiotic nature in terms of substrate utilization and growth. Recombinant protein production was used as a proof-of-principle example to demonstrate the coculture utility and the effects on product formation. As a result, the biomass and recombinant protein titers of E. coli were enhanced in both minimal and rich medium simple batch cocultures. Finally, harnessing both the strains to the production resulted in enhanced recombinant protein titers. The study demonstrates the potential of rationally engineered cocultures for synthetic biology applications.
Ash forming elements in plastics and rubbers.

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Univ Jyvaskyla, University of Jyvaskyla, Dept Chem Renewable Nat Resources & Chem Living E, University of Jyväskylä
Authors: Ranta-Korpi, M., Konttinen, J., Saarimaa, A., Rodriguez, M., Vainikka, P.
Number of pages: 131
Publication date: Sep 2014

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Original language: English

Publication series
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Publisher: VTT Technical Research Centre of Finland
No.: 186
ISSN (Print): 2242-1211
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Links:

Numerical modeling of fine particle and deposit formation in a recovery boiler
In kraft pulp mills, black liquor is concentrated and burned in recovery boilers to produce steam and power and to recover pulping chemicals. Black liquor contains a large amount of alkali compounds, which form ash with low melting temperatures upon combustion. This causes many problems in recovery boiler operation, including fouling of the heat transfer surfaces, plugging of the flue gas passages, reduction of the heat transfer rate, and corrosion of the superheater tubes. This paper presents a model for simulating fine fume particles formed as a result of condensation of alkali compound vapors in the recovery boiler. The modeling method combines CFD modeling, equilibrium chemistry, and fine particle dynamics in a way that enables simulation of a full scale three-dimensional boiler environment. The model has been partially validated with measurements performed in an operating recovery boiler. The modeling results, particularly for the fume particle composition, agree well with the actual measurements. (C) 2014 Elsevier Ltd. All rights reserved.

General information
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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Urban circular bioeconomy (UrCirBio), University of Toronto, Canada, VTT Technical Research Centre of Finland, Valmet Technologies Oy
Authors: Leppänen, A., Tran, H., Taipale, R., Välimäki, E., Oksanen, A.
Number of pages: 9
Pages: 45-53
Publication date: 1 Aug 2014
Peer-reviewed: Yes
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Journal: Fuel
In the thesis the usability and effectiveness of a practice-based innovation tool for university–industry co-operation, the advisory professorship model, is evaluated. The research material was collected by applying the tool with a materials technological emphasis in the regional co-operation network in 2008–2012. The inputs, functions and internal dynamics of the innovation environment, as well as the results and effects of innovation activities in the materials technology advisory professorship programme (MTAP) network, are analysed qualitatively using a conceptual framework for the evaluation of regional innovative capability and the Network-Based Innovative Capability (NBIC) matrix. In the network of the MTAP programme, new practice-based innovation processes, concentrated in practice-based problems and development targets in companies products, operational environment or markets were created. The role of the university was especially in producing of information in the front-end phases of innovation processes, related mostly to properties and processing knowledge of materials, the feasibility of development ideas and in searching of new R&D opportunities. The nature of university based research inputs was typically fast and short-termed. Some innovation processes ended up as new products or product improvements. New knowledge, information and knowledge networks were created. The advisory professorship model can be considered a useful practice-based innovation tool for regional university–industry cooperation with some limitations. In the thesis the materials technology related regional resources, infrastructure and needs from both private and public sectors are also studied and levels of regional availability, access and delivery options for materials technological research are analysed in the Lahti region. Based on this information, it is suggested how the knowledge, network and innovation system related to materials technology should be developed further by public policies and strategies in the region.
Bioprocessing of enhanced cellulase production from a mutant of Trichoderma asperellum RCK2011 and its application in hydrolysis of cellulose

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

Background: Caloramator celer is a strict anaerobic, alkalitolerant, thermophilic bacterium capable of converting glucose to hydrogen ($H_2$), carbon dioxide, acetate, ethanol and formate by a mixed acid fermentation. Depending on the growth conditions $C$. celer can produce $H_2$ at high yields. For a biotechnological exploitation of this bacterium for $H_2$ production it is crucial to understand the factors that regulate carbon and electron fluxes and therefore the final distribution of metabolites to channel the metabolic flux towards the desired product.

Results: Combining experimental results from batch fermentations with genome analysis, reconstruction of central carbon metabolism and metabolic flux analysis (MFA), this study shed light on glucose catabolism of the thermophilic alkalitolerant bacterium $C$. celer. Two innate factors pertaining to culture conditions have been identified to significantly affect the metabolic flux distribution: culture pH and partial pressures of $H_2$ ($P_{H_2}$). Overall, at alkaline to neutral pH the rate of biomass synthesis was maximized, whereas at acidic pH the lower growth rate and the less efficient biomass formation are accompanied with more efficient energy recovery from the substrate indicating high cell maintenance possibly to sustain intracellular pH homeostasis. Higher $H_2$ yields were associated with fermentation at acidic pH as a consequence of the lower synthesis of other reduced by-products such as formate and ethanol. In contrast, $P_{H_2}$ did not affect the growth of $C$. celer on glucose. At high $P_{H_2}$ the cellular redox state was balanced by rerouting the flow of carbon and electrons to ethanol and formate production allowing unaltered glycolytic flux and growth rate, but resulting in a decreased $H_2$ synthesis.

Conclusion: $C$. celer possesses a flexible fermentative metabolism that allows redistribution of fluxes at key metabolic nodes to simultaneously control redox state and efficiently harvest energy from substrate even under unfavorable conditions (i.e. low pH and high $P_{H_2}$). With the $H_2$ production in mind, acidic pH and low $P_{H_2}$ should be preferred for a high yield-oriented process, while a high productivity-oriented process can be achieved at alkaline pH and high $P_{H_2}$. © 2014 Ciranna et al.; licensee BioMed Central Ltd.

General information

State: Published
Ministry of Education 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), Lunds Universitet / Lunds Tekniska Högskola, Lund Univ, Lund University, Department of Applied Microbiology
Authors: Ciranna, A., Pawar, S. S., Santala, V., Karp, M., van Niel, E. W. J.
Publication date: 28 Mar 2014
Peer-reviewed: Yes

Publication information
Journal: Microbial Cell Factories
Volume: 13
Rewiring the wax ester production pathway of acinetobacter baylyi ADP1

Wax esters are industrially relevant high-value molecules. For sustainable production of wax esters, bacterial cell factories are suggested to replace the chemical processes exploiting expensive starting materials. However, it is well recognized that new sophisticated solutions employing synthetic biology toolbox are required to improve and tune the cellular production platform to meet the product requirements. For example, saturated wax esters with alkanol chain lengths C12 or C14 that are convenient for industrial uses are rare among bacteria. Acinetobacter baylyi ADP1, a natural producer of wax esters, is a convenient model organism for studying the potentiality and modifiability of wax esters in a natural host by means of synthetic biology. In order to establish a controllable production platform exploiting well-characterized biocomponents, and to modify the wax ester synthesis pathway of A. baylyi ADP1 in terms product quality, a fatty acid reductase complex LuxCDE with an inducible arabinose promoter was employed to replace the natural fatty acyl-CoA reductase acr1 in ADP1. The engineered strain was able to produce wax esters by the introduced synthetic pathway. Moreover, the fatty alkanol chain length profile of wax esters was found to shift toward shorter and more saturated carbon chains, C16:0 accounting for most of the alkanols. The study demonstrates the potentiality of recircuiting a biosynthesis pathway in a natural producer, enabling a regulated production of a customized bioproduct. Furthermore, the LuxCDE complex can be potentially used as a well-characterized biopart in a variety of synthetic biology applications involving the production of long-chain hydrocarbons. © 2014 American Chemical Society.
An experimental study and numerical modeling of combusting two coal chars in a drop-tube reactor: A comparison between N2/O2, CO2/O2, and N2/CO2/O2 atmospheres

General information
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Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Tolvanen, H., Raiko, R.
Number of pages: 12
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Publication date: 2014
Peer-reviewed: Yes

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Ratings:
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Scopus rating (2015): SJR 1.809 SNIP 2.125 CiteScore 4.46
Scopus rating (2014): SJR 1.667 SNIP 2.331 CiteScore 4.14
Scopus rating (2013): SJR 1.811 SNIP 2.595 CiteScore 4.31
Scopus rating (2012): SJR 1.852 SNIP 2.465 CiteScore 3.99
Scopus rating (2011): SJR 2.093 SNIP 2.427 CiteScore 4.1
Scopus rating (2010): SJR 1.984 SNIP 2.319
Scopus rating (2009): SJR 2.012 SNIP 2.277
Scopus rating (2008): SJR 1.635 SNIP 2.184
Scopus rating (2007): SJR 1.383 SNIP 1.86
Scopus rating (2006): SJR 1.278 SNIP 1.64
Scopus rating (2005): SJR 1.623 SNIP 1.73
Scopus rating (2004): SJR 1.273 SNIP 1.883
Scopus rating (2003): SJR 1.103 SNIP 1.481
Scopus rating (2002): SJR 1.13 SNIP 1.301
Scopus rating (2001): SJR 1.136 SNIP 1.264
Scopus rating (2000): SJR 1.047 SNIP 1.272
Scopus rating (1999): SJR 1.117 SNIP 1.157
Original language: English
DOI:s: 10.1016/j.fuel.2014.01.103

Bibliographical note
Contribution: organisation=keb,FACT1=1<br/>&lt;br/&gt;Portfolio EDEND: 2014-03-15&lt;br/&gt;Publisher name: Elsevier Ltd
Source: researchoutputwizard
Source-ID: 1638
Research output: Scientific - peer-review &gt; Article

Deep levels in 1 eV bandgap dilute nitride antimonide solar cells

General information
Dynamics of time-resolved photoluminescence in GaInNAs and GaNAsSb solar cells

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics
Authors: Gubanov, A., Polojärvi, V., Aho, A., Tukiainen, A., Tkachenko, N. V., Guina, M.
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Nanoscale Research Letters
Volume: 9
Article number: 80
ISSN (Print): 1931-7573
Ratings:
Scopus rating (2016): SJR 0.589 SNIP 0.746 CiteScore 2.15
Scopus rating (2015): SJR 0.538 SNIP 0.653 CiteScore 1.69
Scopus rating (2014): SJR 0.748 SNIP 1.019 CiteScore 2.15
Scopus rating (2013): SJR 0.79 SNIP 0.967 CiteScore 2.23
Scopus rating (2012): SJR 1.049 SNIP 1.073 CiteScore 2.58
Scopus rating (2011): SJR 1.04 SNIP 1.124 CiteScore 2.88
Scopus rating (2010): SJR 1.062 SNIP 1.007
Scopus rating (2009): SJR 1.063 SNIP 1.01
Scopus rating (2008): SJR 0.828 SNIP 0.632
Scopus rating (2007): SJR 1.458 SNIP 0.71
Original language: English
DOIs:

Bibliographical note
Contribution: organisation=orc,FACT1=0.7
Contribution: organisation=keb,FACT2=0.3
Portfolio EDEND: 2014-04-29
Publisher name: SpringerOpen
Source: researchoutputwizard
Source-ID: 371
Influence of powder composition and manufacturing method on electrical and chromium barrier properties of atmospheric plasma sprayed spinel coatings prepared from MnCo2O4 and Mn2CoO4 + Co powders on Crofer 22 APU interconnectors
Influence of surface hydroxylation on the oxidation of FeCr in O2 and air

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

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

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2014-12-15
Source: researchoutputwizard
Source-ID: 480
Research output: Scientific › Chapter

Influence of temperature and pretreatments on the anaerobic digestion of wastewater grown microalgae in a laboratory-scale accumulating-volume reactor

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Kinnunen, V., Craggs, R., Rintala, J.
Number of pages: 11
Pages: 247-257
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 57
Ratings:
Scopus rating (2016): CiteScore 7.49 SJR 2.629 SNIP 2.558
Scopus rating (2015): SJR 2.689 SNIP 2.507 CiteScore 6.63
Scopus rating (2014): SJR 2.957 SNIP 2.727 CiteScore 6.13
Scopus rating (2013): SJR 2.956 SNIP 2.693 CiteScore 6.02
Scopus rating (2012): SJR 2.966 SNIP 2.456 CiteScore 5.15
Scopus rating (2011): SJR 2.867 SNIP 2.374 CiteScore 5.43
Scopus rating (2010): SJR 2.582 SNIP 2.196
Scopus rating (2009): SJR 2.319 SNIP 2.225
Scopus rating (2008): SJR 2.065 SNIP 2.19
Scopus rating (2007): SJR 1.994 SNIP 2.208
Scopus rating (2006): SJR 1.895 SNIP 2.214
Scopus rating (2005): SJR 2.114 SNIP 2.337
Scopus rating (2004): SJR 2.227 SNIP 2.106
Scopus rating (2003): SJR 1.696 SNIP 1.917
Scopus rating (2002): SJR 1.54 SNIP 1.775
Scopus rating (2001): SJR 1.321 SNIP 1.711
Long-term thermophilic mono-digestion of rendering wastes and co-digestion with potato pulp

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Bayr, S., Ojanperä, M., Kaparaju, P., Rintala, J.
Number of pages: 7
Pages: 1853-1859
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 34
Issue number: 10
ISSN (Print): 0956-053X
Ratings:
Scopus rating (2016): CiteScore 4 SJR 1.354 SNIP 2.044
Scopus rating (2015): SJR 1.739 SNIP 2.256 CiteScore 4.33
Scopus rating (2014): SJR 1.777 SNIP 2.482 CiteScore 3.43
Scopus rating (2013): SJR 1.822 SNIP 2.435 CiteScore 3.39
Scopus rating (2012): SJR 1.611 SNIP 2.184 CiteScore 2.91
Scopus rating (2011): SJR 1.698 SNIP 2.085 CiteScore 2.99
Scopus rating (2010): SJR 1.555 SNIP 1.78
Scopus rating (2009): SJR 1.502 SNIP 1.899
Scopus rating (2008): SJR 1.378 SNIP 2.13
Scopus rating (2007): SJR 1.035 SNIP 1.767
Scopus rating (2006): SJR 1.046 SNIP 1.749
Scopus rating (2005): SJR 1.059 SNIP 1.65
Scopus rating (2004): SJR 1.289 SNIP 1.939
Scopus rating (2003): SJR 0.847 SNIP 1.269
Scopus rating (2002): SJR 0.561 SNIP 0.874
Scopus rating (2001): SJR 0.456 SNIP 0.696
Scopus rating (2000): SJR 0.271 SNIP 0.451
Scopus rating (1999): SJR 0.262 SNIP 0.479
Original language: English
DOIs:
10.1016/j.wasman.2014.06.005

Bibliographical note
Contribution: organisation=keb,FACT1=1<br/>Portfolio EDEND: 2014-09-30<br/>Publisher name: Pergamon
Source: researchoutputwizard
Source-ID: 157
Research output: Scientific - peer-review › Article
Mesophilic and thermophilic anaerobic laboratory-scale digestion of Nannochloropsis microalga residues

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Kinnunen, H., Koskinen, P., Rintala, J.
Number of pages: 9
Pages: 314-322
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 155
ISSN (Print): 0960-8524
Ratings:
Scopus rating (2016): CiteScore 5.94 SJR 2.191 SNIP 1.91
Scopus rating (2015): SJR 2.255 SNIP 1.908 CiteScore 5.47
Scopus rating (2014): SJR 2.41 SNIP 2.104 CiteScore 5.3
Scopus rating (2013): SJR 2.412 SNIP 2.503 CiteScore 5.97
Scopus rating (2012): SJR 2.389 SNIP 2.465 CiteScore 5.25
Scopus rating (2011): SJR 2.314 SNIP 2.508 CiteScore 5.56
Scopus rating (2010): SJR 2.086 SNIP 2.355
Scopus rating (2009): SJR 1.912 SNIP 2.231
Scopus rating (2008): SJR 1.734 SNIP 2.732
Scopus rating (2007): SJR 1.529 SNIP 2.423
Scopus rating (2006): SJR 1.315 SNIP 1.98
Scopus rating (2005): SJR 1.269 SNIP 2.006
Scopus rating (2004): SJR 1.197 SNIP 1.659
Scopus rating (2003): SJR 0.948 SNIP 1.639
Scopus rating (2002): SJR 0.882 SNIP 1.3
Scopus rating (2001): SJR 0.541 SNIP 1.208
Scopus rating (2000): SJR 0.464 SNIP 1.049
Scopus rating (1999): SJR 0.669 SNIP 1.061
Original language: English
DOIs:

Bibliographical note
Contribution: organisation=keb,FACT1=1<br/>Portfolio EDEND: 2014-05-06<br/>Publisher name: Elsevier BV
Source: researchoutputwizard
Source-ID: 725
Research output: Scientific - peer-review › Article

Metabolic engineering of Acinetobacter baylyi ADP1 for improved growth on gluconate and glucose
A high growth rate in bacterial cultures is usually achieved by optimizing growth conditions, but metabolism of the bacterium limits the maximal growth rate attainable on the carbon source used. This limitation can be circumvented by engineering the metabolism of the bacterium. Acinetobacter baylyi has become a model organism for studies of bacterial metabolism and metabolic engineering due to its wide substrate spectrum and easy-to-engineer genome. It produces naturally storage lipids, such as wax esters, and has a unique gluconate catabolism as it lacks a gene for pyruvate kinase. We engineered the central metabolism of A. baylyi ADP1 more favorable for gluconate catabolism by expressing the pyruvate kinase gene (pykF) of Escherichia coli. This modification increased growth rate when cultivated on gluconate or glucose as a sole carbon source in a batch cultivation. The engineered cells reached stationary phase on these carbon sources approximately twice as fast as control cells carrying an empty plasmid and produced similar amount of biomass. Furthermore, when grown on either gluconate or glucose, pykF expression did not lead to significant accumulation of overflow metabolites and consumption of the substrate remained unaltered. Increased growth rate on glucose was not accompanied with decreased wax ester production, and the pykF-expressing cells accumulated significantly more of these storage lipids with respect to cultivation time.

General information
Modelling fume deposit growth in recovery boilers: effect of flue gas and deposit temperature

The high ash content of black liquor causes fouling problems in the Kraft recovery boiler. The ash-forming elements condense into submicron-sized fume particles in the superheater area and the boiler bank and can deposit on heat-transfer surfaces. The fume deposits can then lower heat-transfer rate, plug flue gas flow, and expose surfaces to corrosion. This paper presents the results of a sensitivity analysis obtained using a CFD (computational fluid dynamics)-based sub-model of the formation of fume particles and deposits, showing how flue gas and deposit surface temperatures affect instantaneous fume deposit growth. The results indicate that fume deposit growth is a self-limiting process because the growth rate decreases as the deposit surface temperature increases. On the other hand, increasing the flue gas temperature increases the fume deposition rate when the element release factors are kept constant.
Novel design of a multitube microbial fuel cell (UM2FC) for energy recovery and treatment of membrane concentrates

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering
Authors: Köroglu, E. O., YilmazBaysoy, D., Cetinkaya, A. Y., Özkaya, B., Cakmakci, M.
Number of pages: 8
Pages: 58-65
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Biomass & Bioenergy
Volume: 69
ISSN (Print): 0961-9534
Ratings:
Scopus rating (2016): CiteScore 3.71 SJR 1.188 SNIP 1.368
Scopus rating (2015): SJR 1.521 SNIP 1.615 CiteScore 4.03
Scopus rating (2014): SJR 1.888 SNIP 1.985 CiteScore 4.36
Scopus rating (2013): SJR 1.678 SNIP 1.823 CiteScore 4.42
Scopus rating (2012): SJR 1.545 SNIP 1.743 CiteScore 3.66
Scopus rating (2011): SJR 1.793 SNIP 2.283 CiteScore 4.74
Scopus rating (2010): SJR 1.931 SNIP 2.254
Scopus rating (2009): SJR 1.743 SNIP 2.187
Scopus rating (2008): SJR 1.609 SNIP 2.073
Scopus rating (2007): SJR 1.454 SNIP 1.77
Scopus rating (2006): SJR 1.292 SNIP 1.954
Scopus rating (2005): SJR 1.226 SNIP 1.398
Scopus rating (2004): SJR 1.037 SNIP 1.637
Scopus rating (2003): SJR 0.693 SNIP 1.312
Scopus rating (2002): SJR 0.442 SNIP 0.764
Scopus rating (2001): SJR 0.468 SNIP 0.994
Scopus rating (2000): SJR 0.429 SNIP 0.903
Scopus rating (1999): SJR 0.431 SNIP 1.105
Original language: English
Post-mortem evaluation of oxidized atmospheric plasma sprayed Mn-Co-Fe oxide spinel coatings on SOFC interconnectors

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Number of pages: 11
Pages: 17284-17294
Publication date: 2014
Peer-reviewed: Yes

Publication information
Volume: 39
Issue number: 30
ISSN (Print): 0360-3199
Ratings:
Scopus rating (2016): CiteScore 3.74 SJR 1.142 SNIP 1.286
Scopus rating (2015): SJR 1.294 SNIP 1.319 CiteScore 3.46
Scopus rating (2014): SJR 1.212 SNIP 1.494 CiteScore 3.54
Scopus rating (2013): SJR 1.278 SNIP 1.467 CiteScore 3.38
Scopus rating (2012): SJR 1.515 SNIP 1.729 CiteScore 3.96
Scopus rating (2011): SJR 1.456 SNIP 1.837 CiteScore 4.42
Scopus rating (2010): SJR 1.589 SNIP 1.871
Scopus rating (2009): SJR 1.333 SNIP 1.885
Scopus rating (2008): SJR 1.401 SNIP 2.096
Scopus rating (2007): SJR 1.279 SNIP 2.201
Scopus rating (2006): SJR 1.073 SNIP 2.161
Scopus rating (2005): SJR 1.107 SNIP 1.787
Scopus rating (2004): SJR 1.225 SNIP 1.626
Scopus rating (2003): SJR 1.003 SNIP 1.319
Scopus rating (2002): SJR 0.763 SNIP 1.157
Scopus rating (2001): SJR 0.487 SNIP 1.185
Scopus rating (2000): SJR 0.518 SNIP 0.866
Scopus rating (1999): SJR 0.382 SNIP 0.897
Original language: English
DOIs:
10.1016/j.ijhydene.2014.08.105

Stabilization of fine fraction from landfill mining in leach bed reactor

General information
The effect of torrefaction on the chlorine content and heating value of eight woody biomass samples

This study examined and compared the effect of torrefaction on the heating value, elementary composition, and chlorine content of eight woody biomasses. The biomass samples were torrefied in a specially constructed batch reactor at 260 °C for 30, 60, and 90 min. The original biomasses as well as the solid, liquid, and gaseous torrefaction reaction products were analyzed separately. The higher heating values (HHV) of dry samples increased from 19.5–21.0 MJ kg⁻¹ to 21.2–23.2 MJ kg⁻¹ during 60 min of torrefaction. In all samples, the HHV increased 9 % on average. Furthermore, the effect of torrefaction time on the biomass HHV was studied. Measurements showed that after a certain point, increasing the torrefaction time had no effect on the samples' HHV. This optimal torrefaction time varied considerably between the samples. For more reactive biomasses, i.e., birch and aspen, the optimal torrefaction time was close 30 min whereas the HHV of less reactive biomasses, e.g., stumps, increased markedly even after a 60-min torrefaction. Another significant observation was that torrefaction reduced the chlorine content of the biomass samples. The chlorine concentration of the solid product dropped in most samples from the original by half or even as much as 90 %. The highest relative chlorine decrease was observed in the Eucalyptus dunnii sample, which also had the highest chlorine content of all the studied biomasses. The relative carbon content of the biomass samples increased during torrefaction as the average elementary composition changed from CH₀.123O₀.827 to CH₀.105O₀.674 after a 60-min torrefaction.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Urban circular bioeconomy (UrCirBio)
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$_2$ 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$_2$/mol glycerol and 0.66 mol 1,3-PD/mol glycerol (1-stage processes), whereas the highest cumulative production was 74 mmol H$_2$/l culture and 31 mmol 1,3-PD/l culture (2-stage process). © 2013, Hydrogen Energy Publications, LLC. Published by Elsevier Ltd. All rights.
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 m³CH₄/kg - volatile solids added (VS_add), respectively. Trimethyl silanol, hexamethylcyclotrisiloxane (D3), octamethylcyclohexasiloxane (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_add) were detected than in grass silage or maize assays (from 14.7 to 20.4 and from 7.4 to 12.1 μg/kgVS_add, 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.
Bioenergy consumption and biogas potential in Cambodian households

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering
Authors: Mustonen, S., Raiko, R., Luukkanen, J.
Number of pages: 17
Pages: 1875-1892
Publication date: 2013
Peer-reviewed: Yes
Publication information
Journal: Sustainability
Volume: 5
Issue number: 5
ISSN (Print): 2071-1050
Ratings:
Scopus rating (2016): SJR 0.524 SNIP 0.911 CiteScore 1.96
Scopus rating (2015): SJR 0.473 SNIP 0.926 CiteScore 1.78
Scopus rating (2014): SJR 0.499 SNIP 1.048 CiteScore 1.52
Scopus rating (2013): SJR 0.539 SNIP 1.247 CiteScore 1.43
Scopus rating (2012): SJR 0.486 SNIP 0.809 CiteScore 1.18
Scopus rating (2011): SJR 0.27 SNIP 0.501 CiteScore 0.65
Scopus rating (2010): SJR 0.156 SNIP 0.388
Original language: English
DOI:
10.3390/su5051875

CFD-modeling of fume formation in kraft recovery boilers
A computational fluid dynamics (CFD) model was developed to simulate alkali metal chemistry and fume particle formation in a kraft recovery boiler. The modeling results were partially validated against previously obtained field measurements. The model provides information about fume composition, chlorine and potassium enrichment factors, and particle mass concentration at different locations in the boiler.

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Urban circular bioeconomy (UrCirBio), Valmet Technologies Oy, University of Toronto, Canada
Authors: Leppänen, A., Välimäki, E., Oksanen, A., Tran, H.
CO2 capture from biogas: absorbent selection

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Privalova, E., Rasi, S., Mäki-Arvela, P., Eränen, K., Rintala, J., Murzin, D. Y., Mikkola, J.
Number of pages: 6
Pages: 2979-2994
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: RSC Advances
Volume: 3
Issue number: 9
ISSN (Print): 2046-2069
Ratings:
Scopus rating (2016): CiteScore 3.06 SJR 0.875 SNIP 0.743
Scopus rating (2015): SJR 0.959 SNIP 0.837 CiteScore 3.42
Scopus rating (2014): SJR 1.114 SNIP 0.965 CiteScore 3.87
Conjugated donor-acceptor (D-A) copolymers in inverted organic solar cells - a combined experimental and modelling study

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics
Number of pages: 12
Pages: 7451-7462
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Journal of Materials Chemistry A
Volume: 1
Issue number: 25
ISSN (Print): 2050-7488
Ratings:
Scopus rating (2016): SJR 3.037 SNIP 1.468 CiteScore 8.46
Scopus rating (2015): SJR 2.672 SNIP 1.663 CiteScore 8.36
Scopus rating (2014): SJR 2.343 SNIP 1.526 CiteScore 7.27
Original language: English
DOI:
10.1039/c3ta10686a

Bibliographical note
Contribution: organisation=keb,FACT1=1<br/>Portfolio EDEND: 2013-06-29<br/>Publisher name: RSC Publishing
Source: researchoutputwizard
Source-ID: 3188
Research output: Scientific - peer-review › Article

Dipyrrolidinyl-substituted perylene diimide as additive for poly(3-hexylthiophene): [6,6]-Phenyl C61 butyric acid methylester bulk-heterojunction blends

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics
Authors: Vivo, P., Dubey, R., Lehtonen, E., Kivistö, H., Vuorinen, T., Lemmetyinen, H.
Number of pages: 8
Pages: 398-405
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Thin Solid Films
Volume: 548

Dipyrrolidinyl-substituted perylene diimide as additive for poly(3-hexylthiophene): [6,6]-Phenyl C61 butyric acid methylester bulk-heterojunction blends

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics
Authors: Vivo, P., Dubey, R., Lehtonen, E., Kivistö, H., Vuorinen, T., Lemmetyinen, H.
Number of pages: 8
Pages: 398-405
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Thin Solid Films
Volume: 548
Electricity generation from young landfill leachate in a microbial fuel cell with a new electrode material

**General information**

State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering
Authors: Özkaya, B., Cetinkaya, A. Y., Cakmakci, M., Karadag, D., Sahinkaya, E.
Pages: 399-405
Publication date: 2013
Peer-reviewed: Yes

**Publication information**

Journal: Bioprocess and Biosystems Engineering
Volume: 36
Issue number: 4
ISSN (Print): 1615-7591
Ratings:
Scopus rating (2016): SJR 0.628 SNIP 0.956 CiteScore 1.96
Scopus rating (2015): SJR 0.687 SNIP 0.887 CiteScore 1.97
Scopus rating (2014): SJR 0.699 SNIP 0.968 CiteScore 1.95
Scopus rating (2013): SJR 0.792 SNIP 1.085 CiteScore 2.16
Scopus rating (2012): SJR 0.767 SNIP 1.111 CiteScore 2.14
Scopus rating (2011): SJR 0.699 SNIP 0.868 CiteScore 1.92
Scopus rating (2010): SJR 0.805 SNIP 0.996
Scopus rating (2009): SJR 0.675 SNIP 0.94
Scopus rating (2008): SJR 0.587 SNIP 0.876
Scopus rating (2007): SJR 0.656 SNIP 0.822
Excited-state interaction of red and green perylene diimides with luminescent Ru(II) polypyridine complex

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics
Authors: Dubey, R. K., Niemi, M., Kaunisto, K., Stranius, K., Efimov, A., Tkachenko, N., Lemmetyinen, H.
Number of pages: 13
Pages: 9761-9773
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Inorganic Chemistry
Volume: 52
ISSN (Print): 0020-1669
Ratings:
Scopus rating (2016): SJR 1.774 SNIP 1.198 CiteScore 4.64
Scopus rating (2015): SJR 1.805 SNIP 1.239 CiteScore 4.7
Scopus rating (2014): SJR 1.869 SNIP 1.314 CiteScore 4.69
Scopus rating (2013): SJR 1.819 SNIP 1.379 CiteScore 4.9
Scopus rating (2012): SJR 2.08 SNIP 1.35 CiteScore 4.72
Scopus rating (2011): SJR 1.952 SNIP 1.373 CiteScore 4.64
Scopus rating (2010): SJR 1.98 SNIP 1.323
Scopus rating (2009): SJR 1.982 SNIP 1.47
Scopus rating (2008): SJR 2.025 SNIP 1.412
Scopus rating (2007): SJR 2.136 SNIP 1.544
Scopus rating (2006): SJR 1.828 SNIP 1.508
Scopus rating (2005): SJR 2.012 SNIP 1.46
Scopus rating (2004): SJR 1.672 SNIP 1.382
Scopus rating (2003): SJR 1.498 SNIP 1.465
Scopus rating (2002): SJR 1.616 SNIP 1.398
Scopus rating (2001): SJR 1.749 SNIP 1.511
Scopus rating (2000): SJR 1.667 SNIP 1.511
Scopus rating (1999): SJR 1.704 SNIP 1.497
Original language: English
DOIs:
10.1021/ic400474b

Bibliographical note
Fast pyrolysis of coal, peat, and torrefied wood: Mass loss study with a drop-tube reactor, particle geometry analysis, and kinetics modeling

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Tolvanen, H., Kokko, L., Raiko, R.
Pages: 148-156
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Fuel
Volume: 111
Issue number: September
ISSN (Print): 0016-2361
Ratings:
Scopus rating (2016): CiteScore 4.9 SJR 1.744 SNIP 2.179
Scopus rating (2015): SJR 1.809 SNIP 2.125 CiteScore 4.46
Scopus rating (2014): SJR 1.667 SNIP 2.331 CiteScore 4.14
Scopus rating (2013): SJR 1.811 SNIP 2.595 CiteScore 4.31
Scopus rating (2012): SJR 1.852 SNIP 2.465 CiteScore 3.99
Scopus rating (2011): SJR 2.083 SNIP 2.427 CiteScore 4.1
Scopus rating (2010): SJR 1.984 SNIP 2.319
Scopus rating (2009): SJR 2.012 SNIP 2.277
Scopus rating (2008): SJR 1.635 SNIP 2.184
Scopus rating (2007): SJR 1.383 SNIP 1.86
Scopus rating (2006): SJR 1.278 SNIP 1.64
Scopus rating (2005): SJR 1.623 SNIP 1.73
Scopus rating (2004): SJR 1.273 SNIP 1.883
Scopus rating (2003): SJR 1.103 SNIP 1.481
Scopus rating (2002): SJR 1.13 SNIP 1.301
Scopus rating (2001): SJR 1.136 SNIP 1.264
Scopus rating (2000): SJR 1.047 SNIP 1.272
Scopus rating (1999): SJR 1.117 SNIP 1.157
Original language: English
DOIs:
10.1016/j.fuel.2013.04.030

Bibliographical note
Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2013-06-29
Publisher name: Elsevier Ltd.
Source-ID: 3549
Research output: Scientific - peer-review › Article

Generation of heat and power from biogas for stationary applications: boilers, gas engines and turbines, combined heat and power (CHP) plants and fuel cells

General information
State: Published
Ministry of Education publication type: A3 Part of a book or another research book
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Authors: Kaparaju, P., Rintala, J.
In Situ XPS Studies of Electrochemically Negatively Polarized Molybdenum Carbide Derived Carbon Double Layer Capacitor Electrode

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Optoelectronics Research Centre, Research group: Surface Science, Frontier Photonics
Authors: Tonisoo, A., Kruusma, J., Pärna, R., Kikas, A., Hirsimäki, M., Nommiste, E., Lust, E.
Number of pages: 10
Pages: A1084-A1093
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Journal of the Electrochemical Society
Volume: 160
Issue number: 8
ISSN (Print): 0013-4651
Ratings:
Scopus rating (2016): SJR 1.134 SNIP 0.867 CiteScore 2.97
Scopus rating (2015): SJR 1.037 SNIP 1 CiteScore 3.17
Scopus rating (2014): SJR 1.147 SNIP 1.206 CiteScore 3.36
Scopus rating (2013): SJR 1.151 SNIP 1.299 CiteScore 2.92
Scopus rating (2012): SJR 1.329 SNIP 1.296 CiteScore 2.61
Scopus rating (2011): SJR 1.33 SNIP 1.345 CiteScore 2.74
Scopus rating (2010): SJR 1.417 SNIP 1.312
Scopus rating (2009): SJR 1.45 SNIP 1.267
Scopus rating (2008): SJR 1.608 SNIP 1.416
Scopus rating (2007): SJR 1.58 SNIP 1.325
Scopus rating (2006): SJR 1.611 SNIP 1.54
Scopus rating (2005): SJR 1.519 SNIP 1.484
Scopus rating (2004): SJR 1.719 SNIP 1.706
Scopus rating (2003): SJR 1.962 SNIP 1.679
Scopus rating (2002): SJR 2.147 SNIP 1.646
Scopus rating (2001): SJR 1.651 SNIP 1.738
Scopus rating (2000): SJR 1.788 SNIP 1.708
Scopus rating (1999): SJR 1.657 SNIP 1.85
Original language: English
DOI:
10.1149/2.042308jes

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2013-09-29<br/>Publisher name: Electrochemical Society
Source: researchoutputwizard
Optimization of interfacial oxidation properties of FeCr SOFC interconnect alloy

General information
State: Published
Ministry of Education publication type: B2 Part of a book or another research book
Organisations: Optoelectronics Research Centre, Research group: Surface Science
Authors: Ali-Löytty, H., Jussila, P., Hirsimäki, M., Valden, M.
Number of pages: 2
Pages: 1-2
Publication date: 2013

Host publication information
Title of host publication: Max-Lab Activity Report 2012. Reports 2012 Synchroton Radiation. Beamline I311-XPS
Place of publication: Lund, Sweden
Publisher: MAX-LAB
Links:
https://www.maxlab.lu.se/cmis/display?id=workspace%3A%2F%2FSpacesStore%2F0f1d8b0b-533a-48e6-a4cf-a85090776f76
https://www.maxlab.lu.se/node/1693

Bibliographical note
Contribution: organisation=orc,FACT1=1<br/>
Portfolio EDEND: 2013-11-29
Source: researchoutputwizard
Source-ID: 1912
Research output: Scientific › Chapter

Plasma-assisted chemical vapor deposition of Fe:TiO2 films for photoelectrochemical hydrogen production

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry
Authors: Mettenbörger, A., Merod, V., Singh, A., Lemmetyinen, H., Mathur, S.
Number of pages: 8
Pages: 81-88
Publication date: 2013

Host publication information
Title of host publication: Nanostructured Materials and Nanotechnology V - 36th International Conference on Advanced Ceramics and Composites, ICACC 2012, Daytona Beach, FL, USA, 22.-27.1.2013
Publisher: American Ceramic Society
ISBN (Print): 978-111820597-6
Publication series
Name: Ceramic Engineering and Science Proceedings
Volume: 33
No.: 7
ISSN (Print): 0196-6219
ISSN (Electronic): 1940-6339

Bibliographical note
Contribution: organisation=keb,FACT1=1<br/>
Portfolio EDEND: 2013-12-29<br/>
Publisher name: American Ceramic Society
Source: researchoutputwizard
Source-ID: 2921
Research output: Scientific - peer-review › Conference contribution

Testing activity-based costing to large-scale combined heat and power plant using bioenergy

General information
State: Published
Triarylamine-substituted imidazole- and quinoxaline-fused push-pull porphyrins for dye-sensitized solar cells

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Research group: Supramolecular photochemistry, Department of Chemistry and Bioengineering, Frontier Photonics
Authors: Hayashi, H., Touchy, A. S., Kinjo, Y., Kurotobi, K., Toude, Y., Ito, S., Saarenpää, H., Tkachenko, N., Lemmetyinen, H., Imahori, H.
Number of pages: 10
Pages: 508-517
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: ChemSusChem
Volume: 6
Issue number: 3
CFD-Modeling of Fume Formation in Kraft Recovery Boilers

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Energy and Process Engineering, Research group: Power Plant and Combustion Technology, Urban circular bioeconomy (UrCirBio), Valmet Technologies Oy, University of Toronto, Canada
Authors: Leppänen, A., Välimäki, E., Oksanen, A., Tran, H.
Publication date: 2012

Host publication information
Title of host publication: TAPPI PEERS Conference Proceedings 14.-18.10.2012, Savannah, USA
Publisher: TAPPI

Publication series
Name: TAPPI PEERS Conference
Links:

Bibliographical note
ei ut-numeroa 21.8.2013<br/>Contribution: organisation=epr,FACT1=1<br/>Publisher name: TAPPI
Source: researchoutputwizard
Source-ID: 4695
Research output: Scientific - peer-review › Conference contribution

CFD Based Modelling for Predicting Fouling and Corrosion in Kraft Recovery Boilers

General information
State: Published
Modeling of Fine Particles and Alkali Metal Compounds in Kraft Recovery Boiler Furnace

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Authors: Leppänen, A., Välimäki, E., Oksanen, A.
Number of pages: 8
Pages: 1-8
Publication date: 2011

Host publication information
Title of host publication: The 2011 TAPPI PEERS Conference, 2-5 October 2011, Oregon Convention Center in Portland, Oregon USA
Place of publication: Norcross, GA
Publisher: TAPPI

Publication series
Name: TAPPI PEERS Conference
Publisher: TAPPI
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Study of Aerosols of Black Liquor Combustion

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