บทความที่น่าสนใจประจำเดือนธันวาคม 2558

สาขาวิทยาศาสตร์และเทคโนโลยี

1	Title:	Mathematical modeling of solid-state anaerobic digestion
	Author:	Fuqing Xu, Yebo Li, Zhi-Wu Wang
	Journal:	Progress in Energy and Combustion Science, Volume 51, December 2015, Pages 49–66
	Abstract:	Solid-state anaerobic digestion (SS-AD) technology for the conversion of solid organic wastes to renewable energy has been widely studied and applied during the past decades. Due to the nature of the solid medium, the SS-AD process is significantly different from the traditional liquid anaerobic digestion in many aspects, such as the distribution of microbes and substrates in the reactors, mass transfer, and reaction kinetics. Extensive efforts have been dedicated to developing mathematical models for understanding SS-AD mechanisms, predicting its performance, and improving process control. In this review, SS-AD mathematical models derived from theoretical, empirical, and statistical approaches are critically reviewed and discussed regarding their different assumptions, structures, applications, and limitations. Based on this review, it was concluded that significant efforts should be devoted to experimental verification of the model assumptions, measurement of important kinetic parameters specific for SS-AD, and generation of sufficient data for model validation. It is necessary to synergistically improve modeling and experimental approaches in order to gain deeper insight into the SS-AD mechanism. Several promising research directions for the future development of experimental and modeling approaches in SS-AD are proposed.
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2	Title:	Nano-cones on micro-pyramids: modulated surface textures for maximal spectral response and high-efficiency solar cells
	Author:	Andrea Ingenito, Olindo Isabella and Miro Zeman
	Journal:	Progress in Photovoltaics: Research and Applications, Volume 23, Issue 11, November 2015, Pages 1649–1659
	Abstract:	The front-side reflection represents a significant optical loss in solar cells. One way to minimize this optical loss is to nano-texture the front surface. Although nano-textured surfaces have shown a broad-band anti-reflective effect, their light scattering and surface passivation properties are found to be generally worse than those of standard micro-textured surfaces. To overcome these setbacks in crystalline silicon solar cells, advanced texturing and passivation approaches are here presented. In the first approach, we propose a modulated surface texture by superimposing nano-cones on micro-pyramidal surface texture. This advanced texture applied at the front side of crystalline silicon wafers completely suppresses the reflection in a broad wavelength range from 300 nm up to 1000 nm and

		efficiently scatters light up to 1200 nm. In the second approach, we show a method to minimize recombination at nano-textured surfaces by using defect-removal etching followed by dry thermal oxidation. These two approaches are applied here in an interdigitated back-contacted crystalline silicon solar cell and result in decoupling of the interplay between the mechanisms behind short-circuit current density and open-circuit voltage. The device exhibits a conversion efficiency equal to 19.8%, record external quantum efficiency (78%) at short wavelengths (300 nm), and electrical performance equal to the performance of the reference interdigitated back-contacted device based on front-side micro-pyramids.
	Database:	Wiley Online Library

3	Title:	Photonic crystal microcrystalline silicon solar cells
	Author:	Yoshinori Tanaka, Kenji Ishizaki, Menaka De Zoysa, Takami Umeda, Yosuke Kawamoto, Shoya Fujita and Susumu Noda
	Journal:	Progress in Photovoltaics: Research and Applications, Volume 23, Issue 11, November 2015, Pages 1475–1483
	Abstract:	Enhancing the absorption of thin-film microcrystalline silicon solar cells over a broadband range in order to improve the energy conversion efficiency is a very important challenge in the development of low cost and stable solar energy harvesting. Here, we demonstrate that a broadband enhancement of the absorption can be achieved by creating a large number of resonant modes associated with two-dimensional photonic crystal band edges. We utilize higher-order optical modes perpendicular to the silicon layer, as well as the band-folding effect by employing photonic crystal superlattice structures. We establish a method to incorporate photonic crystal structures into thin-film (~500 nm) microcrystalline silicon photovoltaic layers while suppressing undesired defects formed in the microcrystalline silicon. The fabricated solar cells exhibit 1.3 times increase of a short circuit current density (from 15.0 mA/cm2 to 19.6 mA/cm2) by introducing the photonic crystal structure, and consequently the conversion efficiency increases from 5.6% to 6.8%. Moreover, we theoretically analyze the absorption characteristics in the fabricated cell structure, and reveal that the energy conversion efficiency can be increased beyond 9.5% in a structure less than 1/400 as thick as conventional crystalline silicon solar cells with an efficiency of 24%.
	Database:	Wiley Online Library

4	Title:	Correlation of the loss in photovoltaic module performance with the ageing behaviour of the backsheets used
	Author:	Yuliya Voronko, Gabriele C. Eder, Marlene Knausz, Gernot Oreski, Thomas Koch and Karl A. Berger

Journal:	Progress in Photovoltaics: Research and Applications, Volume 23, Issue 11, November 2015, Pages 1501–1515
Abstract:	The influence of the type of backsheet on the electrical performance of test modules was evaluated before and after increasing time of accelerated ageing (damp heat [DH] exposure). Besides the measurement of the electrical power of the modules and the performance of the cells by electroluminescence, the ageing-induced changes within the polymeric encapsulate and backsheets were investigated by means of vibrational spectroscopy and by thermo analytical methods. In addition, the permeability of the backsheets in the original and aged state was determined. This wide set of test parameters and methods allowed for the detection of correlations between (i) physical and chemical properties as well as their ageing-induced changes of the materials and (ii) the module performance. A clear dependence of the relative loss in power output upon exposure under DH conditions for 2000 h could be observed for a set of identical test modules varied in composition only in the type of back cover used. While the modules containing gas-tight backsheets and glass experienced only little loss in the relative power output, some modules with permeable backsheets showed a significant relative decrease in the power output and fill factor in dependence of the backsheet type used. Cell degradation could be visualised by recording electroluminescence images before and after the accelerated ageing test. The permeation properties of the backsheet used and their ageing-induced changes seem to have an influence on the module performance. However, the absolute values neither of the water vapour transmission rate (WVTR) nor of the oxygen transmission rate (OTR) are directly linked to the loss in power output upon accelerated ageing under DH conditions. It could be shown that the ageing-induced changes (relative transmission rates) between WVTR and OTR can be correlated with the module performance. These ageing-induced changes in the permeation behaviour of the backsheets can be explained by (i) physical changes (e.g. post-crystallisation, changes in the crystal structure or the crystalline microstructure) and (ii) chemical ageing effects such as a decrease in the molecular mass of the polyester (PET) polymer chains because of hydrolytic polymer degradation leading to a change in the crystallisation behaviour of PET. Hydrolytic degradation (= chemical ageing) of the PET core layer was observed (with varying extent) for all PET-based backsheets and can, thus, not be directly correlated with the loss in performance of the corresponding test modules. The physical ageing effects, however, were detected only for those backsheets showing (i) strong deviating changes in the relative permeation rates for oxygen and water vapour upon accelerated ageing and (ii) a clear loss in electrical performance.
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Title:	Challenge for lowering concentration polarization in solid oxide fuel cells
Author:	Hiroyuki Shimada, Toshio Suzuki, Toshiaki Yamaguchi, Hirofumi Sumi, Koichi Hamamoto, Yoshinobu Fujishiro

Journal:	Journal of Power Sources, Volume 302, 20 January 2016, Pages 53–60
Abstract:	In the scope of electrochemical phenomena, concentration polarization at electrodes is theoretically inevitable, and lowering the concentration overpotential to improve the performance of electrochemical cells has been a continuing challenge. Electrodes with highly controlled microstructure, i.e., high porosity and uniform large pores are therefore essential to achieve high performance electrochemical cells. In this study, state-of-the-art technology for controlling the microstructure of electrodes has been developed for realizing high performance support electrodes of solid oxide fuel cells (SOFCs). The key is controlling the porosity and pore size distribution to improve gas diffusion, while maintaining the integrity of the electrolyte and the structural strength of actual sized electrode supports needed for the target application. Planar anode-supported SOFCs developed in this study realize 5 μm thick dense electrolyte (yttria-stabilized zirconia: YSZ) and the anode substrate (Ni-YSZ) of 53.6 vol.% porosity with a large median pore diameter of 0.911 μm. Electrochemical measurements reveal that the performance of the anode-supported SOFCs improves with increasing anode porosity. This Ni-YSZ anode minimizes the concentration polarization, resulting in a maximum power density of 3.09 W cm^{-2} at 800 °C using humidified hydrogen fuel without any electrode functional layers.
Database:	ScienceDirect

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Title:	Real-time estimation of battery internal temperature based on a simplified thermoelectric model
Author:	Cheng Zhang, Kang Li, Jing Deng
Journal:	Journal of Power Sources, Volume 302, 20 January 2016, Pages 146–154
Abstract:	Li-ion batteries have been widely used in the EVs, and the battery thermal management is a key but challenging part of the battery management system. For EV batteries, only the battery surface temperature can be measured in real-time. However, it is the battery internal temperature that directly affects the battery performance, and large temperature difference may exist between surface and internal temperatures, especially in high power demand applications. In this paper, an online battery internal temperature estimation method is proposed based on a novel simplified thermoelectric model. The battery thermal behaviour is first described by a simplified thermal model, and battery electrical behaviour by an electric model. Then, these two models are interrelated to capture the interactions between battery thermal and electrical behaviours, thus offer a comprehensive description of the battery behaviour that is useful for battery management. Finally, based on the developed model, the battery internal temperature is estimated using an extended Kalman filter. The experimental results confirm the efficacy of the proposed method, and it can be used for online internal temperature estimation which is a key indicator for better real-time battery thermal management.
Database:	ScienceDirect

7	Title:	Size dependence of warpage in solid oxide fuel cell
	Author:	Khaled Azari, Jamshid Aghazadeh Mohandesi, Younes Alizadeh Vaghasloo
	Journal:	Journal of Power Sources, Volume 301, 1 January 2016, Pages 326–331
	Abstract:	Planar anode-supported solid oxide fuel cells (SOFCs) typically show curvature behavior. The cell is warped due to the mismatch in the properties of the cell layers during fabrication process. Scaling up anode supported cells for industrial and commercial applications increases the warpage due to geometrical consideration. In this work, the curvature radius and maximum deflection of small cells are compared to large cells to gain a better insight into the warpage behavior in the scaling up process. The obtained results show that the curvature radius significantly increases by increasing cell size, whereas with respect to geometrical consideration, scaling up should result in no radius change. Also, the interaction between cell size and applied load (during sintering) has been investigated. The curvature radius generally increases with increasing total load density and cell size. The influence of total load density decreases for the large cells and the influence of cell size decreases with increasing total load density. Furthermore, an expression is proposed for the estimation of the curvature radius in the scaling up process by taking into account the effect of size and applied load and interaction between them.
	Database:	ScienceDirect

8	Title:	2G ethanol from the whole sugarcane lignocellulosic biomass
	Author:	Sandra Cerqueira Pereira, Larissa Maehara, Cristina Maria Monteiro Machado, Cristiane Sanchez Farinas
	Journal:	Biotechnology for Biofuels, December 2015, 8:44
	Abstract:	Background In the sugarcane industry, large amounts of lignocellulosic residues are generated, which includes bagasse, straw, and tops. The use of the whole sugarcane lignocellulosic biomass for the production of second-generation (2G) ethanol can be a potential alternative to contribute to the economic viability of this process. Here, we conducted a systematic comparative study of the use of the lignocellulosic residues from the whole sugarcane lignocellulosic biomass (bagasse, straw, and tops) from commercial sugarcane varieties for the production of 2G ethanol. In addition, the feasibility of using a mixture of these residues from a selected variety was also investigated. Results The materials were pretreated with dilute acid and hydrolyzed with a commercial enzymatic preparation, after which the hydrolysates were fermented using an industrial strain of Saccharomyces cerevisiae. The susceptibility to enzymatic saccharification was higher for the tops, followed by straw and bagasse. Interestingly, the fermentability of the hydrolysates showed a different profile, with straw

	achieving the highest ethanol yields, followed by tops and bagasse. Using a mixture of the different sugarcane parts (bagasse-straw-tops, 1:1:1, in a dry-weight basis), it was possible to achieve a 55% higher enzymatic conversion and a 25% higher ethanol yield, compared to use of the bagasse alone. For the four commercial sugarcane varieties evaluated using the same experimental set of conditions, it was found that the variety of sugarcane was not a significant factor in the 2G ethanol production process. Conclusions Assessment of use of the whole lignocellulosic sugarcane biomass clearly showed that 2G ethanol production could be significantly improved by the combined use of bagasse, straw, and tops, when compared to the use of bagasse alone. The lower susceptibility to saccharification of sugarcane bagasse, as well as the lower fermentability of its hydrolysates, can be compensated by using it in combination with straw and tops (sugarcane trash). Furthermore, given that the variety was not a significant factor for the 2G ethanol production process within the four commercial sugarcane varieties evaluated here, agronomic features such as higher productivity and tolerance of soil and climate variations can be used as the criteria for variety selection.
Database:	SpringerLink

9	Title:	Closely related fungi employ diverse enzymatic strategies to degrade plant biomass
	Author:	Isabelle Benoit , Helena Culleton , Miaomiao Zhou , Marcos DiFalco, Guillermo Aguilar-Osorio, Evy Battaglia, Ourdia Bouzid, Carlo P J M Brouwer, Hala B O El-Bushari, Pedro M Coutinho, Birgit S Gruben, Kristiina S Hildén, Jos Houbraken, Luis Alexis Jiménez Barboza, Anthony Levasseur, Eline Majoor, Miia R Mäkelä, Hari-Mander Narang, Blanca Trejo-Aguilar, Joost van den Brink, Patricia A vanKuyk, Ad Wiebenga, Vincent McKie, Barry McCleary, Adrian Tsang , Bernard Henrissat , Ronald P de Vries
	Journal:	Biotechnology for Biofuels, December 2015, 8:107
	Abstract:	Background Plant biomass is the major substrate for the production of biofuels and biochemicals, as well as food, textiles and other products. It is also the major carbon source for many fungi and enzymes of these fungi are essential for the depolymerization of plant polysaccharides in industrial processes. This is a highly complex process that involves a large number of extracellular enzymes as well as non-hydrolytic proteins, whose production in fungi is controlled by a set of transcriptional regulators. Aspergillus species form one of the best studied fungal genera in this field, and several species are used for the production of commercial enzyme cocktails. Results It is often assumed that related fungi use similar enzymatic approaches to degrade plant

	Abstract:	polysaccharides. In this study we have compared the genomic content and the enzymes produced by eight Aspergilli for the degradation of plant biomass. All tested Aspergilli have a similar genomic potential to degrade plant biomass, with the exception of A. clavatus that has a strongly reduced pectinolytic ability. Despite this similar genomic potential their approaches to degrade plant biomass differ markedly in the overall activities as well as the specific enzymes they employ. While many of the genes have orthologs in (nearly) all tested species, only very few of the corresponding enzymes are produced by all species during growth on wheat bran or sugar beet pulp. In addition, significant differences were observed between the enzyme sets produced on these feedstocks, largely correlating with their polysaccharide composition. Conclusions These data demonstrate that Aspergillus species and possibly also other related fungi employ significantly different approaches to degrade plant biomass. This makes sense from an ecological perspective where mixed populations of fungi together degrade plant biomass. The results of this study indicate that combining the approaches from different species could result in improved enzyme mixtures for industrial applications, in particular saccharification of plant biomass for biofuel production. Such an approach may result in a much better improvement of saccharification efficiency than adding specific enzymes to the mixture of a single fungus, which is currently the most common approach used in biotechnology.
	Database:	SpringerLink

10	Title:	Butanol production from food waste: a novel process for producing sustainable energy and reducing environmental pollution
	Author:	Haibo Huang, Vijay Singh, Nasib Qureshi
	Journal:	Biotechnology for Biofuels, December 2015, 8:147
	Abstract:	Background Waste is currently a major problem in the world, both in the developing and the developed countries. Efficient utilization of food waste for fuel and chemical production can positively influence both the energy and environmental sustainability. This study investigated using food waste to produce acetone, butanol, and ethanol (ABE) by Clostridium beijerinckii P260. Results In control fermentation, 40.5 g/L of glucose (initial glucose 56.7 g/L) was used to produce 14.2 g/L of ABE with a fermentation productivity and a yield of 0.22 g/L/h and 0.35 g/g, respectively. In a similar fermentation 81 g/L of food waste (containing equivalent glucose of 60.1 g/L) was used as substrate, and the culture produced 18.9 g/L ABE with a high ABE productivity of 0.46 g/L/h and a yield of 0.38 g/g. Fermentation of food waste at higher concentrations (129, 181 and 228 g/L) did not remarkably

	increase ABE production but resulted in high residual glucose due to the culture butanol inhibition. An integrated vacuum stripping system was designed and applied to recover butanol from the fermentation broth simultaneously to relieve the culture butanol inhibition, thereby allowing the fermentation of food waste at high concentrations. ABE fermentation integrated with vacuum stripping successfully recovered the ABE from the fermentation broth and controlled the ABE concentrations below 10 g/L during fermentation when 129 g/L food waste was used. The ABE productivity with vacuum fermentation was 0.49 g/L/h, which was 109 % higher than the control fermentation (glucose based). More importantly, ABE vacuum recovery and fermentation allowed near-complete utilization of the sugars (~98 %) in the broth. Conclusions In these studies it was demonstrated that food waste is a superior feedstock for producing butanol using Clostridium beijerinckii. Compared to costly glucose, ABE fermentation of food waste has several advantages including lower feedstock cost, higher productivity, and less residual sugars.
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