

IN THIS ISSUE

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Cover

See Stavros Papadokonstantakis, Vassily Hatzimanikatis *et al.*, pp. 2794-2805. Image reproduced by permission of Konrad Hungerbühler from *Energy Environ. Sci.*, 2016, 9, 2794.

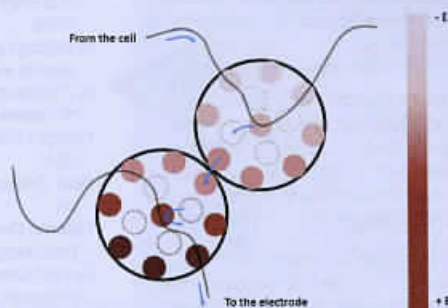
OPINION

2677

The relay network of *Geobacter* biofilms

M. V. Ordóñez,* G. D. Schrott, D. A. Massazza and J. P. Busalmen

The finding of cytochrome complexes in the external matrix of electricity producing biofilms supports the proposal of a new functional model, in which electrons expelled by cells are conducted to the collecting electrode along a redox network interconnected by semiconducting pilus fibres.



REVIEWS

2682

Forthcoming perspectives of photoelectrochromic devices: a critical review

Alessandro Cannavale,* Pierluigi Cossari, Giles E. Eperon, Silvia Colella, Francesco Fiorito, Giuseppe Gigli, Henry J. Snaith and Andrea Listorti

This review article explores the historical development and the recent progress of photoelectrochromic devices (PECDs), evaluating on the bases of components evolution their future perspectives.

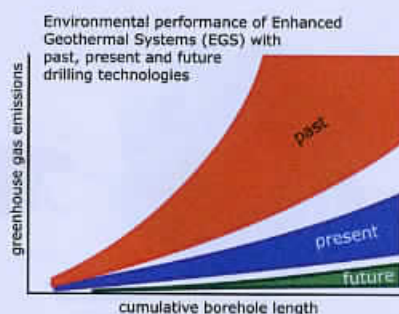


2720

A matter of meters: state of the art in the life cycle assessment of enhanced geothermal systems

Kathrin Menberg,* Stephan Pfister, Philipp Blum and Peter Bayer

This article provides a comprehensive review of the environmental performance of Enhanced Geothermal Systems (EGSs) with a focus on recent and potential future progress in geothermal drilling.

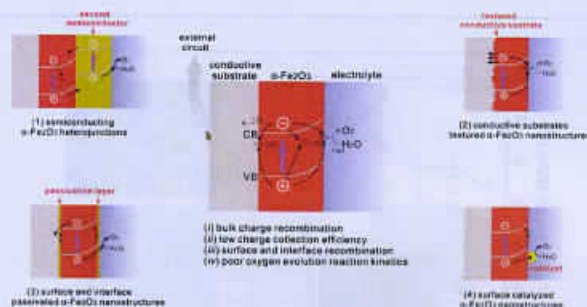


2744

Hematite heterostructures for photoelectrochemical water splitting: rational materials design and charge carrier dynamics

Shaohua Shen,* Sarah A. Lindley, Xiangyan Chen and Jin Z. Zhang*

Different approaches to improving photoelectrochemical performance through $\alpha\text{-Fe}_2\text{O}_3$ heterostructure design.



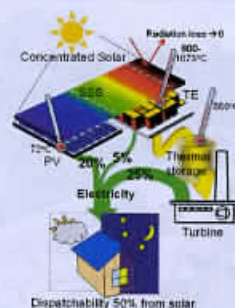
PERSPECTIVE

2776

Hybrid strategies and technologies for full spectrum solar conversion

P. Bermel,* K. Yazawa, J. L. Gray, X. Xu and A. Shakouri

Harvesting the full spectrum of sunlight using a hybrid approach offers the potential for higher efficiencies, lower power production costs, and increased power grid compatibility than any single technology by itself.



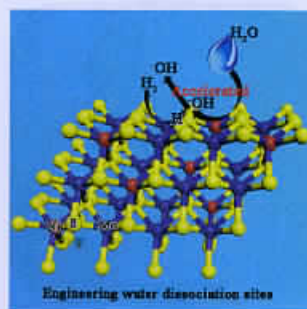
COMMUNICATION

2789

Engineering water dissociation sites in MoS_2 nanosheets for accelerated electrocatalytic hydrogen production

Jian Zhang, Tao Wang, Pan Liu, Shaohua Liu, Renhao Dong, Xiaodong Zhuang, Mingwei Chen and Xinliang Feng*

Engineering the water dissociation sites of MoS_2 nanosheets can efficiently enhance the electrocatalytic hydrogen evolution under alkaline conditions.



2794

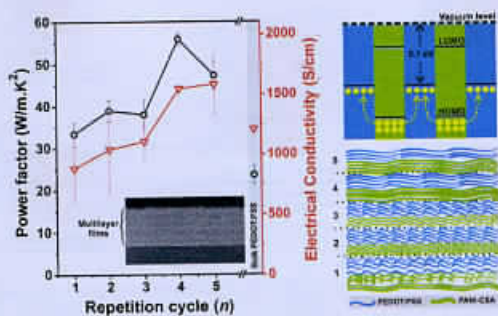


Sustainability assessment of succinic acid production technologies from biomass using metabolic engineering

Merten Morales, Meriç Ataman, Sara Badr, Sven Linster, Ioannis Kourlimpinis, Stavros Papadokonstantakis,* Vassily Hatzimanikatis* and Konrad Hungerbühler

Innovative pathways for bio-succinic acid production from biomass are investigated regarding their environmental impact, economic feasibility and process hazard by including state of the art metabolic engineering in process modelling.

2806



Enhanced thermoelectric performance of PEDOT:PSS/PANI-CSA polymer multilayer structures

Hye Jeong Lee, Gopinathan Anoop, Hyeon Jun Lee, Chingu Kim, Ji-Woong Park, Jaeyoo Choi, Heesuk Kim, Yong-Jae Kim, Eunji Lee, Sang-Gil Lee, Young-Min Kim, Joo-Hyoung Lee and Ji Young Jo*

A layer-by-layer deposition of two conducting polymers, each layer of which is a few tenths of nanometer thick, has been successfully performed to enhance the thermoelectric power factor of organic thin films.

2812

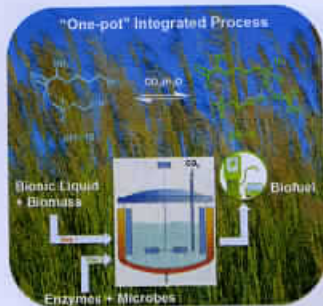


All-inkjet-printed, solid-state flexible supercapacitors on paper

Keun-Ho Choi, JongTae Yoo, Chang Kee Lee and Sang-Young Lee*

All-inkjet-printed, solid-state flexible supercapacitors (SCs) on paper are demonstrated as a new class of power sources with exceptionally versatile aesthetics. The inkjet-printed SCs look like inkjet-printed letters or figures commonly found in office documents and are aesthetically unitized with other printed images on paper.

2822



CO₂ enabled process integration for the production of cellulosic ethanol using bionic liquids

Jian Sun, N. V. S. N. Murthy Konda, Jian Shi, Ramakrishnan Parthasarathi, Tanmoy Dutta, Feng Xu, Corinne D. Scown, Blake A. Simmons and Seema Singh*

An integrated one-pot ionic liquid based biomass processing technology is developed that overcomes pH mismatch of the unit operations and enables ionic liquid reuse resulting in a 50% cost reduction compared with previously studied methods.

2835

Morphology of a high-efficiency...

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2835

Morphology changes upon scaling a high-efficiency, solution-processed solar cell

Hyun Wook Ro, Jonathan M. Downing, Sebastian Engmann, Andrew A. Herzing, Dean M. DeLongchamp,* Lee J. Richter,* Subhrangsu Mukherjee, Harald Ade,* Maged Abdelsamie, Lethy K. Jagadamma, Aram Amassian,* Yuhang Liu and He Yan*

Optimized spin-coating and blade-coating are found to produce similar performance yet notably different morphologies.

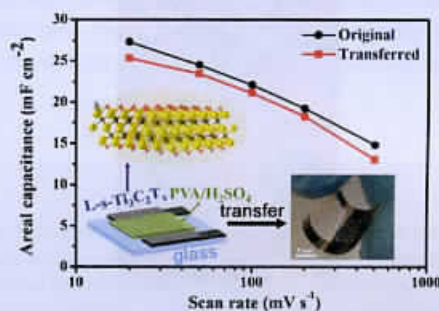


2847

All-MXene (2D titanium carbide) solid-state microsupercapacitors for on-chip energy storage

You-Yu Peng, Bilen Akuzum, Narendra Kurra, Meng-Qiang Zhao, Mohamed Alhabeb, Babak Anasori, Emin Caglan Kumbur, Husam N. Alshareef, Ming-Der Ger and Yury Gogotsi*

Novel, noble-metal-free, solid-state all-titanium carbide ($\text{Ti}_3\text{C}_2\text{T}_x$) MXene microsupercapacitors are fabricated, which exhibit high areal capacitance, excellent rate-capability, and are transferable to any surface.

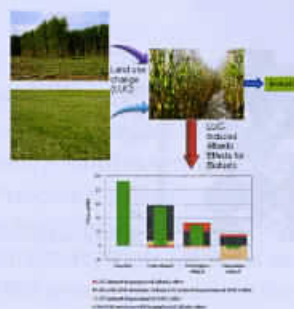


2855

Consideration of land use change-induced surface albedo effects in life-cycle analysis of biofuels

H. Cai,* J. Wang, Y. Feng, M. Wang, Z. Qin and J. B. Dunn

Land use change (LUC)-induced surface albedo effects for expansive biofuel production need to be quantified for improved understanding of biofuel climate impacts.

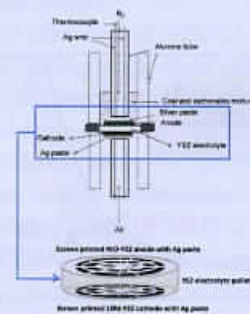


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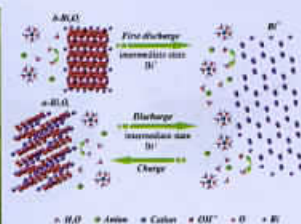
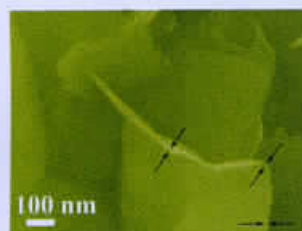
Role of coal characteristics in the electrochemical behaviour of hybrid direct carbon fuel cells

A. Fuente-Cuesta, Cairong Jiang, Ana Arenillas and John T. S. Irvine*

Hybrid direct carbon fuel cells (HDCFCs) are now considered as one of the most efficient options for the generation of clean energy from mineral coals. This work sheds light on the reaction mechanism of the HDCFC operated with raw and pre-treated mineral coals which have been thoroughly characterised and tested.



2881



Bismuth oxide: a versatile high-capacity electrode material for rechargeable aqueous metal-ion batteries

Wenhua Zuo, Weihua Zhu, Dengfeng Zhao, Yunfei Sun, Yuanyuan Li, Jinping Liu* and Xiong Wen (David) Lou*

Bismuth oxide can store energy electrochemically in seventeen aqueous metal ion electrolytes with high capacity based on a "quasi-conversion reaction".

2892

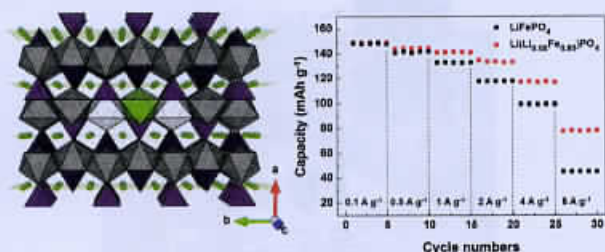


Efficient perovskite solar cells by metal ion doping

J. T.-W. Wang, Z. Wang, S. Pathak, W. Zhang, D. W. deQuilettes, F. Wisnivesky-Rocca-Rivarola, J. Huang, P. K. Nayak, J. B. Patel, H. A. Mohd Yusof, Y. Vaynzof, R. Zhu, I. Ramirez, J. Zhang, C. Ducati, C. Grover, M. B. Johnston, D. S. Ginger, R. J. Nicholas* and H. J. Snaith*

Realizing the theoretical limiting power conversion efficiency (PCE) in perovskite solar cells requires a better understanding and control over the fundamental loss processes occurring in the bulk of the perovskite layer and at the internal semiconductor interfaces in devices.

2902

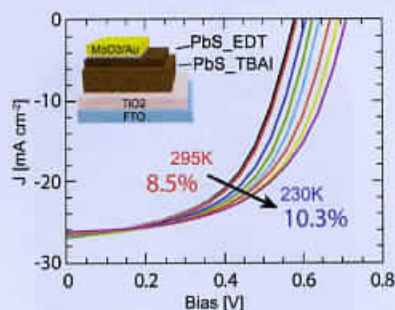


Lithium-excess olivine electrode for lithium rechargeable batteries

Kyu-Young Park, Inchul Park, Hyungsub Kim, Gabin Yoon, Hyeokjo Gwon, Yongbeom Cho, Young Soo Yun, Jung-Joon Kim, Seongsu Lee, Docheon Ahn, Yunok Kim, Haegyeom Kim, Insang Hwang, Won-Sub Yoon and Kisuk Kang*

This article introduces a new type of 'lithium-excess $\text{Li}_{1+x}\text{Fe}_{1-x}\text{PO}_4$ ' cathode material for lithium rechargeable batteries.

2916



Temperature dependent behaviour of lead sulfide quantum dot solar cells and films

Mark J. Speirs, Dmitry N. Dirin, Mustapha Abdu-Aguye, Daniel M. Balazs, Maksym V. Kovalenko and Maria Antonietta Loi*

The temperature dependent behaviour of PbS QD solar cells and thin films was investigated, and guidelines for further improvement of the power conversion efficiency are given.