

IN THIS ISSUE

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Cover
See MacFarlane *et al.*,
pp. 231–249.
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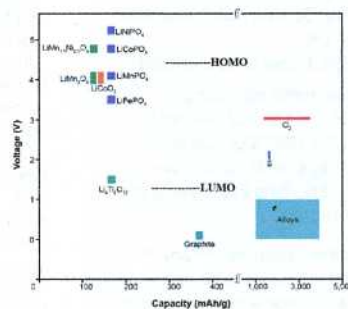
OPINIONS

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Electrochemical energy storage in a sustainable modern society

John B. Goodenough*

Oxide/polymer separator membranes allow alternative strategies for Li-ion and Na-ion batteries storing electrical energy for the grid.



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Reflections on the topic of solar fuels

John Meurig Thomas

For reasons outlined in this article, those who travel on the highly important road towards solar fuels have quite a long way to go before they reach the promised land.

Products from petroleum

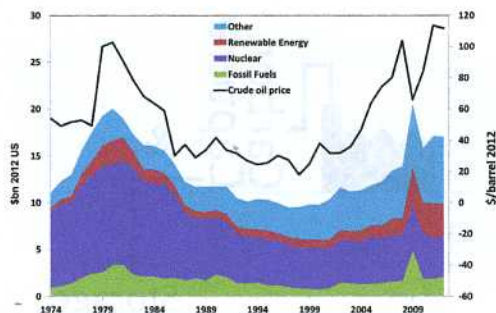
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| <ul style="list-style-type: none"> Teas Crayons Parachutes Telephones Eraser Planes Dishes Cameras Aerobics Artificial Turf Artificial Imbs Bandages Dentures Muscle Cars Folding Doors Hair Cutters Cold cream Movie Film Ski Contact Inners Drinking Cups Fan Belts Car Exhaust Shaving Cream Antiseptic Refrigerators Golf Balls Toothpaste Gasoline | <ul style="list-style-type: none"> Heart Valves Candles Trash Bags House Paint Water Pipes Hand Loom Roller Skates Golf Balls Shampoo Wheels Fair Follies Shower Curtains Guitar Strings Luggage Aspirin Paints Shower Curtains Guitar Strings Luggage Aspirin Safety Glasses Antiseptic Football Helmets Airbags Pyrethrin Clothes Toothbrushes Ice Chests Football Curtains CD's & DVD's Fair Biscuits Deodorant | <ul style="list-style-type: none"> Perfumes TV Cabinets Shag Rugs Electrician's Tape Toilet Racks Car Battery Cases Eraser Plank Mop Wheels Fair Follies Shower Curtains Guitar Strings Luggage Aspirin Safety Glasses Antiseptic Football Helmets Airbags Pyrethrin Clothes Toothbrushes Ice Chests Football Curtains CD's & DVD's Fair Biscuits Deodorant | <ul style="list-style-type: none"> Cartridges Oil/washer parts Tool Boxes Shoe Polish Motorcycle Helmet Caution Parachute Jolly Transparent Tape CD Player Faucet Washers Antiseptic Chisel Curtains Food Preservatives Basketballs Soap Vitamin Capsules Acetic Acid Fluores Shoes Darkboards Carbon Deodorant Football Speakers Dyes Pump Hose Halogenate | <ul style="list-style-type: none"> Dresses Shoes Golf Bags Perfumes Life Jackets Rolling Alcohol Berlin Jackets Rubber Cement Fishing Boats Vaporizers Balloons Sun Glasses Solvents Steel Nail Motor Oil Bearing Grease Ink Flour Wax Ballpoint Pens Football Cleats Upholstery Swimmers Boats Hot-Rubber Bicycle Tires Sports Car Bodies Hull Polish Fishing Lures |
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The renaissance of energy innovation

Jim Skea*

Until recently, energy had all the characteristics of a mature sector.



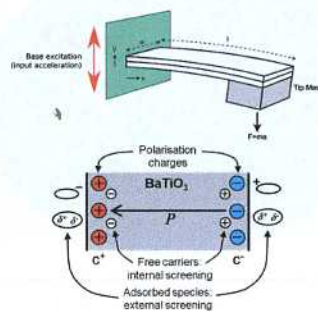
REVIEWS

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Piezoelectric and ferroelectric materials and structures for energy harvesting applications

C. R. Bowen,* H. A. Kim, P. M. Weaver and S. Dunn

This review covers energy harvesting technologies associated with piezoelectric materials along with the sub-classes of pyroelectrics and ferroelectrics. These properties are often present in the same material, providing the intriguing prospect of a material that can harvest energy from multiple sources including vibration, thermal fluctuations and light.

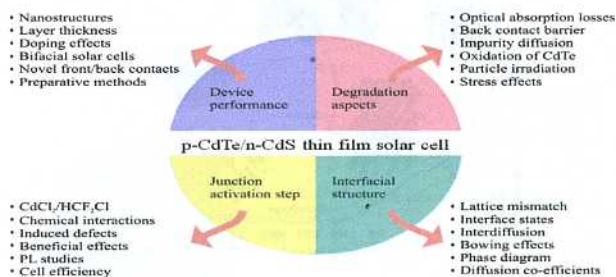


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Physics and chemistry of CdTe/CdS thin film heterojunction photovoltaic devices: fundamental and critical aspects

S. Girish Kumar and K. S. R. Koteswara Rao*

The factors affecting device stability and parameters influencing the device performance are reviewed.



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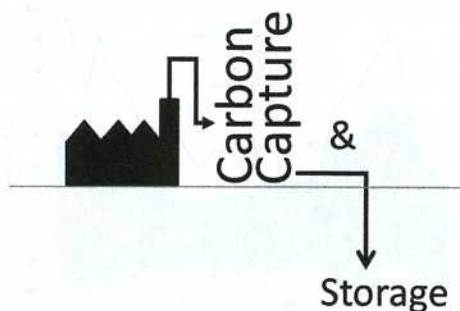
Upgrading of lignin-derived bio-oils by catalytic hydrodeoxygenation

Majid Saidi, Fereshteh Samimi, Dornaz Karimipourfard, Tarit Nimmanwudipong, Bruce C. Gates* and Mohammad Reza Rahimpour*

The incentive for use of renewable resources to replace fossil sources is motivating extensive research on new and alternative fuels derived from biomass.



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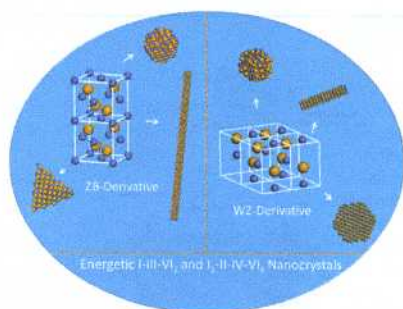


Carbon capture and storage update

M. E. Boot-Handford, J. C. Abanades, E. J. Anthony, M. J. Blunt, S. Brandani, N. Mac Dowell, J. R. Fernández, M.-C. Ferrari, R. Gross, J. P. Hallett, R. S. Haszeldine, P. Heptonstall, A. Lyngfelt, Z. Makuch, E. Mangano, R. T. J. Porter, M. Pourkashanian, G. T. Rochelle, N. Shah, J. G. Yao and P. S. Fennell*

A comprehensive discussion of CCS technologies, deployment and prospects across the world.

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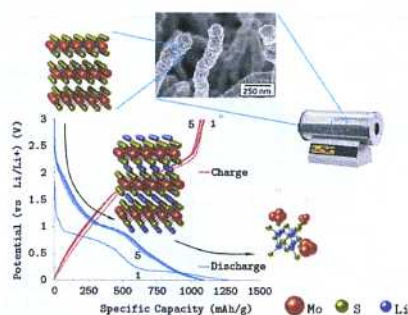


Energetic I-III-VI₂ and I₂-II-IV-VI₄ nanocrystals: synthesis, photovoltaic and thermoelectric applications

Feng-Jia Fan, Liang Wu and Shu-Hong Yu*

Recent developments in colloidal syntheses, photovoltaic and thermoelectric applications of I-III-VI₂ and I₂-II-IV-VI₄ nanocrystals have been summarized and overviewed.

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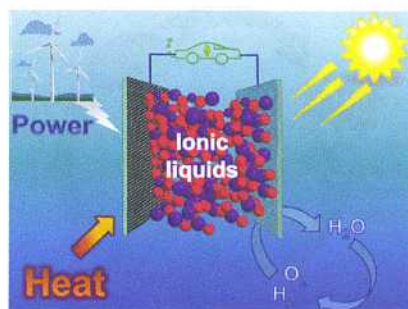
Lithium ion battery applications of molybdenum disulfide (MoS₂) nanocomposites

Tyler Stephenson,* Zhi Li, Brian Olsen and David Mitlin*

This work highlights the synthesis – microstructure – performance relationships for molybdenum disulfide in lithium ion batteries, conducts a comparative assessment, and identifies areas requiring further study.

PERSPECTIVES

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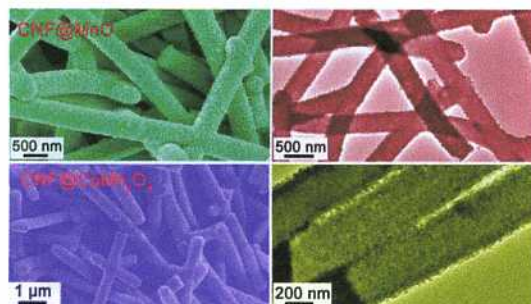


Energy applications of ionic liquids

Douglas R. MacFarlane,* Naoki Tachikawa, Maria Forsyth, Jennifer M. Pringle, Patrick C. Howlett, Gloria D. Elliott, James H. Davis Jr., Masayoshi Watanabe, Patrice Simon and C. Austen Angell

Ionic liquids offer a unique suite of properties that make them important candidates for a number of energy related applications.

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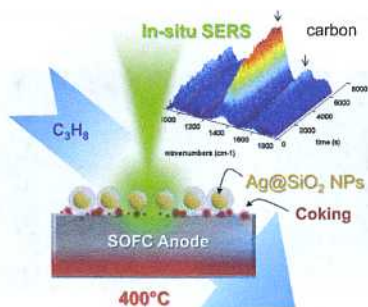


Strongly coupled carbon nanofiber–metal oxide coaxial nanocables with enhanced lithium storage properties

Genqiang Zhang, Hao Bin Wu, Harry E. Hoster and Xiong Wen (David) Lou*

Strongly coupled coaxial nanocables consisting of metal oxides (MnO and CoMn_2O_4) on carbon nanofibers exhibit remarkable reversible lithium storage properties.

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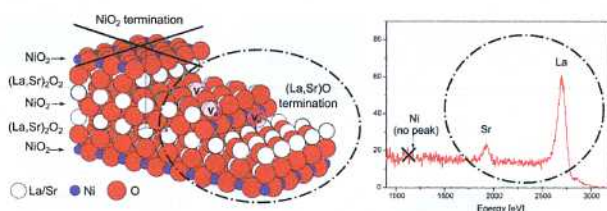


High-temperature surface enhanced Raman spectroscopy for *in situ* study of solid oxide fuel cell materials

Xiaxi Li, Jung-Pil Lee, Kevin S. Blinn, Dongchang Chen, Seungmin Yoo, Bin Kang, Lawrence A. Bottomley, Mostafa A. El-Sayed, Soojin Park and Meilin Liu*

SiO_2 shell isolated Ag nanoparticles significantly amplify the Raman signals from solid oxide fuel cell electrodes, allowing identification of surface species present in trace amounts under *in situ* conditions.

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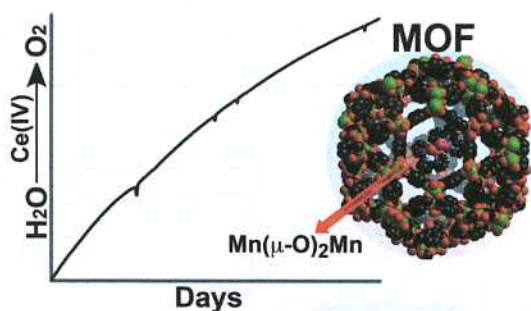


Absence of Ni on the outer surface of Sr doped La_2NiO_4 single crystals

Mónica Burriel,* Stuart Wilkins, John P. Hill, Miguel A. Muñoz-Márquez, Hidde H. Brongersma, John A. Kilner, Mary P. Ryan and Stephen J. Skinner*

Low energy ion scattering used in combination with other surface sensitive techniques has unequivocally shown that Ni is not present in the outermost atomic layer of $\text{La}_{2-x}\text{Sr}_x\text{NiO}_{4+\delta}$.

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Biomimetic di-manganese catalyst cage-isolated in a MOF: robust catalyst for water oxidation with Ce(IV), a non-O-donating oxidant

Rebecca E. Hansen and Siddhartha Das*

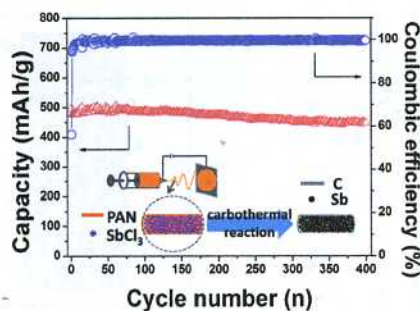
Biomimetic Mn-catalyst shows sustained water oxidation with Ce^{4+} upon isolation in MOF-pores. Importance of single-molecule-cage-isolation is explored.

323

Sb–C nanofibers with long cycle life as an anode material for high-performance sodium-ion batteries

Lin Wu, Xiaohong Hu,* Jiangfeng Qian, Feng Pei, Fayuan Wu, Rongjun Mao, Xinping Ai, Hanxi Yang and Yuliang Cao*

Sb–C nanofiber anodes can deliver a large reversible capacity of 631 mA h g^{-1} and excellent cycling stability for high-performance Na-ion batteries.

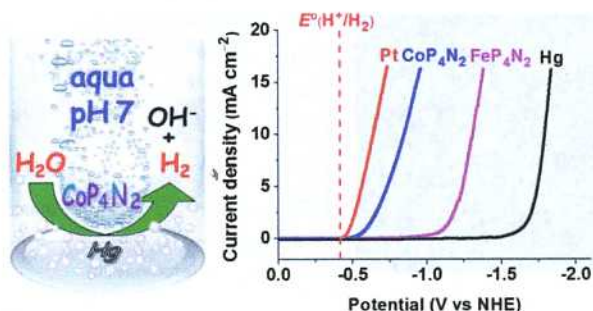


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A super-efficient cobalt catalyst for electrochemical hydrogen production from neutral water with 80 mV overpotential

Lin Chen, Mei Wang,* Kai Han, Peili Zhang, Frederic Gloaguen and Licheng Sun*

A cobalt complex electrocatalyzes hydrogen production from neutral water at low overpotentials while maintaining high activity and good stability.

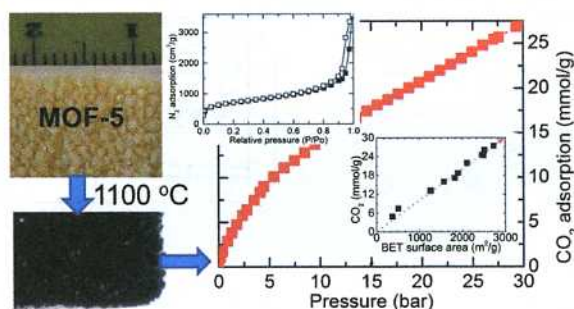


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Exceptional CO₂ capture in a hierarchically porous carbon with simultaneous high surface area and pore volume

Gadipelli Srinivas,* Vaiva Krungleviciute, Zheng-Xiao Guo and Taner Yildirim*

Highly hierarchical porous carbons from MOFs show simultaneously high surface areas, up to $2730 \text{ m}^2 \text{ g}^{-1}$, very high total pore volumes, up to $5.53 \text{ cm}^3 \text{ g}^{-1}$ and excellent CO₂ adsorption over 27 mmol g^{-1} (119 wt%) at 30 bar and 300 K.

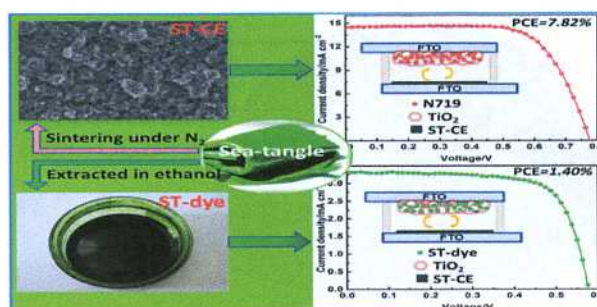


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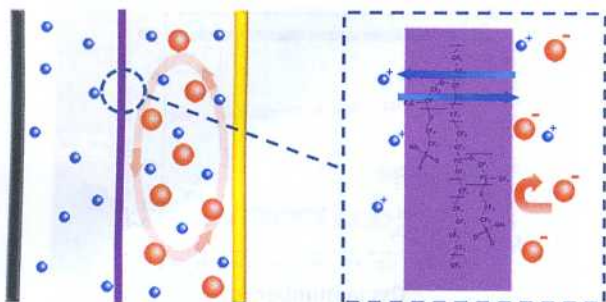
From marine plants to photovoltaic devices

Liang Wang, Yantao Shi,* Xiaogong Bai, Yujin Xing, Hong Zhang, Lin Wang, Wei Guo, Ning Wang, Tingli Ma* and Michael Grätzel

All-natural dye-sensitized solar cells have been assembled and demonstrated excellent performance. They open a new way for rationalising use of natural materials.



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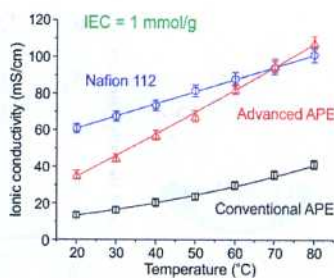
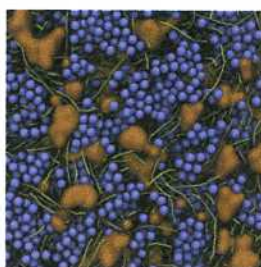


Ionic shield for polysulfides towards highly-stable lithium–sulfur batteries

Jia-Qi Huang, Qiang Zhang,* Hong-Jie Peng, Xin-Yan Liu, Wei-Zhong Qian and Fei Wei*

A polysulfide shield is built by an ion selective membrane, which improves the stability and coulombic efficiency of Li–S cells.

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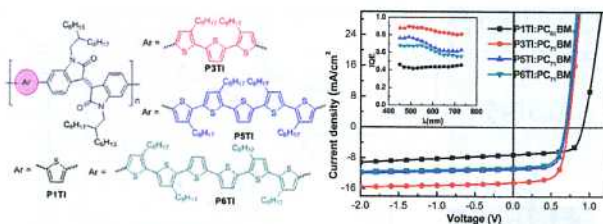


Constructing ionic highway in alkaline polymer electrolytes

Jing Pan, Chen Chen, Yao Li, Lei Wang, Lisheng Tan, Guangwei Li, Xun Tang, Li Xiao, Juntao Lu and Lin Zhuang*

For the first time, the ion conduction in APE can be as efficient as that in Nafion at fuel-cell operating temperatures.

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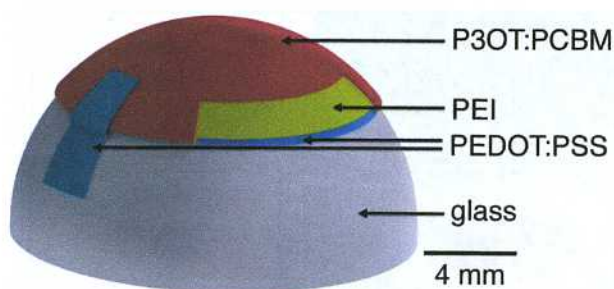


Structure–property relationships of oligothiophene–isoindigo polymers for efficient bulk-heterojunction solar cells

Zaifei Ma, Wenjun Sun, Scott Himmelberger, Koen Vandewal, Zheng Tang, Jonas Bergqvist, Alberto Salleo, Jens Wenzel Andreasen, Olle Inganäs, Mats R. Andersson, Christian Müller, Fengling Zhang and Ergang Wang*

A PCE of 6.9% was achieved by oligothiophene–isoindigo polymer-based solar cells with a driving force as low as ~ 0.1 eV.

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Stretching and conformal bonding of organic solar cells to hemispherical surfaces

Timothy F. O'Connor, Aliaksandr V. Zaretski, Bijan A. Shiravi, Suchol Savagatrup, Adam D. Printz, Mare Ivana Diaz and Darren J. Lipomi*

This paper describes the stretching and conformal bonding (*i.e.*, decal-transfer printing) of organic solar cells in both the "conventional" and "inverted" configurations to hemispherical glass surfaces with radii of 8 mm.

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Human hair-derived carbon flakes for electrochemical supercapacitors

Wenjing Qian, Fengxia Sun, Yanhui Xu, Lihua Qiu, Changhai Liu, Suidong Wang and Feng Yan*

Human hair-derived carbon flakes were prepared and employed for high-performance supercapacitor electrode materials. The HMC-800 shows a specific capacitance of 340 F g^{-1} at a current density of 1 A g^{-1} and an excellent long-term stability over 20 000 cycles.

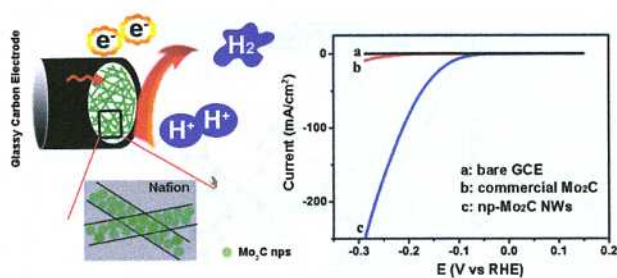


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A nanoporous molybdenum carbide nanowire as an electrocatalyst for hydrogen evolution reaction

Lei Liao, Sinong Wang, Jingjing Xiao, Xiaojun Bian, Yahong Zhang, Micheál D. Scanlon, Xile Hu, Yi Tang,* Baohong Liu* and Hubert H. Girault

Nanoporous molybdenum carbide nanowires exhibit superior electrocatalytic activity towards hydrogen evolution reaction attributed to abundant nanoporosity, large surface area and high dispersibility of np-Mo₂C NWs.



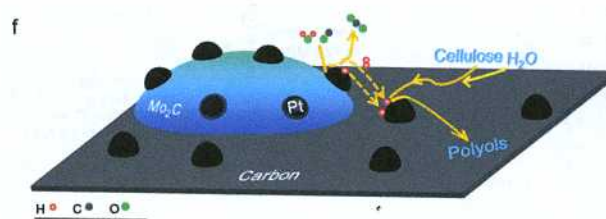
COMMUNICATION

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Direct conversion of cellulose using carbon monoxide and water on a Pt–Mo₂C/C catalyst

Jing Li, Lingtao Liu, Yue Liu, Mingzhe Li, Yihan Zhu, Haichao Liu, Yuan Kou, Jizhe Zhang, Yu Han* and Ding Ma*

Cellulose conversion to polyols using CO–water is realized over Pt–Mo₂C/C catalyst.



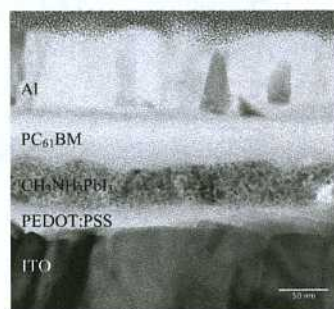
PAPERS

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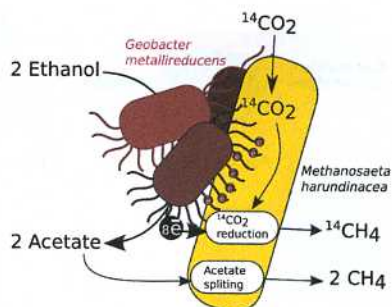
The origin of high efficiency in low-temperature solution-processable bilayer organometal halide hybrid solar cells

Shuangyong Sun, Teddy Salim, Nripan Mathews, Martial Duchamp, Chris Boothroyd, Guichuan Xing, Tze Chien Sum and Yeng Ming Lam*

A planar heterojunction device based on organic–inorganic lead halide/PC₆₁BM can achieve a PCE of 7.4% and an IQE near 100%.



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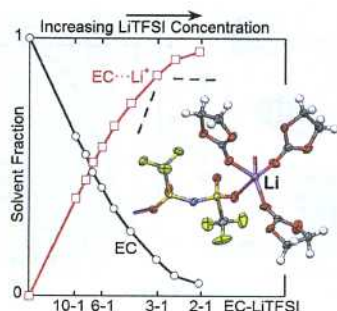


A new model for electron flow during anaerobic digestion: direct interspecies electron transfer to *Methanoseta* for the reduction of carbon dioxide to methane

Amelia-Elena Rotaru,* Pravin Malla Shrestha, Fanghua Liu, Minita Shrestha, Devesh Shrestha, Mallory Embree, Karsten Zengler, Colin Wardman, Kelly P. Nevin and Derek R. Lovley

Novel properties discovered in *Methanoseta*, the world's most prodigious methanogen.

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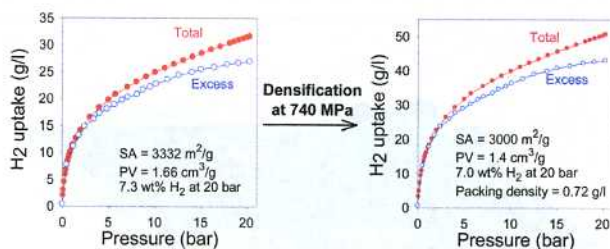


Concentrated electrolytes: decrypting electrolyte properties and reassessing Al corrosion mechanisms

Dennis W. McOwen, Daniel M. Seo, Oleg Borodin, Jenel Vatamanu, Paul D. Boyle and Wesley A. Henderson*

Highly concentrated EC-LiTFSI electrolytes or mixed carbonate solvent-LiTFSI electrolytes have greatly improved thermal and anodic stability, as compared to dilute electrolytes with bulk solvent present, due to extensive solvent and anion coordination to the Li^+ cations. Despite the use of the LiTFSI salt, Al corrosion is effectively suppressed for the concentrated electrolytes.

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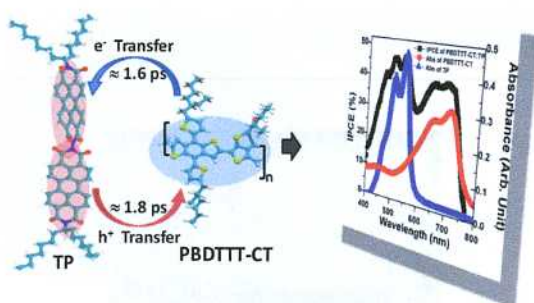


Exceptional gravimetric and volumetric hydrogen storage for densified zeolite templated carbons with high mechanical stability

Eric Masika and Robert Mokaya*

Densification of zeolite templated carbons increases their volumetric hydrogen uptake from ca. 31 g l⁻¹ to >50 g l⁻¹ at 20 bar and -196 °C.

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Charge generation and transport in efficient organic bulk heterojunction solar cells with a perylene acceptor

Ravichandran Shivanna, Safa Shoae,* Stoichko Dimitrov, Sunil Kumar Kandappa, Sridhar Rajaram,* James R. Durrant* and K. S. Narayan*

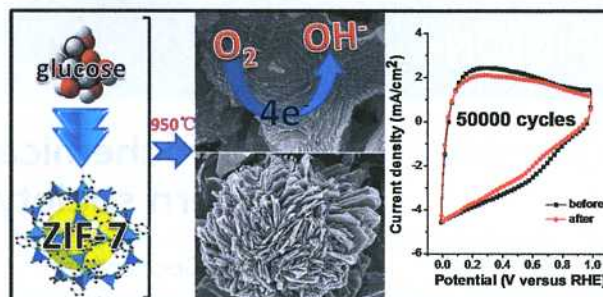
Efficient photoinduced electron and hole transfer between PBDTTT-CT and TP, covering the entire visible range for efficient non-fullerene BHJ solar cells.

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ZIF-derived *in situ* nitrogen-doped porous carbons as efficient metal-free electrocatalysts for oxygen reduction reaction

Peng Zhang, Fang Sun, Zhonghua Xiang, Zhigang Shen, Jimmy Yun and Dapeng Cao*

We found that ZIF-derived nitrogen-doped porous carbons as metal-free electrocatalysts for ORR exhibit excellent electrocatalytic activity and operation stability.

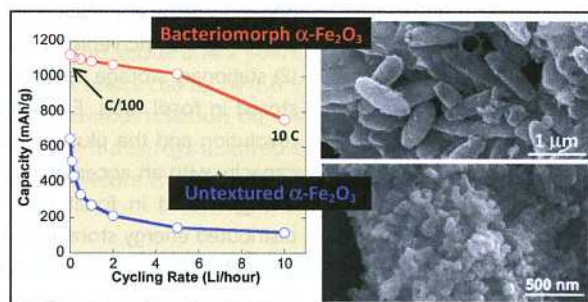


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Biomaterialized α -Fe₂O₃: texture and electrochemical reaction with Li

J. Miot, N. Recham, D. Larcher,* F. Guyot, J. Brest and J.-M. Tarascon

Biomaterialized γ -FeOOH is used as a precursor for α -Fe₂O₃ bacteriomorphs exhibiting enhanced power capabilities and reversibility when reacted with Li.



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