

IN THIS ISSUE

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Cover

See Guillermo C. Bazan *et al.*, pp. 2341–2346. Image reproduced by permission of Guillermo C. Bazan from *Energy Environ. Sci.*, 2015, 8, 2341.



Inside cover

See David W. Wakerley and Erwin Reisner, pp. 2283–2295. Image reproduced by permission of Erwin Reisner from *Energy Environ. Sci.*, 2015, 8, 2283.

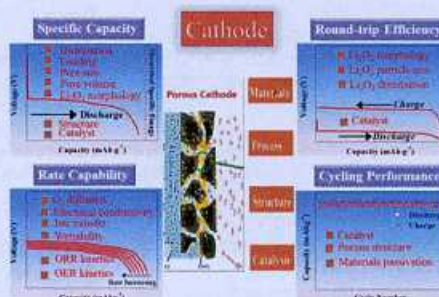
REVIEWS

2144

A review of cathode materials and structures for rechargeable lithium–air batteries

Zhong Ma, Xianxia Yuan,* Lin Li, Zi-Feng Ma, David P. Wilkinson, Lei Zhang and Jiujun Zhang

This review is specifically focused on the progress in the cathodes for non-aqueous Li–air batteries in the terms of the materials, structure and fabrication.

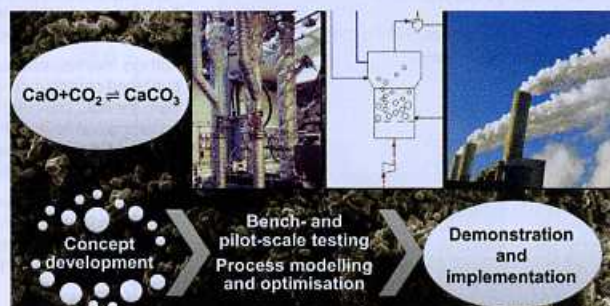


2199

A review of developments in pilot-plant testing and modelling of calcium looping process for CO₂ capture from power generation systems

Dawid P. Hanak, Edward J. Anthony* and Vasilije Manovic

A nearly complete decarbonisation of the power sector is essential to meet the European Union target for greenhouse gas emissions reduction.

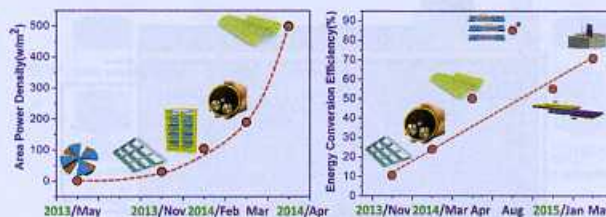


2250

Progress in triboelectric nanogenerators as a new energy technology and self-powered sensors

Zhong Lin Wang,* Jun Chen and Long Lin

A review on the principles, novel applications and perspectives of triboelectric nanogenerators as power sources and as self-powered sensors.



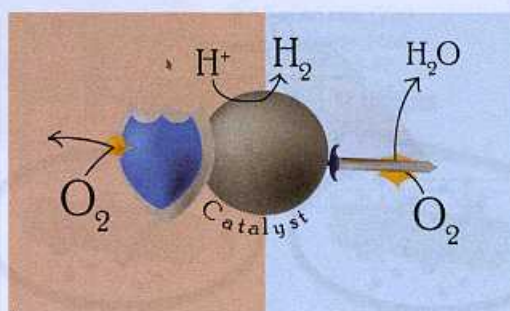
PERSPECTIVES

2283

Oxygen-tolerant proton reduction catalysis: much O₂ about nothing?

David W. Wakerley and Erwin Reisner*

This perspective summarises strategies for avoiding adverse effects of O₂ on H₂-evolving enzymatic systems, molecular synthetic catalysts and catalytic surfaces.

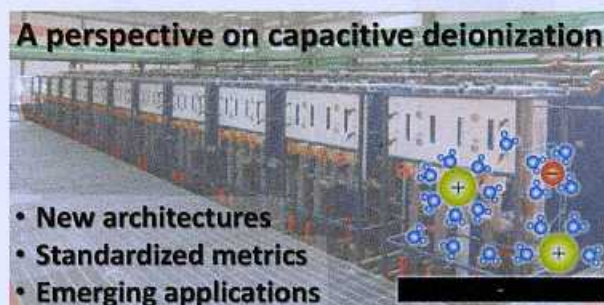


2296

Water desalination via capacitive deionization: what is it and what can we expect from it?

M. E. Suss,* S. Porada, X. Sun, P. M. Biesheuvel, J. Yoon and V. Presser*

Capacitive deionization (CDI) is a promising technology for water desalination that has seen tremendous advances over the past five years.



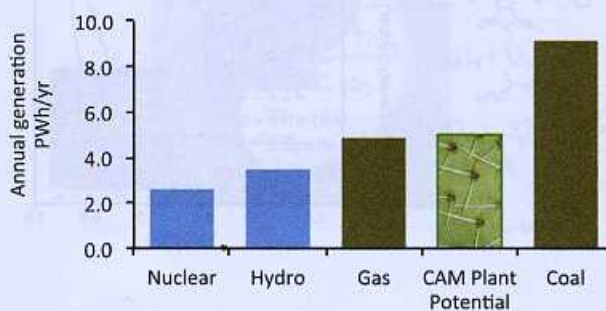
ANALYSIS

2320

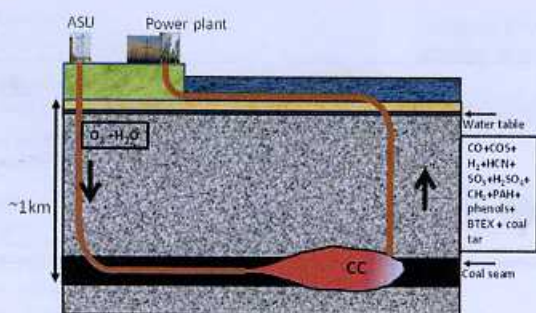
The potential of CAM crops as a globally significant bioenergy resource: moving from 'fuel or food' to 'fuel and more food'

P. M. Mason,* K. Glover, J. A. C. Smith, K. J. Willis, J. Woods and I. P. Thompson

4–15% of the 2.5 bn ha of semi-arid land globally could generate 59 PW h year⁻¹ of electricity without reducing food production, enough to make a major difference to global GHG emissions. The key is anaerobic digestion of a class of understudied, under-developed and hyper-water-efficient plants that use the crassulacean acid metabolism.



2330



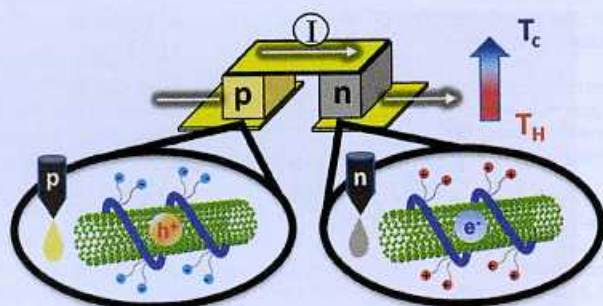
The feasibility of *in situ* geological sequestration of supercritical carbon dioxide coupled to underground coal gasification

David J. Schiffrin

The environmental issues related to the proposed UCG-*in situ* CCS technique are analysed. The putative advantage of synthesising liquid fuels from the produced "syngas" would lead to greatly enhanced CO₂ emissions.

COMMUNICATIONS

2341

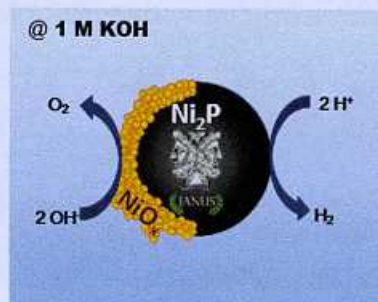


Varying the ionic functionalities of conjugated polyelectrolytes leads to both p- and n-type carbon nanotube composites for flexible thermoelectrics

Cheng-Kang Mai, Boris Russ, Stephanie L. Fronk, Nan Hu, Mary B. Chan-Park, Jeffrey J. Urban, Rachel A. Segalman, Michael L. Chabinyc and Guillermo C. Bazan*

Selective doping of single-walled carbon nanotubes can be achieved by varying pendant ionic functionalities of conjugated polyelectrolytes.

2347

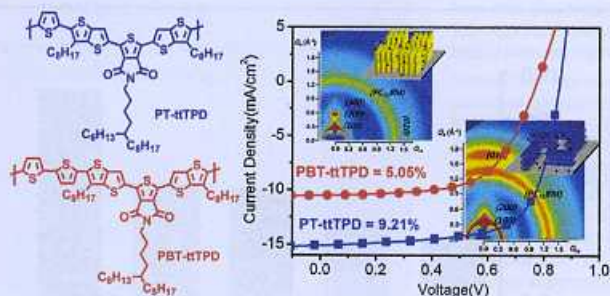


Ni₂P as a Janus catalyst for water splitting: the oxygen evolution activity of Ni₂P nanoparticles

Lucas-Alexandre Stern, Ligang Feng, Fang Song and Xile Hu*

Ni₂P is a bifunctional catalyst for both hydrogen and oxygen evolution reactions.

2352



Well-controlled thieno[3,4-c]pyrrole-4,6-(5H)-dione based conjugated polymers for high performance organic photovoltaic cells with the power conversion efficiency exceeding 9%

Ji-Hoon Kim, Jong Baek Park, In Hwan Jung, Andrew C. Grimsdale, Sung Cheol Yoon, Hoichang Yang and Do-Hoon Hwang*

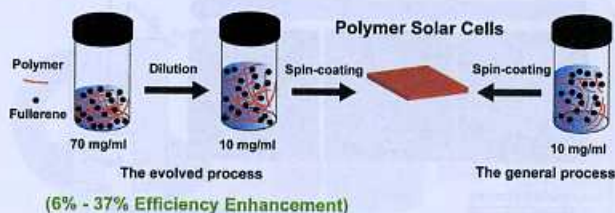
A series of conjugated copolymers based on a TPD moiety was synthesized as donor materials for OPVs.

2357

Diluting concentrated solution: a general, simple and effective approach to enhance efficiency of polymer solar cells

Pei Cheng, Cenqi Yan, Yongfang Li, Wei Ma* and Xiaowei Zhan*

Diluting concentrated solution (DCS) is a new, simple, general and effective approach to improve power conversion efficiencies of polymer solar cells.

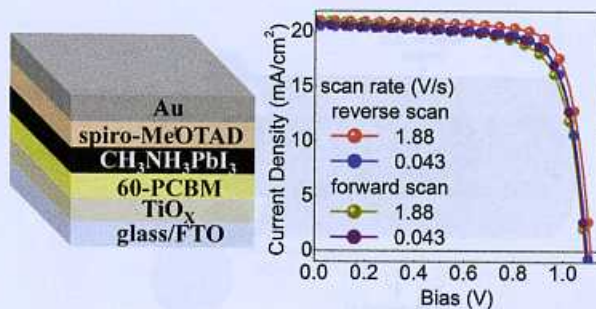


2365

17.6% stabilized efficiency in low-temperature processed planar perovskite solar cells

Chen Tao, Stefanie Neutzner, Letizia Colella, Sergio Marras, Ajay Ram Srimath Kandada, Marina Gandini, Michele De Bastiani, Giuseppina Pace, Liberato Manna, Mario Caironi, Chiara Bertarelli and Annamaria Petrozza*

Compact TiO_2 is replaced by a low-temperature solution-processed $\text{TiO}_x/60\text{-PCBM}$ layer for electron extraction in perovskite solar cells with high steady conversion efficiencies.

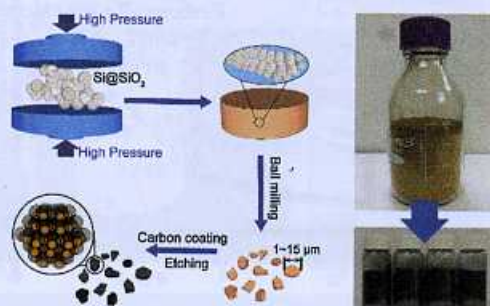


2371

A high tap density secondary silicon particle anode fabricated by scalable mechanical pressing for lithium-ion batteries

Dingchang Lin, Zhenda Lu, Po-Chun Hsu, Hye Ryoung Lee, Nian Liu, Jie Zhao, Haotian Wang, Chong Liu and Yi Cui*

Large-scale fabrication of a high-tape-density and high-performance nanostructured Si anode was achieved by a mechanical approach.

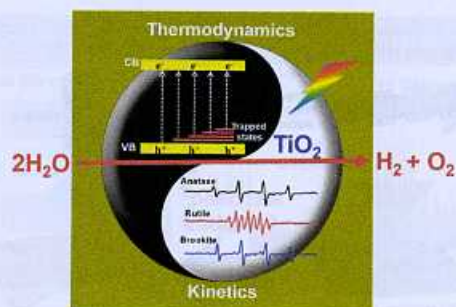


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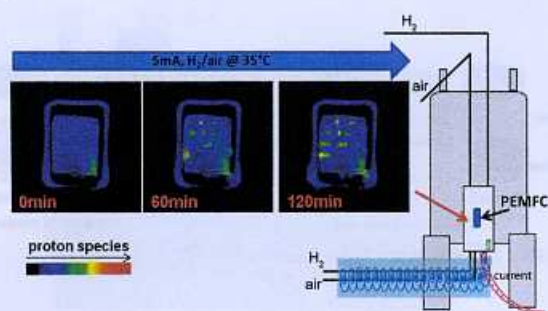
Achieving overall water splitting using titanium dioxide-based photocatalysts of different phases

Rengui Li, Yuxiang Weng, Xin Zhou, Xiuli Wang, Yang Mi, Ruifeng Chong, Hongxian Han and Can Li*

Photocatalytic overall water splitting on TiO_2 -based photocatalysts is determined by both thermodynamics and kinetics simultaneously.



2383

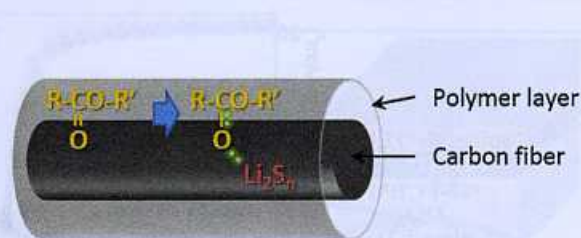


Operando electrochemical NMR microscopy of polymer fuel cells

A. S. Cattaneo, D. C. Villa, S. Angioni, C. Ferrara, R. Melzi, E. Quartarone and P. Mustarelli*

Electrochemical NMR microscopy is a breakthrough in *operando* characterization of electrochemical devices, such as fuel cells and batteries.

2389

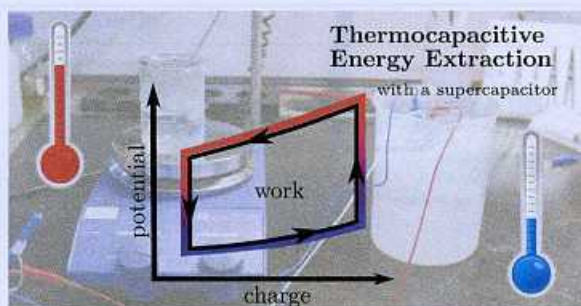


Trapping lithium polysulfides of a Li-S battery by forming lithium bonds in a polymer matrix

Kyusung Park, Joon Hee Cho, Ji-Hoon Jang, Byeong-Chul Yu, Andrea T. De La Hoz, Kevin M. Miller, Christopher J. Ellison and John B. Goodenough*

Trapping lithium polysulfides of a Li-S battery has been successfully demonstrated by forming lithium bonds in a polymer matrix.

2396



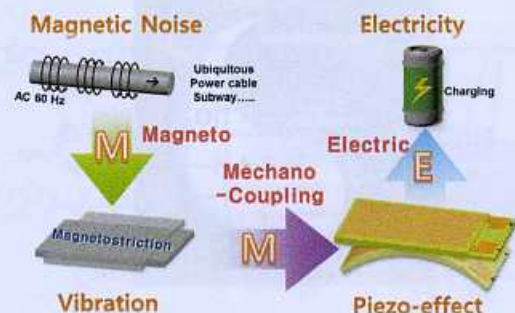
Heat-to-current conversion of low-grade heat from a thermocapacitive cycle by supercapacitors

Andreas Härtel,* Mathijs Janssen, Daniel Weingarth, Volker Presser and René van Roij

The thermal voltage rise in supercapacitors can be used to convert efficiently low-grade heat into electric energy.

PAPERS

2402



Ubiquitous magneto-mechano-electric generator

Jungho Ryu,* Ju-Eun Kang, Yuan Zhou, Si-Young Choi, Woon-Ha Yoon, Dong-Soo Park, Jong-Jin Choi, Byung-Dong Hahn, Cheol-Woo Ahn, Jong-Woo Kim, Yang-Do Kim, Shashank Priya, Seung Yong Lee, Seongsu Jeong and Dae-Yong Jeong*

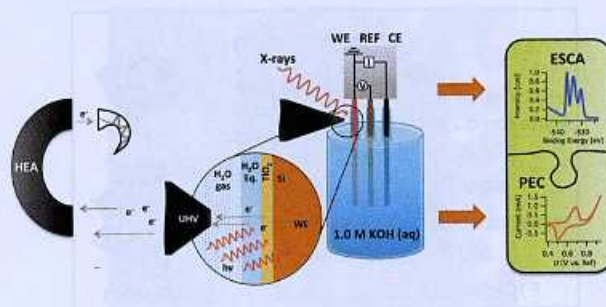
A novel energy capturing technique for wasted parasitic magnetic noise based upon a magneto-mechano-electric (MME) generator, consisting of piezoelectric single crystal fibers and Ni metal plate in the form of cantilever structure.

2409

Direct observation of the energetics at a semiconductor/liquid junction by *operando* X-ray photoelectron spectroscopy

Michael F. Lichterman, Shu Hu, Matthias H. Richter, Ethan J. Crumlin, Stephanus Axnanda, Marco Favaro, Walter Drisdell, Zahid Hussain, Thomas Mayer, Bruce S. Brunschwig,* Nathan S. Lewis,* Zhi Liu* and Hans-Joachim Lewerenz*

Via *operando* XPS, band bending, pinning, and other properties are observed.

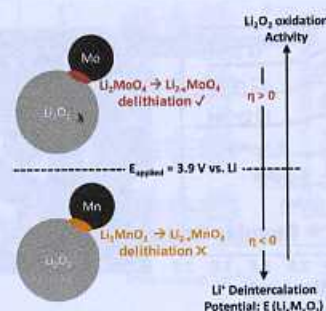


2417

Solid-state activation of Li_2O_2 oxidation kinetics and implications for Li– O_2 batteries

Koffi P. C. Yao, Marcel Risch, Sayed Youssef Sayed, Yueh-Lin Lee, Jonathon R. Harding, Alexis Grimaud, Nir Pour, Zhichuan Xu, Jigang Zhou, Azzam Mansour, Fanny Bardé and Yang Shao-Horn*

Solid-state activation of Li_2O_2 oxidation is mediated by chemical conversion of Li_2O_2 with slow oxidation kinetics to a lithium metal oxide with generally faster kinetics.

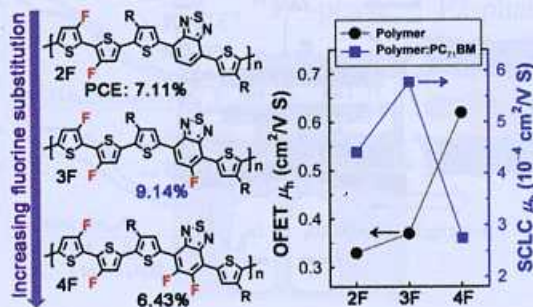


2427

Fluorination on both D and A units in D–A type conjugated copolymers based on difluorobithiophene and benzothiadiazole for highly efficient polymer solar cells

Jea Woong Jo, Jae Woong Jung, Eui Hyuk Jung, Hyungju Ahn, Tae Joo Shin and Won Ho Jo*

The optimization of the number of fluorine substitution in D–A polymers composed of difluorobithiophene and benzothiadiazole reveals that the polymer with mono-fluorinated benzothiadiazole exhibits a PCE of 9.14%.

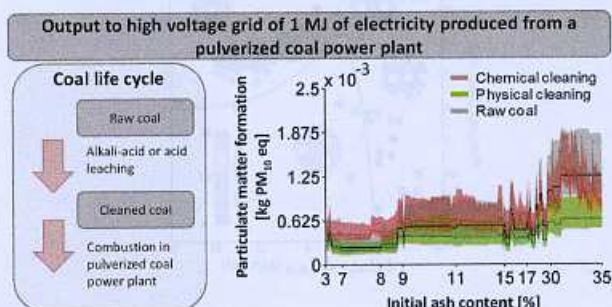


2435

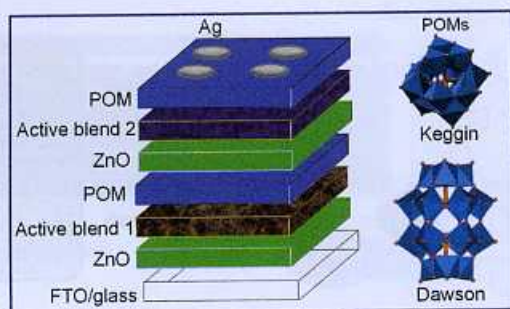
Power generation from chemically cleaned coals: do environmental benefits of firing cleaner coal outweigh environmental burden of cleaning?

Morten W. Ryberg,* Mikotaj Owsianiak, Alexis Laurent and Michael Z. Hauschild

Chemical beneficiation of coals using acid and alkali–acid leaching procedures is assessed as a potential coal cleaning technology employing life cycle assessment.



2448



Annealing-free highly crystalline solution-processed molecular metal oxides for efficient single-junction and tandem polymer solar cells

Maria Vasilopoulou,* Ermioni Polydorou, Antonios M. Douvas, Leonidas C. Palilis, Stella Kennou and Panagiotis Argitis

The compatibility of polyoxometalates as hole extraction layers in single-junction organic photovoltaics and as recombination layers in polymer tandem cells is demonstrated.

2464

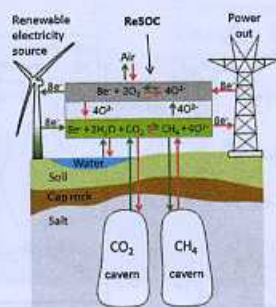


Abnormal crystal growth in $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$ using a multi-cycle solution coating process

Qingfeng Dong, Yongbo Yuan, Yuchuan Shao, Yanjun Fang, Qi Wang and Jinsong Huang*

Multi-cycle coating of mixed halide perovskite films by incorporating Cl in precursors induces abnormal grain growth with appearance of very large grains.

2471

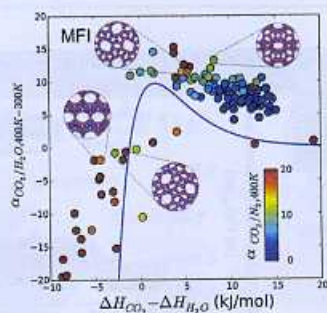


Large-scale electricity storage utilizing reversible solid oxide cells combined with underground storage of CO_2 and CH_4

S. H. Jensen,* C. Graves, M. Mogensen, C. Wendel, R. Braun, G. Hughes, Z. Gao and S. A. Barnett

Electricity storage is needed on an unprecedented scale to sustain the ongoing transition of electricity generation from fossil fuels to intermittent renewable energy sources like wind and solar power.

2480



Carbon capture turned upside down: high-temperature adsorption & low-temperature desorption (HALD)

Lennart Joos, Kurt Lejaeghere, Johanna M. Huck, Veronique Van Speybroeck and Berend Smit*

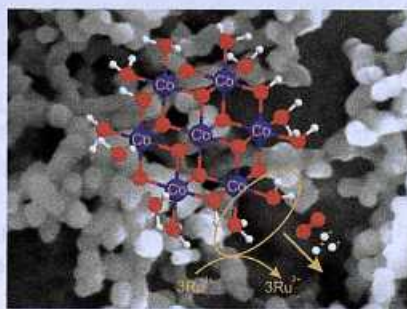
Screening the international zeolite database identified the most promising materials for high-temperature adsorption & low-temperature desorption.

2492

First turnover analysis of water-oxidation catalyzed by Co-oxide nanoparticles

Sergey Koroidov, Magnus F. Anderlund, Stenbjörn Styring, Anders Thapper and Johannes Messinger*

This paper establishes mass spectrometric 'First Turnover Analysis' after rapid $H_2^{18}O$ -labelling as method for deriving the mechanism of water oxidation.

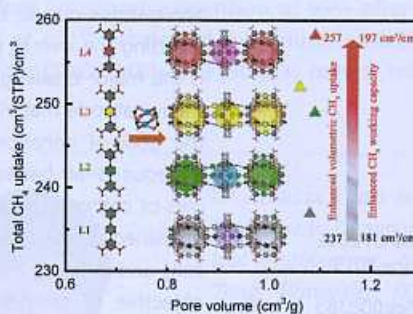


2504

Porous metal-organic frameworks with Lewis basic nitrogen sites for high-capacity methane storage

Bin Li, Hui-Min Wen, Hailong Wang, Hui Wu, Taner Yildirim, Wei Zhou* and Banglin Chen*

Incorporation of functional groups with Lewis basic nitrogen sites, including pyridine, pyridazine and pyrimidine groups, into NOTT-101 can remarkably improve both the total volumetric methane storage (at 65 bar and room temperature) and working capacities.



2512

Structure of the high voltage phase of layered P2- $Na_{2/3-z}[Mn_{1/2}Fe_{1/2}]O_2$ and the positive effect of Ni substitution on its stability

Elahe Talaie, Victor Duffort, Hillary L. Smith, Brent Fultz and Linda F. Nazar*

Using in-depth structural and spectroscopic analysis, we unravel the nature of phenomena specific to the Fe^{3+}/Fe^{4+} redox couple in $P2-Na_{0.67-z}[Ni_yMn_{0.5+y}Fe_{0.5-2y}]O_2$.

