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IN THIS ISSUE

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Cover

See Ming Zhao, Paul S. Fennell *et al.*, pp. 2939–2977. Image reproduced by permission of Ming Zhao from *Energy Environ. Sci.*, 2016, 9, 2939.



Inside cover

See Jiayan Luo, Quan-Hong Yang *et al.*, pp. 3135–3142. Image reproduced by permission of Quanhong Yang from *Energy Environ. Sci.*, 2016, 9, 3135.

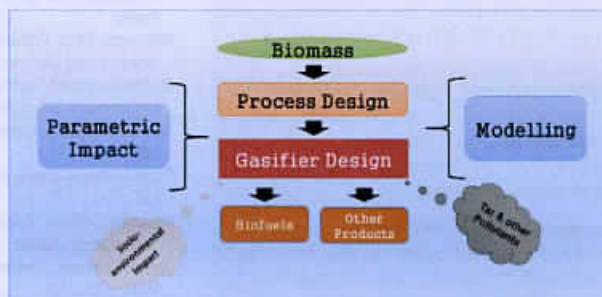
REVIEWS

2939

An overview of advances in biomass gasification

Vineet Singh Sikarwar, Ming Zhao,* Peter Clough, Joseph Yao, Xia Zhong, Mohammad Zaki Memon, Nilay Shah, Edward J. Anthony and Paul S. Fennell*

The article reviews diverse areas of conventional and advanced biomass gasification discussing their feasibility and sustainability *vis-à-vis* technological and socio-environmental impacts.

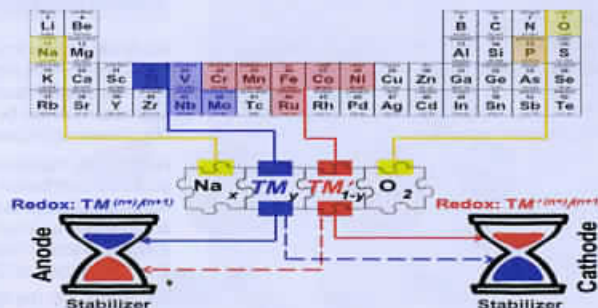


2978

Recent advances in titanium-based electrode materials for stationary sodium-ion batteries

Shaohua Guo, Jin Yi, Yang Sun* and Haoshen Zhou*

This article presents a comprehensive and critical review on the recent progress of titanium-based electrode materials for sodium-ion batteries.

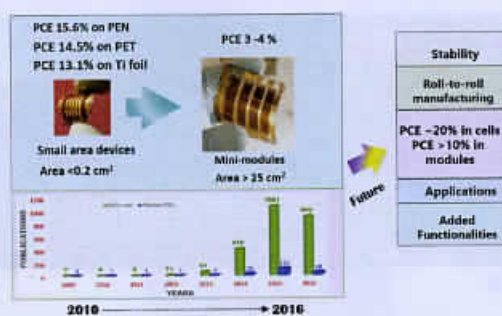


3007

Progress, challenges and perspectives in flexible perovskite solar cells

Francesco Di Giacomo, Azhar Fakharuddin, Rajan Jose and Thomas M. Brown*

A review and perspective on the development of perovskite solar cells on flexible substrates.



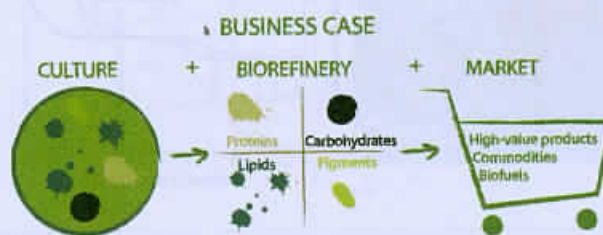
PERSPECTIVES

3036

Towards industrial products from microalgae

Jesús Ruiz, Giuseppe Olivieri, Jeroen de Vree, Rouke Bosma, Philippe Willems, J. Hans Reith, Michel H. M. Eppink, Dorinde M. M. Kleinegriss, René H. Wijffels* and Maria J. Barbosa

Model projections show that production of high-value products from microalgae could be profitable nowadays and commodities will become profitable within 10 years.

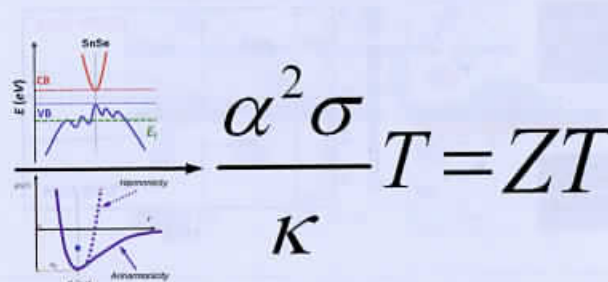


3044

SnSe: a remarkable new thermoelectric material

Li-Dong Zhao,* Cheng Chang, Gangjian Tan and Mercouri G. Kanatzidis*

It is remarkable that SnSe exhibits complex band structures and strong anharmonic bonding, endowing it with a high power factor and low thermal conductivity.



MINIREVIEW

3061

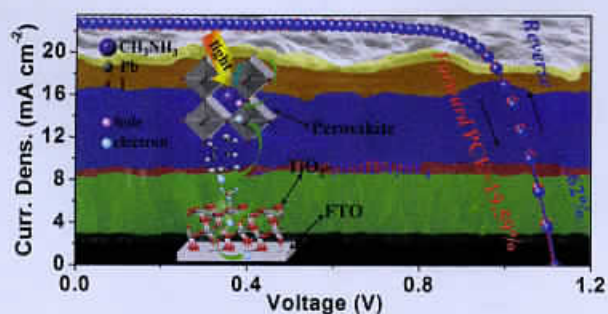
Rational designs and engineering of hollow micro-/nanostructures as sulfur hosts for advanced lithium-sulfur batteries

Zhen Li, Hao Bin Wu and Xiong Wen (David) Lou*

Rationally designed hollow nanostructures are attractive host materials for the sulfur cathode in lithium-sulfur batteries.



3071

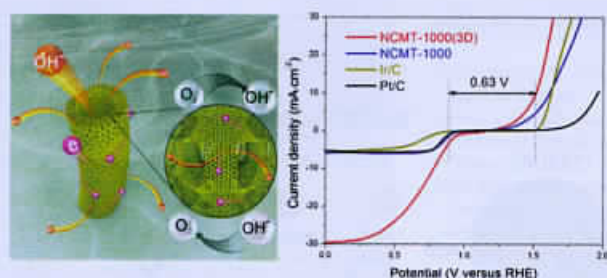


Surface optimization to eliminate hysteresis for record efficiency planar perovskite solar cells

Dong Yang, Xin Zhou, Ruixia Yang, Zhou Yang, Wei Yu, Xiuli Wang, Can Li,* Shengzhong (Frank) Liu* and Robert P. H. Chang

The efficiency of planar $\text{CH}_3\text{NH}_3\text{PbI}_3$ perovskite solar cells has been improved up to 19.62% using an ionic liquid to modify the TiO_2 electron transport layer, and the J - V hysteresis is completely eliminated.

3079

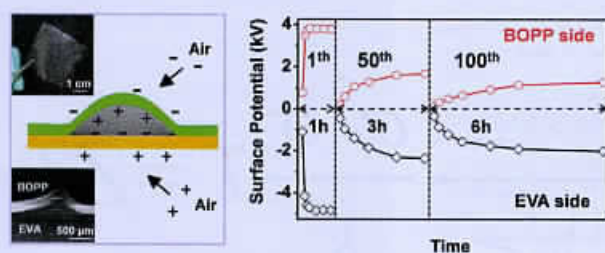


A 3D bi-functional porous N-doped carbon microtube sponge electrocatalyst for oxygen reduction and oxygen evolution reactions

Jin-Cheng Li, Peng-Xiang Hou, Shi-Yong Zhao, Chang Liu,* Dai-Ming Tang, Min Cheng, Feng Zhang and Hui-Ming Cheng

A flexible, dictyophora-like sponge of porous N-doped carbon microtubes demonstrates excellent electrocatalytic activities for both the oxygen reduction reaction and oxygen evolution reaction.

3085

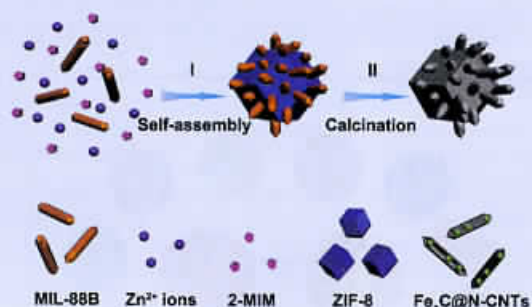


Surface charge self-recovering electret film for wearable energy conversion in a harsh environment

Junwen Zhong, Qize Zhong, Gangjin Chen, Bin Hu, Sheng Zhao, Xin Li, Nan Wu, Wenbo Li, Huimin Yu and Jun Zhou*

A laminated cellular electret film with surface charge self-recovery property for reliable wearable devices was developed.

3092



A dual-metal-organic-framework derived electrocatalyst for oxygen reduction

Bu Yuan Guan, Le Yu and Xiong Wen (David) Lou*

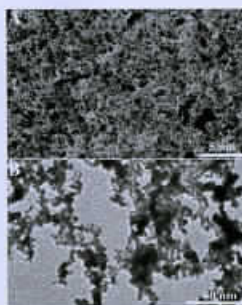
Unique iron carbide nanocrystallite-embedded carbon nanotube assemblies prepared via a dual-MOF confined-pyrolysis strategy exhibit superior electrocatalytic performance for the oxygen reduction reaction.

3097

Designed multimetallic Pd nanosponges with enhanced electrocatalytic activity for ethylene glycol and glycerol oxidation

Suping Li, Jianping Lai, Rafael Luque* and Guobao Xu*

We report an effective synthesis of surfactant-free multimetallic Pd nanosponges with tunable compositions using EDTA as the structure-directing reagent and NaBH_4 as the reducing reagent.

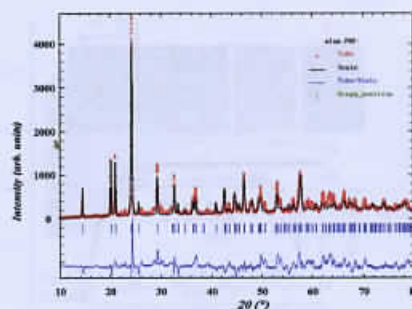


3103

$\text{NaFe}_2\text{PO}_4(\text{SO}_4)_2$: a potential cathode for a Na-ion battery

Konda Shiva, Preetam Singh, Weidong Zhou and John B. Goodenough*

Hexagonal $\text{Na}_3\text{Zr}_2\text{PO}_4(\text{SiO}_4)_2$ is a well-known fast Na^+ conductor commonly referred to as NASICON.

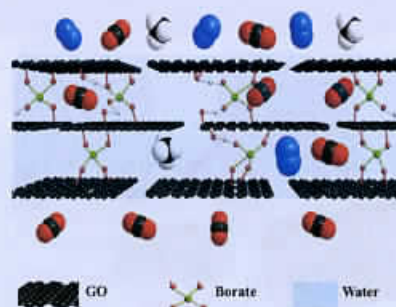


3107

A highly permeable graphene oxide membrane with fast and selective transport nanochannels for efficient carbon capture

Shaofei Wang, Yingzhen Wu, Ning Zhang, Guangwei He, Qingping Xin, Xingyu Wu, Hong Wu, Xingzhong Cao, Michael D. Guiver* and Zhongyi Jiang*

Tailored physicochemical microenvironments in stacked graphene oxide nanochannels give membranes with fast and highly selective CO_2 transport.

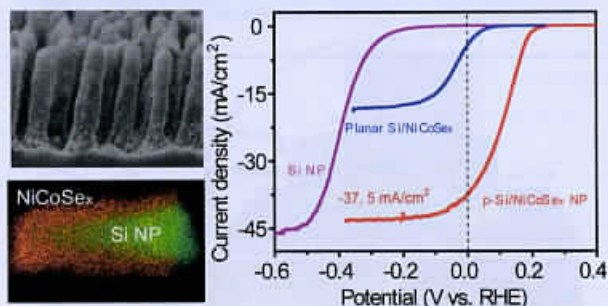


3113

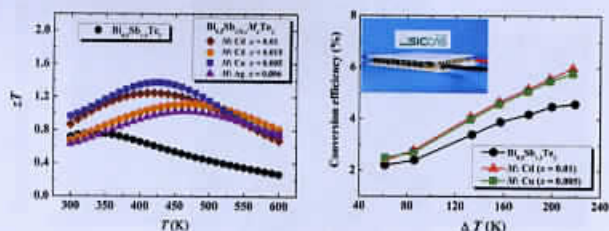
A p-Si/NiCoSe_x core/shell nanopillar array photocathode for enhanced photoelectrochemical hydrogen production

Hongxiu Zhang, Qi Ding, Denghong He, Hu Liu, Wei Liu, Zhongjian Li, Bin Yang, Xingwang Zhang,* Lecheng Lei and Song Jin

We report the rational design and successful preparation of p-Si/NiCoSe_x core/shell nanopillar array photocathodes for enhanced solar-driven photoelectrochemical hydrogen generation.



3120

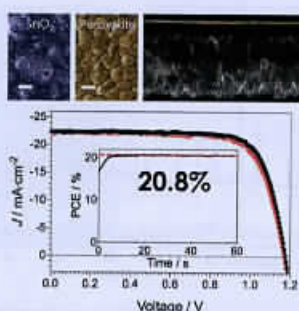


High efficiency Bi_2Te_3 -based materials and devices for thermoelectric power generation between 100 and 300 °C

Feng Hao, Pengfei Qiu, Yunshan Tang, Shengqiang Bai,* Tong Xing, Hsu-Shen Chu, Qihao Zhang, Ping Lu, Tiansong Zhang, Dudi Ren, Jikun Chen, Xun Shi* and Lidong Chen*

High efficiency Bi_2Te_3 -based thermoelectric materials and devices with energy conversion efficiencies of up to 6.0% under a temperature gradient of 217 K.

3128



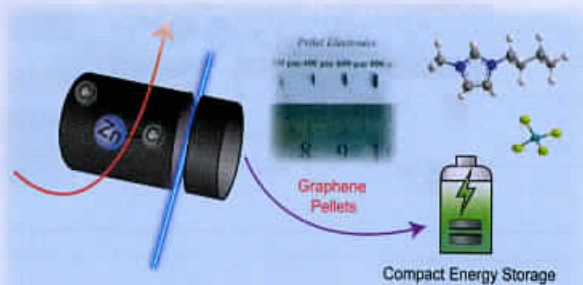
Highly efficient and stable planar perovskite solar cells by solution-processed tin oxide

Elham Halvani Anaraki, Ahmad Kermanpur, Ludmilla Steier, Konrad Domanski, Taisuke Matsui, Wolfgang Tress, Michael Saliba, Antonio Abate, Michael Grätzel, Anders Hagfeldt* and Juan-Pablo Correa-Baena*

Low temperature planar PSCs are fabricated by SnO_2 yielding stable devices and efficiencies *ca.* 21%.

PAPERS

3135

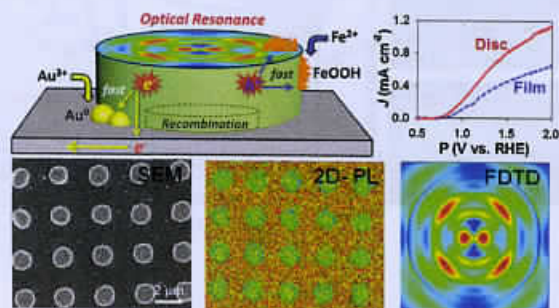


Ultra-thick graphene bulk supercapacitor electrodes for compact energy storage

Huan Li, Ying Tao, Xiaoyu Zheng, Jiayan Luo,* Feiyu Kang, Hui-Ming Cheng and Quan-Hong Yang*

A supercapacitor constructed using ultra-thick graphene pellet electrodes in an ionic liquid electrolyte exhibits an ultrahigh volumetric energy density.

3143



Optical resonance and charge transfer behavior of patterned WO_3 microdisc arrays

Hye Won Jeong, Weon-Sik Chae, Bokyung Song, Chang-Hee Cho, Seong-Ho Baek, Yiseul Park* and Hyunwoong Park*

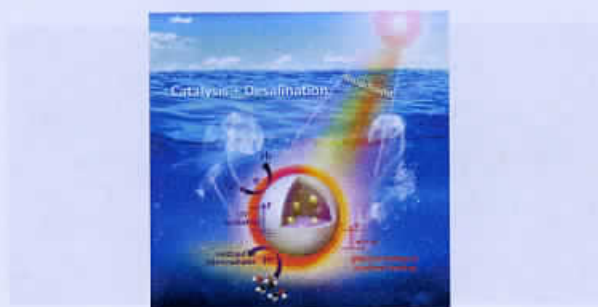
Patterned WO_3 microdisc arrays exhibit excellent photoelectrochemical performances, owing to enhanced light absorption and effective charge separation.

3151

Plasmonic photothermic directed broadband sunlight harnessing for seawater catalysis and desalination

Minmin Gao, Peh Kang Nuo Connor and Ghim Wei Ho*

Solar thermal collector nanocomposites ($\text{SiO}_2/\text{Ag}@\text{TiO}_2$ core-shell) that possess efficient photothermic properties for seawater catalysis and desalination.

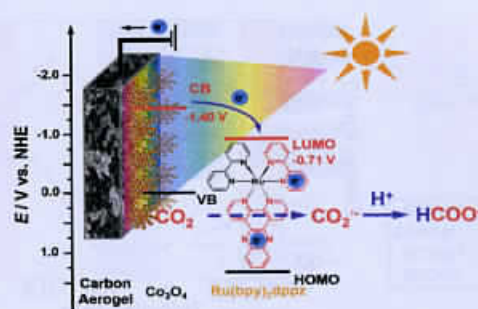


3161

A CO_2 adsorption-enhanced semiconductor/metal-complex hybrid photoelectrocatalytic interface for efficient formate production

Xiaofeng Huang, Qi Shen, Jibo Liu, Nianjun Yang* and Guohua Zhao*

A biomimetic interface based on molecular catalyst $\text{Ru}(\text{bpy})_2\text{dppz}$, photoelectrocatalyst Co_3O_4 , and CO_2 fixation substrate carbon aerogel converts CO_2 to formate.

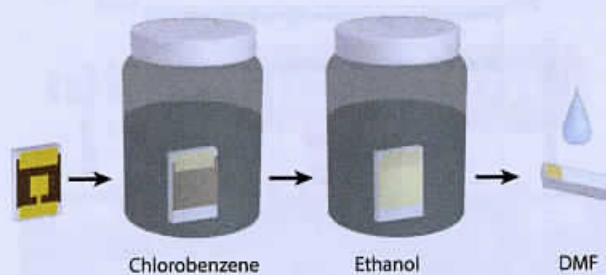


3172

Proof-of-concept for facile perovskite solar cell recycling

Jeannette M. Kadro, Norman Pellet, Fabrizio Giordano, Alexey Ulianov, Othmar Müntener, Joachim Maier, Michael Grätzel* and Anders Hagfeldt*

Recyclability of perovskite solar cells is demonstrated in a simple lab-scale process. Successful recovery of valuable components as well as cell performance underline the technology's potential as sustainable PV.

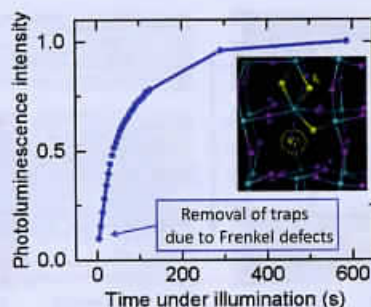


3180

Light-induced annihilation of Frenkel defects in organo-lead halide perovskites

Edoardo Mosconi, Daniele Meggiolaro, Henry J. Snaith, Samuel D. Stranks* and Filippo De Angelis*

The photoinduced removal of trap states due to Frenkel defects is found to enhance the PLQE of perovskite thin films.



3188

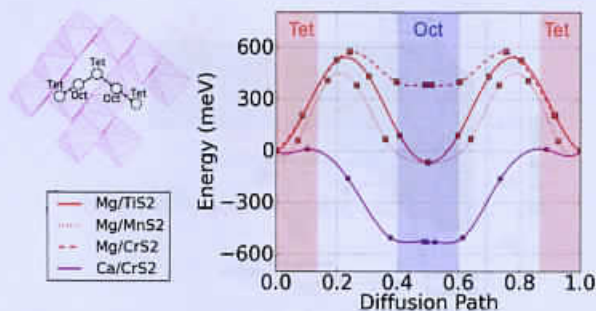


A core-shell electrode for dynamically and statically stable Li-S battery chemistry

Sheng-Heng Chung, Chi-Hao Chang and Arumugam Manthiram*

The design of a core-shell sulfur cathode demonstrates superior dynamic and static stability at a high sulfur loading in Li-S batteries.

3201

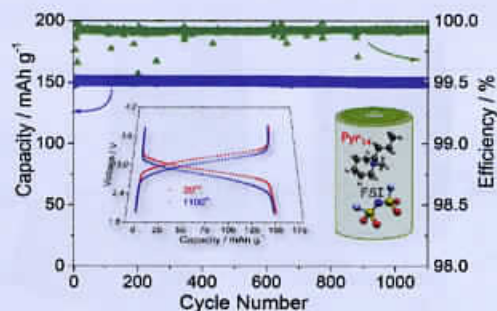


Evaluation of sulfur spinel compounds for multivalent battery cathode applications

Miao Liu, Anubhav Jain, Ziqin Rong, Xiaohui Qu, Pieremanuele Canepa, Rahul Malik, Gerbrand Ceder and Kristin A. Persson*

Promising sulfur spinel systems with facile cation mobility are revealed for multivalent cathode applications based on systematical calculation and screening.

3210

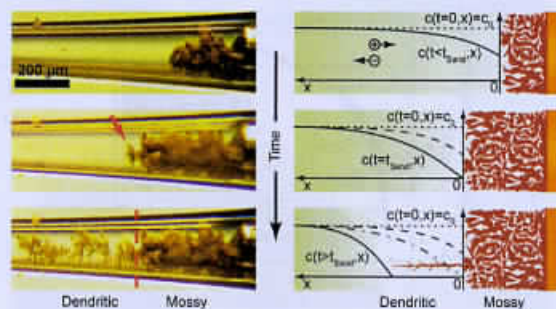


Exceptional long-life performance of lithium-ion batteries using ionic liquid-based electrolytes

Giuseppe Antonio Elia, Ulderico Ulissi, Sangsik Jeong, Stefano Passerini* and Jusef Hassoun*

A lithium ion battery using an ionic liquid electrolyte reveals enhanced safety and exceptionally long life, extended to thousands of cycles.

3221



Transition of lithium growth mechanisms in liquid electrolytes

Peng Bai,* Ju Li, Fikile R. Brushett and Martin Z. Bazant*

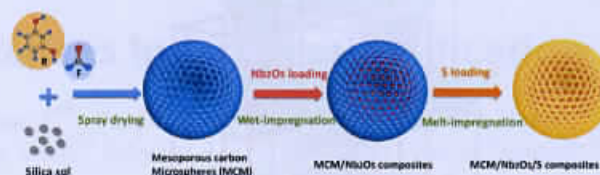
Root-growing, containable mossy lithium changes to tip-growing, short-causing dendritic lithium at "Sand's capacity", which is set by electrolyte diffusion limitation.

3230

Kinetically-enhanced polysulfide redox reactions by Nb₂O₅ nanocrystals for high-rate lithium–sulfur battery

Yingqing Tao, Yanju Wei, Yu Liu,* Jitong Wang, Wenming Qiao, Licheng Ling and Donghui Long*

Rational introduction of electrocatalytically-active nanocrystals into carbon–sulfur enables the accelerated kinetics of sulfur redox reactions, thus achieving an ultra-high-rate and long-life Li–S battery.

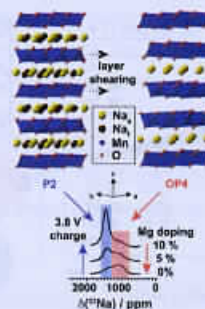


3240

Structurally stable Mg-doped P2-Na_{2/3}Mn_{1-y}Mg_yO₂ sodium-ion battery cathodes with high rate performance: insights from electrochemical, NMR and diffraction studies

Raphaële J. Clément, Juliette Billaud, A. Robert Armstrong, Gurpreet Singh, Teófilo Rojo, Peter G. Bruce and Clare P. Grey*

Mg substitution of a (sustainable) sodium-ion battery positive electrode material results in faster Na-ion motion and fewer structural changes on cycling.

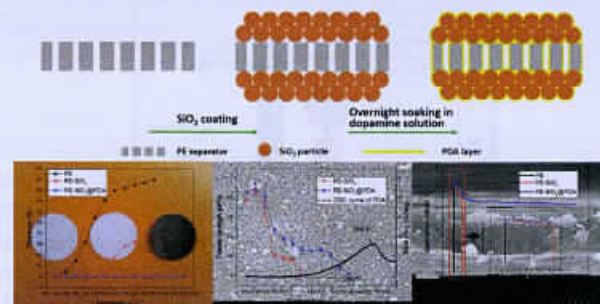


3252

A rational design of separator with substantially enhanced thermal features for lithium-ion batteries by the polydopamine–ceramic composite modification of polyolefin membranes

Jianhui Dai, Chuan Shi, Chao Li, Xiu Shen, Longqing Peng, Dezhi Wu, Daoheng Sun, Peng Zhang* and Jinbao Zhao*

We report a rational design of separator for lithium-ion batteries by the polydopamine–ceramic composite-modification of polyolefin membranes, which leads to substantially enhanced thermal and mechanical stability.

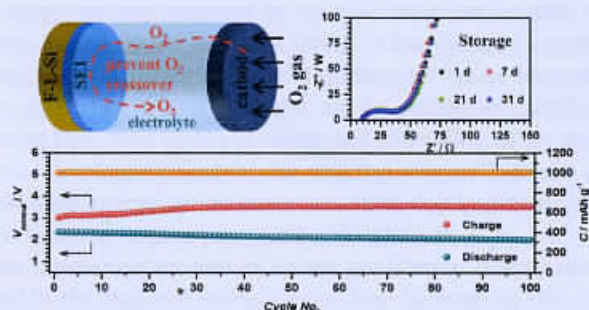


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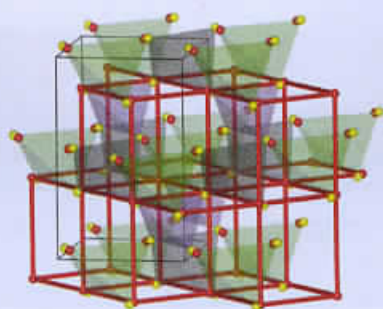
A long-life lithium ion oxygen battery based on commercial silicon particles as the anode

Shichao Wu, Kai Zhu, Jing Tang, Kaiming Liao, Songyan Bai, Jin Yi, Yusuke Yamauchi, Masayoshi Ishida and Haoshen Zhou*

Safe and long-life lithium ion oxygen batteries with commercial silicon particles as anodes are developed for the first time by building a durable oxygen crossover-prohibited film on a silicon surface.



3272

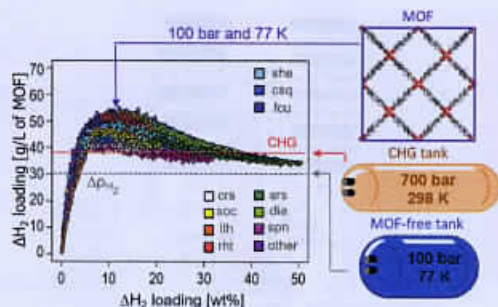


Design of $\text{Li}_{1+2x}\text{Zn}_{1-x}\text{PS}_4$, a new lithium ion conductor

William D. Richards, Yan Wang, Lincoln J. Miara, Jae Chul Kim and Gerbrand Ceder*

Structural screening and *in silico* optimization yields a new Li-ion conductor with a bcc anion framework and high conductivity.

3279

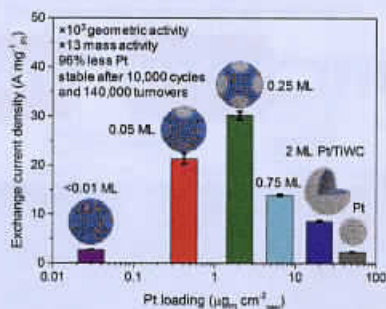


Evaluating topologically diverse metal–organic frameworks for cryo-adsorbed hydrogen storage

Diego A. Gómez-Gualdrón, Yamil J. Colón, Xu Zhang, Timothy C. Wang, Yu-Sheng Chen, Joseph T. Hupp, Taner Yildirim,* Omar K. Farha,* Jian Zhang* and Randall Q. Snurr*

Metal–organic frameworks (MOFs) are porous materials synthesized by combining inorganic and organic molecular building blocks into crystalline networks of distinct topologies.

3290



Activating earth-abundant electrocatalysts for efficient, low-cost hydrogen evolution/oxidation: sub-monolayer platinum coatings on titanium tungsten carbide nanoparticles

Sean T. Hunt, Maria Milina, Zhenshu Wang and Yuri Román-Leshkov*

Decorating titanium tungsten carbide nanoparticles with sub-monolayer platinum surface coatings yields efficient and stable catalysts for hydrogen evolution/oxidation reactions in acidic media.