

Energy & Environmental Science

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IN THIS ISSUE

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Cover

See Michael Saliba *et al.*, pp. 1989–1997.
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Inside cover

See William C. Chueh *et al.*, pp. 2044–2052.
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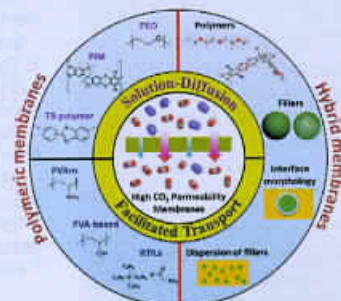
REVIEWS

1863

Advances in high permeability polymer-based membrane materials for CO₂ separations

Shaofei Wang, Xueqin Li, Hong Wu,* Zhizhang Tian, Qingping Xin, Guangwei He, Dongdong Peng, Silu Chen, Yan Yin, Zhongyi Jiang* and Michael D. Guiver*

This review summarizes the major advances since 2012 in highly permeable and CO₂-selective polymer-based membrane materials.

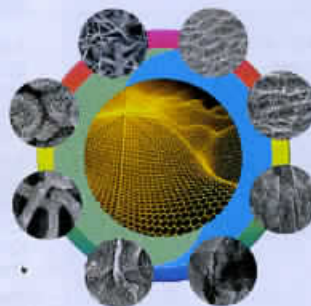


1891

Functionalization of chemically derived graphene for improving its electrocapacitive energy storage properties

Zhibin Lei, Jintao Zhang, Li Li Zhang, Nanjundan Ashok Kumar and X. S. Zhao*

This review summarizes the latest developments in the functionalization of chemically derived graphene for improving its electrocapacitive performance.

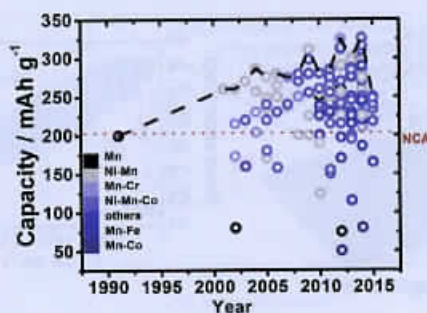


1931

Performance and design considerations for lithium excess layered oxide positive electrode materials for lithium ion batteries

Sunny Hy,* Haodong Liu, Minghao Zhang, Danna Qian, Bing-Joe Hwang and Ying Shirley Meng*

The Li-excess layered oxide compound is one of the most promising positive electrode materials for next generation batteries exhibiting high capacities of $>300 \text{ mA h g}^{-1}$ due to the unconventional participation of the oxygen anion redox in the charge compensation mechanism.



1955

Electrolyte additives for lithium ion battery electrodes: progress and perspectives

Atetegeb Meazah Haregewoin, Aselefech Sorsa Wotango and Bing-Joe Hwang*

This review classifies the additives based on their functions and their effects on the performance and safety of electrode materials for lithium ion batteries.



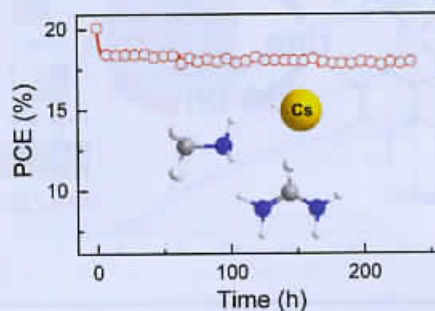
COMMUNICATIONS

1989

Cesium-containing triple cation perovskite solar cells: improved stability, reproducibility and high efficiency

Michael Saliba,* Taisuke Matsui, Ji-Youn Seo, Konrad Domanski, Juan-Pablo Correa-Baena, Mohammad Khaja Nazeeruddin, Shaik M. Zakeeruddin, Wolfgang Tress, Antonio Abate, Anders Hagfeldt and Michael Grätzel

Today's best perovskite solar cells use a mixture of formamidinium and methylammonium as the monovalent cations. Adding cesium improves the compositions greatly.

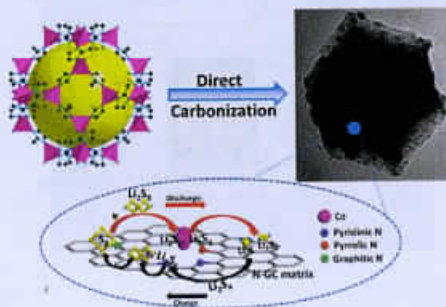


1998

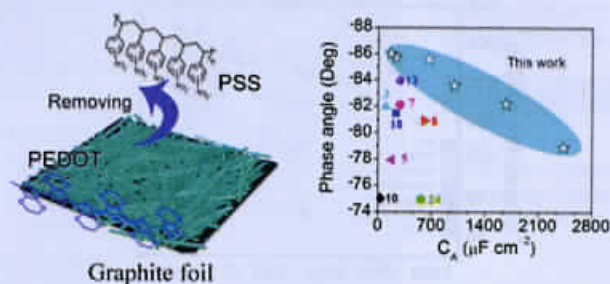
A novel synergistic composite with multi-functional effects for high-performance Li-S batteries

Yi-Juan Li, Jing-Min Fan, Ming-Sen Zheng* and Quan-Feng Dong*

A MOF-derived composite with multi-functional effects for high-performance Li-S batteries, especially its Co-N dual-catalyzing for S redox.



2005

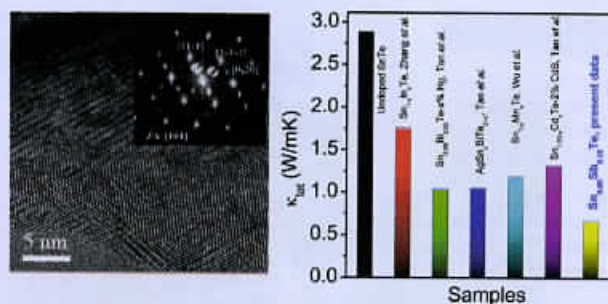


An ultrahigh-rate electrochemical capacitor based on solution-processed highly conductive PEDOT:PSS films for AC line-filtering

Miao Zhang, Qinqin Zhou, Ji Chen, Xiaowen Yu, Liang Huang, Yingru Li, Chun Li and Gaoquan Shi*

An electrochemical capacitor (EC) with H_2SO_4 treated PEDOT:PSS/graphite foil electrodes exhibited the highest areal and volumetric specific capacitances among the reported ECs with phase angles larger than -80° at 120 Hz.

2011

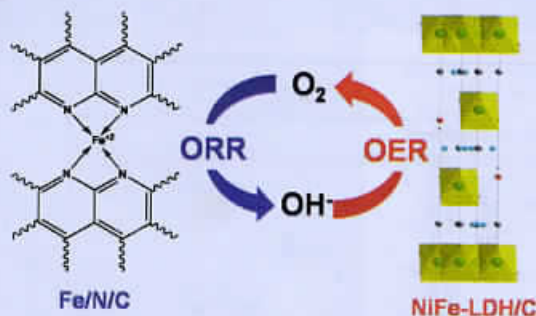


The origin of low thermal conductivity in $Sn_{1-x}Sb_xTe$: phonon scattering via layered intergrowth nanostructures

Ananya Banik, Badri Vishal, Suresh Perumal, Ranjan Datta and Kanishka Biswas*

The spontaneous formation of nanodomains of the Sb-rich layered intergrowth $Sn_mSb_{2n}Te_{3n+m}$ compounds in a SnTe matrix resulted in ultralow lattice thermal conductivity.

2020

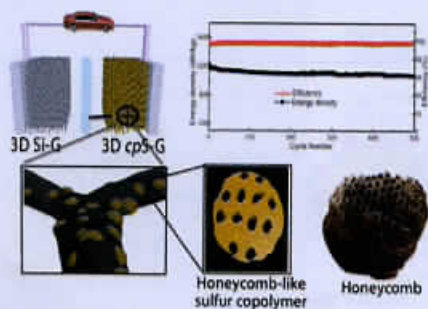


An efficient bifunctional two-component catalyst for oxygen reduction and oxygen evolution in reversible fuel cells, electrolyzers and rechargeable air electrodes

Sören Dresp, Fang Luo, Roman Schmack, Stefanie Kühl, Manuel Glich and Peter Strasser*

We report RDE and MEA performance of an active and stable non-precious, two-phase bifunctional oxygen reduction and evolution (ORR and OER) electrocatalyst for use in unitized reversible fuel cell/electrolyzers or rechargeable metal-air batteries.

2025



A new configured lithiated silicon-sulfur battery built on 3D graphene with superior electrochemical performances

Bin Li, Songmei Li,* Jingjing Xu and Shubin Yang*

A new configured lithiated silicon-sulfur battery was successfully achieved that exhibited high energy density and long cycle performance.

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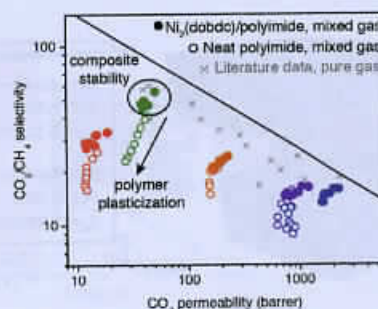
This jour

2031

Plasticization-resistant Ni₂(dobdc)/polyimide composite membranes for the removal of CO₂ from natural gas

Jonathan E. Bachman and Jeffrey R. Long*

Incorporating metal–organic framework nanoparticles into polyimides yields composite membranes that have improved performance for purifying natural gas.

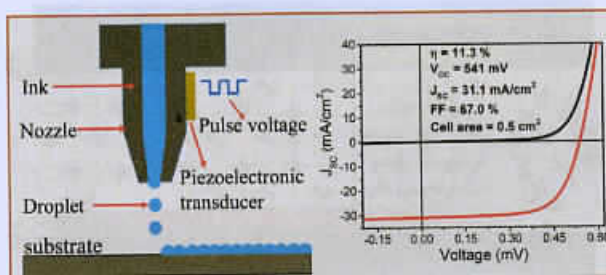


2037

11.3% efficiency Cu(In,Ga)(S,Se)₂ thin film solar cells via drop-on-demand inkjet printing

Xianzhong Lin,* Reiner Klenk, Lan Wang, Tristan Köhler, Jürgen Albert, Sebastian Fiechter, Ahmed Ennaoui and Martha Ch. Lux-Steiner

Highly efficient Cu(In,Ga)(S,Se)₂ thin film solar cells are fabricated using a scalable drop-on-demand inkjet printing approach from environmentally-friendly molecular ink.



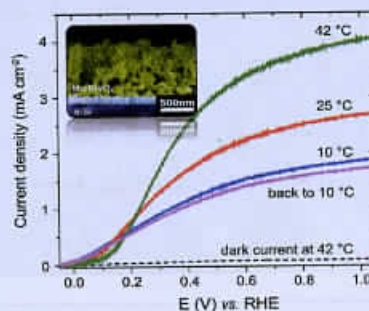
PAPERS

2044

Significantly enhanced photocurrent for water oxidation in monolithic Mo:BiVO₄/SnO₂/Si by thermally increasing the minority carrier diffusion length

Liming Zhang, Xiaofei Ye, Madhur Bloor, Andrey Poletayev, Nicholas A. Melosh and William C. Chueh*

Modestly elevating temperature activates minority carrier hopping in BiVO₄, and dramatically enhances the photoactivity for water oxidation.

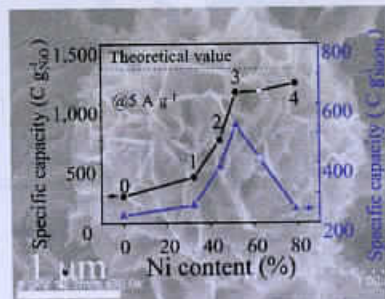


2053

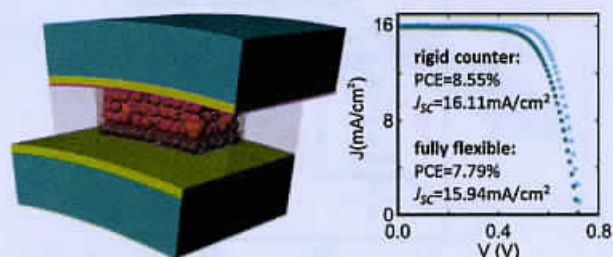
Mesostructured NiO/Ni composites for high-performance electrochemical energy storage

Hongwei Lai, Qiang Wu,* Jin Zhao, Longmei Shang, He Li, Renchao Che, Zhiyang Lyu, Jingfang Xiong, Lijun Yang, Xizhang Wang and Zheng Hu*

The mesostructured NiO/Ni composites boost the electrochemical energy storage performance of NiO to its theoretical limit, which results from the synergism of high accessibility to electrolyte, short solid-state ion diffusion length and high conductivity owing to the unique mesostructure.



2061

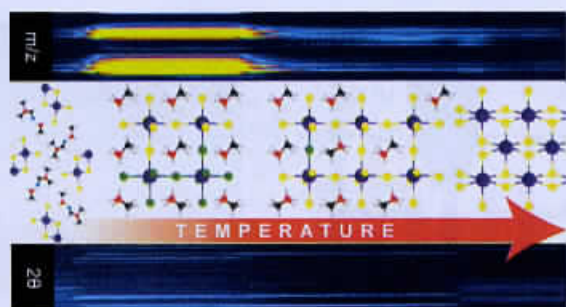


Maximized performance of dye solar cells on plastic: a combined theoretical and experimental optimization approach

Yuelong Li, Sol Carretero-Palacios, Kicheon Yoo, Jong Hak Kim, Alberto Jiménez-Solano, Chul-Ho Lee, Hernán Míguez* and Min Jae Ko*

Maximizing the performance of dye solar cells on plastic using a combined theoretical and experimental optimization approach.

2072

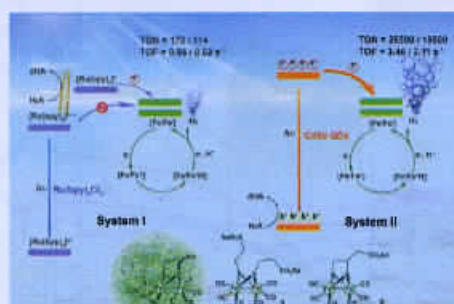


Structural and chemical evolution of methylammonium lead halide perovskites during thermal processing from solution

David P. Nenon, Jeffrey A. Christians, Lance M. Wheeler, Jeffrey L. Blackburn, Erin M. Sanehira, Benjia Dou, Michele L. Olsen, Kai Zhu, Joseph J. Berry and Joseph M. Luther*

Perovskites are processed from solution; understanding the influence of solution composition on crystallization and degradation is critical to their success.

2083

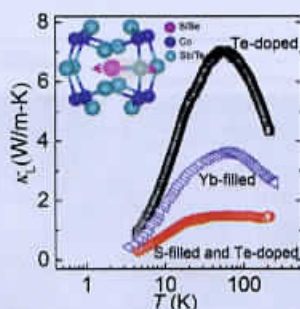


Comparison of H₂ photogeneration by [FeFe]-hydrogenase mimics with CdSe QDs and Ru(bpy)₃Cl₂ in aqueous solution

Jing-Xin Jian, Chen Ye, Xu-Zhe Wang, Min Wen, Zhi-Jun Li, Xu-Bing Li, Bin Chen, Chen-Ho Tung and Li-Zhu Wu*

Two simple water soluble [FeFe]-H₂ase mimic systems (I and II) were designed to understand the basic principles governing photocatalytic H₂ evolution.

2090



Electronegative guests in CoSb₃

Bo Duan, Jiong Yang, James R. Salvador, Yang He, Bo Zhao, Shanyu Wang, Ping Wei, Fumio S. Ohuchi, Wenqing Zhang,* Raphaël P. Hermann, Olivier Gourdon, Scott X. Mao, Yingwen Cheng, Chongmin Wang, Jun Liu, Pengcheng Zhai, Xinfeng Tang, Qingjie Zhang* and Jihui Yang*

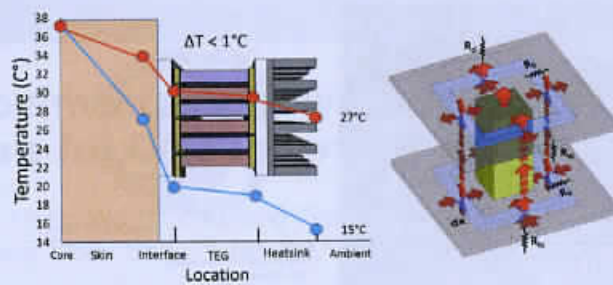
Electronegative guests filled into CoSb₃ yield a unique "cluster vibration" that provides a new perspective on designing novel inclusion compounds.

2099

Designing thermoelectric generators for self-powered wearable electronics

Francisco Suarez, Amin Nozariasbmarz, Daryoosh Vashaee and Mehmet C. Öztürk*

Computational efficient, quasi-3D model for designing body wearable thermoelectric generators and experimental verification.

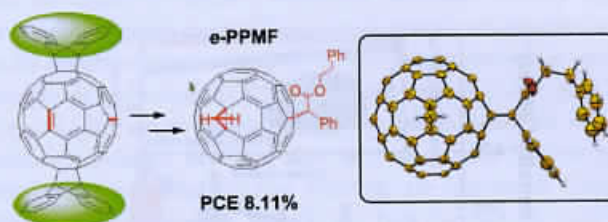


2114

Development of isomer-free fullerene bisadducts for efficient polymer solar cells

Zuo Xiao, Xinjian Geng, Dan He, Xue Jia and Liming Ding*

A prebisaddition-confined bisfunctionalization (PCB) approach was designed for the construction of isomer-free fullerene bisadducts for efficient polymer solar cells.

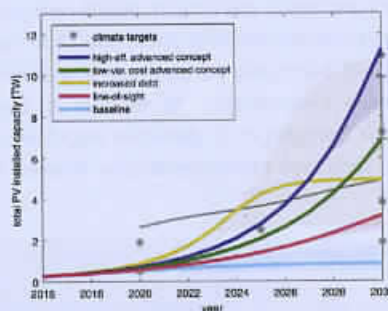


2122

Economically sustainable scaling of photovoltaics to meet climate targets

David Berney Needleman,* Jeremy R. Poindexter, Rachel C. Kurchin, I. Marius Peters, Gregory Wilson and Tonio Buonassisi*

Technological and financial innovations are evaluated to determine what can enable sufficient growth of photovoltaics (PV) manufacturing capacity to meet climate-driven PV deployment targets.

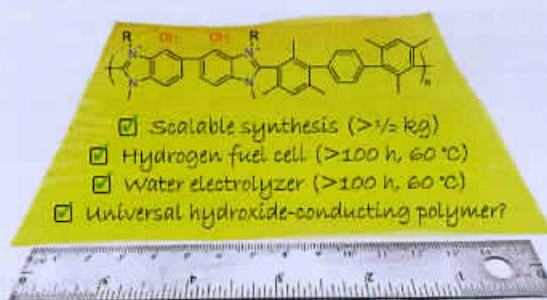


2130

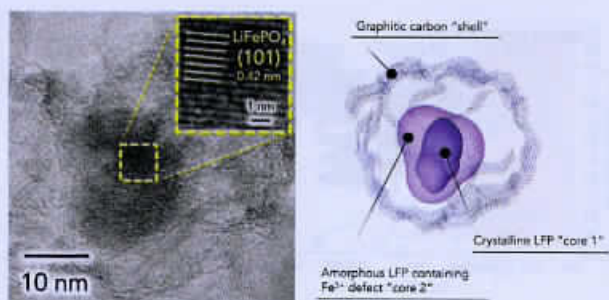
Hexamethyl-*p*-terphenyl poly(benzimidazolium): a universal hydroxide-conducting polymer for energy conversion devices

Andrew G. Wright, Jiantao Fan, Benjamin Britton, Thomas Weissbach, Hsu-Feng Lee, Elizabeth A. Kitching, Timothy J. Peckham and Steven Holdcroft*

A benchmark hydroxide-conducting polymer is utilized in alkaline hydrogen fuel cell and water electrolyzer devices at 60 °C for >100 hours.



2143

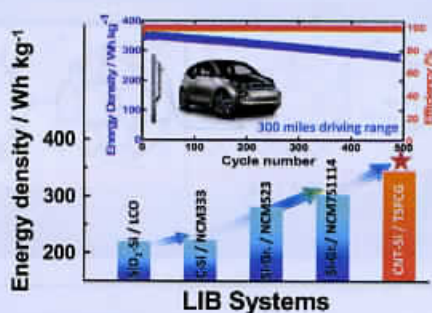


Ultrafast charge–discharge characteristics of a nanosized core–shell structured LiFePO_4 material for hybrid supercapacitor applications

Katsuhiko Naoi,* Kazuaki Kisu, Etsuro Iwama, Shota Nakashima, Yuki Sakai, Yuki Orihara, Philippe Leone, Nicolas Dupr , Thierry Brousse, Patrick Rozier, Wako Naoi and Patrice Simon

Highly dispersed crystalline/amorphous LiFePO_4 (LFP) nanoparticles encapsulated within hollow-structured graphitic carbon were synthesized using an *in situ* ultracentrifugation process.

2152



High-energy-density lithium-ion battery using a carbon-nanotube–Si composite anode and a compositionally graded $\text{Li}[\text{Ni}_{0.85}\text{Co}_{0.05}\text{Mn}_{0.10}]\text{O}_2$ cathode

Joo Hyeong Lee, Chong S. Yoon, Jang-Yeon Hwang, Sung-Jin Kim, Filippo Maglia, Peter Lamp, Seung-Taek Myung and Yang-Kook Sun*

A Li-rechargeable battery system based on state-of-the-art cathode and anode technologies demonstrated high energy density, meeting demands for vehicle application.