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## IN THIS ISSUE

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**Cover**  
See Volker Presser et al., pp. 3392-3398. Image reproduced by permission of Volker Presser from *Energy Environ. Sci.*, 2016, 9, 3392.



**Inside cover**  
See Xiaogang Zhang, Guihua Yu et al., pp. 3399-3405. Image reproduced by permission of Guihua Yu from *Energy Environ. Sci.*, 2016, 9, 3399.

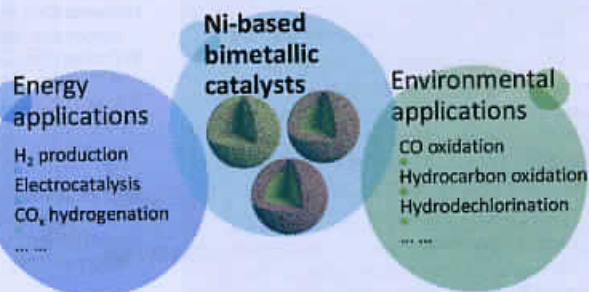
## REVIEWS

3314

### Ni-based bimetallic heterogeneous catalysts for energy and environmental applications

Sudipta De, Jianguang Zhang, Rafael Luque and Ning Yan\*

This review provides a comprehensive overview of nickel based bimetallic catalysts for energy and environmental applications.

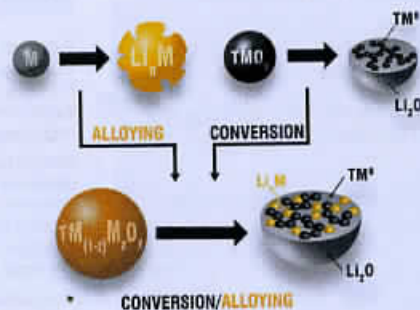


3348

### Leveraging valuable synergies by combining alloying and conversion for lithium-ion anodes

Dominic Bresser, Stefano Passerini\* and Bruno Scrosati\*

This article provides the first comprehensive review of the most recent class of lithium-ion battery materials, hosting lithium by a combined conversion/alloying mechanism.



3368

### Irreproducibility in hydrogen storage material research

D. P. Broom\* and M. Hirscher

Problems regarding publication of irreproducible results in hydrogen storage material research are discussed, together with possible ways forward for the future.

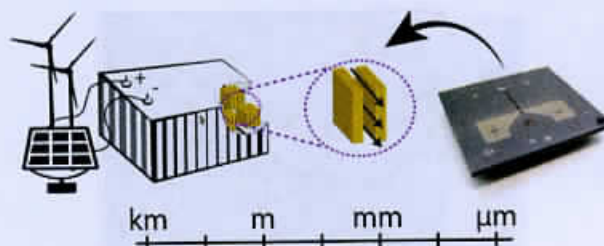


3381

### The potential for microfluidics in electrochemical energy systems

M. A. Modestino,\* D. Fernandez Rivas,\* S. M. H. Hashemi, J. G. E. Gardeniers and D. Psaltis

Energy storage technologies based on microfluidic electrochemical devices show optimal conversion efficiencies, and have potential to reach large-scale applications.



## COMMUNICATIONS

3392

### Tin/vanadium redox electrolyte for battery-like energy storage capacity combined with supercapacitor-like power handling

Juhan Lee, Benjamin Krüner, Aura Tolosa, Sethuraman Sathyamoorthi, Daekyu Kim, Soumyadip Choudhury, Kum-Hee Seo and Volker Presser\*

We introduce a high performance hybrid electrochemical energy storage system based on an aqueous electrolyte containing tin sulfate ( $\text{SnSO}_4$ ) and vanadyl sulfate ( $\text{VOSO}_4$ ) with nanoporous activated carbon.

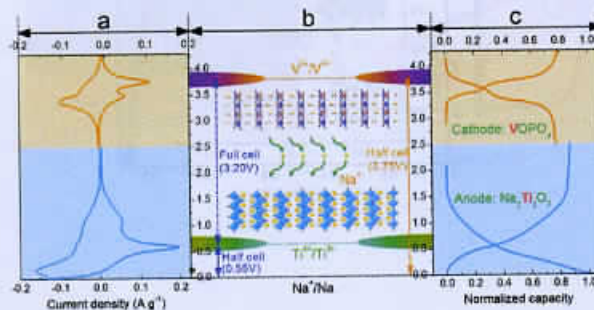


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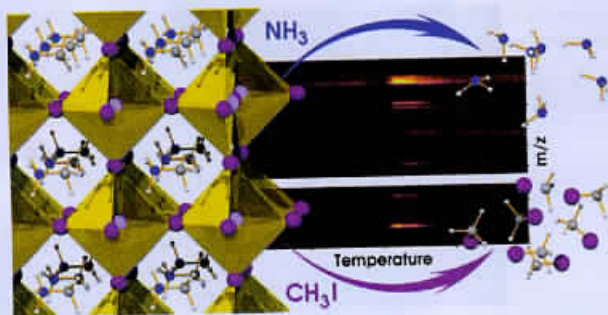
### An advanced high-energy sodium ion full battery based on nanostructured $\text{Na}_2\text{Ti}_3\text{O}_7/\text{VOPO}_4$ layered materials

Hongsen Li, Lele Peng, Yue Zhu, Dahong Chen, Xiaogang Zhang\* and Guihua Yu\*

A sodium ion full battery based on nanostructured  $\text{Na}_2\text{Ti}_3\text{O}_7/\text{VOPO}_4$  layered materials is developed, which exhibits attractive reversible capacity, outstanding rate capability and excellent cycling stability.



3406

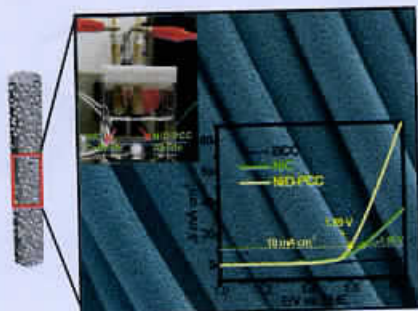


### Thermal degradation of $\text{CH}_3\text{NH}_3\text{PbI}_3$ perovskite into $\text{NH}_3$ and $\text{CH}_3\text{I}$ gases observed by coupled thermogravimetry–mass spectrometry analysis

Emilio J. Juarez-Perez, Zafer Hawash, Sonia R. Raga, Luis K. Ono and Yabing Qi\*

Thermal gravimetric and differential thermal analysis (TG-DTA) coupled with quadrupole mass spectrometry (MS) and first principles calculations were employed to elucidate the chemical nature of released gases during the thermal decomposition of  $\text{CH}_3\text{NH}_3\text{PbI}_3$ .

3411

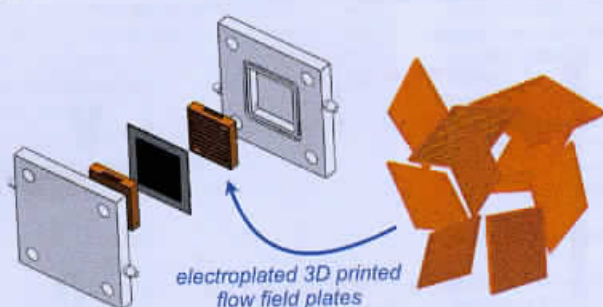


### A monolithic metal-free electrocatalyst for oxygen evolution reaction and overall water splitting

Muhammad-Sadeeq Balogun, Weitao Qiu, Hao Yang, Wenjie Fan, Yongchao Huang, Pingping Fang, Gaoren Li, Hongbing Ji\* and Yexiang Tong\*

Herein, a three-dimensional monolithic and metal-free N-doped porous carbon cloth electrocatalyst was fabricated.

3417

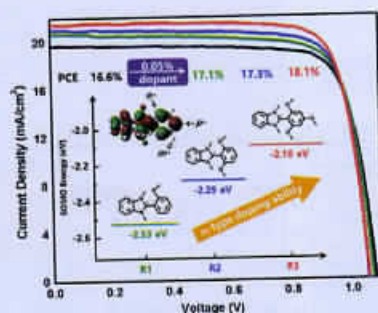


### Rapid prototyping of electrolyzer flow field plates

Jesse R. Hudkins, Danika G. Wheeler, Bruno Peña and Curtis P. Berlinguette\*

Electroplated 3D printed flow field plates are demonstrated for the electrolysis of water to hydrogen fuels.

3424



### Efficient n-type dopants with extremely low doping ratios for high performance inverted perovskite solar cells

Zhengyang Bin, Jiangwei Li, Liduo Wang\* and Lian Duan\*

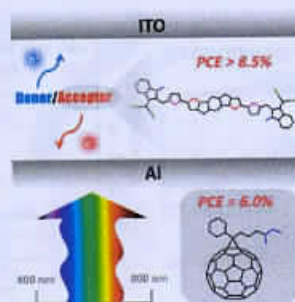
A series of new-efficient n-type dopants are designed and used to dope with PCBM for high performance inverted perovskite solar cells at extremely low doping ratios.

3429

### Non-fullerene polymer solar cells based on a selenophene-containing fused-ring acceptor with photovoltaic performance of 8.6%

Yongxi Li, Lian Zhong, Fu-Peng Wu, Yi Yuan, Hai-Jun Bin, Zuo-Quan Jiang,\* Zhanjun Zhang, Zhi-Guo Zhang,\* Yongfang Li and Liang-Sheng Liao\*

In this work, we present a non-fullerene electron acceptor bearing a fused five-heterocyclic ring containing selenium atoms, denoted as IDSe-T-IC, for fullerene-free polymer solar cells (PSCs).

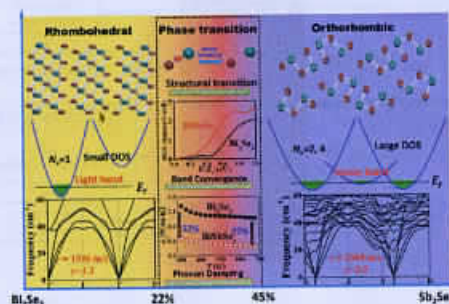


3436

### High thermoelectric performance in Te-free (Bi,Sb)<sub>2</sub>Se<sub>3</sub> via structural transition induced band convergence and chemical bond softening

Shanyu Wang, Yongxing Sun, Jiong Yang, Bo Duan, Lihua Wu, Wenqing Zhang\* and Jihui Yang\*

In Te-free (Bi,Sb)<sub>2</sub>Se<sub>3</sub>, structural transition induced electronic band convergence and intensified phonon scattering triple the thermoelectric ZT to 1.0.

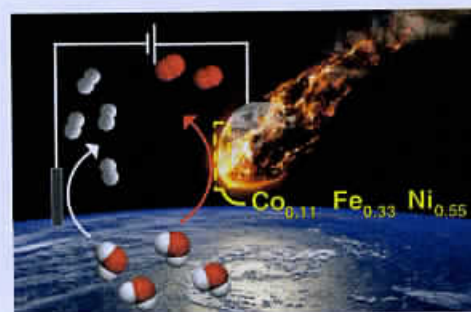


3448

### A Gibeon meteorite yields a high-performance water oxidation electrocatalyst

Florian Le Formal, Néstor Guijarro, Wiktor S. Bourée, Aswin Gopakumar, Mathieu S. Prévot, Albert Daubry, Loris Lombardo, Charlotte Sornay, Julie Voit, Arnaud Magrez, Paul J. Dyson and Kevin Sivula\*

A natural material of extra-terrestrial origin yields a high-performance electrocatalyst for alkaline water oxidation.

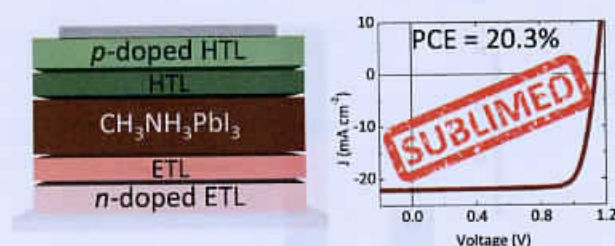


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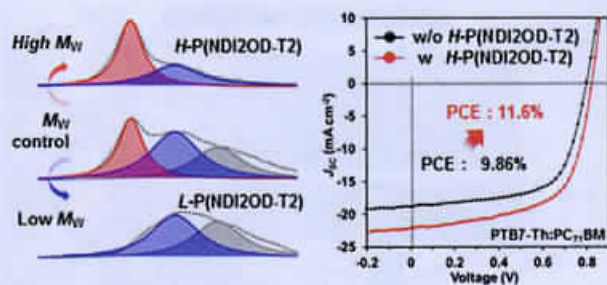
### Efficient vacuum deposited p-i-n and n-i-p perovskite solar cells employing doped charge transport layers

Cristina Momblona, Lidón Gil-Escrig, Enrico Bandiello, Eline M. Hutter, Michele Sessolo, Kay Lederer, Jan Blochwitz-Nimoth\* and Henk J. Bolink\*

The use of small molecular weight intrinsic and doped transport layers allows to obtain fully vacuum deposited, efficient perovskite solar cells.



3464



### The use of an n-type macromolecular additive as a simple yet effective tool for improving and stabilizing the performance of organic solar cells

Kwang Hyun Park, Yujin An, Seungon Jung, Hyesung Park\* and Changduk Yang\*

Introduction of an n-type macromolecular additive (P(NDI2OD-T2) polymer) in organic solar cells brings significant improvements in power conversion efficiency along with robust thermal stability.

3472

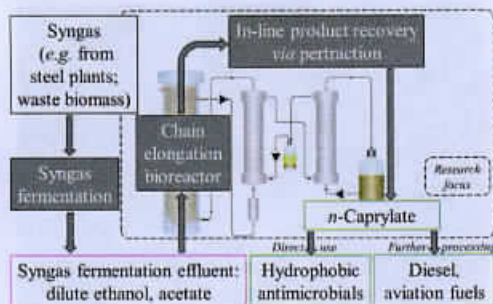


### Carrier trapping and recombination: the role of defect physics in enhancing the open circuit voltage of metal halide perovskite solar cells

Tomas Lejtenš\*, Giles E. Eperon, Alex J. Barker, Giulia Grancini, Wei Zhang, James M. Ball, Ajay Ram Srimath Kandada, Henry J. Snaith and Annamaria Petrozza\*

We show that trapped electrons recombine with free holes unexpectedly slowly, on microsecond time scales, relaxing the limit on obtainable open circuit voltage.

3482

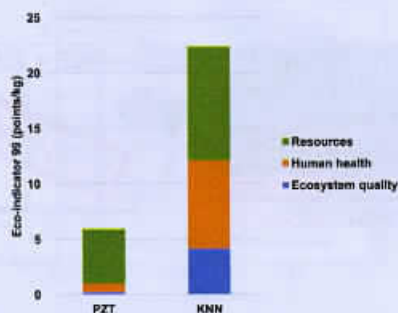


### High n-caprylate productivities and specificities from dilute ethanol and acetate: chain elongation with microbiomes to upgrade products from syngas fermentation

Leo A. Kucek, Catherine M. Spirito and Largus T. Angenent\*

A bioprocess based on open-culture anaerobic biotechnology to elongate acetate and ethanol (C2) into primarily n-caprylate (C8).

3495



### Integrated hybrid life cycle assessment and supply chain environmental profile evaluations of lead-based (lead zirconate titanate) versus lead-free (potassium sodium niobate) piezoelectric ceramics

T. Ibn-Mohammed\*, S. C. L. Koh, I. M. Reaney, A. Acquaye, D. Wang, S. Taylor and A. Genovese

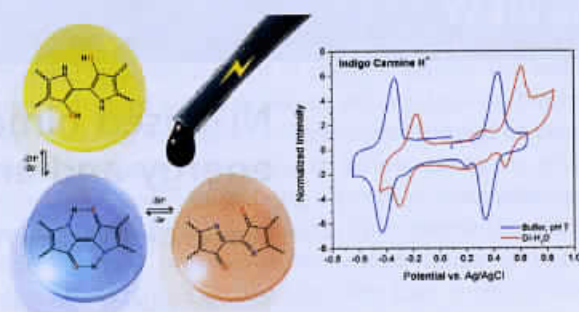
Contrary to conventional knowledge, LCA of PZT vs. KNN indicates the presence of niobium in KNN constitutes far greater impact across all the 16 categories considered in comparison with PZT. The increased environmental impact of KNN occurs in the early stages of the LCA due to raw material extraction and processing.

3521

### Highly water-soluble three-redox state organic dyes as bifunctional analytes

Javier Carretero-González,\* Elizabeth Castillo-Martinez and Michel Armand

Common organic dyes show three stable redox states, offering an alternative to questionable vanadium for the implementation of redox-flow batteries.

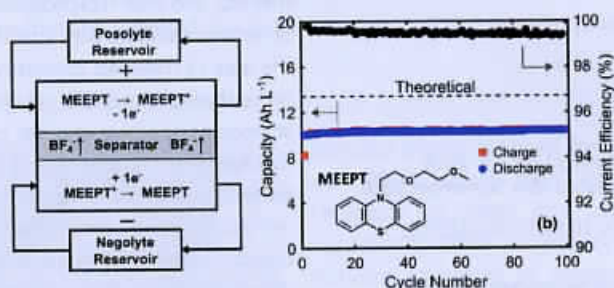


3531

### High current density, long duration cycling of soluble organic active species for non-aqueous redox flow batteries

Jarrod D. Milshtein, Aman Preet Kaur, Matthew D. Casselman, Jeffrey A. Kowalski, Subrahmanyam Modekrutti, Peter L. Zhang, N. Harsha Attanayake, Corrine F. Elliott, Sean R. Parkin, Chad Risko, Fikile R. Brushett\* and Susan A. Odom\*

Symmetric flow cell cycling of a soluble phenothiazine.



3544

### Toward understanding long-distance extracellular electron transport in an electroautotrophic microbial community

Matthew D. Yates, Brian J. Eddie, Nicholas J. Kotloski, Nikolai Lebedev, Anthony P. Malanoski, Baochuan Lin, Sarah M. Strycharz-Glaven and Leonard M. Tender\*

Here we show that long-distance extracellular electron transport occurs in a cathodic biofilm capable of CO<sub>2</sub> fixation and O<sub>2</sub> respiration.

