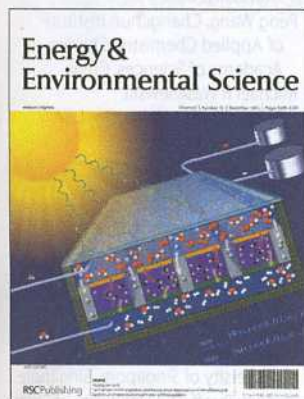


## IN THIS ISSUE

ISSN 1754-5692 CODEN EESNBY 6(12) 3389–3794 (2013)



**Cover**  
See Haussener *et al.*,  
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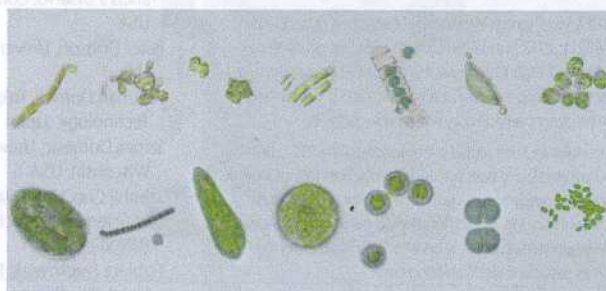
## OPINION

3404

### Survival of the fattest

Peter R. Mooij,\* Gerben R. Stouten, Jelmer Tamis,  
Mark C. M. van Loosdrecht and Robbert Kleerebezem

By creating a selective environment we show how to obtain  
a stable and open system, populated by highly productive  
microalgae.



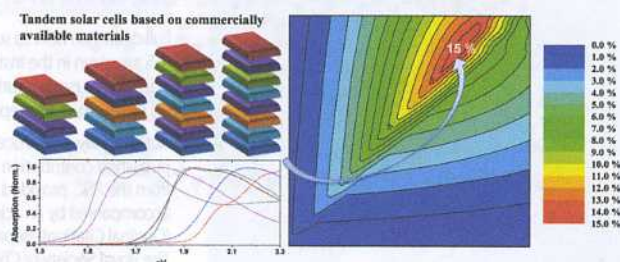
## ANALYSIS

3407

### Towards 15% energy conversion efficiency: a systematic study of the solution-processed organic tandem solar cells based on commercially available materials

Ning Li,\* Derya Baran, Karen Forberich, Florian Machui,  
Tayebeh Ameri, Mathieu Turbiez,  
Miguel Carrasco-Orozco, Martin Drees, Antonio Facchetti,  
Frederik C. Krebs and Christoph J. Brabec

A PCE of 15% becomes possible for organic tandem solar  
cells based on commercially available donor materials.

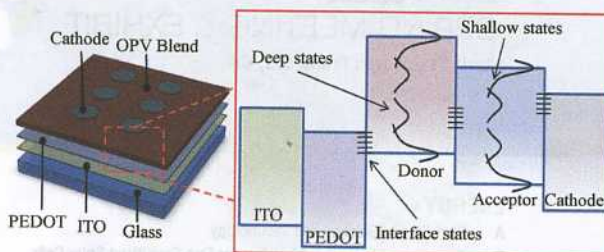


3414

**The identification, characterization and mitigation of defect states in organic photovoltaic devices: a review and outlook**

John A. Carr and Sumit Chaudhary\*

This report comprehensively reviews the identification, characterization, mitigation and effects of electronic defect levels in organic photovoltaic devices.

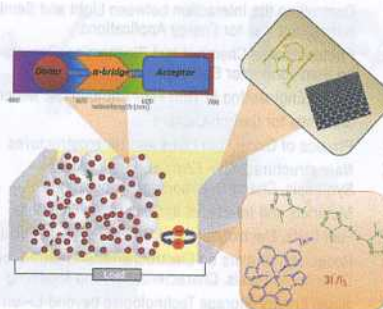


3439

**Metal free sensitizer and catalyst for dye sensitized solar cells**

Shahzada Ahmad,\* Elena Guillén, Ladislav Kavan, Michael Grätzel and Mohammad K. Nazeeruddin

Cost reduction: Towards metal free dye sensitized solar cells.

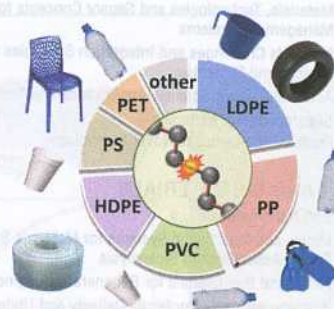


3467

**Retrieving and converting energy from polymers: deployable technologies and emerging concepts**

Bilge Baytekin, H. Tarik Baytekin and Bartosz A. Grzybowski\*

Significant amounts of energy can be retrieved from polymers via approaches ranging from incineration, to thermolysis, to mechanochemistry and thermoelectricity.

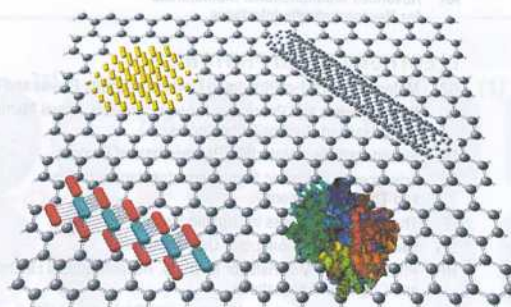


3483

**Graphene-based nanocomposites: preparation, functionalization, and energy and environmental applications**

Haixin Chang\* and Hongkai Wu\*

Graphene nanocomposites with controlled functionalizations and physical and chemical properties provide unique opportunities for energy and environmental science.

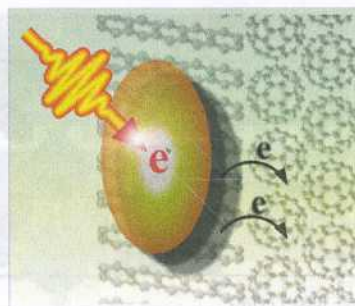


3508

### Exceeding the Shockley–Queisser limit in solar energy conversion

Cory A. Nelson, Nicholas R. Monahan and X.-Y. Zhu\*

Photophysical mechanisms in molecular and nano materials for solar energy conversion beyond the Shockley–Queisser limit.

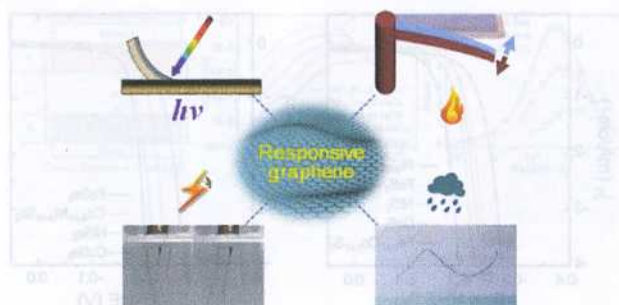


3520

### Stimulus-responsive graphene systems towards actuator applications

Yang Zhao, Long Song, Zhipan Zhang\* and Liangti Qu\*

Smart graphene systems respond to external stimuli for actuator applications.



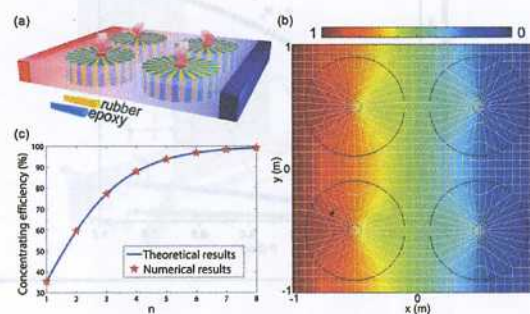
## COMMUNICATIONS

3537

### Theoretical realization of an ultra-efficient thermal-energy harvesting cell made of natural materials

Tiancheng Han, Jiajun Zhao, Tao Yuan, Dang Yuan Lei, Baowen Li and Cheng-Wei Qiu\*

An ultra-efficient thermal-energy harvesting cell made of natural materials.

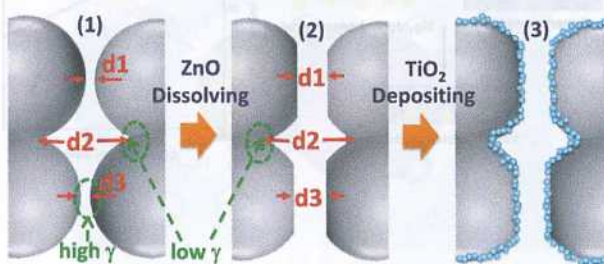


3542

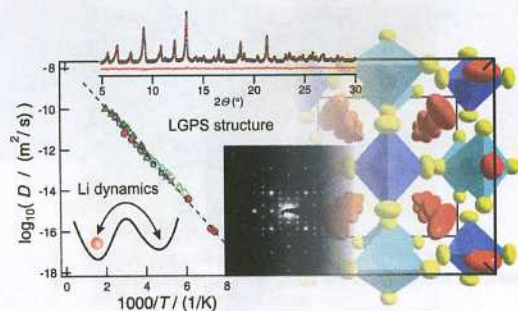
### Architected ZnO photoelectrode for high efficiency quantum dot sensitized solar cells

Jianjun Tian,\* Qifeng Zhang, Evan Uchaker, Rui Gao, Xuanhui Qu, Shengen Zhang and Guozhong Cao\*

A CdS/CdSe quantum dot sensitized solar cell assembled with a ZnO photoelectrode with efficiency of 4.68% was obtained by a facile chemical passivation process.



3548

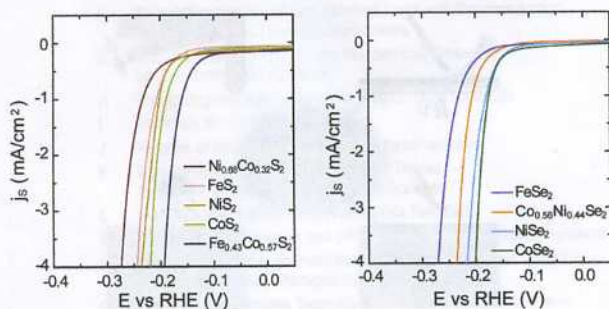


### Tetragonal $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$ and $\text{Li}_7\text{GePS}_8$ – exploring the Li ion dynamics in LGPS Li electrolytes

Alexander Kuhn, Viola Duppel and Bettina V. Lotsch\*

Characterization of the structure and ultrafast Li ion dynamics of the LGPS electrolytes  $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$  and  $\text{Li}_7\text{GePS}_8$ .

3553

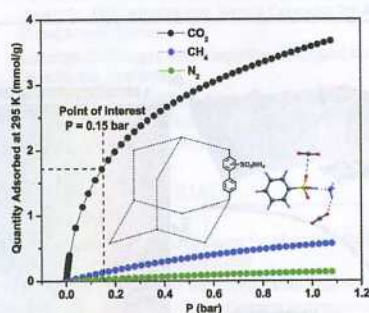


### First-row transition metal dichalcogenide catalysts for hydrogen evolution reaction

Desheng Kong, Judy J. Cha, Haotian Wang, Hye Ryoung Lee and Yi Cui\*

A group of first-row transition metal dichalcogenides are shown to be active catalysts for the hydrogen evolution reaction in an acidic electrolyte.

3559

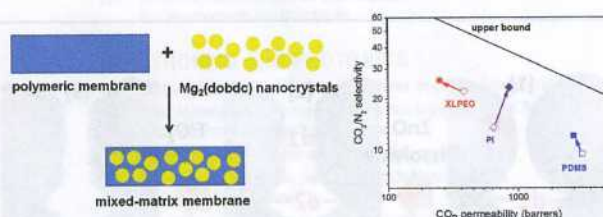


### Building multiple adsorption sites in porous polymer networks for carbon capture applications

Weigang Lu, Wolfgang M. Verdegaa, Jiamei Yu, Perla B. Balbuena, Hae-Kwon Jeong and Hong-Cai Zhou\*

A porous polymer network with multiple adsorption sites boosts  $\text{CO}_2$  capacity at low pressures and selectivity over other gas molecules.

3565



### $\text{CO}_2/\text{N}_2$ separations with mixed-matrix membranes containing $\text{Mg}_2(\text{dobdc})$ nanocrystals

Tae-Hyun Bae and Jeffrey R. Long\*

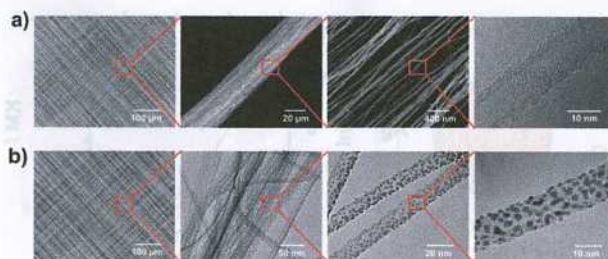
The  $\text{CO}_2/\text{N}_2$  separation performance of a polymer membrane was improved by incorporating nanocrystals of the metal-organic framework  $\text{Mg}_2(\text{dobdc})$  within a glassy polymer with a rigid backbone structure that restricts pore plugging.

3570

### A new catalyst-embedded hierarchical air electrode for high-performance Li-O<sub>2</sub> batteries

Hee-Dae Lim, Hyelynn Song, Hyeokjo Gwon, Kyu-Young Park, Jinsoo Kim, Youngjoon Bae, Hyungsub Kim, Sung-Kyun Jung, Taewoo Kim, Yong Hyup Kim, Xavier Lepró, Raquel Ovalle-Robles, Ray H. Baughman and Kisuk Kang\*

The Li-O<sub>2</sub> battery holds great promise as an ultra-high-energy-density device.

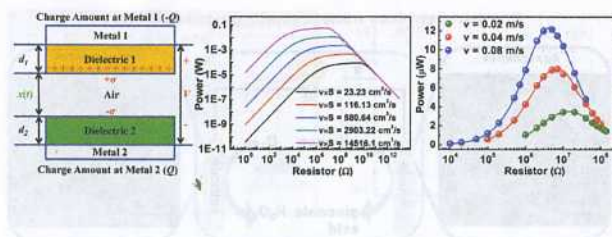


3576

### Theoretical study of contact-mode triboelectric nanogenerators as an effective power source

Simiao Niu, Sihong Wang, Long Lin, Ying Liu, Yu Sheng Zhou, Youfan Hu and Zhong Lin Wang\*

The first comprehensive theoretical model for contact-mode triboelectric nanogenerators is provided, which can serve as important guidance for their rational design.

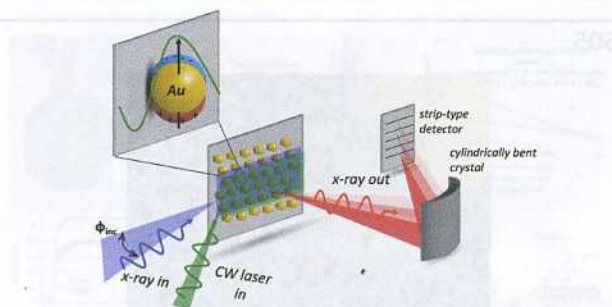


3584

### Direct observation of charge separation on Au localized surface plasmons

Jacinto Sá,\* Giulia Tagliabue, Peter Friedli, Jakub Szlachetko, Mercedes H. Rittmann-Frank, Fabio G. Santomauro, Christopher J. Milne and Hans Sigg

Plasmonic nano-structures of d<sup>10</sup> metals are suggested to be the future of photo-voltaics and photo-catalysis under solar irradiation, thanks to their large light absorption cross-section, versatility, and stability.



3589

### Highly efficient photocatalytic hydrogen generation by solution-processed ZnO/Pt/CdS, ZnO/Pt/Cd<sub>1-x</sub>Zn<sub>x</sub>S and ZnO/Pt/CdS<sub>1-x</sub>Se<sub>x</sub> hybrid nanostructures

S. R. Lingampalli, Ujjal K. Gautam and C. N. R. Rao\*

Excellent hydrogen generation has been achieved by employing hybrid nanostructures of the type ZnO/Pt/Cd<sub>1-x</sub>Zn<sub>x</sub>S (CdS<sub>1-x</sub>Se<sub>x</sub>) prepared by simple solution processing.

