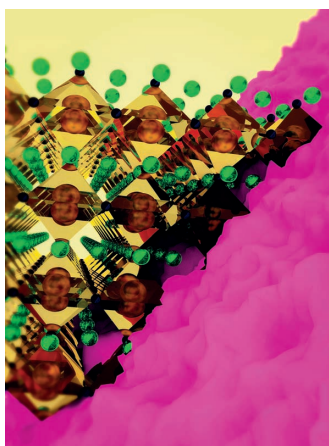


# ADVANCED FUNCTIONAL MATERIALS

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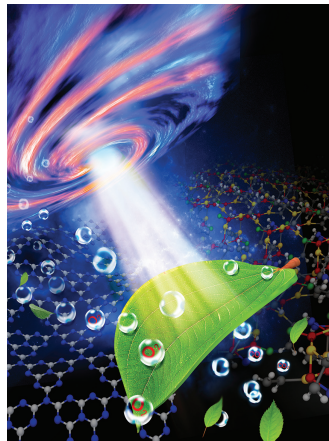


## Hybrid Solar Cells

On page 6875, R. A. Weiss, X. Gong, and co-workers re-engineer the interface between the perovskite active layer and the electron-extraction layer in perovskite hybrid solar cells, using an ultrathin layer of a highly conductive ionomer. The boosted performance of the resulting solar cells is attributed to the reduction in the charge carrier recombination and leakage current, as well as more efficient charge carrier collection.

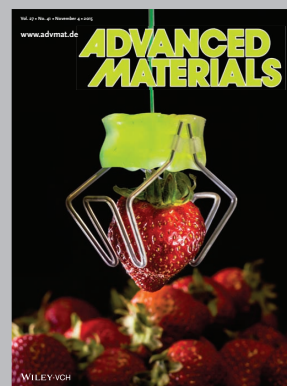
## White Light Phosphors

J. Zhang, W. Chen, and co-workers report non-rare-earth-based white light phosphors composed of graphitic nitrogen carbon and copper-cysteamine on page 6833. These composites exhibit a strong luminescence in the blue and red under ultraviolet single excitation, and are environmentally friendly, easy to synthesize, cost-effective, and free of rare-earth elements. These new white light phosphors have a good potential in solid lighting, displays, and crop improvement.



## Hydrogen Evolution

On page 6885, Z.-H. Huang, Q.-H. Yang, and co-workers demonstrate an efficient thermal etching process for the synthesis of holey graphitic carbon nanosheets, via etching of bulk graphitic carbon nitride under an ammonia atmosphere. These nanosheets exhibit significantly improved photocatalytic activity towards hydrogen evolution reactions under visible light conditions, up to 20 times that of the bulk material.



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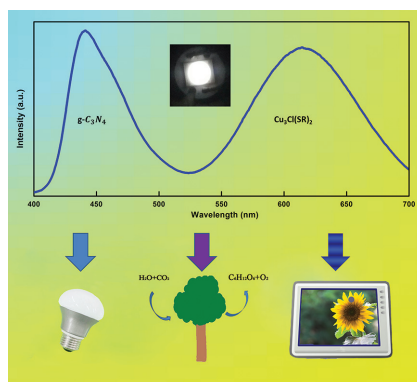
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## FULL PAPERS

**Composites of  $g\text{-C}_3\text{N}_4$  and  $\text{Cu}_3\text{Cl}(\text{SR})_2$  emit white light** when they are excited by a single chip at 365 nm. These non-rare-earth materials are cheap and easy to approach. They can be applied not only for solid lighting and displays but also for crop improvement.

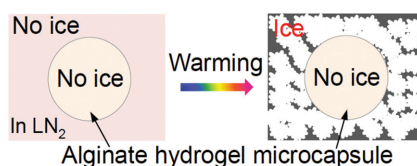


## White Light Phosphors

H. Guo, J. Zhang,\* L. Ma, J. L. Chavez, L. Yin, H. Gao, Z. Tang, W. Chen\* .....6833–6838

## A Non-rare-Earth Ions Self-Activated White Emitting Phosphor under Single Excitation

**Alginate hydrogel microcapsules** are exceptional in inhibiting devitrification in cryopreserved samples during warming, which enables cryopreservation by vitrification in  $\approx 100$  times larger volume using a low and nontoxic concentration of cryoprotectants (i.e., low CPAs) and makes it possible to practically use the low-CPA vitrification technology for cryopreserving stem cells.

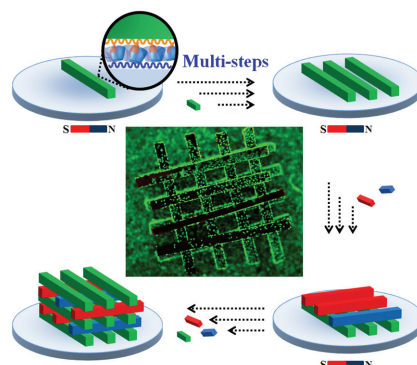


## Cryopreservation

H. Huang, J. K. Choi, W. Rao, S. Zhao, P. Agarwal, G. Zhao, X. He\*...6839–6850

## Alginate Hydrogel Microencapsulation Inhibits Devitrification and Enables Large-Volume Low-CPA Cell Vitrification

**For the first time, macroscopic supramolecular assembly** is applied to fabricate periodically stacked 3D ordered structures with biocompatibility and potential as tissue scaffolds. Special building blocks with bioactive species are introduced in situ to designated locations within the 3D structure, which provides a proof-of-concept idea of fabricating 3D scaffolds with targeted modification of growth factors for directed cell differentiation.

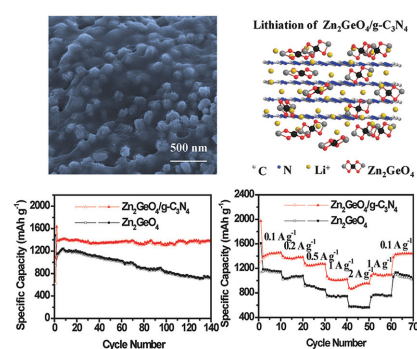


## 3D Structures

M. J. Cheng, Y. Wang, L. L. Yu, H. J. Su, W. D. Han,\* Z. F. Lin, J. S. Li, H. J. Hao, C. Tong, X. L. Li, F. Shi\* .....6851–6857

## Macroscopic Supramolecular Assembly to Fabricate 3D Ordered Structures: Towards Potential Tissue Scaffolds with Targeted Modification

**Smart hybrids of  $\text{Zn}_2\text{GeO}_4$  nanoparticles and ultrathin  $g\text{-C}_3\text{N}_4$  layers** are prepared, in which  $\text{Zn}_2\text{GeO}_4$  nanoparticles are dispersed onto and intercalated into  $g\text{-C}_3\text{N}_4$  layers, thus isolating the ultrathin  $g\text{-C}_3\text{N}_4$  layers from restacking. The structural advantage of  $\text{Zn}_2\text{GeO}_4/g\text{-C}_3\text{N}_4$  hybrids conduces to synergistic lithium storage, resulting in highly reversible capacity, fine cycle performance, and excellent rate capability.



## Lithium Storage

X. Li, Y. Feng, M. Li,\* W. Li, H. Wei, D. Song .....6858–6866

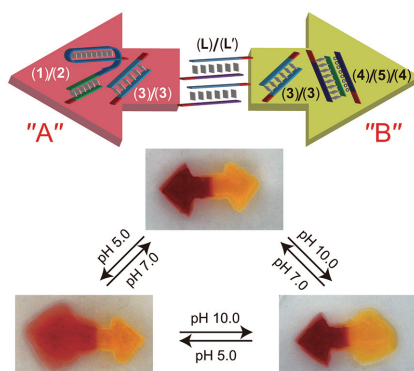
Smart Hybrids of  $\text{Zn}_2\text{GeO}_4$  Nanoparticles and Ultrathin  $g\text{-C}_3\text{N}_4$  Layers: Synergistic Lithium Storage and Excellent Electrochemical Performance

## FULL PAPERS

## Hydrogels

Y. Hu, C.-H. Lu, W. Guo,  
M. A. Aleman-Garcia,  
J. Ren, I. Willner\* ..... 6867–6874

### A Shape Memory Acrylamide/DNA Hydrogel Exhibiting Switchable Dual pH-Responsiveness

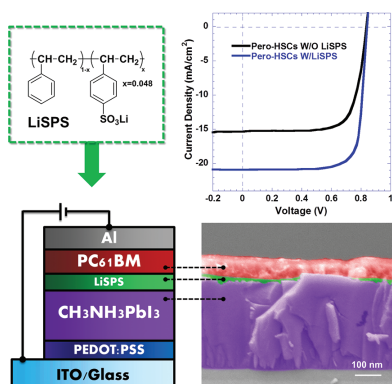


A shape memory acrylamide/DNA hydrogel exhibiting dual switchable pH-responsiveness is presented. The hybrid hydrogel exists at pH = 7.0 in a “two-arrowhead” structure. One domain is transformed into a quasi-liquid shapeless state at pH = 5.0, whereas the second domain transforms into the quasi-liquid state at pH = 10.0. The transformation of the quasi-liquid to shaped hydrogels is reversible due to internal memory elements.

## Hybrid Solar Cells

K. Wang, C. Liu, C. Yi, L. Chen,  
J. Zhu, R. A. Weiss,\*  
X. Gong\* ..... 6875–6884

### Efficient Perovskite Hybrid Solar Cells via Ionomer Interfacial Engineering

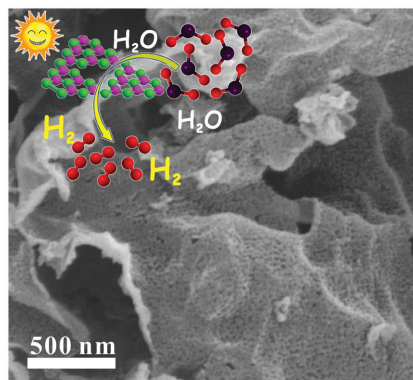


An ultrathin layer of a highly electrical conductive ionomer, 4-lithium styrene-sulfonic acid/styrene copolymer (LiSPS), is employed to re-engineer the interface between the perovskite active layer and the electron-extraction layer in perovskite hybrid solar cells. This results in an enhanced power-conversion efficiency of 13.83% with high reproducibility and low photocurrent hysteresis.

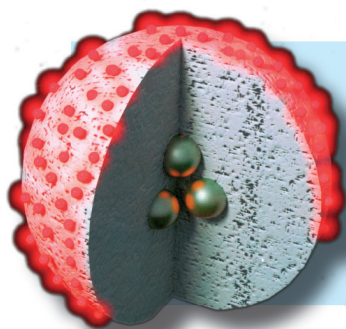
## Hydrogen Evolution

Q. Liang, Z. Li, Z.-H. Huang,\* F. Kang,  
Q.-H. Yang\* ..... 6885–6892

### Holey Graphitic Carbon Nitride Nanosheets with Carbon Vacancies for Highly Improved Photocatalytic Hydrogen Production



An efficient etching process, thermal treatment of bulk graphitic carbon nitride under  $\text{NH}_3$  atmosphere, has been developed to synthesize holey graphitic carbon nitride (HGCN) nanosheets. The resultant HGCN exhibits significantly improved photocatalytic hydrogen production performance under visible light.



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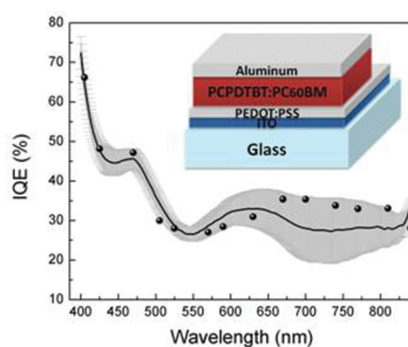
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## FULL PAPERS

The role of excess photon energy on the charge generation efficiency in PCPDTBT:PC60BM-based solar cells is unveiled. The spectral shape of the device internal quantum efficiency (IQE) is determined by combining accurate optoelectronic characterization and comprehensive optical modeling. This joint approach is essential to get reliable values of the IQE that shows an increase trend in photon energy. This holds true independently of the device architecture, reflecting an intrinsic property of the active material.

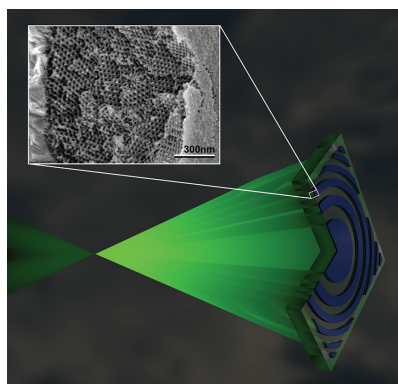


## Organic Solar Cells

G. Grancini,\* M. Binda, S. Neutzner, L. Criante, V. Sala, A. Tagliaferri, G. Lanzani\* .....6893–6899

## The Role of Higher Lying Electronic States in Charge Photogeneration in Organic Solar Cells

Mesoporous networks of conjugated polymers were synthesized by electropolymerisation into templates created by block-copolymer self-assembly. The nanostructured conductive polymer layers were employed to manufacture electrochromic zone-plates that reversibly switch on and off the focusing of light.

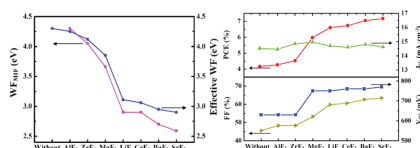


## Nanostructured Polymers

R. Dehmel, A. Nicolas, M. R. J. Scherer, U. Steiner\* .....6900–6905

## 3D Nanostructured Conjugated Polymers for Optical Applications

Organic photovoltaic cells with different metal fluorides as the cathode interfacial layers are fabricated. Parameters of the fluoride-based devices depend on the work function of the corresponding pure metal in the fluoride as a result of the displacement reaction and dipole at the metal fluoride/Al interface.

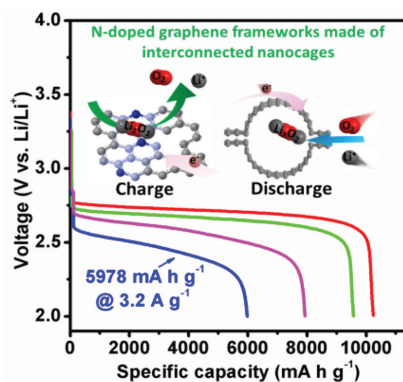


## Organic Photovoltaics

F. Lin, X. Liu,\* Y. Li, Y. Hu, X. Guo\* .....6906–6912

## Ultrathin Metal Fluoride Interfacial Layers for Use in Organic Photovoltaic Cells

3D porous N-doped graphene frameworks constructed by interconnected nanocages are configured with the aid of polystyrene sphere@polydopamine. The interconnected nanocages as the basic building unit of graphene sheets are assembled inside skeletons of graphene aerogels, resulting in well-developed interconnected channels and full exposure of heteroatom sites, thus help to boost the rate capability and cycle life for Li–O<sub>2</sub> batteries.



## Graphene Frameworks

C. T. Zhao, C. Yu, S. H. Liu, J. Yang, X. M. Fan, H. W. Huang, J. S. Qiu\* .....6913–6920

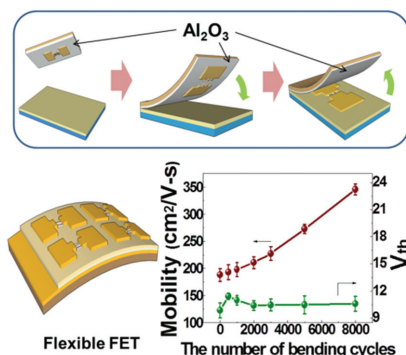
3D Porous N-Doped Graphene Frameworks Made of Interconnected Nanocages for Ultrahigh-Rate and Long-Life Li–O<sub>2</sub> Batteries

# FULL PAPERS

## Flexible Electronics

S. H. Lee, T. I. Lee, M. H. Ham, S. J. Lee,  
J. H. Park, Y. C. Kim, P. Biswas,  
J. M. Myoung\* ..... 6921–6926

### Direct Transfer Printing with Metal Oxide Layers for Fabricating Flexible Nanowire Devices

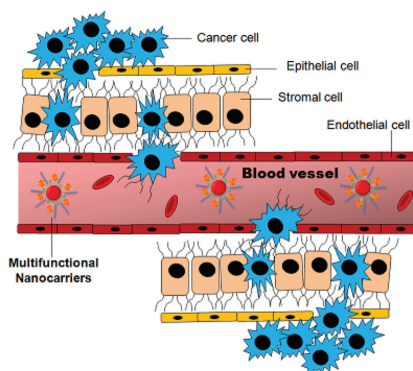


**Flexible Si nanowire field effect transistors (FETs)** are fabricated by a direct printing method applying an  $\text{Al}_2\text{O}_3$  layer. As metal oxide is not damaged by organic solvents, source–drain electrodes with less than  $2\text{ }\mu\text{m}$  can be patterned by photolithography. Unlike typical flexible devices, the FETs produced through the proposed process exhibit enhanced electrical properties with an increasing number of bending cycles.

## Theranostics

T. C. Le, B. Yan,  
D. A. Winkler\* ..... 6927–6935

### Robust Prediction of Personalized Cell Recognition from a Cancer Population by a Dual Targeting Nanoparticle Library

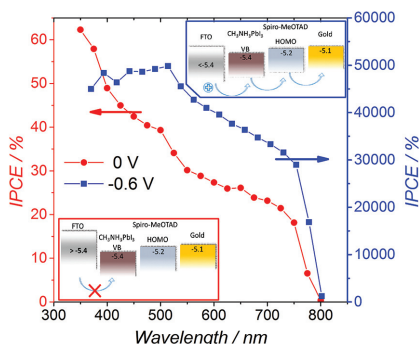


**Efficient targeting of nanoparticles to specific cells** is an important requirement for the development of successful nanoparticle-based cancer theranostics and personalized medicines. The cancer cell targeting ability of gold nanoparticles coated with a library of small organic molecules plus folate is modeled. Computational models can predict the degree of uptake of the nanoparticles as a function of surface chemistry.

## Perovskite Photodetectors

K. Domanski, W. Tress,\* T. Moehl,\*  
M. Saliba, M. K. Nazeeruddin,  
M. Grätzel ..... 6936–6947

### Working Principles of Perovskite Photodetectors: Analyzing the Interplay Between Photoconductivity and Voltage-Driven Energy-Level Alignment



**Different organic–inorganic lead halide perovskites-based photodetector architectures** showing incident photon-to-current efficiency of up to 47 000% at low operation voltage are investigated. The general working principle is explained in terms of a voltage-driven work function alignment of fluorine-doped tin oxide (FTO) with the perovskite due to the accumulation of negative ionic charge at their interface.