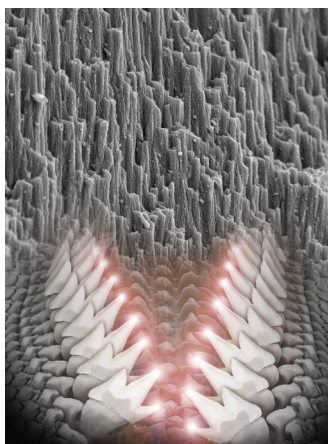


# ADVANCED FUNCTIONAL MATERIALS

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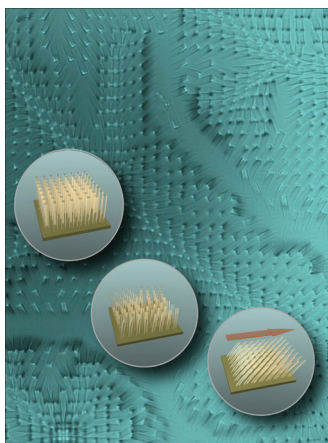


## Biomimetalization

Many biological materials are known for their remarkable structural complexity as well as their impressive mechanical properties. The ultrahard abrasion-resistant radular teeth of the chitons are one such example and members of this group of mollusks, studied by David Kisailus and co-workers on page 2908, have the surprising capacity to erode away the rocky substrates on which they graze for algae. The foreground image depicts the anterior end of the conveyor belt-like radula that contains the magnetite-rich teeth and the background image depicts the oriented rod-like aggregates of magnetic nanoparticles that comprise the material.

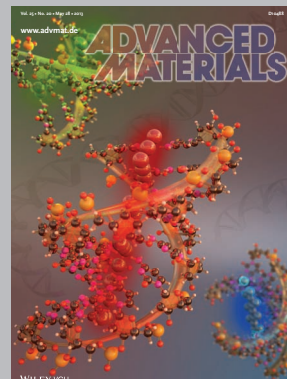
## Hollow Nanostructures

On page 2932, Tze Chien Sum, Shuzhou Li, Zhili Dong, Zhong Chen, and co-workers report an efficient Ag@AgCl cubic cage photocatalyst with well-defined hollow interior, prepared using a water-soluble sacrificial salt-crystal-template process. The photocatalyst shows excellent photocatalytic degradation performance, which is attributed to the significant light confinement and enhancement around the Ag/AgCl interfacial plasmon hot spots, multi-light-reflection inside the cage structure, and the observed ultrafast electron transfer from Ag nanoparticles to AgCl.



## Smart Materials

On page 2964 Eduardo Mendes and co-workers report the production of large arrays of multi-responsive hydrogel cilia using microfabrication techniques. The cilia operate in aqueous solutions and are sensitive to pH, electric, and/or magnetic fields. Electrically stimulated cilia reversibly reduce their size by more than 80%. In the case of magnetoresponsive cilia, high-speed rotational movement is achieved. In addition, a biomimetic system that combines pH-sensor triggered motility is presented.



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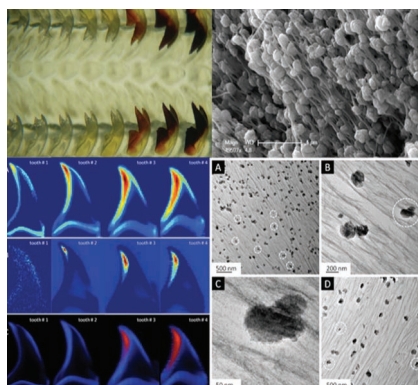
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## FULL PAPERS

## Biom mineralization

Q. Wang, M. Nemoto, D. Li,  
J. C. Weaver, B. Weden, J. Stegemeier,  
K. N. Bozhilov, L. R. Wood,  
G. W. Milliron, C. S. Kim, E. DiMasi,  
D. Kisailus\* .....2908–2917

### Phase Transformations and Structural Developments in the Radular Teeth of *Cryptochiton Stelleri*



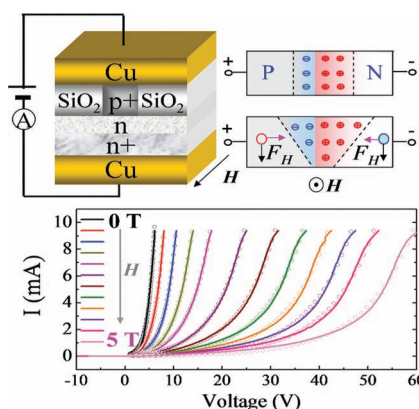
**Dynamic mineralization in the radular teeth of *Cryptochiton stelleri*,** investigated via microscopic and spectroscopic methods, initiates via the templated synthesis of ferrihydrite crystal aggregates along an  $\alpha$ -chitin matrix. These aggregates subsequently transform to magnetite via a solid-state phase transformation, followed by magnetite crystal growth, which yields highly oriented nanorods that exhibit regionally defined geometries affecting the mechanical properties of the mature teeth.

## Magnetoresistance

D. Z. Yang,\* F. C. Wang, Y. Ren,  
Y. L. Zuo, Y. Peng, S. M. Zhou,  
D. S. Xue\* .....2918–2923



### A Large Magnetoresistance Effect in p-n Junction Devices by the Space-Charge Effect

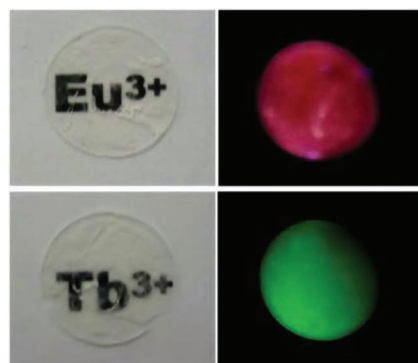


**A large magnetoresistance effect in conventional silicon p-n junctions** is reported. By utilizing the magnetic field to manipulate the space-charge region of the p-n junction, a 2500% magnetoresistance ratio is observed at room temperature with  $H = 5$  T. The p-n junction controlled by both electric field and magnetic field will open a new avenue for future magneto-electronics.

## Composite Materials

P. S. Campbell, C. Lorbeer, J. Cybinska,  
A.-V. Mudring\* .....2924–2931

### One-Pot Synthesis of Luminescent Polymer-Nanoparticle Composites from Task-Specific Ionic Liquids

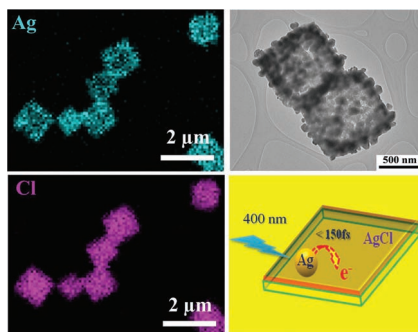


**A multifunction polymerizable ionic liquid, diallyldimethylammonium tetrafluoroborate,** is used in a one-pot synthesis of novel luminescent polymer-nanoparticle composites. Small monodisperse lanthanide fluoride nanoparticles are formed by microwave irradiation in the presence of  $\text{Ln}(\text{OAc})_3 \cdot x\text{H}_2\text{O}$  ( $\text{Ln} = \text{Gd}, \text{Eu}, \text{Tb}$ ,  $\text{OAc} = \text{acetate}$ ) in the ionic liquid. Irradiation under high intensity UV gives colorless, processable polymer materials with good photophysical properties.

## Photocatalysts

Y. Tang, Z. Jiang, G. Xing, A. Li,  
P. D. Kanhere, Y. Zhang, T. C. Sum,\*  
S. Li,\* X. Chen, Z. Dong,\*  
Z. Chen\* .....2932–2940

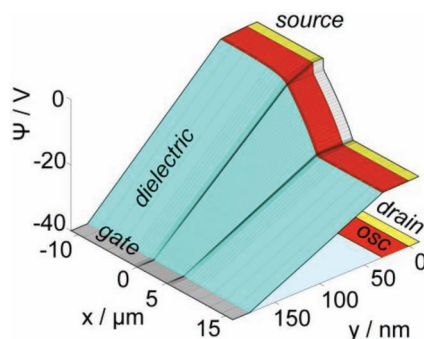
### Efficient Ag@AgCl Cubic Cage Photocatalysts Profit from Ultrafast Plasmon-Induced Electron Transfer Processes



**A novel and economic water-soluble sacrificial salt-crystal-template process** is developed for the large-scale production of hollow Ag@AgCl cage materials. The hollow Ag@AgCl cages show superior photocatalytic performance (28 times larger) compared with the solid form, which profits from the highly efficient electron-hole pair separation that results from ultrafast plasmon-induced electron transfer from Ag nanoparticles to the AgCl surface.

## FULL PAPERS

The contact resistance in organic thin-film transistors is affected by many more parameters than just the injection barrier at the metal/organic interface. The arrangement of the electrodes, the operation conditions, as well as the carrier mobility can change the contact resistance by many orders of magnitude. This can be understood from the details of the potential distribution in the devices.

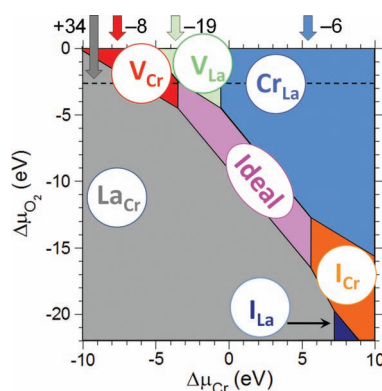


## Thin-Film Transistors

M. Gruber, E. Zojer, F. Schürer,  
K. Zojer\* ..... 2941–2952

## Impact of Materials versus Geometric Parameters on the Contact Resistance in Organic Thin-Film Transistors

The effect of cation stoichiometry and substrate defect density on nucleation, structure, defect formation, and interfacial mixing during III-III perovskite complex oxide heteroepitaxy is explored. Cation imbalance is shown to result in anti-site defect formation within the film, and subsurface cation vacancies promote cation mixing.



## Structure–Property Relationships

L. Qiao, K. H. L. Zhang, M. E. Bowden,  
T. Varga, V. Shutthanandan, R. Colby,  
Y. Du, B. Kabius, P. V. Sushko,  
M. D. Biegalski,  
S. A. Chambers\* ..... 2953–2963

The Impacts of Cation Stoichiometry and Substrate Surface Quality on Nucleation, Structure, Defect Formation, and Intermixing in Complex Oxide Heteroepitaxy—LaCrO<sub>3</sub> on SrTiO<sub>3</sub>(001)

High-aspect-ratio responsive cilia arrays that combine, in one system, sensing and motility functions are fabricated. Based on different approaches the system can be electrically, environmentally, or magnetically activated. Detection of changes in environment, such as a decrease in pH, triggers a collective cilia response, to an external time-dependent magnetic field.

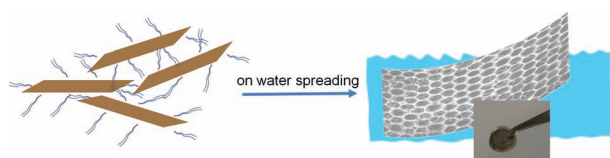


## Hydrogels

P. J. Glazer, J. Leuven, H. An,  
S. G. Lemay, E. Mendes\* ..... 2964–2970

## Multi-Stimuli Responsive Hydrogel Cilia

A facile strategy to create free-standing graphene honeycomb films is developed. The obtained free-standing honeycomb films can be easily transferred to the substrate of interest while retaining their original sizes and structures, and exhibiting broad spectrum antibacterial activity and enhanced efficiency of photoconversion.



## Graphene

S. Yin, Y. Goldovsky, M. Herzberg, L. Liu,  
H. Sun, Y. Zhang, F. Meng, X. Cao,  
D. D. Sun, H. Chen, A. Kushmaro,  
X. Chen\* ..... 2972–2978

## Functional Free-Standing Graphene Honeycomb Films

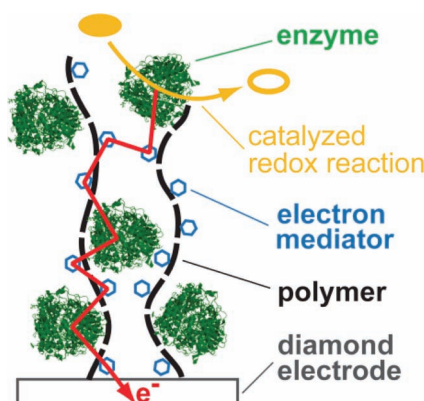


## FULL PAPERS

## Conducting Polymers

A. A. Reitinger, N. A. Hutter, A. Donner,  
M. Steenackers, O. A. Williams,  
M. Stutzmann, R. Jordan,  
J. A. Garrido\* .....2979–2986

**Functional Polymer Brushes on Diamond as a Platform for Immobilization and Electrical Wiring of Biomolecules**

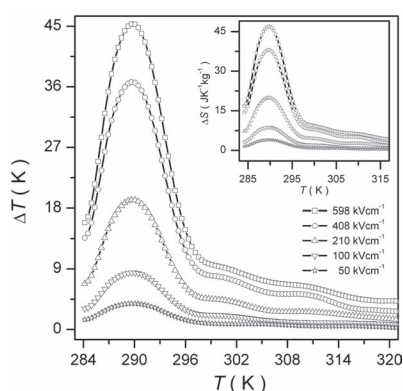


Polymer brushes created by self-initiated photografting and photopolymerization provide a straightforward route for the biofunctionalization of bioelectronic devices, where a high loading and stable immobilization of biomolecules as well as a biocompatible environment and efficient charge transfer are essential. The potential of this approach is demonstrated by the example of amperometric glucose sensing with glucose oxidase- and ferrocene-functionalized poly(methacrylic acid) brushes on nanocrystalline diamond electrodes.

## Thin Films

B. Peng, H. Fan,\*  
Q. Zhang\* .....2987–2992

**A Giant Electrocaloric Effect in Nanoscale Antiferroelectric and Ferroelectric Phases Coexisting in a Relaxor  $\text{Pb}_{0.8}\text{Ba}_{0.2}\text{ZrO}_3$  Thin Film at Room Temperature**

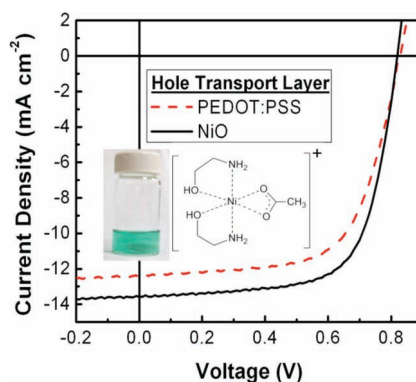


A giant electrocaloric effect at room temperature is obtained in coexisting antiferroelectric and ferroelectric phase relaxor  $\text{Pb}_{0.8}\text{Ba}_{0.2}\text{ZrO}_3$  thin films. Such an effect is usually obtained only at the Curie temperature. This is therefore a promising material for applications in cooling systems near room temperature.

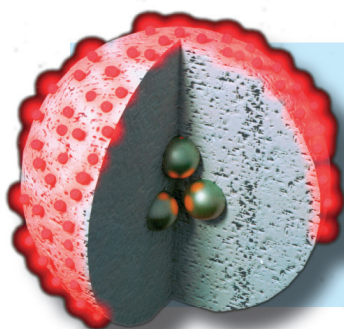
## Organic Electronics

J. R. Manders, S.-W. Tsang,  
M. J. Hartel, T.-H. Lai, S. Chen,  
C. M. Amb,\* J. R. Reynolds,\*  
F. So\* .....2993–3001

**Solution-Processed Nickel Oxide Hole Transport Layers in High Efficiency Polymer Photovoltaic Cells**



By replacing poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) hole-transporting layers (HTLs) with solution-processed nickel oxide (NiO), polymer photovoltaic cells with a power conversion efficiency of 7.8% are fabricated. Solar cells with NiO are more efficient and more air stable than those with PEDOT:PSS. The HTL/active layer interface plays a critical role in solar cell performance.



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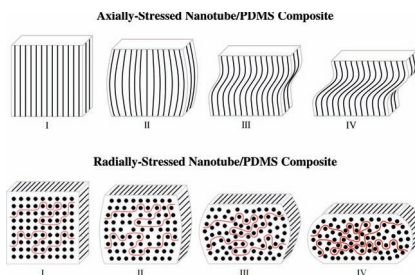
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## FULL PAPERS

The dynamic mechanical compression of continuously reinforced carbon nanotube (CNT)/poly(dimethylsiloxane) composites provides insight into the mechanics of deformation in nanocomposite systems. Loaded along the nanotube axis, these composites respond similar to open-cell forms due to a collective buckling of the CNTs. Compressed normal to nanotube alignment, the CNTs will effectively augment the cross-link density of the elastomer network, lowering the ultimate compressive strain.

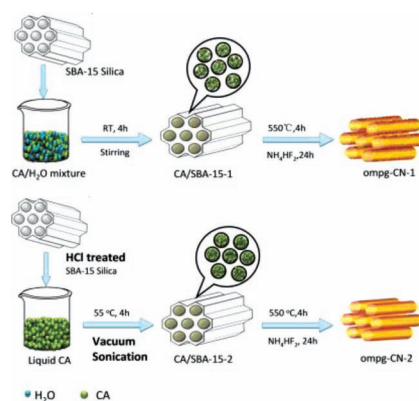


## Nanocomposites

B. J. Carey, P. K. Patra, M. G. Hahm,  
P. M. Ajayan\* .....3002–3007

## Foam-Like Behavior in Compliant, Continuously Reinforced Nanocomposites

Based on a combination of surface acidification and sonication-promoted insertion, an optimized and general synthetic strategy is established for the templated construction of polymeric carbon nitride nanoarchitectures with maximized material and structure functions.



## Photocatalysis

J. Zhang, F. Guo,  
X. Wang\* .....3008–3014

## An Optimized and General Synthetic Strategy for Fabrication of Polymeric Carbon Nitride Nanoarchitectures