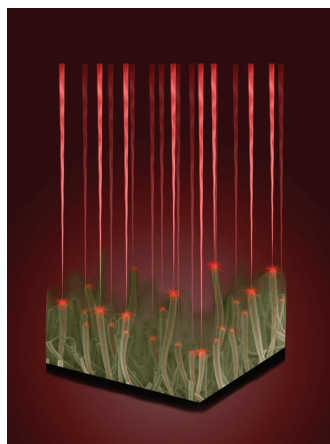


# ADVANCED FUNCTIONAL MATERIALS

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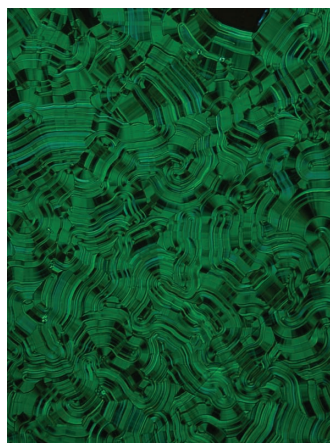


## Hybrid Nanowires

Single-crystal organic nanowires are fabricated and covered by an inorganic wide-bandgap semiconducting shell via chemical vapor deposition. The wires are vertically aligned by A. Borras and co-workers and supported on processable substrates. This method is widely applicable to a range of materials. The waveguide effect on the fluorescence emission of the organic cores and their application as nanoscale waveguides in the 550–750 nm range are explored on page 5981 using perylene and ZnO.

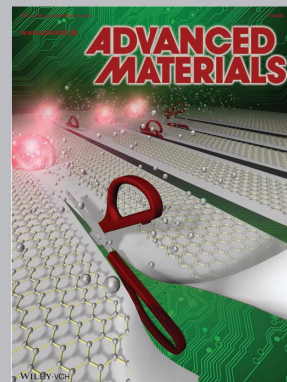
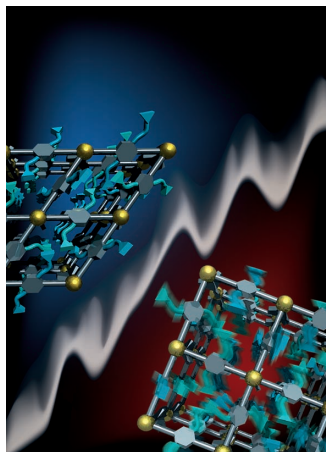
## Porous Materials

Alkoxy-functionalized porous metal–organic frameworks show extreme anisotropic thermal expansion and can reversibly switch between narrow and large pore forms. Flexible alkoxy chains are covalently attached to the crystalline scaffold but exhibit conformational flexibility. The substituents can be viewed as immobilized guests whose thermally induced vibrations trigger a structural response of the entire framework. The detailed thermo-mechanical response of these materials is fine-tuned by S. Henke, A. Schneemann, and R. A. Fischer on page 5990.



## Liquid Crystals

An optical micrograph taken by R. J. Bushby and co-workers using crossed polarizers shows a thin film of 1,4,8,11,15,18,22,25-octaoctylphthalocyanine in its columnar rectangular liquid crystal phase at 100 °C. In such thin, open-to-the-air films, the columns are aligned in-plane but follow random sweeping lines. However, when open-to-the-air films are confined within micrometer-scale channels formed from SU8, all of the columns are aligned and point in the same direction, as shown on page 5997.



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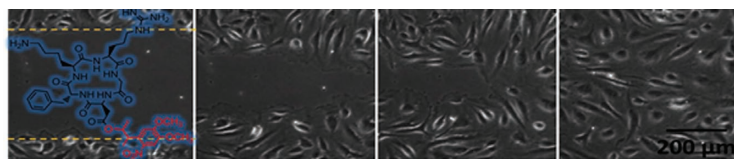
## FULL PAPERS

## Photoactive Biomaterials

M. J. Salierno, A. J. García,  
A. del Campo\* .....5974–5980

### Photo-Activatable Surfaces for Cell Migration Assays

A simple material platform for advanced cell migration studies is developed based on photoactivatable caged adhesive ligands and light-controlled integrin-mediated adhesion and migration events, including their dynamic variation. This strategy allows studies of the dynamics of integrin-dependent migration processes with unprecedented flexibility, multiplexing, reproducibility, and spatiotemporal resolution.

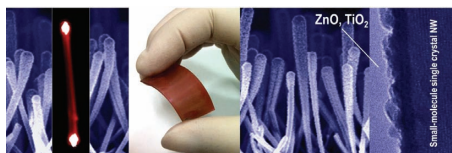


## Hybrid Nanowires

M. Macias-Montero, A. N. Filippin,  
Z. Saghi, F. J. Aparicio, A. Barranco,  
J. P. Espinos, F. Frutos,  
A. R. Gonzalez-Elipe,  
A. Borras\* .....5981–5989

### Vertically Aligned Hybrid Core/Shell Semiconductor Nanowires for Photonics Applications

Hybrid nanomaterials formed by a single crystal organic nanowire covered by a semi-conducting shell are presented. The methodology is fully applicable to  $\pi$ -conjugated small-molecules, different inorganic shell compositions, and processable substrates ranging from silicon wafers to polymeric supports. The wave guiding effect of the organic core luminescent emission on the core/shell nanostructures based on metal perylene (MePTCDI) and ZnO is shown.

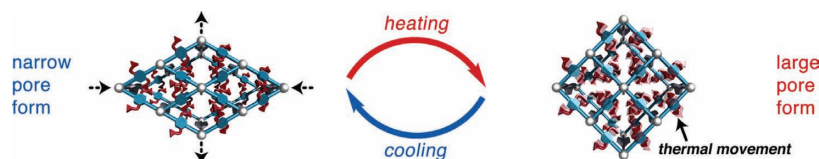


## Porous Materials

S. Henke,\* A. Schneemann,  
R. A. Fischer\* .....5990–5996

### Massive Anisotropic Thermal Expansion and Thermo-Responsive Breathing in Metal–Organic Frameworks Modulated by Linker Functionalization

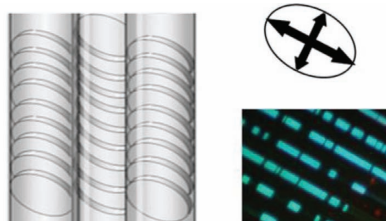
Extremely large thermal expansion is shown by pillared-layered metal–organic frameworks (MOFs) exhibiting alkoxy-functionalized 1,4-benzenedicarboxylate linkers. At a certain threshold temperature the materials reversibly switch from a narrow pore to large pore form. This unprecedented thermo-mechanical behavior is an intrinsic property of the materials and can be modulated substantially by mixing differently functionalized linkers to obtain mixed linker MOF solid solutions.



## Liquid Crystals

J. Cattle, P. Bao, J. P. Bramble,  
R. J. Bushby,\* S. D. Evans, J. E. Lydon,  
D. J. Tate .....5997–6006

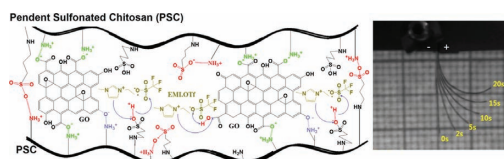
### Controlled Planar Alignment of Discotic Liquid Crystals in Microchannels Made Using SU8 Photoresist



Capillary action can be used to fill SU8 microchannels with a discotic liquid crystal. The liquid crystal aligns with the column director in-plane and across the channels. SU8-capped electrodes allow the current–voltage characteristics of the liquid crystal to be addressed and, in the case of the rectangular columnar phase, there is a separation between two types of domain with equal and opposite rotations of the optical axes.

## FULL PAPERS

**A high-performance, electro-active nano-biopolymer based on pendent sulfonated chitosan (PSC), functionalized graphene oxide (GO) and ionic liquid (IL) with superior electro-chemo-mechanical properties is synthesized. The pendent sulfonated chitosan and functionalized graphene oxide show strong interfacial ionic interactions at the molecular level, resulting in the formation of chemically stable nano-biopolymer membranes with high mechanical stiffness.**

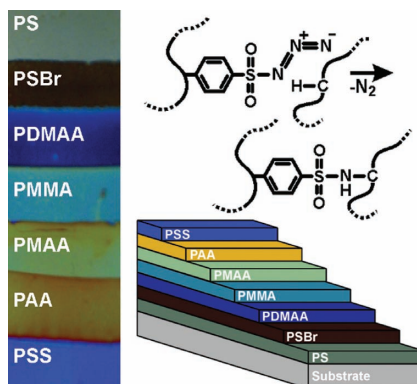


### Artificial Muscles

J.-H. Jeon, R. K. Cheedarala,  
C.-D. Kee,\* I.-K. Oh\* .....6007–6018

**Dry-Type Artificial Muscles Based on Pendent Sulfonated Chitosan and Functionalized Graphene Oxide for Greatly Enhanced Ionic Interactions and Mechanical Stiffness**

**Polymer multilayers are generated in a layer-by-layer fashion using polymers with sulfonyl-azide groups. Upon thermal activation C–H insertion reactions cause the polymers to crosslink and attach to the respective substrate. Through step-and-repeat procedures, multilayer assemblies are generated where all layers are covalently linked. The assembly process does not require any specific molecular interactions and thus represents a general strategy to generate tailor-made multilayer coatings.**

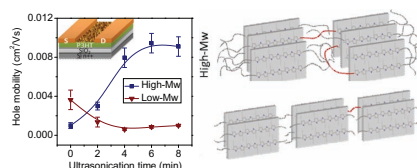


### Thin Films

K. Schuh, O. Prucker,  
J. R  he\* .....6019–6023

**Tailor-Made Polymer Multilayers**

**Conjugated polymer chains of poly(3-hexylthiophene) (P3HT) are gradually disentangled in solution and trends in carrier transport mechanisms in organic thin film transistors for low- and high-molecular weight P3HT are investigated. While intrachain and interchain ordering within ordered domains are the key bottlenecks to charge transport in high- $M_w$  P3HT films, the limited interconnectivity of ordered domains acts as the primary bottleneck to carrier transport in low- $M_w$  P3HT films.**

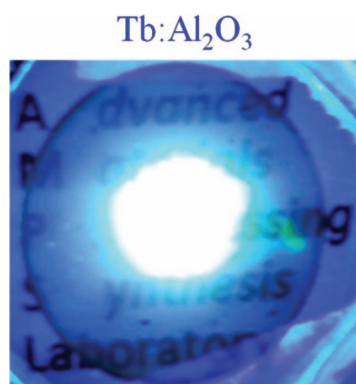


### Polymers

K. Zhao, H. U. Khan, R. Li, Y. Su,  
A. Amassian\* .....6024–6035

**Entanglement of Conjugated Polymer Chains Influences Molecular Self-Assembly and Carrier Transport**

**Tb<sup>3+</sup> ions at concentration of 0.5 at% are incorporated into a dense alumina matrix, achieving a transparent light-emitting ceramic. These doped ceramics have a high transmission (~75% at 800 nm) and display photoluminescence (PL) peaks centered at 485 nm and 543 nm, characteristic of Tb<sup>3+</sup> emission. The high transparencies and PL properties of these ceramics have exciting prospects for high-energy laser technologies.**



### Transparent Ceramics

E. H. Penilla, Y. Kodera,  
J. E. Garay\* .....6036–6043

**Blue–Green Emission in Terbium-Doped Alumina (Tb:Al<sub>2</sub>O<sub>3</sub>) Transparent Ceramics**

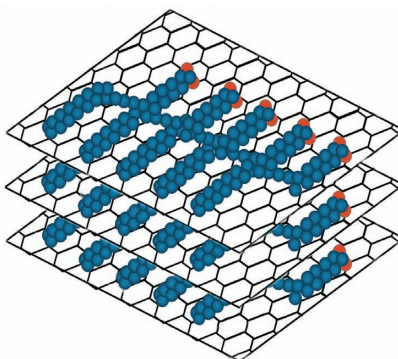


## FULL PAPERS

## Sensors

X. N. Wang, X. L. Sun, P. A. Hu,\*  
J. Zhang, L. F. Wang, W. Feng, S. B. Lei,  
B. Yang, W. W. Cao .....6044–6050

**Colorimetric Sensor Based on Self-Assembled Polydiacetylene/Graphene-Stacked Composite Film for Vapor-Phase Volatile Organic Compounds**

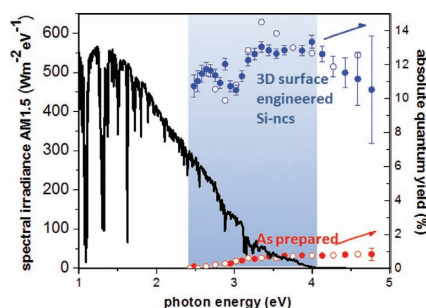


**Polydiacetylene (PDA)/graphene chemosensors** are prepared by the self-assembly of PDA monomers on graphene sheets. The graphene is exploited as a transparent and efficient supporter for the highly ordered PDA monolayer, enabling effective detection of environmentally hazardous volatile organic compounds (VOCs). This colorimetric sensor shows sensitive response to low concentrations of VOCs (~0.01%), such as tetrahydrofuran, chloroform, dimethylformamide, and methanol.

## Solar Cells

V. Svrcek,\* K. Dohnalova, D. Mariotti,  
M. T. Trinh, R. Limpens, S. Mitra,  
T. Gregorkiewicz, K. Matsubara,  
M. Kondo .....6051–6058

**Dramatic Enhancement of Photoluminescence Quantum Yields for Surface-Engineered Si Nanocrystals within the Solar Spectrum**

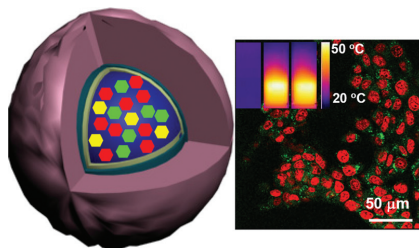


**Dramatic improvements in the absolute photoluminescence quantum yield (QY) and stability** of surfactant-free 3D surface-engineered silicon nanocrystals (Si-ncs) within an important spectral region are demonstrated. The microplasma-induced 3D surface engineering results in more than 120 times enhancement QY for low energy photons (<2.7 eV) and ≈15 times higher for high energy photons (3.5–4.8 eV).

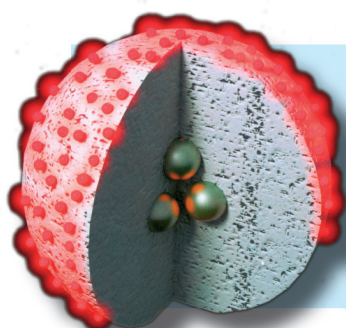
## Cancer Treatments

H. Gong, L. Cheng, J. Xiang, H. Xu,  
L. Z. Feng, X. Z. Shi, Z. Liu\* ...6059–6067

**Near-Infrared Absorbing Polymeric Nanoparticles as a Versatile Drug Carrier for Cancer Combination Therapy**



**A novel nanoparticle drug carrier based on near-infrared absorbing conjugated polymer** is developed and used to load various types of aromatic therapeutic molecules by  $\pi$ - $\pi$  stacking. While multiple types of therapeutic molecules can be simultaneously co-loaded on nanoparticles, the photothermal effect of nanoparticles could also be utilized to promote the delivery of therapeutic agent, showing promise for applications in cancer combination therapy.



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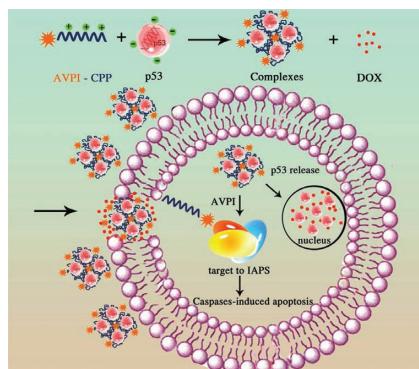
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## FULL PAPERS

### Cancer Treatments

H. Y. Wang, Q. Q. Guo, Y. F. Jiang,  
E. G. Liu, Y. X. Zhao, H. X. Wang,  
Y. P. Li,\* Y. Z. Huang\* .....6068–6075

#### Co-delivery of Cell-permeable Chimeric Apoptosis AVPIR<sub>8</sub> Peptide/p53 DNA for Cocktail Therapy

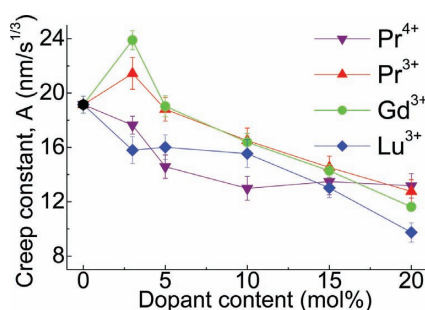


The dual-functionalized AVPIR<sub>8</sub>, the strategically designed cell-penetrating chimeric apoptotic peptide, not only effectively induces tumor cell apoptosis, but also works as gene carrier for transferring the tumor suppressor p53 DNA into cells, thus constructing a co-delivery drug system (AVPIR<sub>8</sub>/p53). Such system, combined with doxorubicin as cocktail therapy, provides benefits of enhanced treatment outcomes yet greatly reduced adverse toxicity.

### Ion Conductors

R. Korobko, S. K. Kim, S. Kim,\*  
S. R. Cohen, E. Wachtel,  
I. Lubomirsky\* .....6076–6081

#### The Role of Point Defects in the Mechanical Behavior of Doped Ceria Probed by Nanoindentation

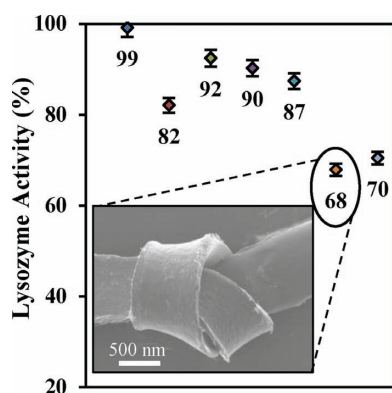


Nanoindentation measurements performed on ceria doped with Pr<sup>4+</sup>, Pr<sup>3+</sup>, Lu<sup>3+</sup>, Gd<sup>3+</sup> demonstrate that the rearrangement of point defects may be a major source of creep at room temperature. Nanoindentation is shown to be an effective technique for identifying materials with labile point defects, which may point to practical functionality such as high ionic conductivity, large electrostriction, and inelasticity.

### Carbon Nanotubes

D. W. Horn, G. Ao, M. Maugey, C. Zakri,  
P. Poulin, V. A. Davis\* .....6082–6090

#### Dispersion State and Fiber Toughness: Antibacterial Lysozyme-Single Walled Carbon Nanotubes

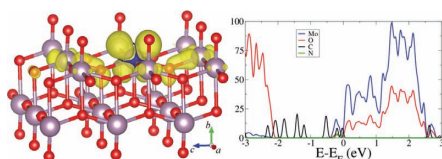


High strength antibacterial fibers can be dry spun from stabilized aqueous dispersions of single-walled carbon nanotubes in lysozyme. Toughness four times greater than that of spider silk is achieved by understanding and manipulating the phase behavior of a multi-component spinning solution. The fraction of native lysozyme activity retained varies with composition and processing conditions.

### Optoelectronics

T. A. Papadopoulos, J. Meyer, H. Li,  
Z. Guan, A. Kahn,  
J.-L. Brédas\* .....6091–6099

#### Nature of the Interfaces Between Stoichiometric and Under-Stoichiometric MoO<sub>3</sub> and 4,4'-N,N'-dicarbazole-biphenyl: A Combined Theoretical and Experimental Study



The interface between MoO<sub>x</sub> and an organic hole transport material is investigated in a joint theoretical and experimental study. Gap states are found to be associated with different types of oxygen vacancies and adsorption of the organic material, which induce electron donor states at different energy levels within the band gap.

## FULL PAPER

## Carbon Nanotubes

D. Ma, L. Liang, W. Chen, H. Liu,  
Y.-F. Song\* .....6100–6105

**Covalently Tethered Polyoxometalate–  
Pyrene Hybrids for Noncovalent  
Sidewall Functionalization of Single-  
Walled Carbon Nanotubes as High-  
Performance Anode Material**

A covalently tethered polyoxometalate (POM)–pyrene hybrid (Py–SiW<sub>11</sub>) is utilized for the noncovalent functionalization of single-walled carbon nanotubes (SWNTs). When used as anode material in lithium-ion batteries, the SWNTs/Py–SiW<sub>11</sub> nanocomposite exhibits higher discharge capacities, and better rate capacity and cycling stability than the individual components.

