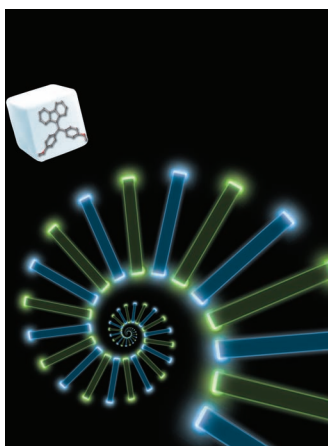


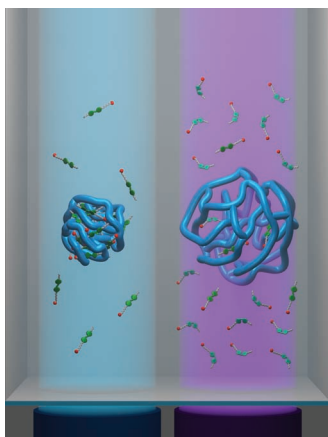
# ADVANCED FUNCTIONAL MATERIALS

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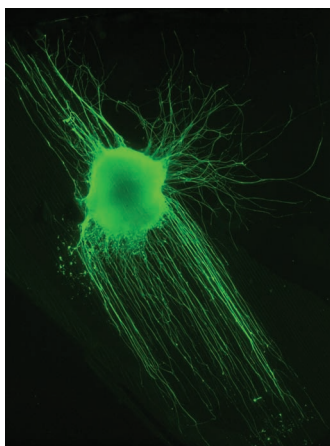
## Hierarchical Structures

Hierarchically structured scaffolds are generated by controlled freeze casting of an aqueous biopolymer solution. As reported by Ulrike G. K. Wegst and co-workers on page 4920, under specific freezing conditions, the scaffolds exhibit a highly regular and aligned lamellar architecture. These ridges run parallel to the pore axis and are seen to act as secondary guidance features to align the neuritis of dorsal root ganglia, which is imaged by fluorescent microscopy.



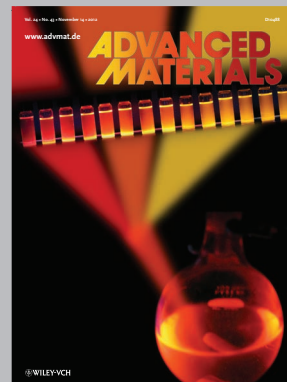
## Optical Waveguides

The solid state emission of di(p-methoxyphenyl) dibenzofulvene and analogues is polymorphism dependent. The crystalline forms are strongly emissive, whereas the amorphous solid is weakly fluorescent. As reported by Guanxin Zhang, Deqing Zhang, and co-workers on page 4862, organic crystalline microrods based on the same molecular entity exhibit strong blue and yellow-green emission, outstanding optical waveguide behavior, and amplified spontaneous emission.



## Stimuli-Responsive Materials

As reported by Yuriy Zakrevskyy and co-workers on page 5000, all-optical reversible control of the swelling/contraction transition of a microgel is realized using an azobenzene-containing surfactant. The azobenzene unit is switched between the more hydrophobic trans (blue light) and the more hydrophilic cis (UV light) state, which alters the surfactant's affinity to the microgel. The trans-surfactant binds to the gel triggering its contraction and the cis-surfactant unbinds leading to microgel swelling.



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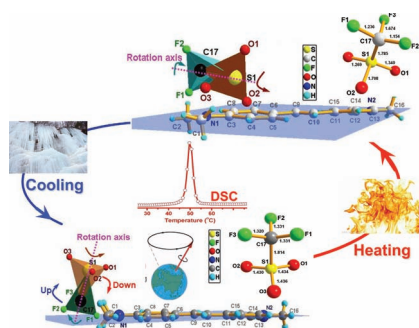
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# FULL PAPERS

## Dielectrics

Z. Sun, J. Luo,\* T. Chen,  
L. Li, R.-G. Xiong, M.-L. Tong,  
M. Hong .....4855–4861

### Distinct Molecular Motions in a Switchable Chromophore Dielectric 4-*N,N*-Dimethylamino-4'-*N'*-methylstilbazolium Trifluoromethanesulfonate

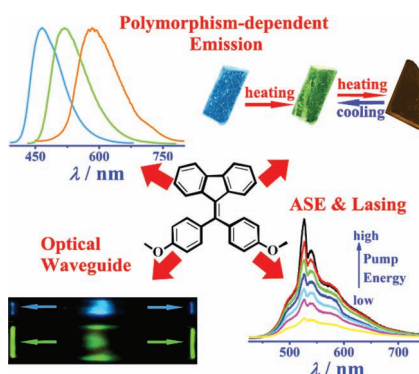


A new organic chromophore dielectric, 4-*N,N*-dimethylamino-4'-*N'*-methylstilbazolium trifluoromethanesulfonate, which undergoes a reversible phase transition with striking dielectric anomalies, is synthesized as a molecular rotator. Two very distinct molecular motions are observed, namely the “earth rotation” of partial units and the “earth revolution” of the whole molecule. Above its critical point, the anionic moiety exhibits an unprecedented 51.2° orientational motion.

## Solid-State Emission

X. G. Gu, J. J. Yao, G. X. Zhang,\*  
Y. L. Yan, C. Zhang, Q. Peng, Q. Liao,  
Y. S. Wu, Z. Z. Xu, Y. S. Zhao,  
H. B. Fu, D. Q. Zhang\* .....4862–4872

### Polymorphism-Dependent Emission for Di(p-methoxyphenyl)dibenzofulvene and Analogues: Optical Waveguide/Amplified Spontaneous Emission Behaviors

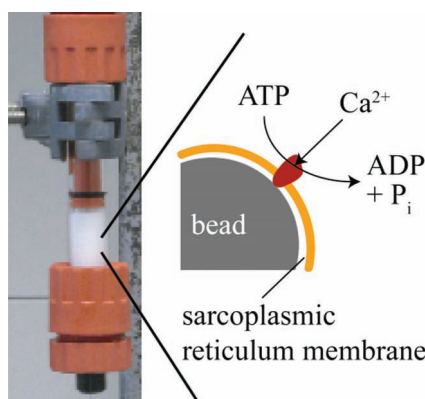


Di(p-methoxyphenyl)dibenzofulvene and its analogues are investigated. Two crystalline forms of di(p-methoxyphenyl)dibenzofulvene are strongly blue- and yellow-green-emissive, whereas the amorphous solid is weakly fluorescent with orange emission. The results also manifest that the solid-state emission of diphenyldibenzofulvene can be tuned by varying the length of the alkoxyl chains. Moreover, their microrods exhibit outstanding optical waveguide and amplified spontaneous emission behaviors.

## Functional Coatings

M. Tutus, S. Kaufmann, I. M. Weiss,  
M. Tanaka\* .....4873–4878

### Functional Coating of Porous Silica Microparticles with Native Biomembranes towards Portable Flow-Through Biochemical Microreactors

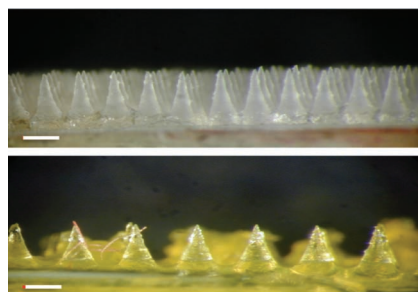


Deposition of native sarcoplasmic reticulum membranes on porous silica microparticles enables one to confine a large amount (1.1 m<sup>2</sup>) of transmembrane Ca<sup>2+</sup>-ATPase on a portable flow-through biochemical microreactor that can be operated in a robust and stable manner.

## Drug Delivery

R. F. Donnelly,\* T. R. R. Singh,  
M. J. Garland, K. Migalska,  
R. Majithiya, C. M. McCrudden,  
P. L. Kole, T. M. T. Mahmood,  
H. O. McCarthy,  
A. D. Woolfson .....4879–4890

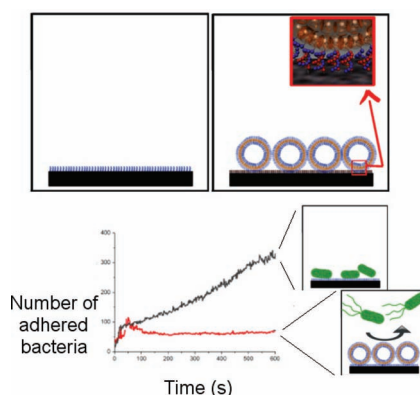
### Hydrogel-Forming Microneedle Arrays for Enhanced Transdermal Drug Delivery



Microneedle arrays prepared from crosslinked polymers, which contain no drug themselves, are described. They rapidly take up skin interstitial fluid upon skin insertion to form continuous, unblockable, hydrogel conduits from attached patch-type drug reservoirs to the dermal microcirculation. This technology has the potential to further enhance the capabilities of microneedle strategies for transdermal drug delivery, while bypassing current difficulties.

## FULL PAPERS

**Oligonucleotide-polymer hybrids form vesicular structures that can be immobilized onto surfaces through hybridization.** This type of soft coating is able to prevent bacterial adhesion and colonization without an antimicrobial agent. This interesting property is due to the mechanical properties of the coating and is attributed to the dissipative properties of the vesicle-based coating.

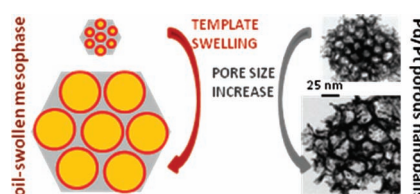


## Functional Coatings

N. Cottenye, K. Anselme, L. Ploux, C. Veber-Nardin\* .....4891–4898

**Vesicular Structures Self-Assembled from Oligonucleotide-Polymer Hybrids: Mechanical Prevention of Bacterial Colonization Upon their Surface Tethering Through Hybridization**

**Hexagonal mesophases composed of oil-swollen surfactant-stabilized tubes arranged on a lattice in water and doped with metallic salts are used as soft templates for the synthesis of porous bimetallic nanostructures of controlled porosity and composition.** The pore size can be varied from 10 to 55 nm. Control over such a large porosity range of nano-materials is reported for the first time.

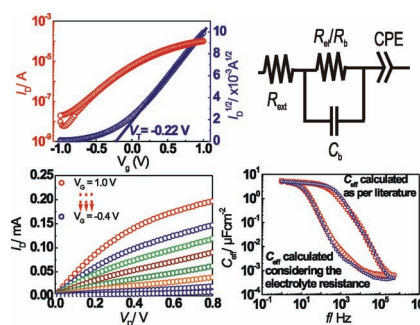


## Metallic Nanoparticles

A. Lehoux, L. Ramos, P. Beaunier, D. B. Uribe, P. Dieudonné, F. Audonnet, A. Etcheberry, M. José-Yacamán, H. Remita\* .....4900–4908

**Tuning the Porosity of Bimetallic Nanostructures by a Soft Templating Approach**

**Ink-jet-printed and electrochemically gated, high-mobility field-effect transistors based on inorganic-oxide nanoparticles are presented.** The speed of electrochemical gating is experimentally assessed with equivalent circuits involving blocking electrodes. Effective capacitance is calculated considering the double-layer capacitance and the electrolyte resistance. The electrolyte polarization is found to be fast enough to ensure that the maximum attainable speed of the long-channel, printed transistors is limited by the printing resolution.

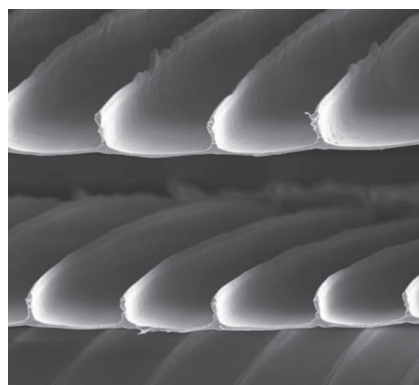


## Field-Effect Transistors

S. Dasgupta,\* G. Stoesser, N. Schweikert, R. Hahn, S. Dehm, R. Kruk, H. Hahn .....4909–4919

**Printed and Electrochemically Gated, High-Mobility, Inorganic Oxide Nanoparticle FETs and Their Suitability for High-Frequency Applications**

**Hierarchically structured scaffolds are generated by controlled freeze casting of an aqueous biopolymer solution.** Under specific freezing conditions, the scaffolds exhibit a highly regular and aligned lamellar architecture. These ridges run parallel to the pore axis and are seen to act as secondary guidance features to align the neurites.



## Hierarchical Structures

B. W. Riblett, N. L. Francis, M. A. Wheatley, U. G. K. Wegst\* .....4920–4923

**Ice-Templated Scaffolds with Microridged Pores Direct DRG Neurite Growth**

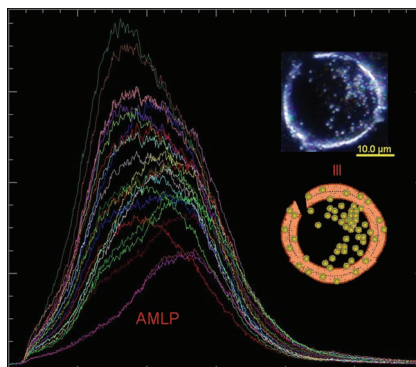


## FULL PAPERS

## Nanoparticles

J. S. Lee, C.-H. Tung\* .....4924–4930

## Enhancing the Cellular Delivery of Nanoparticles Using Lipo-Oligoarginine Peptides

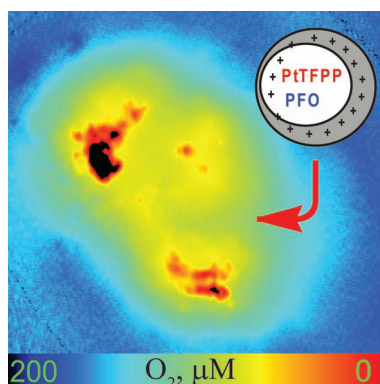


Gold nanoparticles (AuNPs) are functionalized by conjugating a hydrophobic fatty acid moiety and hydrophilic oligoarginine cell penetrating peptide on their surface to enhance cellular uptake and intracellular localization into cells. AMLPs (AuNPs conjugated with a myristoyl acid and an oligoarginine group) are effectively delivered into intracellular compartments of a cell without detectable cellular toxicity.

## Phosphorescent Nanoparticles

A. V. Kondrashina, R. I. Dmitriev, S. M. Borisov, I. Klimant, I. O'Brien, Y. M. Nolan, A. V. Zhdanov, D. B. Papkovsky\* .....4931–4939

## A Phosphorescent Nanoparticle-Based Probe for Sensing and Imaging of (Intra)Cellular Oxygen in Multiple Detection Modalities



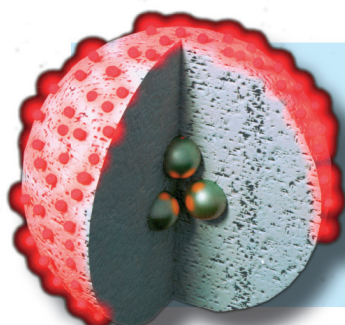
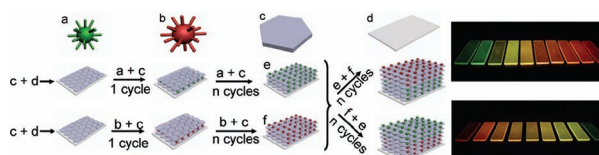
A new cell-penetrating nanoparticle-based O<sub>2</sub> probe based on Pt(II)-5,10,15,20-tetrakis-(2,3,4,5,6-pentafluorophenyl)-porphyrin (PtTFPP) and poly(9,9-dioctylfluorene) (PFO) antennae dye is described. The probe allows for the sensing and imaging of molecular oxygen in different detection modalities including ratiometric intensity and lifetime-based imaging under one- and two-photon excitation.

## Quantum Dots

R. Z. Liang, S. M. Xu, D. P. Yan, W. Y. Shi, R. Tian, H. Yan, M. Wei,\* D. G. Evans, X. Duan .....4940–4948

## CdTe Quantum Dots/Layered Double Hydroxide Ultrathin Films with Multicolor Light Emission via Layer-by-Layer Assembly

The fabrication of finely tunable multicolor-light-emitting ultrathin films (UTFs) with 2D architecture based on CdTe QDs and MgAl-layered double hydroxide nanosheets via the layer-by-layer deposition technique is reported. The UTFs, which have significantly enhanced luminescence efficiency and stability, can be potentially applied in multicolor optical and optoelectronic devices.



## How to contact us:

## Editorial Office:

Phone: (+49) 6201-606-235/531  
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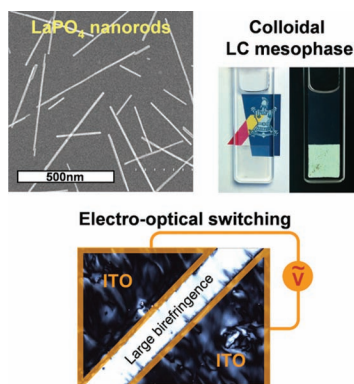
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## FULL PAPERS

A new type of mineral liquid crystal system composed of  $\text{LaPO}_4$  particles with tuned long rod-like morphology self-organizes into different mesophases. An electro-optical experiment shows a very efficient alignment of the nanorod suspension exhibiting large birefringence under a weak electric field. This result, combined with the high intrinsic transparency and athermal behavior, opens the way towards a new class of self-assembling materials for electro-optical applications.

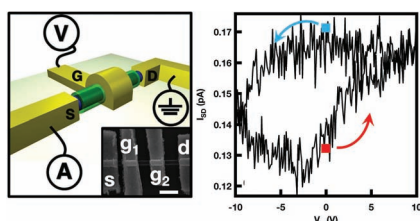


## Liquid Crystals

J. Kim, A. de la Cotte, R. Deloncle, S. Archambeau, C. Biver, J.-P. Cano, K. Lahlil, J.-P. Boilot, E. Grelet,\* T. Gacoin\* .....4949–4956

### $\text{LaPO}_4$ Mineral Liquid Crystalline Suspensions with Outstanding Colloidal Stability for Electro-Optical Applications

The ferroelectric field effect is demonstrated within individual semiconductor silicon-core, ferroelectric  $\text{PbZr}_{0.52}\text{Ti}_{0.48}\text{O}_3$  (PZT)-shell nanowires. The observed effect on the measured source-drain current approaches four orders of magnitude, despite a ferroelectric layer/semiconducting channel ratio nearly three orders smaller than that of conventional planar ferroelectric field-effect transistors (FeFETs).

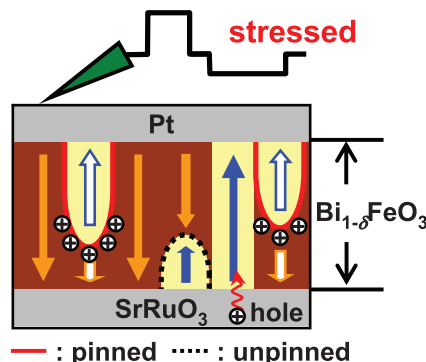


## Core/Shell Nanowires

S. S. Nonnenmann, M. A. Islam, B. R. Beatty, E. M. Gallo, T. McGuckin, J. E. Spanier\* .....4957–4961

### The Ferroelectric Field Effect within an Integrated Core/Shell Nanowire

Continuous control of charge transport and polarization hysteresis in Bi-deficient  $\text{BiFeO}_3$  films through local ferroelectric switching is demonstrated. Application of a dc voltage stress to  $\text{Bi}_{1-\delta}\text{FeO}_3$  capacitors causes local polarization switching. In the switched domain regions, holes are injected at the film/bottom electrode interface, leading to reverse diode behavior. The injected holes are trapped near tail-to-tail domain walls, inducing a pinning effect with shrinkage of the polarization hysteresis loop.

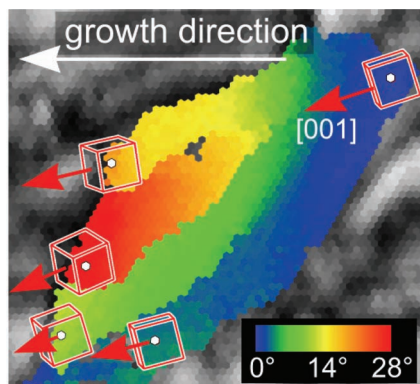


## Ferroelectric Materials

T. H. Kim, B. C. Jeon, T. Min, S. M. Yang, D. Lee, Y. S. Kim, S.-H. Baek, W. Saenrang, C.-B. Eom, T. K. Song, J.-G. Yoon,\* T. W. Noh .....4962–4968

### Continuous Control of Charge Transport in Bi-Deficient $\text{BiFeO}_3$ Films Through Local Ferroelectric Switching

Industrially produced chemical vapor deposition (CVD)-ZnS is analyzed using electron backscatter diffraction (EBSD) and X-ray diffraction (XRD). Wurtzite is detected within the first layer of deposition. The following 1000  $\mu\text{m}$  of crystal growth occur in the form of large, heavily twinned grains. A sharp grain-size transition to grains  $<50 \mu\text{m}$  in length is observed. Local textures are described as well as twinning and grain fragmentation in the form of continuous orientation change.



## Ceramics

T. Zscheckel, W. Wisniewski,\* C. Rüssel .....4969–4974

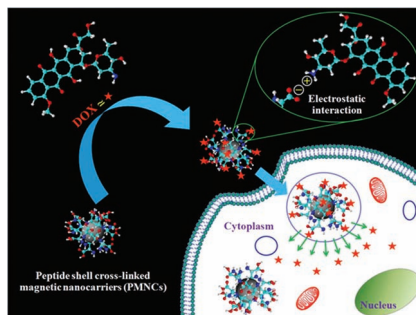
### Microstructure and Texture of Polycrystalline CVD-ZnS Analyzed via EBSD

# FULL PAPERS

## Drug Delivery

K. C. Barick, S. Singh, N. V. Jadhav,  
D. Bahadur, B. N. Pandey,  
P. A. Hassan\* .....4975–4984

### pH-Responsive Peptide Mimic Shell Cross-Linked Magnetic Nanocarriers for Combination Therapy

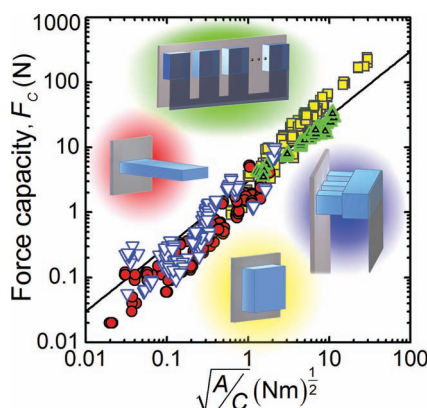


The design and development of water dispersible, pH responsive peptide mimic shell cross-linked magnetic nanocarriers with functionalized exteriors (amine and carboxyl) for conjugation of drugs is reported. Specifically, the high loading affinity of nanocarriers for an anticancer drug (doxorubicin), their sustained release profiles, magnetic-field-induced heating, low toxicity, and good cellular internalization make them suitable for combination therapy involving hyperthermia and chemotherapy.

## Biomimetics

M. D. Bartlett, A. B. Croll,  
A. J. Crosby\* .....4985–4992

### Designing Bio-Inspired Adhesives for Shear Loading: From Simple Structures to Complex Patterns

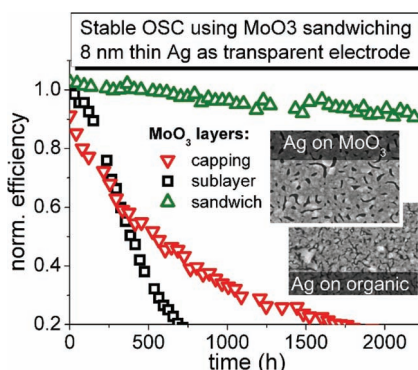


Design criteria for bio-inspired adhesives under shear loading is presented. Force capacity predictions of common geometric control parameters such as thickness, aspect ratio, and contact area are experimentally confirmed. This understanding is extended to over 25 simple and complex adhesive patterns. The force capacity of the various attachment features is described with a simple scaling parameter.

## Solar Cells

S. Schubert,\* M. Hermenau,  
J. Meiss, L. Müller-Meskamp,\*  
K. Leo .....4993–4999

### Oxide Sandwiched Metal Thin-Film Electrodes for Long-Term Stable Organic Solar Cells

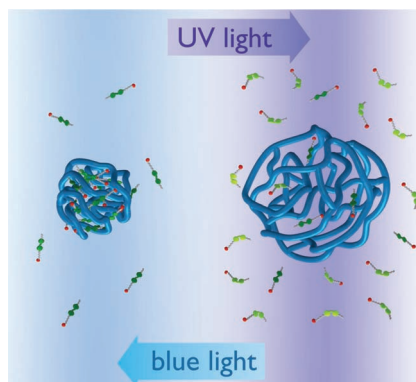


A stable semitransparent thin silver top contact for organic solar cells is fabricated by sandwiching it between thermally evaporated MoO<sub>3</sub> layers. By using a MoO<sub>3</sub> interlayer, the morphology of the Ag electrode is improved, leading to better charge collection. The sandwich increases the electrode transmittance, photocurrent generation, and lifetime. With this, more efficient solar cells with lifetimes of 4500 h are achieved.

## Microgel Manipulation

Y. Zakrevsky,\* M. Richter,  
S. Zakrevska, N. Lomadze,  
R. von Klitzing,  
S. Santer .....5000–5009

### Light-Controlled Reversible Manipulation of Microgel Particle Size Using Azobenzene-Containing Surfactant

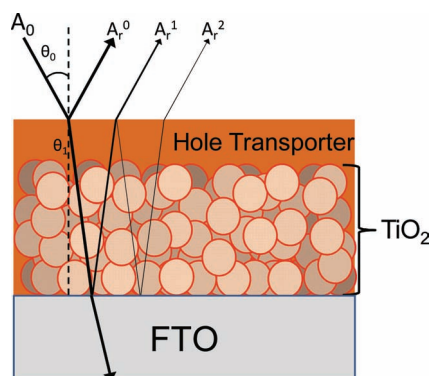


Remote reversible control of swelling/contraction transition of a microgel is realized using azobenzene-containing surfactant. The azobenzene unit is switched between more hydrophilic *cis* (UV light) and more hydrophobic *trans* (blue light) state, which alters the surfactant's affinity to the microgel. The *trans*-surfactant binds to the gel, triggering its contraction, and the *cis*-surfactant unbinds, leading to microgel swelling.



## FULL PAPERS

A facile and accurate optical method for determining the pore-filling fraction of organic hole-transporters into mesoporous  $\text{TiO}_2$  photoanodes is described. Using this technique it is determined that maximum pore-filling fractions of up to 80% are achievable, and the long-held belief that pore-filling is the limiting factor to fabricate efficient thick (over  $5\ \mu\text{m}$ ) devices, which is necessary to achieve optimum photovoltaic performance with standard dyes, is challenged.



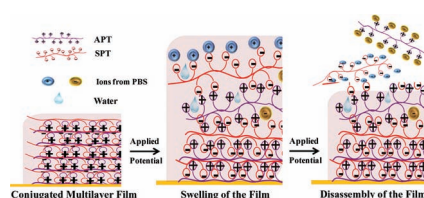
## Photovoltaic Devices

P. Docampo, A. Hey, S. Guldin,  
R. Gunning, U. Steiner,  
H. J. Snaith\* .....5010–5019

### Pore Filling of Spiro-OMeTAD in Solid-State Dye-Sensitized Solar Cells Determined Via Optical Reflectometry



Induced controlled dissolution of electroactive multilayer films constructed using water soluble polythiophenes can be achieved in response to applied potentials. For the first time, the disassembly of conducting-polymer-based multilayers is demonstrated to be induced by the application of a potential, opening the way for new architectural designs for bionic devices.

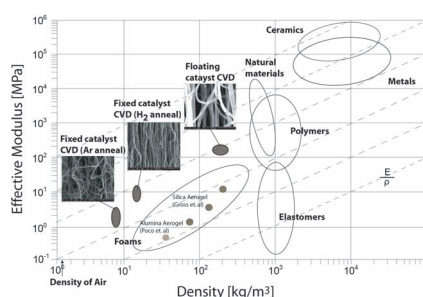


## Multilayer Films

D. Mawad,\* P. J. Molino, S. Gambhir,  
J. M. Locke, D. L. Officer,  
G. G. Wallace\* .....5020–5027

### Electrically Induced Disassembly of Electroactive Multilayer Films Fabricated from Water Soluble Polythiophenes

Wide range stiffness tuning of carbon nanotube (CNT) forests over three orders of magnitude is presented by directly modifying the diameter and packing density of CNTs through the modulation of chemical vapor deposition (CVD) parameters. Fixed catalyst and floating catalyst CVD techniques exhibit significantly different deformation mechanisms and the open-cell foam model predicts the stiffness ratio within one type of CVD method very well.

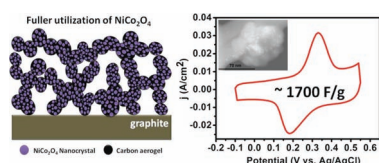


## Carbon Nanotubes

O. Yaglioglu,\* A. Cao, A. J. Hart,  
R. Martens, A. H. Slocum .....5028–5037

### Wide Range Control of Microstructure and Mechanical Properties of Carbon Nanotube Forests: A Comparison Between Fixed and Floating Catalyst CVD Techniques

An outstanding supercapacitor electrode material,  $\text{NiCo}_2\text{O}_4$ /carbon aerogel composite, is developed that exhibits an ultrahigh specific capacitance. The success is made possible by the fuller utilization of  $\text{NiCo}_2\text{O}_4$ , enabled by using highly conductive mesoporous carbon aerogels as the hosting matrix and the successful creation of an ultrathin  $\text{NiCo}_2\text{O}_4$  nanostructure on the backbone of the matrix through a two-step wet chemistry process.



## Supercapacitors

H.-C. Chien, W.-Y. Cheng, Y.-H. Wang,  
S.-Y. Lu\* .....5038–5043

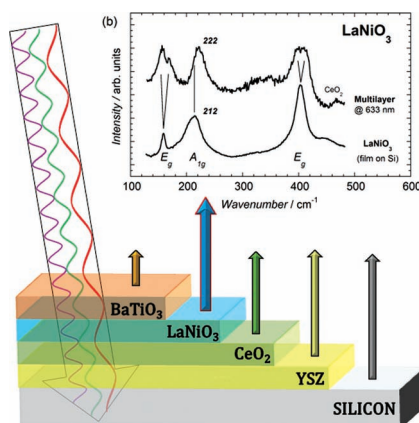
### Ultrahigh Specific Capacitances for Supercapacitors Achieved by Nickel Cobaltite/Carbon Aerogel Composites

# FULL PAPERS

## Thin-Film Multilayers

J. Kreisel,\* M. C. Weber, N. Dix,  
F. Sánchez, P. A. Thomas,  
J. Fontcuberta .....5044–5049

### Probing Individual Layers in Functional Oxide Multilayers by Wavelength-Dependent Raman Scattering

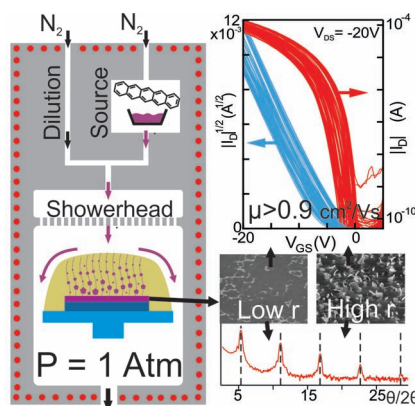


The integration of functional oxides on silicon requires the use of complex heterostructures where the structure and properties strongly depend on the strain state. A Raman study of a multilayer  $\text{BaTiO}_3/\text{LaNiO}_3/\text{CeO}_2/\text{YSZ}$  thin-film structure on silicon is reported, demonstrating that wavelength-dependent Raman scattering is well adapted for the investigation of strain and structural changes in complex heterostructures or even nanocomposites.

## Thin Films

C. Rolin,\* K. Vasseur, B. Niesen,  
M. Willegems, R. Müller, S. Steudel,  
J. Genoe, P. Heremans .....5050–5059

### Vapor Phase Growth of Functional Pentacene Films at Atmospheric Pressure



The effect of carrier gas pressure on the growth of pentacene by organic vapor phase deposition is explored. At high pressures ( $>100$  mbar), gas phase nucleation is observed, which results in rough layers. An optimized process window is defined to grow smooth pentacene thin films at atmospheric pressure. State-of-the-art transistors and circuits based on these films are demonstrated.