Materials Views

Editor: Sandra Kalveram (sk)
Contributors: M. Farrell (mf), D. W. Flanagan (df), G. Kemeling (gk), S. Ladden (sl), L. Wylie (lw), S. Spiegel (sp), L. Stimson (ls)
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Materials science is a vast field in which every day exciting breakthroughs are made. Materials Views is a new service which will help keep you updated on these new developments, by providing you with a selection of highlights selected by the editors of some of the top journals in the field. All areas of materials will be covered from the borders of chemistry and physics, to life sciences and engineering, and from basic research to applications.

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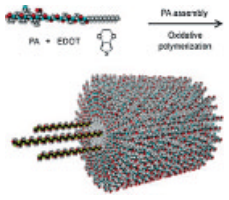
We hope that you will enjoy the reading and would be happy to receive your comments and suggestions.

Dr. Sandra Kalveram
Editor

Conducting Polymers Inside Nanostructures

Many new platforms in bionanotechnology require materials capable of transforming biological events into measurable responses; for example, DNA hybridization and the binding of viruses and proteins are particularly important for sensing applications. Previous detection methods have involved modifying metal or semiconductor surfaces with a ligand or receptor chosen for a particular recognition event. Now, in a new study, Stupp et al. have created conducting polymers within bioactive aqueous gel matrices formed by peptide amphiphiles. The hydrophobic lipid environment that forms as these



molecules self-assemble into cylindrical nanostructures provides a reservoir for the uptake of a hydrophobic monomer. These conductive, bioactive gels are important materials in the transduction of biological signals at the nanoscale and could be useful in processes requiring electrical stimuli that can be controlled externally. "Peptide amphiphile nanofibers are very effective as matrices for cell signaling," said Stupp. "Their integration with conducting polymers will offer possibilities to electrically stimulate cells or electrically sense biological events in vivo"./sl

S. I. Stupp *et al.*, *Small* **2007**, *3*, 2024

Nanoscale Surface Patterning: Bottom Up Meets Top Down

Bottom-up self-assembly of block copolymers and top-down photolithography are valuable processes for the fabrication and manipulation of nanostructured surfaces in their own right. In a recent paper, Hawker and co-workers have demonstrated that the power of combining these techniques for the preparation of novel substrates with specific surface properties. A photolithographic mask is used to selectively irradiate, and subsequently cross-link, a random copolymer film. The variation in the surface interactions between non-irradiated and irradiated regions leads to different differences in orientation and morphology of diblock copolymer microdomains deposited on the surface, resulting in controlled surface patterning on the nanoscale./ls

Adv. Mater. C. J. Hawker *et al.*, DOI: 10.1002/adma.200701866

In Brief

Fire in the Hole
A mechanical hole-burning spectroscopy technique is used to investigate the order–disorder transition temperature of a triblock copolymer./sl
X. Shi *et al.*, *J. Polym. Sci., Part B: Polym. Phys.* **2007**, *45*, 3277

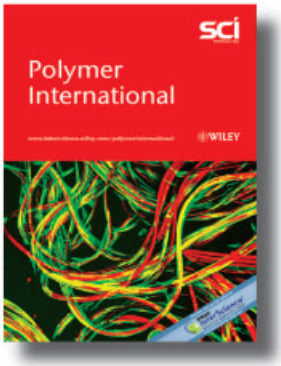
In the Spotlight
A solvent-free DSC in combination with a low-viscosity binary ionic liquid is used to achieve a photon-to-electricity conversion efficiency of 7.6% under illumination in full sunlight. /sl
M. Grätzel *et al.*, *Small* **2007**, *3*, 2094

Giant Functional Fibers
Solvent-vapor annealing can be used to induce self-assembly of millimeter-long crystalline fibers that display remarkable mass transport properties./lw
P. Samorì *et al.*, *Adv. Funct. Mater.* **2007**, *17*, 3791

Polymer Implants
Biodegradable polymer implants for application a tumor sites are made from cylindrical polymers loaded with tamoxifen citrate and characterized in vivo./sl
J. G. Hiremath *et al.*, *J. Appl. Polym. Sci.* **2007**, *107*, 2745

Polymerized Dimethacrylates
Homogenous networks are formed by RAFT polymerization of dimethacrylates. The network structure is attributed to slow chain growth, which allows the chains to relax and minimizes intramolecular reactions and formation of microgels./sl
Q. Yu *et al.*, *Macromol. Chem. Phys.*, DOI: 10.1002/macp.200700464

Polymer International – IUPAC Award 2008 for Creativity in Applied Polymer Science or Polymer Technology



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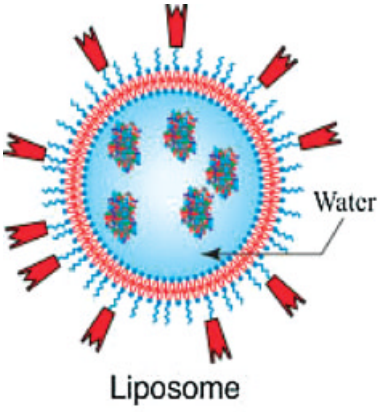
Power to the Proteins

New strategies for curing diseases not only require safe and efficient drugs, but also an evaluation of how these drugs can be best administered to patients. Protein therapeuticals have the advantage of being very specific, but denaturation and high molecular masses are two examples of factors that need to be considered in their delivery.

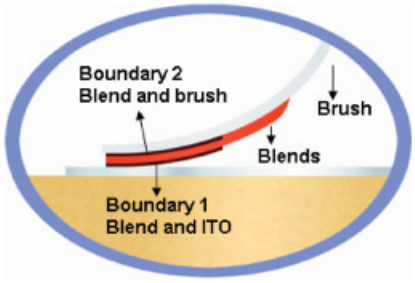


In his Highlight article, Roberto Solaro describes research on a variety of nanometer-scale carriers for the targeted delivery of proteins to cells. The described carriers range from liposomes and nanoparticles to virosomes and fusion proteins. At this moment, the different carrier strategies are still not optimal, which may perhaps be due to them being adapted versions of carriers for low-molecular-mass drugs. The development of carriers specifically focused on the delivery of proteins would bring considerable advances to this important field./gk

R. Solaro, *J. Polym. Sci., Part A: Polym. Chem.*, **2008**, *46*, 1.

Photovoltaic Brushstrokes

As reserves of fossil fuels diminish and environmental issues continue to occupy an increasingly significant position on the political agenda, renewable energy resources become more and more important. Solar power is a clean, sustainable source of energy that is already being harnessed to meet domestic and commercial needs. However, the production of efficient photovoltaic cells is still a relatively complex, expensive, and



time-consuming process. Recently, Kim et al. reported the development of a simplified fabrication technique that allows thin films of polymeric solar-cell materials to be deposited by simple brush painting. This method allows non-flat surfaces to be coated with flexible solar cells, unleashing the possibility of deposition in a wide range of situations, for example, on roof tiles, fencing, and other existing structures, further reducing the environmental impact of solar energy solutions./ls

Adv. Mater. D.-Y. Kim *et al.*, DOI: 10.1002/adma.200702040

Molecular Resists for Next Generation Lithography

Lithography at the nanometer scale is of increasing importance for the fabrication of semiconductor devices. Among the various lithographic techniques, electron-beam (EB) lithography and extreme ultraviolet (EUV) lithography are promising candidates for the next generation lithography.

Conventionally, the polarity change of positive tone resists is performed by deprotection reactions, with the disadvantage that outgassing occurs from the protecting groups under exposure conditions. H. Mori et al. recently presented a novel positive-tone molecular resist for EB lithography in *Macromolecular Rapid Communications*. This resist material contains an oxabenzonorbornadiene moiety as a reactive functional group which can be easily converted to the alkaline soluble β-naphthol. This new scheme, in which the polarity change is done by isomerization instead of deprotection, is a promising concept for EB and EUV positive tone resists, as it is expected that outgassing will be avoided./sk

H. Mori *et al.*, *Macromol. Rapid Commun.*, DOI: 10.1002/marc.200700604

Highly Read Articles

Shape-Controlled Synthesis of Metal Nanostructures: The Case of Palladium
Y. Xia *et al.*
Adv. Mater. **2007**, *19*, 3385

Tunable Synthesis of Various Wurtzite ZnS Architectural Structures and Their Photocatalytic Properties
Y. Qian *et al.*
Adv. Funct. Mater. **2007**, *17*, 2728

Direct Low-Temperature Synthesis of Rutile Nanostructures in Ionic Liquids
B. M. Smarsly *et al.*
Small **2007**, *3*, 1753

Synthesis of polymeric core-shell particles using surface-initiated living free-radical polymerization
K. R. Carter *et al.*
J. Polym. Sci., Part A: Polym. Chem. **2007**, *45*, 1575

Preparation of a superhydrophobic rough surface
S. Michielsen *et al.*
J. Polym. Sci., Part B: Polym. Phys. **2007**, *45*, 253

Functionalized Poly(benzimidazole)s as Membrane Materials for Fuel Cells
K. Müllen *et al.*
Macromol. Chem. Phys. **2007**, *208*, 2258

Effect of the Molecular Weight of Poly(3-hexylthiophene) on the Morphology and Performance of Polymer Bulk Heterojunction Solar Cells
A. J. Heeger *et al.*
Macromol. Rapid Commun. **2007**, *28*, 1776

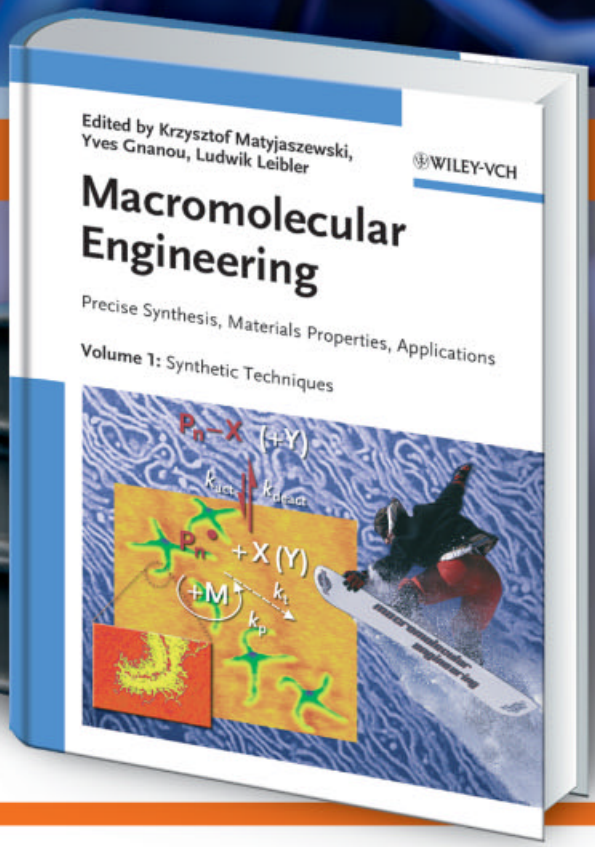
Epoxy-Based Fibre Reinforced Nanocomposites
J. Njuguna *et al.*
Adv. Eng. Mater. **2007**, *9*, 835

Preparation and characterization of poly(vinyl chloride)-graft-acrylic acid membrane by electron beam
Y.-Y. Xu *et al.*
J. Appl. Polym. Sci. **2007**, *105*, 291

A Simplified Model for Prediction of Molecular Weight Distributions in Ethylene-Hexene Copolymerization Using Ziegler-Natta Catalysts
K. B. McAuley *et al.*
Macromol. Reaction Eng. **2007**, *1*, 523

Processing and physical properties of native grass-reinforced biocomposites
L. T. Drzal *et al.*
Polym. Eng. Sci. **2007**, *47*, 969

Toward Next Generation Materials



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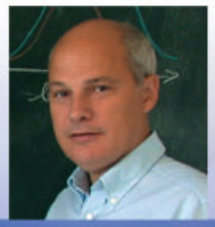

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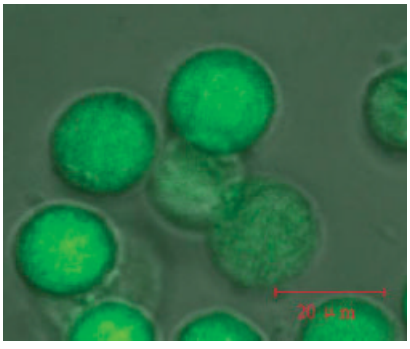
Energy Storage Devices

Significant research effort at present is devoted to the development of safe, environmentally friendly lithium-ion batteries for use in consumer electronic devices. In this contribution Xia and Luo present an aqueous lithium-ion battery that consists of a $LiMn_2O_4$ cathode, a carbon-coated $LiTi_2(PO_4)_3$ anode, and a Li_2SO_4 electrolyte. The cell exhibits excellent reversibility and delivers a capacity of 40 mA h g^{-1} and a specific energy of 60 W h kg^{-1} based on the total weight of the active electrode materials. This performance can compete with Ni–Cd and Pb–acid batteries that are already widely used in numerous technical applications. The assembly also exhibits excellent cycling performance with a capacity loss of only about 20% over 200 charge/discharge cycles. The significantly enhanced cycling stability of carbon-coated $LiTi_2(PO_4)_3$ in comparison to bare $LiTi_2(PO_4)_3$ is attributed to improved conductivity, facilitated by the nanometer-thick carbon layer./mf

Y.-Y. Xia *et al.*, *Adv. Funct. Mater.* **2007**, *17*, 3877.

Antiviral Polymer-Drug Conjugates

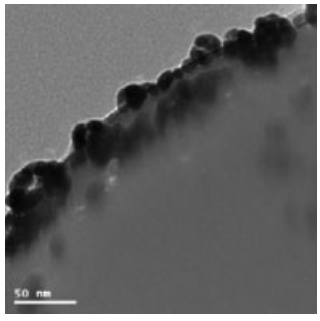
Aciclovir is a popular antiviral drug used in the treatment of herpes and shingles. However, it suffers from low oral bioavailability due to its low water solubility, and its elimination half-life is only 2–3 hours in adults. Xian-Fu Lin and colleagues at Zhejiang University in Hangzhou, China have addressed these problems by attaching the aciclovir drug molecule to a polymer backbone via a degradable linker. The polymer backbone is functionalized with galactose to specifically target liver cells, potentially reducing side effects, while the linker provides more constant release over a longer time. A similar approach could be used to create other tailored multifunctional polymer—drug conjugates./df



X.-F. Lin *et al.*, *J. Polym. Sci., Part A: Polym. Chem.* **2008**, *46*, 117.

Colloid Particles

Thiol-stabilized gold nanoparticles have potential applications in many fields. These nanoparticles can be prepared via the use of polymers that have dithioester end groups, which can easily be converted to thiol groups with the use of a reductant. In their latest work, Zhao *et al.* have grafted hydrophobic polystyrene and hydrophilic PPEGMA polymer brushes onto the surface of gold nanoparticles via the interaction of thiol groups with the nanoparticles. These gold nanoparticles are found to stabilize oil droplets in water; the nanoparticles collect at the oil–water interface, reducing the size of the oil droplets.



When styrene oil droplets are polymerized, polystyrene colloid particles with gold nanoparticles on the surface are obtained. "These nanoparticles may find important applications in protein separation and catalysis of chemical reactions", said Zhao. "They could also be used to prepare polymer colloid particles via Pickering suspension polymerization"./sl

H. Zhao *et al.*, *Macromol. Rapid Commun.*, DOI: 10.1002/marc.200700610

In Brief

Hierarchical Self-Assembly

High-resolution scanning tunneling microscopy imaging and manipulation is used to investigate the adsorption of thymine molecules at various coverages on a Au(III) surface. /mf

F. Besenbacher *et al.*, *Small* **2007**, *3*, 2011

Blue Polymers

Fluorine substituents are used to protect the carbazole repeat units in linked main-chain polymers, resulting in blue-light-emitting materials with enhanced electrolytic stability./sl

A. Iraqi *et al.*, *Polym. Adv. Technol.* **2007**, DOI: 10.1002/pat.1010

Nano-Explosions of Polymer Nanoparticles

A new mechanism for the sudden release of embedded substances by the disruption of polymer nanoparticles (induced by nitrogen gas overpressure inside the particles) is demonstrated./ssp

K. Landfester *et al.*, *Macromol. Mater. Eng.*, **2007**, *292*, 1237

Permeability of Deformed Woven Fabrics

The permeability of sheared fabrics is characterized by measuring the components of the in-plane permeability tensor. Permeability is affected by the reduction of the sheared fiber volume fraction as well as changes in the geometry of the fabric structure./sl

F. Trochu *et al.*, *Polym. Compos.* **2007**, *28*, 797

Unique ZnO Structures

A new low-temperature, polyvinylpyrrolidone-based method is used to selectively synthesize high-purity ZnO structures with up to fifteen different shapes and tunable bandgaps and morphologies./sl

J. Zhang *et al.*, *Adv. Funct. Mater.* **2007**, *17*, 3897

Polymerization Kinetics Inside Submicron Particles

Controlled/living radical systems with an extremely short active period are investigated theoretically, resulting in the concept of an acceleration window of the polymerization rate./ssp

H. Tobita, *Macromol. Theory Simul.* **2007**, *16*, 810

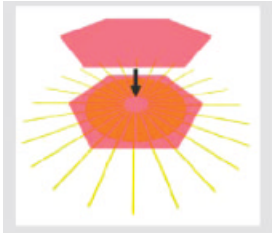
Metallopolyynes in Plastic Solar Cells

Increasing demand for inexpensive renewable sources of energy has driven interest in the development of low-cost, lightweight photovoltaic devices. One way of achieving this aim is to substitute expensive inorganic components with organic materials, which are cheaper and offer easier fabrication of the elements used in devices. Platinum metallopolyynes, which are strongly absorbing, are good electron donor materials for such devices, and by blending them with methanofullerene as an electron acceptor, devices with power conversion efficiencies of over 4%. In this article, Wai-Yeung Wong gives an overview of the recent research towards achieving these remarkable results./lw

W.-Y. Wong, *Macromol. Chem. Phys.*, DOI: 10.1002/macp.200700563

Charge Transport

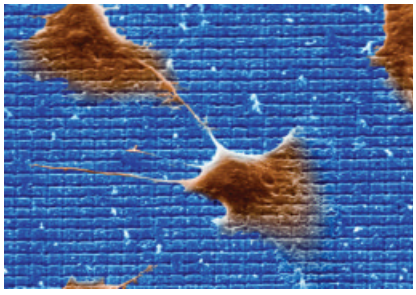
Organic molecular crystals, particularly single crystals, are invaluable tools in probing the electronic properties of organic materials and measuring intermolecular proximity and orientation within a specific crystal structure. Now, in a new technique, Bao and Reese have combined a single-crystal field-effect transistor and a unique device structure to obtain high-resolution measurements of the electronic properties of single-crystal semiconductors. The structure allows a molecular crystal to be "stuck" to an inert poly(dimethylsiloxane) dielectric interface and characterized without moving the crystal. A circular array of electrodes incorporating two unique devices at each angular orientation gives 360-degree probing and nearly arbitrary angular resolution. Also, the size of the device is determined only by the lithographic tool used and is thus not limited to large or rigid crystals. "This is an important step towards our long-term goal of rational design of organic semiconductors", said Professor Bao, and she is confident that this versatile technique will allow the proximity and orientation of solid-state molecules to be compared to experimentally observed properties./sl



Z. Bao *et al.*, *Adv. Mater.*, DOI: 10.1002/adma.200701139

Engineering Biomaterials

Materials scientists and engineers are facing more and more situations where materials are confronted with challenging biological environments. Therefore a recent issue of *Advanced Engineering Materials*, guest-edited by Klaus D. Jandt and Kaiyang Cai, has been devoted to the rapidly growing field of Biomaterials, with the main focus on bone replacement materials.



The articles compiled in this issue give an overview about the recent developments the fields of surface engineering of biomaterials, tissue engineering and the development of new biomaterials based on natural polymers and ceramics. Furthermore, topics such as biomaterials in contact with blood and drug delivery are also covered.

In 2008 a regular section on "Advanced Biomaterials" is planned for publication in AEM (four times per year)./sk

Adv. Eng. Mater. **2007**, issue 12.

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