

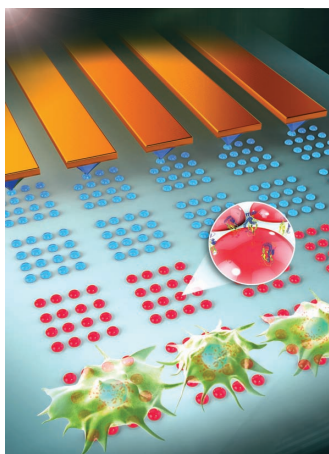
ADVANCED FUNCTIONAL MATERIALS

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Tissue Engineering

A 3D woven fiber scaffold infiltrated with an interpenetrating network hydrogel mimics the load-bearing and tribological properties of native cartilage. The woven fiber scaffold, created by X. Zhao, F. Guilak, and co-workers on page 5833, provides controlled tensile and compressive mechanical properties in three dimensions, while the infused hydrogel, consisting of an interpenetrating network of alginate and polyacrylamide, provides high toughness and a low coefficient of friction. This biomimetic, fiber-reinforced composite structure has potential as an acellular or cell-based replacement for cartilage.

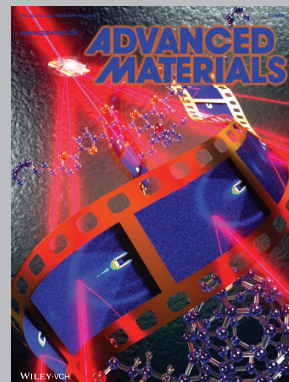
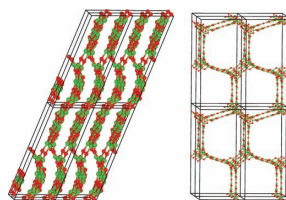


Nanolithography

A subcellular-scaled protein array is fabricated by J.-W. Jang and co-workers on page 5840 using a parallel dip-pen nanolithography (DPN) patterned template. Micro- or nano-arrays of aldehyde-silane are patterned on a SiO_x substrate by DPN printing. Extracellular matrix (ECM) proteins, such as fibronectin, are then attached onto the aldehyde-silane template. Finally, individual cell arrays are also available by anchoring on ECM protein array. Some big advantages of this method are that the aldehyde-silane template can be stored for up to 1 year, and that user-friendly protein and cell patterning are available.

Nanoporous Materials

Ultra-flexible, low-energy forms of boron oxides are demonstrated by F. Claeysens, N. L. Allan, and co-workers. On page 5887 they discover that the minima in the energy landscapes of structures with volume changes of over 200% are very broad. This is attributed to the angular flexibility of the B–O–B bridges linking the ring structures, which is unusual for covalent bonds. The larger structures are found to be nanoporous, suggesting that these structures may make good hosts.



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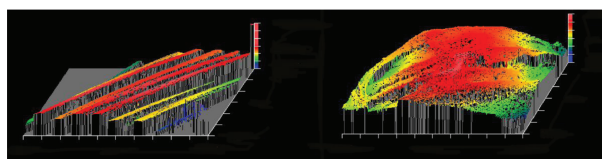
FULL PAPERS

Tissue Engineering

I.-C. Liao, F. T. Moutos, B. T. Estes,
X. Zhao,* F. Guilak*5833–5839

**Composite Three-Dimensional Woven
Scaffolds with Interpenetrating
Network Hydrogels to Create
Functional Synthetic Articular Cartilage**

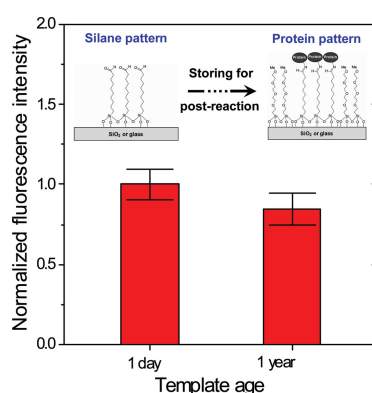
A three-dimensionally woven fiber scaffold (left) shows significant reduction in surface roughness after being infused with an interpenetrating network (IPN) hydrogel consisting of alginate and polyacrylamide (right), as measured using an optical profiler. These fiber-reinforced IPN scaffolds provide a versatile composite structure as a potential acellular or cell-based replacement for tissue repair.



Nanolithography

J.-W. Jang,* J. M. Collins,
S. Nettikadan5840–5845

**User-Friendly Universal and Durable
Subcellular-Scaled Template for Protein
Binding: Application to Single-Cell
Patterning**

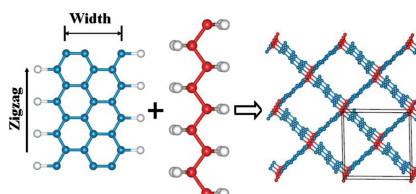


A new method for subcellular sized protein patterning on a SiOx substrate is demonstrated by dip-pen nanolithography printed aldehyde-terminated alkylsilane template. The aldehyde-silane template is stable and durable; maintaining its reactivity for up to one year. Subcellular sized arrays of IgG and extracellular matrix (ECM) proteins are obtained by chemical binding (aldehyde-amine reaction) on the template.

Self-Assembly

X. Jiang, J. Zhao,* Y.-L. Li,
R. Ahuja5846–5853

**Tunable Assembly of sp^3 Cross-Linked
3D Graphene Monoliths: A First-
Principles Prediction**

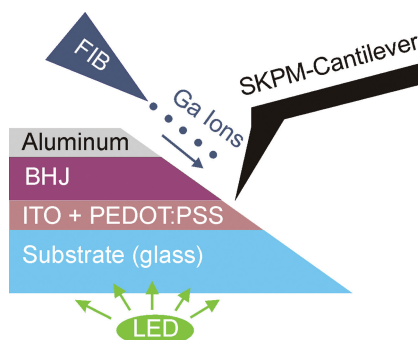


Two series of 3D graphene monoliths (GMs) are constructed using zigzag or armchair graphene nanoribbons as building blocks and sp^3 carbon chains as junction nodes. The perfect match between sp^2 nanoribbons and sp^3 linkers results in favorable energy and mechanical/dynamic stability. Negative linear compressibilities in a wide range are found for the zigzag GMs due to their unique wine-rack-like structures and anisotropic mechanical strength.

Organic Electronics

R. Saive,* M. Scherer, C. Mueller,
D. Daume, J. Schinke, M. Kroeger,
W. Kowalsky5854–5860

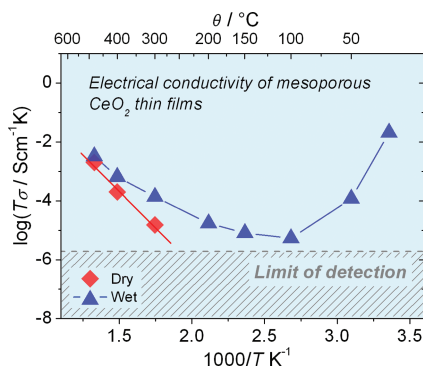
**Imaging the Electric Potential within
Organic Solar Cells**



The charge transport in P3HT:PCBM bulk heterojunction solar cells in conventional and inverted device structures is investigated by surface potential measurements via scanning Kelvin probe microscopy. The cross-section of solar cells is accessed by milling holes with a focused ion beam, which enables the direct scan along the charge transport path.

FULL PAPERS

Mesoporous nanocrystalline CeO₂ thin films exhibit proton conductivity at low temperatures ($\theta < 300$ °C). This is related to water being adsorbed in the open pores. Notably, both proton transport in bulk water as well as enhanced proton conduction due to space charge effects on the water side of the water/ceria interface can explain the enhanced proton conductivity.

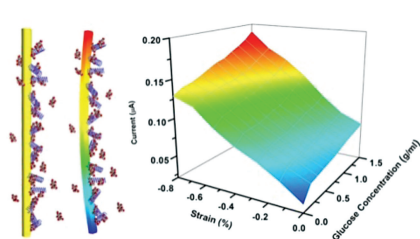


Thin Films

G. Gregori,* M. Shirpour,
J. Maier5861–5867

Proton Conduction in Dense and Porous Nanocrystalline Ceria Thin Films

The sensitivity, detection limit, and sensing resolution of a ZnO nanowire glucose sensor are largely enhanced by the piezotronic effect. The strain-introduced change of interfacial characteristics is accounted for the enhancement. A theoretical model is proposed to explain the observed behavior. A triboelectric nanogenerator is integrated with the sensor to form a self-powered glucose monitoring system.

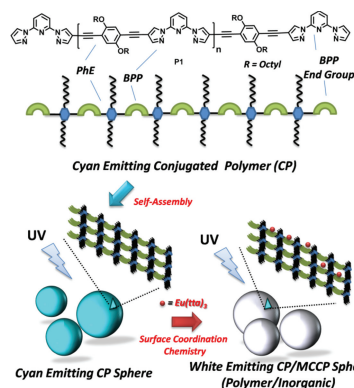


Nanowires

R. M. Yu, C. F. Pan, J. Chen, G. Zhu,
Z. L. Wang*5868–5874

Enhanced Performance of a ZnO Nanowire-Based Self-Powered Glucose Sensor by Piezotronic Effect

An efficient technique for the fabrication of white emitting 2,6-bis(pyrazolyl)pyridine-co-octylated phenylethynyl conjugated polymer (CP)/metal containing conjugated polymer (MCCP)-based hybrid films and self-assembled nano/microscale spheres, is presented. The hybrid structures display white emissions with the standard coordinates nearly close to the Commission Internationale de l'Eclairage (CIE) coordinates for ideal white-light ($x = 0.33$, $y = 0.33$).

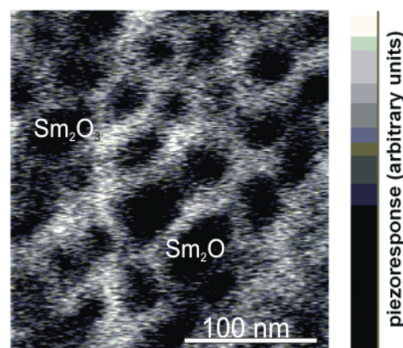


Polymers

Y. S. L. V. Narayana, S. Basak,
M. Baumgarten, K. Müllen,
R. Chandrasekar*5875–5880

White-Emitting Conjugated Polymer/Inorganic Hybrid Spheres: Phenylethynyl and 2,6-Bis(pyrazolyl)pyridine Copolymer Coordinated to Eu(tta)₃

High-temperature lead-free ferroelectrics are needed for green actuators. A green BaTiO₃-based nanocomposite film actuator that works up to 250 °C and has comparable performance to the industry standard Pb_{1-x}Zr_xTiO₃ (PZT) is reported. The transverse piezoelectric coefficient, d_{31} , is $>+200$ pm V⁻¹. Its positive sign indicates auxetic behavior, arising from 3D strain in the film and this opens up exciting new application opportunities.



Sm₂O₃ nanopillars in BaTiO₃ matrix

Nanocomposites

A. Kursumovic, E. Defay, O. J. Lee,
C.-F. Tsai, Z. Bi, H. Wang,
J. L. MacManus-Driscoll*5881–5886

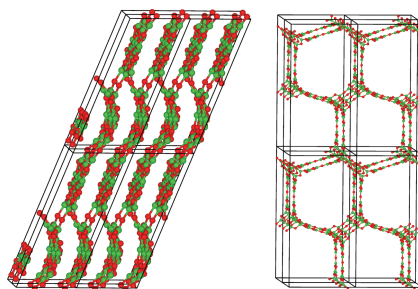
A New Material for High-Temperature Lead-Free Actuators

FULL PAPERS

Nanoporous Materials

F. Claeysens,* J. N. Hart,
N. C. Norman, N. L. Allan*...5887–5892

Ultra-Flexible Boron-Oxygen 3D Solid-State Networks

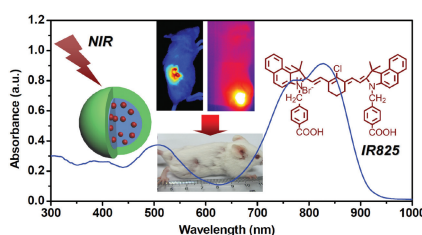


Low-energy 3D networks of boron oxide based on six-membered rings connected by B-O-B bridges are reported. The B-O-B connections are extremely flexible, enabling volume changes exceeding 200% with very little internal energy change ($<10 \text{ kJ mol}^{-1}$). At larger volumes these materials exhibit a nanoporous microstructure, which collapses to a closed form with negligible energy change.

Cancer Therapies

L. Cheng, W. He, H. Gong, C. Wang,
Q. Chen, Z. Cheng,*
Z. Liu*...5893–5902

PEGylated Micelle Nanoparticles Encapsulating a Non-Fluorescent Near-Infrared Organic Dye as a Safe and Highly-Effective Photothermal Agent for In Vivo Cancer Therapy



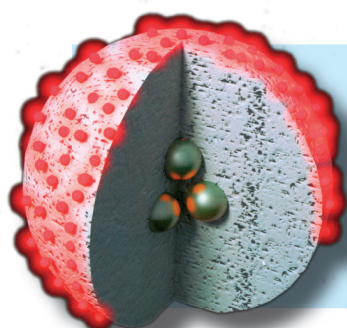
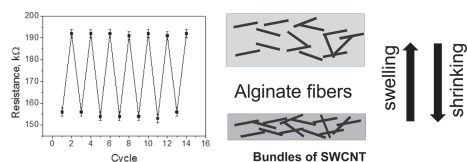
A new generation of photothermal agent based on PEGylated micelles of a low-quantum yield organic dye, IR825, is developed. IR825-PEG micelles exhibit strong NIR absorbance, excellent photostability, ultra-long blood circulation time, and very high in vivo tumor uptake after intravenous injection. They could serve as a powerful photothermal agent for effective tumor ablation under a low-power laser irradiation, without rendering any appreciable toxicity to animals.

Composite Materials

A. Grigoryev, V. Sa, V. Gopishetty,
I. Tokarev, K. G. Kornev,*
S. Minko*...5903–5909

Wet-Spun Stimuli-Responsive Composite Fibers with Tunable Electrical Conductivity

Alginate hydrogel fibers loaded with a high concentration of single-walled carbon nanotubes are prepared by wet-spinning and covalent crosslinking via catalytic acetalization. The fibers are electroconductive and sensitive to humidity, pH, and ionic strength. They reversibly deform during swelling/shrinking cycles. In the swollen state, the fibers are less conductive, while they return to the same level of conductivity after shrinking.



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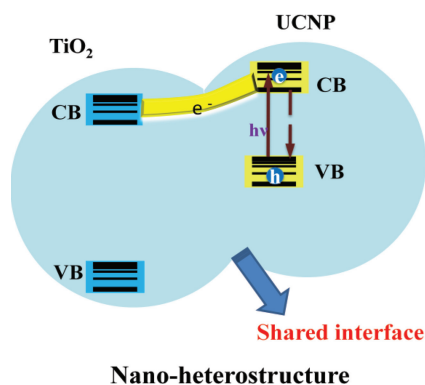
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FULL PAPERS

TiO₂/UCNP heterostructures, where UCNP are nanoparticles capable of up-conversion, are prepared in situ on the TiO₂ photoanode of dye-sensitized solar cells (DSCs). The shared interface of the nano-heterostructure facilitates electron injection from the UCNP (NaYF₄: Yb³⁺, Er³⁺) to the TiO₂ conduction band (CB); in contrast, the crystal interface resulting from the simple mixture of the NP and TiO₂ hinders electron transfer. The overall efficiency (η) of the DSC using the photoanode containing the nano-heterostructure was 17% higher than that of devices without UCNP.

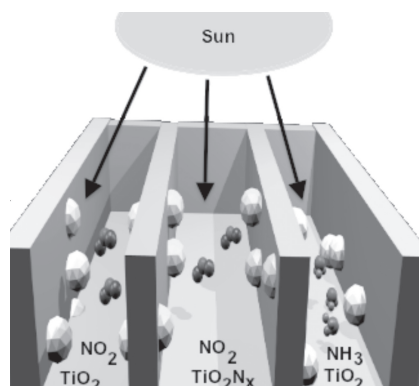


Solar Cells

J. Chang, Y. Ning, S. Wu,* W. Niu, S. Zhang5910–5915

Effectively Utilizing NIR Light Using Direct Electron Injection from Up-Conversion Nanoparticles to the TiO₂ Photoanode in Dye-Sensitized Solar Cells

Visible and UV light are demonstrated to significantly enhance the sensing properties of an n-type porous silicon (PS) extrinsic semiconductor interface to which TiO₂ and TiO_{2-x}N_x photocatalytic nanostructures are fractionally deposited. The acid/base chemistry of NH₃, a moderately strong base, and NO₂, a moderately strong acid, couples to the majority charge carriers of the doped semiconductor and nanostructured materials.

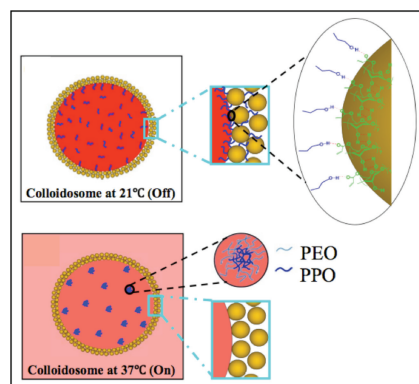


Solar Sensors

W. I. Laminack, J. L. Gole*5916–5924

Light Enhanced Electron Transduction and Amplified Sensing at a Nanostructure Modified Semiconductor Interface

Nanoparticle colloidosomes, whose release can be switched on and off in response to a temperature change, are fabricated. The release occurs due to the adsorption or desorption of a block copolymer, dissolved in the core, at the inner surface of the colloidosome shell, concomitantly blocking or unblocking the pores in the shell.

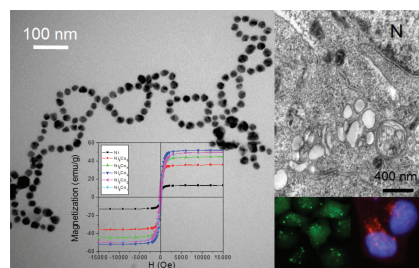


Nanoparticles

S. Zhou,* J. Fan, S. S. Datta, M. Guo, X. Guo, D. A. Weitz*5925–5929

Thermally Switched Release from Nanoparticle Colloidosomes

Ni–Co alloy nanocrystal assemblies: Ni–Co magnetic alloy nanocrystals (NCs) with different assembled structures can be synthesized, and their magnetic property and the autophagy-inducing activity for Ni–Co alloy nanocrystal (NC) assemblies can be differentially “tuned” through altering the material composition, showing that the autophagy-inducing activity and toxicity of these alloy NCs present an elevated tendency with the increase of nickel component.



Nanocrystals

L. Dong, Y. Liu, Y. Lu, L. Zhang, N. Man, L. Cao, K. Ma, D. An, J. Lin, Y.-J. Xu, W.-P. Xu, W.-B. Wu, S.-H. Yu,* L.-P. Wen*5930–5940

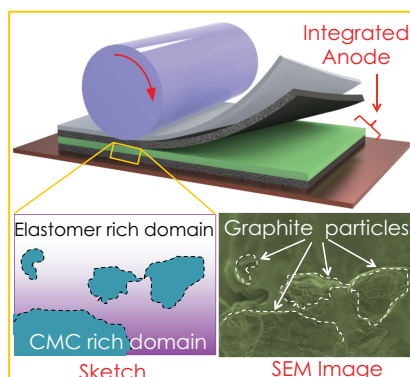
Tuning Magnetic Property and Autophagic Response for Self-Assembled Ni–Co Alloy Nanocrystals

FULL PAPERS

Flexible Electronics

M. M. Ombaba, R. Vidu,
L. V. Jayaraman, M. Triplett, J. Hsu,
M. S. Islam*5941–5951

**Seamless Integration of an Elastomer
with Electrode Matrix and its In-Situ
Conversion into a Solid State
Electrolyte for Robust Li-Ion Batteries**

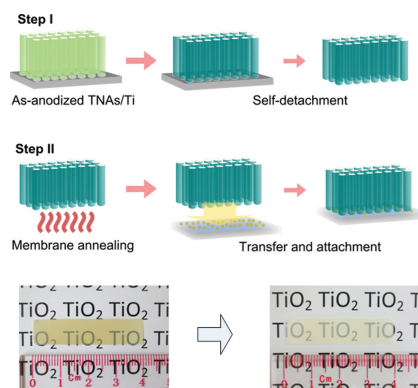


Herein, a simple process of seamlessly integrating an elastomer onto a graphitic anode and its conversion into an elastic electrolyte in-situ with a preferential uni-axial expansion in the normal plane for Li-ion battery applications are reported. The integrated electrode is amenable for roll-to-roll manufacturing, exhibits superb electrochemical characteristics, mechanical stability, and is elastic.

Nanotube Films

J. Lin, M. Guo, C. T. Yip, W. Lu,
G. Zhang, X. L. Liu, L. Zhou,
X. F. Chen,* H. Huang*5952–5960

**High Temperature Crystallization of
Free-Standing Anatase TiO₂ Nanotube
Membranes for High Efficiency Dye-
Sensitized Solar Cells**



High-quality self-detached TiO₂ nanotube array membranes by electrochemical anodization exhibit excellent structure integrity and crystal phase stability under high temperature crystallization. These membranes, with improved crystallinity and reduced electron trap states, possess superior electron transport for application in dye-sensitized solar cells, leading to the significantly improved solar power conversion efficiency.