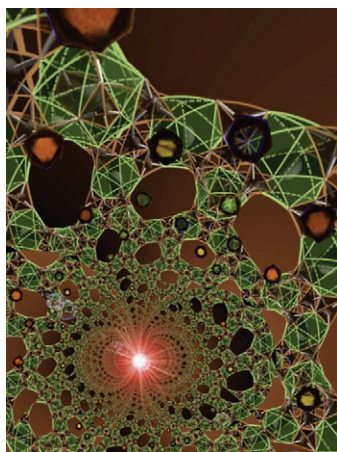


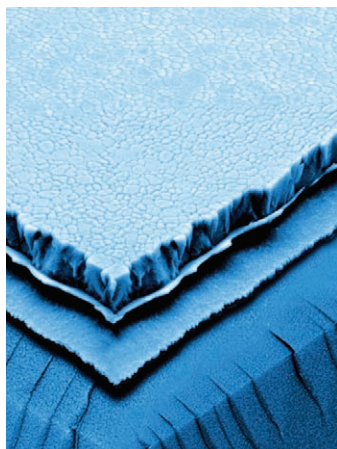
ADVANCED FUNCTIONAL MATERIALS

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Anion Exchange Materials

NDTB-1 ($[\text{ThB}_5\text{O}_6(\text{OH})_6][\text{BO}(\text{OH})_2] \cdot 2.5\text{H}_2\text{O}$ (Notre Dame Thorium Borate-1)) is a cationic framework material that selectively traps a variety of radioactive anions. As part of the study on page 2241, William H. Casey, Thomas E. Albrecht-Schmitt, and co-workers report that it is selective for the removal of pertechnetate (TcO_4^-) from nuclear waste streams. The cover shows both the icosahedral building units and pores of the material as well as the crystals themselves, which change to the color of the anions that they trap. The anion exchange is reversible and the material can be recycled.

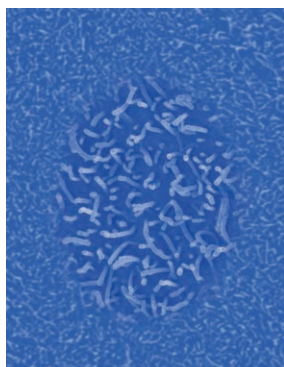


Functional Coatings

On page 2295, Jon F. Ihlefeld and co-workers reveal how proper metallization adhesion layer selection results in chemically homogeneous complex oxide films with enhanced ferroelectric and dielectric responses. The image shows a cross-sectional scanning electron microscopy image of a lead zirconate titanate thin film on a platinumized silicon wafer.

Nanocomposites

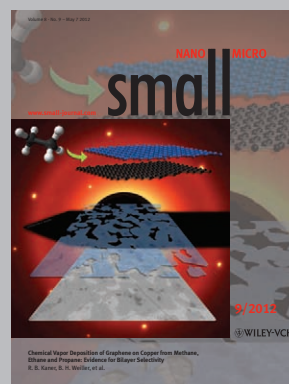
It is commonly thought that conventional polymer/carbon nanotube (CNT) nanocomposites are electrically conductive because the CNTs easily percolate in the polymer matrix. On page 2338 Kenichi Hayashida and Hiromitsu Tanaka report that this is not the case. A multiwalled CNT onto which poly(cyclohexyl methacrylate) is densely grafted has much higher volume resistivity than a conventional nanocomposite. Impedance analysis clearly shows that the highly insulated nanocomposite is a dielectric, not a conductor.



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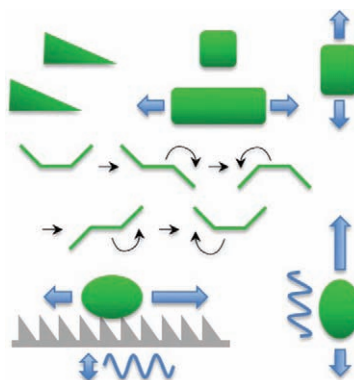
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FEATURE ARTICLE

Biomimetics

M. J. Hancock, K. Sekeroglu,
M. C. Demirel*2223–2234

Bioinspired Directional Surfaces for Adhesion, Wetting, and Transport



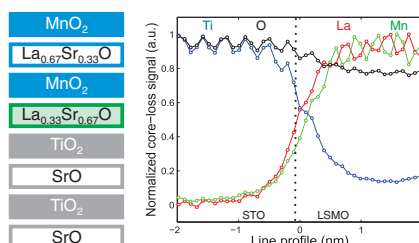
Recent developments in the area of bioinspired directional surfaces with precisely tuned physicochemical surface properties are summarized. These surfaces, characterized by asymmetric features, can transport droplets, provide directional wet and dry adhesion, and exhibit directional friction.

FULL PAPERS

Electronic Materials

H. Boschker, J. Verbeeck, R. Egoavil,
S. Bals, G. van Tendeloo, M. Huijben,
E. P. Houwman, G. Koster,
D. H. A. Blank,
G. Rijnders*2235–2240

Preventing the Reconstruction of the Polar Discontinuity at Oxide Heterointerfaces

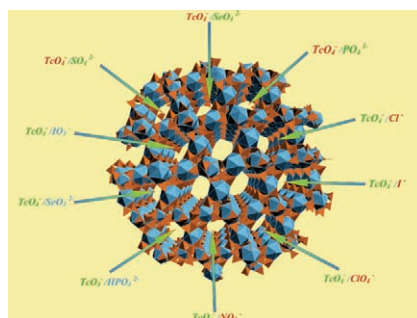


Compositional interface engineering prevents reconstruction at the $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3/\text{SrTiO}_3$ (LSMO/STO) interface caused by polar discontinuities in perovskite oxide epitaxial heterostructures. The polar discontinuity at this interface can be removed by the insertion of a single $\text{La}_{0.33}\text{Sr}_{0.67}\text{O}$ layer, resulting in improved interface magnetization and electrical conductivity.

Anion Exchange

S. Wang, P. Yu, B. A. Purse,
M. J. Orta, J. Diwu, W. H. Casey,*
B. L. Phillips, E. V. Alekseev,
W. Depmeier, D. T. Hobbs,
T. E. Albrecht-Schmitt*2241–2250

Selectivity, Kinetics, and Efficiency of Reversible Anion Exchange with TcO_4^- in a Supertetrahedral Cationic Framework

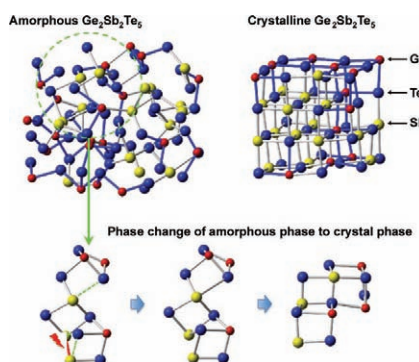


$[\text{ThB}_5\text{O}_6(\text{OH})_6][\text{BO}(\text{OH})_2] \cdot 2.5\text{H}_2\text{O}$ (NDTB-1) is an inorganic supertetrahedral cationic framework material that exhibits facile single crystal to single crystal anion exchange with a variety of common anions. NDTB-1 is selective for the removal of TcO_4^- from nuclear waste streams even though there are large excesses of competing anions. Anions trapped in NDTB-1 can be exchanged using higher-charged anions with a similar size and therefore the material can be easily recycled and reused.

Data Storage

K. Ohara, L. Temleitner, K. Sugimoto,
S. Kohara, T. Matsunaga, L. Pusztai,
M. Itou, H. Ohsumi, R. Kojima,
N. Yamada, T. Usuki, A. Fujiwara,
M. Takata*2251–2257

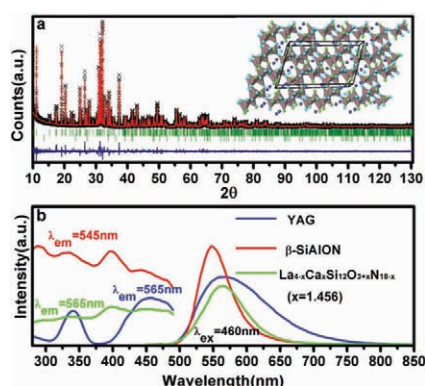
The Roles of the Ge-Te Core Network and the Sb-Te Pseudo Network During Rapid Nucleation-Dominated Crystallization of Amorphous $\text{Ge}_2\text{Sb}_2\text{Te}_5$



In the rapid phase change material $\text{Ge}_2\text{Sb}_2\text{Te}_5$, the Ge-Te core network stabilizes the amorphous phase at room temperature. This network is also present in the crystalline phase, thus enabling rapid phase change. The Sb-Te pseudo network, defined by atoms that are somewhat further apart than the covalent Sb-Te distance, is responsible for triggering critical nucleation.

FULL PAPERS

Heuristics optimization-assisted combinatorial chemistry involving parameterization of material novelty makes it possible to discover a single-phase, yellow-green-emitting luminescent material, $\text{La}_{4-x}\text{Ca}_x\text{Si}_{12}\text{O}_{3+x}\text{N}_{18-x}:\text{Eu}^{2+}$, which has a strong potential for practical use in white-light-emitting diodes (WLEDs). The heuristics optimization involves a non-dominated-sorting genetic algorithm and particle-swarm optimization, and is applied together with a parameterization of the material novelty.

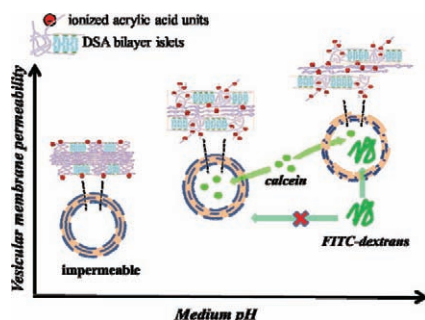


Combinatorial Chemistry

W. B. Park, N. Shin, K.-P. Hong, M. Pyo, K.-S. Sohn*2258–2266

A New Paradigm for Materials Discovery: Heuristics-Assisted Combinatorial Chemistry Involving Parameterization of Material Novelty

Polymer vesicles attained from the self-assembly of distearin-modified poly(acrylic acid) (PAAc) in the aqueous phase show a tunable membrane permeability to hydrophilic cargoes of varying sizes by simple manipulation of the pH of the medium. The pH-evolved size-selective permeability of the vesicular membranes is governed by the lipid content of the copolymer and the addition of Ca^{2+} cations.

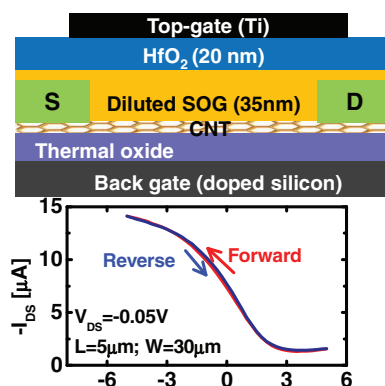


Polymer Vesicles

W.-C. Huang, W.-H. Chiang, S.-J. Lin, Y.-J. Lan, H.-L. Chen, C.-S. Chern, H.-C. Chiu*2267–2275

Lipid-Containing Polymer Vesicles with pH/ Ca^{2+} -Ion-Manipulated, Size-Selective Permeability

Theoretical and experimental studies of gate-induced hysteresis in the current–voltage characteristics of carbon nanotube field-effect transistors are reported. The results reveal the locations, types, and densities of defects that contribute to this behavior, as well as their dependence on materials and processing techniques. Insights developed from this analysis yield optimized nanotube growth conditions and gate dielectric materials that can eliminate hysteresis almost entirely.

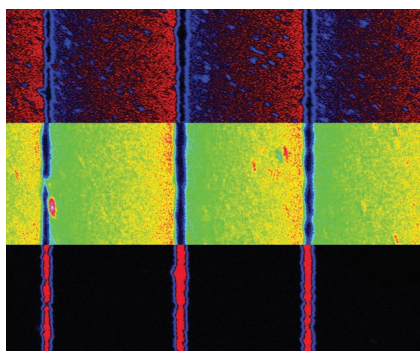


Field-Effect Transistors

S. H. Jin, A. E. Islam, T.-i. Kim, J.-h. Kim, M. A. Alam, J. A. Rogers*2276–2284

Sources of Hysteresis in Carbon Nanotube Field-Effect Transistors and Their Elimination Via Methylsiloxane Encapsulants and Optimized Growth Procedures

Bismuth sodium titanate (BNT)-derived materials show extended strain under applied electric fields, surpassing that of lead zirconate titanate (PZT), which is the most commonly used piezoelectric. The mechanism of the extended strain is, however, poorly understood, in particular its structural and chemical origins. The results presented clarify the causes of the extended strain and the peculiar temperature-dependent properties encountered in this system.



Ferroelectrics

D. Schütz,* M. Deluca, W. Krauss, A. Feteira, T. Jackson, K. Reichmann2285–2294

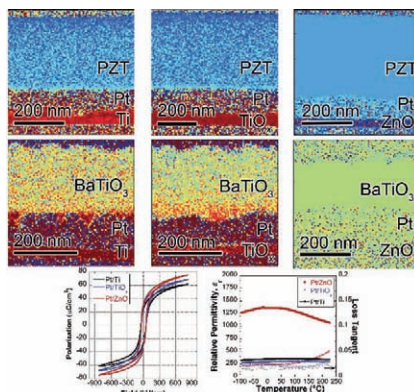
Lone-Pair-Induced Covalency as the Cause of Temperature- and Field-Induced Instabilities in Bismuth Sodium Titanate

FULL PAPERS

Thin Films

C. T. Shelton, P. G. Kotula,
G. L. Brennecke, P. G. Lam,
K. E. Meyer, J.-P. Maria, B. J. Gibbons,
J. F. Ihlefeld* 2295–2302

Chemically Homogeneous Complex Oxide Thin Films Via Improved Substrate Metallization

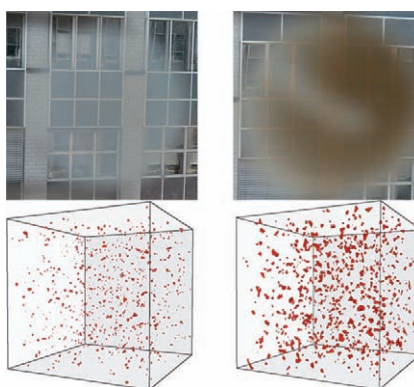


Through selection of an appropriate adhesion layer for platinum on silicon, an ability to process complex oxide thin films devoid of chemical gradients is demonstrated. The chemically homogeneous films display significantly enhanced electronic and dielectric responses across two separate material systems, PZT and BaTiO₃, with nearly 35% increases in remanent polarization and 300% increases in permittivity observed, respectively.

Ceramics

M. Stuer,* P. Bowen,
M. Cantoni, C. Pecharroman,
Z. Zhao* 2303–2309

Nanopore Characterization and Optical Modeling of Transparent Polycrystalline Alumina

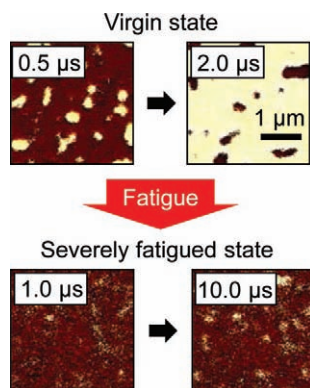


A full 3D reconstruction of pores in transparent polycrystalline alumina is performed, demonstrating that pores smaller than ≈ 50 nm have a drastically smaller effect on the degree of transparency than commonly presumed. Furthermore, how to quantitatively incorporate the pore characteristics into the conventional optical transmittance model by deterministically modifying its input parameters is shown.

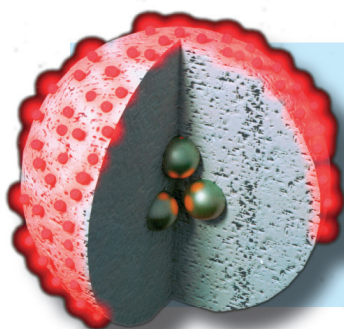
Ferroelectrics

S. M. Yang, T. H. Kim, J.-G. Yoon,
T. W. Noh* 2310–2317

Nanoscale Observation of Time- Dependent Domain Wall Pinning as the Origin of Polarization Fatigue



A time-dependent domain wall pinning process is found using modified-piezo-response force microscopy studies to be the microscopic origin of polarization fatigue. Nanoscale domain switching dynamics are visualized directly for different fatigue stages in epitaxial ferroelectric thin films. The evolution of domain wall pinning is directly observed from the suppression of sideways domain growth to the blockage of forward domain growth during fatigue.



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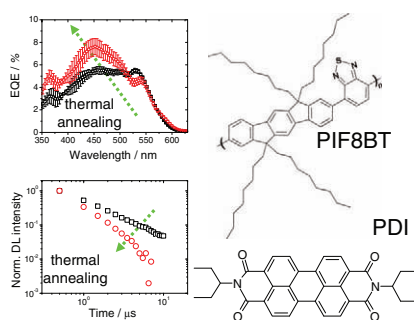
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FULL PAPERS

Delayed luminescence (DL) spectroscopy in the microsecond time range is presented as a simple non-destructive optical technique for the fast screening of organic photovoltaic (OPV) composites and of their corresponding devices. Thermal annealing of the poly(9,9-dicyclopentylindenofluorene-co-benzothiadiazole) (PIF8BT):*N'*-bis(1-ethylpropyl)-3,4,9,10-perylene tetracarboxy diimide (PDI) OPV layer results in accelerated non-geminate recombination microsecond-scale dynamics of the PIF8BT/PDI exciplex emission that positively correlates with the increased photocurrent generation of the PIF8BT:PDI device.

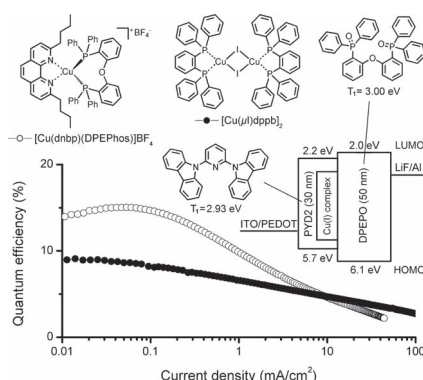


Photovoltaic Devices

P. E. Keivanidis,* V. Kamm, W. Zhang, G. Floudas, F. Laquai, I. McCulloch, D. D. C. Bradley, J. Nelson2318–2326

Correlating Emissive Non-Geminate Charge Recombination with Photocurrent Generation Efficiency in Polymer/Perylene Diimide Organic Photovoltaic Blend Films

The zero-zero energy of the triplet charge-transfer (^3CT) state of green emissive $[\text{Cu}(\text{dnbp})(\text{DPEPhos})]\text{BF}_4$ and $[\text{Cu}(\mu\text{I})\text{dppb}]_2$ is found to be up to 2.7 eV based on the onset of their low-temperature ^3CT spectra. Using the high triplet energy charge transport material as a host and an exciton-blocking layer, a $[\text{Cu}(\text{dnbp})(\text{DPEPhos})]\text{BF}_4$ based organic light-emitting diode (OLED) achieves a very high external quantum efficiency.

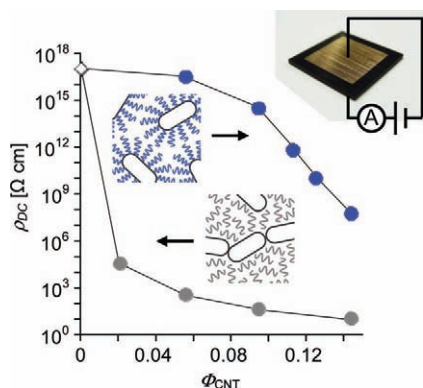


Light-Emitting Diodes

Q. Zhang, T. Komino, S. Huang, S. Matsunami, K. Goushi, C. Adachi*2327–2336

Triplet Exciton Confinement in Green Organic Light-Emitting Diodes Containing Luminescent Charge-Transfer Cu(I) Complexes

Electrical resistivity of poly(cyclohexyl methacrylate)/carbon nanotube (CNT) nanocomposites prepared using surface-initiated polymerization is much higher than that of conventional composites. This is because the grafted polymer with a combination of the high molecular weight and the high grafting density isolates individual CNTs at a long distance in the polymer-grafted CNT system.

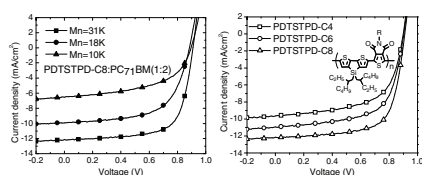


Composite Materials

K. Hayashida,* H. Tanaka2338–2344

Ultrahigh Electrical Resistance of Poly(cyclohexyl methacrylate)/Carbon Nanotube Composites Prepared Using Surface-Initiated Polymerization

High-molecular-weight alternating copolymers of dithienosilole and thienopyrrolodione (PDTSTPDs) lead to a higher hole mobility, lower device series resistance, a larger fill factor, and a higher photocurrent. Having longer alkyl chains (C8) in the thienopyrrole-4,6-dione (TPD) unit not only improves the solubility but also facilitates the formation of lamellar structures in the polymer film.



Photovoltaic Devices

T.-Y. Chu, J. Lu,* S. Beaupré, Y. Zhang, J.-R. Pouliot, J. Zhou, A. Najari, M. Leclerc,* Y. Tao*2345–2351

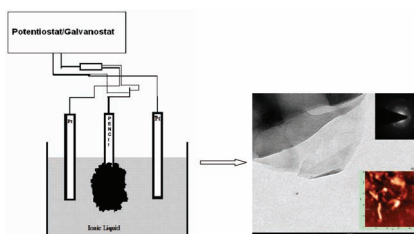
Effects of the Molecular Weight and the Side-Chain Length on the Photovoltaic Performance of Dithienosilole/Thienopyrrolodione Copolymers

FULL PAPERS

Graphene

V. V. Singh, G. Gupta, A. Batra,
A. K. Nigam, M. Boopathi,*
P. K. Gutch, B. K. Tripathi,
A. Srivastava, M. Samuel,
G. S. Agarwal, B. Singh,
R. Vijayaraghavan.....2352–2362

Greener Electrochemical Synthesis of High Quality Graphene Nanosheets Directly from Pencil and its SPR Sensing Application

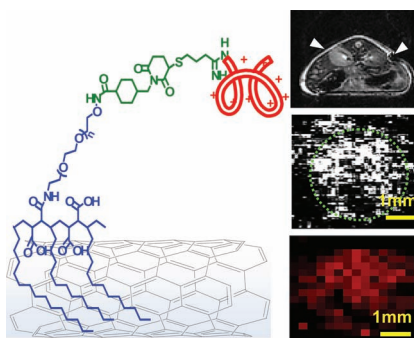


A green, simple, fast, cost-effective, and one-pot synthesis of pure graphene oxide (GO) and graphene nanosheets (GNs) using pencil in an ionic liquid medium is presented. The morphology and microstructure of the prepared GNs and GO are examined using microscopy and spectroscopy techniques. The synthesized GO is used for real-time and label-free surface plasmon resonance (SPR) sensing of the biological warfare agent *Salmonella typhi*.

Biomedical Applications

C. Wang, X. X. Ma, S. Q. Ye, L. Cheng,
K. Yang, L. Guo, C. H. Li, Y. G. Li,*
Z. Liu*.....2363–2375

Protamine Functionalized Single-Walled Carbon Nanotubes for Stem Cell Labeling and In Vivo Raman/Magnetic Resonance/Photoacoustic Triple-Modal Imaging

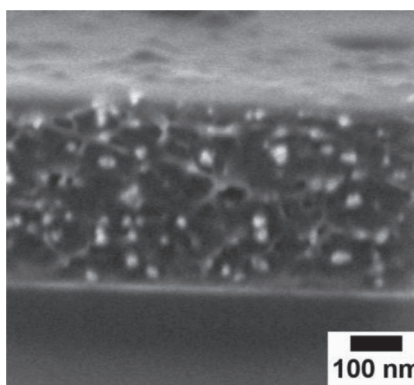


Human mesenchymal stem cells are labeled with protamine conjugated, polyethylene glycol coated, single-walled carbon nanotubes (SWNTs), which are able to enter cells with ultrahigh efficiency without affecting cell proliferation and differentiation. Using the intrinsic properties of nanotubes, in vivo tracking of SWNT-labeled stem cells is successfully demonstrated in mice by triple-modal Raman/magnetic resonance/photoacoustic imaging.

Biomedical Applications

V. B. Schwartz, F. Th  tiot,
S. Ritz, S. P  tz, L. Choritz, A. Lappas,
R. F  rch, K. Landfester,
U. Jonas*2376–2386

Antibacterial Surface Coatings from Zinc Oxide Nanoparticles Embedded in Poly(N-isopropylacrylamide) Hydrogel Surface Layers

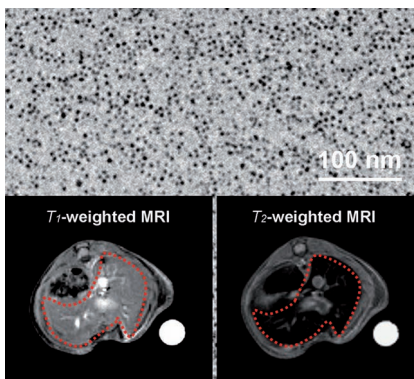


Novel antimicrobial composite materials incorporating zinc oxide nanoparticles into biocompatible poly(N-isopropylacrylamide) hydrogel layers are prepared by simple film preparation from a mixture of both components in solution, followed by photocrosslinking. The nanocomposite films exhibit bactericidal behavior towards *Escherichia coli* (*E. coli*) while being non-cytotoxic towards mammalian cells.

Magnetic Nanoparticles

Z. Li,* P. W. Yi, Q. Sun, H. Lei,
H. L. Zhao, Z. H. Zhu, S. C. Smith,
M. B. Lan, G. Q. (M.) Lu* ...2387–2393

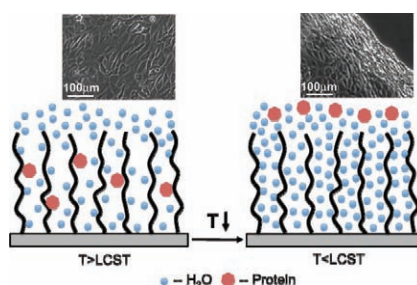
Ultrasmall Water-Soluble and Biocompatible Magnetic Iron Oxide Nanoparticles as Positive and Negative Dual Contrast Agents



Ultrasmall monodispersed magnetic iron oxide nanoparticles produced by a high-temperature coprecipitation are successfully used as efficient dual contrast agents for magnetic resonance imaging (MRI). Both in vitro and in vivo results show their excellence as dual contrast agents, in particular as an alternative to Gd-based positive agents, which have the risk of inducing side effects in patients.

FULL PAPERS

Reversible protein adsorption and expulsion is governed by the relative balance between temperature-dependent protein-segment attraction and osmotic repulsion. At a temperatures, T , greater than the lower critical solution temperature (LCST) protein-polymer attraction promotes protein insertion and adsorption to the polymers. At $T < \text{LCST}$, osmotic repulsion forces protein from the brush.

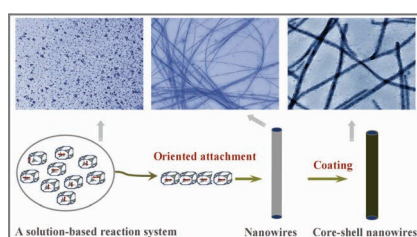


Polymeric Materials

C. Xue, B.-C. Choi, S. Choi, P. V. Braun, D. E. Leckband*2394–2401

Protein Adsorption Modes Determine Reversible Cell Attachment on Poly(*N*-isopropyl acrylamide) Brushes

A novel catalyst-free synthetic strategy is proposed for producing CdTe nanowires in solution. High-quality ultralong (up to 10 μm) and ultrathin (less than 10 nm) CdTe nanowires are produced using this strategy. Furthermore, the transformation of CdTe nanowires into CdTe/CdSe core-shell heterostructures is successfully achieved by using a proper coating protocol.

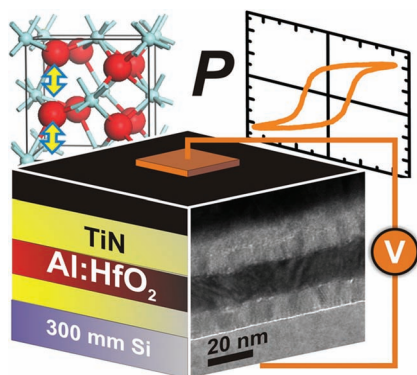


Nanowires

F. Jiang, J. J. Liu, Y. C. Li,* L. Z. Fan, Y. Q. Ding, Y. F. Li*2402–2411

Ultralong CdTe Nanowires: Catalyst-Free Synthesis and High-Yield Transformation into Core-Shell Heterostructures

Polarization measurements show anti-ferroelectric-to-ferroelectric transitions in 16 nm thin film capacitors depending on annealing conditions and the molar concentration of incorporated aluminium. The ferroelectricity is attributed to a centrosymmetric to non-centrosymmetric phase transition with decreasing aluminium content in the HfO_2 host lattice. The incipient ferroelectric properties of the investigated material system hold the potential for various ferroelectric, piezoelectric, and semiconductor applications.

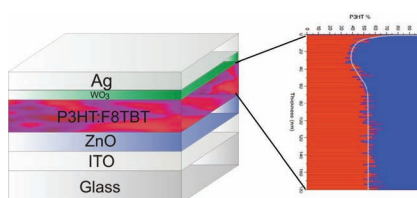


Ferroelectrics

S. Mueller,* J. Mueller, A. Singh, S. Riedel, J. Sundqvist, U. Schroeder, T. Mikolajick2412–2417

Incipient Ferroelectricity in Al-Doped HfO_2 Thin Films

The composition and morphology of one of the best performing all-polymer photovoltaic systems, P3HT:F8TBT, is examined. By combining photoemission spectroscopy studies on thin and thick polymer films with atomic force microscopy imaging, it is found that the empirically optimized device fabrication procedure results in phase separation with a typical domain size of ≈ 40 nm.



Solar Cells

Y. Vaynzof, T. J. K. Brenner, D. Kabra, H. Sirringhaus, R. H. Friend* 2418–2424

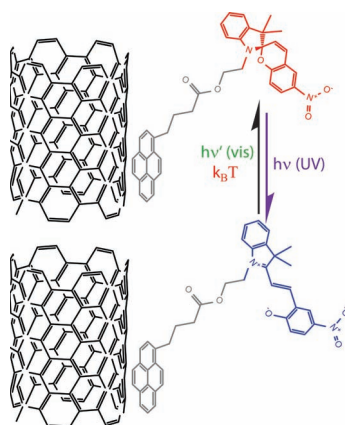
Compositional and Morphological Studies of Polythiophene/Polyfluorene Blends in Inverted Architecture Hybrid Solar Cells

FULL PAPER

Carbon Nanotubes

A. Setaro,* P. Bluemmel, C. Maity,
S. Hecht,* S. Reich.....2425–2431

**Non-Covalent Functionalization of
Individual Nanotubes with Spiropyran-
Based Molecular Switches**



A route for routine functionalization of bulk samples of individual nanotubes in solution with reversible photoswitches is developed using a functionalization scheme that isolates and stabilizes carbon nanotubes in solution while covering them with photoswitches. The approach preserves the 1D quantum nature of the nanotubes as proven by their bright light emission, which has never been reported before.