ADVANCED FUNCTIONAL MATERIALS

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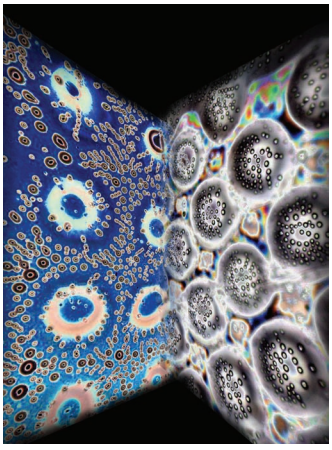
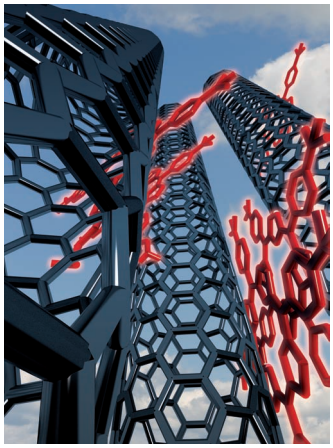


Liquid Crystals

Pico-femtoliter nematic liquid crystal droplets are fragmented on a functionalized lithium niobate substrate covered with polydimethylsiloxane (PDMS) circular microstructures. On page 3267, Francesco Merola and co-workers report that the droplets move and assemble themselves outside or inside the structures, driven by electric field lines that are generated by the pyroelectric effect.

Thin Films

In a race to find alternatives for indium tin oxide (ITO) in flat panel display technology, new replacement materials are being extensively investigated. As reported by Aleksander Rečnik and co-workers on page 3136, the basic principles of crystal growth under geometrically constrained conditions can be exploited to manufacture highly transparent and conductive ZnO films on glass. The image was recorded using a JEOL JSM-7600F microscope by Matejka Podlogar and graphically designed by Aljaž Iveković.



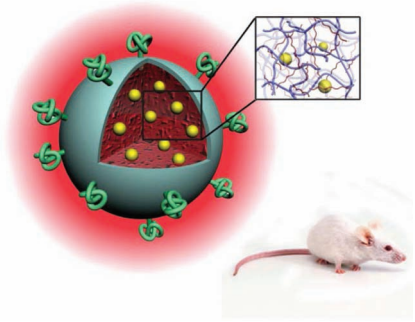
Optoelectronic Devices

On page 3209, Sorin Melinte, Philippe Dubois, Roberto Lazzaroni, Nicola Armaroli, and Davide Bonifazi, and co-workers present new insights into the structural and photophysical properties of porphyrin—double-walled carbon nanotube (DWCNT) hybrid materials. Contrary to previous observations in solution, the spectral features of porphyrin—nanotube derivatives recorded in the solid state show the presence *J*- and *H*-type aggregates that influence the performance of optoelectronic devices. A covalent porphyrin—nanotube hybrid promotes *J*-type, head-to-tale, aggregation whereas the non-covalent hybrid exhibits typical face-to-face *H*-type assembly.

CONTENTS

FULL PAPERS

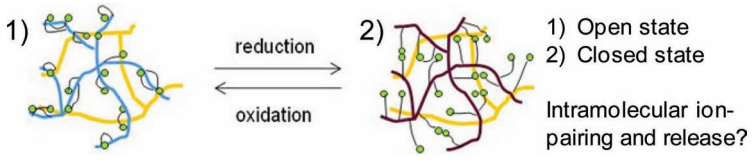
Biomedical Applications



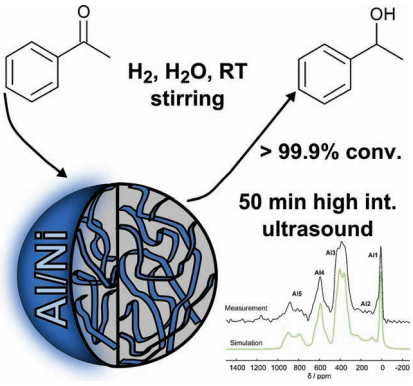
Conjugated polymer based nanoparticles as fluorescent-magnetic probes with targeting ability to folate-receptor-overexpressed cancer cells is reported. In vivo far-red/near-infrared fluorescence and magnetic resonance imaging studies suggest that the conjugated polymer based dual-modal imaging probes hold great promise in advanced bioimaging applications.

Conducting Polymers

An interpenetrating polymer network (IPN) with molecular tethers can be reversibly switched between two conducting states by the application of a small voltage in the absence of standard liquid electrolyte. The switching causes the nanoporosity of the IPN to change, thus the IPN is able to adopt an "open" state and a "closed" state. The diffusivities of vapor molecules are strongly influenced by the changes in nanoporosity.

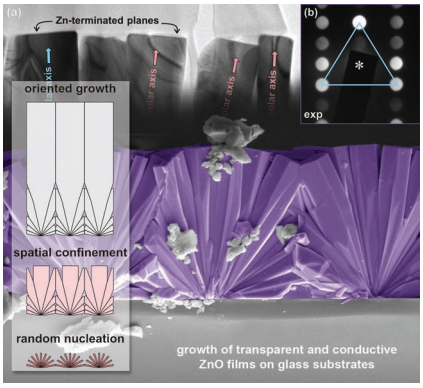


Catalysts



Sonochemical activation of Al/Ni particles results in nanostructuring of initial Al/Ni alloy and the formation of an effective and reusable catalyst for the hydrogenation reactions. This catalyst can be stored and handled under ambient conditions, in comparison to traditional Raney Ni catalysts. The catalyst is fully characterized and catalytic experiments are carried out.

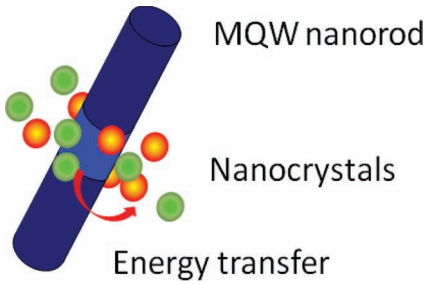
Thin Film Displays



In a race to find alternatives to indium-tin-oxide (ITO) in flat panel display technology, replacement materials are extensively investigated. The basic principles of crystal growth under geometrically constrained conditions are exploited to manufacture highly transparent (82%) and conductive (100 Ω sq^{-1}) ZnO films on inexpensive glass substrates.

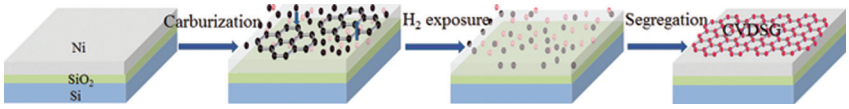
FULL PAPERS

Energy transfer between InGaN multiple-quantum-well (MQW) nanorods and semiconductor nanocrystals is studied for white light conversion in a proximal side-wall coupling configuration. The roles of bound excitons and free carriers are identified using temperature-dependent transient spectroscopy. An exceptional contribution of the carrier transport confinement effect to the energy transfer mechanisms is observed.



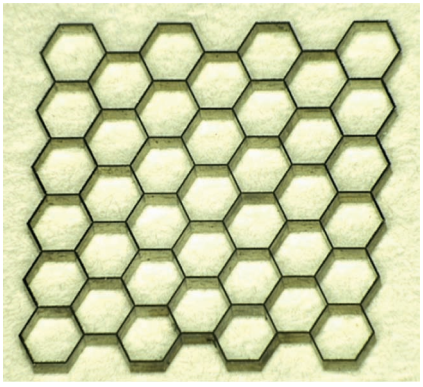
Colloidal Nanocrystals

The layer-controlled synthesis of uniform and high-quality graphene films is a challenging task. A novel and viable synthesis of layer-controlled high-quality graphene films on a wafer-scale Ni surface by the sequentially separated steps of gas carburization, hydrogen exposure, and segregation at ambient pressure is developed. The hydrogen exposure plays a critical role in promoting the preferential segregation through reducing carbon content in the Ni.



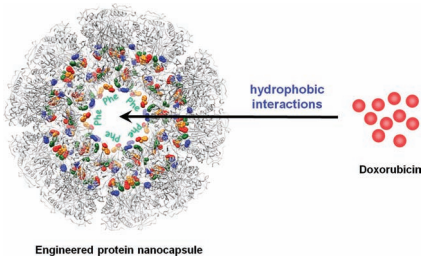
Graphene

A combination of lithography and thermoplastic forming allows for the fabrication of honeycombs from bulk metallic glass (BMG) and for the selective manipulation of the structure. The characteristics of the honeycomb, such as ligament length over thickness, are varied and how changes in these characteristics affect properties under uniaxial in-plane compression testing is determined.



Microfabrication

A biomimetic strategy that encapsulates organic molecules into a protein nanocapsule by engineering non-native hydrophobicity into the interior of the capsule is demonstrated. These complexes enable delivery of drug molecules to cancer cells. This novel approach may be broadly utilized to attach guest molecules non-covalently to other protein-based materials for molecular transport and has applications in bionanotechnology.

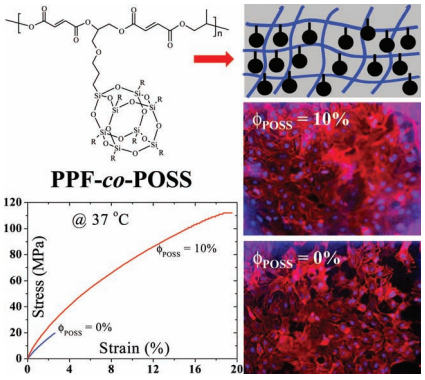


Drug Delivery

CONTENTS

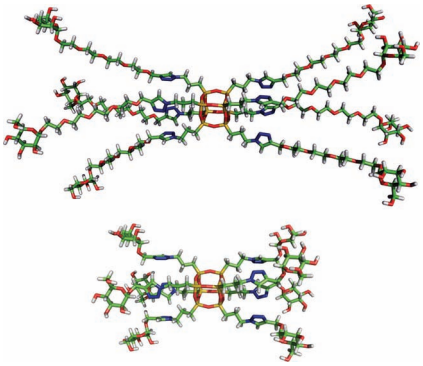
FULL PAPERS

Biomedical Applications



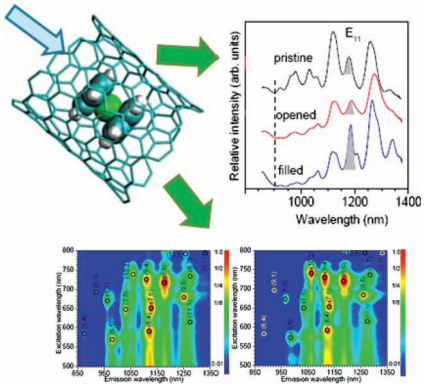
Novel injectable and photo-crosslinkable poly(propylene fumarate) (PPF)-*co*-polyhedral oligomeric silsesquioxane (POSS) copolymers are synthesized to improve both stiffness and toughness and to promote biological performance of bone tissue engineering scaffolds. The mechanical properties with the non-monotonic dependence on weight compositions of POSS are correlated with mouse pre-osteoblastic MC3T3-E1 cell attachment, spreading, proliferation, differentiation, and gene expression.

Hybrid Materials

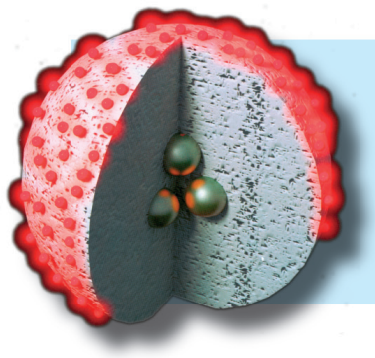


Polyhedral oligosilsesquioxanes (POSS)-based cubic glycoclusters (glyco-POSS) are readily obtained by "click" chemistry. These nanohybrid bioconjugates slowly disassemble under physiological conditions. The disassembling process offers an important advantage for POSS conjugates over other nanoparticle conjugates intended for in vivo applications in terms of the expected rapid clearance from the body and low toxicity of their organosilane fragments, thus preventing bioaccumulation and saturation of complementary receptors.

Carbon Nanotubes



Organometallic compounds inside single-walled carbon nanotubes can drastically change their properties. Using biocompatible standardized suspensions of pristine, opened, and ferrocene-filled nanotubes, a selective enhancement of the photoluminescence and optical absorption up to a factor of three is observed. This is attributed to a local electron charge transfer from the encapsulated molecules.



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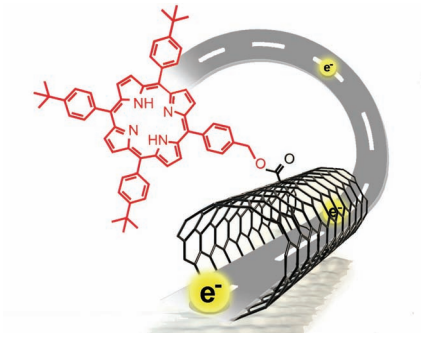
FULL PAPERS

The synthesis as well as the structural and photophysical properties of porphyrin-double-walled carbon nanotubes (DWCNTs) are comprehensively described. By means of absorption and emission spectroscopies, new insights into the electronic communication existing between CNTs and covalently linked porphyrin molecules are unravelled both in solution and in the solid state.

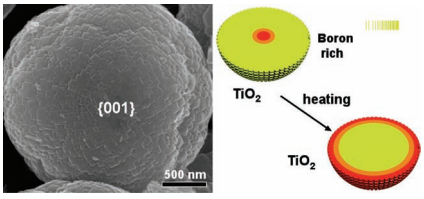


Optoelectronic Devices

Interface defects in silicon nanocrystals strongly affect the photoluminescence (PL) efficiency and optical absorption. Passivation of the nanocrystals nearly eliminates dangling-bond defects, decreasing absorption below the quantum-confined bandgap and enhancing PL efficiency by an order of magnitude. Remaining, unpassivated, non-paramagnetic defects are revealed using photothermal deflection spectroscopy. Theoretical studies attribute these defects to distorted bonds at the nanocrystal surface: Si–Si and bridging Si–O–Si bonds.

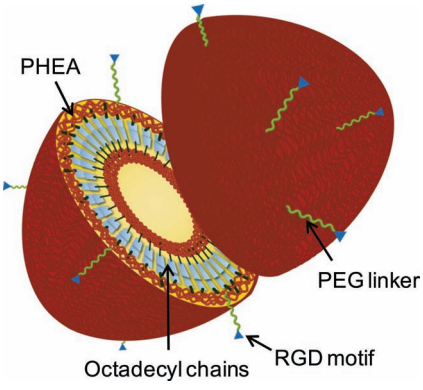
Silicon Nanocrystals

By moving heteroatom boron from the core to the shell of an anatase TiO_2 microsphere via thermal diffusion control, the photocatalysis reaction preferences towards hydrogen and oxygen evolution from water splitting can be sensitively switched.



Catalysis

Ellipsoidal polymersomes are made by self-assembly of polyaspartamide substituted with poly(ethylene glycol) (PEG) chains. Further modification of the ellipsoidal polymersomes with peptides containing an Arg-Gly-Asp(RGD) sequence leads to a significant increase in the rate of association with a substrate coated with $\alpha_v\beta_3$ integrins and also more binding with targeted cells in vitro than their spherical counterparts.



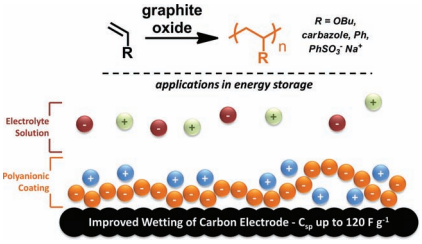
Biomedical Applications

CONTENTS

FULL PAPERS

Catalysis

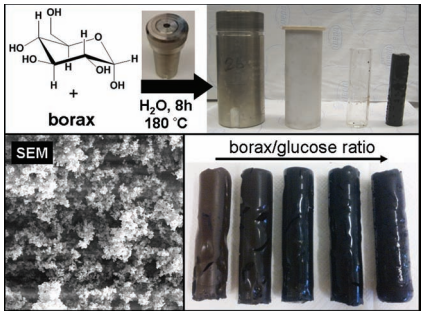
Graphite Oxide as an Olefin Polymerization Carbocatalyst: Applications in Electrochemical Double Layer Capacitors



Graphite oxide (GO) is found to be an efficient heterogeneous catalyst for the polymerization of various olefinic monomers. For example, the polymerization of sodium 4-styrenesulfonate using GO affords composites of the corresponding polymer. After thermal treatment, the composites are fabricated into electrodes for use in electrochemical double layer capacitors. The devices display high specific capacitances and low cell resistances.

Aerogels

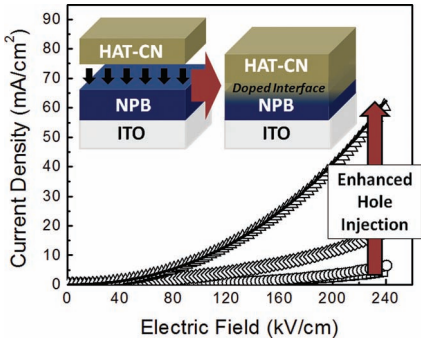
Borax-Mediated Formation of Carbon Aerogels from Glucose



Hierarchically structured carbon aerogels with high surface areas are produced using only glucose as a carbon precursor. A simple, rapid, efficient, and sustainable hydrothermal approach is presented in which sodium borate (borax) is used as a novel catalyst and complex structure directing agent leading to nanostructured, carbonaceous monoliths that are structurally similar to the well-known sol-gel monoliths made of resorcinol and formaldehyde.

Organic Electronics

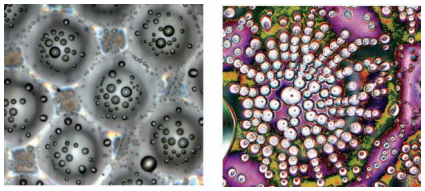
Origin of Enhanced Hole Injection in Inverted Organic Devices with Electron Accepting Interlayer



Hole injection is substantially enhanced using 1,4,5,8,9,11-hexaazatriphenylene hexacarbonitrile (HAT-CN) as a hole-injection layer (HIL) with a top anode. The enhanced hole injection is achieved due to the strong electron accepting nature of the hole-transporting layer HAT-CN molecule and efficient doping at the surface of the hole-transporting layer (HTL). The more efficient top injection contact is due to the stronger doping effect of the HIL.

Liquid Crystals

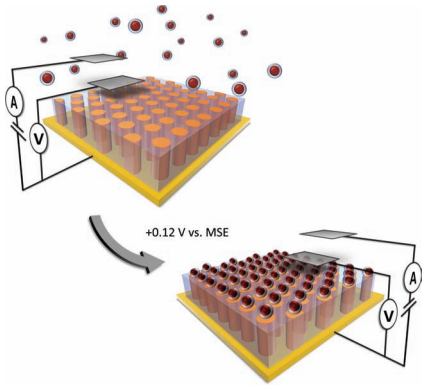
Reversible Fragmentation and Self-Assembling of Nematic Liquid Crystal Droplets on Functionalized Pyroelectric Substrates



The pyroelectric effect is able to drive a reversible fragmentation process in liquid crystal drops, starting from nanoliter drops and obtaining pico/femtoliter droplets. These small droplets are patterned according to the geometry of the substrate and aligned along the electric field lines. Applications such as spatial modulation of the wettability and dynamical optical elements able to switch from a diffuser (fragmentation) state to a microlens array (coalescence state) are foreseen.

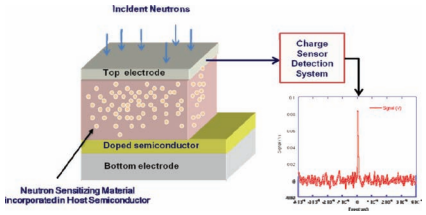
FULL PAPERS

The selective adsorption of the cage protein ferritin onto self-assembled diblock copolymer surfaces is reported. When desired, the adsorption is triggered in situ by changing the potential. Upon this potential change, the minority block, consisting of amorphous polyferrocenylsilane, becomes positively charged. Electrostatic forces are then responsible for the local adsorption of the globally negatively charged ferritin molecules.



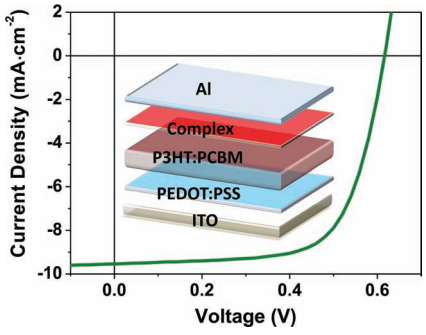
Thin Films

An in situ semiconductor synthesis and film deposition facilitates a novel neutron detector configuration consisting of a host inorganic semiconductor matrix impregnated with a guest neutron sensitizing material. It consists of interpenetrating networks of the host semiconductor nanocrystals and sensitizing guest material that self-assemble during film formation. The detectors show high sensitivity to ionizing radiation and an ability to detecting thermal neutrons.



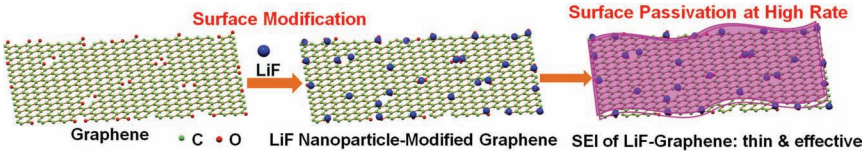
Hybrid Materials

A simple method is demonstrated to improve the film-forming properties and air stability of a conjugated polyelectrolyte. Using this complex as a cathode interface layer, a high power conversion efficiency of 4% can be obtained in poly(3-hexylthiophene):[6,6]-phenyl C_{61} butyric acid methyl ester (P3HT:PCBM) solar cells together with improved stability in air. Moreover, ≈20% performance enhancement can also be achieved when the complex is used to replace calcium metal for low bandgap polymer-based bulk heterojunction (BHJ) systems.



Solar Cells

A surface modified strategy is proposed to synthesize LiF nanoparticle-modified graphene as an advanced electrode for high-power and high-energy lithium ion batteries. The crystalline LiF nanoparticles anchored on the graphene surface act as an effective electrode additive to suppress the electrolyte-decomposition reaction, affect the solid electrolyte interphase components, and reduce their thickness. The Li-storage performance is significantly improved at fast charge/discharge rates.

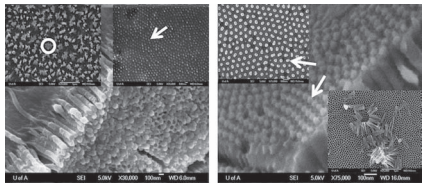


Batteries

FULL PAPERS

Organic Nanowires

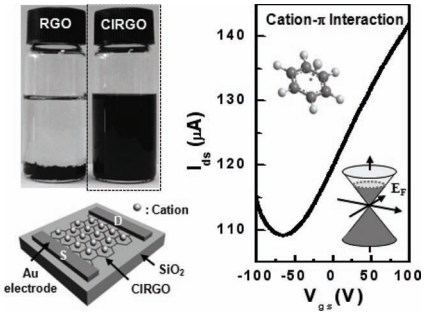
Template-Assisted Synthesis of π-Conjugated Molecular Organic Nanowires in the Sub-100 nm Regime and Device Implications



A novel fabrication process that allows growth of nanowires of π-conjugated small-molecular organics (e.g., rubrene, Alq_3, [6,6]-phenyl-C_{61}-butyric acid methyl ester (PCBM), and fullerene) in sub-100 nm diameter channels of nanoporous anodic alumina template is demonstrated. This process can be extended to synthesize more complex, radially and axially hetero-structured organic nanowires. Structural, compositional, and transport characterizations are performed, highlighting possible device implications.

Printed Electronics

Highly Concentrated and Conductive Reduced Graphene Oxide Nanosheets by Monovalent Cation–π Interaction: Toward Printed Electronics



Highly concentrated and conductive reduced graphene oxide (RGO) nanosheets are prepared by introducing monovalent cation–π interactions between Na^+ or K^+ ions and six-membered sp^2 carbons on graphene. Current–voltage characteristics demonstrate the interactions in terms of the presence of n-type doping effect due to the adsorption of cations with high electron mobility (39 $cm^2\ V^{-1}\ s^{-1}$).