ADVANCED FUNCTIONAL MATERIALS

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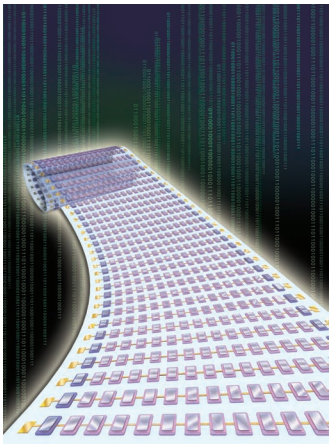
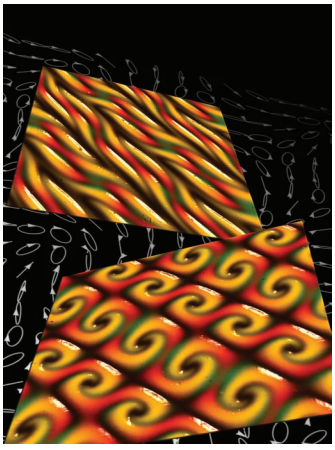


Organic Electronics

Monolithically inkjet-printed, flexible 256-bit polymer NAND flash memory is demonstrated by using a chargeable polymer electret for the memory cell and polystyrene for ground- and bit-line select transistors as a dielectric layer. On page 2915, Kang-Jun Baeg, Yong-Young Noh, and co-workers report that the first demonstration of an inkjet-printed, flexible NAND flash memory array may move up the commercialization of organic memory devices.



Smart Materials

On page 2964 Gabriella Cipparrone and co-workers report on the supramolecular chiral structuring of an amorphous azo-polymer guided by 2D polarization light patterns. Periodic chiral microstructures with spiral- or ribbon-like shape and identical or opposite helicity are demonstrated. They exhibit high stability and complete reconfigurability. These results provide an alternative approach to design a new class of materials with periodic chiral arrangements that have potential advantages for applications in smart functional devices.

Photonic Crystals

On page 2980, Shu Yang and co-workers report the fabrication of microstructured diamond photonic crystals with controllable nanoroughness made by varying the processing conditions, which include the degree of photocrosslinking density and the choice of solvent for developing and rinsing during the holographic lithography process. The resulting dual-scale photonic crystals exhibit structural color together with superhydrophobicity, thus mimicking butterfly wings, and have significantly enhanced dye adsorption compared to that of a smooth-surfaced crystal.

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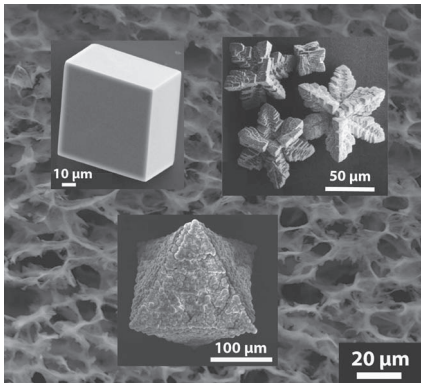
FEATURE ARTICLE

Hydrogels

Crystal Growth of Calcium Carbonate in Hydrogels as a Model of Biomineralization

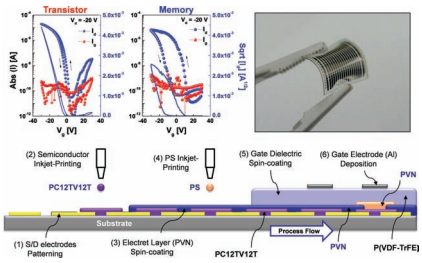


The porous networks formed by hydrogel matrices provide a versatile medium for crystal growth of a wide range of crystalline materials varying from single crystal equilibrium morphologies to non-equilibrium morphologies and self-organized structures. In addition, the crystalline products can incorporate the hydrogel matrix forming crystalline composites.

FULL PAPERS

Organic Electronics

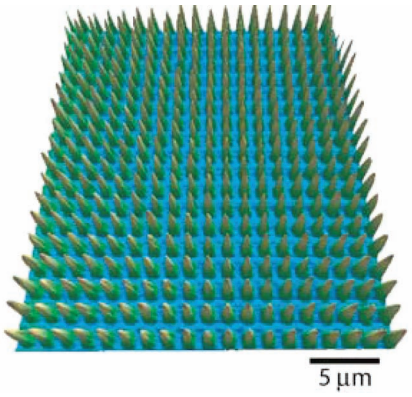
High-Performance Top-Gated Organic Field-Effect Transistor Memory using Electrets for Monolithic Printed Flexible NAND Flash Memory



A facile strategy for the successful development of monolithically printed and flexible organic NAND flash memory is reported. The success comes from proper selection of polymer electrets (poly(2-vinylnaphthalene) or polystyrene in top-gate/bottom-contact polymer field-effect transistors with bi-layered polymer dielectrics, i.e., poly(vinylidenefluoride trifluoroethylene) and electret.

Lithography

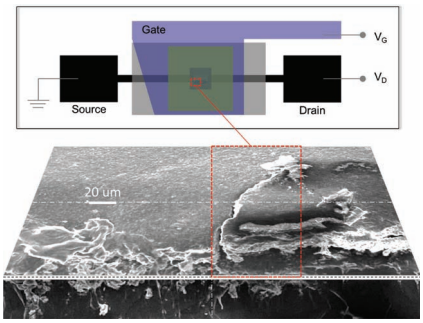
Triangular Elastomeric Stamps for Optical Applications: Near-Field Phase Shift Photolithography, 3D Proximity Field Patterning, Embossed Antireflective Coatings, and SERS Sensing



A decal transfer lithography technique is used to fabricate elastomeric stamps with triangular cross sections. These stamps, which contain triangular prisms or cones, are used in several prototypical optical applications that illustrate the utility of triangular poly(dimethylsiloxane) decals for manipulating light–matter interactions in a predictable and controllable manner.

Transistors

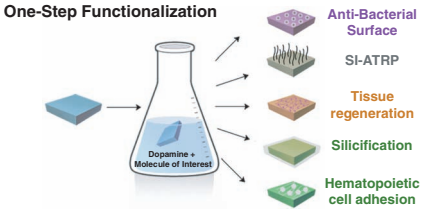
Simplified Large-Area Manufacturing of Organic Electrochemical Transistors Combining Printing and a Self-Aligning Laser Ablation Step



A hybrid sheet-based manufacturing approach for organic electrochemical transistors is reported. It combines screen and inkjet printing with a self-aligning laser ablation step.

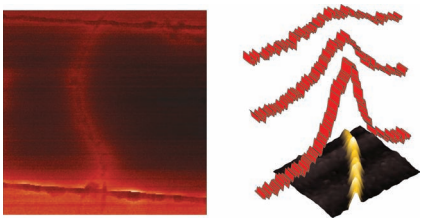
FULL PAPERS

A one-step surface modification method that can immobilize diverse functional molecules onto surfaces is reported. Molecules with carboxyl, primary/quaternary amines, thiol, and enediol groups that have a wide range of molecular weights are immobilized onto versatile substrates of oxides, noble metals, ceramics, and synthetic polymers for multipurpose surface functionalizations.



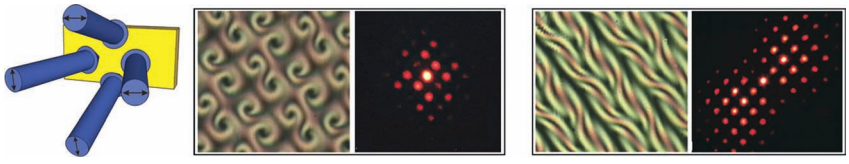
Surface Modification

The thermoacoustic effect from isolated single wall carbon nanotubes aligned between electrodes is experimentally observed for the first time by imaging the emitted acoustic wave using an atomic force microscopy-based technique specifically developed for the task.



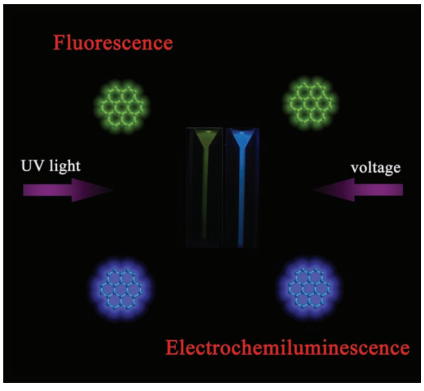
Carbon Nanotubes

The unique characteristics of an amorphous azo-polymer and its response to light stimuli enable the building of optical architectures with great complexity. A four-beam holographic approach is adopted and 2D polarization patterns allow the formation of spiral- and ribbon-like chiral structures. The results suggest an alternative way to design supramolecular chiral materials that are characterized by high stability and complete reconfigurability.



Smart Materials

Two-color graphene quantum dots are prepared using a facile microwave-assisted approach to have fluorescent quantum yields as high as 22.9%. The graphene quantum dots are demonstrated to be electrochemiluminescent. A novel electrochemiluminescence sensor for Cd^{2+} is proposed based on the competitive coordination between cysteine and graphene quantum dots for metal ions.



Quantum Dots

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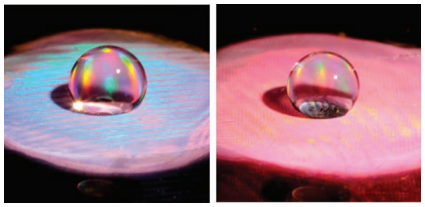
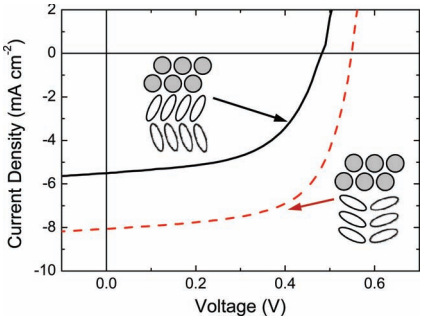
Photonic Crystals



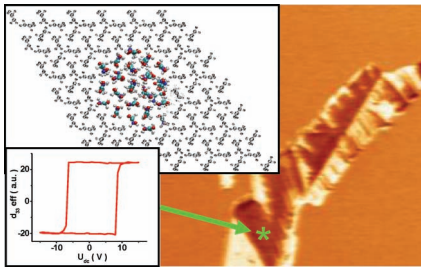
Microstructured diamond photonic crystals with controllable nanoroughness are fabricated by varying the processing conditions, including degree of photocrosslinking density and choice of solvents for developing and rinsing during the holographic lithography process. The resulting dual-scaled photonic crystals exhibit structural color together with superhydrophobicity and enhanced dye adsorption.

Photovoltaic Devices

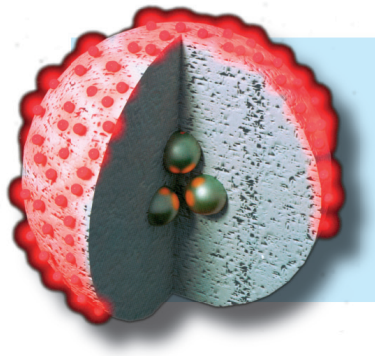


The effect of molecular orientation on the photovoltaic processes of a polycrystalline zinc phthalocyanine/C_{60} heterojunction are explored. Not only is absorption affected by molecular orientation, but exciton transport and charge transfer efficiency are also influenced and these processes account for an increase by nearly a factor of two in the efficiency of the bilayer cells studied.

Ferroelectrics



γ-Glycine is for the first time reported to be a ferroelectric, as evidenced by the existence of switchable ferroelectric domains and Curie–Weiss behavior. The experimental results are rationalized by molecular simulations that establish that the polarization vector in γ-glycine can be switched on the nanoscale level, opening a pathway to novel classes of bioelectronic logic and memory devices.



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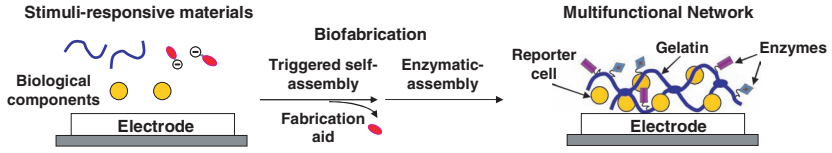
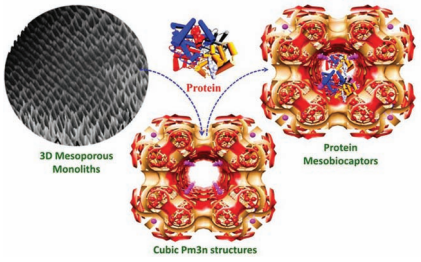
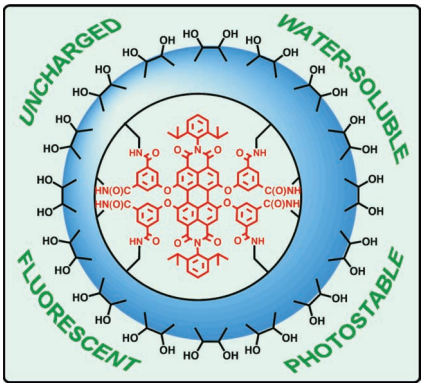
A multifunctional matrix is biofabricated by coupling self-assembly with enzymatic assembly. Self-assembly is triggered using stimuli-responsive materials and device-imposed electrical signals to electrodeposit a gelatin matrix. Enzymatic reactions serve to crosslink the gelatin and conjugate proteins to this matrix. These studies demonstrate the potential for enlisting biological materials and mechanisms to construct multifunctional soft matter.



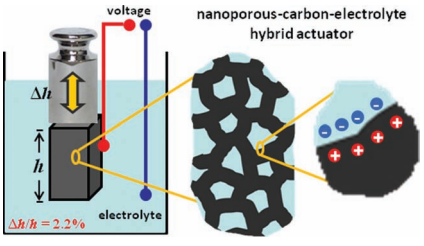
Mesobiocaptors with large, cylindrical cavities can encapsulate large quantities of protein. Geometrical models of the biocaptor indicate the encapsulation of protein into the interior pores. The protein removal from mixtures is based on size- and shape-selective separation. These findings will open new avenues of research in encapsulation of proteins and bioanalysis.



Water-soluble and biocompatible dendritic polyglycerols are highly effective in solubilizing and protecting hydrophobic dyes. The dendritic encapsulation produces water-soluble and fluorescent perylenediimide-cored dendrimers, which are insensitive to metal ion quenchers. Intramolecular crosslinking of the dendritic shells further protects the fluorescent core and affords additional photostability with a more compact dentritic shell.



A novel nanoporous carbon/electrolyte hybrid material for actuation is presented. The nanoporous carbon matrix provides a 3D network that combines mechanical strength, light weight, and low cost with an extremely high surface area. The hybrid material exhibits appreciable strength and can be loaded in compression. This electrically tunable actuator reaches strain amplitudes and mass-specific work density values that are comparable or even superior to many conventional actuation materials.



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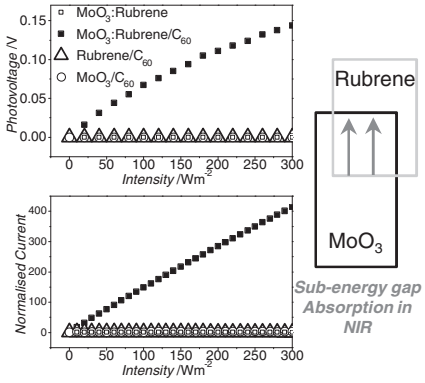
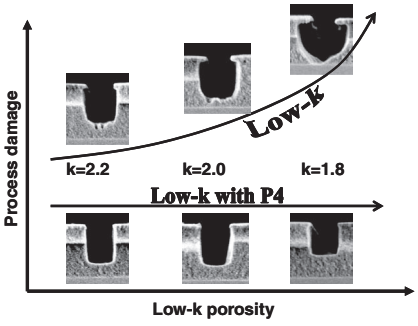
Photovoltaic Devices



A simple approach to achieve near-infrared electric power generation using the interactive charge-transfer complex formed between molybdenum (VI) oxide (MoO_3) and the wide-energy-gap 5,6,11,12-tetraphenylnaphthacene (rubrene) is presented. An intermediate state induced within the energy gap of rubrene leads to sub-energy-gap absorption and photopower generation.

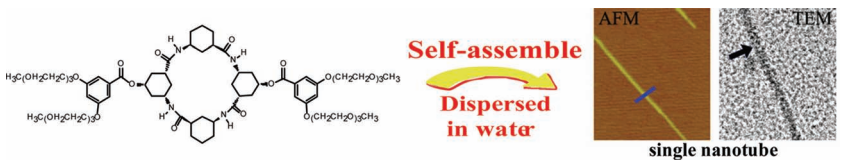
Composite Materials



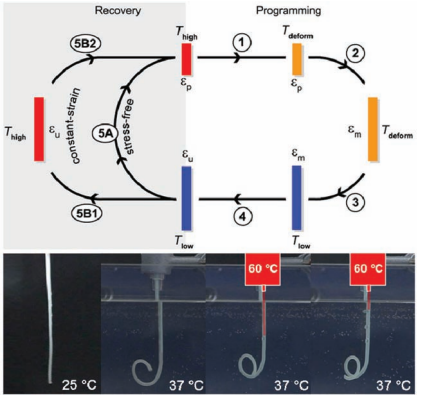
Protecting the porosity of ultralow dielectric constant (*k*) materials allows for limitation of the processing damage to a constant minimal level, independent of the porosity. This trend holds true on both blanket wafers and patterned structures, highlighting how the post porosity plasma protection (P4) can allow the extendibility of actual semiconductor manufacturing processes to future highly porous dielectrics.

Self-Assembly

Hydrophobic inner cyclic γ-tetrapeptides are synthesized using a one-pot cyclodimerization. Fourier transform infrared (FTIR) and NMR analysis, along with density functional theory (DFT) calculations, indicate that the cyclopeptide can self-assemble into nanotubes through hydrogen-bond-mediated parallel stacking. The transmission electron microscopy (TEM) and atomic force microscopy (AFM) images reveal that the individual nanotubes are formed by dispersed aggregates in water.



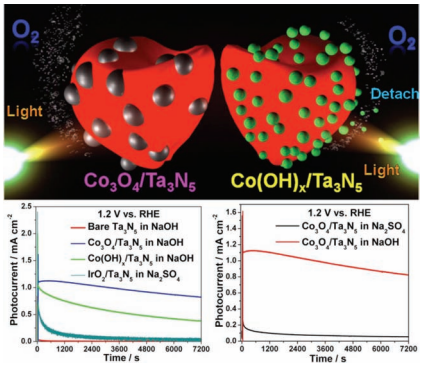
Stimuli-Sensitive Materials



Biomedical applications often require intelligent devices that can perform self-sufficient shape changes or can be fixed in an adapted geometry. The working principle of temperature-memory catheters based on copolyesterurethanes containing poly(ω-pentadecalactone) and poly(ε-caprolactone) segments as controlling units for the temperature-memory effect are explored. The response temperatures of such polymers can be adjusted in a range relevant for biomedical applications.

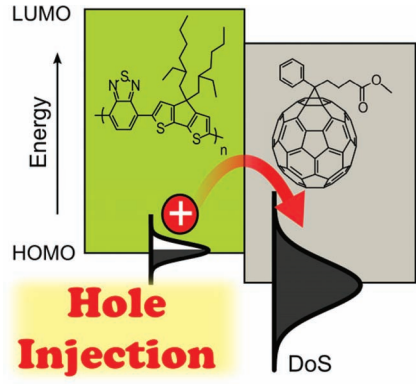
FULL PAPERS

Nanoparticulate Co_3O_4 water oxidation catalyst is uniformly deposited onto the surface of a Ta_3N_5 photoanode with abundant and compact nanojunctions formed between Co_3O_4 and Ta_3N_5. Profitting from the unique features of the Co_3O_4 water oxidation catalyst and the alkaline solution, the improved kinetics of water oxidation cause the Co_3O_4/Ta_3N_5 photoanode to have the best durability against photocorrosion shown to date.



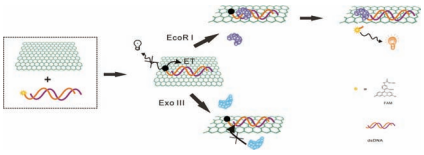
Photochemistry

The mechanism for forming [6,6]-phenyl-C_{61}-butyric acid methyl ester (PCBM) cation in polymer/PCBM blend films is studied using transient absorption spectroscopy. On a sub-microsecond time scale, PCBM cations are generated by hole injection from the polymer to PCBM domains in the blend films. The final fraction of PCBM cations depends on the highest occupied molecular orbital (HOMO) energy level of the donor polymers.



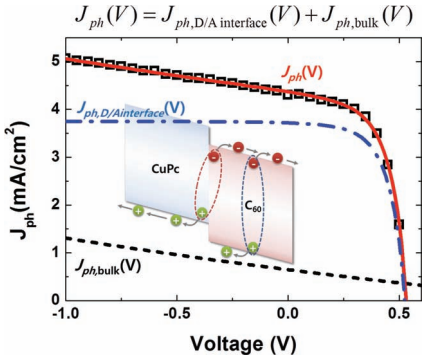
Solar Cells

The duplex DNA/graphene oxide (GO) biointerface, as well as its biological enzyme digestion effect, are experimentally investigated. The results suggest that GO can adsorb DNA duplexes and has specific effects on enzymatic degradation. The unusual non-covalent assembly of double-stranded DNA on the graphene is envisioned for potential diversified future applications, such as biological imaging, material science, sensing, and biomedicine.



Biointerfaces

The bias-dependent change of the photocurrent in copper phthalocyanine/C_{60} planar heterojunction solar cells is mainly attributed to charge generation by the process of the bulk ionization in the C_{60} layer. Due to the photoconductivity of C_{60}, a significant current is generated from the bulk of the C_{60} layer. This results in a linear dependence of the photocurrent on the applied bias.



Solar Cells