ADVANCED FUNCTIONAL MATERIALS

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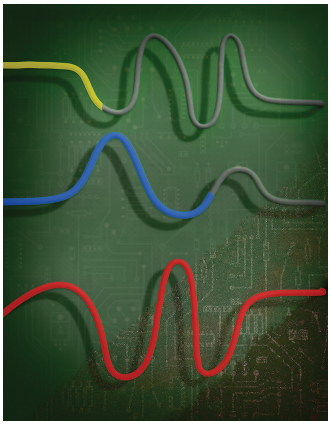
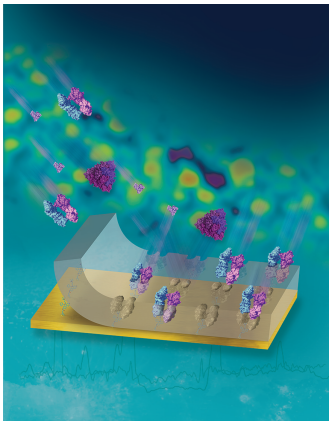


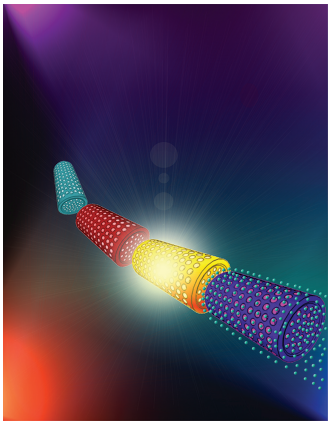
Transient Electronics

The functions and characteristics of electronic devices are modified on-demand by wirelessly triggered etching via the use of wireless microfluidic devices. J. A. Rogers and co-workers show, on page 5100, that functional transformations of target constituent components are achieved by dissolving the strategy point of circuit with etching solution injected through microfluidic channels on demand.

Biomimetic Sensors

On page 5178, R. E. Gyurcsányi, F. W. Scheller, and co-workers demonstrate specific recognition of acetylcholinesterase, a potential marker of Alzheimer´s disease, by a hybrid material which shows threefold selectivity gain by the "shape-specific" electrosynthesized molecularly imprinted polymer, oriented binding to the propidium layer and signal generation exclusively by the enzyme bound to the nanofilm. Acetylcholinesterase is detected in the nanomolar range, whilst interfering proteins are effectively suppressed.



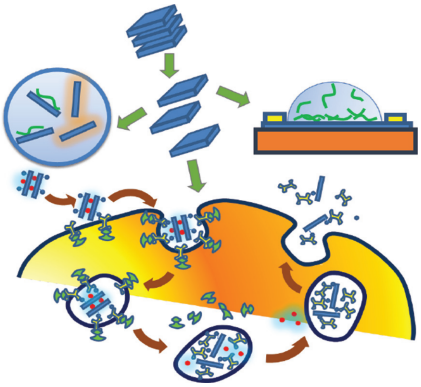


Microcarriers

A. Santos, D. Losic, and co-workers demonstrate on page 5107 the preparation of luminescent silicon diatom replicas with unique porous microcapsule structures, by conversion from silica diatoms using a reduction process. These silicon diatoms are biodegradable and have intrinsic luminescence, sensing and drug-releasing properties which make them outstanding candidates for low-cost micro-carriers for drug delivery, theranostics, and guided micro-robotic devices.

FEATURE ARTICLE

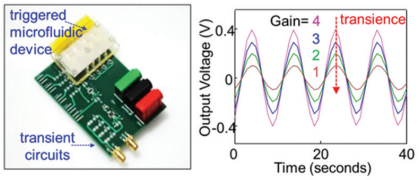
Two-dimensional transition metal dichalcogenides demonstrate a plethora of unique properties, including tunable electronic and optical characteristics, stability in aqueous environments, large surface areas that can be manipulated and functionalized, and intercalatable layered structures. Relatively low levels of toxicity and facile synthesis routes make these materials suitable for future biological systems.



Dichalcogenides

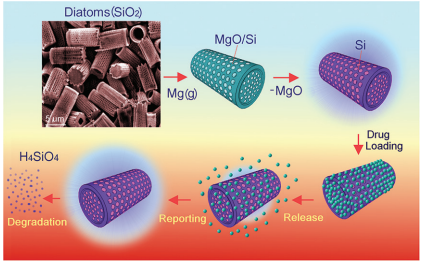
FULL PAPERS

Unusual materials and designs for electronics enable systems with the ability for on-demand, triggered functional transformations via the use of wireless microfluidic devices that initiate dissolution of targeted constituent components in a sequential, selective manner. Demonstration examples involve reconfigurable circuits for signal processing and data encryption.



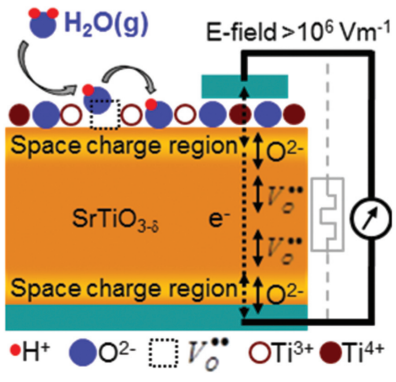
Transient Electronics

Toward the development of advanced self-reporting microcarriers with biologically derived shapes for sustained drug delivery. Luminescent silicon diatom replicas prepared from silica diatoms by a simple magnesiothermic reduction process feature outstanding drug delivery capacity, biodegradability, and self-reporting capabilities, which make them outstanding candidates for advanced microcarriers for intravitreal and other medical therapies.



Microcarriers

The memristive response in anionic-electronic resistive switching devices is incontestably related to the humidity level of the surrounding air. Water molecules present in the air are incorporated into the oxide thin film and interfere strongly with the space-charge region at the metal|oxide interface, thus affecting the resistive switching of the device operating under high local electric fields.



Resistors

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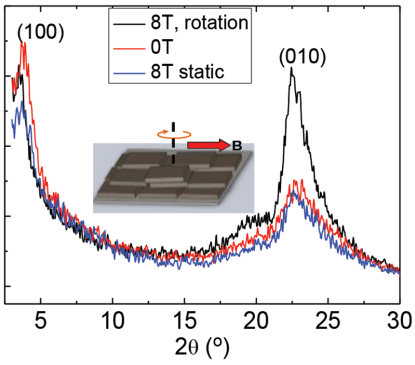
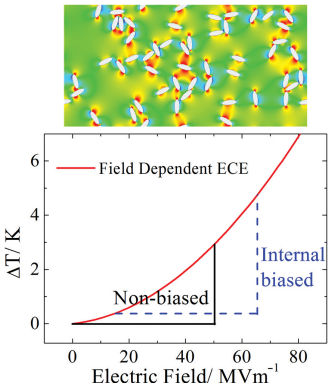
Semiconducting Polymers



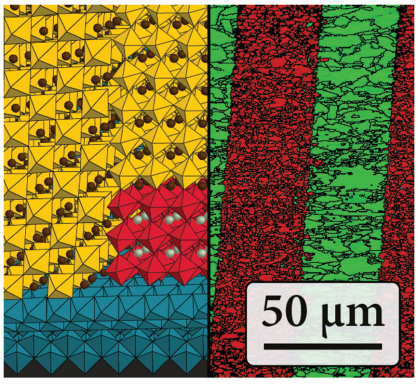
Molecular orientation and film texture of n-type semicrystalline polymer P(NDI2OD-T2) at both in-plane and out-of-plane directions is controlled effectively via the improved solution-processings under high magnetic field. The mechanism on magnetically induced film growth is also elucidated. The magnetically aligned P(NDI2OD-T2) films exhibit remarkably enhanced electron mobility and high mobility anisotropy.

Ferroelectrics

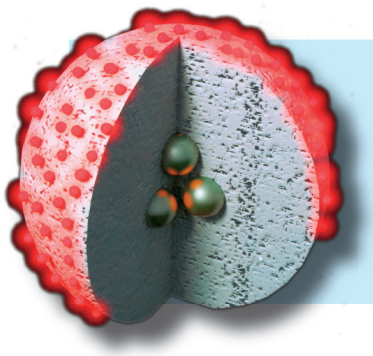


By internal biasing a relaxor ferroelectric polymer, it is demonstrated numerically and experimentally that both electrocaloric effect and electrocaloric coefficient can be enhanced. This approach provides a general route to enhance low-field electrical performances of such square-rule materials and thus pave the way to develop smart electroactive devices with better electrical reliability and safety.

Film Growth



Perovskite thin films are deposited on Si substrates covered with inorganic nanosheets of $Ca_2Nb_3O_{10}$ or $Ti_{0.87}O_2$. These nanosheets are used to control the nucleation of films that consist of a $SrTiO_3$ buffer layer and a $SrRuO_3$ top layer. The two types of nanosheets are micropatterned to locally tailor the crystallographic orientation, allowing lateral control of the magnetic properties of $SrRuO_3$.



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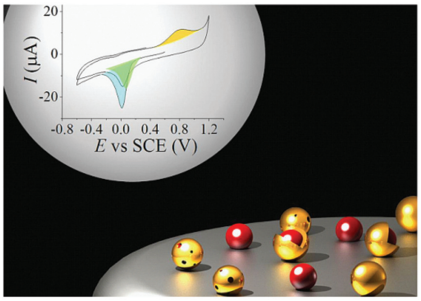
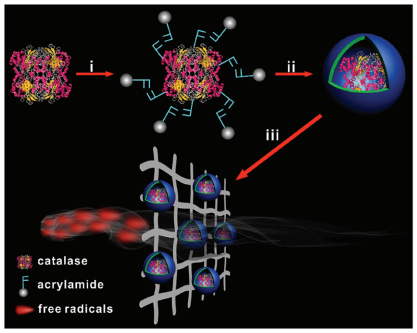
FULL PAPERS

A method of characterizing multifunctional materials beyond imaging is presented, distinguishing and quantifying intact and broken or cracked core–shell nanoparticles by using the different redox reactivities of the core and the shell material. Fe_3O_4@Au and Au@SnO_2 samples are studied as two proof-of-concept systems.



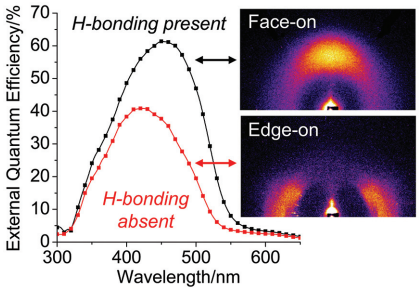
Core–Shell Nanoparticles

The catalytic activity of catalases can be retained by encapsulating the enzymes in rigid polymer shells. The covalent bonding with the polymer shells protects the catalases from dissociating into subunits under high operational temperature. As-prepared catalase nanocapsules can be incorporated in cigarette filters as scavengers to clean free radicals from tobacco smoke.



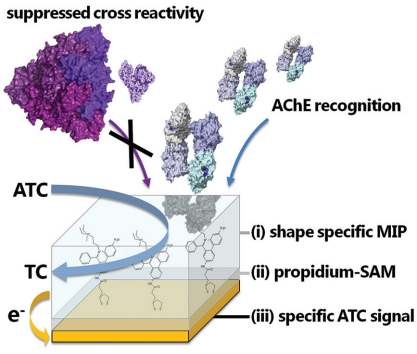
Core-Shell Structures

Tailored hydrogen-bonding interactions between molecular donors in blends with C_{60} result in vertically aligned π-stacks, shorter π-stacking distances, higher charge collection efficiency, and redshifted absorption relative to non-H-bonding comparator molecules. For two quaterthiophene families, the benefits result in a twofold enhancement in power conversion efficiency and a maximum external quantum efficiency of 64% in photovoltaic devices.



Photovoltaics

Recognition of tetrameric acetylcholinesterase (AChE), a potential marker of Alzheimer's disease, is accomplished by a hybrid nanofilm consisting of a propidium-terminated self-assembled monolayer (SAM) and an ultrathin electrosynthesized molecularly imprinted polymer (MIP) cover layer. A threefold selectivity gain is provided by i) the "shape-specific" MIP filter, ii) the propidium-SAM, and iii) signal generation only by the AChE bound to the nanofilm.



Biomimetic Sensors

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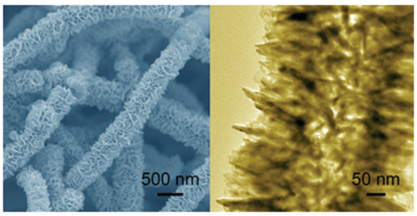
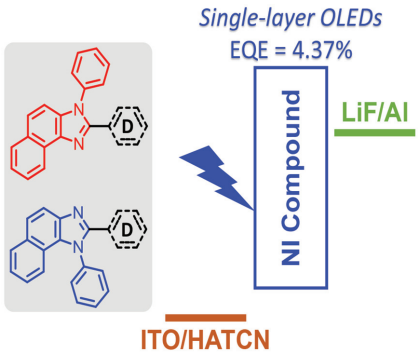
Electrode Materials



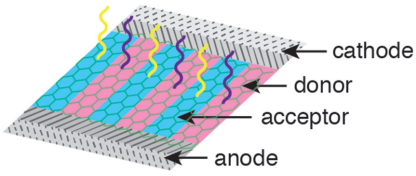
A general strategy is developed for the synthesis of hierarchical tubular structures of Mn-based mixed metal oxides. The derived Co-Mn mixed oxide hierarchical tubular structures manifest enhanced electrochemical properties as electrodes for both hybrid supercapacitors and lithium ion batteries.

Organic Electronics



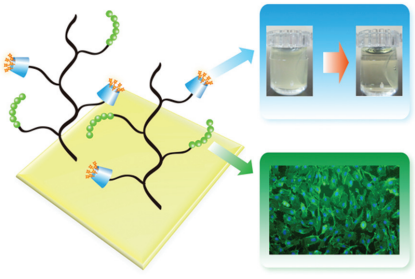
Novel naphtho[1,2-d]imidazole derivatives are developed as light-emitting materials for OLEDs. 1*H*-naphtho[1,2-d]imidazole based compounds exhibit a significantly superior performance than their isomeric counterparts in the single-layer devices owing to the much higher electron injection ability directly from the cathode. However, in the multi-layer devices, uniformly high efficiencies are obtained with a desirable bluecolor that is more pure than that of their benzimidazole and phenanthro[9,10-d]imidazole analogues.

Graphene Heterostructures



The device performance of a single-sheet solar cell made of graphene sheet functionalized into 1D stripes is analyzed using a combination of ab initio simulation and scaling analysis, as a prototype system of in-plane heterostructure engineering. The results suggests highly correlated optoelectronic properties can be optimized simultaneously via independent tuning of the partition width, device length, and functionalizations.

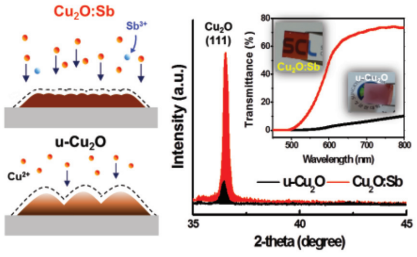
Hemocompatible Surfaces



A bioinspired, blood compatible surface is developed with the capability to both lyse nascent clots and promote endothelialization. The surface is fabricated by sequential coimmobilization of two biomolecules with respective properties via host–guest interaction and covalent bonding, respectively. Neither function of the two biomolecules is compromised by the presence of the other.

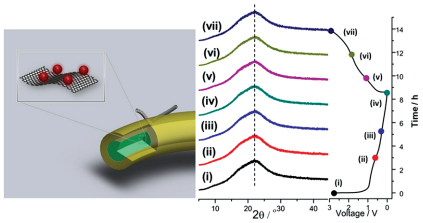
FULL PAPERS

Highly stable p-type cuprous oxide films with extremely improved optical performance are achieved by simple low-temperature electrochemical deposition in the presence of antimony dopants. The Cu_2O:Sb films demonstrate single-domain-like crystallinity with low angle tilted boundaries and exhibit semitransparent properties.



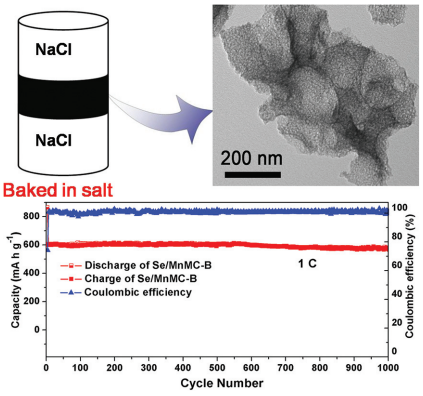
Cuprous Oxides

Li-ion and Na-ion storage behaviors of ultrafine amorphous SnO_x particles embedded in carbon nanofiber/carbon nanotube composites are investigated. They reveal an anomalous electrochemical mechanism with all intermediate phases maintaining an amorphous state during the entire charge/discharge process, which gives rise to excellent reversibility of the electrodes.



Battery Electrodes

A new baked-in-salt approach to let Se infiltrate into porous carbon is proposed, without the need for a protective argon or vacuum environment. The use of NaCl, which has a higher specific heat capacity than Se, assures an almost constant fabrication temperature, by reducing temperature fluctuations in the system. The Se/C sample exhibits excellent electrochemical performance both in Li–Se and Na–Se batteries. Furthermore, this approach should also be effective for confining other low melting point materials into porous carbon.



Batteries