ADVANCED FUNCTIONAL MATERIALS

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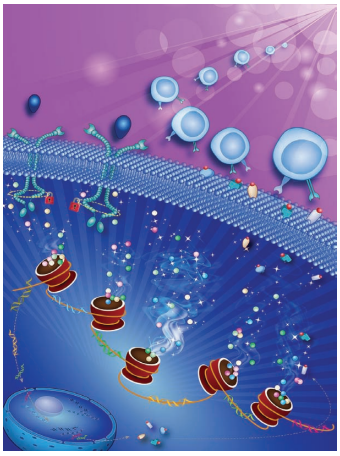
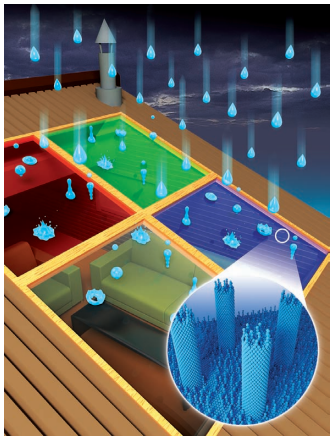


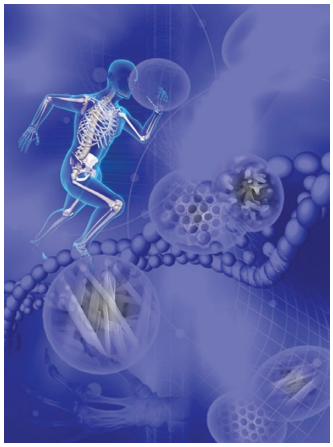
Drug Delivery

Supramolecular cationic polymers, developed by Y. Ping, G. Tang, and co-workers on page 5482, are designed for the sequential delivery of immunotherapeutic agents and molecular targeted drugs to fight lung cancer. This new therapeutic modality combines the advantages of superantigens to activate antitumor immunity and the specificity feature of tyrosine kinase inhibitors to selectively induce tumor cell apoptosis, and reveals a synergistic effect on tumor inhibition over mouse models with lung carcinoma xenografts. The supramolecular cationic polymers can potentially be used for treating a wide spectrum of cancers.

Hydrophobic Surfaces

On page 5550, H. Yoon, K. Char, and colleagues demonstrate a superhydrophobic surface with various optical functions. The trilevel mesoporous structures fabricated by soft imprinting method show outstanding water repelling properties with high transparency in visible. In addition, various optical functions such as photochromism are realized by incorporating different dyes inside the mesoporous structure.





Nanomaterials

Functionalized biomaterials are playing important roles in healthcare research as well as disease diagnosis and therapy. Recent advances in the biomedical application of functionalized TiO_2-based nanomaterials in the areas of bone reconstruction, intravascular stents, drug delivery systems, and biosensors are reviewed by S. L. Wu, P. K. Chu, and team on page 5464.

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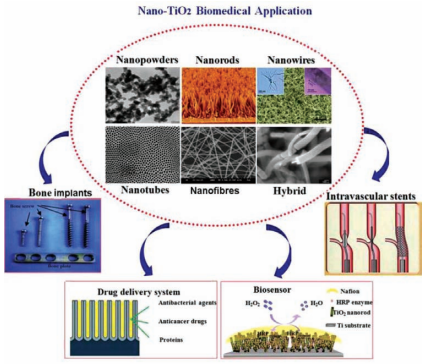
FEATURE ARTICLE

Biomedical Applications

Functionalized TiO_2 Based Nanomaterials for Biomedical Applications

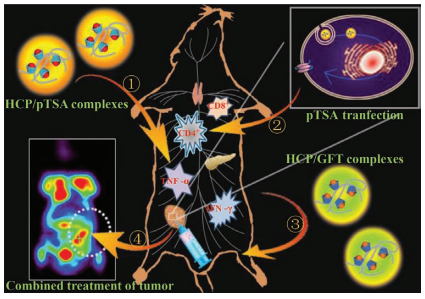


TiO_2 based nanomaterials with various structures have been widely used for a variety of biomedical applications ranging from tissue engineering to diseases diagnosis systems. Here, recent advances pertaining to nanostructured TiO_2 in four important areas are reviewed, namely bone scaffolds, intravascular stents, drug delivery systems, and biosensors.

FULL PAPERS

Drug Delivery

Synergistic Enhancement of Lung Cancer Therapy Through Nanocarrier-Mediated Sequential Delivery of Superantigen and Tyrosin Kinase Inhibitor

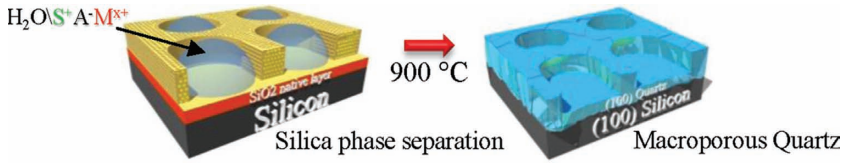


Sequential delivery of superantigen and tyrosin kinase inhibitor by nanocarriers is proven to synergistically promote lung cancer therapy. The new therapeutic modality combines the advantages of superantigens to activate antitumor immunity with the specificity feature of tyrosine kinase inhibitors to selectively induce tumor cell apoptosis. This proof-of-concept study defines a unique strategy of effective lung cancer therapy for future clinical translation.

Quartz Films

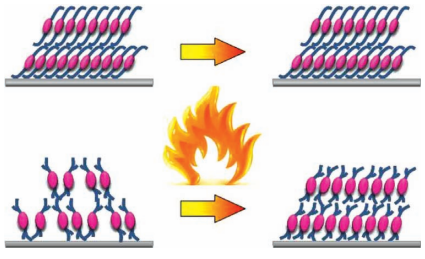
Water-Induced Phase Separation Forming Macrostructured Epitaxial Quartz Films on Silicon

Macroporous piezoelectric epitaxial quartz films on (100)-silicon are directly obtained from amorphous silica films deposited through dip-coating and doped with metal cations to catalyze quartz crystallization. This process involves a novel silica phase separation, allowing the structuring of quartz. The piezoelectric functionality of films is preserved within the macroporosity, providing large scope for nanosized quartz piezoelectrics.



Organic Electronics

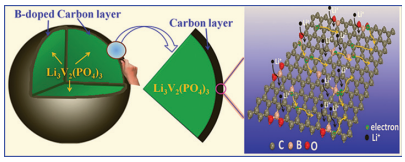
Enhancing the Charge Transport in Solution-Processed Perylene Di-imide Transistors via Thermal Annealing of Metastable Disordered Films



Substituting a dicyanoperylene molecule with asymmetric branched alkyl chains is revealed to be an effective strategy for obtaining, upon thermal annealing, field-effect transistors with enhanced transport properties with respect to linear alkyl chains.

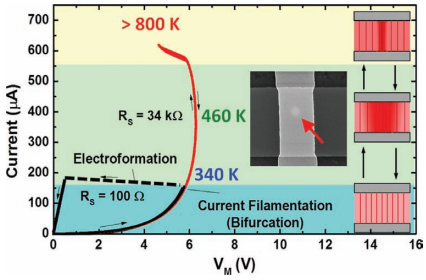
FULL PAPERS

An evolutionary modification approach, B-doped carbon coating, is initially used to improve the electrochemical performance of $Li_3V_2(PO_4)_3$ cathode material and exhibits its obvious and significant modification effects. Furthermore, the immediate causes and powerful evidences for this modification effect are given, analyzed, and verified in detail.



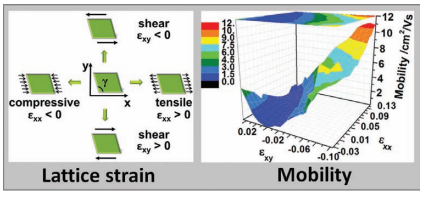
Boron Doping

Oxide-based resistive switching devices exhibit a characteristic electronic bistability and negative differential resistance leading to a reversible constriction of the current flow to a narrow filament prior to the permanent "forming" event. Using a high-speed self-consistent thermometry, the local temperature and radius are tracked as the current conduction reversibly collapses from uniform regime to a sub-10 nm electronic filament.



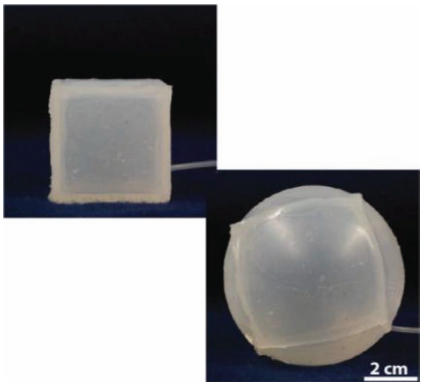
Resistive Memory

Motivated by recent solution-shearing experiments, a multiscale theoretical approach is employed to investigate charge-transport properties of 6,13-bis (triisopropylsilylethynyl) pentacene under various lattice strains, enabling a deep understanding of the lattice strain–molecular packing–charge carrier mobility relationship. The elucidated structure–property relationship is a prerequisite to efficient and targeted control of charge transport in organic semiconductors.



Charge Transport

3D structures fabricated from elastomeric tiles change shape when inflated or deflated. The pneumatic expansion or contraction of these structures is "programmed" by selecting tiles with different mechanical properties. Connecting these structures together provides a method to explore soft machines with 3D architectures. Structures including electrically conductive tiles increase the designs and functions possible in soft machines.



Soft Robots

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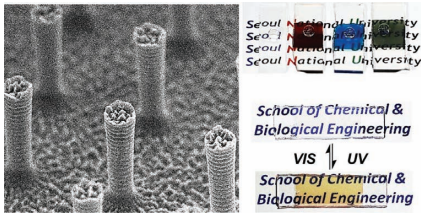
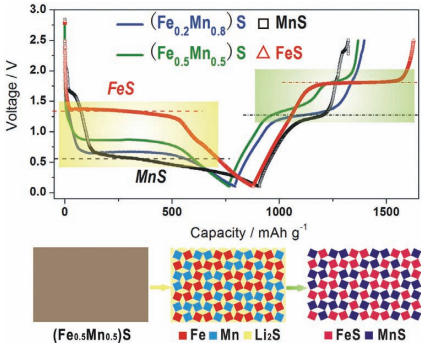
Hydrophobic Surfaces



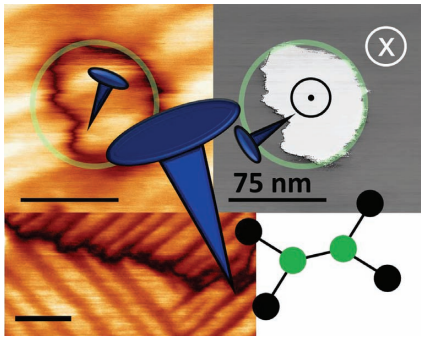
A highly transparent multilevel structure consisting of sub-100 nm nanoparticles with excellent water repellency is developed using a soft molding technique. Suppressing Mie scattering, high transparency is achieved in the structure with a low density of micro-features. Moreover, a thin silica film and photoresponsive dyes attached to TiO_2 nanoparticles are further introduced to realize multifunctional surfaces with high stability against UV light.

Batteries

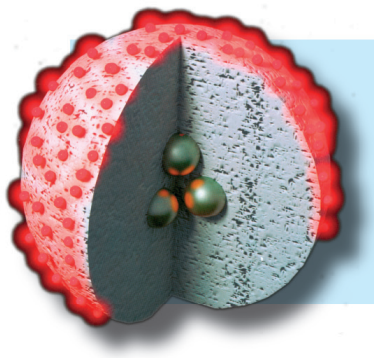


A series of $Fe_xMn_{1-x}S$ (x = 0.2, 0.5, 0.8) monosulphide compounds is synthesized using a simple solid state reaction method. The lithium storage voltage can be tuned by the content of Fe in $Fe_xMn_{1-x}S$, while the electrochemical performance of electrodes based on $Fe_xMn_{1-x}S$ is greatly enhanced in comparison with that of MnS. The lithium storage mechanism of $Fe_{0.5}Mn_{0.5}S$ is investigated in detail.

Nano-Multiferroics



The structure, energy and topology of ferroelectric domains pinning as a result of extended structural defect are studied. Enhanced piezoresponse force microscopy is used to study the statics and dynamics of pinned domains. The pinning is analyzed in terms of Bornarel's theory, and Srolovitz and Scott's model, while a quantitative method to evaluate the energy of a pinned or distorted domain using the Landauer framework is presented.



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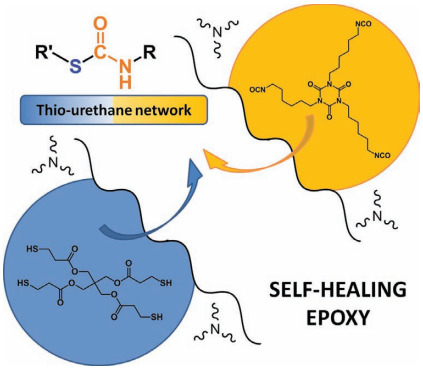
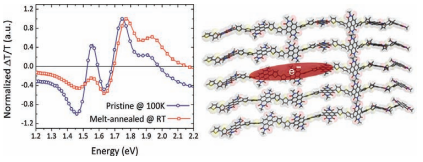
Thiol-isocyanate chemistry is applied for the development of extrinsic self-healing epoxy materials. The self-healing ability is obtained by embedding both thiol- and isocyanate-containing microcapsules into an epoxy thermoset. Tertiary amines present in the epoxy matrix are shown to catalyze the formation of the healed network. The stringent demands of industry concerning toxicity, thermal stability, and costs are approached.



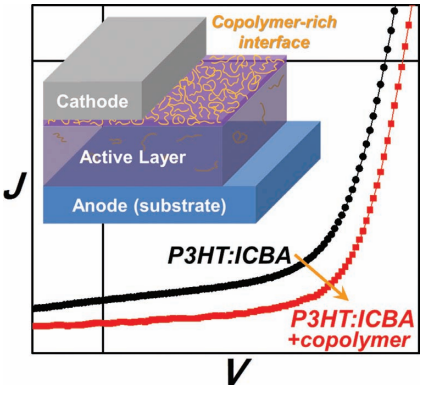
Self Healing

The degree of localization of polaronic charge carriers in a high mobility naphthalenediimide based semiconducting copolymer is revealed. By combining charge modulation spectroscopy and current–voltage characterization of field-effect transistors with density functional theory calculations, it is demonstrated that the charge transport process involves only intramolecular polaronic species. This finding evidences that intermolecular hopping favored by strong electronic coupling is sufficient to sustain a charge carrier mobility in the 0.1 to 1 $cm^2 V^{-1}s^{-1}$ range in a semiconducting polymer film.



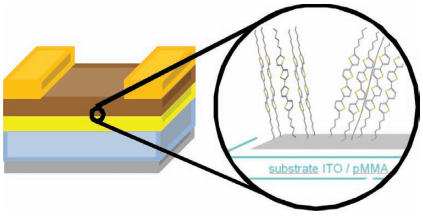
Polymer Semiconductors

Power conversion efficiencies are enhanced by up to 20% when an all-conjugated copolymer is incorporated into the P3HT:ICBA bulk heterojunction solar cells. The copolymer additive influences the internal active layer morphology as well as the interfacial composition, both of which can be correlated to a reduction of non-geminate carrier recombination.



Copolymers

An amorphous conjugated thin film, even though ideally flat, is not always an inert substrate for the growth of highly ordered molecular domains. Indeed it can induce an increase in the amount of non-ordered domains in the upper layer. This effect needs to be carefully taken into account when designing multilayered devices based on a transistor architecture for high-performance applications.



Organic–Organic Interfaces