ADVANCED FUNCTIONAL MATERIALS

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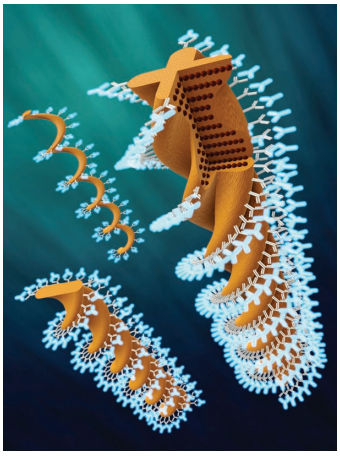
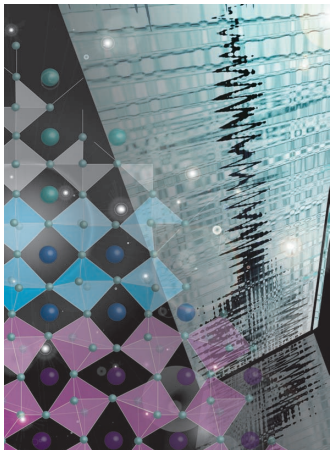


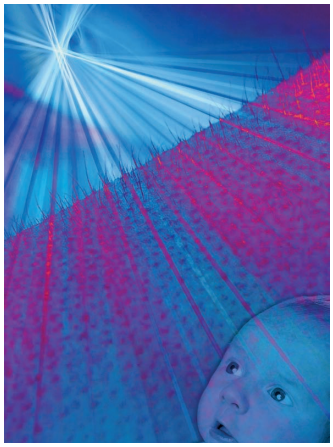
Paramagnetism

Directed nanoparticle self-organization and two-photon polymerization are combined to enable three-dimensional soft-magnetic actuators with complex shapes and shape-independent magnetic properties as demonstrated by the twist-type microactuators. As discussed by C. Peters and co-workers on page 5269, generic and facile combination of glycine grafting and subsequent protein immobilization exploits the actuator's increased surface area, providing for a swimming microrobotic platform with enhanced load capacity desirable for future biomedical applications.

Thin Films

On page 5177, D. Kan, H. Kurata, and co-workers discuss high-resolution ABF-STEM observations which reveal that picometer-order displacements of the oxygen atoms at the heterointerfaces between transition-metal oxides have a close correlation with structural distortions in the thin film heterostructures. The oxygen displacement can also be modified by inserting a unit-cell thick oxide layer, demonstrating that the manipulation of the oxygen displacement at the interface is a good way to control the structural distortions that determine functional properties of oxide thin films.



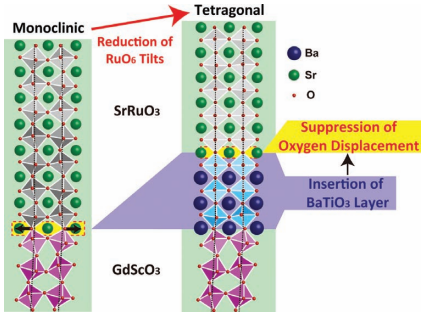


Hydrogels

Photochromic transparent membranes with reversible color switching and pronounced permeability change are demonstrated by K. Schöller, L. Scherer, and co-workers on page 5194. Light-responsive spiropyran and spirooxazine derivatives are introduced to amphiphilic polymer co-networks to achieve the stimuli-responsive behavior of the delivery membrane and a similar heterophase structure and permeability like natural skin (shown in the picture). These properties are requested when applied as a "smart" light-responsive membrane in a transdermal caffeine-delivery system for pre-term neonates.

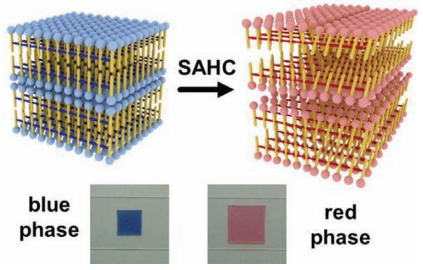
FULL PAPERS

Thin Films



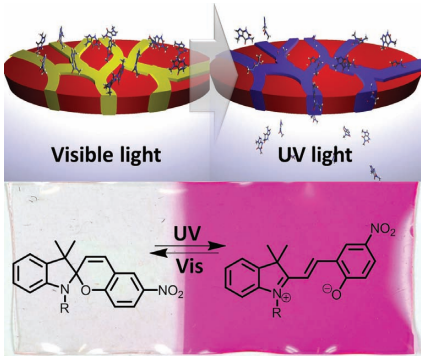
The manipulation of the displacement of the apical oxygen atom at the heterointerface is demonstrated as a tool to control the structural distortions that determine functional properties of transition-metal oxide thin films. High-resolution ABF-STEM imaging reveals that the interfacial octahedral connection angle is characterized by the picometer-order displacement of apical the oxygen atom. The findings provide a further degree of freedom for designing novel oxide-based heterostructures.

Colorimetry



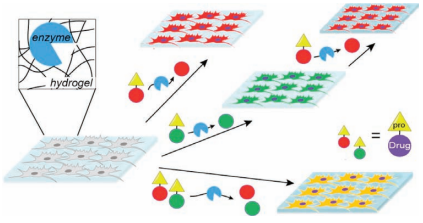
By taking advantage of a mechanochromic conjugated polydiacetylene (PDA) and the hydrocarbon-induced swelling properties of polydimethylsiloxane (PDMS), a sensor film that enables colorimetric differentiation among saturated aliphatic hydrocarbons (SAHCs) is developed. The unprecedented PDA–PDMS composite sensor undergoes a blue-to-red colorimetric transition that is dependent on the chain length of the hydrocarbon target.

Hydrogels



Photochromic membranes with reversible color switching and pronounced permeability change are created by incorporating spiropyran and spirooxazine derivatives into amphiphilic polymer co-networks. Truly tunable and responsive characteristics and the heterophase structure of the membranes are demonstrated to match the permeability properties of a given skin.

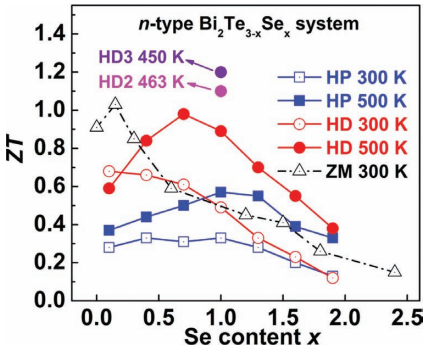
Drug Delivery



Hydrogel biomaterials are equipped with the tools of biocatalysis to achieve in situ synthesis of drugs—locally, at the time point desired, and a dose to suit a particular application. It is demonstrated that biocatalytic hydrogels synthesize multiple, dissimilar therapeutic molecules: individually, sequentially, or in combination.

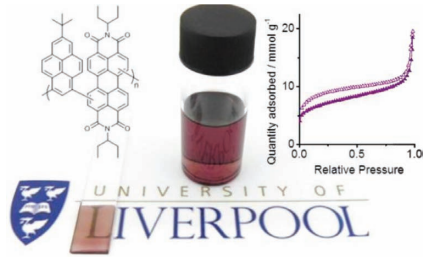
FULL PAPERS

Atomic scale point defect engineering is introduced as a new strategy to optimize the electrical properties and lattice thermal conductivity of thermoelectric materials simultaneously. $(Bi,Sb)_2(Te,Se)_3$ thermoelectric materials are selected as a paradigm to demonstrate the applicability of this new approach. The present results strongly demonstrate the efficacy of this strategy and provide a new route for improving thermoelectric properties.



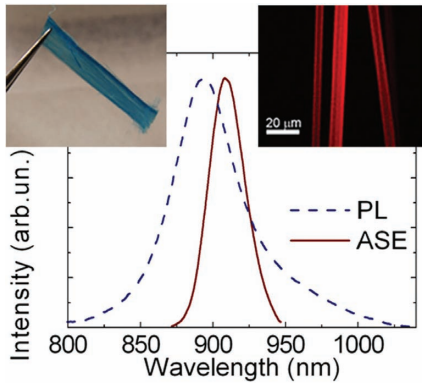
Thermoelectrics

A range of linear conjugated polymers of intrinsic microporosity (C-PIMs) is reported, combining for the first time the properties of conjugated microporous polymers (tunable electronic properties, compositional variation) and linear polymers of intrinsic microporosity (PIMs; solution processability and film formation). These soluble materials have a number of potential applications, for example as components in devices where large, porous interfaces are combined with extended electronic conjugation.



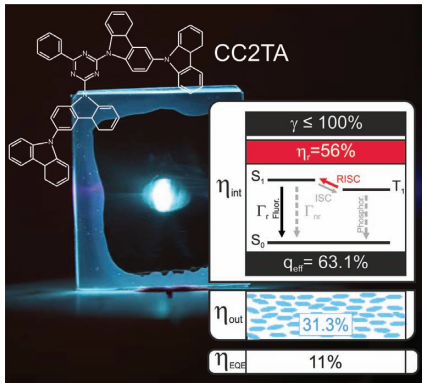
Porous Materials

Optical gain in the near infrared spectral range is demonstrated in electrospun fibers. The fibers can be aligned in free-standing arrays and show amplified spontaneous emission as well as self-waveguiding properties. The infrared optical gain opens the way for the embedding of electrospun materials in fiber amplifiers and nanolasers.



Optical Gain

The thermally activated delayed fluorescence (TADF) emitter CC2TA shows a high degree of horizontal orientation. Using excited states lifetime measurements of the prompt fluorescence, its radiative quantum efficiency can be determined. This is the basis for a comprehensive analysis of the efficiency boost of organic light-emitting diodes beyond the classical limit due to emitter orientation and TADF.



Organic Electronics

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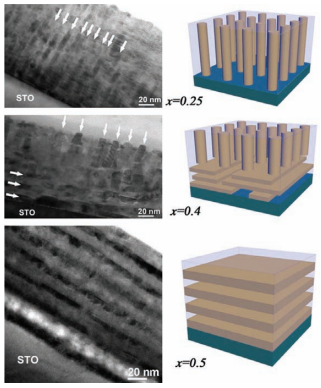
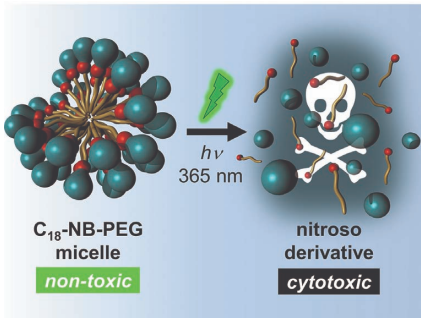
Nanocomposites



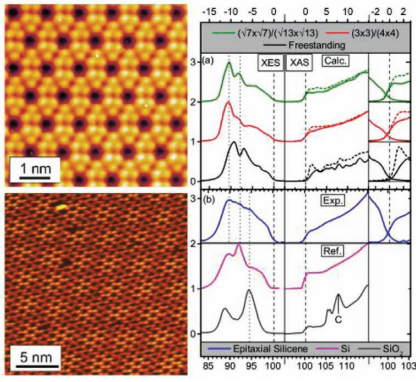
The precise tuning of inorganic nanocomposite thin films is realized using $(YBa_2Cu_3O_{7-\delta})_{1-x}$:$(BaZrO_3)_x$ as a model system. A nanostructure switch from a vertical columnar structure to a horizontal multilayered structure is found with a transition, cross-ply structure at $x = 0.4$. Energetic considerations are used to explain the observed structures.

Biomedical Applications

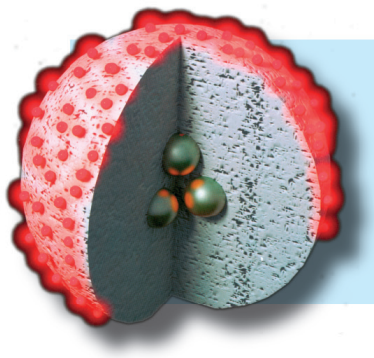


The development of a photo-responsive micellar system capable of triggering cell death is reported. Illumination of the photo-responsive micelles produces a cytotoxic species that is utilized in the on-demand inhibition of cellular proliferation.

Epitaxy



The electronic structure of epitaxial silicene monolayers on Ag(111) is explored through the complementary techniques of density functional theory (DFT) calculations and synchrotron-based soft X-ray spectroscopy experiments. Interaction with the underlying Ag substrate is found to confer a metallic nature upon the silicene monolayers, ruling them out as possible Dirac cone hosts.



How to contact us:

Editorial Office:
Phone: (+49) 6201-606-286/531
Fax: (+49) 6201-606-500
Email: afm@wiley-vch.de

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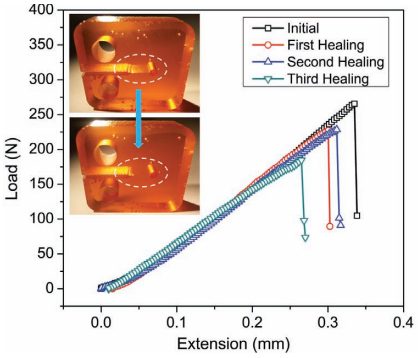
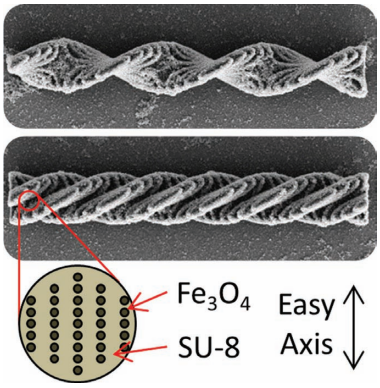
Thermo-responsive self-healing polyurethanes that can be healed repeatedly without the application of external forces are developed. Instead, these polymers use the shape-memory effect to autonomously bring the two crack surfaces together during the healing process.



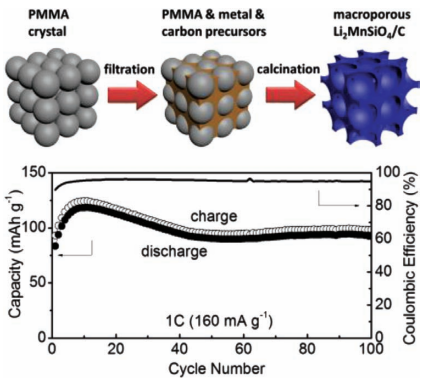
Self Healing

Directed nanoparticle self-organization and two-photon polymerization are combined to enable three-dimensional soft-magnetic actuators with complex shapes and shape-independent magnetic properties as demonstrated by the twist-type microactuators. A generic and facile combination of glycine grafting and subsequent protein immobilization exploits the actuator's increased surface area, providing for a swimming microrobotic platform with enhanced load capacity, desirable for future biomedical applications.



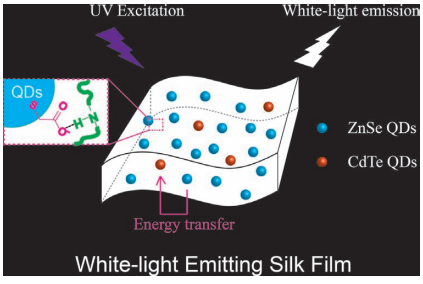
Superparamagnetic Actuators

Li_2MnSiO_4/C nanocomposite with a bimodal macro-/mesoporous structure is prepared as a potential cathode material for Li-ion batteries. The cells show high reversible capacities at a practical current rate of 1 C at 45 °C, implying that the stability of Li_2MnSiO_4 cathodes can be greatly improved via appropriate optimization.



Batteries

White-light-emitting silk protein/quantum dot hybrid films are successfully prepared by controlling the molar ratio of blue luminescent ZnSe and yellow luminescent CdTe quantum dots via an assembly method based on hydrogen bonding. The silk films with uniform quantum dot dispersion show unique advantages, and are a promising candidate for application in optical devices.



Hybrid Materials

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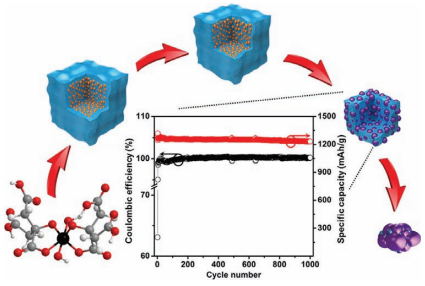
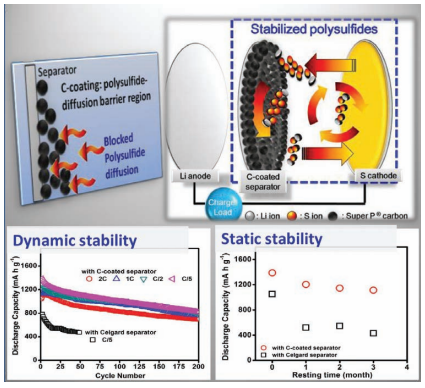


A novel, facile synthetic route to produce nanometer-sized Ge interconnected by carbon is proposed. Amorphous GeO_2/C composite is synthesized by the decomposition of a germanium-citrate complex at relatively low temperature, followed by calcination in an inert atmosphere. Low-temperature reaction prevents the aggregation of Ge observed at high temperatures. Electrodes based on nanometer-sized Ge interconnected by a carbon layer show excellent electrochemical performances and great potential as anode materials for lithium ion batteries.

Lithium-Sulfur Batteries



A bifunctional separator with a light-weight carbon-coating offers excellent dynamic electrochemical stability with Li-S cells: a high initial discharge capacity of 1389 mA h g^{-1} and long cycle life. The static electrochemical stability is further evidenced by low self-discharge and excellent capacity retention after a 3 month rest period.