ADVANCED FUNCTIONAL MATERIALS

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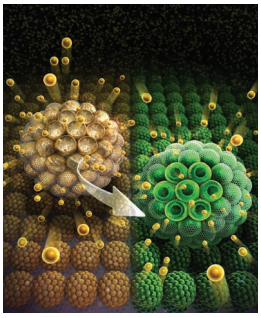
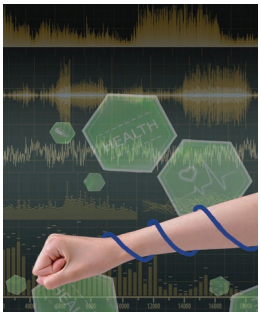


Rechargeable Batteries

The front cover of this issue depicts three dimensional (3D) MoS_2-graphene composite microspheres consisting of multiple nanospheres for sodium insertion and desertion processes. On page 1780 the 3D MoS_2-graphene composite microspheres presented by J.-K. Lee, Y. C. Kang, and co-workers show high reversible capacity and long cycle stability as anode materials for sodium ion batteries.

Energy Storage

Constructing a self-buffered nanostructure is demonstrated to be a facile and effective strategy to enhance lithium battery performance. On page 1773 L. Mai and team construct a novel polygonal nanoscroll (PNS) structure via the self-rolling, Ostwald ripening and scroll-by-scroll mechanism. This novel PNS structure offers the robust outer wall and expandable inner space to buffer the swelling stress during Li+ ion intercalation/extraction, which effectively improves the cycling stability.

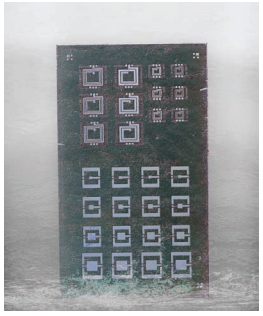


Sensors

On page 1798, J. Zhou and colleagues present two kinds of pretreated cotton threads that are entangled to form an double helixes-structure generator. The generator is then coiled around a silicone fiber to form an active fiber-based strain sensor which shows sensitive and stable performance and has the ability to detect human body motions. This indicates potential applications in future self-powered healthy monitor systems by detecting the mechanical deformation of the human body and surrounding environment.

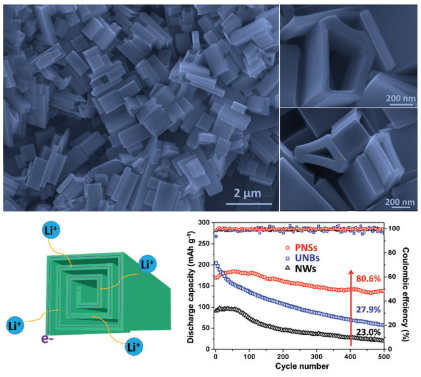
Transient Eletronics

The back cover image shows an array of transient electronic devices on a thin molybdenum foil, designed to dissolve completely in aqueous solutions in a controlled manner. The results presented by J. A. Rogers and co-workers on page 1789 suggest that biodegradable metal foils can provide robust and practical substrates for new applications such as those in temporary implants for biomedical diagnosis and treatment, eco-friendly electronics, and hardware-secure systems.



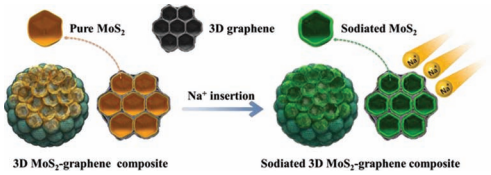
FULL PAPERS

Polygonal inorganic nanoscrolls are successfully synthesized for the first time via a self-rolling, Ostwald ripening, and scroll-by-scroll process in aqueous solution. This kind of novel polygonal nanoscroll structure represents an interesting model with robust outwall and expandable inner space which buffers the swelling stress during cycling, resulting in the largely enhanced cycling stability. This novel structure is interesting and has great potential in other applications.



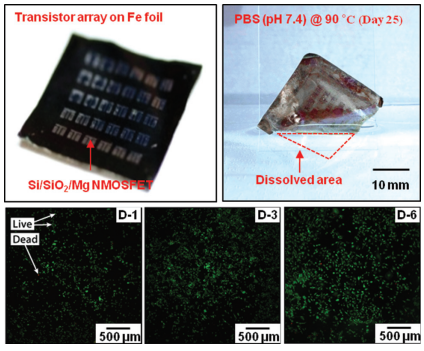
Energy Storage

3D MoS_2–graphene composite microspheres consisting of multiple nanospheres are prepared by a one-pot spray pyrolysis process with high scale-up potential. The 3D MoS_2–graphene composite microspheres show high reversible capacity and long cycle stability as anode materials for sodium-ion batteries. The facile and continuous synthesis of 3D graphene-based composite microspheres could be applied to the potential materials for various fields including energy storage.



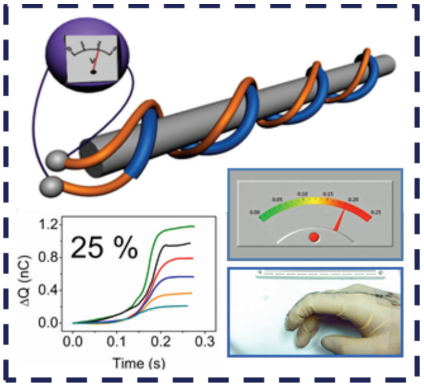
Rechargeable Batteries

Materials, fabrication strategies, dissolution kinetics, and biocompatibility studies of transient electronics systems built on thin metal foils passivated by layers of spin-on glass (SOG) are presented. Transient electronic components exhibit comparable performances to conventional, nontransient substrates. Dissolution kinetics of the materials cured at different temperatures reveal key aspects of their corrosion chemistry, and in vitro cell cultures demonstrate their biocompatibility.



Transient Electronics

A fiber-based electret generator is coiled around a stretchable silicone fiber to form an active fiber-based strain sensor (AFSS). The AFSS shows the sensitive and stable performance and has the ability to detect the strain up to 25%, which is also demonstrated to detect finger motion states. It may play an essential role in future self-powered sensor system.



Sensors

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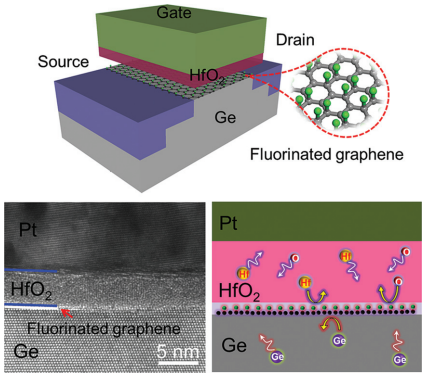
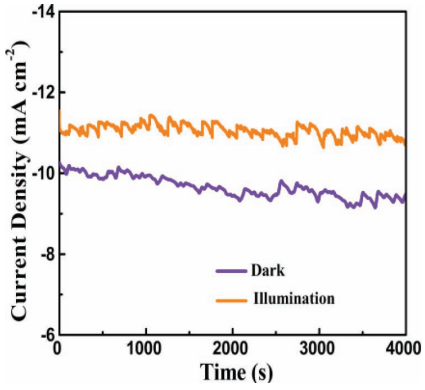
Fluorinated Graphene



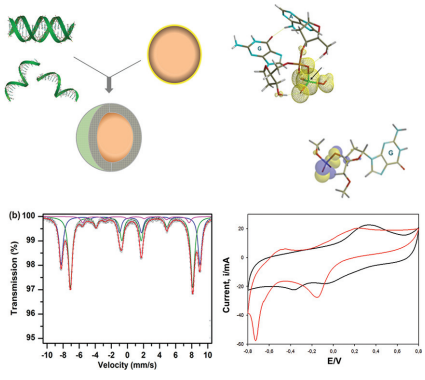
A barrier layer of fluorinated graphene is applied to suppress the interdiffusion and unstable interfacial oxide in HfO_2/Ge-based metal-oxide-semiconductor devices. The device exhibits negligible *C–V* hysteresis, extremely low leakage, and superior equivalent oxide thickness. The concept is expected to expedite the implementation of germanium as a channel material in next-generation nanoelectronic devices.

Hydrogen

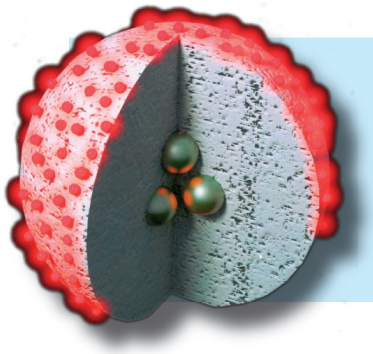


The cathodic current of a $MoSe_2$–rGO/PI composite film hardly decreases at –0.6 V compared to SCE by current density versus time curves, both illuminated and dark, illustrating how it possesses high stability and sufficient cathodic current density. These properties show its potential as a better catalyst for hydrogen evolution reaction, and even solar-driven hydrogen evolution.

DNA Conductivity



DNA based self-assembled nanoconjugates and a macroscopic metamaterial are synthetized, using naked maghemite nanoparticles as electroactive supports. DNA nanoconjugates show reversible electrochemical behavior and better electrochemical performances with respect to bare nanoparticles. The intimate contact between DNA and nanoparticles is studied and electron transfer at the interface between nanoparticles and DNA is unequivocally demonstrated by Mössbauer spectroscopy and modeled by density functional theory.



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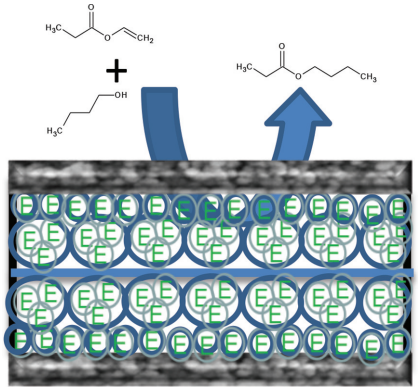
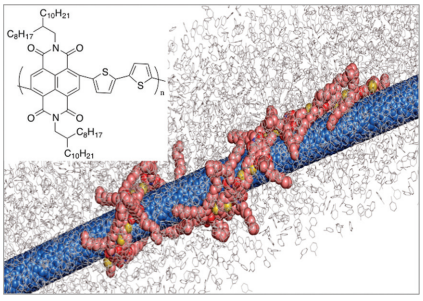
Zeolite-coated highly porous arrays with gradient porosity are used as filter-panels for enzyme encapsulation using a novel approach. By this method the encapsulated enzyme molecules are freely mobile like in their native form within the gradient pores of stainless steel discs, while the zeolite layer on top of the discs acts as a protective layer against enzyme leaching.



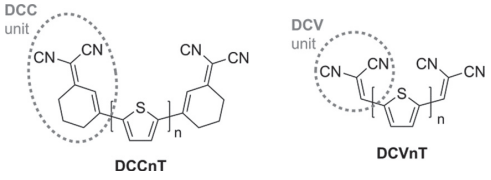
Bionanotechnology

Selective dispersion of semiconducting carbon nanotubes by an n-type conjugated polymer is demonstrated. Molecular dynamics stimulations reveal various polymer wrapping geometries for different types of nanotubes. These polymer-wrapped semiconducting carbon nanotubes exhibit ambipolar transport, which is utilized for fabrication of flexible complementary metal-oxide-semiconductor-like logic circuits without the need of n-doping.



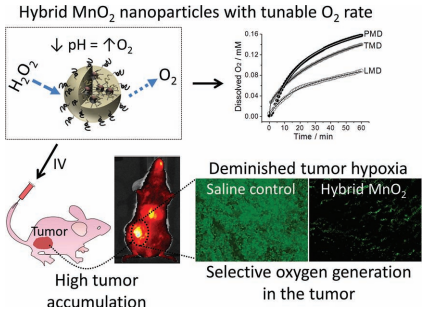
Flexible Circuits

A new series of acceptor-substituted oligothiophenes (DCC*n*T) is investigated. Structural, thermal, optoelectronic, and photovoltaic properties are contrasted to dicyanovinylene-capped oligothiophenes (DCV*n*T). Melting temperatures and solubilities are significantly enhanced for the DCC*n*Ts versus DCV*n*Ts. Oligomers with equal numbers of double bonds, show very similar absorption profiles. In vacuum-processed planar heterojunction solar cells, DCC-terthiophenes DCC3T and DCC3T-Me show superior photovoltaic parameters compared to conjugated corresponding DCV-quaterthiophenes.



Photovoltaics

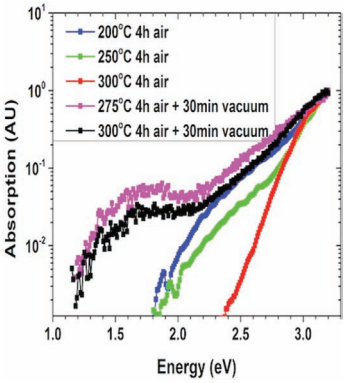
Terpolymer/protein and polymer/lipid matrices are used to design hybrid MnO_2 nanoparticles with tailored hydrophobicity and structure for programmable oxygen generation in a solid tumor. They feature prolonged circulation in the blood, superior tumor accumulation, and higher reactivity with H_2O_2 in the acidic tumor microenvironment for the production of O_2 and modulation of tumor hypoxia through both local and systemic administration.



Hybrid Nanoparticles

FULL PAPERS

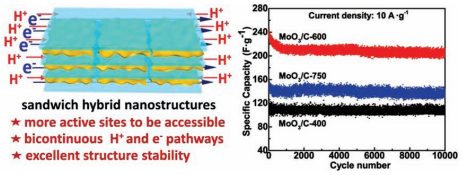
Semiconductors



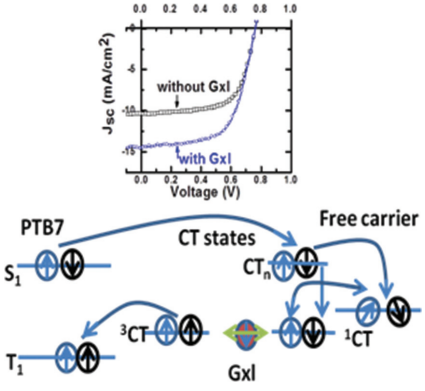
The electronic structure of low-temperature, solution-processed indium–zinc–oxide thin-film transistors is probed, using X-ray photoelectron spectroscopy, ultraviolet photoemission spectroscopy, and photothermal deflection spectroscopy. A compensation of a significant density of acceptor states below the conduction band by shallow hydrogen and oxygen vacancy-induced donor levels is identified as the key factor for achieving high device performance at low temperature.

Hybrid Materials

A sandwich MoO_3/C hybrid nanostructure assembled by α-MoO_3 and graphene layers at a molecular level provides more accessible active sites and bicontinuous pathways for quick transfer of charges inside the interlayers, as well as an excellent structure stability in the charge/discharge process. The electrode material has a high rate discharge capability accompanying with a long cycle life.



Organic Photovoltaics



Charge transfer process in an organic photovoltaic (OPV) cell is studied in thin films and devices of a low bandgap polymer. Major loss in copolymer-based OPV devices is the formation of triplet excitons in the polymer donor from ^{3}CT at the donor–acceptor interfaces. A method is presented to circumvent this process by incorporating spin ½ additives.