ADVANCED FUNCTIONAL MATERIALS

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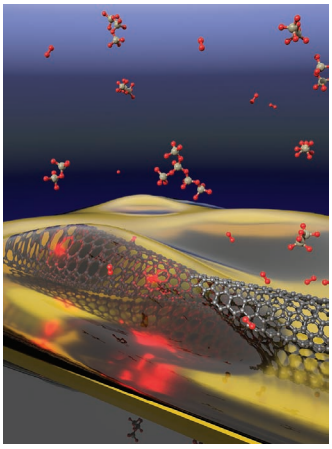
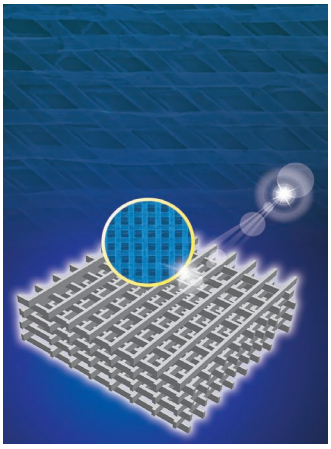


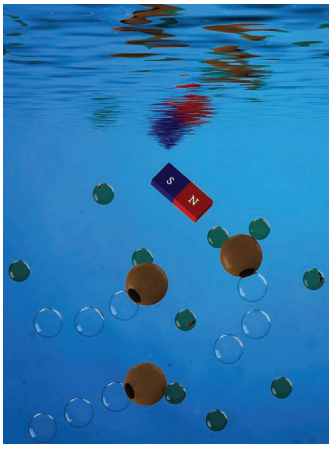
Carbon Nanotubes

On page 6157, S. K. Doorn, H. Htoon, and co-workers report a novel procedure for the fabrication of photostable oxygen-doped single-walled carbon nanotubes (SWCNTs) in a SiO_2 matrix. The SWCNTs are effectively doped by oxygen radicals produced during the e-beam deposition of a SiO_2 thin film, which introduces new emitting states at the dopant sites. The SiO_2 layer enhances the photoluminescence stability by protecting dopant states, making the integration of doped nanotubes into electronic and photonic devices more feasible.

Controllable Fabrication

A chemical vapor deposition approach for 3D controllable fabrication of macroscopically interconnected and conductive graphene networks with controllable patterns, pore and skeleton sizes and orientation angle, is reported by G. Cheng and co-workers on page 6165, using a metallic template of lithographically fabricated Ni scaffold. The obtained graphene networks display higher electrical conductivity, remarkably mechanical stability in stretching and bending tests, and excellent performance as a freestanding supercapacitor electrode.



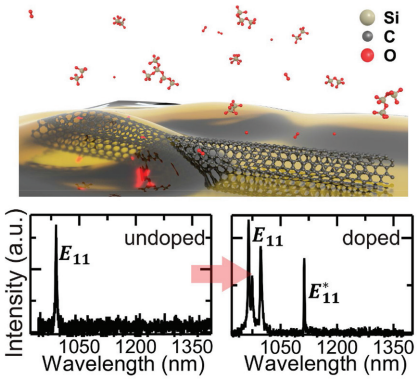


Micromotors

J. G. Guan and co-workers demonstrate, on page 6173, a magnetically-controlled pot-like $MnFe_2O_4$ micromotor with a simple single-layered structure, fabricated via a facile and versatile growing bubble-templated nanoparticle assembly approach. Due to their excellent magnetic properties, velocity and direction of motion is controllable via modulation of an external magnetic field. The high catalytic activity for O_2 bubble production and surface-hydrophobicity suggest direct applications in environmental oil removal.

FULL PAPERS

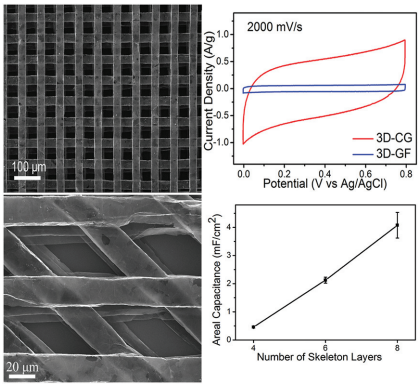
A novel procedure for effective fabrication of photostable oxygen-doped single-walled carbon nanotubes (SWCNTs) in solid-state matrices by electron beam evaporation has been developed. The thin film doping efficiency can be effectively controlled by the deposition time and types of surfactants wrapping the SWCNTs. Oxygen-doped tubes prepared by this procedure exhibit significantly higher photostability than those prepared via ozonolysis in aqueous phase.



Carbon Nanotubes

Solid-State Approach for Fabrication of Photostable, Oxygen-Doped Carbon Nanotubes

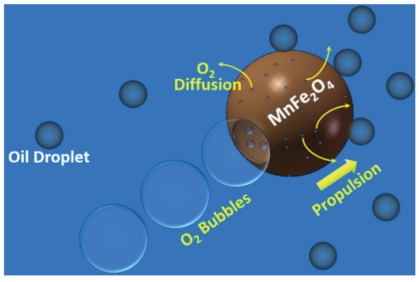
An approach for the fabrication of macroscopically interconnected graphene networks with controllable patterns, pore and skeleton sizes, via chemical vapor deposition based on lithographically fabricated Ni templates, is reported. Because of the well-defined nature of photolithography, the obtained three dimensional interconnected graphene has great structure and geometry controllability with outstanding performances for flexible conductor and supercapacitor electrode.



Controllable Fabrication

Interconnected Graphene Networks with Uniform Geometry for Flexible Conductors

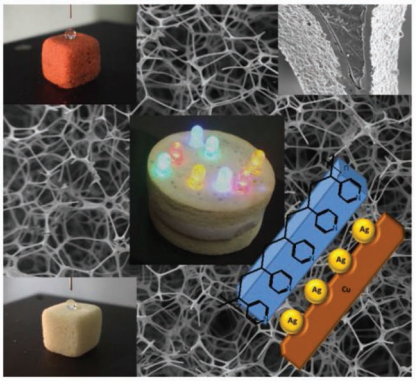
Pot-like $MnFe_2O_4$ micromotors are fabricated by a simple growing-bubble-templated nanoparticle assembly approach. These micromotors can be directly used for environmental oil remediation without any further surface modification besides the magnetically modulated self-propulsion in aqueous media.



Micromotors

Magnetically Modulated Pot-Like $MnFe_2O_4$ Micromotors: Nanoparticle Assembly Fabrication and their Capability for Direct Oil Removal

Electrically heatable metallized 3D polymer sponges of macroscopic dimensions with exceptional conductivity (240 S cm^{-1}), thermally insulating, and superhydrophobic properties are shown. The multipurpose sponges are prepared by in-depth homogeneous wet metallization of melamine-formaldehyde sponges.

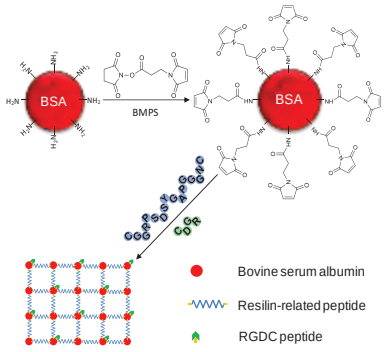


Polymer Sponges

Large Multipurpose Exceptionally Conductive Polymer Sponges Obtained by Efficient Wet-Chemical Metallization

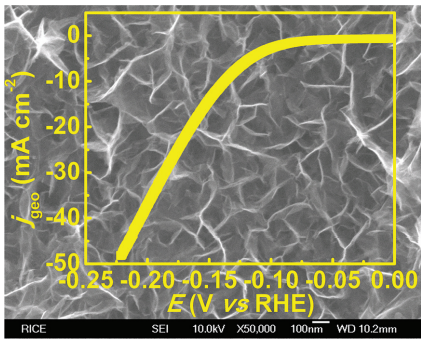
FULL PAPERS

Tissue Engineering



A universal and facile approach for the formation of a protein hydrogel is presented. The concept is to introduce maleimide, which is highly reactive with dithiol-containing crosslinkers, onto proteins. Bovine serum albumin is used as a model protein and a resilin-related peptide is used as the crosslinker. The fabricated hydrogel shows good biocompatibility and can promote cell spreading and growth by incorporating an RGD ligand.

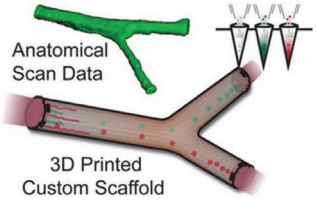
Nanosheets

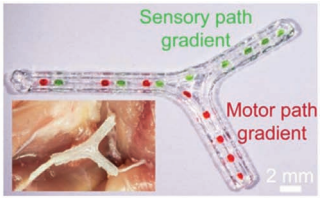


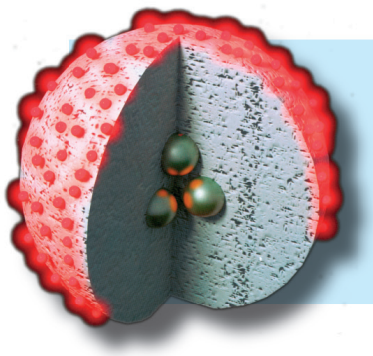
Vertically aligned WS_2 nanosheet films are fabricated in a simple process. The well-exposed WS_2 edges and interconnected porous structure give these materials excellent hydrogen evolution reaction activity and long-term durability. The proposed fabrication technique also indicates that nanoengineering can be used to tailor the catalytic activity of layered transition-metal dichalcogenides, which will open a new direction in designing efficient catalysts.

Tissue Engineering

An imaging-coupled 3D printing methodology for the design, optimization, and fabrication of a customized nerve repair technology for complex injuries is presented. The custom scaffolds are deterministically fabricated via microextrusion printing, which enables the simultaneous incorporation of anatomical geometries, biomimetic physical cues, and spatially-controlled biochemical gradients in a one-pot 3D manufacturing approach.







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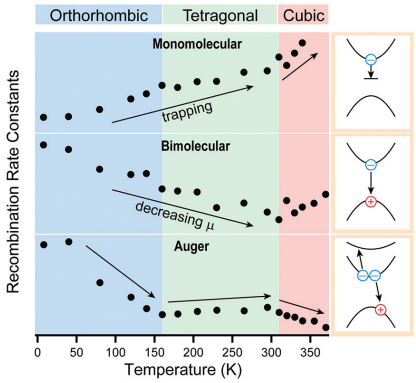
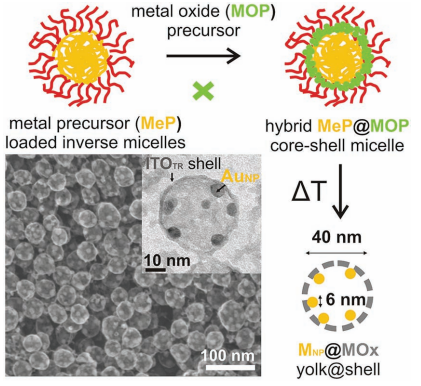
FULL PAPERS

The photoconductivity in $CH_3NH_3PbI_3$ thin films is investigated from 8 to 370 K across three structural phases. Analysis of the charge-carrier recombination dynamics reveals a variety of starkly differing recombination mechanisms. Evidence of charge-carrier localization is observed only at low temperature. High charge mobility and diffusion length are maintained at high temperature beyond the tetragonal-to-cubic phase transition at ≈310 K.



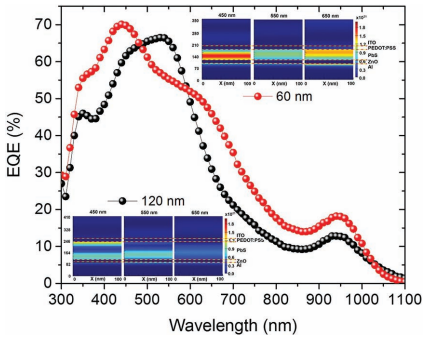
Excitons

A facile strategy for the one-pot synthesis of metal@metal oxide yolk@shell nanomaterials (M@MOx) is presented. As exemplified for gold nanoparticle@tin-rich ITO yolk@shell nanostructures ($Au@ITO_{TR}$), our approach takes advantage of gold precursor loaded inverse micelles as two compartment nanoreactor templates. Simple calcination of the precursor micelles yields highly defined $Au@ITO_{TR}$ nanostuctures in line with the micellar size and compositon featuring high activity and stability for electrocatalytic CO oxidation.



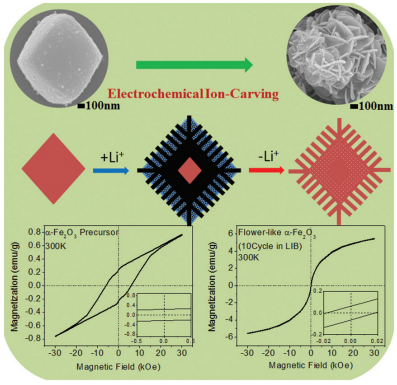
Inverse Micelles

Rear-junction colloidal quantum dot (CQD) photovoltaic devices with an improved performance are developed using single-step coated thin CQD active layers (thickness of ≈60 nm). Charge generation and extraction in CQD photovoltaic devices are simultaneously improved through optical management of thin CQD active layers. Sufficient optical generation and efficient charge extraction afford a power conversion efficiency of ≈6%.



Photovoltaic Devices

Electrochemical ion-carving is demonstrated as a nanomachining approach for the top-down creation of highly-ordered nanostructures from microparticle precursors, using Fe_2O_3 as a model. The battery-derived flower-like Fe_2O_3 nanostructures show interesting magnetic properties that are significantly different from the precursor Fe_2O_3 rhombohedra particles.

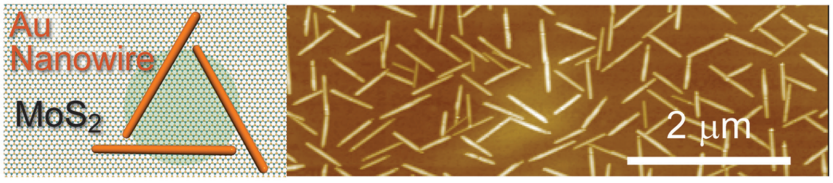


Nanostructures

FULL PAPERS

Gold Nanowires

Au nanowires (NWs) are laterally grown on a 2D material, molybdenum disulfide (MoS_2) via treatment with $AuCl_3$ solution. The Au NWs are oriented on the MoS_2 surface with C3 symmetry, reflecting the surface of the MoS_2 crystal plane. Analysis of the electrical characteristics indicates a surface charge transfer reaction between $AuCl_3$ and MoS_2, showing p-type doping up to the degenerate limit.



Carbon Nitride Films

Enhanced photoelectrochemical activity of carbon nitride thin films is achieved by in situ supramolecular-driven preorganization of phenyl-contained monomers in molten sulfur. Textured growth and more effective integration of phenyl groups in the carbon nitride frameworks lead to extended light absorption alongside with increased conductivity and better charge transfer, and as a result remarkably improved photoelectrochemical currents are obtained.