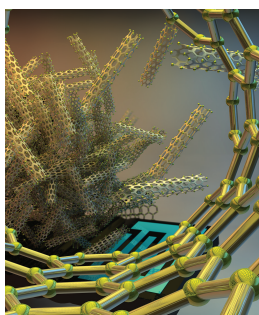


ADVANCED FUNCTIONAL MATERIALS

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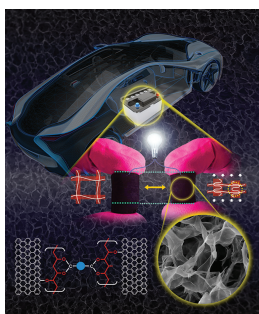
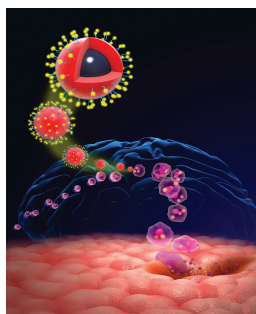


Carbon Nanotubes

A simple, dry, rapid, and chemical-free approach is developed by J. R. Friend and team for the deagglomeration and shear-induced alignment of commercially sourced, pristine multi-walled carbon nanotubes in air. On page 1014 the surface acoustic waves in a piezoelectric substrate are used to generate extremely large accelerations of $\approx 10 \text{ Mm/s}^2$ that, together with the electric field on the substrate, deagglomerates the nanotubes in tens of seconds, without affecting their chemical structure. The cover image was designed by Ella Marushchenko (scientific illustrations).

Stem Cells

On page 1024 C. Zhang, G.-Y. Yang, and co-workers synthesize an MRI/SPECT/fluorescent tri-modal probe to label mesenchymal stem cells, and evaluate the cell delivery routes on the distribution of cell in vivo and the concomitant therapeutic effects using a rat ischemic stroke model. They find that cell delivery routes significantly affect the cell distribution, but don't affect the therapeutic efficacy of the cells on ischemic brain.

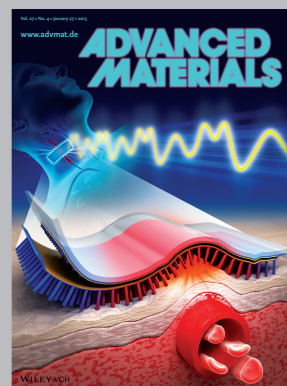
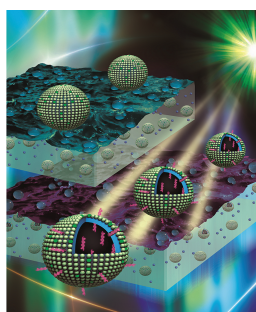


Energy Storage

Reversibly compressible and durable graphene aerogels are demonstrated by J. Kong, H. S. Park, and colleagues on page 1053 for energy storage where volume and mass must be limited. Taking advantage of the polymer assisted self assembly and cross linking, high porosity and low density yet mechanical durability and elasticity are achieved in cross linked reduced graphene oxide aerogels. They are highly and reversibly compressible while maintaining 3D interconnecting networked pathways for applications in ultra compact electrochemical capacitors.

Superhydrophobic Surfaces

UV-responsive microcapsules by Pickering emulsion polymerization using TiO_2 and SiO_2 as Pickering agents are successfully synthesized and further fabricated by S. Zhou, L. Wu, and co-workers on page 1035 for excellent waterborne self-healing and superhydrophobic self-cleaning coatings.



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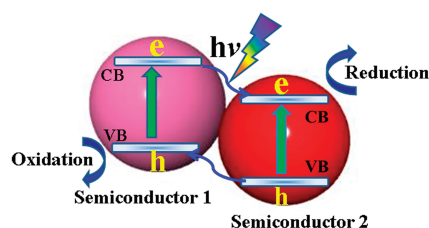
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FEATURE ARTICLE

The state-of-the-art progress of semiconductor/semiconductor heterostructured photocatalysts with diverse models is concisely summarized and highlighted, including type-I and type-II heterojunctions, Z-scheme system, p-n heterojunctions, and homojunction band alignments, which are explored for effective improvement of photocatalytic activity through increase of the visible-light absorption, promotion of separation and transportation of the photoinduced charge carries, and enhancement of the photocatalytic stability.



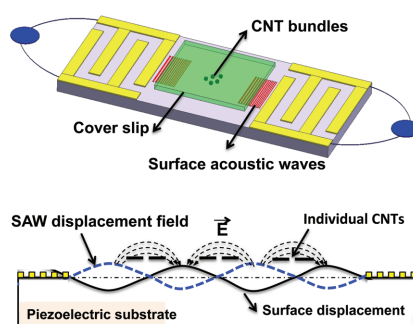
Semiconductors

H. J. Li, Y. Zhou,* W. G. Tu, J. Ye,
Z. G. Zou* 998–1013

State-of-the-Art Progress in Diverse Heterostructured Photocatalysts toward Promoting Photocatalytic Performance

FULL PAPERS

A uniquely simple, dry, rapid, and chemical-free approach is developed for the deagglomeration and shear-induced alignment of commercially sourced, pristine multi-walled carbon nanotubes in air. The surface acoustic waves in a piezoelectric substrate are used to generate extremely large accelerations of $\approx 10 \text{ Mm/s}^2$ that, together with the electric field on the substrate, deagglomerates the nanotubes in tens of seconds, without affecting their chemical structure.

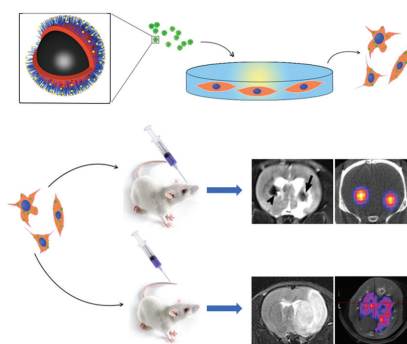


Carbon Nanotubes

M. Miansari, A. Qi, L. Y. Yeo,
J. R. Friend* 1014–1023

Vibration-Induced Deagglomeration and Shear-Induced Alignment of Carbon Nanotubes in Air

An MRI/SPECT/fluorescent tri-modal probe is synthesized and used for labeling and quantitative tracking of mesenchymal stem cells transplanted intracerebrally or intravenously into stroke rats. About 35% of intracerebrally implanted mesenchymal stem cells migrate from the injection sites and accumulate in the lesion area. While mesenchymal stem cells injected intravenously are primarily trapped in the lung, both injection routes improve brain function.

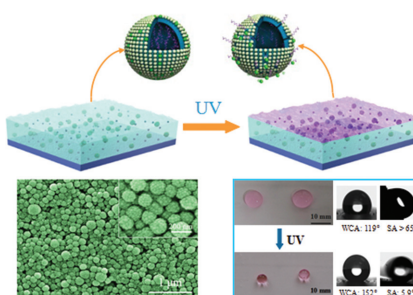


Stem Cells

Y. Tang, C. Zhang,* J. Wang, X. Lin,
L. Zhang, Y. Yang, Y. Wang, Z. Zhang,
J. W. M. Bulte, G.-Y. Yang* 1024–1034

MRI/SPECT/Fluorescent Tri-Modal Probe for Evaluating the Homing and Therapeutic Efficacy of Transplanted Mesenchymal Stem Cells in a Rat Ischemic Stroke Model

An environmentally benign, all-water-based self-repairing superhydrophobic coating based on UV-responsive microcapsules is fabricated, which exhibits excellent self-healing and self-cleaning ability in an outdoor environment, and after mechanical damage and contamination by organics.



Superhydrophobic Surfaces

K. Chen, S. Zhou,* S. Yang,
L. Wu* 1035–1041

Fabrication of All-Water-Based Self-Repairing Superhydrophobic Coatings Based on UV-Responsive Microcapsules

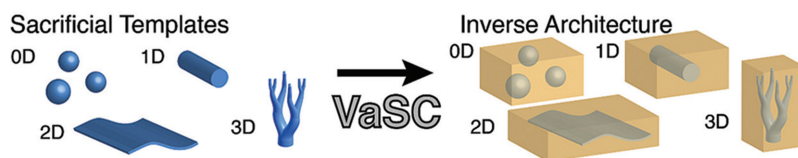
FULL PAPERS

Biopolymers

R. C. R. Gergely, S. J. Pety, B. P. Krull,
J. F. Patrick, T. Q. Doan, A. M. Coppola,
P. R. Thakre, N. R. Sottos, J. S. Moore,
S. R. White* 1043–1052

Multidimensional Vascularized Polymers using Degradable Sacrificial Templates

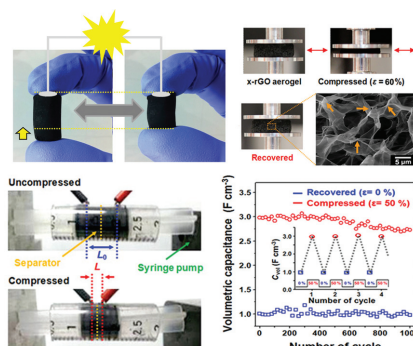
Sacrificial templates of 0D to 3D are fabricated and used to create vascular and porous architectures. Embedded sacrificial templates are removed using a thermal treatment process, vaporization of sacrificial components (VaSC), leaving behind an inverse replica. The effectiveness of VaSC is verified both ex situ and in situ, and the resulting structures are validated via flow rate testing.



Energy Storage

J.-Y. Hong, B. M. Bak, J. J. Wie, J. Kong,*
H. S. Park* 1053–1062

Reversibly Compressible, Highly Elastic, and Durable Graphene Aerogels for Energy Storage Devices under Limiting Conditions

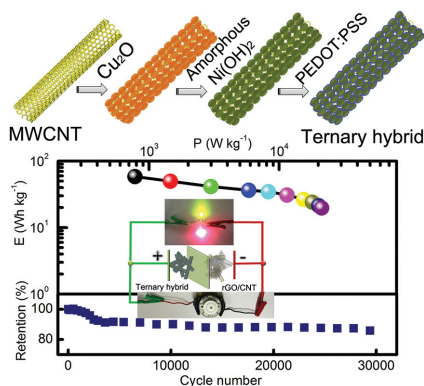


Reversibly compressible graphene-based aerogels are demonstrated for energy storage where volume and mass must be limited. Taking advantage of the polymer-assisted self-assembly and cross-linking, high porosity and low density yet mechanical durability and elasticity are achieved in cross-linked reduced graphene oxide (x-rGO) aerogels. They are compressible while maintaining 3D interconnecting networked pathways for applications in ultra-compact electrochemical capacitors.

Hybrid Materials

W. Jiang, D. Yu, Q. Zhang, K. Goh,
L. Wei, Y. Yong, R. Jiang, J. Wei,
Y. Chen* 1063–1073

Ternary Hybrids of Amorphous Nickel Hydroxide–Carbon Nanotube–Conducting Polymer for Supercapacitors with High Energy Density, Excellent Rate Capability, and Long Cycle Life

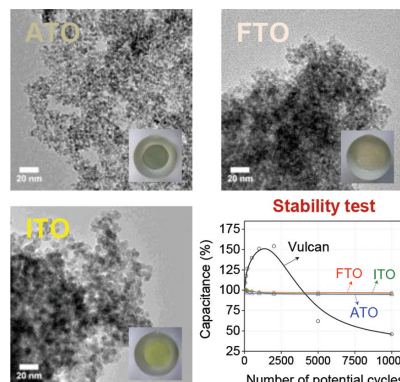


Ternary hybrid: A ternary hybrid material comprising of amorphous $\text{Ni}(\text{OH})_2$ deposited on multiwalled carbon nanotubes wrapped with conductive polymer exhibits an ultrahigh gravimetric specific capacitance of 3262 F g^{-1} . The assembled asymmetric supercapacitors exhibit a high specific energy density of 58.5 W h kg^{-1} as well as excellent long cycle life (86% capacitance retention after 30 000 cycles).

Electrochemical Catalysis

H.-S. Oh, H. N. Nong,
P. Strasser* 1074–1081

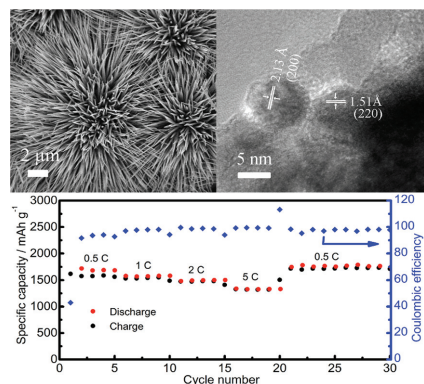
Preparation of Mesoporous Sb-, F-, and In-Doped SnO_2 Bulk Powder with High Surface Area for Use as Catalyst Supports in Electrolytic Cells



The M-doped tin oxides (M = Sb, F, and In) for use as catalyst supports in electrolytic cells are synthesized, showing high surface area, mesoporous structure, good electrical conductivity, and high corrosion resistance. Therefore, this synthesis method is a very effective way to prepare the metal oxide as electrocatalyst supports.

FULL PAPERS

Hierarchical CoO nanowire clusters comprising ultra-small nanoparticles (≈ 10 nm) on copper foil are successfully fabricated. When used as an anode material for lithium-ion batteries, this binder-free electrode exhibits an ultra-high capacity and excellent rate capability. What is more, the origins of the additional capacity are investigated in detail. Hierarchical core-shell CoO@SiO₂ nanowire clusters are also fabricated, to improve cycle stability.

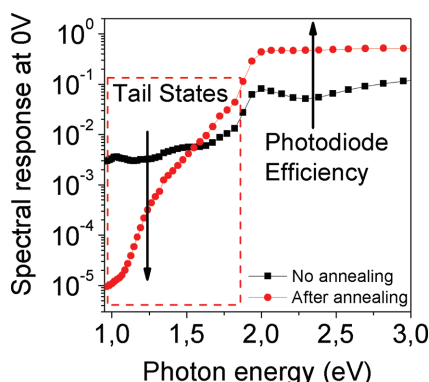


Electrodes

K. Cao, L. Jiao,* Y. Liu, H. Liu, Y. Wang, H. Yuan.....1082–1089

Ultra-High Capacity Lithium-Ion Batteries with Hierarchical CoO Nanowire Clusters as Binder Free Electrodes

The predominance of the band tail states reorganization, characterized by spectral response measurement, in the improvement of the solar cell performances during the annealing step of the active layer is discussed. This energetic reorganization leads to a lowering of the recombinations assisted by trap state (efficiency improvement) and a decrease of the thermal generation from trap states (reverse dark current).

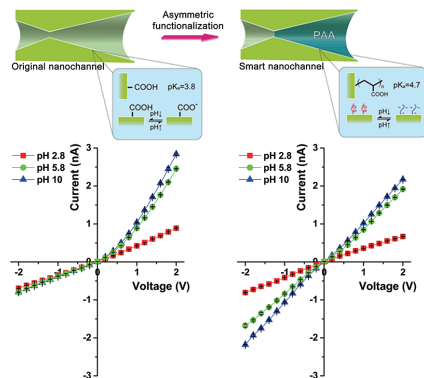


Solar Cells

B. Bouthinon,* R. Clerc, J. Vaillant, J. M. Verilhac, J. Faure-Vincent, D. Djurado, I. Ionica, G. Man, A. Gras, G. Pananakakis, R. Gwoziecki, A. Kahn.....1090–1101

Impact of Blend Morphology on Interface State Recombination in Bulk Heterojunction Organic Solar Cells

Inspired by asymmetric ion channels with symmetric pH gating features, a bio-inspired asymmetric shaped nanodevice is reported that shows symmetric pH-gating ion transport features based on an asymmetric-polyelectrolyte-functionalized asymmetric hourglass nanochannel. This work, as an example, demonstrates the feasibility of using the asymmetric chemical modification method to achieve symmetric pH gating behaviors inside the asymmetric nanochannels.

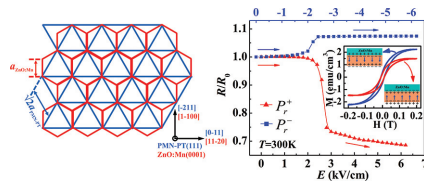


Nanofluidics

H. Zhang, X. Hou, J. Hou, L. Zeng, Y. Tian, L. Li,* L. Jiang*1102–1110

Synthetic Asymmetric-Shaped Nanodevices with Symmetric pH-Gating Characteristics

High-quality ZnO:Mn semiconductor thin films are successfully integrated with high-performance (111)-oriented perovskite Pb(Mg_{1/3}Nb_{2/3})O₃-PbTiO₃ single crystals. Unprecedented room temperature charge-mediated electric-field-control of electronic transport and magnetism is demonstrated for Pb(Mg_{1/3}Nb_{2/3})O₃-PbTiO₃ single-crystal-based oxide heterostructures in which the relative importance of the strain effect and the interfacial charge effect can be tuned by appropriately adjusting the charge carrier density of the films.



Multiferroic Heterostructures

Q.-X. Zhu, M.-M. Yang, M. Zheng, R.-K. Zheng,* L.-J. Guo, Y. Wang, J.-X. Zhang, X.-M. Li,* H.-S. Luo, X.-G. Li.....1111–1119

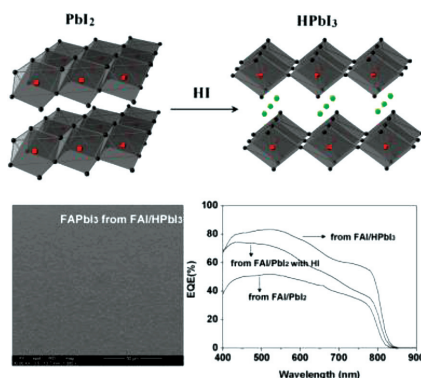
Ultrahigh Tunability of Room Temperature Electronic Transport and Ferromagnetism in Dilute Magnetic Semiconductor and PMN-PT Single-Crystal-Based Field Effect Transistors via Electric Charge Mediation

FULL PAPERS

Perovskite

F. Wang, H. Yu, H.H. Xu,
N. Zhao* 1120–1126

HPbI₃: A New Precursor Compound for Highly Efficient Solution-Processed Perovskite Solar Cells

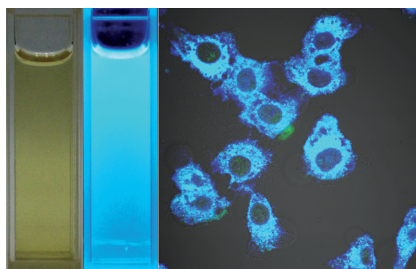


HPbI₃ is introduced as a novel precursor to solve the non-uniformity problem of formamidinium lead iodide (FAPbI₃) perovskite films from one-step solution-processed method. Interestingly, the FAPbI₃ films exhibit high crystallinity with (110) plane orientation and the corresponding devices yield an average photovoltaic efficiency of 15.4% under 1 sun illumination. Present results demonstrate that precursor engineering is an effective approach to produce perovskites with attractive properties.

Bioimaging

S. Xu, D. Li, P. Wu* 1127–1136

One-Pot, Facile, and Versatile Synthesis of Monolayer MoS₂/WS₂ Quantum Dots as Bioimaging Probes and Efficient Electrocatalysts for Hydrogen Evolution Reaction

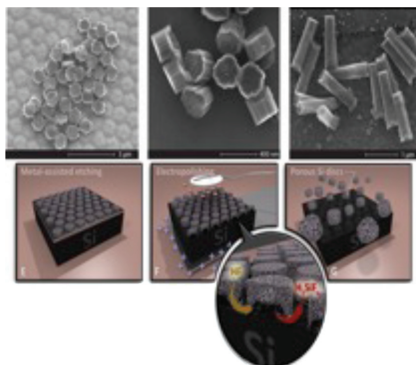


A facile, low cost, and versatile way to prepare monolayer MoS₂/WS₂ quantum dots on a large scale with fluorescent properties is proposed via the combination of sonication and solvothermal treatment of MoS₂/WS₂ powder. The prepared MoS₂/WS₂ quantum dots exhibit low cytotoxicity and good cell permeability in living cells as well as excellent electrocatalytic activity toward hydrogen evolution reaction.

Drug Delivery

H. Alhmoud, B. Delalat, R. Elnathan,
A. Cifuentes-Rius, A. Chaix,
M.-L. Rogers, J.-O. Durand,
N. H. Voelcker* 1137–1145

Porous Silicon Nanodiscs for Targeted Drug Delivery

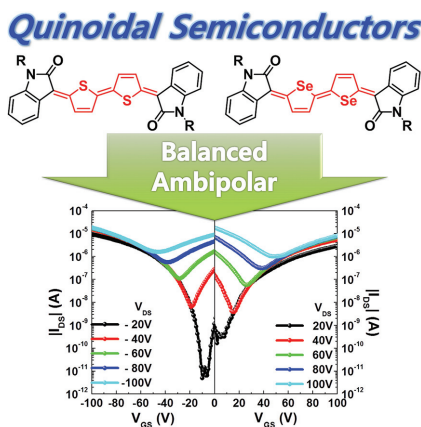


The fabrication of disc-shaped porous silicon nanoparticles through nanosphere lithography and metal-assisted chemical etching is described. The presented method provides a facile approach to controlling the shape and size of the resulting porous silicon nanoparticles. The targeted delivery of an anticancer drug to cancer cells is undertaken to demonstrate the potential of these particles as drug nanocarriers.

Semiconductors

H. Hwang, D. Khim, J.-M. Yun, E. Jung,
S.-Y. Jang, Y. H. Jang, Y.-Y. Noh,*
D.-Y. Kim* 1146–1156

Quinoidal Molecules as a New Class of Ambipolar Semiconductor Originating from Amphoteric Redox Behavior



Quinoidal organic semiconductors containing dichalcogenophene (quinoidal bithiophene and quinoidal biselenophene) are designed and synthesized by facile synthetic route. Due to the extended delocalization of quinoid structure, they show low band gap and amphoteric redox behavior. Compared with common aromatic compounds, such unusual properties of quinoid structure give rise to balanced ambipolar charge transport in the top gate field-effect transistor devices.