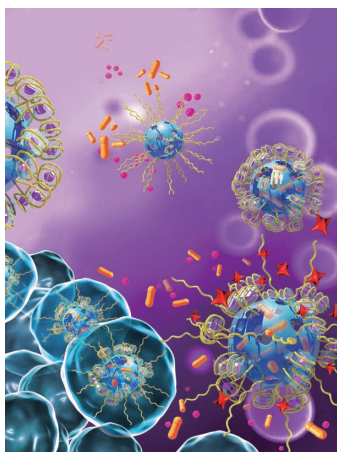


ADVANCED FUNCTIONAL MATERIALS

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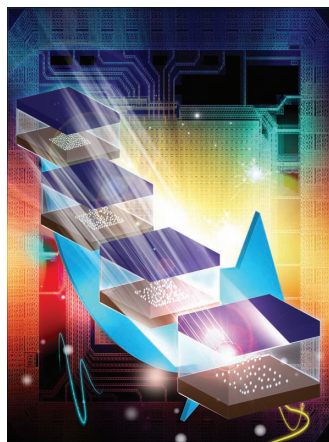


Mesoporous Nanoparticles

On page 5662, I. Willner and team show how K^+ -ion-stabilized G-quadruplexes act as locks for the entrapment of substrates in mesoporous silica nanoparticles. The pores are unlocked by the Kryptofix $\times [2.2.2]$ (KP) through the removal of the K^+ ions. Also, programmed duplex structures lock the anticancer drug doxorubicin in mesoporous silica nanoparticles. The pores are unlocked by the separation of the duplex through the formation of a G-quadruplex.

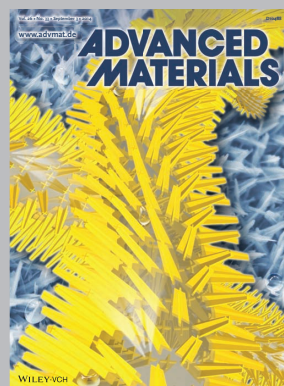
Nanocomposites

Hybrid hierarchical nanocomposite is demonstrated on page 5671 by S. H. Ko and colleagues to provide efficient multiscale electron transport path with Ag nanowire current backbone collector and local CNT percolation network by combining the enhanced mechanical compliance, electrical conductivity, and optical transparency of small CNTs and the enhanced electrical conductivity of relatively bigger Ag nanowire backbone. It is also applied to demonstrate highly flexible, stretchable, and transparent conductors.



Memory Switching

Q. Liu, M. Liu, and co-workers present direct evidence to illuminate microscopic mechanism of threshold and memory resistive switching in oxide-electrolyte RRAM on page 5679. The conversion between two switching modes results from morphology change of conductive filament based on SEM and TEM observations. Combining with I - V fitting and in situ AFM analysis, the conduction mechanisms of both switching modes are demonstrated.



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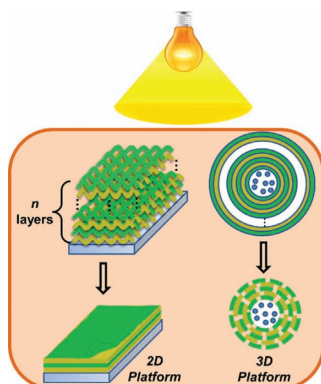
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FEATURE ARTICLE

Multilayer Assemblies

J. Borges,* L. C. Rodrigues, R. L. Reis,
J. F. Mano* 5624–5648

Layer-by-Layer Assembly of Light-Responsive Polymeric Multilayer Systems



Photoresponsive layer-by-layer polymeric multilayer systems have been widely studied and developed by modifying surfaces with stimuli-responsive polymeric materials that ideally exhibit reversible switchable physicochemical properties, precisely tailored structures, compositions, and functions. A comprehensive overview of the recent advancements in designing and fabricating 2D and 3D light-responsive polymeric multilayer systems is given along with their potential applications, future challenges, and opportunities.

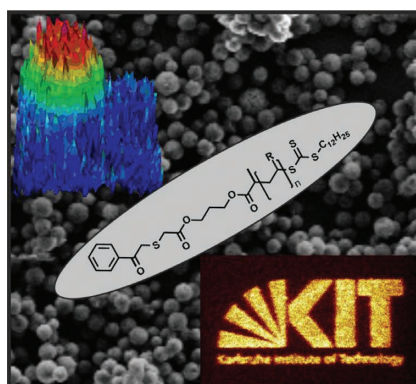
FULL PAPERS

Surface Modification

M. Kaupp, A. S. Quick,
C. Rodriguez-Emmenegger, A. Welle,
V. Trouillet, O. Pop-Georgievski,
M. Wegener,
C. Barner-Kowollik* 5649–5661



Photo-Induced Functionalization of Spherical and Planar Surfaces via Caged Thioaldehyde End-Functional Polymers



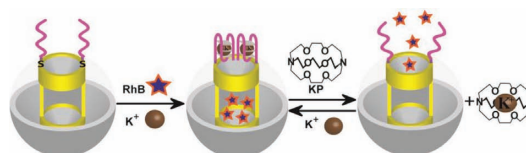
A reversible addition-fragmentation chain transfer (RAFT) agent containing a photocaged thioaldehyde allows the controlled polymerization of various (functional) polymers and subsequent photografting to porous polymeric microspheres. In combination with two-photon direct laser writing, planar surfaces can be patterned with RAFT polymers, which can be visualized with time-of-flight secondary ion mass spectrometry.

Mesoporous Nanoparticles

Z. Zhang, F. Wang, Y. S. Sohn,
R. Nechushtai, I. Willner* 5662–5670

Gated Mesoporous SiO₂ Nanoparticles Using K⁺-Stabilized G-Quadruplexes

K⁺-ion-stabilized G-quadruplexes act as locks for the entrapment of substrates in mesoporous silica nanoparticles. The pores are unlocked by the Kryptofix [2.2.2] (KP) through the removal of the K⁺ ions. Also, programmed duplex structures lock the anti-cancer drug doxorubicin in mesoporous silica nanoparticles. The pores are unlocked by the separation of the duplex through the formation of a G-quadruplex.

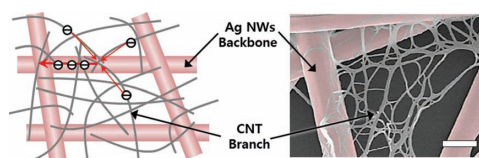


Nanocomposites

P. Lee, J. Ham, J. Lee, S. Hong, S. Han,
Y. D. Suh, S. E. Lee, J. Yeo, S. S. Lee,
D. Lee, S. H. Ko* 5671–5678

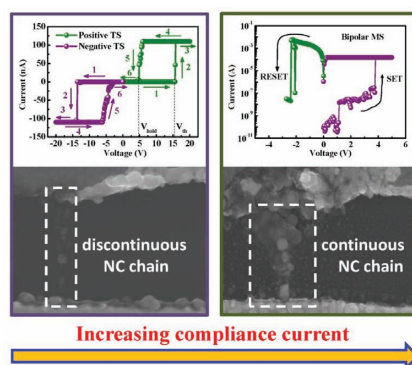
Highly Stretchable or Transparent Conductor Fabrication by a Hierarchical Multiscale Hybrid Nanocomposite

Highly stretchable, flexible, or transparent conductors are developed from a hierarchical multiscale nanocomposite to realize wearable electronics. The hybrid nanocomposite shows the enhanced mechanical compliance, electrical conductivity, and optical transparency by providing efficient multiscale electron transport path with a relatively big AgNW ($d \approx 150$ nm) current backbone collector and local small CNT ($d \approx 1.2$ nm) percolation network.



FULL PAPERS

The coexistence of volatile threshold and non-volatile memory switching phenomena is observed in oxide-electrolyte-based resistive random access memory (RRAM). The switching behaviors of the device transform from threshold to memory switching when increasing the compliance current in electroforming. Analysis reveals that the threshold and memory switching behaviors correspond to the conductive filament consisting of isolated Ag nanocrystals and continuous Ag nanocrystals, respectively.

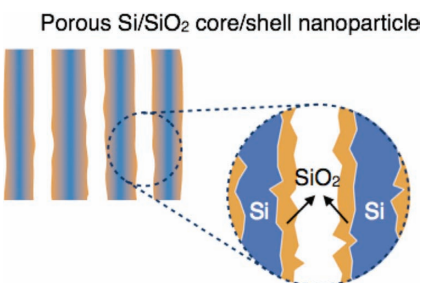


Memory Switching

H. Sun, Q. Liu,* C. Li, S. Long, H. Lv, C. Bi, Z. Huo, L. Li, M. Liu* ...5679–5686

Direct Observation of Conversion Between Threshold Switching and Memory Switching Induced by Conductive Filament Morphology

Systematic activation of photoluminescent porous silicon/silicon oxide core/shell nanoparticle provides a material with greater physiological stability and improved photoluminescence quantum yield (up to 23%). Borax treatment promotes surface oxidation of the porous silicon skeleton and consequently generates an electronically passivated Si–SiO₂ interface.

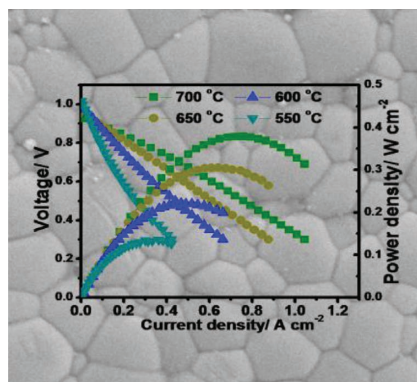


Photoluminescence

J. Joo, J. F. Cruz, S. Vijayakumar, J. Grondek, M. J. Sailor*5688–5694

Photoluminescent Porous Si/SiO₂ Core/Shell Nanoparticles Prepared by Borate Oxidation

An easily sintered and chemically stable proton conductor BaZr_{0.8}Y_{0.15}In_{0.05}O_{3-δ} is developed. The fuel cell with a 12-μm-thick BaZr_{0.8}Y_{0.15}In_{0.05}O_{3-δ} electrolyte film delivers a peak power density of as high as 379 mW cm⁻² at 700 °C. The result demonstrates that Y and In co-doping is an effective strategy for exploring sintering active and chemically stable BaZrO₃-based proton conductors for high performance proton-conducting solid oxide fuel cells.

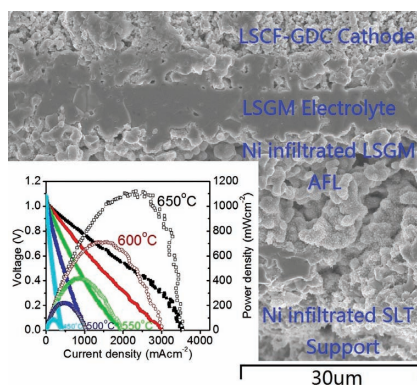


Solid Oxide Fuel Cells

W. P. Sun,* Z. Shi, M. F. Liu, L. Bi, W. Liu*5695–5702

An Easily Sintered, Chemically Stable, Barium Zirconate-Based Proton Conductor for High-Performance Proton-Conducting Solid Oxide Fuel Cells

Thin-(La_{0.9}Sr_{0.1})_{0.98}Ga_{0.8}Mg_{0.2}O_{3-δ} (LSGM)-electrolyte SOFCs on Sr_{0.8}La_{0.2}TiO_{3-α} (SLT) supports, yielding high power densities at temperatures ≤ 650 °C, e.g., 1.12 Wcm⁻² at 650 °C, are fabricated using a novel processing method. First, ceramic layers—porous SLT support, porous LSGM anode functional layer (AFL), and dense LSGM layer—are co-fired and then nano-scale Ni is infiltrated into the porous layers.



Solid Oxide Fuel Cells

Z. Gao,* E. C. Miller, S. A. Barnett5703–5709

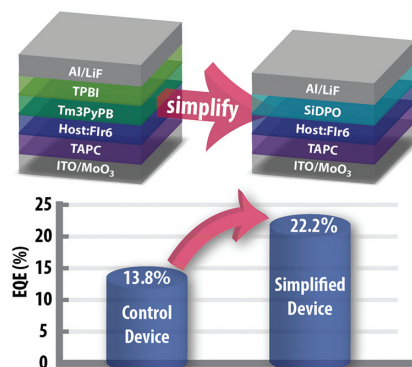
A High Power Density Intermediate-Temperature Solid Oxide Fuel Cell with Thin (La_{0.9}Sr_{0.1})_{0.98}(Ga_{0.8}Mg_{0.2})O_{3-δ} Electrolyte and Nano-Scale Anode

FULL PAPERS

Organic Electronics

S. Gong, N. Sun, J. Luo, C. Zhong,
D. Ma,* J. Qin, C. Yang* 5710–5718

Highly Efficient Simple-Structure Blue and All-Phosphor Warm-White Phosphorescent Organic Light-Emitting Diodes Enabled by Wide-Bandgap Tetraarylsilane-Based Functional Materials

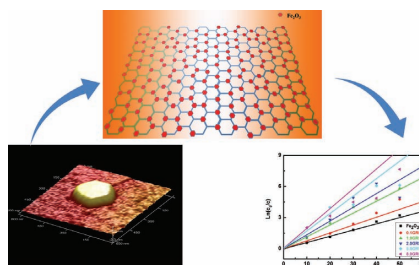


A three-organic-layer blue phosphorescent organic light-emitting diode (PhOLED) with external quantum efficiency up to 22.2% is demonstrated by employing tetraarylsilane-based host and electron-transporting materials. The introduction of an orange emitter realizes an all-phosphor warm-white PhOLED with a peak power efficiency of 47.2 lm W⁻¹. This work reveals that judicious molecular design of functional materials holds promise in simplifying structure of PhOLEDs while maintaining high efficiency.

Catalysts

S. C. Han, L. F. Hu,* Z. Q. Liang,
S. Wageh, A. A. Al-Ghamdi, Y. S. Chen,
X. S. Fang* 5719–5727

One-Step Hydrothermal Synthesis of 2D Hexagonal Nanoplates of α -Fe₂O₃/Graphene Composites with Enhanced Photocatalytic Activity

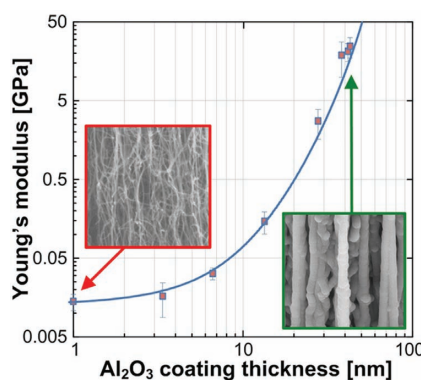


Hexagonal nanoplates of α -Fe₂O₃/graphene composites are synthesized for the first time using a simple one-step template-free hydrothermal method. This achieves the effective reduction of graphene oxide to graphene and intimate, large contact interfaces of the α -Fe₂O₃ nanoplates with graphene. The effective charge transfer leads to significant improvement in the photocatalytic activity of the α -Fe₂O₃/graphene.

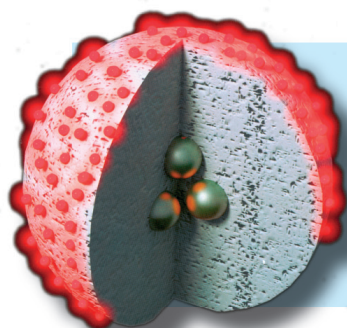
Nanotubes

A. Brieland-Shoultz, S. Tawfick,
S. J. Park, M. Bedewy,
M. R. Maschmann, J. W. Baur,
A. J. Hart* 5728–5735

Scaling the Stiffness, Strength, and Toughness of Ceramic-Coated Nanotube Foams into the Structural Regime



Composite foams are manufactured by aligned carbon nanotube (CNT) growth followed by conformal nanoscale ceramic coating. Via this method, approximately 1000-fold control of Young's modulus, ultimate compressive strength, and energy absorption is realized. The strength and toughness values exceed commercial aluminum foams by 10-fold. This combination of mechanics and morphology is especially attractive for catalysis, filtration, and thermal protection.



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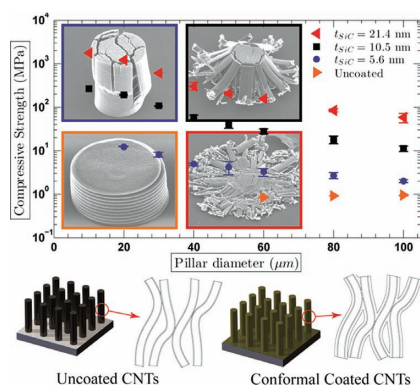
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FULL PAPERS

The effects of nanoscale conformal coatings of amorphous silicon carbide on the mechanical properties of CNT pillars are investigated. Several interesting mechanical failure modes such as “bamboo” and brittle-like composite rupture are observed as the coating thickness increases. A remarkable increase in strength, makes the fast growing coated CNT arrays useful as structural material for high-aspect-ratio 3D micro-architectures.

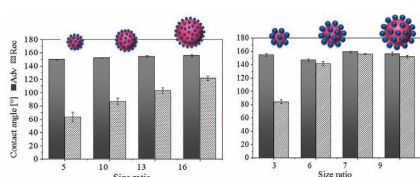


Carbon Nanotubes

R. H. Poelma, B. Morana, S. Vollebregt, E. Schlangen, H. W. van Zeijl, X. J. Fan, G. Q. Zhang*5737–5744

Tailoring the Mechanical Properties of High-Aspect-Ratio Carbon Nanotube Arrays using Amorphous Silicon Carbide Coatings

The roughness factors to fine-tune the superhydrophobicity of practical films are determined based on monolayers of well-defined raspberry silica-silica nanoparticles with variable dual-scale roughness size and ratio. To reach superhydrophobicity, the smaller features must have a minimum size and size ratio. These new insights on wetting of rough surfaces can direct the design of practical superhydrophobic surfaces.

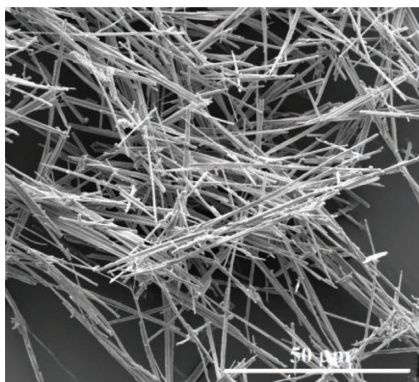


Superhydrophobicity

C. C. M. C. Carcouët, A. C. C. Esteves,* M. M. R. M. Hendrix, R. A. T. M. van Benthem, G. de With*5745–5752

Fine-Tuning of Superhydrophobicity Based on Monolayers of Well-defined Raspberry Nanoparticles with Variable Dual-roughness Size and Ratio

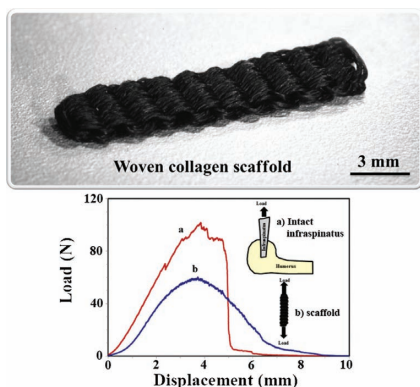
A well-scalable and economic synthesis technique, viz. a re-crystallization, is reported. This new approach allows the “one-pot” preparation of a CaO-based, MgO-stabilized CO₂ sorbent. The synthetic material stabilized with 8 wt% of MgO possesses an excellent CO₂ uptake of 10.71 mmol(CO₂) g(sorbent)^{−1} after 10 cyclic experiments of calcination and carbonation under very harsh regeneration conditions (900 °C, 100% CO₂ atmosphere).

CO₂ Capture

M. Broda, A. M. Kierzkowska, C. R. Müller*5753–5761

Development of Highly Effective CaO-based, MgO-stabilized CO₂ Sorbents via a Scalable “One-Pot” Recrystallization Technique

Electrophoretically aligned collagen threads are woven as mechanically robust biotextiles. Mechanical properties of the scaffold approached those of the native tendon. Porosity enables mesenchymal stem cell (MSC) seeding throughout the scaffold. Cells proliferate and become elongated within the woven collagen artifacts. Topographical cues provided by the aligned collagen threads induce the MSCs to undergo tenogenic differentiation without growth factor supplementation.



Collagen Scaffolds

M. Younesi, A. Islam, V. Kishore, J. M. Anderson, O. Akkus*5762–5770

Tenogenic Induction of Human MSCs by Anisotropically Aligned Collagen Biotextiles