ADVANCED FUNCTIONAL MATERIALS

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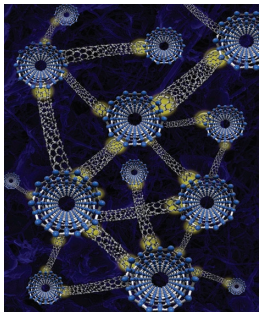
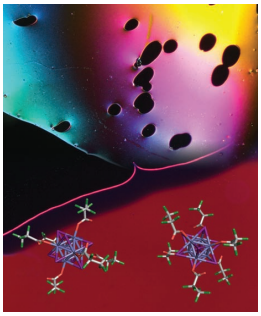
Batteries

On page 4948, I. Y. Kim and co-workers demonstrate that the in situ formation of metal sulfides using CS_2 is effective in synthesizing novel nanocomposites consisting of $Li_{0.96}Ti_{1.08}S_2$ domains embedded in $Li_4Ti_5O_{12}$. The metallization of the semiconducting oxide in the composite formation is very efficient for exploring promising composite electrode materials with good rate characteristics.

Covalent Networks

A novel approach for fabrication of 3D interconnected carbon nanotube (CNT)–silicon carbide composites is reported by M. Terrones and co-workers on page 4985. The two-step fabrication route involves coating CNTs with silicon oxide via a sol-gel process, followed by spark plasma sintering, during which the SiO_x is carbothermally reduced to SiC. A covalently interconnected SiC–CNT network composite with high thermal and electrical conductivities is created.





Photoluminescence

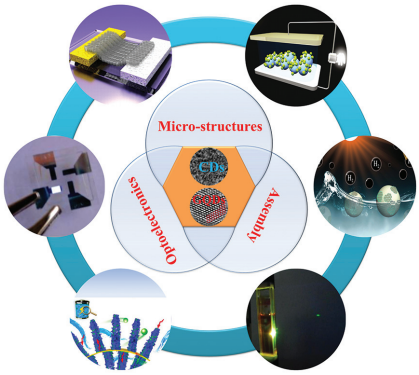
As shown by L. Dupont, Y. Molard, and co-workers on page 4966, the functionalization of $[Mo_6I_8(C_nF_{2n+1}COO)_6]^{2-}$ ($n = 1, 2, 3$) red–near-infrared phosphorescent nanocluster units with specific organic cations leads to a nematic liquid crystalline material that can be homogeneously mixed with E7 commercial liquid crystal. Integration in electro-controlled devices modulates the cluster photoluminescence intensity, demonstrating the potential of these hybrid materials for photonic or optoelectronic applications.

Flexible Lithography

Micro-supercapacitors and other microscale energy storage devices can be fabricated on curvilinear surfaces using a simple marker pen. H. N. Alshareef and co-workers show on page 4976 that the pen ink can be used as a sacrificial layer that selectively dissolves in some solvents to enable fabrication of devices without the need for masks. Traditional photolithography would be difficult to use on such curved surfaces.

FEATURE ARTICLE

Carbon dots and graphene quantum dots have been investigated for several years and researchers' interest is moving from photoluminescence towards device applications. In this Feature Article, applications in optoelectronic and energy devices of carbon dots and graphene quantum dots are summarized, as well as their optical properties. Future directions, challenges, and other possible applications are also put forward.



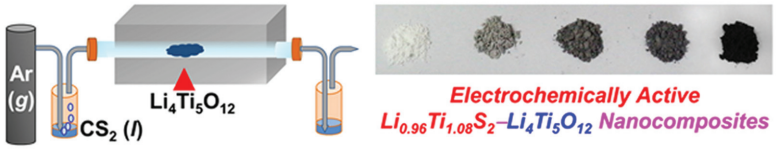
Carbon

X. M. Li, M. C. Rui, J. Z. Song, Z. H. Shen, H. B. Zeng*.....4929–4947

Carbon and Graphene Quantum Dots for Optoelectronic and Energy Devices: A Review

FULL PAPERS

An effective synthetic route to novel metal sulfide–metal oxide nanocomposites is developed on the basis of the in situ formation of conductive metal sulfide domains in a metal oxide matrix. The resulting $Li_{0.96}Ti_{1.08}S_2$–$Li_4Ti_5O_{12}$ nanocomposites show promising functionality as anode materials for lithium secondary batteries with excellent rate characteristics, underscoring the usefulness of the present in situ composite formation route.

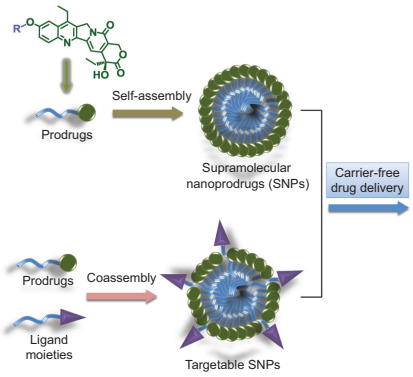


Batteries

I. Y. Kim, J. Seo, S. M. Oh, S. B. Patil, S.-J. Hwang* 4948–4955

In Situ Formation of Conductive Metal Sulfide Domain in Metal Oxide Matrix: An Efficient Way to Improve the Electrochemical Activity of Semiconducting Metal Oxide

A novel carrier-free drug delivery platform relying on amphiphilic self-assembly of pure prodrugs is successfully constructed by rational engineering of antitumor agent 7-ethyl-10-hydroxycamptothecin (SN-38). Specifically, the prodrugs modified with polyunsaturated fatty acids exhibit enhanced stability, which contributes to their superior antitumor activity in vivo. Besides, additional valuable functionalities such as tumor-specific ligands can be readily incorporated to improve antitumor efficacy.

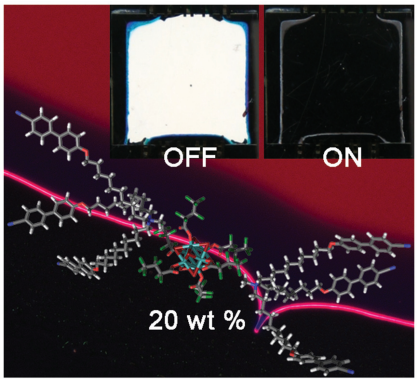


Drug Engineering

H. Wang, H. Xie, J. Wang, J. Wu, X. Ma, L. Li, X. Wei, Q. Ling, P. Song, L. Zhou, X. Xu,* S. Zheng* 4956–4965

Self-Assembling Prodrugs by Precise Programming of Molecular Structures that Contribute Distinct Stability, Pharmacokinetics, and Antitumor Efficacy

The functionalization of highly phosphorescent $[Mo_6I_8(C_nF_{2n+1}COO)_6]^{2-}$ (n = 1, 2, 3) nanocluster anionic units with appropriate ammonium cations, leads to the formation of the most fluid of all liquid crystalline phases: the nematic phase. The excellent photostability of these hybrid materials makes them suitable candidates for the design of electro-optical devices directed toward photonic or optoelectronic applications.



Photoluminescence

M. Prévôt, M. Amela-Cortes, S. K. Manna, R. Lefort, S. Cordier, H. Folliot, L. Dupont,* Y. Molard* 4966–4975

Design and Integration in Electro-Optic Devices of Highly Efficient and Robust Red-NIR Phosphorescent Nematic Hybrid Liquid Crystals Containing $[Mo_6I_8(OCOC_nF_{2n+1})_6]^{2-}$ (n = 1, 2, 3) Nanoclusters

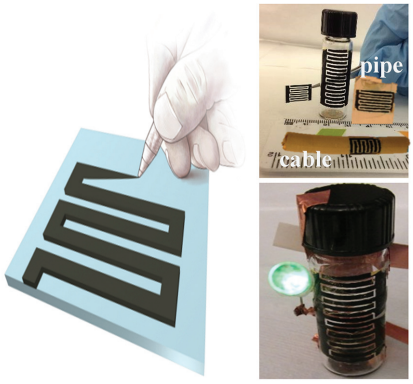
CONTENTS

FULL PAPERS

Flexible Lithography

Q. Jiang, N. Kurra,
H. N. Alshareef* 4976–4984

Marker Pen Lithography for Flexible and Curvilinear On-Chip Energy Storage

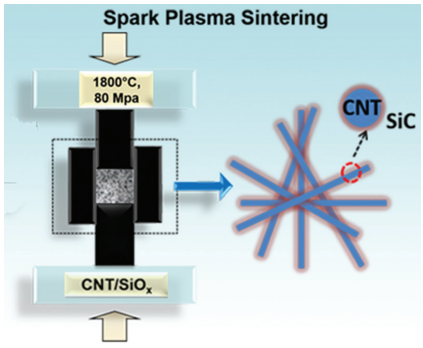


Marker pen ink is used for writing sacrificial patterns to fabricate energy storage devices on a variety of surfaces, including on-chip, round, and curved surfaces, as micropower units capable of glowing a light-emitting diode. This process can be used in both lift-off and etching modes, and the possibility of multistack design of active materials using simple pen lithography is demonstrated.

Covalent Networks

L. P. Rajukumar, M. Belmonte,
J. E. Slimak, A. L. Elías, E. Cruz-Silva,
N. Perea-López, A. Morelos-Gómez,
H. Terrones, M. Endo, P. Miranzo,
M. Terrones* 4985–4993

3D Nanocomposites of Covalently Interconnected Multiwalled Carbon Nanotubes with SiC with Enhanced Thermal and Electrical Properties

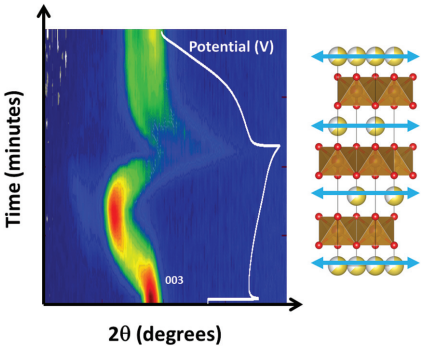


A 3D interconnected carbon nanotube (CNT)–silicon carbide (SiC) composite is fabricated by coating the tubes with silica followed by spark plasma sintering at high temperature and pressure. The resultant SiC–CNT composite possesses excellent thermal and electrical conductivity owing to the covalent 3D network. This is a novel route to produce multifunctional CNT-based composites.

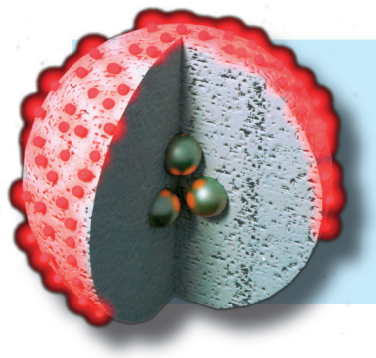
Batteries

N. Sharma,* E. Gonzalo, J. C. Pramudita,
M. H. Han, H. E. A. Brand, J. N. Hart,
W. K. Pang, Z. Guo, T. Rojo*...4994–5005

The Unique Structural Evolution of the O3-Phase $Na_{2/3}Fe_{2/3}Mn_{1/3}O_2$ during High Rate Charge/Discharge: A Sodium-Centred Perspective



O3-$Na_{2/3}Fe_{2/3}Mn_{1/3}O_2$ undergoes sequential reactions during charge and discharge but maintains the same O3 structural motif. This has direct implications on the electrochemical performance of this polymorph. Rietveld refinements and calculations are used to show the sodium content evolution of this cathode in a functioning sodium-ion battery.



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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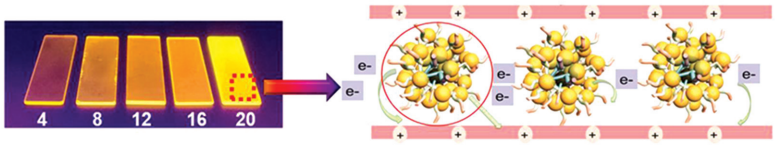
FULL PAPERS

An ultrathin film material is fabricated based on the localization of Au nanoclusters onto layered double hydroxide nanosheets, and exhibits temperature-responsive photoluminescence and electrochemiluminescence performances with high sensitivity and stability.

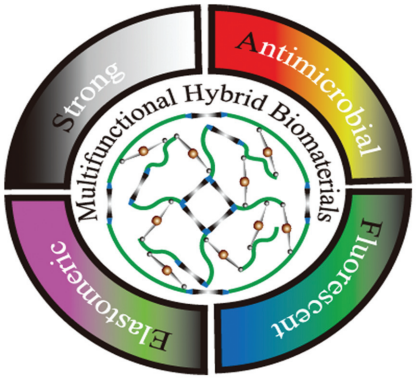


Thin Films

R. Tian, S. Zhang, M. Li, Y. Zhou, B. Lu, D. Yan,* M. Wei,* D. G. Evans, X. Duan.....5006–5015

Localization of Au Nanoclusters on Layered Double Hydroxides Nanosheets: Confinement-Induced Emission Enhancement and Temperature-Responsive Luminescence

A multifunctional platform based on strong, intrinsically photoluminescent and antimicrobial silica-poly(citrates)-based hybrid elastomers is developed for bone tissue regeneration. The silica-based hybrid elastomers demonstrate a strong mechanical strength of 976 ± 15 MPa (modulus), stable intrinsic photoluminescent ability, inherent antibacterial properties against *Staphylococcus aureus*, the osteogenic differentiation of cells, as well as the minimal inflammatory response.

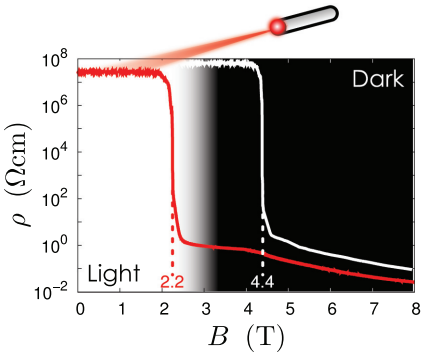


Hybrid Elastomers

Y. Du, M. Yu, J. Ge, P. X. Ma,* X. Chen, B. Lei*.....5016–5029

Development of a Multifunctional Platform Based on Strong, Intrinsically Photoluminescent and Antimicrobial Silica-Poly(citrates)-Based Hybrid Biodegradable Elastomers for Bone Regeneration

The colossal magnetoresistive insulator-to-metal switching of almost nine orders of magnitude under significantly reduced magnetic field is achieved by illumination for low bandwidth manganite thin films. The magnetic field biasing amplifies the samples response to illumination, having colossal effect on the resistivity, which could have significant impact on the new generation phase-change memories working under affordable conditions.

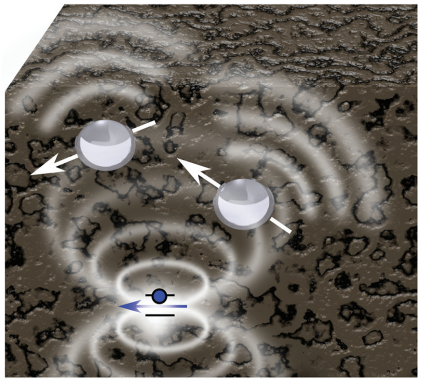


Magnetophotoresistance

T. Elovaara,* S. Majumdar, H. Huhtinen, P. Paturi.....5030–5037

Photoinduced Colossal Magnetoresistance under Substantially Reduced Magnetic Field

Adding plasmonic core–shell nanoparticles (Ag@TiO_2) to perovskite solar cells is shown to improve the photocurrent and thus the overall efficiency. A theoretical model, introducing a novel photon recycling scheme, predicts that highly polarizable nanoparticles act as antennas for light re-emitted from radiative recombination. The work elucidates the complicated, subtle interactions between light and matter in plasmonic photovoltaic composites.



Photovoltaics

M. Saliba, W. Zhang, V. M. Burlakov, S. D. Stranks, Y. Sun, J. M. Ball, M. B. Johnston, A. Goriely, U. Wiesner, H. J. Snaith*.....5038–5046

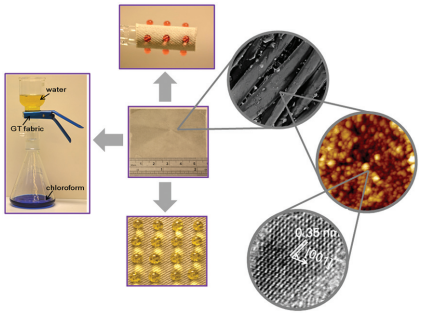
Plasmonic-Induced Photon Recycling in Metal Halide Perovskite Solar Cells

FULL PAPERS

Smart Surfaces

Y. Liu, X. Wang, B. Fei, H. Hu, C. Lai, J. H. Xin* 5047–5056

Bioinspired, Stimuli-Responsive, Multifunctional Superhydrophobic Surface with Directional Wetting, Adhesion, and Transport of Water



A smart stimuli-responsive surface is fabricated based on a graphene and TiO_2 nanofilm. The bioinspired hierarchical dual roughness endows the surface with superhydrophobicity, while tunable adhesiveness, wettability, and directionality are achieved utilizing the UV-induced interaction between graphene and TiO_2. This novel multifunctional smart surface design provides a potent insight for overcoming the evolving material challenge.

Adhesives

H. J. Meredith, J. J. Wilker* ...5057–5065

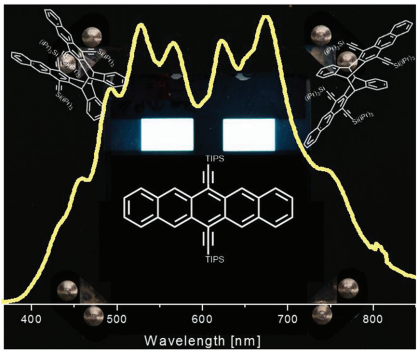
The Interplay of Modulus, Strength, and Ductility in Adhesive Design Using Biomimetic Polymer Chemistry

A mussel mimicking adhesive terpolymer is synthetically tuned to identify the composition at which the material becomes toughened. The way the strength, ductility, and modulus of an adhesive interact to create the most robust joints between plastic and metal substrates is shown in this systematic study.

Electroluminescence

M. D. Weber, M. Adam, R. R. Tykwinski, R. D. Costa*..... 5066–5074

Controlling the Chromaticity of Small-Molecule Light-Emitting Electrochemical Cells Based on TIPS-Pentacene



TIPS-pentacene has been tested as an emitter in small-molecule light-emitting electrochemical cells (SM-LECs). The formation of high-energy band gap species via photoinduced cycloaddition process has been exploited to control the device chromaticity from red to white. As such, this work provides a proof-of-concept that opens a new avenue to fabricate white lighting sources based on pentacene derivatives.