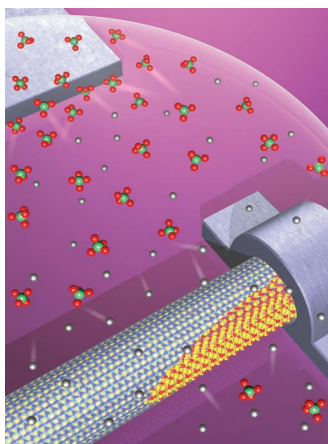


ADVANCED FUNCTIONAL MATERIALS

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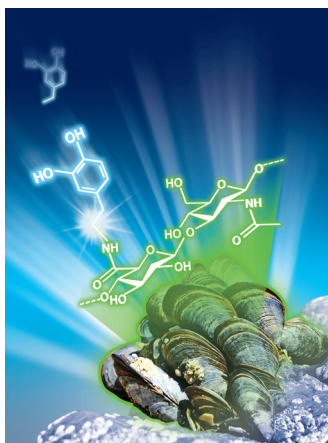
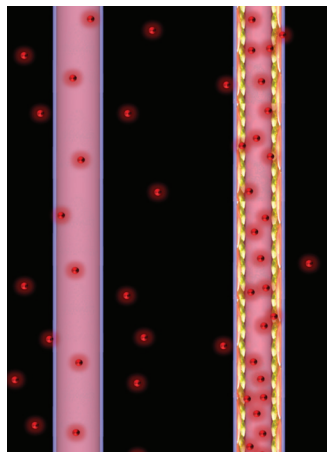


Flexible Electronics

Part of an enhanced-mode electrolyte-gated nanowire channel metal oxide semiconductor field-effect transistor (MOSFET) is illustrated. As reported by Subho Dasgupta and co-workers on page 1750, the complete nanowire and a part of the in-plane gate electrode are covered with a printed droplet of composite solid polymer electrolyte, working as a dielectric. A positive gate bias attracts cations (Li^+) towards the nanowire channel resulting in accumulation of charge carriers and driving it to the conducting (ON) state.

Biomedical Applications

Multilayered blood capillary analogs are constructed in biodegradable hydrogels as reported by Mitsuru Akashi and co-workers on page 1736. The size, orientation, length, layer, and cell type of the artificial blood capillaries are easily controlled. Additionally, permeability control of serum albumin by altering blood vessel cell layers is demonstrated. This technique will be useful as an innovative technology for drug permeability assessment to human blood vessels.



Bioinspired Materials

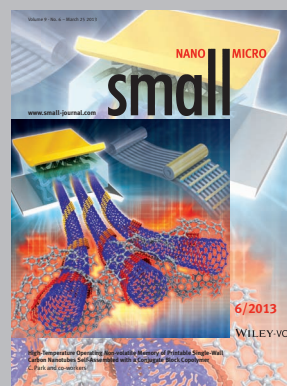
A mussel, which is a sticky organism underwater, provides researchers inspiration to develop novel bio-adhesives. Catechol is a key chemical moiety for developing such adhesives. The results reported by Seung-Woo Cho, Haeshin Lee, and co-workers on page 1774 show the dual roles of catechol, with its properties of cohesion and adhesion depending on environmental conditions such as pH. Catechol is chemically tethered onto hyaluronic acid and the resulting conjugate is demonstrated to be useful for human neural stem cell culture.



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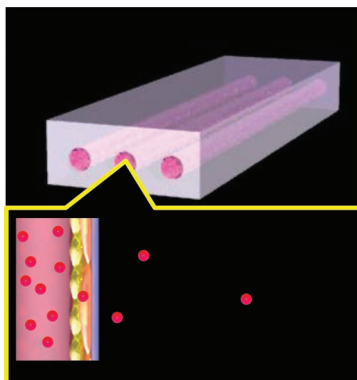
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FULL PAPERS

Hydrogels

H. Yoshida, M. Matsusaki,
M. Akashi*1736–1742

Multilayered Blood Capillary Analogs in Biodegradable Hydrogels for In Vitro Drug Permeability Assays

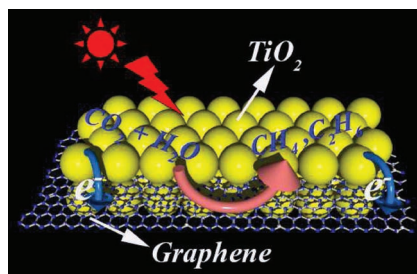


Blood capillary networks consisting of bilayered structures of human endothelial cells and smooth muscle cells are prepared inside biodegradable hydrogels by a combination of uniaxial tubular micro-channel fabrication and hierarchical cell manipulation. These blood capillary analogs, possessing blood barrier functions similar to native blood capillaries, can be useful for in vitro permeability assays of drugs and as drug delivery carriers.

Catalysis

W. Tu, Y. Zhou,* Q. Liu, S. Yan,
S. Bao, X. Wang, M. Xiao,
Z. Zou*1743–1749

An In Situ Simultaneous Reduction-Hydrolysis Technique for Fabrication of TiO₂-Graphene 2D Sandwich-Like Hybrid Nanosheets: Graphene-Promoted Selectivity of Photocatalytic-Driven Hydrogenation and Coupling of CO₂ into Methane and Ethane

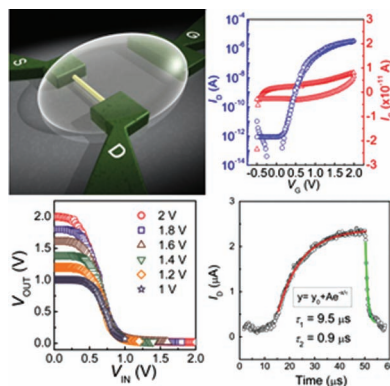


A novel, in situ simultaneous reduction-hydrolysis technique (SRH) is developed for fabrication of TiO₂-graphene hybrid nanosheets in a binary ethylenediamine (En)/H₂O solvent. The photogenerated electrons in TiO₂ nanoparticles are transferred onto graphene, which minimizes charge recombination losses to improve the efficiency of photoreduction of CO₂ into hydrocarbon fuel. The synergistic effect of the surface-Ti³⁺ abundant TiO₂ and graphene favors the generation of C₂H₆.

Field-Effect Transistors

B. Nasr, D. Wang, R. Kruk, H. Rösner,
H. Hahn, S. Dasgupta*1750–1758

High-Speed, Low-Voltage, and Environmentally Stable Operation of Electrochemically Gated Zinc Oxide Nanowire Field-Effect Transistors

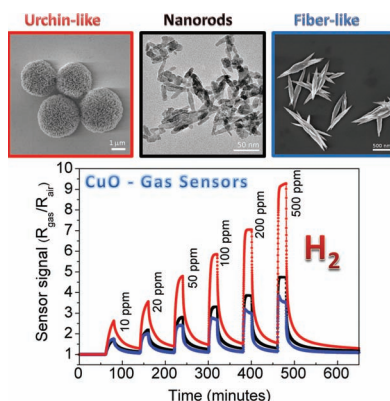


Flexible ZnO nanowire-based field-effect transistors (FETs) are built with a composite solid polymer electrolyte as the gate insulator to ensure battery-compatible, low voltage operation (≤ 2 V). Long-term, stable performance of the nanowire FETs in air is demonstrated. Even though electrochemically gated, the in-plane device geometry already shows an extremely fast switching of >100 kHz, which should increase further for the top-gate configuration.

Sensors

D. P. Volanti, A. A. Felix,*
M. O. Orlandi, G. Whitfield,
D.-J. Yang, E. Longo, H. L. Tuller,*
J. A. Varela1759–1766

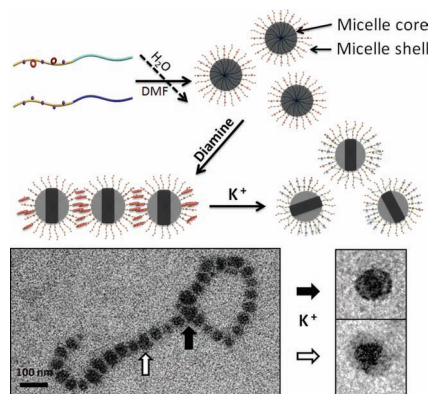
The Role of Hierarchical Morphologies in the Superior Gas Sensing Performance of CuO-Based Chemiresistors



High-performance gas sensors based on CuO hierarchical morphologies with in situ gas sensor comparison are reported. Urchin-like morphologies with high hydrogen sensitivity and selectivity that show chemical and thermal stability and low temperature operation are analyzed. The role of morphological influences in p-type gas sensor materials is discussed.

FULL PAPERS

Isolated, complex micelle-like nanoparticles assemble through a solvent mixing process from a binary diblock copolymer mixture with a crown ether modification on only one diblock copolymer. Particle-particle association is triggered by the addition of diamines to the solution resulting in uniform particle-chain and particle-ring superstructures. Further dissociation of the superstructures can be triggered by the addition of potassium ions into the solution. Importantly, manipulated by the shell interactions between the neighboring particles, varied phase segregation occurs in the micelle core giving rise to novel multi-compartment nanoparticles.

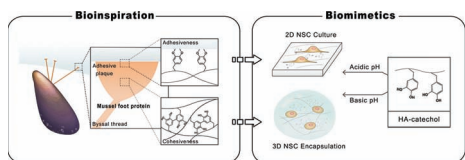


Hierarchical Assemblies

J. Zhu, S. Zhang, F. Zhang,
K. L. Wooley,*
D. J. Pochan* 1767–1773

Hierarchical Assembly of Complex Block Copolymer Nanoparticles into Multicompartment Superstructures through Tunable Interparticle Associations

Hyaluronic acid catechol conjugate is able to change between adhesiveness and cohesiveness in a smart way. This is demonstrated to be useful for human neural stem cell culture, which cannot be stably cultured on typical polystyrene culture plates.

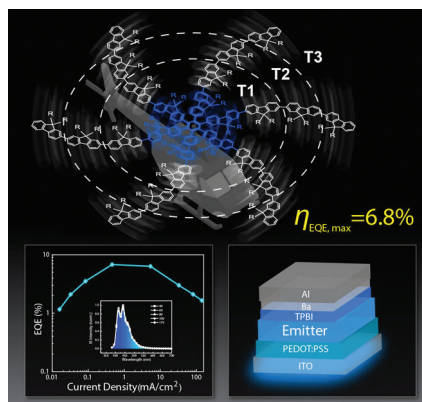


Biomedical Applications

S. Hong, K. Yang, B. Kang, C. Lee,
I. T. Song, E. Byun, K. I. Park,
S.-W. Cho,* H. Lee* 1774–1780

Hyaluronic Acid Catechol: A Biopolymer Exhibiting a pH-Dependent Adhesive or Cohesive Property for Human Neural Stem Cell Engineering

Grafting six fluorene units to a benzene ring generates a novel highly twisted core of hexakis(fluorene-2-yl)benzene. The new star-shaped macromolecules T1–T3, based on the propeller-like core, show high efficiency deep-blue emission. T2- and T3-based organic light-emitting diodes (OLEDs) exhibit the highest efficiency for non-doped solution-processed deep-blue OLEDs based on star-burst oligofluorenes. These star-shaped oligofluorenes are also demonstrated to be good hole-transporting materials.

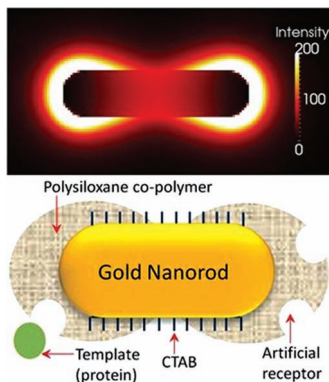


Light-Emitting Devices

Y. Zou, J. Zou, T. Ye, H. Li, C. Yang,*
H. Wu,* D. Ma,* J. Qin,
Y. Cao 1781–1788

Unexpected Propeller-Like Hexakis(fluorene-2-yl)benzene Cores for Six-Arm Star-Shaped Oligofluorenes: Highly Efficient Deep-Blue Fluorescent Emitters and Good Hole-Transporting Materials

Macromolecular imprinting of gold nanorods is achieved using reversible template immobilization and siloxane copolymerization. The anisotropic capping of the nanorods is used to selectively localize the protein imprints at the nanorod plasmonic hot-spots. This configuration represents the first protein-imprinted localized surface plasmon resonance nanosensor dedicated to the detection of biomarkers at clinically relevant concentrations.



Biosensing

A. Abbas, L. Tian, J. J. Morrissey,
E. D. Kharasch,
S. Singamaneni* 1789–1797

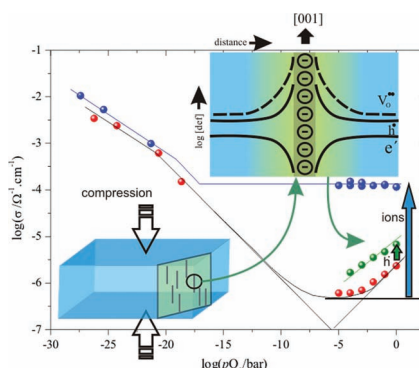
Hot Spot-Localized Artificial Antibodies for Label-Free Plasmonic Biosensing

FULL PAPERS

Structure-Property Relationships

K. K. Adepalli, M. Kelsch, R. Merkle,*
J. Maier 1798–1806

Influence of Line Defects on the Electrical Properties of Single Crystal TiO_2

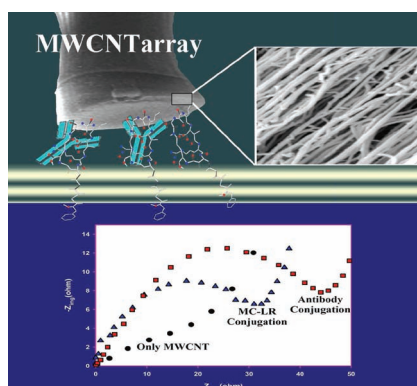


One-dimensional defects created in TiO_2 single crystals by uniaxial pressure strongly increase the conductivity parallel to the formed dislocations (at oxygen partial pressures from 10^{-5} bar to 1 bar) and even change the type from predominantly electronic to ionic. This can be explained by the accumulation of positive point defects in space charge zones adjacent to negatively charged dislocation cores.

Sensors

C. Han, A. Doecke, W. Cho,
V. Likodimos, A. A. de la Cruz,
T. Back, W. R. Heineman,
H. B. Halsall, V. N. Shanov,
M. J. Schulz, P. Falaras,
D. D. Dionysiou* 1807–1816

A Multiwalled-Carbon-Nanotube-Based Biosensor for Monitoring Microcystin-LR in Sources of Drinking Water Supplies

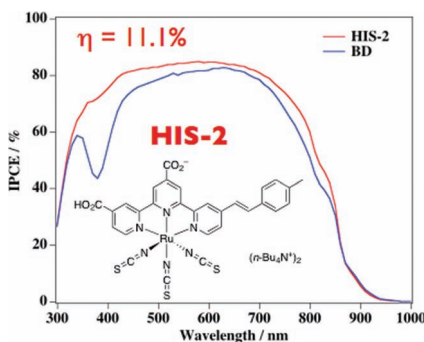


An highly sensitive Faradaic electrochemical impedance biosensor for monitoring microcystin-LR (MC-LR) in sources of drinking water supplies is developed using millimeter-long multiwalled carbon nanotube (MWCNT) arrays grown by water-assisted chemical vapor deposition with vertical alignment. A linear sensing response shows a wide microcystin-LR concentration range that is below the World Health Organization (WHO) provisional guideline limit of $1 \mu\text{g L}^{-1}$ for MC-LR in drinking water.

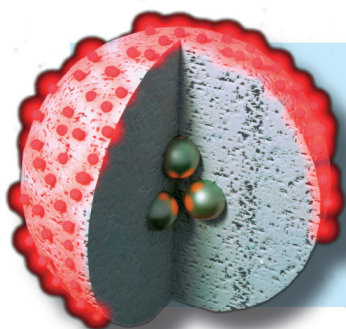
Solar Cells

Y. Numata, S. P. Singh, A. Islam,
M. Iwamura, A. Imai, K. Nozaki,
L. Han* 1817–1823

Enhanced Light-Harvesting Capability of a Panchromatic Ru(II) Sensitizer Based on π -Extended Terpyridine with a 4-Methylstyryl Group for Dye-Sensitized Solar Cells



Moderate electron-donating substituents are important for enhancement of the light harvesting capability of Ru(II) sensitizers. Substitution of a terpyridyl ligand with a 4-methylstyryl group increases the molecular absorption coefficient from the UV to the NIR region compared with black dye owing to the wider lowest unoccupied molecular orbital (LUMO) distributed over the terpyridyl and extended π -conjugation. The intense absorption gives a high J_{SC} of 23.07 mA cm^{-2} , and a resulting overall conversion efficiency of 11.1%.



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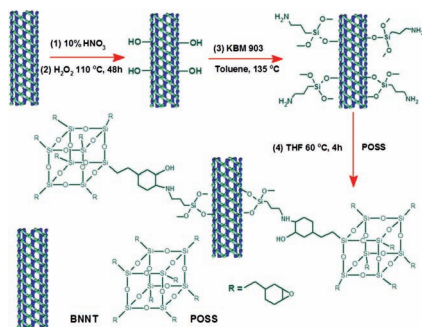
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FULL PAPERS

An ideal, dielectric, thermally conductive epoxy nanocomposite is successfully fabricated using polyhedral oligosilsesquioxane (POSS) functionalized boron nitride nanotubes (BNNTs) as fillers. Compared with the pure epoxy resin, the nanocomposites with POSS modified BNNTs not only exhibit much lower dielectric constant and dielectric loss tangent but also have high thermal conductivity and a low coefficient of thermal expansion.

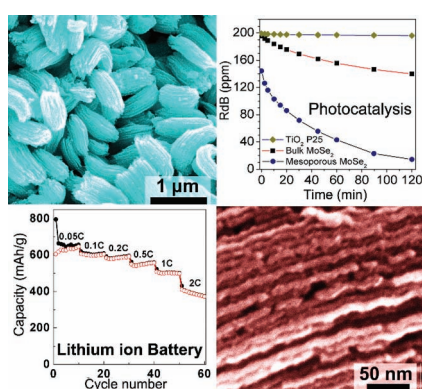


Nanocomposites

X. Huang, C. Zhi,* P. Jiang, D. Golberg, Y. Bando, T. Tanaka* 1824–1831

Polyhedral Oligosilsesquioxane-Modified Boron Nitride Nanotube Based Epoxy Nanocomposites: An Ideal Dielectric Material with High Thermal Conductivity

Ordered mesoporous crystalline MoSe_2 is synthesized using mesoporous silica as a hard template via a nanocasting strategy. It shows a strong light absorption throughout the entire visible wavelength region and has remarkable photocatalytic activity for the degradation of rhodamine B under visible light irradiation. The synthesized mesoporous MoSe_2 has a reversible lithium storage capacity of 630 mAh g^{-1} and better rate performance than the analogously synthesized mesoporous MoS_2 .

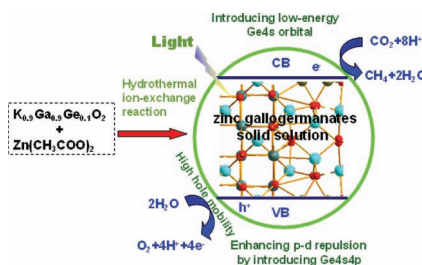


Mesoporous Materials

Y. F. Shi,* C. X. Hua, B. Li, X. P. Fang, C. H. Yao, Y. C. Zhang, Y.-S. Hu,* Z. X. Wang, L. Q. Chen, D. Y. Zhao, G. D. Stucky 1832–1838

Highly Ordered Mesoporous Crystalline MoSe_2 Material with Efficient Visible-Light-Driven Photocatalytic Activity and Enhanced Lithium Storage Performance

A hydrothermal ion-exchange reaction route is used to synthesize a solid solution of cubic spinel ZnGa_2O_4 and pseudocubic inverse spinel Zn_2GeO_4 . Introducing Zn_2GeO_4 into ZnGa_2O_4 narrows the band gap and induces the light-hole effective mass. As a result of band gap narrowing and high hole mobility, the zinc gallogermanates solid solution exhibits high activity in converting CO_2 and H_2O into CH_4 and O_2 .

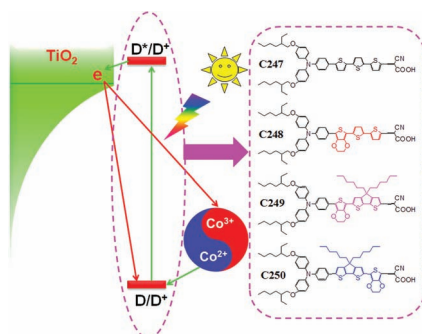


Photocatalysis

S. C. Yan,* J. J. Wang, H. L. Gao, N. Y. Wang, H. Yu, Z. S. Li, Y. Zhou,* Z. G. Zou* 1839–1845

Zinc Gallogermanate Solid Solution: A Novel Photocatalyst for Efficiently Converting CO_2 into Solar Fuels

Four new triphenylamine-cyanoacrylic acid photosensitizers with different thiophene conjugated linkers are synthesized and their important photocurrent and photovoltage features in mesoscopic titania solar cells based on a cobalt electrolyte are detailed via measuring transient photophysical and electrical signals. The best C250 dye presents an excellent power conversion efficiency of 9.4% at the AM1.5G conditions.



Solar Cells

N. Cai, Y. Wang, M. Xu, Y. Fan, R. Li,* M. Zhang,* P. Wang* 1846–1854

Engineering of Push-Pull Thiophene Dyes to Enhance Light Absorption and Modulate Charge Recombination in Mesoscopic Solar Cells