ADVANCED
FUNCTIONAL
MATERIALS

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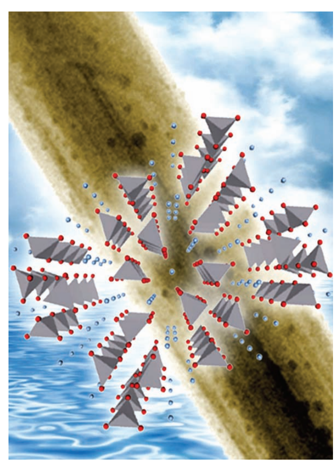
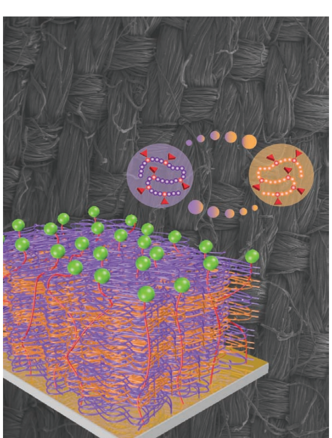
Hydrogels

Multiple shells with discrete porosities are created by D. Trau and co-workers on page 5108, within the matrix of a hydrogel. The front cover image illustrates, from both 2D and 3D perspectives, the increasing density of concentric shells from inner- to outermost layer. The 2D confocal images reflect the unique inwards interweaving behavior of polyallylamine (red) and polystyrenesulfonic acid (green) to produce a yellow layer. Intricate multi-porous architectures can be fabricated via this facile and easily tunable approach.

Nanoribbon Devices

Two basic building blocks including nano-field-effect transistors (nano-FETs) and nano-Schottky barrier diodes (nano-SBDs) are constructed by S.-H. Yu and co-workers, indicating the great potential of β-$AgVO_3$ nanoribbons for application in nanoelectronic devices. On page 5116, the diameter of the bridging nanoribbons and their numbers are tailored, and the surfaces are modified through light-irradiating the backbones of the nanoribbons.



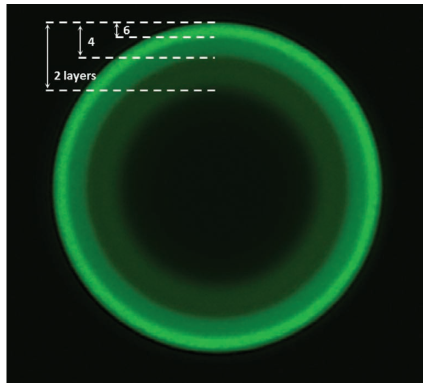


Polymer Films

F. Caruso, G. G. Qiao, and co-workers recently developed an efficient technique, termed the continuous assembly of polymers (CAP), to build nanoscale cross-linked films on surfaces via a simple coating procedure using pre-formed polymers. On page 5159, the CAP approach allows on-demand switching of surface properties (between superhydrophobic and hydrophilic surfaces) by facile alternate dipping in different polymer solutions, forming multilayered amphiphilic films.

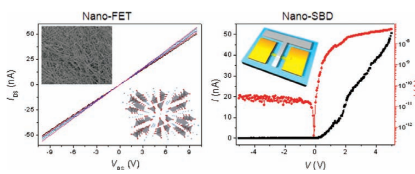
FULL PAPERS

Hydrogels



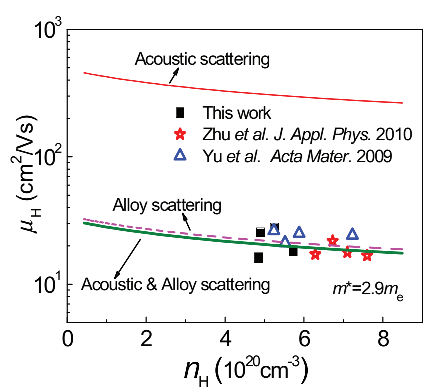
The inwards interweaving of polyamine and polyacid layers within an agarose matrix leads to the creation of well-defined, spherical multi-shells with different porosities. The higher the density of interweaving layers, the lower the porosity. The number and thickness of different levels of porosity are easily tuned by varying the number of polymer depositions and polymer concentration, respectively.

Nanoribbon Devices



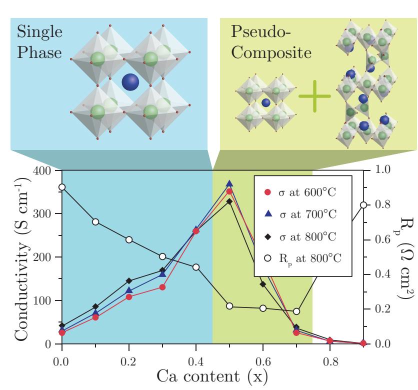
Two basic building blocks including nano-field-effect transistor (nano-FET) and nano-Schottky barrier diode (nano-SBD) can be constructed, indicating the great potential of β-$AgVO_3$ nanoribbons (NRs) for their applications in nanoelectronic devices.

Thermoelectrics



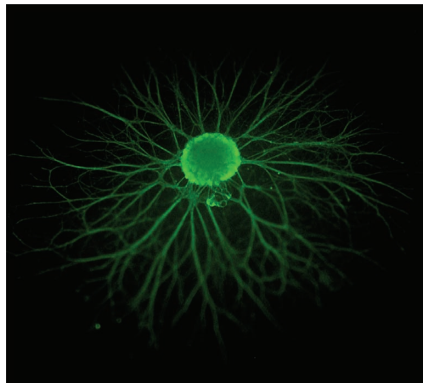
Alloy scattering dominated charge transport is found in the ZrNiSn thermoelectric solid solutions. A low deformation potential and a low alloy scattering potential are derived by a quantitative modeling of electrical transport properties, which is beneficial for a relatively high mobility. These intrinsic favorable features can contribute to the high power factors of the half-Heusler alloys.

Fuel Cells

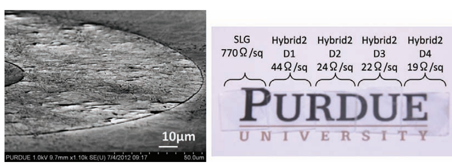


A wide compositional range of materials are proposed and applied as cathodes featuring highly competitive performance. Contrary to expectations, the formation of perovskite-brownmillerite pseudo-composites with high Ca substitution results in significant improvements to electrochemical performance and excellent thermomechanical compatibility with electrolytes. Furthermore, new insights are gained into the material surface properties controlling oxygen reduction processes.

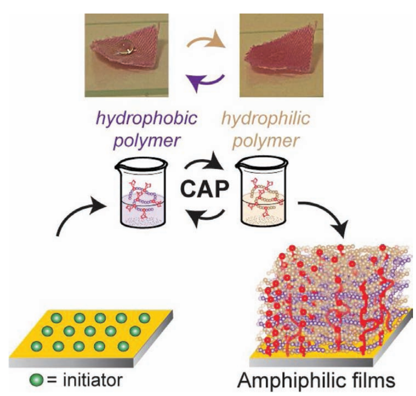
Silk hydrogels are soft biomaterials of stiffness matching that of nervous system tissues. Significant chick dorsal root ganglion explant outgrowth is exhibited on 2 to 4% w/v silk hydrogels supplemented with neurotrophic factors exemplifying their employment in extracellular matrix functionalization for neural tissue engineering applications.



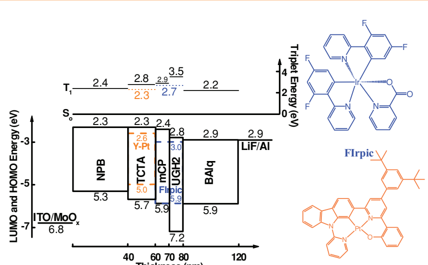
Single layer graphene-silver nanowire network co-percolating 2D-1D hybrid transparent conducting electrodes (TCE) with very low sheet resistance-optical transparency values (22 Ω/□ (stabilized to 13 Ω/□ after 4 months) at 88% transmittance at $\lambda = 550$ nm) are achieved. The development of such a high performance (chemically/mechanically/optically stable) material is inspired by a theoretical prediction of co-percolating transport in graphene-wrapped silver nanowire network.



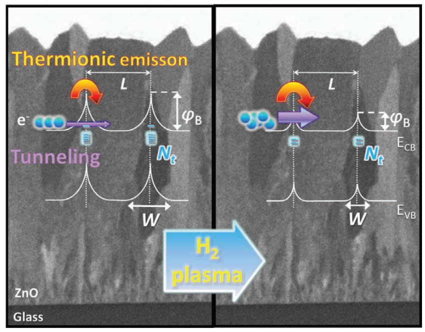
The continuous assembly of polymers (CAP) is utilized to fabricate advanced functional nanocoatings with tunable film compositions on various substrates. The versatility of CAP is demonstrated by the formation of (super) hydrophobic coatings on hydrophilic substrates including paper, cotton, aluminium foil, and glass. Moreover, by simple alternate dipping in hydrophilic and hydrophobic macro-crosslinker solutions, novel stratified amphiphilic films can be assembled via CAP.



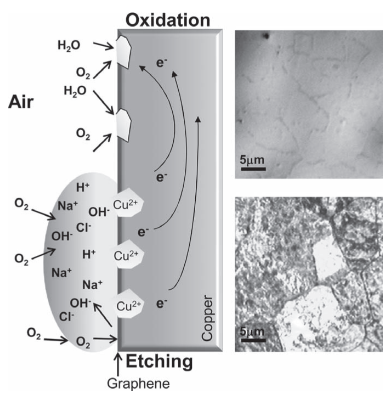
An effective and simple approach for boosting the performance of white organic light-emitting devices (WOLEDs) is demonstrated. A modified device structure consisting of a composite blue host that can significantly improve both device efficiency and efficiency roll-off is developed. With the modified structure, a WOLED exhibiting twofold enhancement in the total efficacy from 31 up to 61 lm W^{-1} is realized.



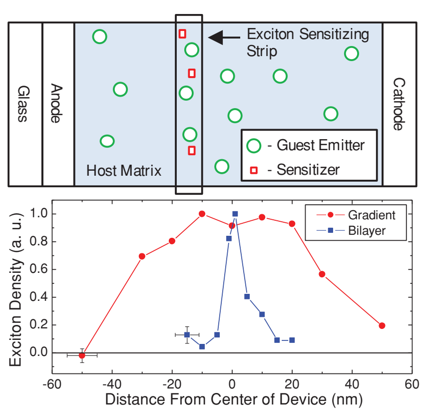
FULL PAPERS



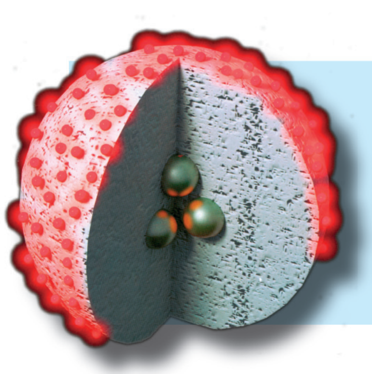
Enhanced mobility and conductivity are reached in polycrystalline zinc oxide films by hydrogen plasma post-deposition treatment. Optoelectrical characterization methods show that electron trap defects at grain boundaries are passivated, free electron concentration is increased, and that the electron transport is no longer limited by grain boundary scattering, even for non-intentionally doped films.



An effective method for nondestructive characterization of graphene defects is shown by enhancing oxidation of a Cu film underneath graphene through the graphene grain boundaries in air by electron injection supplied from electrochemical reaction of the graphene/Cu film. This process involves no appreciable oxidation of the graphene layer or the graphene grain boundary, as confirmed by detailed Raman and X-ray photoelectron spectroscopy.



The impact of emissive layer architecture on the exciton recombination zone in organic light-emitting devices is investigated. A technique to measure the location and spatial extent of exciton recombination in organic light-emitting devices is demonstrated. The technique relies on the Förster energy transfer of an exciton from a luminescent guest to a dilute sensitizing molecule included in narrow strips within the emissive layer. It is found that the recombination zone depends strongly on emissive layer composition and architecture.



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 PAPER

Field-Effect Transistors

Red-emitting CdSe quantum dots coated with pyridine, self assembled into a layer over a large area single-sheet graphene, serve as photosensitizers. Pyridine coating of the quantum dots enhances their adhesion to the graphene surface, and provides electronic coupling that is essential for efficient photoinduced electron transfer from the CdSe to the 2D carbon allotrope. A hole shift to the pyridinium ligands accompanies the electron transfer, making this interfacial charge transfer electrostatically favorable.