ADVANCED FUNCTIONAL MATERIALS

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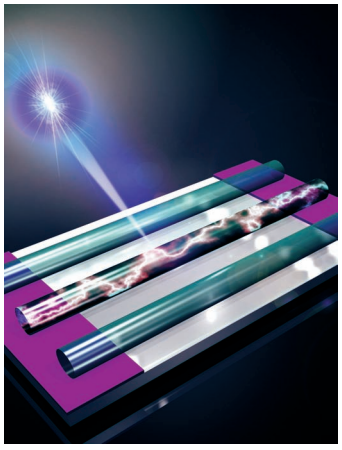
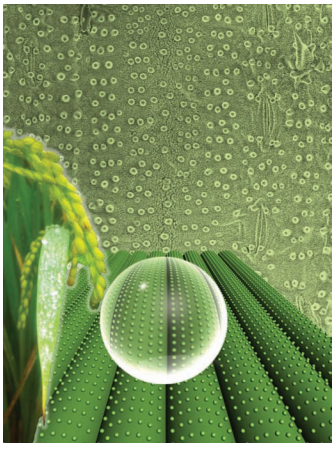


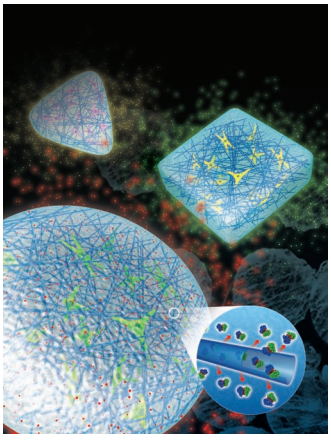
Organic Phototransistors

On page 629, Hojeong Yu, Zhenan Bao, and Joon Hak Oh report single-crystalline nanowire organic phototransistors (NW-OPTs) fabricated using an n-channel organic semiconductor, *N,N′*-bis(2-phenylethyl)-perylene-3,4:9,10-tetracarboxylic diimide. Highly sensitive and reproducible photoresponses are observed from the NW-OPTs and photogenerated charge carrier behavior is quantitatively investigated. The findings highlight single-crystalline NW-OPTs as an alternative to conventional thin-film-type photodiodes and could pave the way for optoelectronic device miniaturization.

Biomimetics

Inspired by the hierarchical structures of rice leaf surfaces, synthetic rice leaf-like wavy surfaces with tunable anisotropic wettability are described by Kilwon Cho and co-workers on page 547. The nanometer scale roughness of the rice leaf-like surfaces is controlled to yield tunable anisotropic wettability and hydrophobic properties that transition between the anisotropic/pinned, anisotropic/rollable, and isotropic/rollable water droplet behavior states.





Drug Delivery

On page 591, Won-Gun Koh and co-workers report a simple method to generate well-defined microscopic architectures of electrospun nanofibers and describe their potential applications in biomedical fields. A combination of electrospinning and hydrogel patterning generates microarchitectured nanofibers that are localized within various shapes of hydrogel microparticles. Resultant nanofiber-entrapped hydrogels can be used for sustained release of protein and cell encapsulation

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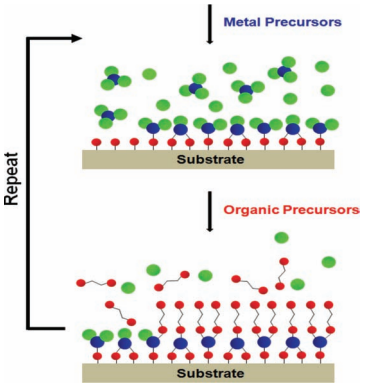
FEATURE ARTICLE

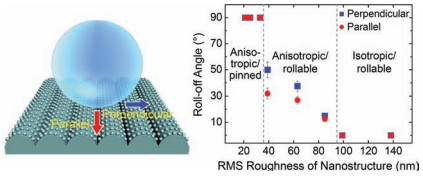
Hybrid Materials



Hybrid organic–inorganic films can be grown using molecular layer deposition (MLD) techniques. MLD utilizes sequential, self-limiting reactions to deposit conformal films with atomic level control. Metal alkoxide films known as "metalcones" can be fabricated using metal precursors and organic alcohols. The functional properties of metalcone films can be tuned by varying the relative fraction of their organic and inorganic constituents.

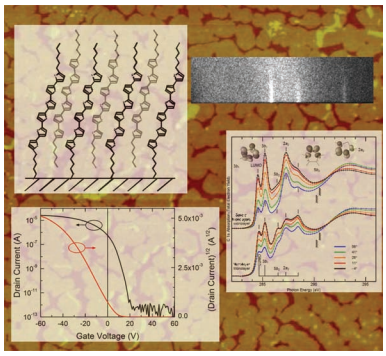
FULL PAPERS

Superhydrophobicity



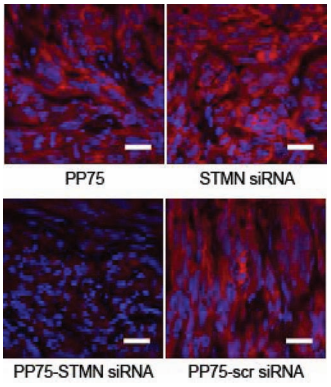
Rice leaf-like wavy surfaces with tunable anisotropic wettability are fabricated through the combination of electrostatic layer-by-layer assembly and surface wrinkling. The hierarchically structured surfaces, with a surface roughness that can be tuned by changing the number of polyelectrolyte and nanoparticle deposition cycles, yields controlled anisotropic/pinned, anisotropic/rollable, or isotropic/rollable dynamic water droplet behavior states.

Organic Semiconductor Monolayers



Two-dimensional monolayers of α,ω-dihexylsexithiophene (α,ω-DH6T) exhibit field-effect hole mobilities of up to 0.032 $cm^2\ V^{-1}\ s^{-1}$, higher than the mobilities commonly observed in monolayers of other small-molecule organic semiconductors. X-ray diffraction and spectroscopy reveal that the structure of these monolayers is distinct from bulk α,ω-DH6T.

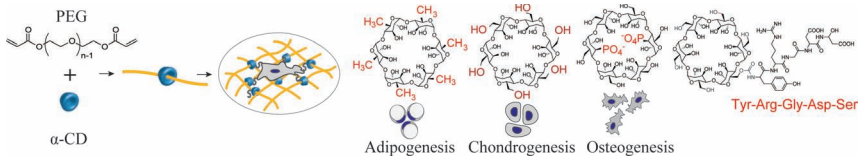
Tumor Therapy



Stathmin expressing malignant glioma tumors injected with PP75-stathmin siRNA conjugates have decreased expression of stathmin (red fluorescence) compared to control tumors injected with PP75, stathmin siRNA, and PP75-scrambled siRNA conjugates. Blue fluorescence is due to DAPI staining of nuclei.

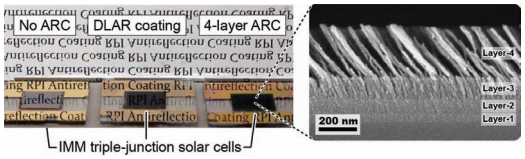
FULL PAPERS

Poly(ethylene glycol) is used to create synthetic hydrogel microenvironments for cells, but the ether backbone lacks sites for functionalization. Here, supramolecular chemistry is applied to create modular hydrogels using α-cyclodextrins modified with biological and chemical functional groups with independently controlled crosslinking densities designed to direct stem cell functions.



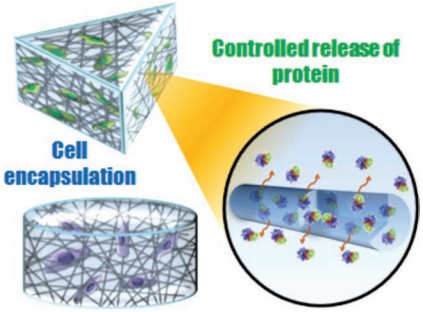
Tissue Engineering

A multiple-discrete-layer omnidirectional and broadband anti-reflection (AR) coating is demonstrated on an inverted metamorphic (IMM) triple-junction solar cell device. Due to an excellent refractive index matching with the ambient air and a genetic algorithm optimization of the discrete refractive index profile, the IMM device employing a four-layer AR coating shows better photovoltaic performance at all incident angles (0°–80°) than an IMM device employing a traditional double layer AR coating.



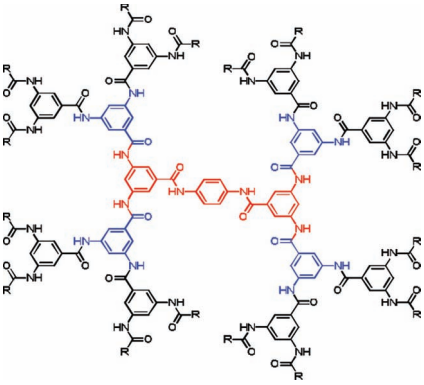
Photovoltaics

Microarchitectured nanofibers that are localized within hydrogel microparticles are fabricated by combining electrospinning and photolithography. It is demonstrated that the resultant microarchitectures can achieve sustained release of protein and efficiently encapsulate mammalian cells.



Drug Delivery

Amphiphilic aromatic polyamide dendrimers (G1–G3) are synthesized and used for modification of a commercial TFC-S membrane by direct percolation. The dendrimer size plays an important role in the formation of the new active layer. Significantly improved solute rejection is observed for the modified membrane even at low modification levels.



Water Purification

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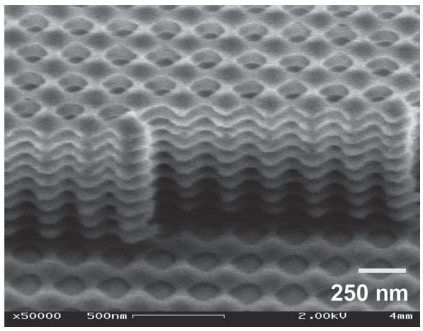
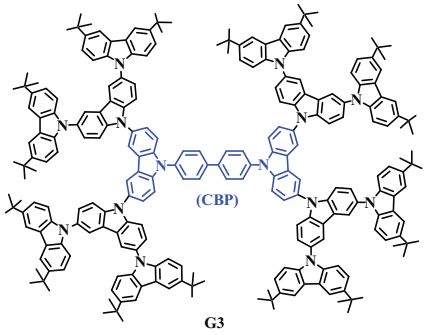
Holography



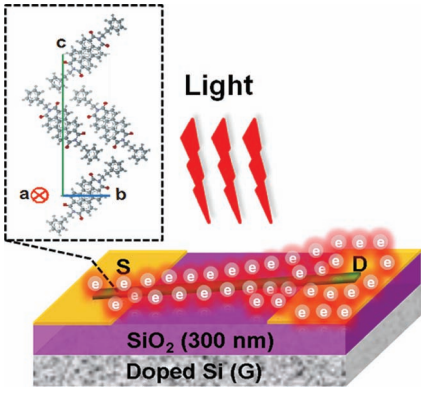
High-aspect-ratio three-dimensional photoresist nanostructures are fabricated with simple two-beam holography that relies on the novel use of vertical standing wave phenomena. The nanostructures, with large pattern coverage areas, are employed for various additive and subtractive pattern transfer processes, such as etching, deposition, and molding, for potential applications as photonic crystals, in photovoltaic solar cells, and as photocatalysts in water decontamination.

Organic Light-Emitting Diodes

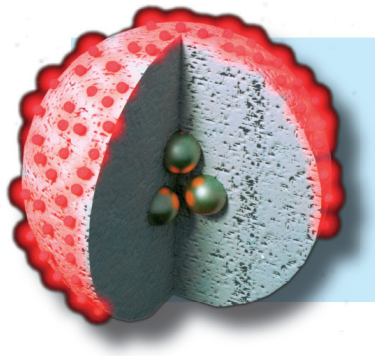


The dendritic analogues of a small molecular phosphorescent host (4,4′-N,N′-dicarbazolebiphenyl (CBP)) inherit similar triplet energies and HOMO/LUMO levels to those of CBP, but exhibit extra merits of amorphous nature and solution-processible capability. These dendrimers greatly enhance device performance in comparison with traditional polyvinylcarbazole (PVK) when used as hosts in phosphorescent organic light-emitting diodes (PHOLEDs), representing perfect alternatives to PVK as solution-processible phosphorescent hosts for PHOLEDs.

Transistors



Organic nanowire phototransistors based on BPE-PTCDI exhibit interesting photoelectronic properties upon different light irradiation and yield much higher photoconductive gains and external quantum efficiencies than their thin-film counterparts. Photogenerated charge-carrier behavior of single-crystalline nanowires is also investigated by analyzing the charge accumulation and release rates, indicating how the additional free-charge-carrier density varies quantitatively upon light irradiation.



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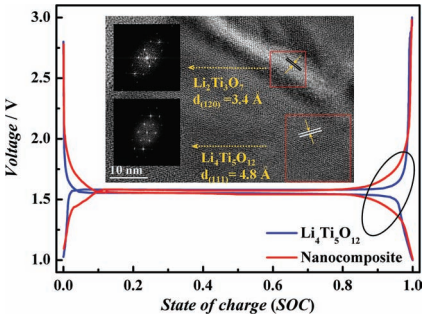
A highly crystalline binary $Li_4Ti_5O_{12}$–$Li_2Ti_3O_7$ nanocomposite is prepared in a facile manner, and the challenging voltage-based state of charge (SOC) estimation for the $Li_4Ti_5O_{12}$ anode is successfully carried out. The nanocomposite consists of interconnected nanograins of ≈20 nm size with a hierarchical nanoporous structure, resulting in an enhanced rate capability and excellent cycling stability. The nanocomposite consequently has significant potential to be used as an anode material in large lithium-ion batteries for electric vehicle and stationary power source applications.



Lithium Batteries