ADVANCED FUNCTIONAL MATERIALS

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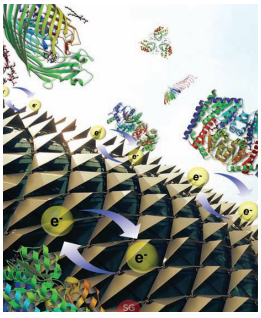
Wearables

R. Matsuzaki and K. Tabayashi develop a highly stretchable, global, and distributed local strain sensing electrode made of GaInSn and polydimethylsiloxane for wearable devices. On page 3806, simultaneous measurement of the distributed local and global strains can be achieved using a single electrode line. A data-glove prototype is manufactured as an application of the strain sensing line, demonstrating identification of the folding state of fingers.

Tissue Reconstruction

Mussel-inspired, catechol-modified hyaluronic acid (HA) hydrogel is demonstrated to exhibit higher biocompatibility and improved tissue adhesiveness in comparison to HA hydrogel crosslinked via photopolymerization. The tissue adhesive HA hydrogel presented by S.-W. Cho and team on page 3814 enables highly effective, minimally invasive cell therapy by mediating simple painting of the cells onto various organs with defective functions such as resected liver and infarcted heart.



Biosensors

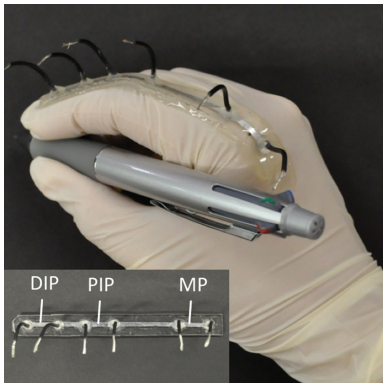
On page 3840, W. S. Kuan, D. T. Leong, and colleagues develop DNA nanopyramid-based biosensing of *Escherichia coli* developed by using the highly specific sandwich immunoassay assembly. Low detection limits are obtained for *E. coli* lipopolysaccharides, bacteria lysate, and whole bacteria. This system can also distinguish the bacteria in a complex mixture while not getting interferences from the mixture components. (Protein molecules images: RCSB PDB. SG50 Logo - "Singapore50.sg".)

Memory Devices

Resistive switching (RS) devices with configurable functionality based on silk protein are demonstrated by T. Wu, X. Chen, and co-workers on page 3825. The types of RS can be effectively and exactly controlled between memory and threshold. The results suggest that silk protein has great potential in cross-bar array applications for biocompatible and environmentally friendly high density data storage.

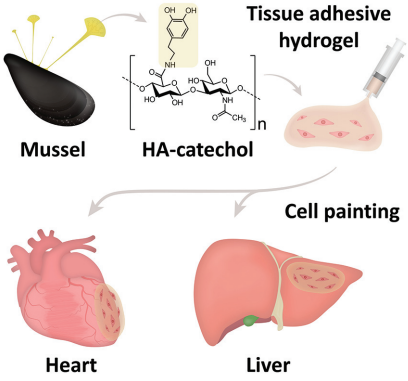
FULL PAPERS

A highly stretchable, global, and distributed local strain sensing electrode made of GaInSn and polydimethylsiloxane is developed for wearable devices. Simultaneous measurement of the distributed local and global strains can be achieved using a single electrode line. A data-glove prototype is manufactured as an application of the strain sensing line, demonstrating identification of the folding state of fingers.



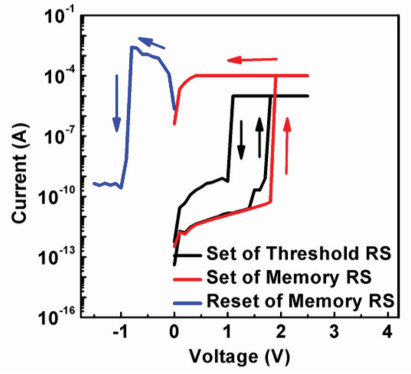
Wearables

Bioinspired, catechol-modified hyaluronic acid (HA) hydrogel is highly biocompatible and exhibits improved tissue adhesiveness in comparison to HA hydrogel crosslinked via photopolymerization. Tissue adhesive catechol-modified HA hydrogel can mediate highly effective, minimally invasive cell therapy in defected models such as liver resection and myocardial infarction.



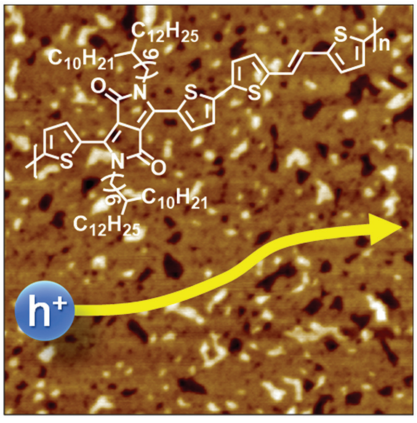
Tissue Reconstruction

Resistive switching (RS) devices with configurable functionality based on protein are successfully achieved. By controlling the compliance current in the set process, the types of RS (memory and threshold RS) can be effectively and exactly controlled. In addition, two types of memory devices including random access memory and read only memory can be achieved with the RS effect.



Memory Devices

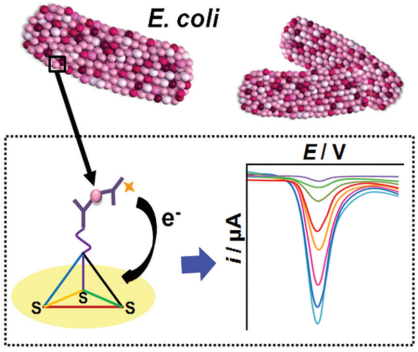
A donor–acceptor diketopyrrolopyrrole derivative copolymer with long, linear, space-separated alkyl side chains and thiophene vinylene thiophene can form percolated nanogranules of edge-on molecules in an as-spun film. Thermal annealing at 200 °C for 10 min yields a layered morphology with 27 Å steps and π-overlap of 3.55 Å; the resulting organic field-effect transistor (OFET) has μ_{FET} as high as 3.7 $cm^2 V^{-1} s^{-1}$.



Organic Semiconductors

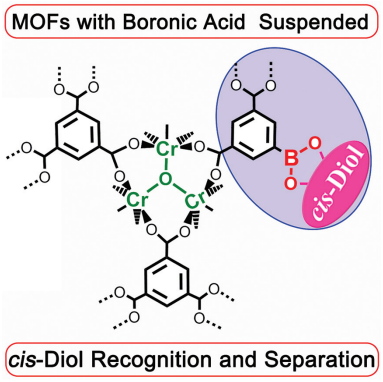
FULL PAPERS

Biosensors



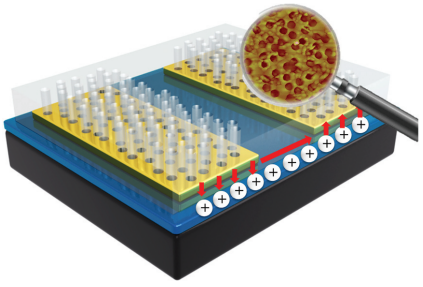
DNA nanopyramid-based biosensing of *Escherichia coli* is developed by using the highly specific sandwich immunoassay assembly. Coupled with the sensitive square wave voltammetry readout method, low detection limits are obtained for *E. coli* lipopolysaccharides, bacteria lysate, and whole bacteria. This system can also distinguish the bacteria in a complex mixture while not getting interferences from the mixture components.

Porous Materials

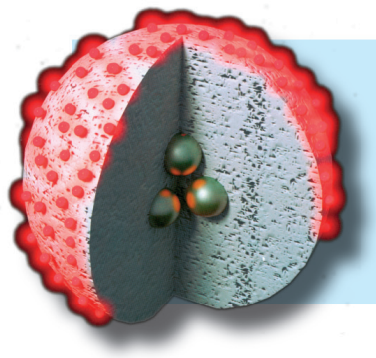


Introduction of accessible boronic acid functionality into metal–organic frameworks is successfully achieved using a facile linker fragmentation strategy. In virtue of their accessible boronic acid groups, exceptional chemical stability, as well as high porosity, the newly elaborated functional material offers a new platform for the recognition and separation of *cis*-diol containing biomolecules.

Nanopore Structures



Nanopore-structured source/drain electrodes are introduced into fabricating bottom-gate bottom-contact configuration organic field effect transistors (OFETs) by nanosphere lithography. The introduction of this nanopore structure tremendously enhances the charge injection and accordingly improves the mobility of charge carriers in the OFETs about 20 times when compared with results in the literature. It is believed that this electrode structure is a valuable approach for improving organic filed effect transistors.



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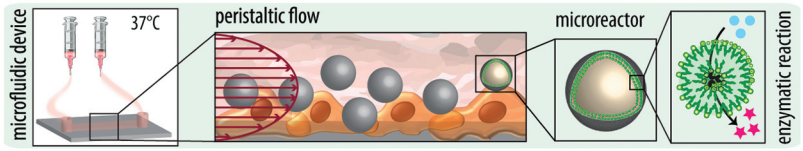
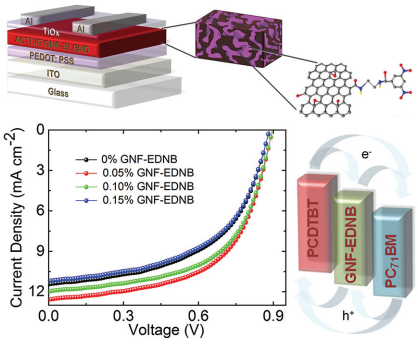
Subcompartmentalized microreactors consisting of liposomes trapped within a poly(dopamine) carrier are extracellular active in a microfluidic set-up which mimics the peristaltic movement of the intestine. The nonhuman enzyme phenylalanine ammonia lyase loaded within the liposomal subunits converts the undesired amino acid phenylalanine into the nontoxic compound *trans*-cinnamic acid toward an oral treatment for phenylketonuria.



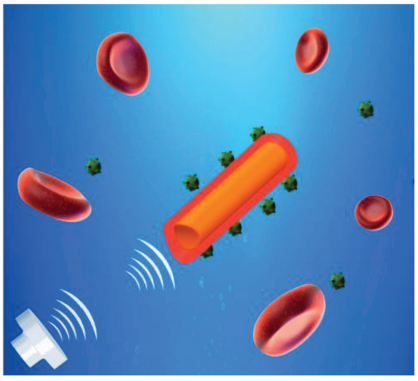
Enzyme Defects

Graphene nanoflakes functionalized with 3,5-dinitrobenzoyl with tunable energy levels are used as an electron-cascade acceptor in air-processed ternary organic solar cells (OSCs). Ternary OSCs exhibit an efficiency of 6.41%, 18% higher than the binary blend and one of the highest for air-processed OSCs.



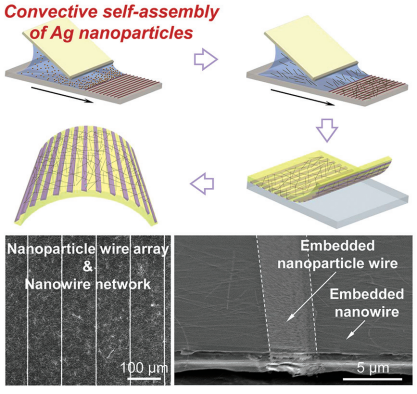
Organic Photovoltaics

A red blood cell membrane-coated nanowire that can function as a biomimetic motor sponge is presented. The unique membrane coating and powerful ultrasound propulsion allow it to serve as a moving toxin decoy to efficiently remove membrane-damaging toxins. Such motor sponges bridge artificial nanomotors with biological entities and hold great promise for treating injuries and diseases caused by membrane-damaging toxins.



Biomimetic Motors

Well-organized and highly conductive Ag nanoparticle wire arrays are realized using the surfactant-assisted convective self-assembly. A thermally sintered hybrid structure of nanoparticle wire array and nanowire network is reliably transferred into a transparent polymer matrix, which shows extremely good optoelectrical and electromechanical properties. The nanoparticle wire arrays can be applied to improve the performance of other transparent conductors or electronic devices.

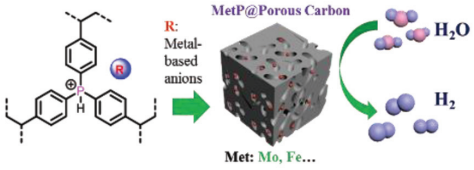


Optoelectronics

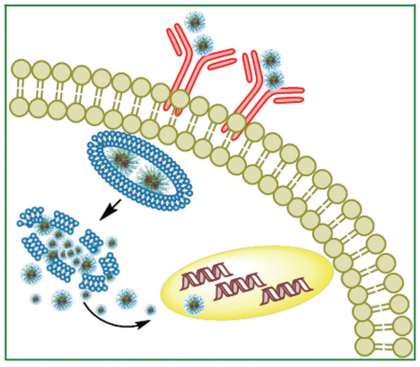
FULL PAPERS

Electrocatalysts

Metal-phosphide-loaded porous carbons (MetP@PCs) are prepared from a phosphorous-containing ionic-polymer framework. Unlike previously reported transition-metal-based electrocatalysts, the metal source for MetP@PCs are complex ions, rather than metal salts. Their performance in the electrochemical catalysis of the hydrogen evolution reaction is very promising, and the performance of the PC loaded with molybdenum phosphide is comparable with that of the commercial Pt/C catalyst.

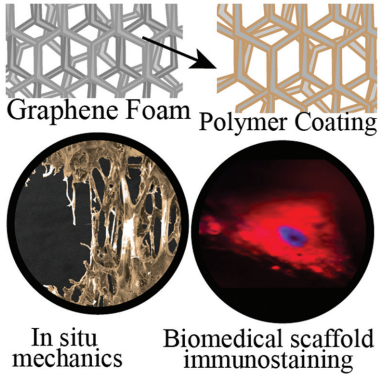


Gene Delivery



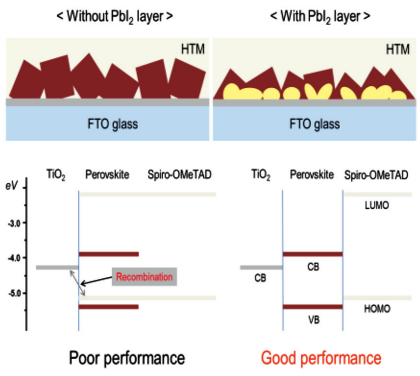
Preserving the integrity of plasmid DNA (pDNA) after endocytosis by promoting quick release of pDNA from endosome compartment is believed to be vital for gene transfection. In this article, the first evidence is presented that suggests that slow and sustained release of the pDNA from endosome is the key for achieving efficient transfection. This can be achieved by covalent coating of nanoplexes with chondroitin sulfate.

Tissue Engineering



A novel 3D graphene foam (GrF)/PLC copolymer composite scaffold is synthesized by dip-coating. GrF-PLC scaffold retains porous 3D structure resulting in 3700% enhancement in strength and 3100% increase in ductility over pure GrF. The unique mechanical and biotolerant properties of the GrF-PLC scaffold are studied by culturing of human mesenchymal stem cells for musculoskeletal tissue engineering applications.

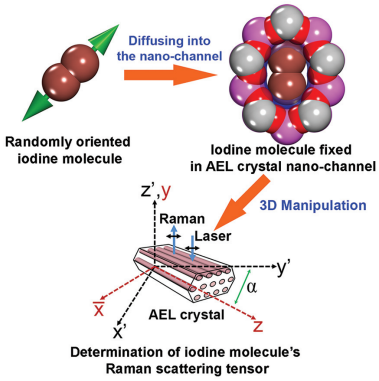
Energy Conversion



The influence of the unreacted PbI_2 to the performance of perovskite solar cells is investigated. The optimized morphology of the PbI_2 under layer is found to be essential to form a dense perovskite layer preventing recombination by direct contact between TiO_2 and a hole transporting layer, and increase the charge collection efficiency.

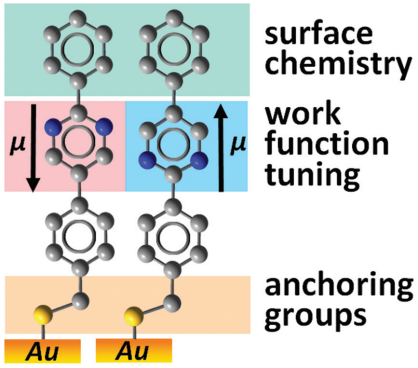
FULL PAPERS

For the first time, the Raman scattering tensor is directly determined on orientation-fixed single iodine molecules, which are confined inside the nano-sized channels of zeolite $AlPO_4$–11 (AEL) single crystals. It indicates that the big family of zeolites may be utilized as directing template database for orientating a large number of guest molecules to estimate their structures by polarized Raman spectroscopy.



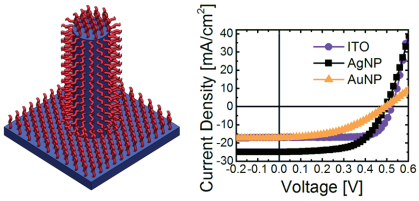
Raman Spectroscopy

A highly promising approach for changing charge-injection barriers at the nanoscale through conjugated self-assembled monolayers (SAMs) is described. This—in sharp contrast to the typically pursued tail-group substitution—is realized without affecting the SAM-ambient interface. The goal is achieved by embedding dipolar groups at varying orientation in the SAM-forming molecules.



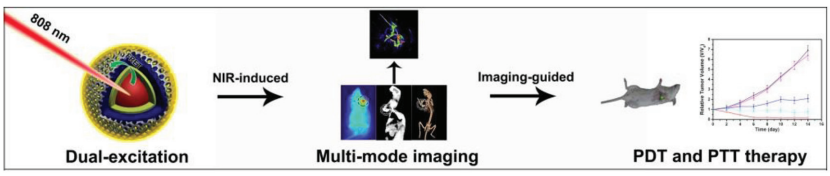
Interface Control

Sacrificial thin polymer films prepared by surface-initiated polymerization are used as a template for the fabrication of highly conformal metal nanoparticle solar cell electrodes. These metal nanoparticle films are dual functional in that they not only mediate charge transport, but also enhance light capture due to the plasmonic scattering properties of the nanoparticles.



Solar Cells

Au nanoclusters with photodynamic therapy and photothermal therapy effects are combined with upconversion nanoparticles for the first time to form a new multifunctional cancer therapy platform with multimode imaging and dual phototherapy function. The nanoparticles could be promising to achieve the light-induced and imaging-guided cancer therapy with low side effects.



Cancer Treatment