ADVANCED FUNCTIONAL MATERIALS

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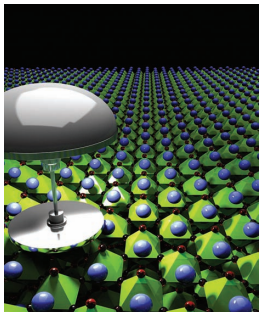
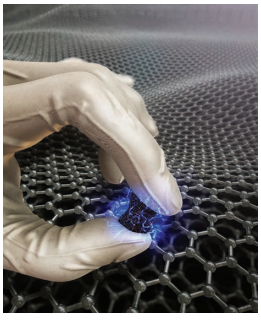


Indoor Light Harvesting

On page 7064, H.-W. Lin and co-workers demonstrate the use of photovoltaic cells with an organometallic perovskite as the active layer for indoor dim-light energy harvesting. Careful design of the electron transporting materials and fabrication processes allows the traps in the perovskite active layers and carrier dynamics to be controlled. Power conversion efficiencies of ≈20–27% are achieved under 100–1000 lux fluorescent lamp illumination.

Aerogels

K.-Y. Chun, J. Oh, and co-workers present the synthesis of ultra-low-density 3D reduced graphene oxide (rGO) aerogels on page 6976. These N-doped rGO aerogels, produced via a combined method of hydrothermal and thermal annealing, exhibit high electrical conductivities and compressibility. This synthetic method provides fundamental insights for further design and construction of other 3D layered hybrid aerogel materials for energy, photocatalysis, environmental, and sensing applications.

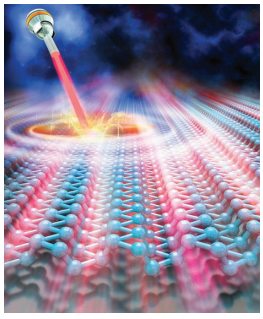


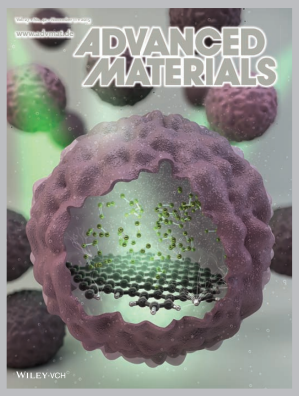
Metallic Printing

A new method for 3D printing complex metallic structures is presented by R. N. Shah and co-workers on page 6985. Particle-laden liquid inks comprised of metals, metal oxides, and other metal compound powders are 3D printed into complex solid architectures. The printed objects are then thermochemically processed in a reducing hydrogen atmosphere, leading to a metallic structure maintaining the structural integrity of the printed form, with no warping or cracking.

Phosphorene

On page 6996, H. Zhang, X.-F. Yu, and co-workers describe a simple liquid exfoliation method for production of phosphorene with excellent water stability, controllable size and layer number, as well as high yield. The resulting 1–4-layered phosphorene exhibits layer-dependent Raman scattering characteristics, which provide a fast and efficient means for in situ determination of the layer number of phosphorene.





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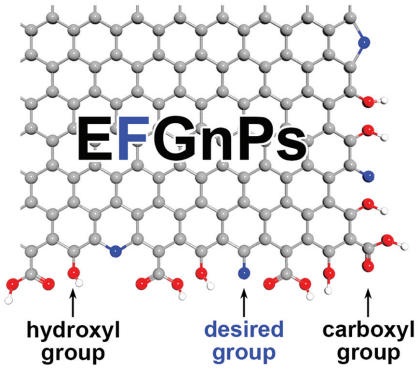
FEATURE ARTICLE

A method for producing edge-selectively functionalized graphene nanoplatelets (EFGnPs) is developed by simple mechanochemical ball-milling graphite in the presence of the desired reactant(s). Due to their advantages such as manufacturing simplicity, edge-selectivity, eco-friendliness, low-cost and high-quality over other commonly used methods, EFGnPs have potential in a broad range of applications.



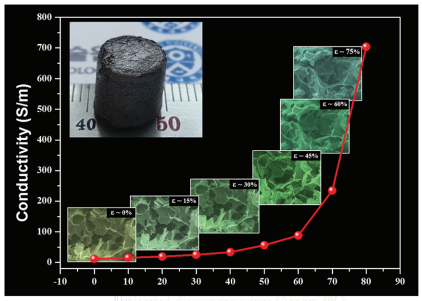
Graphene Nanoplatelets

I.-Y. Jeon,* S.-Y. Bae, J.-M. Seo, J.-B. Baek* 6961–6975

Scalable Production of Edge-Functionalized Graphene Nanoplatelets via Mechanochemical Ball-Milling

FULL PAPERS

The synthesis of a novel ultralightweight, compressible, electrically conductive, and hydrophobic N-doped reduced graphene oxide aerogel is described.



Aerogels

I. K. Moon, S. Yoon, K.-Y. Chun,* J. Oh* 6976–6984

Highly Elastic and Conductive N-Doped Monolithic Graphene Aerogels for Multifunctional Applications

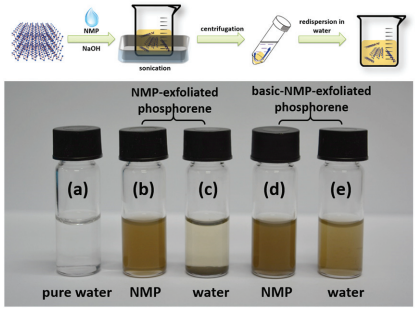
Particle-laden liquid inks are comprised of metals, metal oxides, and other metal compound powders. These inks are rapidly 3D-printed into powder-dense solids via simple extrusion to create the user-defined architecture. Upon thermochemical processing in a reducing hydrogen atmosphere, the 3D-printed objects reduce to metals, sinter, and result in a metallic architecture that maintains the as-printed form without warping or cracking.

Metallic Printing

A. E. Jakus, S. L. Taylor, N. R. Geisendorfer, D. C. Dunand, R. N. Shah* 6985–6995

Metallic Architectures from 3D-Printed Powder-Based Liquid Inks

A basic *N*-methyl-2-pyrrolidone liquid exfoliation method is described to produce phosphorene with an excellent water stability, controllable size and layer number, as well as in a high yield. Phosphorene with one to four layers exhibits layer-dependent Raman scattering characteristics thus providing a fast and efficient means for the in situ determination of the thickness of phosphorene.



Phosphorene

Z. Guo, H. Zhang,* S. Lu, Z. Wang, S. Tang, J. Shao, Z. Sun, H. Xie, H. Wang, X.-F. Yu,* P. K. Chu ... 6996–7002

From Black Phosphorus to Phosphorene: Basic Solvent Exfoliation, Evolution of Raman Scattering, and Applications to Ultrafast Photonics

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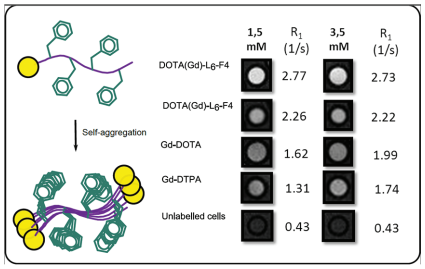
FULL PAPERS

Contrast Agents

C. Diaferia, E. Gianolio, P. Palladino, F. Arena, C. Boffa, G. Morelli, A. Accardo* 7003–7016

Peptide Materials Obtained by Aggregation of Polyphenylalanine Conjugates as Gadolinium-Based Magnetic Resonance Imaging Contrast Agents

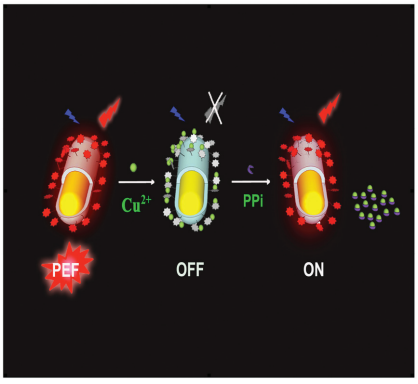


Novel peptide materials are proposed as a new class of supramolecular gadolinium based magnetic resonance imaging contrast agents. These materials, containing four phenylalanine residues, a Gd-DOTA or Gd-DTPA complex, and a poly(ethylene glycol) spacer, are able to self-aggregate in amyloid type fibrils with an antiparallel alignment in acqueos solution at very low concentration.

Biosensors

L. Wang, Q. Song, Q. Liu, D. He, J. Ouyang* 7017–7027

Plasmon-Enhanced Fluorescence-Based Core–Shell Gold Nanorods as a Near-IR Fluorescent Turn-On Sensor for the Highly Sensitive Detection of Pyrophosphate in Aqueous Solution

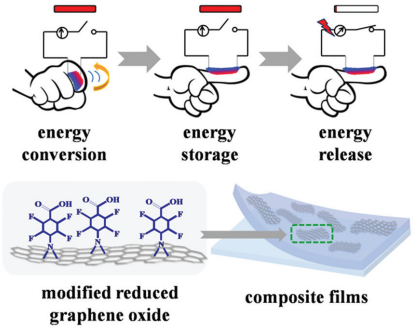


Core–shell gold nanorods are employed to significantly enhance the fluorescence intensity of *meso*-tetra(4-carboxyphenyl) porphyrin via the plasmon-enhanced fluorescence effect. These nanostructures combined with the quenching effect of Cu^{2+} are applied to turn-on detection of pyrophosphate with nanomolar sensitivity in aqueous solutions, which may provide great potential for the development of highly sensitive sensing systems in biological and biomedical applications.

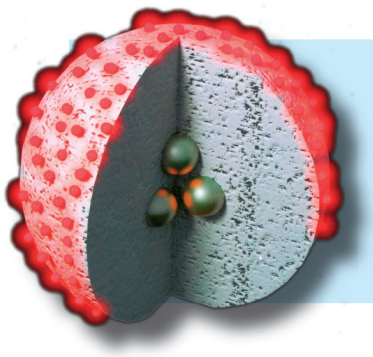
Energy Storage

W. Tong, Y. Zhang,* Q. Zhang, X. Luan, F. Lv, L. Liu, Q. An* 7029–7037

An All-Solid-State Flexible Piezoelectric High-*k* Film Functioning as Both a Generator and In Situ Storage Unit



An all-solid-state flexible generator–capacitor film is fabricated by employing the dual role of PVDF-HFP: it serves as both the piezoelectric generator and the polymeric matrix of the capacitor. Chemically modified reduced graphene oxide fillers effectively enhance film permittivity. The film converts low-frequency biomechanical energy to stored electricity and can delayed release the electric signal on demand.



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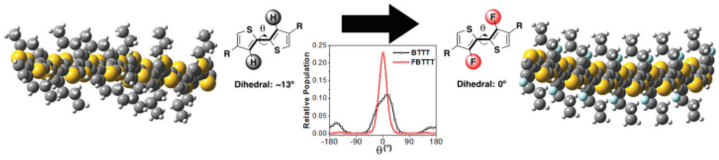
FULL PAPERS

Backbone fluorination of the benchmark liquid crystalline polymer poly(2,5-bis(3-alkylthiophen-2-yl)thieno[3,2-b]-thiophene) is shown to significantly influence its physical properties, substantially increasing the melting point and promoting aggregation. Density functional theory calculations suggest that this is related to a more coplanar backbone for the fluorinated polymer. Field effect transistor measurements show a fourfold increase in mobility upon fluorination.

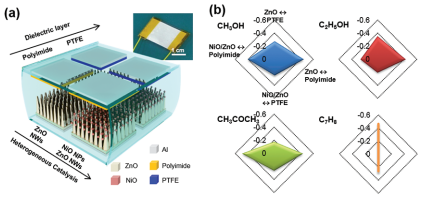


Fluorination

P. Boufflet, Y. Han, Z. Fei, N. D. Treat, R. Li, D.-M. Smilgies, N. Stingelin, T. D. Anthopoulos, M. Heeney*.....7038–7048

Using Molecular Design to Increase Hole Transport: Backbone Fluorination in the Benchmark Material Poly(2,5-bis(3-alkylthiophen-2-yl) thieno[3,2-*b*]-thiophene (pBTTT)

A two-dimensional microarray functioning as a self-powered electronic nose with high gas selectivity is shown. This electronic sensor is based on the triboelectrification between ZnO nanowires and dielectric layers and the heterogeneous catalytic reaction occurring on those structures. The electronic noses are able to distinguish between four volatile organic compound gases with a detection limit of 0.1% and work at room temperature without an external power source.

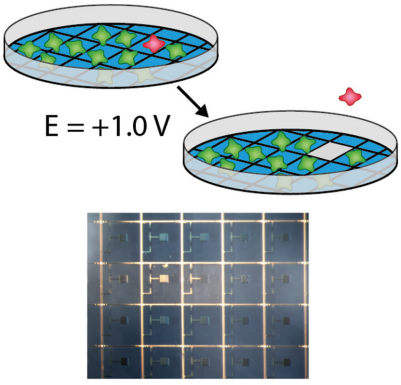


Sensors

J.-h. Kim, J. Chun, J. W. Kim, W. J. Choi, J. M. Baik*.....7049–7055

Self-Powered, Room-Temperature Electronic Nose Based on Triboelectrification and Heterogeneous Catalytic Reaction

Selective and electronically controlled cell detachment is achieved using a conjugated polymer that detaches when electrochemically oxidized. The polymer is patterned to create a matrix with individually addressable pixels. The addressing is based on passive matrix addressing and is controlled by a resistance network. Human skin cells are cultured on the matrix, show good viability, and can be selectively detached.

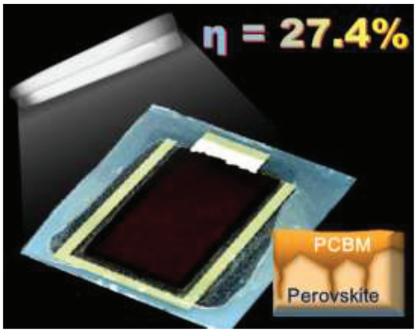


Tissue Engineering

K. M. Persson, S. Lönnqvist, K. Tybrandt, R. Gabrielsson, D. Nilsson, G. Kratz, M. Berggren* 7056–7063

Matrix Addressing of an Electronic Surface Switch Based on a Conjugated Polyelectrolyte for Cell Sorting

Device engineering of perovskite photovoltaics dedicated to indoor dim-light applications is reported. The trap density in the perovskite layer is effectively eliminated by judiciously controlling the fabrication of the electron-transporting layers. Small-area lab cell and 5.44 cm^2 large-area device attain maximum efficiencies up to 27.4% and 20.4% under indoor illumination, respectively.



Indoor Light Harvesting

C.-Y. Chen, J.-H. Chang, K.-M. Chiang, H.-L. Lin, S.-Y. Hsiao, H.-W. Lin* 7064–7070

Perovskite Photovoltaics for Dim-Light Applications

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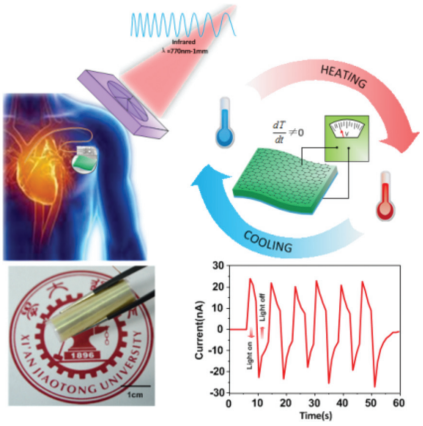
FULL PAPERS

Bioelectronics

H. Liu, T. Zhao, W. Jiang,* R. Jia, D. Niu, G. Qiu, L. Fan, X. Li, W. Liu, B. Chen, Y. Shi, L. Yin, B. Lu 7071–7079

Flexible Battery-Less Bioelectronic Implants: Wireless Powering and Manipulation by Near-Infrared Light

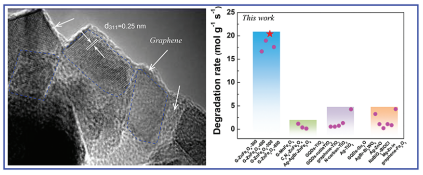


By investigating the pyroelectric performances of poly(vinylidene difluoride) (PVDF) and its remote-manipulability under near-infrared (nIR) irradiation, a flexible battery-less implantable device is proposed. The device is constructed by laminated graphene–PVDF–graphene sandwiches, which can be wirelessly powered and supply regulatable electrical pulses for nerve stimulation by nIR irradiation.

Photocatalysts

D. Yang, J. Feng, L. Jiang, X. Wu, L. Sheng, Y. Jiang, T. Wei, Z. Fan* 7080–7087

Photocatalyst Interface Engineering: Spatially Confined Growth of $ZnFe_2O_4$ within Graphene Networks as Excellent Visible-Light-Driven Photocatalysts

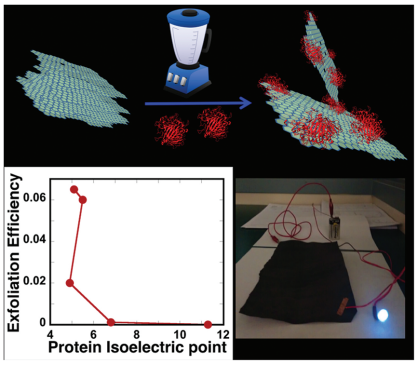


A novel strategy for the synthesis of ultra-small and highly crystallized graphene–$ZnFe_2O_4$ photocatalysts through interface engineering is reported. As a result, ≈20 nm $ZnFe_2O_4$ with highly crystallized (311) plane confined in the graphene network exhibits an excellent visible-light-driven photocatalytic activity with an ultrafast degradation rate of 1.924×10^{-7} mol g_{cat}^{-1} s^{-1} for methylene blue.

Graphene

A. Pattammattel, C. V. Kumar* 7088–7098

Kitchen Chemistry 101: Multigram Production of High Quality Biographene in a Blender with Edible Proteins



Graphite exfoliates to high-quality, few-layer graphene when subjected to shear forces in a kitchen blender on a multigram scale, which is assisted by ordinary, edible proteins. Protein charge plays a very important role in the exfoliation mechanism, and the graphene samples are highly conductive. The graphene suspensions in water are stable against temperature (5–50 °C) and a pH range from 3 to 11 for well over a month, and are suitable for biological applications.

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