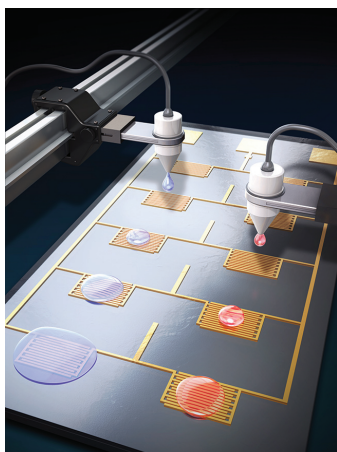


ADVANCED FUNCTIONAL MATERIALS

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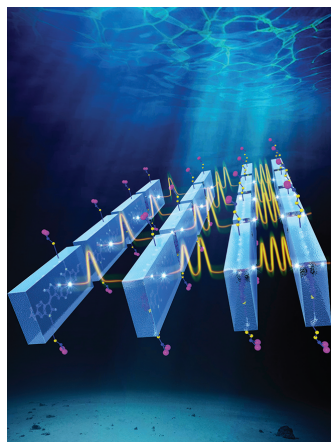
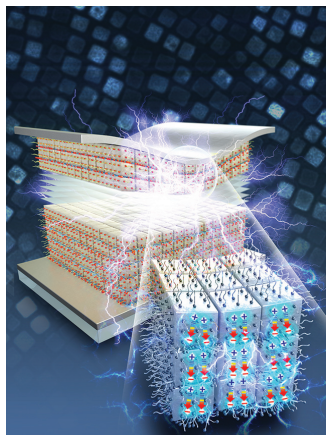


Organic Electronics

Selective tuning the operation mode of organic transistors from ambipolar to unipolar by using molecular doping is reported by Y. Xu, D.-Y. Kim, Y.-Y. Noh, and colleagues on page 6252. The ink-jet printed dopants do not degrade device properties but rather distinctively alter the ambipolar operation to be either n-channel or p-channel with greater performance and stability. Complementary high-performance inverters incorporating only one organic semiconductor and two different dopants are succeeded.

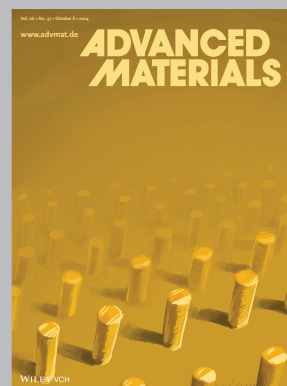
Piezoelectrics

Perovskite nanoparticle-based nanocomposite thin films composed of oleic acid-stabilized BaTiO_3 nanoparticles and poly(acrylic acid) are prepared by S.-W. Kim, J. Cho, and team on page 6262 using ligand exchange layer-by-layer assembly in organic media. The resultant nanocomposite films with high dielectric constant and low leakage current exhibit ferroelectric and piezoelectric properties that could be exactly controlled by the bilayer number, the type of inserted polymer, and the nanoparticle size.



Conjugated Polymers

Polymer field-effect transistors have gone through rapid development. Nevertheless, charge transport mechanism and structure–property relationship are not well understood. On page 6270, J.-Y. Wang, J. Pei, and co-workers use strong electron-deficient benzodifurandione-based poly(p-phenylene vinylene) (BDPPV) as the polymer backbone and develop six BDPPV-based polymers with various side-chain branching positions to systematically study the side-chain effect on device performance.



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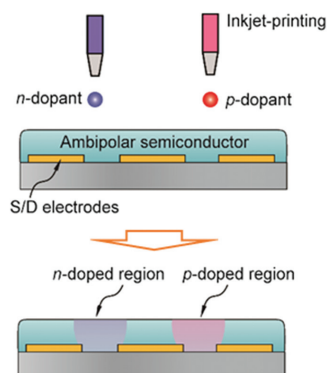
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FULL PAPERS

Organic Electronics

D. Khim, K.-J. Baeg, M. Caironi,
C. Liu, Y. Xu,* D.-Y. Kim,*
Y.-Y. Noh* 6252–6261

Control of Ambipolar and Unipolar Transport in Organic Transistors by Selective Inkjet-Printed Chemical Doping for High Performance Complementary Circuits

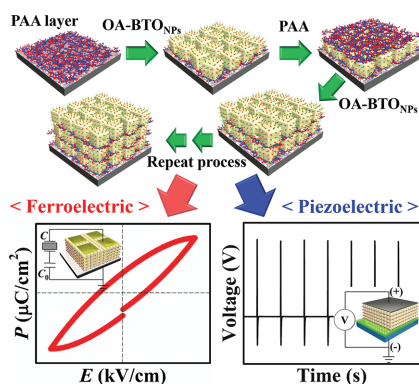


Local molecular doping via inkjet printing of dopants on a pre-coated ambipolar semiconductors is demonstrated to unipolarize and optimize complementary transistors. The mobility and turn-on voltages both for electrons and holes are precisely modulated by doping. Finally, high performance complementary ambipolar inverters are achieved by the selective inkjet printing of n- and p-type dopant.

Piezoelectrics

Y. Kim, K. Y. Lee, S. K. Hwang, C. Park,
S.-W. Kim,* J. Cho* 6262–6269

Layer-by-Layer Controlled Perovskite Nanocomposite Thin Films for Piezoelectric Nanogenerators



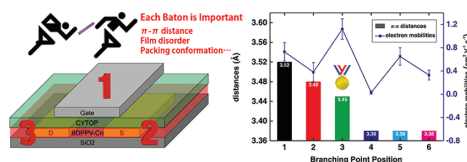
Perovskite nanoparticle-based nanocomposites tailored using layer-by-layer (LbL) assembly in organic media are successfully synthesized. Ferroelectricity and piezoelectricity of multilayers composed of BaTiO₃ nanoparticles and poly(acrylic acid) can be controlled by altering the bi-layer number, inserted polymer type, and nanoparticle size. These LbL can increase the quantity of BaTiO₃ nanoparticles, resulting in the enhancement of electric power output from the piezoelectric nanogenerators.

Conjugated Polymers

J.-H. Dou, Y.-Q. Zheng, T. Lei,
S.-D. Zhang, Z. Wang, W.-B. Zhang,
J.-Y. Wang,* J. Pei* 6270–6278

Systematic Investigation of Side-Chain Branching Position Effect on Electron Carrier Mobility in Conjugated Polymers

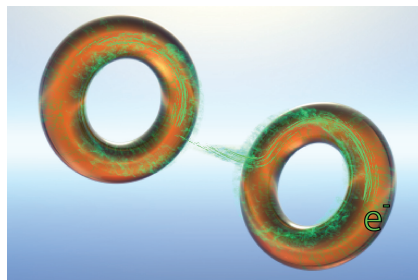
Six BDPPV-based polymers with various side-chain branching positions are synthesized and characterized in detail. All the polymers exhibit ambient-stable n-type transporting behavior with the highest electron mobility up to 1.40 cm² V⁻¹ s⁻¹. By means of multiple characterization methods, film morphology, and microstructure of all the six polymers are systematically investigated.



Lanthanides

A. Baniodeh, Y. Liang, C. E. Anson,
N. Magnani, A. K. Powell,*
A.-N. Unterreiner,* S. Seyffertle,
M. Slota, M. Dressel, L. Bogani,
K. Goß* 6280–6290

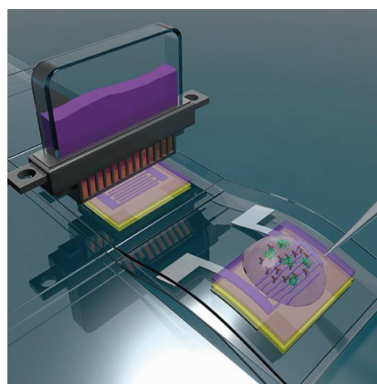
Unraveling the Influence of Lanthanide Ions on Intra- and Inter-Molecular Electronic Processes in Fe₁₀Ln₁₀ Nano-Toruses



Inter- and intra-molecular electron-transport processes are studied for a family of lanthanide-based molecular toruses using ultrafast-optical and electron-transport techniques. A relationship between trap efficiency and gaps is found; charge-hopping and surface-limited transport are dominant. The comparison between intra- and inter-molecular processes highlights the importance of excited electronic states, showing the influence of Kramers' parity on mobility.

FULL PAPERS

A flexible BioFET for label-free biosensing is reported. It is based on an inkjet-printed organic thin-film transistor whose insulator is functionalized with specific antibodies for protein recognition. As proof-of-concept, the BioFET is evaluated for quantification of human immunoglobulin G (HlgG).

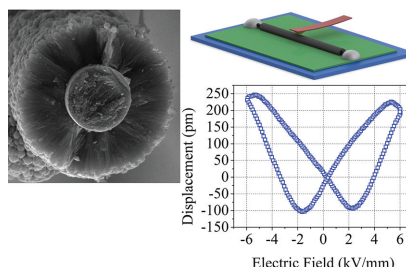


Biosensors

M. Medina-Sánchez,
C. Martínez-Domingo, E. Ramon,
A. Merkoçi*6291–6302

An Inkjet-Printed Field-Effect Transistor for Label-Free Biosensing

Barium titanate is synthesized on carbon fiber through a two-step hydrothermal reaction to create a multifunctional fiber. The mechanical strength of the carbon fiber is preserved while adding functionality from the ferroelectric properties of barium titanate. Ferroelectric property characterization and power harvesting tests are performed on these novel multifunctional fibers.

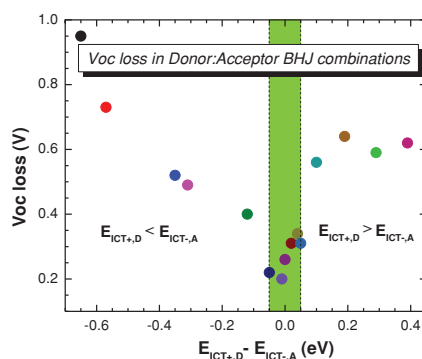


Nanowire Films

C. Bowland, Z. Zhou,
H. A. Sodano*6303–6308

Multifunctional Barium Titanate Coated Carbon Fibers

The large variation in open circuit voltage for regioregular-poly(3-hexylthiophene):fullerene bulk heterojunction organic photovoltaic (BHJ) devices that yield a roughly constant effective donor ionization potential to acceptor electron affinity energy difference at the donor–acceptor interface is found to be a consequence of trap-assisted recombination via integer charge transfer states. Based on the results, novel design rules for organic BHJ photovoltaics are proposed.

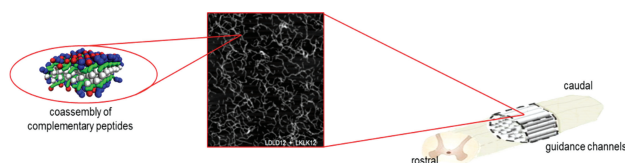


Organic Photovoltaics

Q. Bao,* O. Sandberg, D. Dagnelund,
S. Sandén, S. Braun, H. Aarnio, X. Liu,
W. M. Chen, R. Österbacka,
M. Fahlman*6309–6316

Trap-Assisted Recombination via Integer Charge Transfer States in Organic Bulk Heterojunction Photovoltaics

New co-assembling peptides for neural tissue engineering are developed with a “full” bottom-up approach. LKLK12, LDLD12, and KLPGWSG-LDLD12 are simulated in silico, synthesized and characterized to assess aggregate secondary structures, morphological features of the assembled nanofibers, and biomechanical properties of hydrogels. The biological influence on viability and differentiation of neural stem cells is tested and the neuroregenerative potential in complete spinal cord transections is verified.



Molecular Design

A. Raspa, G. A. A. Saracino, R. Pugliese,
D. Silva, D. Cigognini, A. Vescovi,
F. Gelain*6317–6328

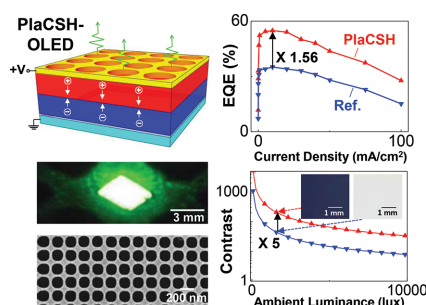
Complementary Co-assembling Peptides: From In Silico Studies to In Vivo Application

FULL PAPERS

Display Quality

W. Ding, Y. Wang, H. Chen,
S. Y. Chou* 6329–6339

Plasmonic Nanocavity Organic Light-Emitting Diode with Significantly Enhanced Light Extraction, Contrast, Viewing Angle, Brightness, and Low-Glare



A new organic LED structure is proposed and experimentally demonstrated using a novel plasmonic nanocavity, termed “plasmonic cavity with subwavelength hole-array” (PlaCSH), to significantly enhance over conventional LEDs: i) 1.57-fold higher external quantum efficiency and light extraction efficiency (55% and 60%); ii) 2.5-fold higher ambient light absorption over 400 nm band; iii) a contrast of fivefold higher; and others.

Piezoelectrics

T. Vuorinen, M. Zakrzewski, S. Rajala,
D. Lupo, J. Vanhala, K. Palovuori,
S. Tuukkanen* 6340–6347

Printable, Transparent, and Flexible Touch Panels Working in Sunlight and Moist Environments

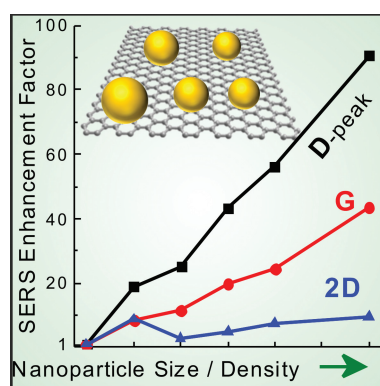
Fabrication and functionality of transparent, flexible, and water-proof touch panel is reported. Graphene-based transparent electrodes are solution-processed on a piezoelectric polymer, polyvinylidene difluoride (PVDF), which works as a functional substrate material. The use of solution-processed electrodes allows the low-cost and high throughput panel manufacturing. Also, the transparent touch panel shows very small pyroelectric response under exposure to light.



Hybrid Nanostructures

K. Balasubramanian,* L. Zuccaro,
K. Kern 6348–6358

Tunable Enhancement of Raman Scattering in Graphene-Nanoparticle Hybrids

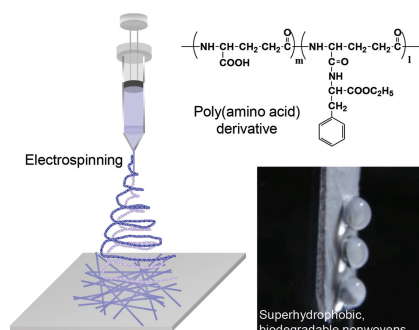


A systematic investigation of surface-enhanced Raman scattering (SERS) in graphene-nanoparticle-hybrids is obtained by a versatile electrochemical procedure. The evolution of Raman enhancement is followed by varying nanoparticle size and density at the same location. The magnitude of SERS enhancement is found to be dependent on the vibrational mode of graphene with both electromagnetic and chemical contributions.

Surface Engineering

H. Yoshida, D. Klee, M. Möller,*
M. Akashi* 6359–6364

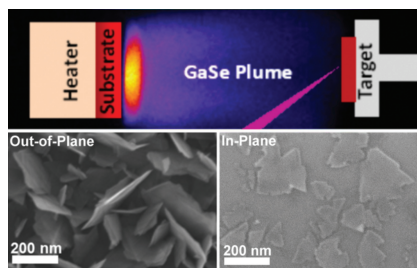
Creation of Superhydrophobic Electrospun Nonwovens Fabricated from Naturally Occurring Poly(Amino Acid) Derivatives



Superhydrophobic, biodegradable nonwovens are fabricated by electrospinning from a naturally occurring poly(amino acid). The nonwovens exhibit a petal-type superhydrophobicity and water droplet sticks to the surface even after it is turned over. The material design and processing is applicable to different biopolymers, and such functional materials can be useful for biomedical and environmental applications.

FULL PAPERS

Novel synthesis techniques to rapidly explore the properties of new 2D layered materials, beyond graphene, are of significant current interest. Here, it is demonstrated that pulsed laser deposition (PLD) can be used to synthesize functional gallium selenide (GaSe) nanosheet networks by spatial confinement of the ablation plume to preserve the stoichiometric transfer of material while providing sufficient kinetic energy for surface diffusion.

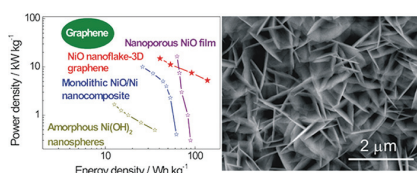


Laser Deposition

M. Mahjouri-Samani,* R. Gresback, M. Tian, K. Wang, A. A. Poretzky, C. M. Rouleau, G. Eres, I. N. Ivanov, K. Xiao, M. A. McGuire, G. Duscher, D. B. Geohegan.....6365–6371

Pulsed Laser Deposition of Photoresponsive Two-Dimensional GaSe Nanosheet Networks

Hierarchical nickel oxide nanoflake 3D graphene electrodes are developed by growing NiO nanoflakes atop 3D architecture of graphene on Ni foam. The optimum structure enables the 3-electrode pseudocapacitors and 2-electrode full cells to deliver outstanding electrochemical performance. In a full cell configuration, the achieved power density is much higher than that of commercially available asymmetric capacitors.

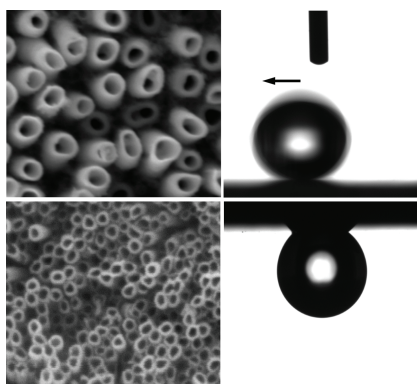


Supercapacitors

C. D. Wang, J. L. Xu, M.-F. Yuen, J. Zhang, Y. Y. Li, X. F. Chen,* W. J. Zhang*.....6372–6380

Hierarchical Composite Electrodes of Nickel Oxide Nanoflake 3D Graphene for High-Performance Pseudocapacitors

Two extreme superhydrophobic states with adhesive forces of ≈ 4.4 and $\approx 89.6 \mu\text{N}$ are realized on chemically modified TiO₂ nanotubular arrays. The water droplet rolls off the low adhesive surface quickly, whereas it is pinned on the high adhesive surface at a tilted angle of 180°. The regulated water adhesion shows application for no-loss liquid transfer, anti-icing, and self-cleaning.

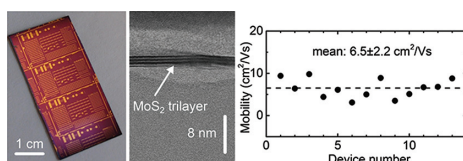


Bioinspired Surfaces

Z. Hu, X. Zhang, Z. Liu,* K. Huo,* P. K. Chu, J. Zhai,* L. Jiang6381–6388

Regulating Water Adhesion on Superhydrophobic TiO₂ Nanotube Arrays

A temperature-dependent synthesis study of large-area MoS₂ by direct sulfurization of evaporated Mo thin films is presented. The resulting film quality is similar to geological MoS₂. An unprecedented uniformity of $\pm 0.07 \text{ nm}$ over a large area ($>10 \text{ cm}^2$) is achieved with trilayer MoS₂. The estimated intrinsic field-effect mobility is approximately $6.5 \pm 2.2 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$.



Wafer-Scale Devices

A. Tarasov,* P. M. Campbell, M.-Y. Tsai, Z. R. Hesabi, J. Feirer, S. Graham, W. J. Ready, E. M. Vogel.....6389–6400

Highly Uniform Trilayer Molybdenum Disulfide for Wafer-Scale Device Fabrication