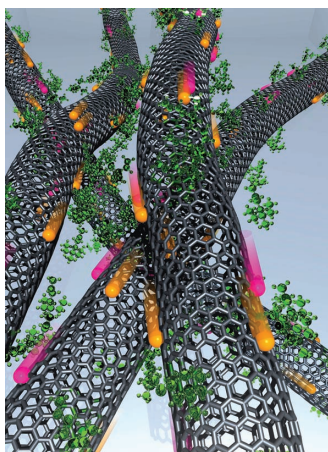


ADVANCED FUNCTIONAL MATERIALS

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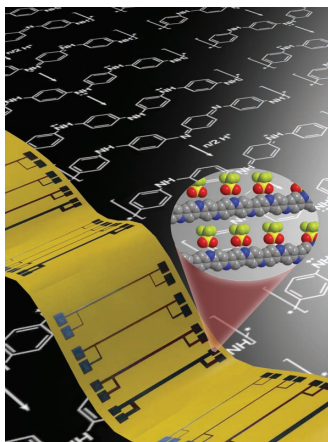


Carbon Nanotubes

H. Shimotani and co-workers report the substantial changes in the conductance of a metallic SWNT thin film with an ionic-liquid gating. On page 3305, number of current-carrying subbands in metallic SWNTs as well as semiconducting SWNTs are electrochemically controlled and observed in situ with optical absorption spectrometer. The conductance of SWNT thin films shows stepwise increases when the number of current-carrying subbands increases.

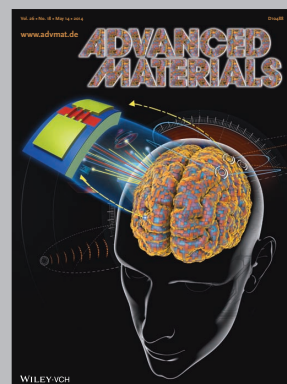
Drug Delivery

Novel multi-stimuli-responsive microcapsules with adjustable controlled-release characteristics are reported by X.-J. Ju, L.-Y. Chu, and co-workers on page 3312. The microcapsules can achieve targeted delivery at specific sites by applying an external magnetic field, pH-responsive drug release at acidic environments and flexibly adjustable controlled-release rate depending on temperature regulation, which provide a new mode for designing “intelligent” controlled-release systems and for realizing more rational drug administration.



Flexible Electronics

Flexible devices made of doped polyaniline (PANI) are directly deposited by inkjet printing on a plastic sheet (polyimide). The molecular arrangement of the functional material is also represented, showing its crystalline ordering. Inks are synthesized by A. Chiolerio and co-workers through a water-based process, avoiding the use of toxic/mutagenic substances normally employed in PANI production. On page 3375, These printed devices show the highest negative supercapacitance measured so far ($-2.3 \text{ mF @ } 30 \text{ Hz}$) corresponding to a specific mass capacity of -799 Fg^{-1} .



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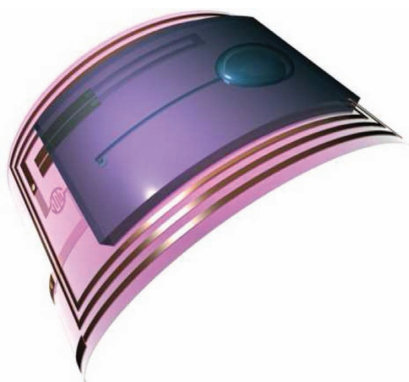
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FULL PAPERS

Flexible Electronics

W. Honda, S. Harada, T. Arie, S. Akita,
K. Takei* 3299–3304

Wearable, Human-Interactive, Health-Monitoring, Wireless Devices Fabricated by Macroscale Printing Techniques

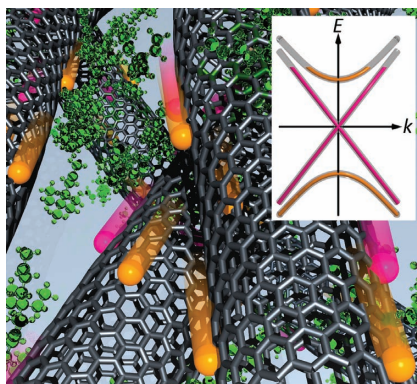


Human-interactive smart bandage: Touch sensors, temperature sensors, and a drug-delivery pump with a wireless coil are integrated on a flexible substrate and conformally covered surrounding human arm as a wearable device. The device can monitor real-time temperature and touch detections of human and drug curing.

Carbon Nanotubes

H. Shimotani,* S. Tsuda, H. T. Yuan,
Y. Yomogida, R. Moriya, T. Takenobu,
K. Yanagi, Y. Iwasa 3305–3311

Continuous Band-Filling Control and One-Dimensional Transport in Metallic and Semiconducting Carbon Nanotube Tangled Films

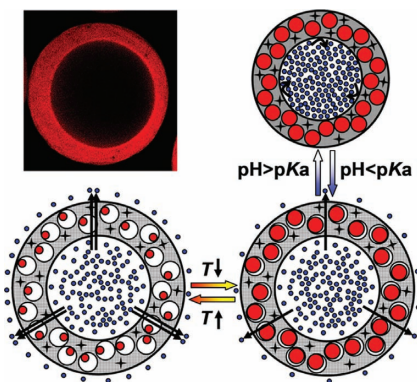


Electrochemical carrier control of pure metallic and semiconducting single-walled carbon nanotube (SWNT) films enable simultaneous measurements of the band filling by optical absorption spectroscopy and conductivity. The metallic SWNT film as well as the semiconducting SWNT film show substantial change in the conductivity by the subband filling.

Drug Delivery

J. Wei, X.-J. Ju,* X.-Y. Zou, R. Xie,
W. Wang, Y.-M. Liu,
L.-Y. Chu* 3312–3323

Multi-Stimuli-Responsive Microcapsules for Adjustable Controlled-Release

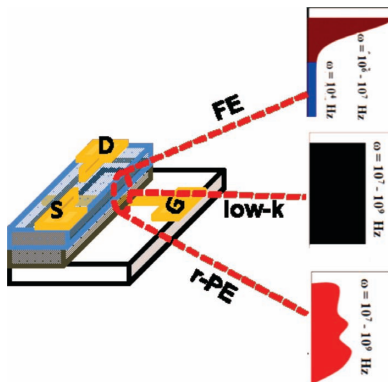


Multi-stimuli-responsive microcapsules with adjustable controlled-release characteristics are successfully prepared by embedding magnetic nanoparticles and temperature-responsive sub-microspheres into pH-responsive chitosan microcapsule membranes. This kind of microcapsules can simultaneously achieve targeted delivery by applying an external magnetic field, self-regulated drug release according to pH difference at pathological sites, and adjustable controlled-release depending on temperature regulation.

Ferroelectrics

S. P. Senanayak,
K. S. Narayan* 3324–3331

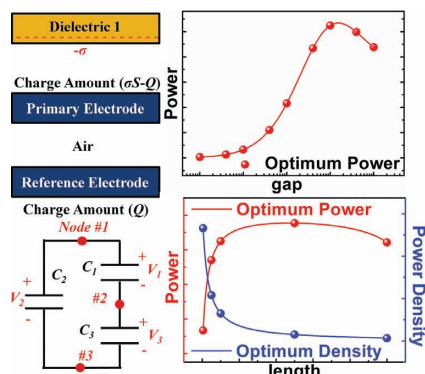
Strategies for Fast-Switching in All-Polymer Field Effect Transistors



Systematic control and enhancement of the switching speed in polymer transistors has enormous implications in flexible electronics. Polymer logic circuits with switching frequency >1 MHz at printable channel length is demonstrated. General guidelines to obtain fast polymer circuits include: polymers with high mobility and isolated conjugated core, dielectrics with co-operative dipoles, high transverse field, and ordered interface for transport.

FULL PAPERS

A comprehensive theoretical model is developed for single-electrode triboelectric nanogenerators. The real time output characteristics are calculated by different numerical calculation methods. A three-capacitance equivalent circuit model is built to clarify the working principle of single-electrode triboelectric nanogenerators. Finally, the impact of electrode gap distance and area size on the performance of the devices are investigated and strategies for the structural optimization are provided.

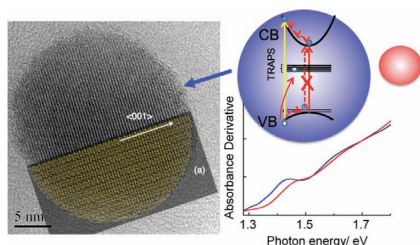


Energy Harvesting

S. Niu, Y. Liu, S. Wang, L. Lin, Y. S. Zhou, Y. Hu, Z. L. Wang* 3332–3340

Theoretical Investigation and Structural Optimization of Single-Electrode Triboelectric Nanogenerators

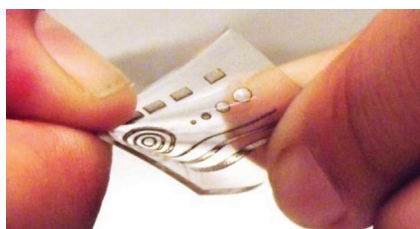
Bandgap tunability and density of mid-gap states in Bi_2S_3 colloidal nanocrystals are investigated. Energy shifts of tens of meV are observed in nanocrystals with 3 nm size. Similar bandgap tunability is envisaged for pnictide chalcogenides with the same ribbon-like structure $[\text{Pn}_4\text{Ch}_6]_n$ (Pn = Bi, Sb; Ch = S, Se). An intragap density of states in excess of 10^{20} cm^{-3} is found.

 Bi_2S_3

M. Aresti, M. Saba, R. Piras, D. Marongiu, G. Mula, F. Quochi, A. Mura, C. Cannas, M. Mureddu, A. Ardu, G. Ennas, V. Calzia, A. Mattoni, A. Musinu,* G. Bongiovanni* ...3341–3350

Colloidal Bi_2S_3 Nanocrystals: Quantum Size Effects and Midgap States

Methods to rapidly produce elastically-soft electronics composed of liquid-phase gallium–indium alloy and conductive elastomer in minutes using a commercial CO_2 laser are introduced. This work builds upon previous efforts in GaIn patterning and has the potential to further broaden its impact in the field of soft-matter electronics by introducing methodologies for inexpensive rapid prototyping and scalable manufacturing.

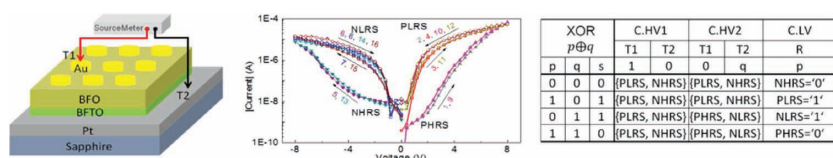


Stretchable Electronics

T. Lu, L. Finkenauer, J. Wissman, C. Majidi* 3351–3356

Rapid Prototyping for Soft-Matter Electronics

A $\text{BiFeO}_3/\text{Ti}/\text{BiFeO}_3$ (BFTO/BFO) bilayer structure with optimized BFTO thickness reveals nonvolatile symmetric bipolar resistive switching due to the migration of oxygen vacancies/ions in an electric field. For nonvolatile logic applications, all 16 Boolean logic functions can be configured into a single BFTO/BFO cell using terminal T1 and T2 for positive and negative writing (C.HV1, C.HV2) and reading biases (C.LV).



Memristors

T. You,* Y. Shuai, W. Luo, N. Du, D. Bürger, I. Skorupa, R. Hübner, S. Henker, C. Mayr, R. Schüffny, T. Mikolajick, O. G. Schmidt, H. Schmidt 3357–3365

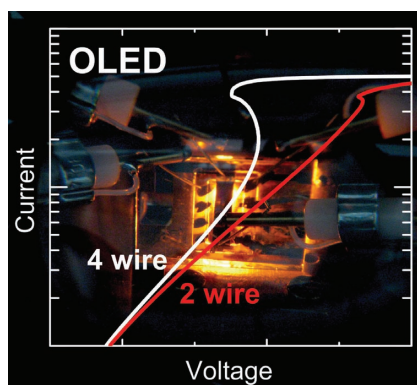
Exploiting Memristive BiFeO_3 Bilayer Structures for Compact Sequential Logics

FULL PAPERS

Organic Electronics

A. Fischer,* T. Koprucki, K. Gärtner,
M. L. Tietze, J. Brückner, B. Lüssem,
K. Leo, A. Glitzky, R. Scholz...3367–3374

Feel the Heat: Nonlinear Electrothermal Feedback in Organic LEDs

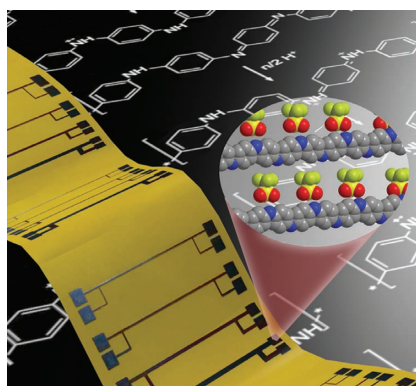


S-shaped negative differential resistance in organic LED is observed as a feature of their nonlinear electrothermal feedback. By 4-wire measurements and multi-physics simulations, the lateral propagation of NDR as well as “switched-back” regions through the OLED is described. The results are transferred to a large area OLED tile and compared with experimental results, explaining the extreme brightness inhomogeneities under self-heating.

Flexible Electronics

A. Chiolerio,* S. Bocchini,
S. Porro...3375–3383

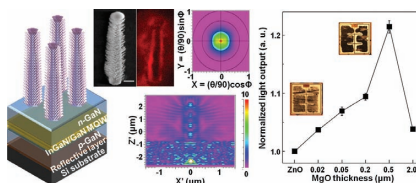
Inkjet Printed Negative Supercapacitors: Synthesis of Polyaniline-Based Inks, Doping Agent Effect, and Advanced Electronic Devices Applications



Polyaniline is synthesized starting from aniline dimer and polyaniline doped with different organic acids is easily deposited by ink-jet printing. These materials present negative capacitance and supercapacitance properties.

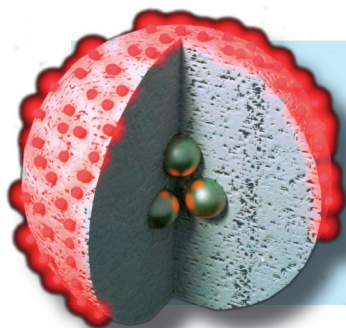
Nanowires

B. U. Ye, B. J. Kim, J. Park, H. Y. Jeong,
J. Y. Park, J. K. Kim, J.-H. Hur,
M. H. Kim, J.-L. Lee,*
J. M. Baik*...3384–3391



Three-Dimensional Branched Nanowire Heterostructures as Efficient Light-Extraction Layer in Light-Emitting Diodes

A facile method to grow 3D branched nanowire heterostructures by combining bottom-up and top-down approaches is suggested. The ZnO nanowires with a small tapering angle ($\approx 6^\circ$) are grown on GaN by hydrothermal method. The tapering enables the oblique angle flux incidence of MgO, producing the branch nanowires. The LEDs with the branch nanowires show a remarkable enhancement in the light emission by 21% due to the decrease in the wave-guiding modes and total internal reflection.



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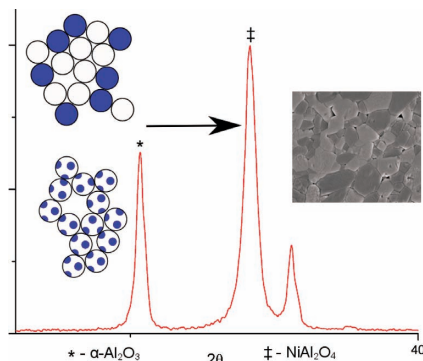
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FULL PAPERS

Dense $\text{NiAl}_2\text{O}_4/\alpha\text{-Al}_2\text{O}_3$ composites are synthesized from both highly atomically-mixed single phase metastable spinel nanopowders and from submicrometer mixed NiAl_2O_4 and Al_2O_3 nanopowders to study bottom-up synthesis from the nanoscale to bulk materials. Surprisingly, both composites sinter to similar densities with similar microstructural properties and grain sizes, suggesting that the bottom-up approach may not be the best choice for bulk synthesis.

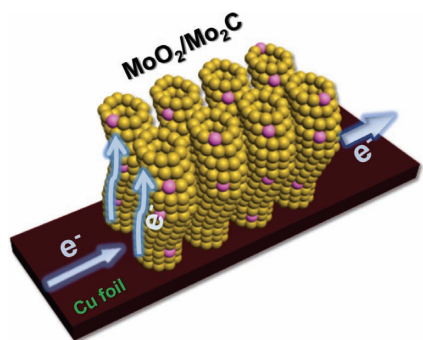


Nanopowders

N. J. Taylor, A. J. Pottebaum, V. Uz, R. M. Laine*3392–3398

The Bottom Up Approach is Not Always the Best Processing Method: Dense $\alpha\text{-Al}_2\text{O}_3/\text{NiAl}_2\text{O}_4$ Composites

Hierarchical porous $\text{MoO}_3/\text{Mo}_2\text{C}$ heteronanotubes are obtained by using a mesoporous carbon CMK-3 as both the template and the reactant. Taking advantage of the incorporation of high electronic conductive Mo_2C and the hierarchical porous structure, the cycling and rate performance of the heteronanotubes is markedly enhanced.

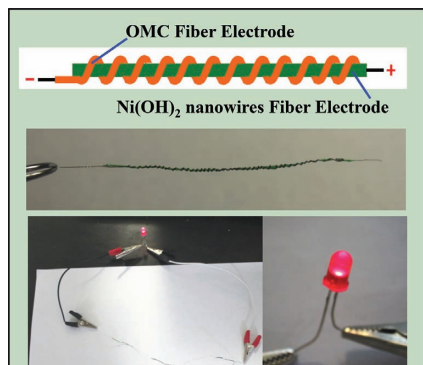


Batteries

H.-J. Zhang, K.-X. Wang,* X.-Y. Wu, Y.-M. Jiang, Y.-B. Zhai, C. Wang, X. Wei, J.-S. Chen*3399–3404

$\text{MoO}_3/\text{Mo}_2\text{C}$ Heteronanotubes Function as High-Performance Li-Ion Battery Electrode

The high performance of a flexible, wire-shaped, and solid-state micro-supercapacitor, which is prepared by twisting a $\text{Ni}(\text{OH})_2$ -nanowire fiber-electrode and an ordered mesoporous carbon fiber-electrode together with solid-state polymer electrolyte, is demonstrated.

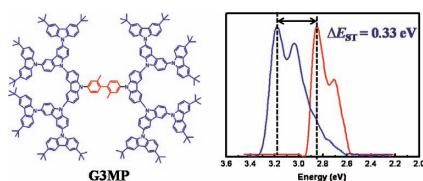


Microelectronics

X. Dong, Z. Guo, Y. Song, M. Hou, J. Wang, Y. Wang,* Y. Xia*3405–3412

Flexible and Wire-Shaped Micro-Supercapacitor Based on $\text{Ni}(\text{OH})_2$ -Nanowire and Ordered Mesoporous Carbon Electrodes

A high triplet energy and suitable HOMO/LUMO levels for effective charge injection are realized in dendrimer G3MP with a third-generation carbazole dendron, due to a small exchange energy of 0.33 eV. Therefore, G3MP can be utilized as a high-performance universal host for a wide color range of phosphors from deep blue to red.



OLEDs

X. Wang, S. Wang, Z. Ma, J. Ding,* L. Wang,* X. Jing, F. Wang3413–3421

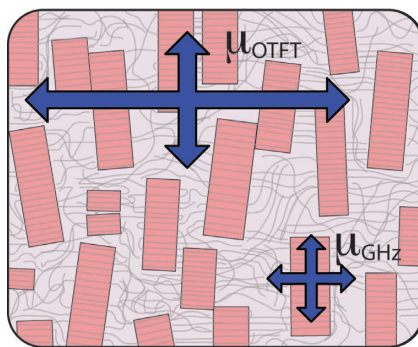
Solution-Processible 2,2'-Dimethylbiphenyl Cored Carbazole Dendrimers as Universal Hosts for Efficient Blue, Green, and Red Phosphorescent OLEDs

FULL PAPERS

Organic Electronics

B. T. O'Connor,* O. G. Reid, X. Zhang,
R. J. Kline, L. J. Richter, D. J. Gundlach,
D. M. DeLongchamp,* M. F. Toney,
N. Kopidakis, G. Rumbles* .. 3422–3431

Morphological Origin of Charge Transport Anisotropy in Aligned Polythiophene Thin Films

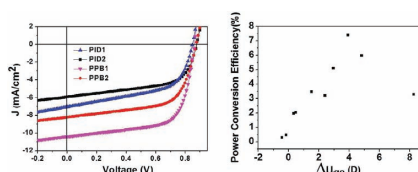


Macroscale charge transport anisotropy is compared to the local transport anisotropy in highly aligned P3HT films. The macroscale charge mobility anisotropy is substantially higher than the local anisotropy, which is attributed to preferentially aligned tie-chains. The local mobility anisotropy is found to be surprisingly low, suggesting that P3HT has relative low intrachain mobility due to local disorder associated with the flexible backbone.

Organic Photovoltaics

T. Xu, L. Y. Lu, T. Y. Zheng, J. M. Szarko,
A. Schneider, L. X. Chen,*
L. P. Yu* 3432–3437

Tuning the Polarizability in Donor Polymers with a Thiophenesaccharin Unit for Organic Photovoltaic Applications

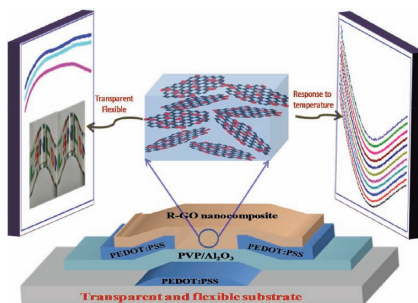


Low bandgap copolymers incorporating an artificial sweetener derivative (TID) are synthesized. They exhibit a diminished power-conversion efficiency (PCE) with a large local dipole moment change between ground and excited states $\Delta\mu_{ge}$, indicating that the linear correlation between $\Delta\mu_{ge}$ and PCE does not extend further to a larger internal dipolar change region. The strongly electron-withdrawing sulfonyl group is detrimental to charge separation in copolymer TID.

Flexible Electronics

T. Q. Trung, S. Ramasundaram,
S. W. Hong, N.-E. Lee* 3438–3445

Flexible and Transparent Nanocomposite of Reduced Graphene Oxide and P(VDF-TrFE) Copolymer for High Thermal Responsivity in a Field-Effect Transistor

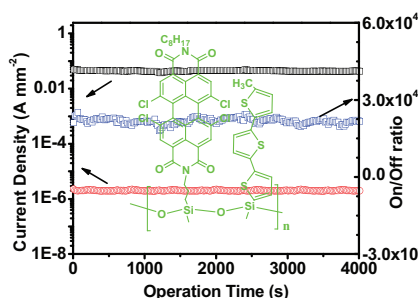


A transparent and flexible temperature sensor based on a nanocomposite field-effect transistor (FET) with high thermal responsivity, stability, and reproducibility is produced. The novelty of the sensor is the incorporation of a nanocomposite channel as a sensing layer that is highly responsive to temperature and is optically transparent and mechanically flexible. The sensing layer of the nanocomposite is easily coated onto a large-area substrate for fabrication of transparent and flexible FET.

Memory Devices

G. Wen, Z. Ren,* D. Sun, T. Zhang,
L. Liu, S. Yan* 3446–3455

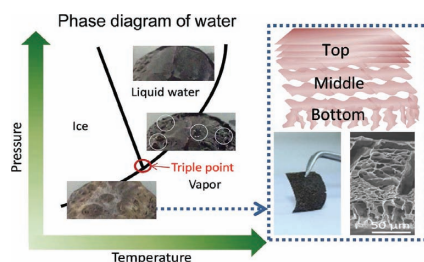
Synthesis of Alternating Copolysiloxane with Terthiophene and Perylenediimide Derivative Pendants for Involatile WORM Memory Device



Alternating copolysiloxane with both electron donor terthiophene and electron acceptor perylenediimide derivative pendants (PTSi-alt-PDISi) is synthesized successfully, showing high thermal and morphological stability. The fabricated memory device-based PTSi-alt-PDISi shows nonvolatile WORM memory characteristics with low turn-on threshold voltage and high ON/OFF current density ratio. This suggests that the new donor-acceptor polysiloxanes have potential applications in the field of memory devices.

FULL PAPERS

Inspired by the phase diagram of the water, the phase changes of water trapped in freshly formed graphene oxide membrane are utilized to generate strong forces to tune and fix its final microstructure, and a membrane with graded structure is finally obtained. Such a membrane shows high sheet utilization and reveals high adsorption and electrochemical performance after reduction.

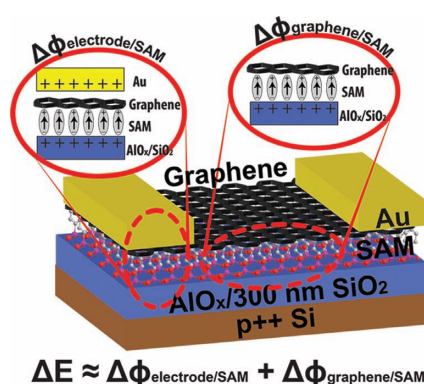


Supercapacitors

W. Lv, Z. J. Li, G. M. Zhou, J.-J. Shao, D. B. Kong, X. Y. Zheng, B. H. Li, F. Li, F. Y. Kang, Q.-H. Yang*3456–3463

Tailoring Microstructure of Graphene-Based Membrane by Controlled Removal of Trapped Water Inspired by the Phase Diagram

A series of functionalized aromatic self-assembled monolayers (SAMs) are used to systemically control the doping of CVD graphene transistors. A direct correlation between the predicted SAM dipole determined via density functional theory and the charge neutrality point of graphene transistors is found when doping effects due to the metal electrode contacts are taken into account.



Graphene Transistors

N. Cernetic, S. Wu, J. A. Davies, B. W. Krueger, D. O. Hutchins, X. Xu, H. Ma,* A. K.-Y. Jen*3464–3470

Systematic Doping Control of CVD Graphene Transistors with Functionalized Aromatic Self-Assembled Monolayers