

ADVANCED FUNCTIONAL MATERIALS

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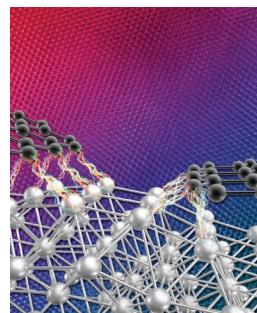


Vitamins

Pyridoxal 5'-phosphate (PLP), an active form of vitamin B₆, is demonstrated as a multifunctional compound for surface functionalization by S.-W. Cho, H. Lee, and co-workers on page 4754. The functionalized surfaces are hydrophilic and allow for covalent tethering of bioactive molecules, enhancing adhesion, migration, and proliferation of cells. This surface coating promotes the healing of biomedical devices by improving functionality and biocompatibility

Synthetic Alloys

As shown by L. G. Salamanca-Riba and co-workers on page 4768, 3D-epitaxy of carbon in silver is achieved by electro-charging assisted bulk processing. The carbon and silver bond covalently when a high current is applied to a mixture of liquid silver and particles of activated carbon. Upon solidification, graphitic structures form within the metal with an epitaxial orientation with the silver lattice. Image courtesy of Jiaqi Dai from the University of Maryland.



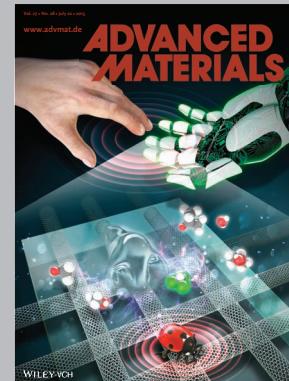
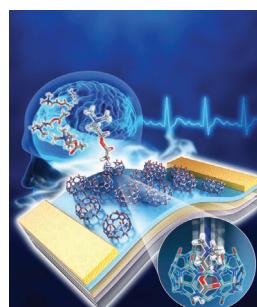
Epidermal Electronics

U. Paik, J. A. Rogers, and co-workers present miniaturized flexible electronic systems with wireless power and near-field communication capabilities on page 4761. The key features are thin, lightweight, flexible construction and minimized interfacial stresses for bio-integration. These concepts provide new opportunities in biosensors and electronic implants with wireless communication, for use on the fingernails and other regions of the body.



Organic Electronics

Sensors for biogenic substances have received great interest for use in early diagnosis and consultation. On page 4882, I. Hwang, K. Kim, J. H. Oh, and co-workers report highly sensitive organic-transistor-based sensors functionalized with a synthetic receptor, a cucurbit[6]uril derivative that can selectively detect a neurotransmitter acetylcholine. This work describes a viable methodology for the fabrication of high-performance biosensors without enzyme immobilization.



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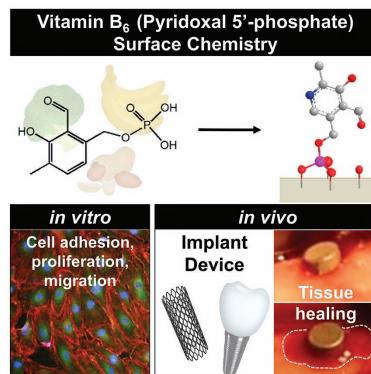
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FULL PAPERS

Pyridoxal 5'-phosphate (PLP; vitamin B₆) is demonstrated as a multifunctional compound for surface functionalization. Vitamin B₆ can be anchored onto surfaces via the phosphate group, converting them into hydrophilic surfaces that allow covalent tethering of molecules. Enhancement in endothelial cell and osteoblast proliferation, migration, and differentiation on PLP-coated surfaces as well as healing of PLP-coated dental implants *in vivo* is observed.



Vitamins

J. S. Lee, K. Kim, K. Lee, J. P. Park, K. Yang, S.-W. Cho,* H. Lee*... 4754–4760

Surface Chemistry of Vitamin: Pyridoxal 5'-Phosphate (Vitamin B₆) as a Multifunctional Compound for Surface Functionalization

Materials and design concepts are introduced for miniaturized flexible electronic systems with wireless power and near-field communication (NFC) capabilities. The devices have thin, lightweight, flexible construction and advantages in mechanical strength, placement versatility, and minimized interfacial stresses for integration on the body. These concepts can apply to other wireless communication systems including new opportunities in biosensors and electronic implants.

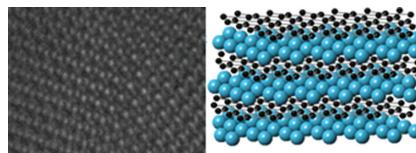


Epidermal Electronics

J. Kim, A. Banks, Z. Xie, S. Y. Heo, P. Gutruf, J. W. Lee, S. Xu, K.-I. Jang, F. Liu, G. Brown, J. Choi, J. H. Kim, X. Feng, Y. Huang, U. Paik,* J. A. Rogers*..... 4761–4767

Miniaturized Flexible Electronic Systems with Wireless Power and Near-Field Communication Capabilities

Incorporation of C in the lattice of silver is produced by electrocharging assisted bulk processing to create a synthetic alloy called silver covetic. In some regions the carbon forms layers of graphene intercalated between the atomic planes of silver forming a 3D nanoepitaxial structure. Carbon and silver atoms bond at carbon vacancies and edges of graphene-like sheets or ribbons.

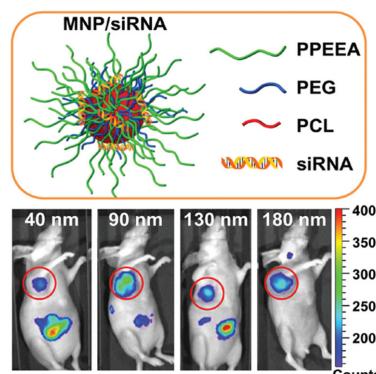


Synthetic Alloys

L. G. Salamanca-Riba,* R. A. Isaacs, M. C. LeMieux, J. Wan, K. Gaskell, Y. Jiang, M. Wuttig, A. N. Mansour, S. N. Rashkeev, M. M. Kuklja, P. Y. Zavalij, J. R. Santiago, L. Hu 4768–4777

Synthetic Crystals of Silver with Carbon: 3D Epitaxy of Carbon Nanostructures in the Silver Lattice

To investigate the optimal size of nanocarriers for siRNA delivery, different sized MNP/siRNAs are rationally designed. Size-dependent biological effects on circulation, internalization, retention, and overall antitumor efficacy are carefully and comprehensively evaluated. These results indicate that 90 nm could be at or close to the optimal size for systemic delivery of siRNA.



Cancer Therapy

S. Liang, X.-Z. Yang,* X.-J. Du, H.-X. Wang, H.-J. Li, W.-W. Liu, Y.-D. Yao, Y.-H. Zhu, Y.-C. Ma, J. Wang,* E.-W. Song* 4778–4787

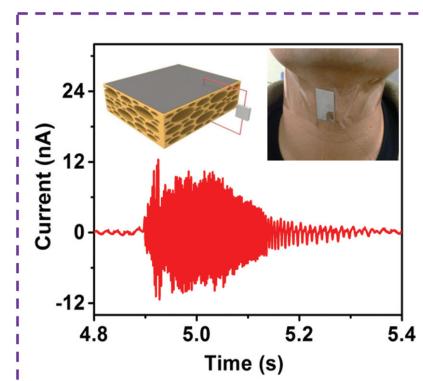
Optimizing the Size of Micellar Nanoparticles for Efficient siRNA Delivery

FULL PAPERS

Wearables

N. Wu, X. Cheng, Q. Zhong,
J. Zhong, W. Li, B. Wang, B. Hu,
J. Zhou* 4788–4794

Cellular Polypropylene Piezoelectret for Human Body Energy Harvesting and Health Monitoring

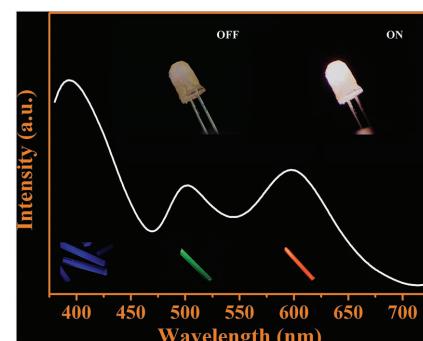


Simple-structured and efficient human body energy harvesting and self-powered human health monitoring systems are demonstrated basing on the cellular polypropylene piezoelectret. A maximum peak power density of $\approx 52.8 \text{ mW m}^{-2}$ is obtained and human physiological signals, such as coughing action and arterial pulse, are detected. These systems develop a new way for self-powered and wearable electronics.

White Light

Y. Cui, T. Song, J. Yu, Y. Yang, Z. Wang,
G. Qian* 4796–4802

Dye Encapsulated Metal-Organic Framework for Warm-White LED with High Color-Rendering Index

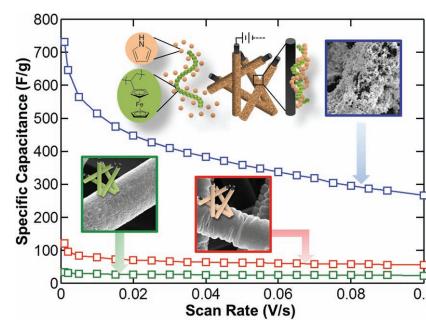


A strategy of encapsulating organic dyes into the pores of a luminescent metal-organic framework is developed to achieve white-light-emitting phosphor. The resulting composite ZJU-28-DSM/AF (0.02 wt% DSM, 0.06 wt% AF) exhibits a broadband white emission with ideal CIE coordinates of (0.34, 0.32), high CRI value of 91, and moderate CCT value of 5327 K.

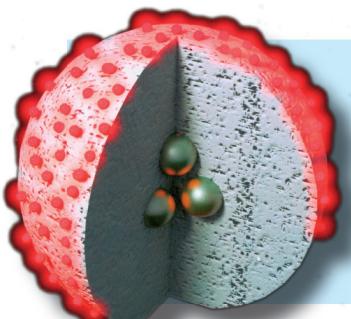
Redox Polymers

W. Tian, X. Mao, P. Brown,
G. C. Rutledge,*
T. A. Hatton* 4803–4813

Electrochemically Nanostructured Polyvinylferrocene/Polypyrrole Hybrids with Synergy for Energy Storage



The π - π stacking interactions between aromatic monomers and metallocene moieties are exploited via simultaneous electroprecipitation of polyvinylferrocene and electropolymerization of pyrrole to form a highly porous redox-responsive hybrid. The resulting synergistic enhancement of the utilization efficiency of ferrocene and the accessibility of ions to polypyrrole leads to the significantly improved electrochemical energy storage performance.



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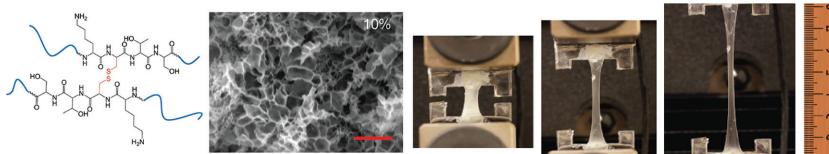
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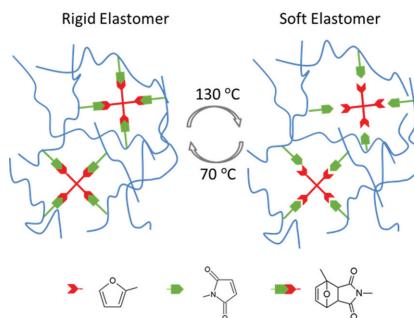
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FULL PAPERS

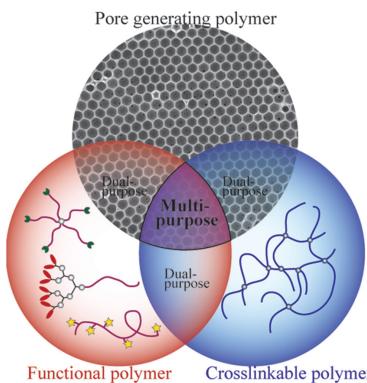
Photocrosslinkable elastin-like polypeptides (ELPs) are demonstrated to be potential biomedical constructs. ELPs with only canonical amino acids are crosslinked with the addition of photoinitiator, resulting in tunable modulus and tensile strength based upon the ELP concentration. *In vitro* and *in vivo* biocompatibility, in addition to their extensibility, make these ELPs candidates for sealants and hemostats among other biomedical applications requiring extensible substrates.



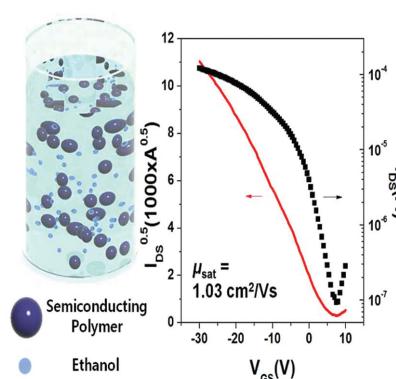
New dielectric elastomers exhibiting variable moduli are presented. The elastomers contain furan-maleimide Diels–Alder adduct moieties to administer the crosslinking densities, resulting in changes in the elastomers' moduli. Capacitive strain sensors based on this elastomer can be operated in both rigid and soft modes. Actuators are fabricated and operated in both high strain and high force output modes.



A new generation of high performance honeycomb membranes is presented from multiprogrammable block copolymers. Facile crosslinking results in functional membranes that are noticed to withstand temperatures up to 400 °C and pH from 1–14. These state-of-art honeycomb membranes are found to be excellent cell repellent surfaces and are exploited as masters for soft lithographical applications.



Colloidal solutions of conjugated semiconducting polymer are fabricated using a simple dispersion method of conjugated random copolymer in low-molecular-weight alcohols, including ethanol, propanol, and butanol. From such environmentally benign processes, for the first time, high-mobility ($>1 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$) polymer field effect transistors are demonstrated.



Hydrogels

Y.-N. Zhang, R. K. Avery,
Q. Vallmajó-Martin, A. Assmann,
A. Vegh, A. Memic, B. D. Olsen,
N. Annabi,*
A. Khademhosseini* 4814–4826

A Highly Elastic and Rapidly Crosslinkable Elastin-Like Polypeptide-Based Hydrogel for Biomedical Applications

Elastomers

W. Hu, Z. Ren, J. Li, E. Askounis,
Z. Xie, Q. Pei* 4827–4836

New Dielectric Elastomers with Variable Moduli

Block Copolymers

S. Mongkhotreerat, M. V. Walter,
O. C. J. Andrén, Y. Cai,
M. Malkoch* 4837–4843

Beyond State of the Art Honeycomb Membranes: High Performance Ordered Arrays from Multiprogrammable Linear-Dendritic Block Copolymers

Semiconductors

K. H. Cheon, H. Ahn, J. Cho, H.-J. Yun,
B. T. Lim, D. J. Yun, H.-K. Lee,
S.-K. Kwon, Y.-H. Kim,*
D. S. Chung* 4844–4850

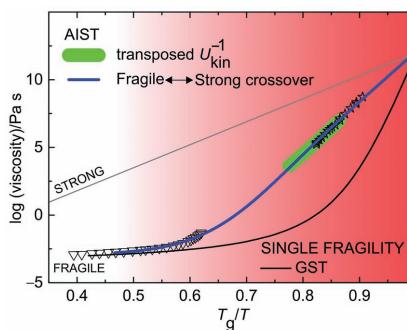
Alcohol as a Processing Solvent of Polymeric Semiconductors to Fabricate Environmentally Benign and High Performance Polymer Field Effect Transistors

FULL PAPERS

Crystallization

J. Orava, D. W. Hewak,
A. L. Greer* 4851–4858

Fragile-to-Strong Crossover in Supercooled Liquid Ag-In-Sb-Te Studied by Ultrafast Calorimetry

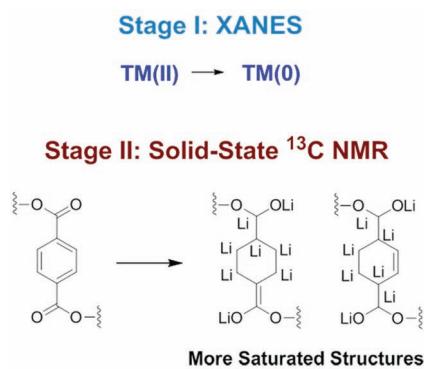


The temperature-dependent viscosity inferred for liquid Ag-In-Sb-Te (AIST) presents evidence for a fragile-to-strong crossover on cooling the liquid. Such a crossover is relevant for the application of AIST and other chalcogenides, helping to understand the distinction between nucleation- and growth-dominated crystallization, and guiding materials design to combine fast switching and non-volatility for application in phase-change memory and neuromorphic computing.

Batteries

H. H. Lee, Y. Park, S. H. Kim,
S.-H. Yeon, S. K. Kwak, K. T. Lee,*
S. Y. Hong* 4859–4866

Mechanistic Studies of Transition Metal-Terephthalate Coordination Complexes upon Electrochemical Lithiation and Delithiation

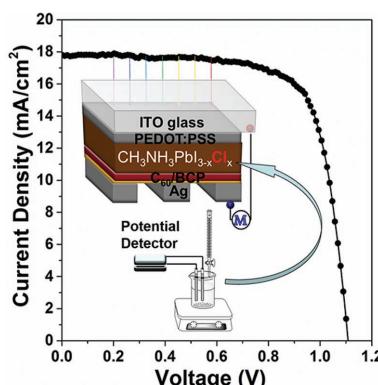


The multi-electron redox mechanism of transition metal terephthalates upon electrochemical lithiation and delithiation is investigated via synchrotron-sourced X-ray absorption spectroscopy and solid state ^{13}C NMR analysis.

Perovskites

Y. Li, W. Sun, W. Yan, S. Ye, H. Peng,
Z. Liu*, Z. Bian,* C. Huang. 4867–4873

High-Performance Planar Solar Cells Based On $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$ Perovskites with Determined Chlorine Mole Fraction

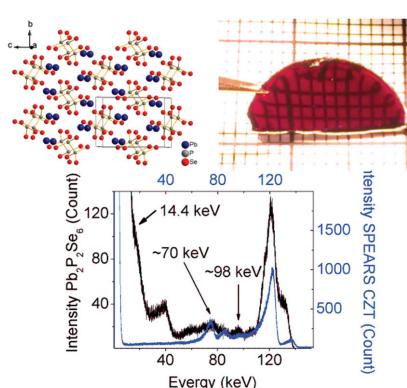


A unique potentiometric titration method is used to measure the chlorine content of $\text{CH}_3\text{NH}_3\text{I}_{3-x}\text{Cl}_x$ perovskites. The maximum chlorine mole fraction of $\text{CH}_3\text{NH}_3\text{I}_{3-x}\text{Cl}_x$ fabricated by low-temperature two-step dipping method can be up to 0.220 ± 0.020 and the corresponding inverted solar cell shows 14.5% efficiency with a high V_{oc} of 1.11 V.

Radiation Detectors

P. L. Wang, Z. Liu, P. Chen, J. A. Peters,
G. Tan, J. Im, W. Lin, A. J. Freeman,
B. W. Wessels,
M. G. Kanatzidis* 4874–4881

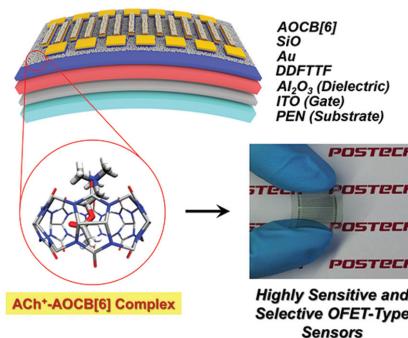
Hard Radiation Detection from the Selenophosphate $\text{Pb}_2\text{P}_2\text{Se}_6$



Wide bandgap selenophosphate $\text{Pb}_2\text{P}_2\text{Se}_6$ is identified as a cost-effective X-ray and γ -ray detector material. The crystal growth of $\text{Pb}_2\text{P}_2\text{Se}_6$ and characterizations in terms of its optical, electrical, thermal, and mechanical properties are reported. A $\text{Pb}_2\text{P}_2\text{Se}_6$ single crystal detector is able to resolve ^{57}Co radiation.

FULL PAPERS

Highly sensitive organic-transistor-based sensors that can selectively detect a neurotransmitter acetylcholine without enzyme immobilization are prepared by functionalization with a synthetic receptor, a cucurbit[6]uril derivative. These sensors exhibit highly sensitive (detection limit of 1×10^{-12} M) and selective sensing behaviors. This work describes a low-cost and viable way for the fabrication of high-performance sensors for the detection of bioactive molecules.

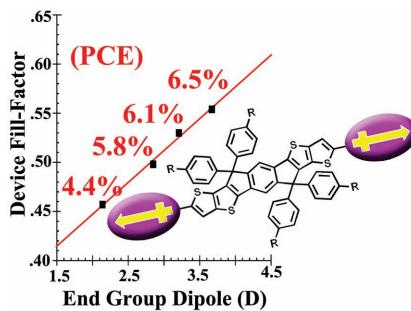


Organic Electronics

M. Jang, H. Kim, S. Lee, H. W. Kim, J. K. Khedkar, Y. M. Rhee, I. Hwang,* K. Kim,* J. H. Oh* 4882–4888

Highly Sensitive and Selective Biosensors Based on Organic Transistors Functionalized with Cucurbit[6]uril Derivatives

Four new ladder-type molecular donors are reported with varying end groups and their photovoltaic properties are explored. It is found that utilizing end groups with larger ground-state dipole moments results in significantly enhanced fill factors and decreased voltage losses in devices.

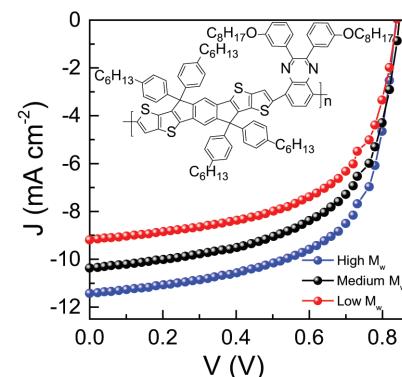


Organic Electronics

J. J. Intemann, K. Yao, F. Ding, Y. Xu, X. Xin, X. Li, A. K.-Y. Jen* 4889–4897

Enhanced Performance of Organic Solar Cells with Increased End Group Dipole Moment in Indacenodithieno[3,2-b]-thiophene-Based Molecules

The synthesis of a series of indacenodithieno[3,2-b]thiophene based donor-acceptor copolymers (PIDTT) and the strong correlations between polymer fractionation and its optoelectronics characteristics are demonstrated. In the best case, the active material exhibits more than 6% PCE in inverted solar cells processed via doctor blading in air, without requiring thermal treatment.

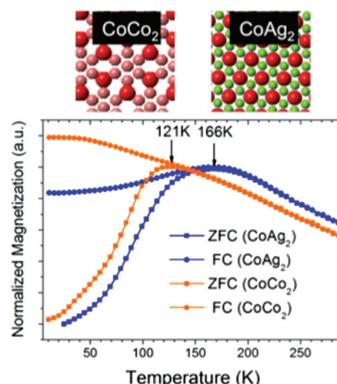


Organic Photovoltaics

N. Gasparini,* A. Katsouras, M. I. Prodromidis, A. Avgeropoulos, D. Baran, M. Salvador, S. Fladischer, E. Specker, C. L. Chochos, T. Ameri,* C. J. Brabec 4898–4907

Photophysics of Molecular-Weight-Induced Losses in Indacenodithienothiophene-Based Solar Cells

3D magnetic binary supracrystals are fabricated, and the magnetic dipolar interactions are found to be controllable by the binary structure and the type of small nanoparticles. The presence of small ferromagnetic nanoparticles can lead to a weaker dipolar interaction than the insertion of nonmagnetic ones.



Magnetic Nanoparticles

Z. Yang, J. Wei, P. Bonville, M.-P. Pileni* 4908–4915

Engineering the Magnetic Dipolar Interactions in 3D Binary Supracrystals Via Mesoscale Alloying