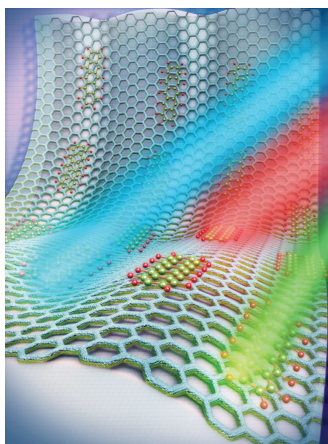


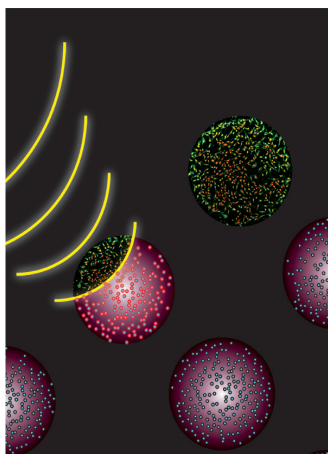
# ADVANCED FUNCTIONAL MATERIALS

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## Organic–Inorganic Heterojunctions

On page 3398, Byeong-Kwon Ju, Zhenqiang Ma, and co-workers report an organic–inorganic multifunctional p–n heterojunction prepared by combining a mesh patterned n-type single crystal silicon nanomembrane with p-type pentacene on a flexible plastic substrate. The device exhibits rectifying characteristics, high optical transparency, high photosensitivity, and outstanding mechanical bending characteristics.

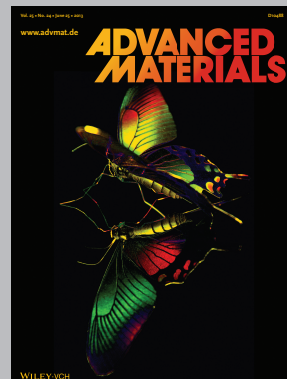
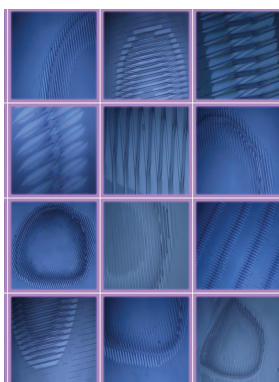


## Microbubbles

A new method reported by Cheri X. Deng, Shuichi Takayama, and co-workers on page 3420 for studying apoptosis adapts microbubbles commonly used for ultrasound imaging to open pores in cell membranes when ultrasound is applied. The ability to pattern microbubbles directly on cells will enable high throughput studies of cell death.

## Microstructures

On page 3453 Congrui Jin, Anand Jagota, and Chung-Yuen Hui report that patterns of interfacial dislocations between two elastomeric sheets, each with shape-complementary surface ridges and channels, allow the sheets to adhere strongly to each other despite some relative misorientation. The system may provide an experimental tool to assist in research on geometry-controlled adhesion and also provides a test bed for stability theories of interacting dislocations and crack fronts.



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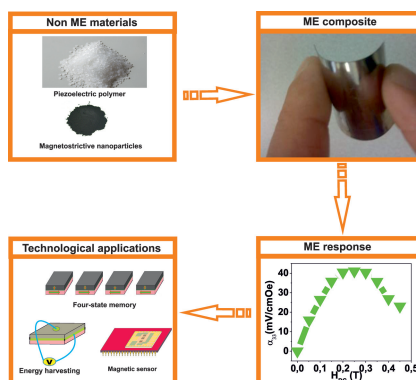
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## FEATURE ARTICLE

## Magnetoelectric Materials

P. Martins,  
S. Lanceros-Méndez\* .....3371–3385

## Polymer-Based Magnetoelectric Materials



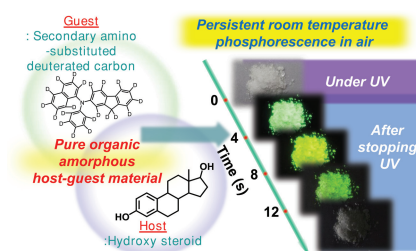
Polymer-based magnetoelectric materials have great potential for advanced applications such as four-state memories, energy harvesting materials, and magnetic sensors. New flexible, low cost, and easily processible magnetoelectric materials are being developed by combining electroactive polymers and magnetostrictive materials, allowing the achievement of larger areas or non-planar structures and meeting the current technological challenges.

## FULL PAPERS

## Phosphorescent Materials

S. Hirata,\* K. Totani, J. Zhang,  
T. Yamashita, H. Kaji, S. R. Marder,  
T. Watanabe,\* C. Adachi\* ....3386–3397

## Efficient Persistent Room Temperature Phosphorescence in Organic Amorphous Materials under Ambient Conditions

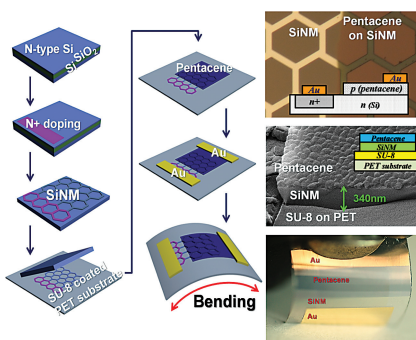


Efficient persistent room temperature phosphorescence with a quantum efficiency of greater than 10% and a lifetime longer than 1 s from pure organic amorphous host-guest materials is demonstrated in air. Physical rigidity and oxygen blocking characteristics of amorphous steroidal compounds as the host greatly minimize quenching of long-lifetime triplet excitons of the guest by interaction with the host and oxygen.

## Photodetectors

J.-H. Seo, T.-Y. Oh, J. Park, W. Zhou,  
B.-K. Ju,\* Z. Ma\* .....3398–3403

## A Multifunction Heterojunction Formed Between Pentacene and a Single-Crystal Silicon Nanomembrane

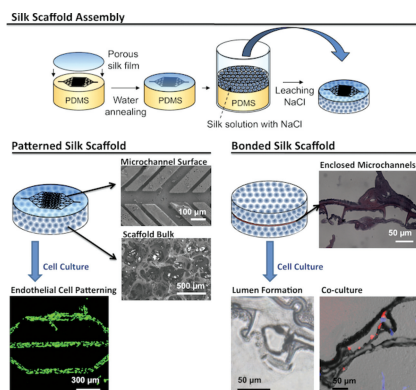


A mesh patterned n-type single-crystalline silicon nanomembrane is complementally combined with a p-type pentacene layer to form a heterogeneous p-n junction on a flexible plastic substrate. The flexible heterogeneous photodetector also exhibits good photosensitivity and external quantum efficiency at visible wavelengths. Over 60% average transmittance in the visible spectrum is measured and outstanding mechanical bending characteristics are observed.

## Tissue Engineering

L. S. Wray, K. Tsiaris, E. S. Gil,  
F. G. Omenetto,  
D. L. Kaplan\* .....3404–3412

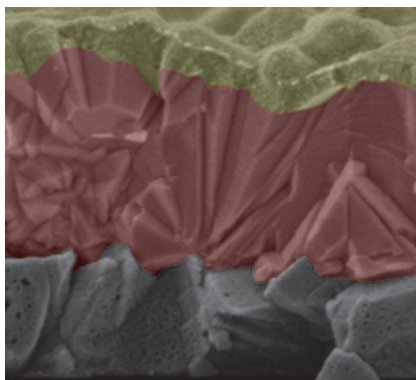
## Microfabricated Porous Silk Scaffolds for Vascularizing Engineered Tissues



A silk scaffold is patterned with porous microchannels for engineering vascularized tissues. Microchannel dimensions range from 25 to 300 μm and endothelial cells proliferate to confluence within the channels. The microchannels are enclosed with biocompatible tissue adhesive. The scaffold supports endothelial lumen formation in the enclosed microchannels and supports stem cell co-culture in the bulk space.

## FULL PAPERS

A  $\text{Cu}_2\text{O}$ -based solar cell synthesized using atmospheric atomic layer deposition (AALD) and employing a back surface field architecture is demonstrated for the first time. Enhanced charge collection is observed when a layer of AALD  $\text{Cu}_2\text{O}^+$  is overlaid on electrodeposited  $\text{ZnO}/\text{Cu}_2\text{O}$  layers. These cells produce a record short circuit current density of  $>6.3 \text{ mA cm}^{-2}$  for a fully atmospherically deposited  $\text{ZnO}/\text{Cu}_2\text{O}$  device.

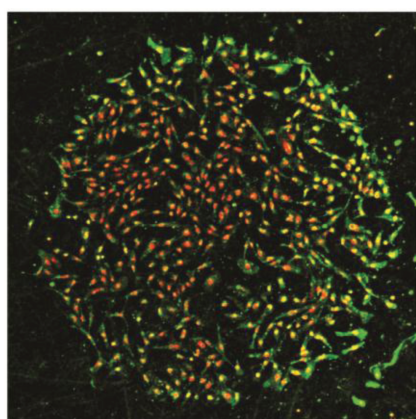


## Photovoltaics

A. T. Marin, D. Muñoz-Rojas,  
D. C. Iza, T. Gershon,  
K. P. Musselman,  
J. L. MacManus-Driscoll\* .....3413–3419

**Novel Atmospheric Growth Technique to Improve Both Light Absorption and Charge Collection in  $\text{ZnO}/\text{Cu}_2\text{O}$  Thin Film Solar Cells**

A new method is described for patterning microbubbles on cell monolayers to target ultrasound treatment to cells. This novel platform provides a controlled system for high throughput testing of the effects of ultrasound-mediated cell membrane disruption on cell physiology. Using this patterning method, it is possible to induce apoptosis in select populations of cells.

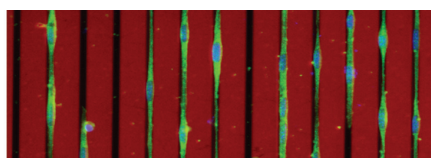
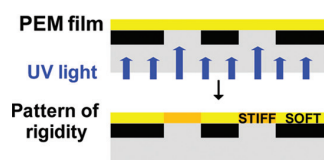


## Sonoporation

J. P. Frampton, Z. Fan, A. Simon,  
D. Chen, C. X. Deng,\*  
S. Takayama\* .....3420–3431

**Aqueous Two-Phase System Patterning of Microbubbles: Localized Induction of Apoptosis in Sonoporated Cells**

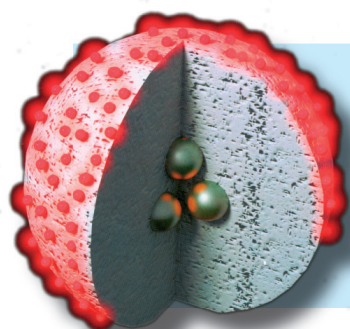
Rigidity photopatterns are created by the photo-crosslinking of a polyelectrolyte multilayer film made of a photoreactive hyaluronan derivative. Orientation of C2C12 myoblasts and nuclear elongation is observed on linear micropatterns.



## Micropatterning

C. Monge, N. Saha, T. Boudou,  
C. Pózos-Vásquez, V. Dulong,  
K. Glinel,\* C. Picart\* .....3432–3442

**Rigidity-Patterned Polyelectrolyte Films to Control Myoblast Cell Adhesion and Spatial Organization**



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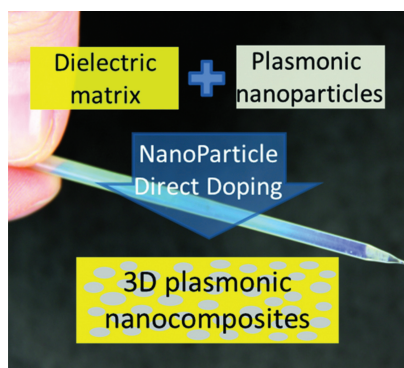


## FULL PAPERS

## Plasmonics

M. Gajc,\* H. B. Surma,  
A. Klos, K. Sadecka, K. Orlinski,  
A. E. Nikolaenko, K. Zdunek,  
D. A. Pawlak\* ..... 3443–3451

**Nanoparticle Direct Doping: Novel Method for Manufacturing Three-Dimensional Bulk Plasmonic Nanocomposites**

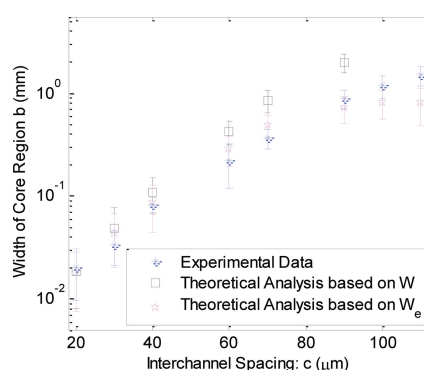


**Metallo-dielectric materials with plasmonic resonances at optical and infrared wavelengths** are attracting increasing interest, due to their potential novel applications in photonics, plasmonics, and photovoltaics. A manufacturing method is presented with experimental realizations of volumetric nanocomposites doped with plasmonic nanoparticles that exhibit resonances at visible/infrared wavelengths.

## Microstructures

C. Jin, A. Jagota,\*  
C.-Y. Hui\* ..... 3453–3462

**Structure and Energetics of Dislocations at Micro-Structured Complementary Interfaces Govern Adhesion**



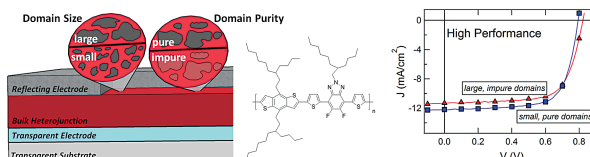
**Poly(dimethylsiloxane) (PDMS)** is used to fabricate microstructured complementary surfaces by molding into a silicon master with microchannel profiles patterned by photolithography. For each pair of complementary surfaces, dislocation defects are observed in the form of visible striations, and the misalignment angle is found to be the key factor controlling dislocation distribution and adhesion strength. The ability to control the orientation and periodicity of dislocation patterns by changing the misalignment angle makes this system eminently controllable.

## Organic Solar Cells

J. R. Tumbleston, A. C. Stuart, E. Gann,  
W. You, H. Ade\* ..... 3463–3470

**Fluorinated Polymer Yields High Organic Solar Cell Performance for a Wide Range of Morphologies**

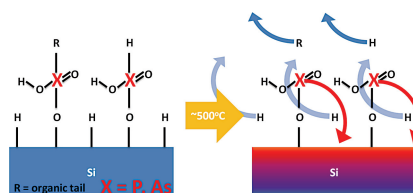
**Narrow ranges of morphological properties are typically required to achieve high performance** in bulk heterojunction organic solar cells. This is not the case for the particular fluorinated polymer-based blend investigated, for which excellent performance is achieved for a range of domain sizes and domain purities. Broad processing latitudes and unconventionally thick active layers afforded by this material offer the potential to rapidly fabricate high performing devices without strict morphological control.



## Self-Assembly

R. C. Longo, K. Cho, W. G. Schmidt,  
Y. J. Chabal, P. Thissen\* ..... 3471–3477

**Monolayer Doping via Phosphonic Acid Grafting on Silicon: Microscopic Insight from Infrared Spectroscopy and Density Functional Theory Calculations**



**Density functional theory (DFT)** is used to explore how alkylphosphonic acid molecules can, in just one chemical step, be grafted on H-terminated Si(111). It is further demonstrated by means of in situ infrared spectroscopy and DFT calculations that the weak link of an alkylphosphonic acid is the P-C bond, with typical release of the carbon ligand around 500 °C. Finally, after release of the carbon ligand, an unsaturated electron configuration is the driving force for the phosphorous to start the monolayer doping process.