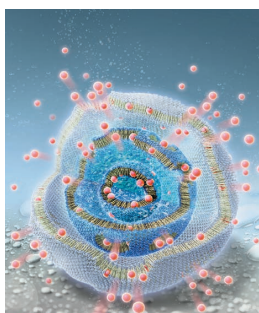


ADVANCED FUNCTIONAL MATERIALS

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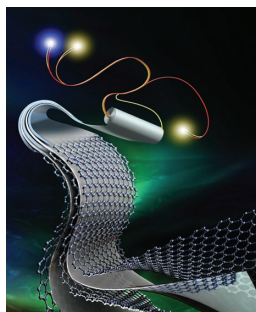


Semicrystalline Polymers

On page 4570, E. Lee and team demonstrate the fabrication of aqueous onion-like vesicles with multi-walls based on the controlled assembly of biocompatible and degradable semicrystalline polymers (PEO-b-PCL). The multi-walled vesicles formed by emulsion droplet instability lead to high drug-loading capacity and stepwise drug-releasing behavior through sequential hydrolytic degradation from the outermost to innermost wall.

Supercapacitors

J. Chen, M. Xue, and colleagues report 3D interdigital electrodes based on reduced graphene oxide for stretchable all-solid-state supercapacitors with adjustable volumetric capacitance, which are accomplished via pressure spray printing and machine coating. The supercapacitor presented on page 4601 can remain high specific volumetric capacitance while keeping its stretchability, and the specific volumetric capacitance can be adjusted by tuning the thickness of electrode layers.

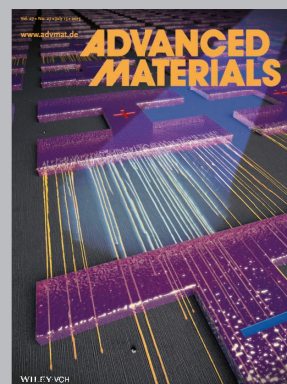
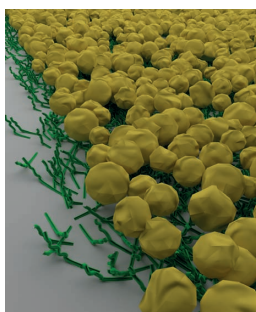


Transparent Electronics

An oxide-free strategy to fabricate extremely thin, flexible, and smooth transparent electrodes is introduced by H. J. Son, J.-W. Kim, and co-workers on page 4580. The developed method, an inverted layer-by-layer process, enables the design and fabrication of highly efficient organic solar cells showing excellent mechanical stability with ultra-small folding radiuses.

Data Storage

$L1_0$ CoPt can be used in data storage, but high temperatures (500 °C) are usually needed to achieve this. On page 4590, J. Galloway and colleagues demonstrate a bioinspired and ecological synthesis that uses a biotemplating peptide to form $L1_0$ CoPt nanoparticles at room temperature. A surface covered with biotemplated magnetic nanoparticles is illustrated in the back cover by Dr. Marcin Górzny (marcingorzny.com).



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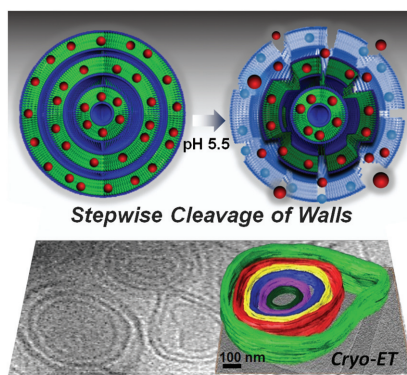
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FULL PAPERS

Tailoring unique nanostructures of biocompatible and degradable polymers and elucidating their shape effects in drug delivery open tremendous opportunities to not only broaden their biomedical applications but also to identify new directions for designing nanomedicine. The exquisite fabrication of onion-like vesicles, based on the assembly of poly(ethylene oxide)-*block*-poly(ϵ -caprolactone), allows stepwise anticancer drug release through the sequential hydrolytic cleavage of multi-walls.

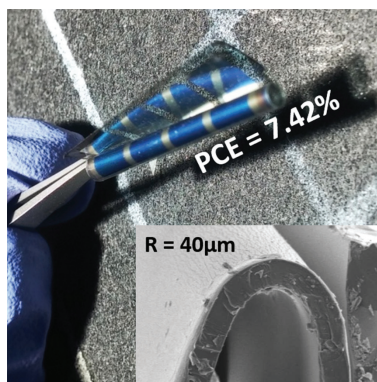


Semicrystalline Polymers

M.-K. Park, S. Jun, I. Kim, S.-M. Jin, J.-G. Kim, T. J. Shin, E. Lee* ...4570–4579

Stepwise Drug-Release Behavior of Onion-Like Vesicles Generated from Emulsification-Induced Assembly of Semicrystalline Polymer Amphiphiles

An extremely flexible Ag nanowire based composite electrode is developed through a solution-based inverted layer-by-layer process. A polymer solar cell based on this composite electrode offers a very stable performance, with a PCE loss of no more than 5% when folded at a radius of 40 μm , with a maximum PCE of 7.42% being achievable.



Transparent Electronics

Y. Kim, T. I. Ryu, K.-H. Ok, M.-G. Kwak, S. Park, N.-G. Park, C. J. Han, B. S. Kim, M. J. Ko, H. J. Son,* J.-W. Kim*4580–4589

Inverted Layer-By-Layer Fabrication of an Ultraflexible and Transparent Ag Nanowire/Conductive Polymer Composite Electrode for Use in High-Performance Organic Solar Cells

A dual affinity peptide is designed to template the formation of technologically valuable L1_0 CoPt, a magnetic material for use in data storage, onto a surface. This biokleptic synthesis is the first time that L1_0 CoPt has been formed at room temperature from an aqueous solution and offers a cheaper, greener route to developing biotemplated magnetic thin films for recording.

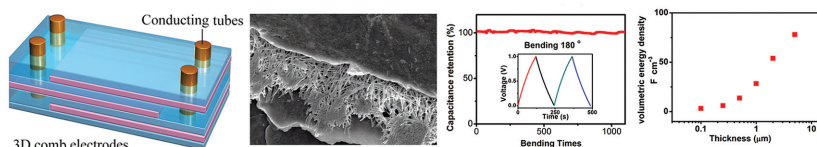


Data Storage

J. M. Galloway,* J. E. Talbot, K. Critchley, J. J. Miles, J. P. Bramble4590–4600

Developing Biotemplated Data Storage: Room Temperature Biomineralization of L1_0 CoPt Magnetic Nanoparticles

3D interdigital electrodes ensure the adjustable volumetric capacitance of stretchable supercapacitors. A 3D interdigital electrode supercapacitor is composed of reduced graphene oxide (rGO) electrodes (with sandwiched Ag nanowire layers as currents collector) via pressure spray printing and solid electrolyte multilayers via machine coating. It can retain high specific volumetric capacitance while keeping its stretchability, and the specific volumetric capacitance can be adjusted by tuning the thickness of rGO layers.



Supercapacitors

F. Li, J. Chen,* X. Wang, M. Xue,* G. F. Chen4601–4606

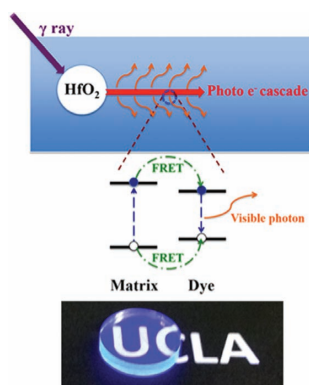
Stretchable Supercapacitor with Adjustable Volumetric Capacitance Based on 3D Interdigital Electrodes

FULL PAPERS

Radiation Detectors

C. Liu, T. J. Hajagos, D. Kishpaugh,
Y. Jin, W. Hu, Q. Chen,
Q. Pei* 4607–4616

Facile Single-Precursor Synthesis and Surface Modification of Hafnium Oxide Nanoparticles for Nanocomposite γ -Ray Scintillators

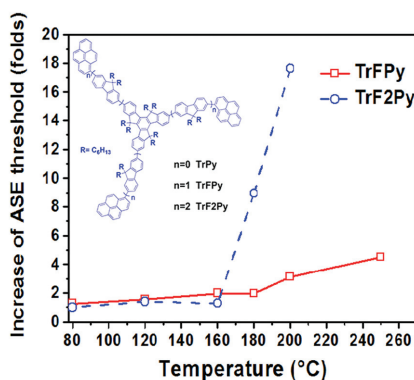


An efficient multigram-scale single-precursor synthesis of high-quality hafnium oxide nanoparticles is reported. After surface modification, these nanoparticles are used to fabricate highly transparent nanocomposite monoliths (2 mm thick, $T_{550\text{ nm}} > 75\%$) at loadings up to 40 wt%. The nanocomposite monoliths are efficient in detecting gamma radiation, being capable of producing a full energy photopeak with deconvoluted resolution $< 8\%$.

Organic Lasers

W. Xu, J. Yi, W.-Y. Lai,* L. Zhao,
Q. Zhang, W. Hu, X.-W. Zhang, Y. Jiang,
L. Liu, W. Huang* 4617–4625

Pyrene-Capped Conjugated Amorphous Starbursts: Synthesis, Characterization, and Stable Lasing Properties in Ambient Atmosphere

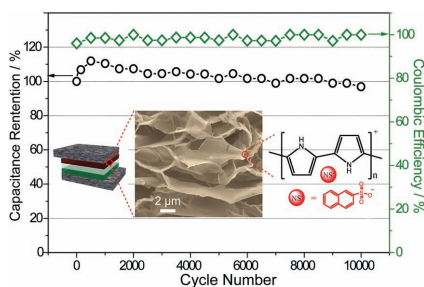


Well-defined starburst conjugated macromolecules with pyrene moieties as end-capped groups are explored as the optical gain media for organic semiconductor lasers. The length of oligofluorene bridges between the truxene core and pyrene capers is carefully tuned. The relationships between their morphology, thermal stability, and amplified spontaneous emission stability in an ambient condition are systematically investigated, suggesting that the pyrene-capped molecular design improves the optical gain stability.

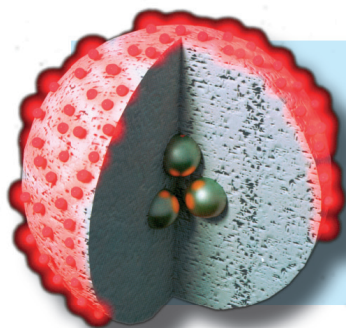
Pseudocapacitors

Y. Song, T.-Y. Liu, X.-X. Xu, D.-Y. Feng,
Y. Li,* X.-X. Liu* 4626–4632

Pushing the Cycling Stability Limit of Polypyrrole for Supercapacitors



By a doping polypyrrole film supported on functionalized partial-exfoliated graphite (FEG) substrate with β -naphthalene sulfonate anions, the polypyrrole electrode achieves a remarkable capacitance retention rate of 97.5% after cycling between -0.8 and 0 V versus saturated calomel electrode for 10 000 cycles. An asymmetric pseudocapacitor using the stabilized PPy film as anode can also retain 97% of capacitance after 10 000 cycles.



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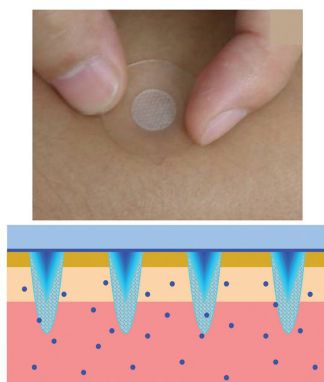
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FULL PAPERS

Phase-transition microneedle (PTM) patch is designed for efficient transdermal delivery of biomedicines without skin deposition of the needle tip materials because of its water-swelling (instead of dissolving) activated drug release. The main matrix of the PTM is formed from polyvinyl alcohol, a unique hydrophilic polymer whose solution may convert to water-insoluble hydrogel by forming microcrystalline domains as the cross-linking junctions via a mild freeze-thaw treatment.

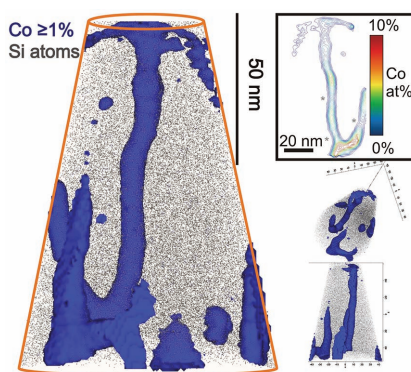


Microneedles

S. Yang, F. Wu, J. Liu, G. Fan, W. Welsh, H. Zhu, T. Jin*4633–4641

Phase-Transition Microneedle Patches for Efficient and Accurate Transdermal Delivery of Insulin

A novel single-phase, filamentary inhomogeneous alloy composed of crystalline silicon with at least 10 atomic % Co incorporated, formed by ion implantation of high doses of Co into crystalline silicon followed by ultrafast pulsed-laser melting is investigated. Using atom probe tomography measurements of local composition and morphology, the kinetics of formation of this material is explored.

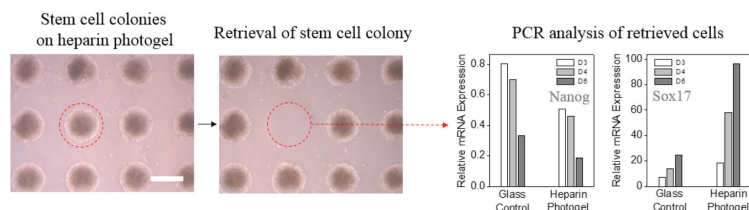


Semiconductors

A. J. Akey,* D. Recht, J. S. Williams, M. J. Aziz, T. Buonassisi4642–4649

Single-Phase Filamentary Cellular Breakdown Via Laser-Induced Solute Segregation

A photodegradable bioactive hydrogel helps to improve stem cell differentiation while opening the possibility to retrieve specific colonies from the culture dish for downstream analysis.

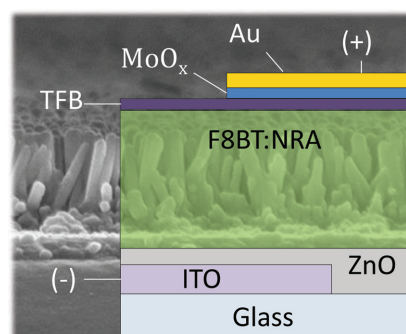


Photodegradable Gels

J. You,* A. Haque, D.-S. Shin, K. J. Son, C. Siltanen, A. Revzin*4650–4656

Bioactive Photodegradable Hydrogel for Cultivation and Retrieval of Embryonic Stem Cells

Hybrid LEDs combining vertically aligned ZnO nanorods as electron injection layers and polymeric emitters are demonstrated using a simple solution-processing route. Performance enhancements are achieved by combining a thermal anneal with the inclusion of an electron-blocking polymer. The measured brightness and efficiencies, up to 8600 cd m⁻² and 1.66 cd A⁻¹, highlight the applicability of such architectures for general lighting applications.



Organic Electronics

J. C. D. Faria, A. J. Campbell, M. A. McLachlan*4657–4663

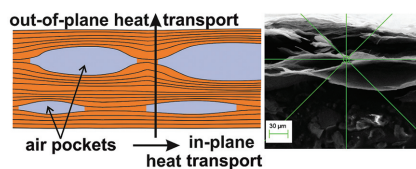
ZnO Nanorod Arrays as Electron Injection Layers for Efficient Organic Light Emitting Diodes

FULL PAPERS

Graphene

J. D. Renteria, S. Ramirez, H. Malekpour,
B. Alonso, A. Centeno, A. Zurutuza,
A. I. Cocemasov, D. L. Nika,
A. A. Balandin* 4664–4672

**Strongly Anisotropic Thermal
Conductivity of Free-Standing Reduced
Graphene Oxide Films Annealed at High
Temperature**

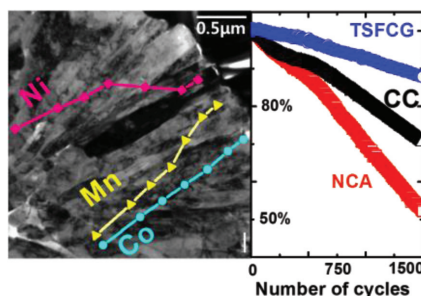


The high-temperature treatment of reduced graphene oxide films dramatically increases their in-plane thermal conductivity at room temperature. The cross-plane thermal conductivity reveals an opposite trend of decreasing to a very small value in the films annealed at 1000 °C. The synthesized films demonstrate an exceptionally strong anisotropy of thermal conductivity, which is useful for thermal management applications.

Batteries

B.-B. Lim, S.-J. Yoon, K.-J. Park,
C. S. Yoon, S.-J. Kim, J. J. Lee,
Y.-K. Sun* 4673–4680

**Advanced Concentration Gradient
Cathode Material with Two-Slope for
High-Energy and Safe Lithium Batteries**

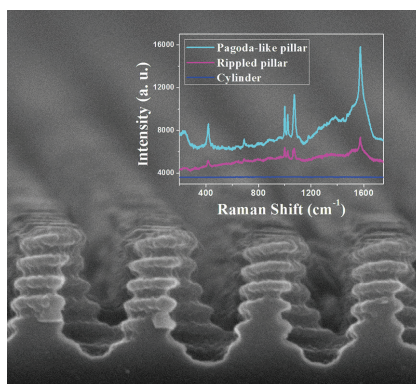


Two-sloped full concentration gradients (TSFCG) of Ni, Co, and Mn ions throughout the cathode particles to maximize the average Ni concentration are successfully synthesized via coprecipitation. The TSFCG cathode exhibits the best cycling stability compared to conventional cathode and $\text{Li}[\text{Ni}_{0.8}\text{Co}_{0.15}\text{Al}_{0.05}]\text{O}_2$, which delivers a discharge capacity in excess of 200 mAh g⁻¹ with excellent cycle life and thermal stability.

Raman Scattering

T. Y. Jeon, S.-G. Park, D.-H. Kim,*
S.-H. Kim* 4681–4688

**Standing-Wave-Assisted Creation
of Nanopillar Arrays with Vertically
Integrated Nanogaps for SERS-Active
Substrates**

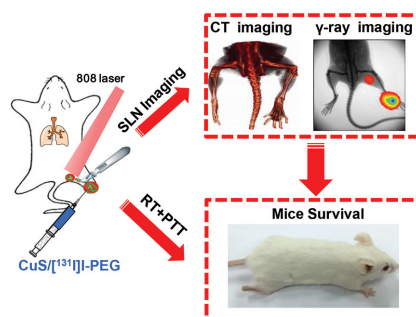


Arrays of pagoda-like nanopillars are created by employing a standing wave during phase-shift interference lithography. A series of metallic nanogaps on the side walls of the nanopillars provide a high density of hot spots for the localization of the electric field, thereby making the arrays an effective surface-enhanced Raman scattering substrate. The arrays can be further micropatterned by photolithography, enabling the analysis of multiple samples on a single substrate.

Cancer Therapy

X. Yi, K. Yang,* C. Liang, X. Zhong,
P. Ning, G. Song, D. Wang, C. Ge,
C. Chen, Z. Chai, Z. Liu* 4689–4699

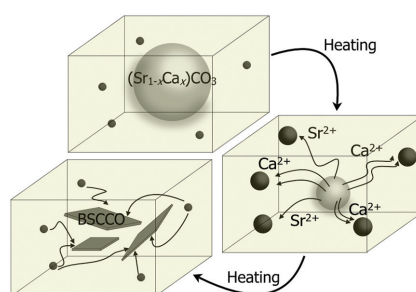
**Imaging-Guided Combined
Photothermal and Radiotherapy to Treat
Subcutaneous and Metastatic Tumors
Using Iodine-131-Doped Copper Sulfide
Nanoparticles**



Radionuclide iodine-131-doped CuS/I nanoparticles are developed for imaging guided combined photothermal and radiotherapy. Such a treatment strategy not only offers synergistic therapeutic effect in the treatment of subcutaneous tumors, but also enables effective treatment of sentinel lymph nodes under the guidance of multimodal gamma and CT imaging to prevent tumor metastasis.

FULL PAPERS

The precise mechanism of formation of the superconductor $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ (Bi-2212) is unknown. Via extensive X-ray diffraction, infrared spectroscopy, and thermogravimetric analysis, the mechanism is identified, and it is found that a carbonate eutectic $(\text{Sr}_{1-x}\text{Ca}_x)\text{CO}_3$ is the key driver in the formation of Bi-2212. The introduction of potassium ions leads to the formation of Bi-2212 at a temperature 50 °C lower than that achieved previously.

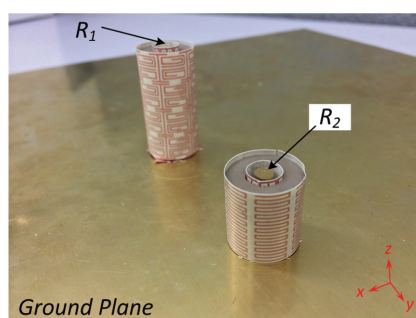


Superconductors

D. C. Green, R. Boston, S. Glatzel, M. R. Lees, S. C. Wimbush, J. Potticary, W. Ogasawara, S. R. Hall*4700–4707

On the Mechanism of Cuprate Crystal Growth: The Role of Mixed Metal Carbonates

Integrated ultralightweight metasurface cloaking coatings are demonstrated for restoring intrinsic properties of electromagnetic radiators. By tailoring the dispersive properties of the metasurfaces, the mutual coupling and mutual blockage between multiple radiators can be simultaneously reduced. The general concept and design approach pave the way for dense deployment of terahertz/optical antennas as well as radiators in other realms of physics.

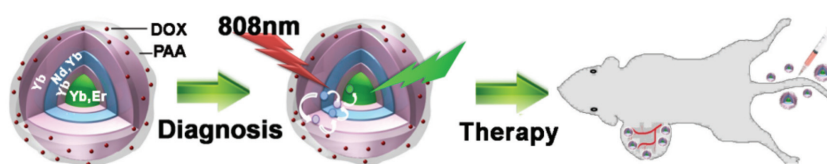


Metamaterials

Z. H. Jiang, P. E. Sieber, L. Kang, D. H. Werner*4708–4716

Restoring Intrinsic Properties of Electromagnetic Radiators Using Ultralightweight Integrated Metasurface Cloaks

Multifunctional uniform core-shell nanoparticles $\text{NaYF}_4:\text{Yb}$, $\text{Er}@\text{NaYF}_4:\text{Yb}@\text{NaNdF}_4:\text{Yb}@\text{NaYF}_4:\text{Yb}@\text{PAA}$ (UCNP@PAA) consist of a highly effective 808-nm-to-visible UCNP core (with an absolute upconversion quantum yield of 0.18% in green emission mode) and a thin shell of PAA. These UCNP@PAA nanoparticles are designed and synthesized to simultaneously achieve in vitro/in vivo upconversion bioimaging and pH-sensitive chemotherapy.

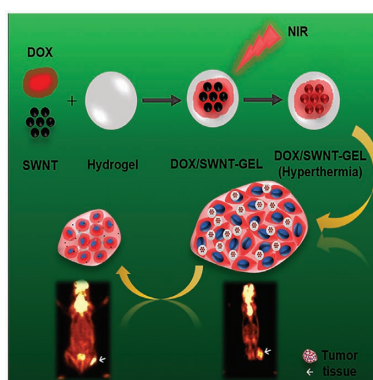


Cancer Treatment

B. Liu, Y. Chen, C. Li,* F. He, Z. Hou, S. Huang, H. Zhu, X. Chen, J. Lin*4717–4729

Poly(Acrylic Acid) Modification of Nd^{3+} -Sensitized Upconversion Nanophosphors for Highly Efficient UCL Imaging and pH-Responsive Drug Delivery

A DOX-loaded SWNT-based thermo-sensitive hydrogel (DOX/SWNT-GEL) in situ drug delivery system is reported. DOX/SWNT-GEL exhibits pro-apoptosis effect through a hyperthermia therapy mechanism by NIR radiation, as well as better tumor growth suppression efficacy compared with free DOX in vivo. The combination of controlled drug release and photothermal transduction of DOX/SWNT-GEL provides a promising prospect in future nanomedicine progress.



Drug Delivery

M. Zhou, S. Liu, Y. Jiang, H. Ma, M. Shi, Q. Wang, W. Zhong, W. Liao,* M. M. Q. Xing*4730–4739

Doxorubicin-Loaded Single Wall Nanotube Thermo-Sensitive Hydrogel for Gastric Cancer Chemo-Photothermal Therapy