

# Nano Research

December · 2020

Volume 13 · Number 12

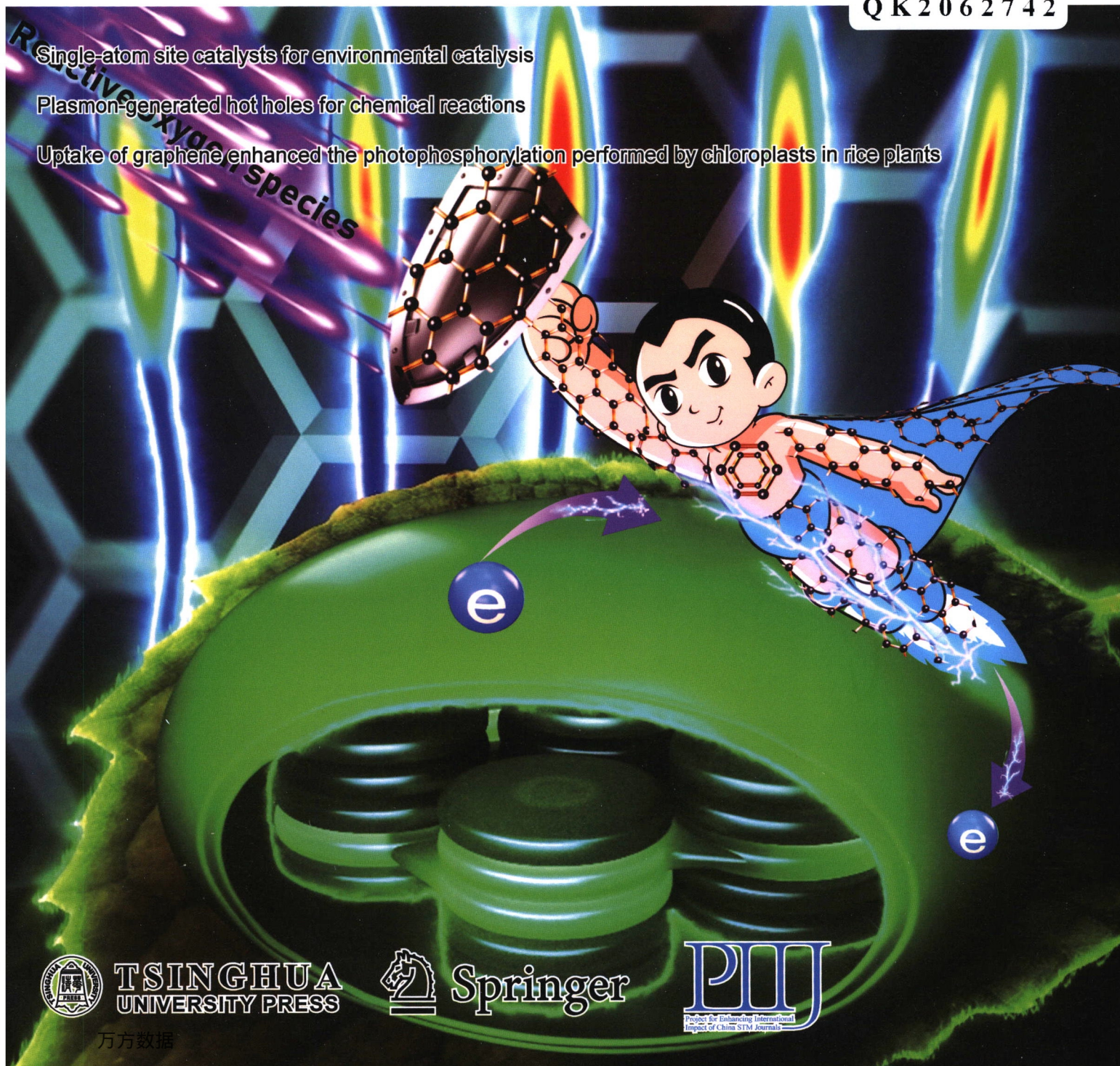


QK2062742

Single-atom site catalysts for environmental catalysis

Plasmon-generated hot holes for chemical reactions

Uptake of graphene enhanced the photophosphorylation performed by chloroplasts in rice plants



TSINGHUA  
UNIVERSITY PRESS



Springer



万方数据



# Contents

## Review Articles

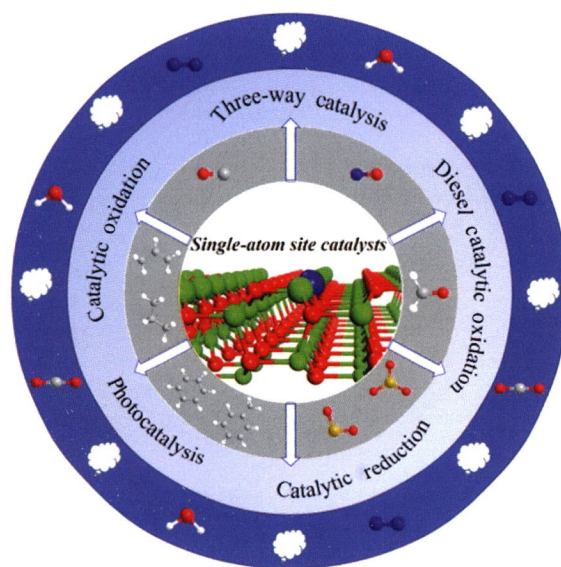
### Single-atom site catalysts for environmental catalysis

Ningqiang Zhang<sup>1</sup>, Chenliang Ye<sup>1</sup>, Han Yan<sup>1</sup>, Lingcong Li<sup>3,\*</sup>,  
Hong He<sup>2</sup>, Dingsheng Wang<sup>1,\*</sup>, and Yadong Li<sup>1</sup>

<sup>1</sup> Tsinghua University, China

<sup>2</sup> Beijing University of Technology, China

<sup>3</sup> Hokkaido University, Japan



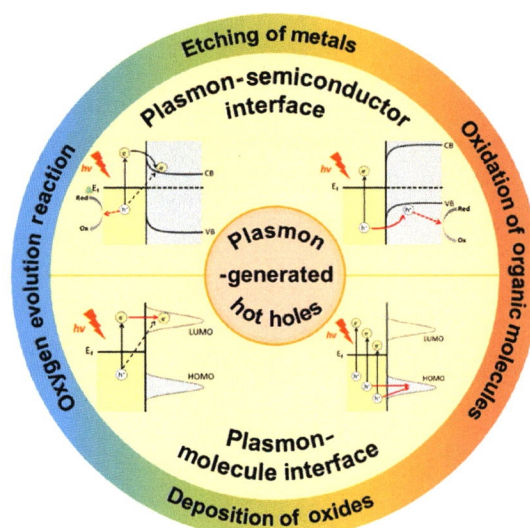
The progress of single-site atom catalysts in application of catalytic elimination of environmental pollutants is summarized and analyzed.

3165–3182

### Plasmon-generated hot holes for chemical reactions

Chengyu Zhang, Fucan Jia, Zhuoyao Li, Xiao Huang, and  
Gang Lu\*

Nanjing Tech University, China



This review focuses on the photochemistry driven by the plasmon-generated hot holes. The generation and energy distribution of the plasmon-generated hot carriers, the dynamics of the hot holes are discussed at the interface between plasmonic metal and semiconductor or adsorbed molecules, after which the utilization of these hot holes in redox reactions is reviewed.

3183–3197



## Research Articles

## Uptake of graphene enhanced the photophosphorylation performed by chloroplasts in rice plants

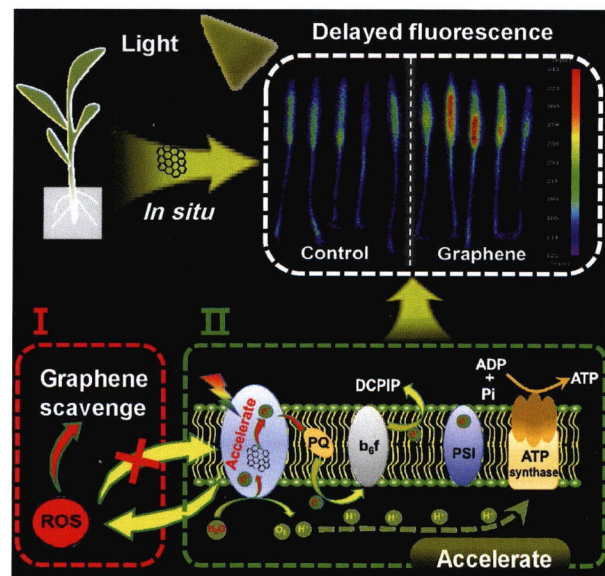
Kun Lu<sup>1</sup>, Danlei Shen<sup>1</sup>, Shipeng Dong<sup>1</sup>, Chunying Chen<sup>2</sup>, Sijie Lin<sup>3</sup>, Shan Lu<sup>1</sup>, Baoshan Xing<sup>4</sup>, and Liang Mao<sup>1,\*</sup>

<sup>1</sup> Nanjing University, China

<sup>2</sup> National Center for Nanoscience and Technology, China

<sup>3</sup> Tongji University, China

<sup>4</sup> University of Massachusetts, USA



Under light irradiation, the reactive oxygen species (ROS) as by-products of photosynthesis reactions was quenched by graphene, protecting the photosystem II (PS II) against photo-bleaching. Moreover, owing to its superior electrical conductivity, graphene facilitated the electron transfer process of PS II, resulting in obviously improved delayed fluorescence intensity.

3198–3205

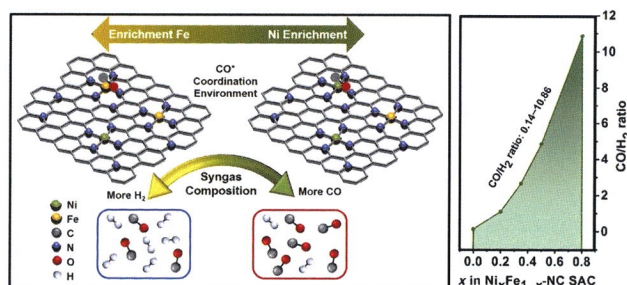
Electrochemical conversion of CO<sub>2</sub> to syngas with a wide range of CO/H<sub>2</sub> ratio over Ni/Fe binary single-atom catalysts

Meng Zhang<sup>1</sup>, Zheng Hu<sup>1</sup>, Lin Gu<sup>3</sup>, Qinghua Zhang<sup>3</sup>, Linghui Zhang<sup>1</sup>, Qian Song<sup>1</sup>, Wei Zhou<sup>1</sup>, and Shi Hu<sup>1,2,\*</sup>

<sup>1</sup> Tianjin University, China

<sup>2</sup> Hefei Comprehensive National Science Center, China

<sup>3</sup> Institute of Physics, Chinese Academy of Sciences, China



Binary single-atom catalysts of Fe and Ni on nitrogen-doped carbon are fabricated using glucose-chelating method, which exhibits wide-range of controllable CO/H<sub>2</sub> ratio depending on the Fe/Ni content. The variation of the product selectivity with composition is justified by density functional theory (DFT) calculation of the reaction barrier in both hydrogen evolution and CO<sub>2</sub> reduction reactions.

3206–3211



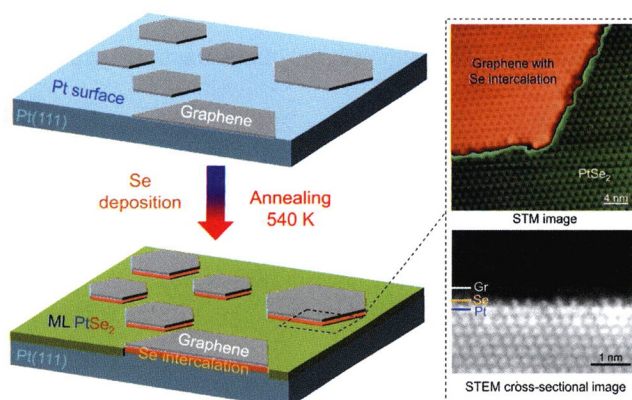
### Using graphene to suppress the selenization of Pt for controllable fabrication of monolayer PtSe<sub>2</sub>

Zhong-Liu Liu<sup>1</sup>, Zhi-Li Zhu<sup>1</sup>, Xu Wu<sup>2</sup>, Jin-An Shi<sup>1</sup>, Wu Zhou<sup>1</sup>, Li-Wei Liu<sup>2</sup>, Ye-Liang Wang<sup>2,1,3,\*</sup>, and Hong-Jun Gao<sup>1,3,\*</sup>

<sup>1</sup> University of Chinese Academy of Sciences, China

<sup>2</sup> Beijing Institute of Technology, China

<sup>3</sup> CAS Center for Excellence in Topological Quantum Computation, China



By inducing confined conditions with a pre-coating of graphene, the selenization of Pt(111) can be suppressed to form a Se intercalated layer, instead of a PtSe<sub>2</sub> monolayer, which provides an approach for controllable fabrication of PtSe<sub>2</sub> in patterns.

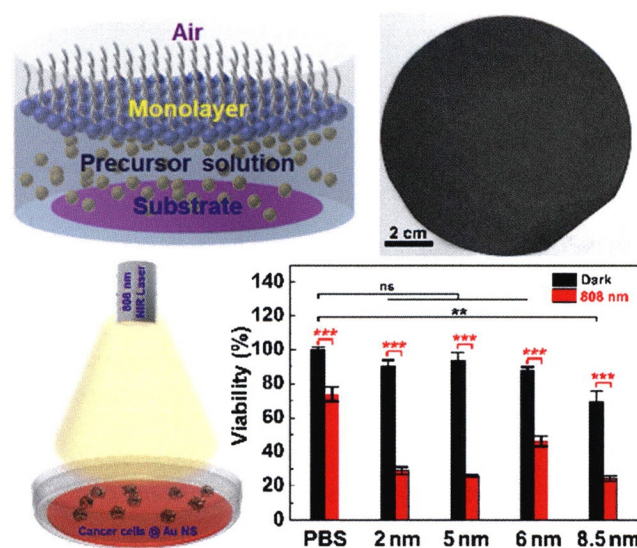
3212–3216

### *In vitro* study of enhanced photodynamic cancer cell killing effect by nanometer-thick gold nanosheets

Ziyi Zhang<sup>1</sup>, Dalong Ni<sup>1,2</sup>, Fei Wang<sup>1</sup>, Xin Yin<sup>1</sup>, Shreya Goel<sup>1</sup>, Lazarus N. German<sup>1</sup>, Yizhan Wang<sup>1</sup>, Jun Li<sup>1</sup>, Weibo Cai<sup>1,2,\*</sup>, and Xudong Wang<sup>1,\*</sup>

<sup>1</sup> University of Wisconsin-Madison, USA

<sup>2</sup> University of Wisconsin Carbone Cancer Center, USA



This paper reports the development of a novel two-dimensional (2D) ultrathin gold nanosheet structure that offers superior efficacy for cancer treatment via photodynamic effect.

3217–3223



### An *in-situ* spectroscopy investigation of alkali metal interaction mechanism with the imide functional group

Xu Lian<sup>1</sup>, Zhirui Ma<sup>1</sup>, Zhonghan Zhang<sup>2</sup>, Jinlin Yang<sup>1,3</sup>, Shuo Sun<sup>1</sup>, Chengding Gu<sup>1</sup>, Yuan Liu<sup>1,4</sup>, Honghe Ding<sup>5</sup>, Jun Hu<sup>5</sup>, Xu Cao<sup>5</sup>, Junfa Zhu<sup>5</sup>, Shuzhou Li<sup>2,\*</sup>, and Wei Chen<sup>1,3,4,\*</sup>

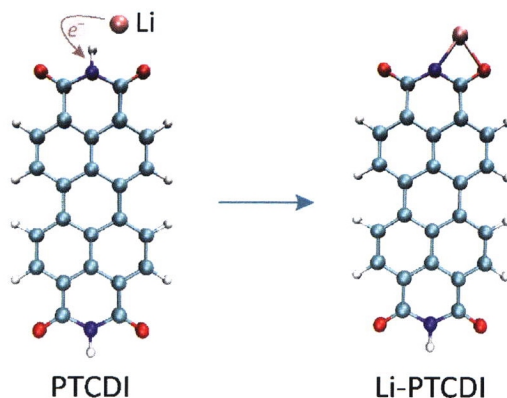
<sup>1</sup> National University of Singapore, Singapore

<sup>2</sup> Nanyang Technological University, Singapore

<sup>3</sup> National University of Singapore (Suzhou) Research Institute, China

<sup>4</sup> International Campus of Tianjin University, China

<sup>5</sup> University of Science and Technology of China, China



The chemical insertion of alkali ions in an organic anode material of perylene-3,4,9,10-tetracarboxylic diimide (PTCDI) has been investigated by *in-situ* X-ray photoelectron spectroscopy (XPS), ultraviolet photoelectron spectroscopy (UPS), synchrotron-based near edge X-ray absorption fine structure (NEXAFS). Both Li and Na follow a hydrogen replacing mechanism upon chemical insertion in PTCDI.

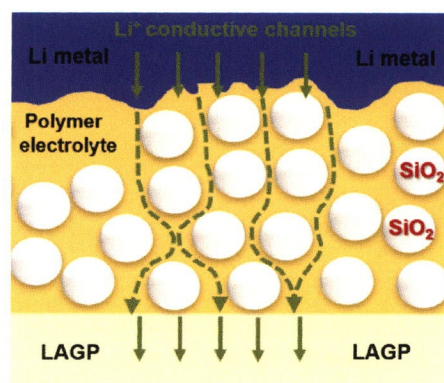
3224–3229

### Inorganic/polymer hybrid layer stabilizing anode/electrolyte interfaces in solid-state Li metal batteries

Yiran Hu<sup>1,2</sup>, Yiren Zhong<sup>2</sup>, Limin Qi<sup>1,\*</sup>, and Hailiang Wang<sup>2,\*</sup>

<sup>1</sup> Peking University, China

<sup>2</sup> Yale University, USA



An inorganic/polymer hybrid interlayer composed of a Li<sup>+</sup> polymer electrolyte and SiO<sub>2</sub> submicrospheres stabilizes the interface between Li metal and Li<sub>1.5</sub>Al<sub>0.5</sub>Ge<sub>1.5</sub>(PO<sub>4</sub>)<sub>3</sub> (LAGP) in all-solid-state batteries.

3230–3234

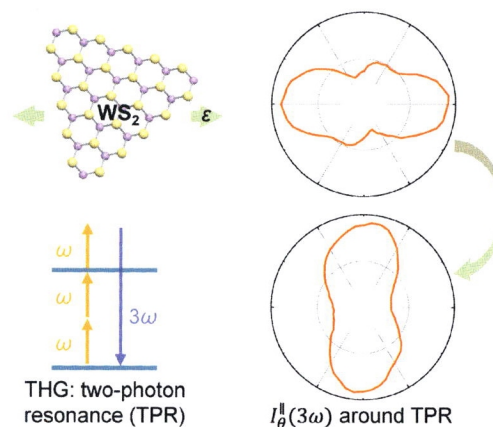
### Giant pattern evolution in third-harmonic generation of strained monolayer WS<sub>2</sub> at two-photon excitonic resonance

Jing Liang<sup>1</sup>, He Ma<sup>1</sup>, Jinhuan Wang<sup>2</sup>, Xu Zhou<sup>1</sup>, Wentao Yu<sup>1</sup>, Chaojie Ma<sup>1</sup>, Muhong Wu<sup>1</sup>, Peng Gao<sup>1</sup>, Kaihui Liu<sup>1,2,\*</sup>, and Dapeng Yu<sup>3</sup>

<sup>1</sup> Peking University, China

<sup>2</sup> Beijing Institute of Technology, China

<sup>3</sup> Southern University of Science and Technology, China



The polarization dependence of third-harmonic generation (THG) in strained monolayer WS<sub>2</sub> undergoes a giant pattern evolution around two-photon resonance (TPR).

3235–3240



### 3D RNA nanocage for encapsulation and shielding of hydrophobic biomolecules to improve the *in vivo* biodistribution

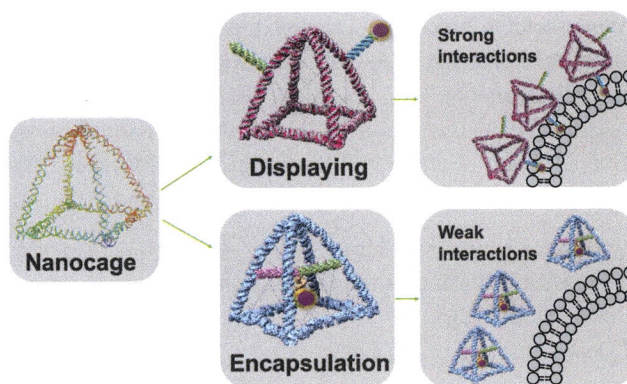
Congcong Xu<sup>1</sup>, Kaiming Zhang<sup>2</sup>, Hongran Yin<sup>1</sup>, Zhefeng Li<sup>1</sup>, Alexey Krasnoslobodtsev<sup>3,4</sup>, Zhen Zheng<sup>1</sup>, Zhouxiang Ji<sup>1</sup>, Sijin Guo<sup>1</sup>, Shanshan Li<sup>2</sup>, Wah Chiu<sup>2</sup>, and Peixuan Guo<sup>1,\*</sup>

<sup>1</sup> The Ohio State University, USA

<sup>2</sup> Stanford University, USA

<sup>3</sup> University of Nebraska, USA

<sup>4</sup> University of Nebraska Medical Center, USA



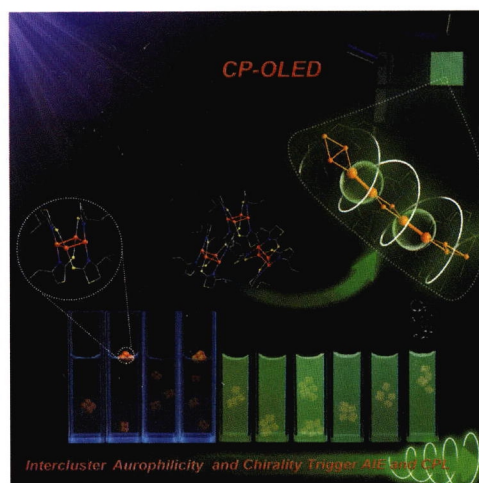
A three-dimensional (3D) RNA nanocage was developed for encapsulation of hydrophobic biomolecules to improve the *in vivo* biodistribution.

3241–3247

### Intercluster aurophilicity-driven aggregation lighting circularly polarized luminescence of chiral gold clusters

Zhen Han, Xueli Zhao, Peng Peng, Si Li, Chong Zhang, Man Cao, Kai Li, Zhao-Yang Wang\*, and Shuang-Quan Zang\*

Zhengzhou University, China



Inter-cluster Au–Au interactions drove the aggregation of chiral gold clusters and produced circularly polarized luminescence with photoluminescence quantum yield of 41.4% and dissymmetry factor  $|g_{PL}|$  of  $7.0 \times 10^{-3}$ , enabling the fabrication of the first pair of circularly polarized organic light-emitting diodes (OLEDs).

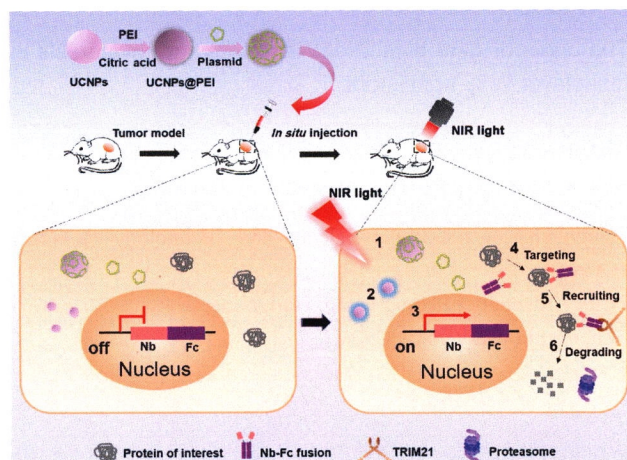
3248–3252

### Spatiotemporal regulation of ubiquitin-mediated protein degradation via upconversion optogenetic nanosystem

Yafeng Hao<sup>1</sup>, Taofeng Du<sup>2</sup>, Gaoju Pang<sup>1</sup>, Jiahua Li<sup>1</sup>, Huizhuo Pan<sup>1</sup>, Yingying Zhang<sup>1</sup>, Lizhen Wang<sup>2</sup>, Jin Chang<sup>1</sup>, En-min Zhou<sup>2,\*</sup>, and Hanjie Wang<sup>1,\*</sup>

<sup>1</sup> Tianjin University, China

<sup>2</sup> Northwest A&F University, China



Upconversion optogenetic nanosystem spatiotemporally regulates ubiquitin-mediated target protein degradation.

3253–3260



## Water-soluble boron carbon oxynitride dots with excellent solid-state fluorescence and ultralong room-temperature phosphorescence

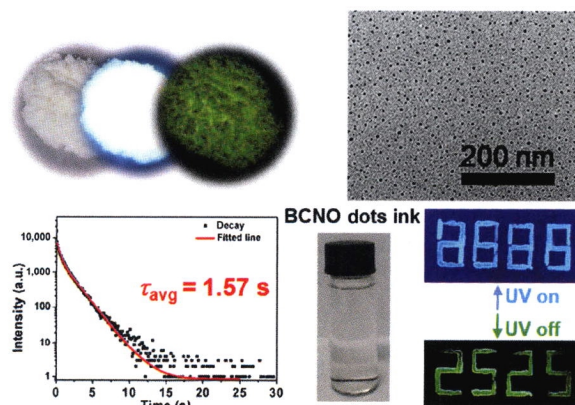
Shenghui Han<sup>1</sup>, Gang Lian<sup>1,\*</sup>, Xiaoliang Zeng<sup>2</sup>, Zhaozhen Cao<sup>1</sup>, Qilong Wang<sup>1</sup>, Deliang Cui<sup>1</sup>, and Ching-Ping Wong<sup>3,\*</sup>

<sup>1</sup> Shandong University, China

<sup>2</sup> Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

<sup>3</sup> Georgia Institute of Technology, USA

3261–3267



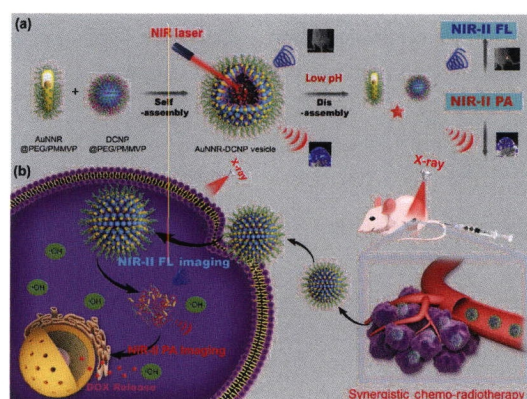
Water-soluble boron carbon oxynitride (BCNO) dots, displaying superior blue fluorescence and ultralong green room temperature phosphorescence ( $> 1.5$  s), were first synthesized by a one-step microwave approach. Its potential applications, as a novel advanced security ink, in anti-counterfeiting, information encryption and fluorescent staining are demonstrated.

## Dual activated NIR-II fluorescence and photoacoustic imaging-guided cancer chemo-radiotherapy using hybrid plasmonicfluorescent assemblies

Tao Chen, Lichao Su, Xiaoguang Ge, Wenmin Zhang, Qingqing Li, Xuan Zhang, Jiamin Ye, Lisen Lin, Jibin Song\*, and Huanghao Yang\*

Fuzhou University, China

3268–3277



In summary, we reported a novel plasmonic-fluorescent hybrid nanogapped gold nanorod (AuNNR)-down-conversion nanoparticles (DCNP) vesicle with pH responsive bimodal second near-infrared window (NIR-II) photoacoustic/fluorescence (PA/FL) imaging performances for guiding cancer chemo-radiotherapy. In an acidic environment, the vesicles were disassembled into single AuNNR and DCNP, leading to localized DOX release and responsive variation of NIR-II PA and FL signals. The hybrid vesicle served as a smart theranostic agent for accurate cancer chemo-radithery-guided by dual NIR-II PA and FL imaging.

## The origin of gate bias stress instability and hysteresis in monolayer WS<sub>2</sub> transistors

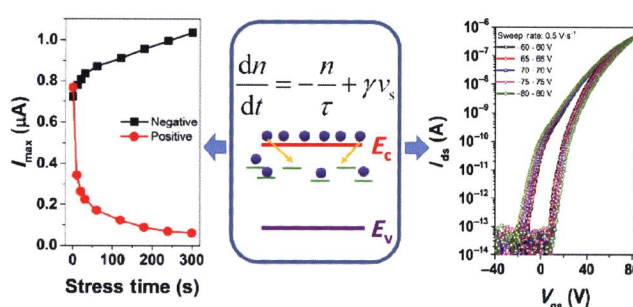
Changyong Lan<sup>1</sup>, Xiaolin Kang<sup>2</sup>, You Meng<sup>2</sup>, Renjie Wei<sup>2</sup>, Xiuming Bu<sup>2</sup>, SenPo Yip<sup>2</sup>, and Johnny C. Ho<sup>2,3,\*</sup>

<sup>1</sup> University of Electronic Science and Technology of China, China

<sup>2</sup> City University of Hong Kong, Hongkong, China

<sup>3</sup> Zhengzhou University, China

3278–3285



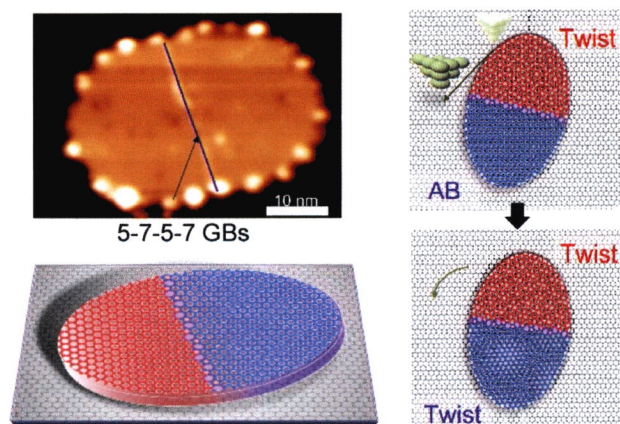
The origin of gate bias stress instability and hysteresis in monolayer WS<sub>2</sub> transistors are carefully investigated, where charge trapping is identified to induce the time decay characteristic of output current, contributing to the instability and hysteresis phenomena. A rate equation, considering the time decay effect, is proposed and developed to model the bias stress instability and hysteresis with excellent consistency with experimental results, validating the model and providing the further insights for charge trapping induced effects for transistors.



## Fabrication and manipulation of nanosized graphene homojunction with atomically-controlled boundaries

Hui Chen, De-Liang Bao, Dongfei Wang, Yande Que, Wende Xiao, Yu-Yang Zhang, Jiatao Sun, Shixuan Du\*, and Hong-Jun Gao\*

University of Chinese Academy of Sciences, China



Controlling the atomic configurations of structural defects in graphene nanostructures is crucial for achieving desired functionalities. Here, we report the controlled fabrication and manipulation of nanosized graphene homojunction with 5-7-5-7 GBs.

3286–3291

## Unconventional dual-vacancies in nickel diselenide-graphene nanocomposite for high-efficiency oxygen evolution catalysis

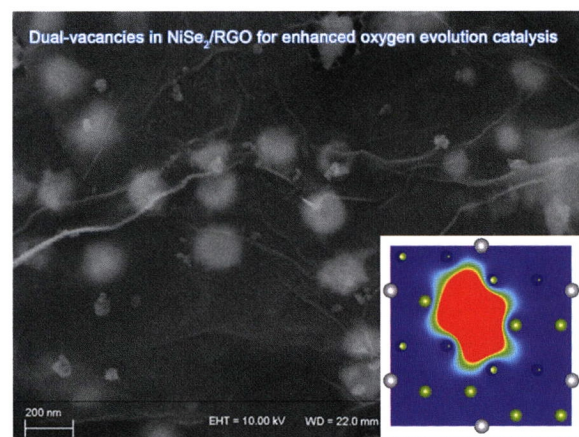
Pengkun Wei<sup>1</sup>, Zewei Hao<sup>1</sup>, Yang Yang<sup>1</sup>, Mingyang Liu<sup>1,2,\*</sup>, Haijun Zhang<sup>3,\*</sup>, Min-Rui Gao<sup>4,\*</sup>, and Shu-Hong Yu<sup>4,\*</sup>

<sup>1</sup> Nankai University, China

<sup>2</sup> Rice University, USA

<sup>3</sup> Civil Aviation University of China, China

<sup>4</sup> University of Science and Technology of China, China



A new kind of hollow NiSe<sub>2</sub>/reduced graphene oxide (RGO) composite catalyst with unconventional dual Ni-Se vacancies can be prepared by annealing Ni<sub>0.85</sub>Se/RGO at 400 and 450 °C under an inert atmosphere, which exhibits excellent activity and stability for catalyzing the oxygen evolution reaction.

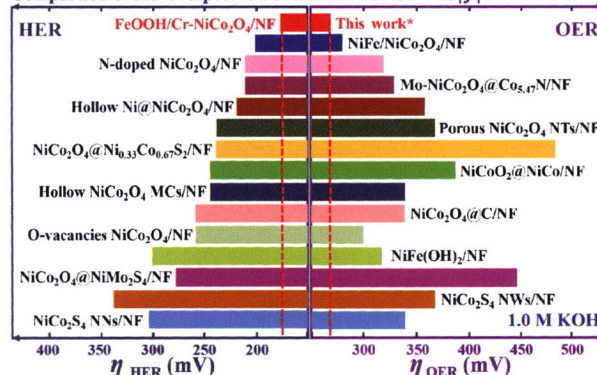
3292–3298

## Nickel foam supported Cr-doped NiCo<sub>2</sub>O<sub>4</sub>/FeOOH nanoneedle arrays as a high-performance bifunctional electrocatalyst for overall water splitting

Tengyi Liu and Peng Diao\*

Beihang University, China

### Comparison of the overpotentials for HER and OER at |j| of 100 mA·cm<sup>-2</sup>



Nickel foam supported Cr-doped NiCo<sub>2</sub>O<sub>4</sub>/FeOOH nanoneedle arrays act as a highly efficient bifunctional electrocatalyst for both hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). The high activity mainly originates from Cr-doping, which greatly improves the conductivity of nanoneedles and enables the non-connected active sites to be electrochemically accessible.

3299–3309



### Enhancement of oxygen reduction reaction activity by grain boundaries in platinum nanostructures

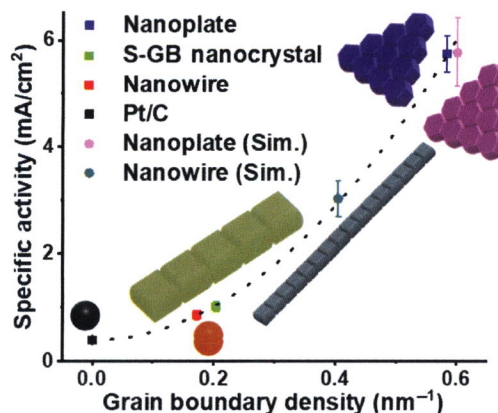
Enbo Zhu<sup>1,2</sup>, Wang Xue<sup>1</sup>, Shiyi Wang<sup>3</sup>, Xucheng Yan<sup>1</sup>, Jingxuan Zhou<sup>1</sup>, Yang Liu<sup>1</sup>, Jin Cai<sup>1</sup>, Ershuai Liu<sup>4</sup>, Qingying Jia<sup>4</sup>, Xiangfeng Duan<sup>1</sup>, Yujing Li<sup>2</sup>, Hendrik Heinz<sup>3,\*</sup>, and Yu Huang<sup>1,\*</sup>

<sup>1</sup> University of California, Los Angeles, USA

<sup>2</sup> Beijing Institute of Technology, China

<sup>3</sup> University of Colorado Boulder, USA

<sup>4</sup> Northeastern University, USA



Increasing grain boundary density remarkably enhances oxygen reduction reaction (ORR) activity by favoring the residence of oxygen on the Pt catalyst surface.

3310–3314

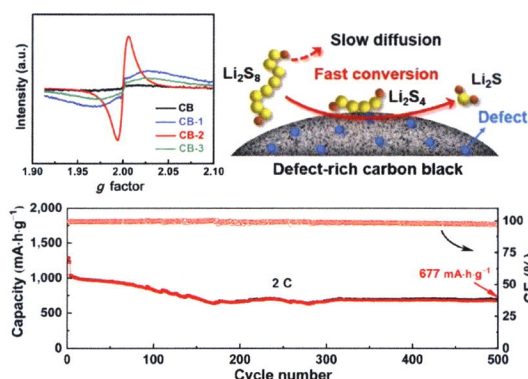
### Defect engineering on carbon black for accelerated Li-S chemistry

Wenlong Cai<sup>1</sup>, Yingze Song<sup>2,\*</sup>, Yuting Fang<sup>1</sup>, Weiwei Wang<sup>1</sup>, Songlin Yu<sup>2</sup>, Huaisheng Ao<sup>1</sup>, Yongchun Zhu<sup>1,\*</sup>, and Yitai Qian<sup>1</sup>

<sup>1</sup> University of Science and Technology of China, China

<sup>2</sup> Southwest University of Science and Technology, China

#### Defect-rich carbon black for promoted Li-S chemistry



The as-designed defect-rich carbon black by rationally regulated defect engineering can serve as an active electrocatalyst to enable the polysulfide conversion and thus boost the electrochemical performances of Li-S batteries.

3315–3320

### Noble-metal-free catalyst with enhanced hydrogen evolution reaction activity based on granulated Co-doped Ni-Mo phosphide nanorod arrays

Heping Xie<sup>1,2,\*</sup>, Cheng Lan<sup>1,2</sup>, Bin Chen<sup>2</sup>, Fuhuan Wang<sup>1,2</sup>, and Tao Liu<sup>1</sup>

<sup>1</sup> Sichuan University, China

<sup>2</sup> Shenzhen University, China



Co-doped Ni-Mo phosphide nanorod arrays on porous Ni foam were fabricated by phosphorization and shown to be an efficient binder-free electrocatalyst for water splitting.

3321–3329

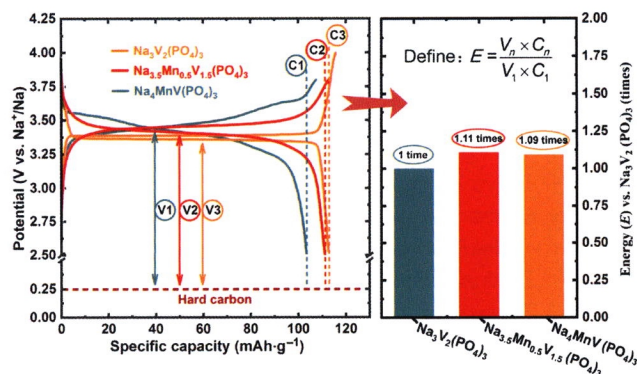


### Tuning crystal structure and redox potential of NASICON-type cathodes for sodium-ion batteries

Xuemei Ma<sup>1</sup>, Xinxin Cao<sup>1,\*</sup>, Yifan Zhou<sup>1</sup>, Shan Guo<sup>1</sup>, Xiaodong Shi<sup>1</sup>, Guozhao Fang<sup>1</sup>, Anqiang Pan<sup>1</sup>, Bingan Lu<sup>2</sup>, Jiang Zhou<sup>1,\*</sup>, and Shuquan Liang<sup>1,\*</sup>

<sup>1</sup> Central South University, China

<sup>2</sup> Hunan University, China



We elucidate the effects of manganese ions infusing on the crystallographic structure and electrochemical behavior of NASICON-structured  $\text{Na}_{3+x}\text{Mn}_x\text{V}_{2-x}(\text{PO}_4)_3$  ( $0 \leq x \leq 1$ ) cathodes. The optimized structure of  $\text{Na}_{3.5}\text{Mn}_{0.5}\text{V}_{1.5}(\text{PO}_4)_3/\text{C}$  with favorable operating voltage and high ionic diffusion capability, delivers high-rate capacity and long cycling stability, even under high-area-loading and all-climate temperature conditions.

3330–3337

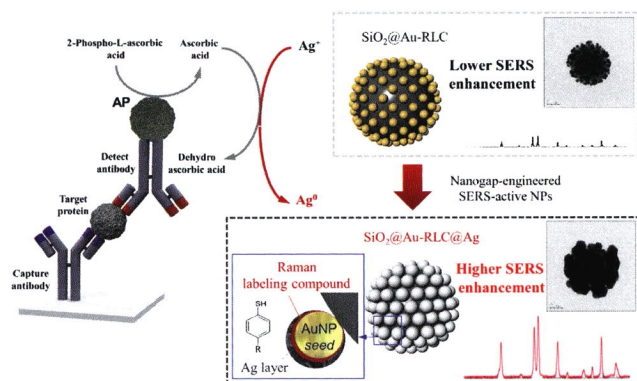
### Enzyme-amplified SERS immunoassay with Ag-Au bimetallic SERS hot spots

Xuan-Hung Pham<sup>1</sup>, Eunil Hahm<sup>1</sup>, Tae Han Kim<sup>1</sup>, Hyung-Mo Kim<sup>1</sup>, Sang Hun Lee<sup>1</sup>, Sang Chul Lee<sup>2</sup>, Homan Kang<sup>3</sup>, Ho-Young Lee<sup>2</sup>, Dae Hong Jeong<sup>2</sup>, Hak Soo Choi<sup>3,\*</sup>, and Bong-Hyun Jun<sup>1,\*</sup>

<sup>1</sup> Konkuk University, Republic of Korea

<sup>2</sup> Seoul National University, Republic of Korea

<sup>3</sup> Massachusetts General Hospital and Harvard Medical School, USA



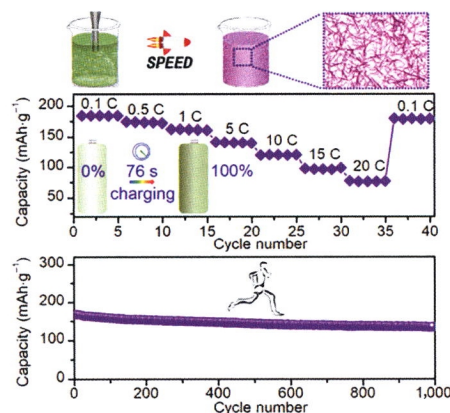
Surface-enhanced Raman scattering (SERS) enables rapid detection of single molecules with high specificity. The plasmonic SERS immunoassay for IgG detection showed a high linearity of SERS intensity in the range of 0.6 to 9.0 ng/mL with a detection limit (LOD) of 0.09 ng/mL, while an LOD of 0.006 ng/mL was obtained for prostate-specific antigen (PSA).

3338–3346

### An ultrasound-triggered cation chelation and reassembly route to one-dimensional Ni-rich cathode material enabling fast charging and stable cycling of Li-ion batteries

Yongjian Lai, Zhaojie Li, Wenxia Zhao, Xiaoning Cheng, Shuo Xu, Xiao Yu, and Yong Liu\*

Sun Yat-sen University, China



An ultrasound-triggered ultrafast cation chelation process was developed to produce  $\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\text{O}_2$  precursor, and the whole synthesis time is only 20 min. The fabricated cathodes achieve long cycling stability (95.1% and 82.4% capacity retention for 100 and 1,000 cycles, respectively) and enable 76 s fast charging at an extremely high rate of 20 C.

3347–3357



## Room temperature ferromagnetism in ultra-thin van der Waals crystals of 1T-CrTe<sub>2</sub>

Xingdan Sun<sup>1,2</sup>, Wanying Li<sup>1,2</sup>, Xiao Wang<sup>3,4,5</sup>, Qi Sui<sup>6</sup>, Tongyao Zhang<sup>7</sup>, Zhi Wang<sup>1,2</sup>, Long Liu<sup>1,2</sup>, Da Li<sup>1,2</sup>, Shun Feng<sup>1,2,10</sup>, Siyu Zhong<sup>8</sup>, Hanwen Wang<sup>1,2</sup>, Vincent Bouchiat<sup>9</sup>, Manuel Nunez Regueiro<sup>9</sup>, Nicolas Rougemaille<sup>9</sup>, Johann Coraux<sup>9</sup>, Anike Purbawati<sup>9</sup>, Abdellali Hadj-Azzem<sup>9</sup>, Zhenhua Wang<sup>1,2</sup>, Baojuan Dong<sup>7</sup>, Xing Wu<sup>8</sup>, Teng Yang<sup>1,2,\*</sup>, Guoqiang Yu<sup>3,4,5,\*</sup>, Bingwu Wang<sup>6,\*</sup>, Zheng Han<sup>1,2,7,\*</sup>, Xiufeng Han<sup>3,4,5</sup>, and Zhidong Zhang<sup>1,2</sup>

<sup>1</sup> Institute of Metal Research, Chinese Academy of Sciences, China

<sup>2</sup> University of Science and Technology of China, China

<sup>3</sup> Institute of Physics, Chinese Academy of Sciences, China

<sup>4</sup> University of Chinese Academy of Sciences, China

<sup>5</sup> Songshan Lake Materials Laboratory, China

<sup>6</sup> Peking University, China

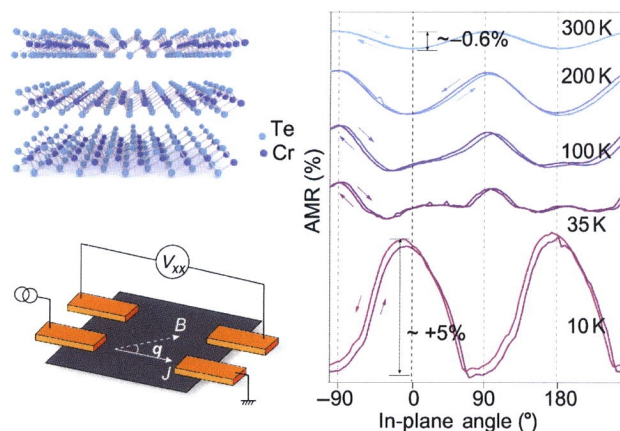
<sup>7</sup> Shanxi University, China

<sup>8</sup> East China Normal University, China

<sup>9</sup> University Grenoble Alpes, France

<sup>10</sup> ShanghaiTech University, China

3358–3363



In this work, we revealed that ferromagnetism can hold above 300 K in a metallic phase of 1T-CrTe<sub>2</sub> down to the few-layer limit. An in-plane room-temperature negative anisotropic magnetoresistance (AMR) was obtained in ultra-thin CrTe<sub>2</sub> devices, with a sign change in the AMR at lower temperature, with  $-0.6\%$  and  $+5\%$  at 300 and 10 K, respectively.

## Multifunctional shape-dependent plasmonic nanoprobe by enzymatic etching of single gold triangular nanoplate

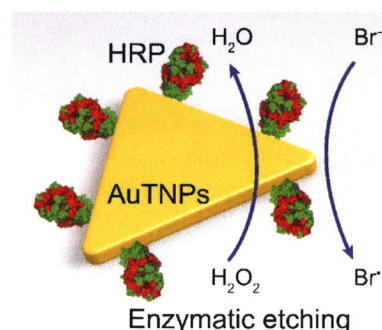
Ning Feng<sup>1</sup>, Jingjing Shen<sup>1</sup>, Yu Chen<sup>1</sup>, Chang Li<sup>1</sup>, Yanling Hu<sup>1,2</sup>, Lei Zhang<sup>1,\*</sup>, Shufen Chen<sup>1</sup>, Quli Fan<sup>1</sup>, Wei Huang<sup>1,3</sup>, and Lianhui Wang<sup>1,\*</sup>

<sup>1</sup> Nanjing University of Posts and Telecommunications, China

<sup>2</sup> Nanjing Polytechnic Institute, China

<sup>3</sup> Northwestern Polytechnical University (NPU), China

3364–3370



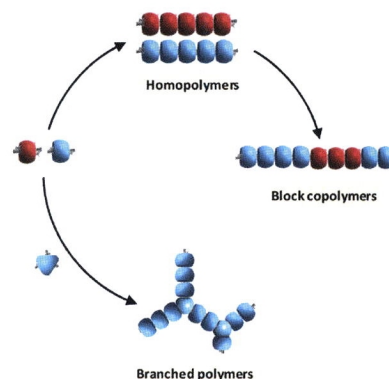
Based on the enzymatic activity of horseradish peroxidase (HRP) which could induce the gradual oxidation of gold triangular nanoprisms in the presence of H<sub>2</sub>O<sub>2</sub> and HBr as gold complexing agents, we developed a multifunctional shape-dependent plasmonic nanoprobe for detecting H<sub>2</sub>O<sub>2</sub> and realized morphology-based logic operations and write-once plasmonic memories.

## Self-assembly of colloidal polymers from two-patch silica nanoparticles

Weiya Li, Bin Liu, Céline Hubert, Adeline Perro, Etienne Duguet, and Serge Ravaine\*

Univ. Bordeaux, France

3371–3376



We demonstrate that two-patch silica nanoparticles are able to self-assemble side-by-side to form colloidal polymers. The colloidal chains can be assembled together to form block copolymer analogues or branched through the introduction of three-patch nanoparticles, offering a route to two-dimensional (2D) superstructures of high complexity.



### Core-satellite metal-organic framework@upconversion nanoparticle superstructures via electrostatic self-assembly for efficient photodynamic theranostics

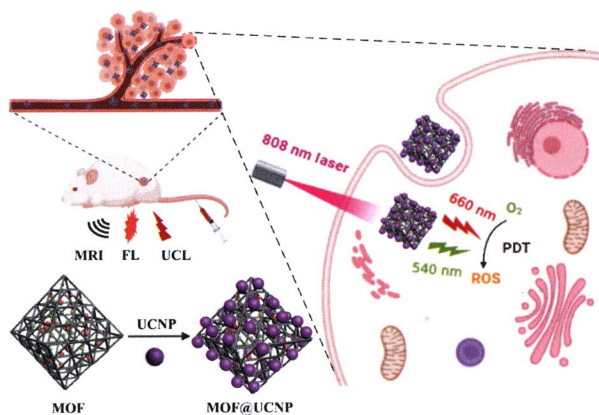
Zhike Li<sup>1</sup>, Xi Qiao<sup>1</sup>, Guihua He<sup>1</sup>, Xin Sun<sup>1</sup>, Danhua Feng<sup>1</sup>, Liefeng Hu<sup>1</sup>, Hua Xu<sup>2</sup>, Hai-Bing Xu<sup>3</sup>, Shengqian Ma<sup>4,\*</sup>, and Jian Tian<sup>1,\*</sup>

<sup>1</sup> Wuhan University, China

<sup>2</sup> Southeast University, China

<sup>3</sup> Hubei University, China

<sup>4</sup> University of North Texas, USA



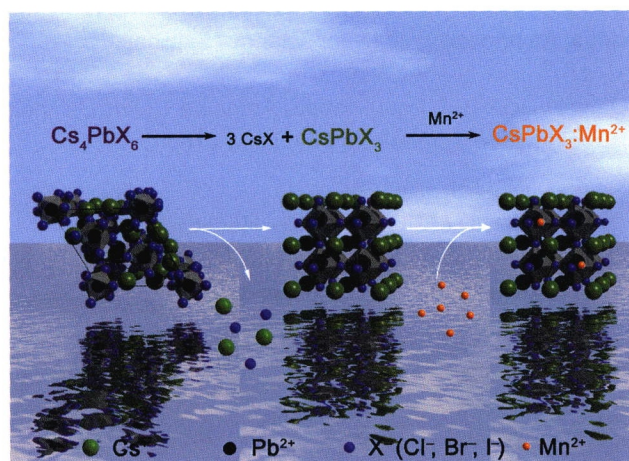
Core-satellite metal-organic framework@upconversion nanoparticle superstructures are fabricated via a facile electrostatic self-assembly strategy. The resultant superstructures realize high co-loading capacity of dual photosensitizers and efficient photodynamic theranostics under 808 nm near-infrared light irradiation.

3377–3386

### Water triggered interfacial synthesis of highly luminescent CsPbX<sub>3</sub>:Mn<sup>2+</sup> quantum dots from nonluminescent quantum dots

Jiejun Ren, Xiaopeng Zhou, and Yuhua Wang\*

Lanzhou University, China



A facile post-treatment doping method is proposed, which enables the preparation of highly luminescent low-toxic CsPbX<sub>3</sub>:Mn<sup>2+</sup> quantum dots from nonluminescent Cs<sub>4</sub>PbX<sub>6</sub> quantum dots at water interface.

3387–3395

### Competing magnetic states in silicene and germanene 2D ferromagnets

Dmitry V. Averyanov<sup>1</sup>, Ivan S. Sokolov<sup>1</sup>, Mikhail S. Platunov<sup>2,†</sup>, Fabrice Wilhelm<sup>2</sup>, Andrei Rogalev<sup>2</sup>, Pierluigi Gargiani<sup>3</sup>, Manuel Valvidares<sup>3</sup>, Nicolas Jaouen<sup>4</sup>, Oleg E. Parfenov<sup>1</sup>, Alexander N. Taldenkov<sup>1</sup>, Igor A. Karateev<sup>1</sup>, Andrey M. Tokmachev<sup>1</sup>, and Vyacheslav G. Storchak<sup>1,\*</sup>

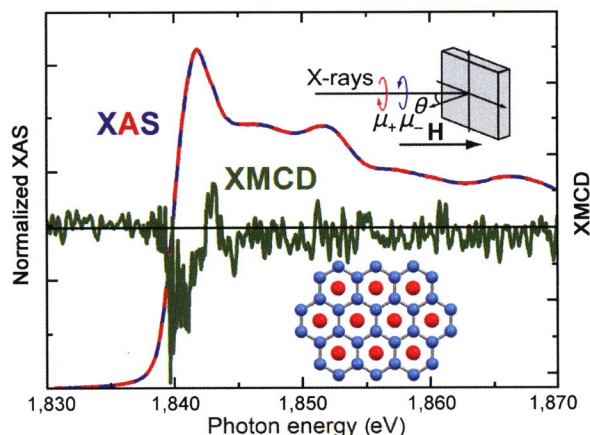
<sup>1</sup> National Research Center, Russia

<sup>2</sup> ESRF-The European Synchrotron, France

<sup>3</sup> ALBA Synchrotron Light Source, Spain

<sup>4</sup> Synchrotron SOLEIL, France

<sup>†</sup> Present address: Federal Research Center, Russia



Element-selective X-ray magnetic circular dichroism (XMCD) study probes the coexistence of ferromagnetism and antiferromagnetism in two-dimensional (2D) silicene and germanene coupled with rare-earths. It determines the layer-dependent evolution of magnetism with applied magnetic field, magnetic polarization of the Xene backbone, spin, and angular contributions to the magnetic moments.

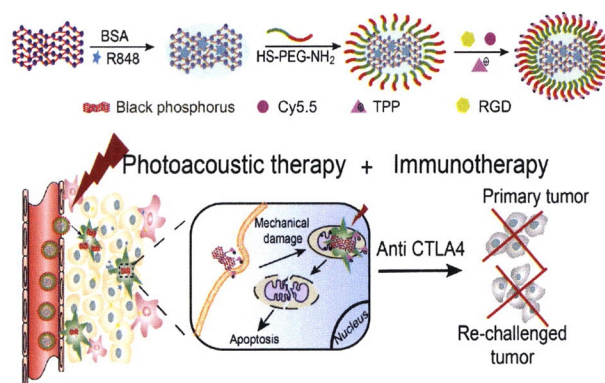
3396–3402



### Photoacoustic-immune therapy with a multi-purpose black phosphorus-based nanoparticle

Fanchu Zeng, Huan Qin\*, Liming Liu, Haocai Chang, Qun Chen, Linghua Wu, Le Zhang, Zhujun Wu, and Da Xing\*

South China Normal University, China



Dual targeting potency of BP/TPP/RGD/R848 nanoparticle can achieve precise eradication of the primary tumor without damage to normal tissue. Photoacoustic (PA) therapy that combines with checkpoint-blockade immunotherapy can stimulate a strong anti-tumor immune response, achieve inhibit metastases, and prevent tumor relapses.

3403–3415

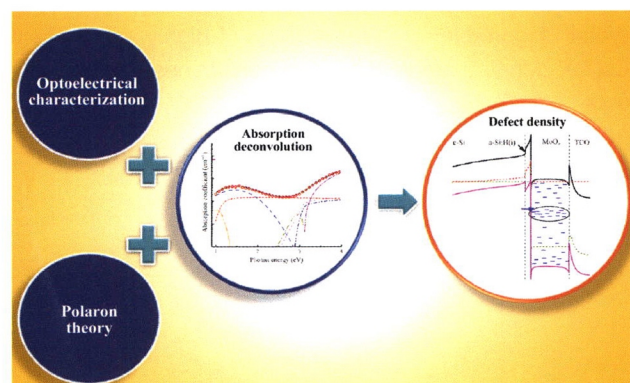
### Sub-gap defect density characterization of molybdenum oxide: An annealing study for solar cell applications

Daniele Scirè<sup>1,2,\*</sup>, Paul Procel<sup>2</sup>, Antonino Gulino<sup>3</sup>, Olindo Isabella<sup>2</sup>, Miro Zeman<sup>2</sup>, and Isodiana Crupi<sup>1</sup>

<sup>1</sup> University of Palermo, Italy

<sup>2</sup> Delft University of Technology, The Netherlands

<sup>3</sup> University of Catania, Italy



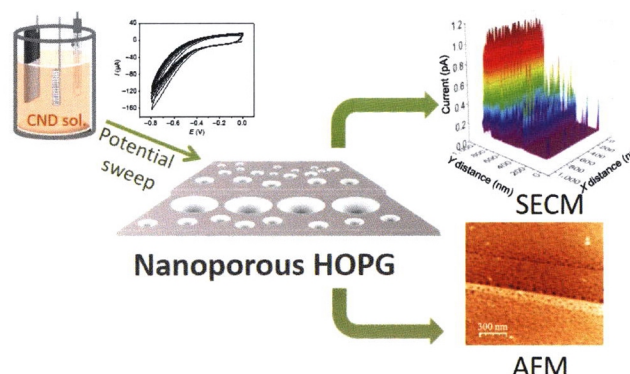
We report a method to extract the defect density through optoelectrical measures taking into account the presence of small polaron. Such characterization is crucial for the optimization of solar cells implementing molybdenum oxide as hole selective contact.

3416–3424

### Carbon nanodots: A new precursor to achieve reactive nanoporous HOPG surfaces

Cristina Gutiérrez-Sánchez\*, Emiliano Martínez-Periñán, Carlos Busó-Rogero, Mónica Revenga-Parra, Félix Pariente, and Encarnación Lorenzo\*

Universidad Autónoma de Madrid, Spain



A new method for preparing nanoporous highly oriented pyrolytic graphite (HOPG) surfaces has been developed. Carbon nanodot (CND) combined with the electrochemical etching treatment is responsible for generating nanopores on the HOPG surface.

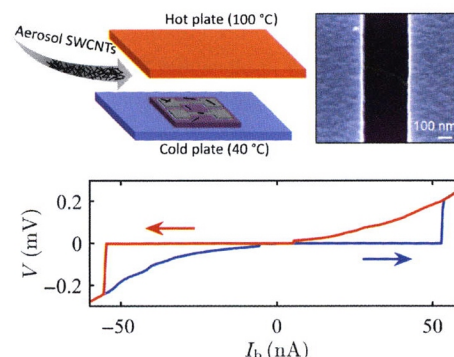
3425–3432



### Suspended superconducting weak links from aerosol-synthesized single-walled carbon nanotubes

Jukka-Pekka Kaikkonen\*, Abhilash Thanniyil Sebastian, Patrik Laiho, Nan Wei, Marco Will, Yongping Liao, Esko I. Kauppinen, and Pertti J. Hakonen\*

Aalto University, Finland



Suspended superconducting weak links were fabricated by thermophoretic deposition of aerosol-synthesized single-walled carbon nanotubes on top of prefabricated superconducting electrodes. Transparent contacts to nanotubes were produced by vacuum-annealing and the resulting individual carbon nanotubes, suspended over molybdenum-rhenium electrodes, sustained proximity-induced supercurrents up to 53 nA.

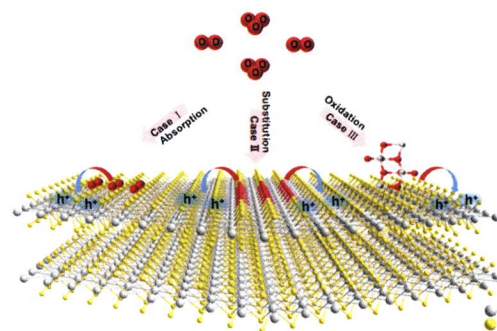
3433–3438

### Oxygen-induced controllable p-type doping in 2D semiconductor transition metal dichalcogenides

Qijie Liang<sup>1,2</sup>, Jian Gou<sup>2</sup>, Arramel<sup>2</sup>, Qian Zhang<sup>2,\*</sup>, Wenjing Zhang<sup>1,\*</sup>, and Andrew Thye Shen Wee<sup>2,\*</sup>

<sup>1</sup> Shenzhen University, China

<sup>2</sup> National University of Singapore, Singapore



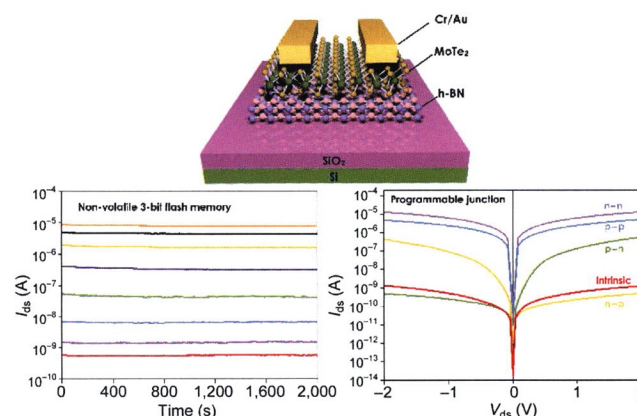
Controllable hole doping is achieved by oxygen interaction in pentagonal and hexagonal two-dimensional (2D) transition metal dichalcogenides (TMDs) with three dominated mechanisms in five few-layered TMDs ( $\text{MoTe}_2$ ,  $\text{PdSe}_2$ ,  $\text{MoSe}_2$ ,  $\text{WSe}_2$  and  $\text{PtSe}_2$ ), which is investigated by combined scanning tunneling microscopy (STM), electrical transport, atomic force microscopy (AFM) and X-ray photoelectron spectroscopy (XPS).

3439–3444

### Non-volatile programmable homogeneous lateral $\text{MoTe}_2$ junction for multi-bit flash memory and high-performance optoelectronics

Enxiu Wu\*, Yuan Xie, Shijie Wang, Daihua Zhang, Xiaodong Hu\*, and Jing Liu\*

Tianjin University, China



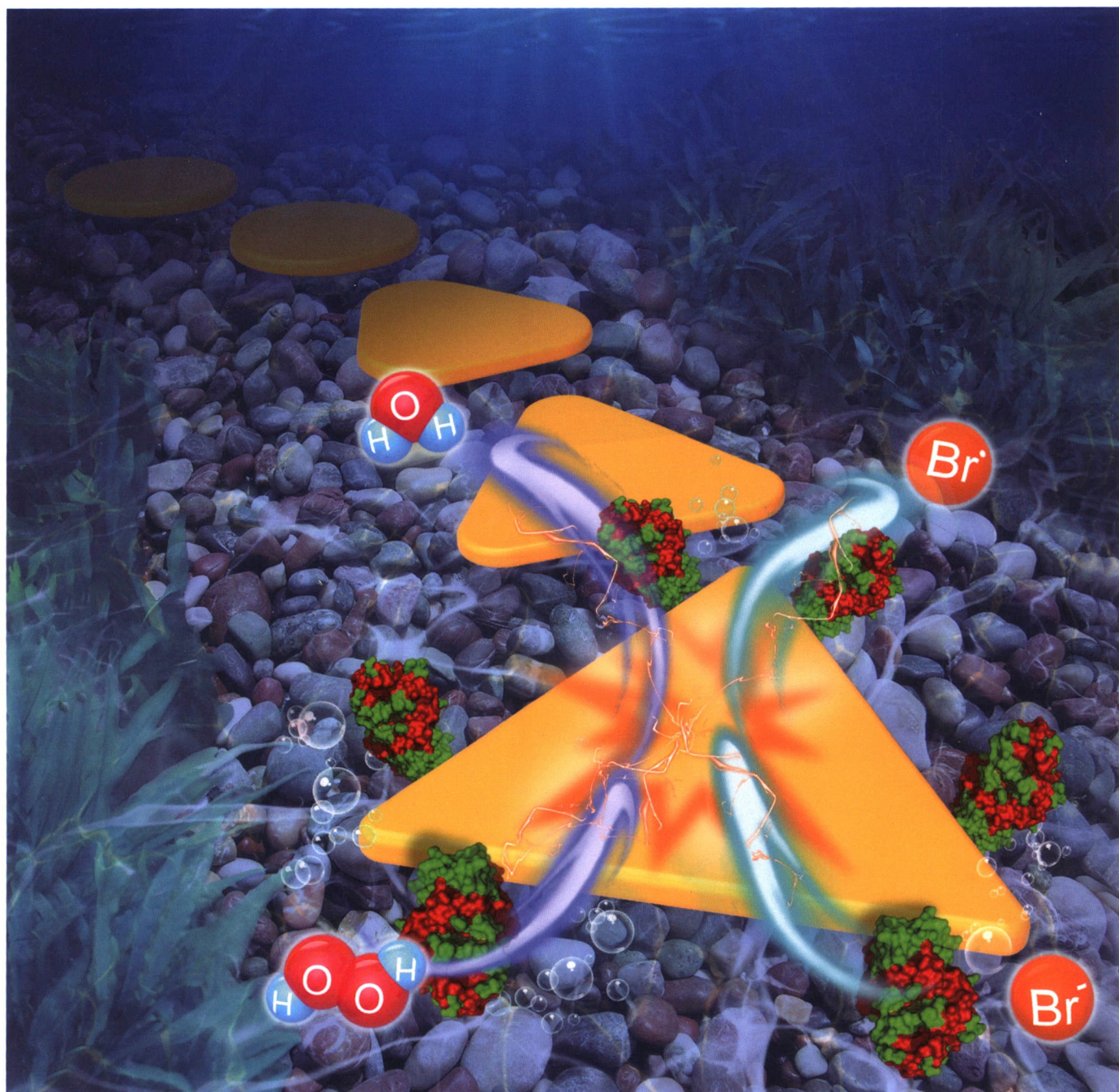
A non-volatile opto-electrical doping approach with spatial resolution is developed, which enables 3-bit flash memory and various programmable homojunctions based on the same  $\text{MoTe}_2/\text{BN}$  heterostructure.

3445–3451

Erratum to: Removing contaminants from transferred CVD graphene (<https://doi.org/10.1007/s12274-020-2671-6>)

3452





纳米研究 (英文版) (月刊, 2008年创刊) 第13卷 第12期 2020年12月出版

Editors-in-Chief Yadong Li, Shoushan Fan

Sponsored by Tsinghua University & Chinese Chemical Society

Edited by Nano Research Editorial Office

Published by Tsinghua University Press

Address Xueyan Building,  
Tsinghua University,  
Beijing 100084, China

Website [www.theNanoResearch.com](http://www.theNanoResearch.com) & [www.springer.com/journal/12274](http://www.springer.com/journal/12274)

Online Manuscript Submission, Review and Tracking System [www.editorialmanager.com/nare](http://www.editorialmanager.com/nare)

主管单位 中华人民共和国教育部

主办单位 清华大学

中国化学会

主 编 李亚栋 范守善

编 辑 《纳米研究》编辑部

出版发行 清华大学出版社有限公司

印刷单位 北京地大彩印有限公司

ISSN 1998-0124

