

Nano Research

August · 2019

Volume 12 · Number 8



QK1945163

Strategies for improving the storage performance of silicon-based anodes in lithium-ion batteries

Heterostructures in two-dimensional colloidal metal chalcogenides:
Synthetic fundamentals and applications

Immune-adjuvant loaded Bi_2Se_3 nanocage for photothermal-improved PD-L1
checkpoint blockade immune-tumor metastasis therapy



TSINGHUA
UNIVERSITY PRESS



Springer



Project for Enhancing Publications
Impact of Chinese STM Journals

Contents

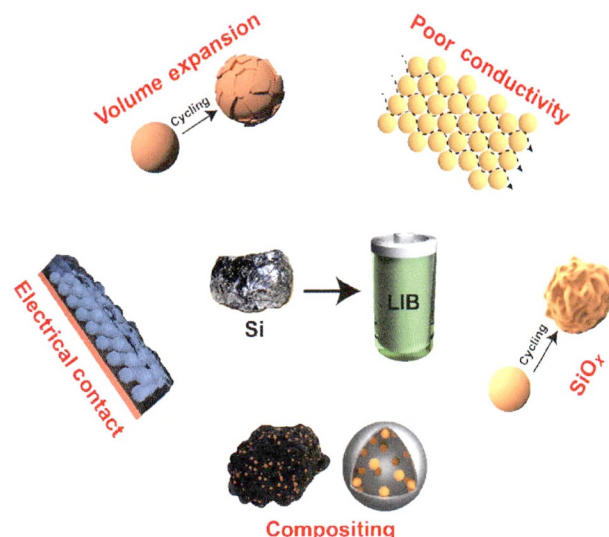
Review Articles

Strategies for improving the storage performance of silicon-based anodes in lithium-ion batteries

Wei Tao¹, Ping Wang¹, Ya You², Kyusung Park², Cao-Yu Wang¹, Yong-Ke Li¹, Fei-Fei Cao^{1,*}, and Sen Xin^{2,*}

¹ Huazhong Agricultural University, China

² The University of Texas at Austin, USA



Targeting at the electrochemical drawbacks of silicon anode during its use in lithium-ion batteries (LIBs), this perspective introduces several nano-strategies for improving the lithium storage performance of silicon-based anode materials.

1739–1749

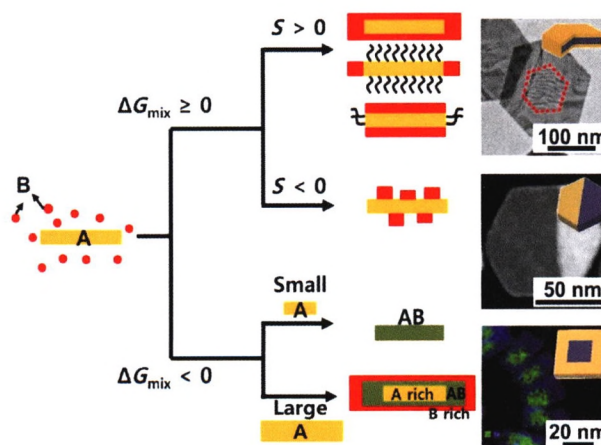
Heterostructures in two-dimensional colloidal metal chalcogenides: Synthetic fundamentals and applications

Yuho Min¹, Eunmi Im³, Geon-Tae Hwang¹, Jong-Woo Kim¹, Cheol-Woo Ahn¹, Jong-Jin Choi¹, Byung-Dong Hahn¹, Joon-Hwan Choi¹, Woon-Ha Yoon¹, Dong-Soo Park¹, Dong Choon Hyun², and Geon Dae Moon^{3,*}

¹ Korea Institute of Materials Science (KIMS), Republic of Korea

² Kyungpook National University, Republic of Korea

³ Korea Institute of Industrial Technology, Republic of Korea



Solution-based constructing two-dimensional (2D) metal chalcogenide (MC) heterostructures are based on thermodynamic and kinetic aspects related to growth mechanism determining their final morphologies leading to different physical and chemical features.

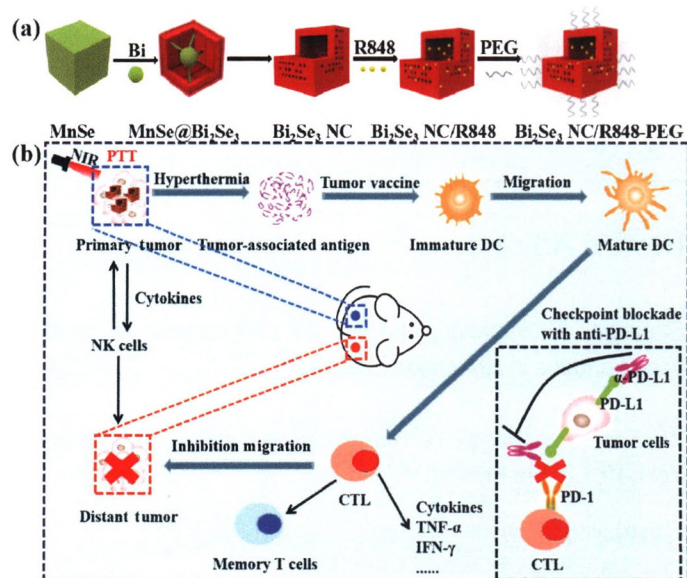
1750–1769

Research Articles

Immune-adjuvant loaded Bi_2Se_3 nanocage for photothermal-improved PD-L1 checkpoint blockade immune-tumor metastasis therapy

Yilin Song, Yidan Wang, Siyu Wang, Yu Cheng, Qianglan Lu, Lifang Yang, Fengping Tan, and Nan Li*

Tianjin University, China



Immunogenic Bi_2Se_3 nanocages mediated photothermal therapy (PTT) sensitizes tumors to checkpoint inhibition mediated by a PD-L1 antibody, not only ablating cancer cells upon NIR laser but also causing strong anti-cancer immunity to suppress distant tumor growth post PTT.

1770–1780

Exploring the synthesis conditions to control the morphology of gold-iron oxide heterostructures

Pablo Tancredi¹, Luelc Souza da Costa^{2,3}, Sebastian Calderon⁴, Oscar Moscoso-Londoño^{2,5}, Leandro M. Socolovsky⁶, Paulo J. Ferreira^{4,7}, Diego Muraca², Daniela Zanchet^{2,*}, and Marcelo Knobel^{2,*}

¹ University of Buenos Aires – CONICET, Argentina

² University of Campinas (UNICAMP), Brazil

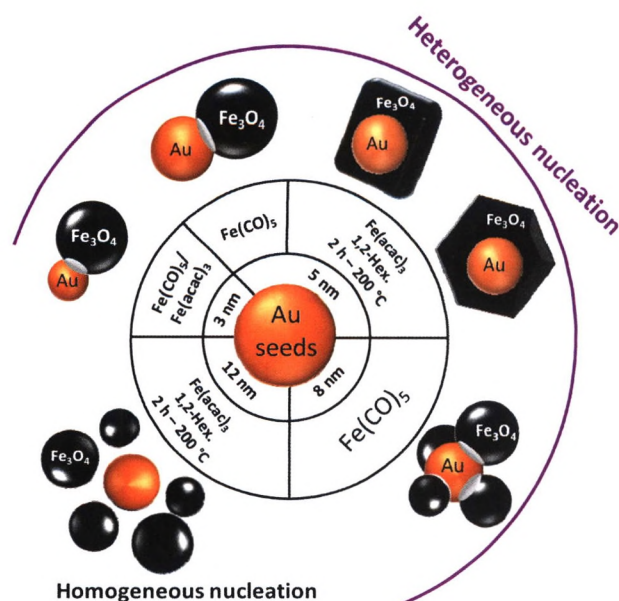
³ Brazilian Nanotechnology National Laboratory (LNNano), Brazil

⁴ International Iberian Nanotechnology Laboratory (INL), Portugal

⁵ Antigua Estación del Ferrocarril, Colombia

⁶ Universidad Tecnológica Nacional, Argentina

⁷ The University of Texas at Austin, USA



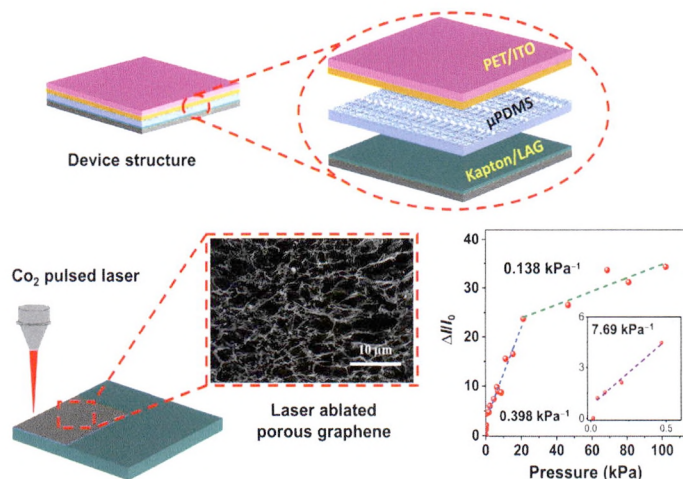
A detailed structural analysis of a set of Au/FeO_x nano-heterostructures is presented. The events of heterogeneous nucleation and the final morphology of the samples were controlled by carefully tuning the synthesis conditions.

1781–1788

A laser ablated graphene-based flexible self-powered pressure sensor for human gestures and finger pulse monitoring

Partha Sarati Das, Ashok Chhetry, Pukar Maharjan, M. Salauddin Rasel, and Jae Yeong Park*

Kwangwoon University, Republic of Korea



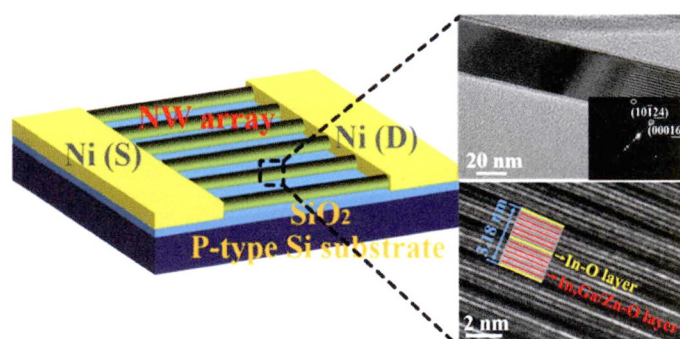
Laser ablated graphene-based flexible self-powered pressure sensor fabricated by stacking microstructured polydimethylsiloxane (PDMS) and polyethylene terephthalate/indium tin oxide (PET/ITO) reveals high sensitivity and stable response over > 4,000 compression–release cycles. The approach is highly efficient, scalable and cost-effective for self-powered systems.

1789–1795

Crystalline InGaZnO quaternary nanowires with superlattice structure for high-performance thin-film transistors

Fangzhou Li, SenPo Yip, Ruoting Dong, Ziyao Zhou, Changyong Lan, Xiaoguang Liang, Dapan Li, You Meng, Xiaolin Kang, and Johnny C. Ho*

City University of Hong Kong, Hong Kong, China



Crystalline InGaZnO quaternary nanowires with controllable stoichiometry and perfect superlattice structure have been successfully fabricated by the enhanced ambient-pressure chemical vapor deposition. When configured into transistors, they exhibit the excellent performance of high electron mobility and large on/off current ratio, being comparable or even better than other state-of-the-art metal-oxide thin film transistors.

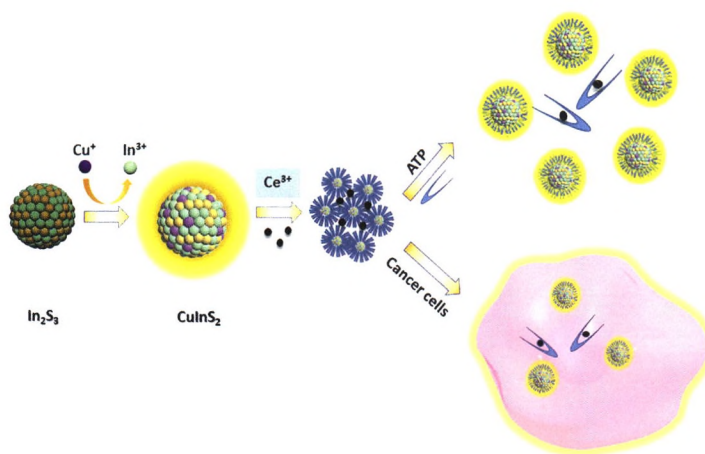
1796–1803

Highly efficient luminescent I-III-VI semiconductor nanoprobe based on template-synthesized CuInS₂ nanocrystals

Xian Li^{1,2}, Datao Tu^{1,2,*}, Shaohua Yu¹, Xiaorong Song¹, Wei Lian¹, Jiaojiao Wei¹, Xiaoying Shang¹, Renfu Li¹, and Xueyuan Chen^{1,2,*}

¹ Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, China

² Fujian Normal University, China



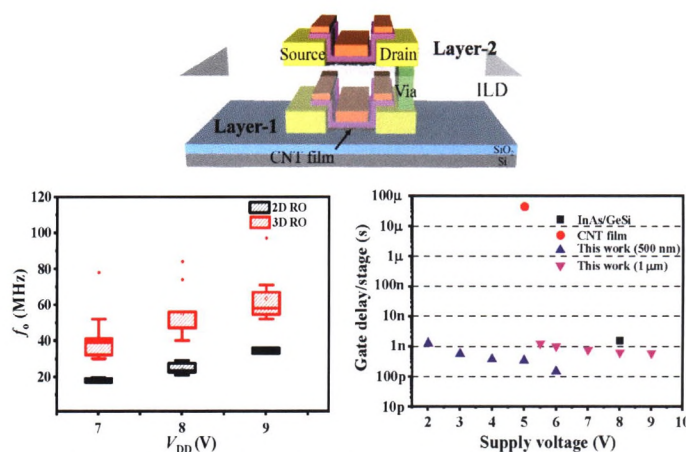
In₂S₃ nanocrystals were used as template for the synthesis of highly efficient luminescent CuInS₂ nanoprobe, which were explored for sensitive adenosine triphosphate (ATP) detection and ATP-targeted cancer cell imaging.

1804–1809

Speeding up carbon nanotube integrated circuits through three-dimensional architecture

Yunong Xie, Zhiyong Zhang*, Donglai Zhong, and Lianmao Peng*

Peking University, China



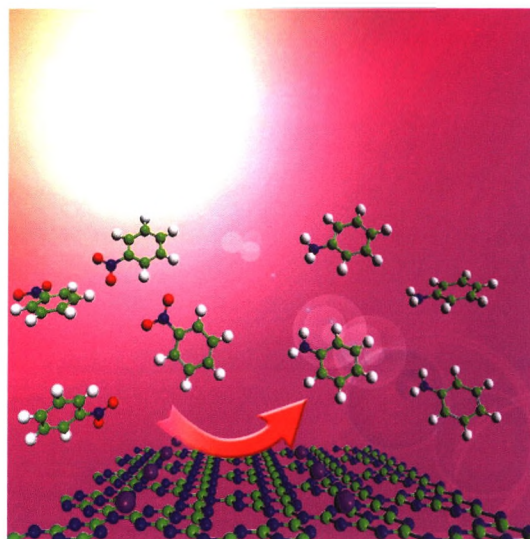
We develop a three-dimensional (3D) integrated circuit (IC) technology through integrating multi-layer high performance carbon nanotube (CNT) film field-effect transistors (FETs) into one chip, and show that it promotes the operation speed of CNT based 3D ICs considerably. Specially, we demonstrate the fabrication of 3D five-stage ring-oscillator circuits with an oscillation frequency of up to 680 MHz and stage delay of 0.15 ns, which represents the highest speed of 3D CNT-based ICs.

1810–1816

Single Pt atom decorated graphitic carbon nitride as an efficient photo-catalyst for the hydrogenation of nitrobenzene into aniline

Tianwei He, Chunmei Zhang, Lei Zhang, and Aijun Du*

Gardens Point Campus, Australia



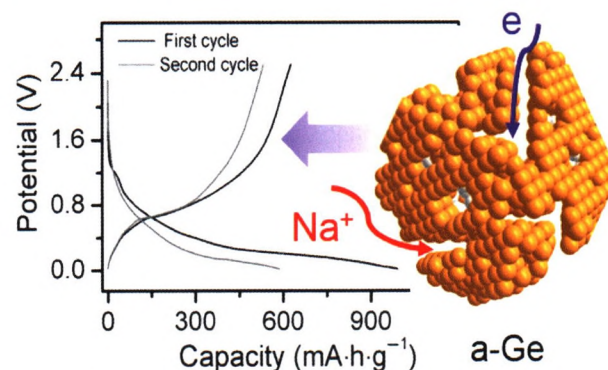
An interesting single-atom photocatalyst (Pt@g-C₃N₄) is proposed for efficient hydrogenation of nitrobenzene to aniline under a sustainable and green approach.

1817–1823

Meso-porous amorphous Ge: Synthesis and mechanism of an anode material for Na and K storage

Zheng Yi, Ning Lin*, Tieqiang Li, Ying Han, Yang Li, and Yitai Qian

University of Science and Technology of China, China



Amorphous Ge with mesoporous architecture was fabricated by a simple acid-etching route at room temperature, which exhibited enhanced Na storage performance such as high rate capability and cycle stability. The *in-situ* Raman spectrum explored that the Na could reversibly insert/extract into/out the amorphous Ge, but not in the crystalline Ge.

1824–1830

All-in-one cellulose based hybrid tribo/piezoelectric nanogenerator

Ming Li^{1,2}, Yang Jie^{1,2}, Li-Hua Shao³, Yilin Guo^{1,2}, Xia Cao^{1,2,4,*}, Ning Wang^{4,*}, and Zhong Lin Wang^{1,2,5,*}

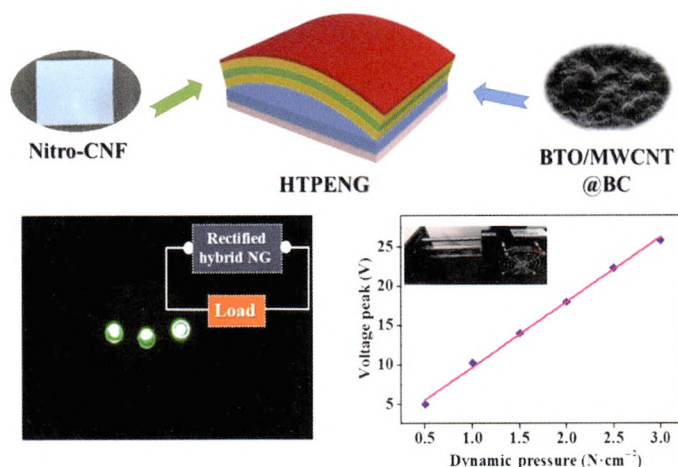
¹ National Center for Nanoscience and Technology (NCNST), China

² University of Chinese Academy of Sciences, China

³ Beihang University, China

⁴ University of Science and Technology Beijing, China

⁵ Georgia Institute of Technology, USA



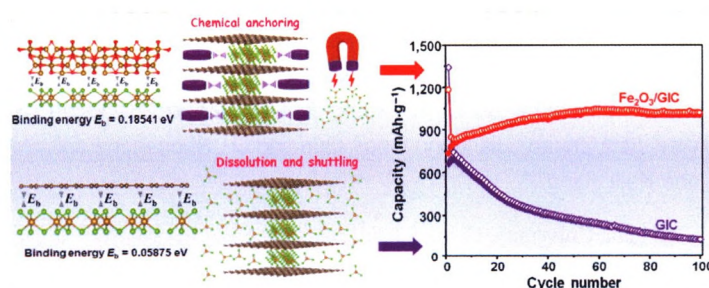
The triboelectric and piezoelectric paper produced by different modification of cellulose has a good performance. With a sandwich design, triboelectric nanogenerator and piezoelectric nanogenerator are integrated into a hybrid nanogenerator that not only can harvest ambient mechanical energy but also can detect the dynamic pressure.

1831–1835

Improving the cycle stability of FeCl₃-graphite intercalation compounds by polar Fe₂O₃ trapping in lithium-ion batteries

Zheng Li, Chengzhi Zhang, Fei Han*, Fuquan Zhang, Dianwu Zhou, Shaohua Xu, Hongbo Liu, Xuanke Li, and Jinshui Liu*

Hunan University, China



Flake-like Fe₂O₃ was introduced on the edge of the FeCl₃-graphite intercalation compounds to suppress the dissolution of chlorides on the basis of a polar-polar interaction mechanism, thus improving the cycle stability for lithium ion storage.

1836–1844

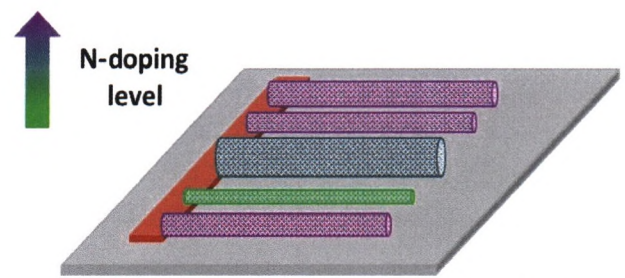
Diameter dependent doping in horizontally aligned high-density N-doped SWNT arrays

Pan Li¹, Yiming Li¹, Xiao Zhang², Jun Chen¹, Yingwen Cheng³, Yi Li¹, Yanwen Ma^{1,*}, and Jie Liu^{2,*}

¹ Nanjing University of Posts & Telecommunications, China

² Duke University, USA

³ Northern Illinois University, USA



Substitutional doping of nitrogen atoms into the sp^2 carbon frameworks of carbon nanotubes has rendered the doped nanotubes excellent properties, with doping mechanism still unclear. Here we unveil the diameter-dependent-doping mechanism in single-walled carbon nanotube array. The N-doping level increases along with the nanotube diameter but loses the increasing trend or slightly decreases when the diameter becomes larger.

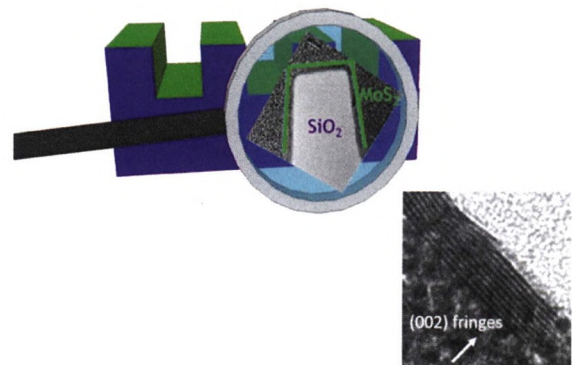
1845–1850

Large-area patterning of substrate-conformal MoS_2 nano-trenches

Christian Martella^{1,2,*}, Luca Ortolani^{1,*}, Elena Cianci¹, Alessio Lamperti¹, Vittorio Morandi¹, and Alessandro Molle^{1,*}

¹ IMM-CNR, Italy

² ISC-CNR, Italy



The combination of atomic layer deposition and chemical vapour deposition is presented as a general approach for the growth of transition metal dichalcogenides patterned in arbitrary complex geometry. High-resolution electron microscopy investigations reveal the conformal growth of MoS_2 nanosheets on large area regular nano-trenches obtained in SiO_2 substrates. Resonant Raman scattering shows the influence of the patterned morphology on the electron-phonon coupling into the nanosheets.

1851–1854

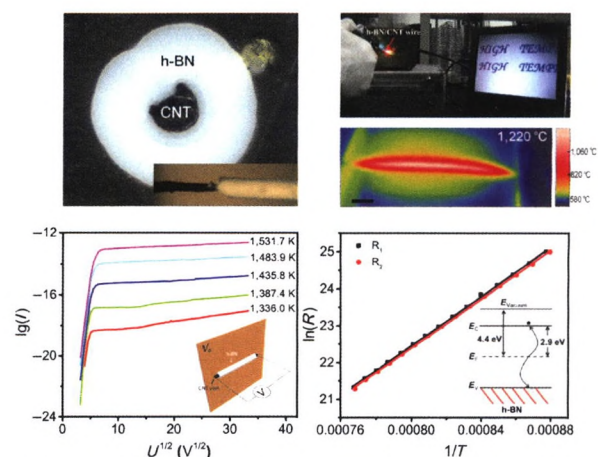
High temperature performance of coaxial h-BN/CNT wires above 1,000 °C: Thermionic electron emission and thermally activated conductivity

Xinhe Yang¹, Peng Liu^{1,*}, Duanliang Zhou¹, Feng Gao², Xinhe Wang³, Shiwei Lv¹, Zi Yuan¹, Xiang Jin¹, Wei Zhao¹, Haoming Wei¹, Lina Zhang¹, Jiandong Gao², Qunqing Li¹, Shoushan Fan¹, and Kaili Jiang^{1,*}

¹ Tsinghua University, China

² Yantai HeFuXiang Ceramics Co., Ltd, China

³ Beihang University, China



A light-weight coaxial h-boron nitride (BN)/carbon nanotube (CNT) wire which can tolerate 1,200 °C in air has been fabricated. Thermionic electron emission (1,200 K) and thermally activated conductivity (1,000 K) are two principal mechanisms of the insulation failure of h-BN at high temperature. This light-weight high temperature wire can transmit electrical signal normally under burning by liquefied petroleum gas flame. It is hoped the h-BN/CNT wire will open up new possibilities for a wide spectrum of applications in extreme high temperature conditions.

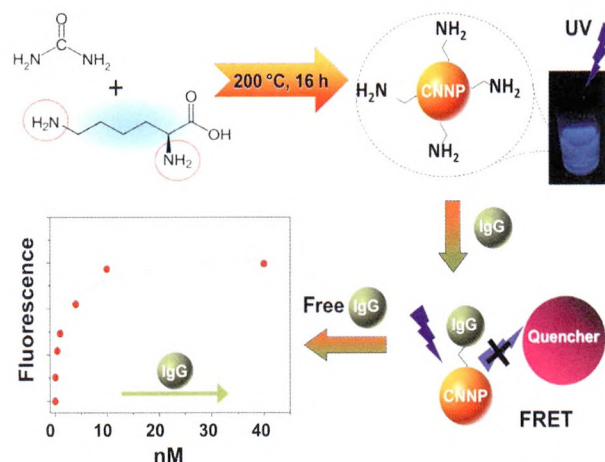
1855–1861

Amine-rich carbon nitride nanoparticles: Synthesis, covalent functionalization with proteins and application in a fluorescence quenching assay

Gabriele Capilli[†], Simone Cavallera, Laura Anfossi^{*}, Cristina Giovannoli, Marco Minella^{*}, Claudio Baggiani, and Claudio Minero

University of Torino, Italy

[†] Present address: McGill University, Canada



Through a facile and versatile synthetic approach, we synthesized brightly fluorescent, hydrophilic carbon nitride nanoparticles (CNNPs) which incorporate tailored anchoring points—primary amino-groups—for the covalent coupling of biomolecules. The CNNP was linked to Staphylococcal protein A and used to develop a one-step fluorescent quenching assay for detecting human immunoglobulins (IgG).

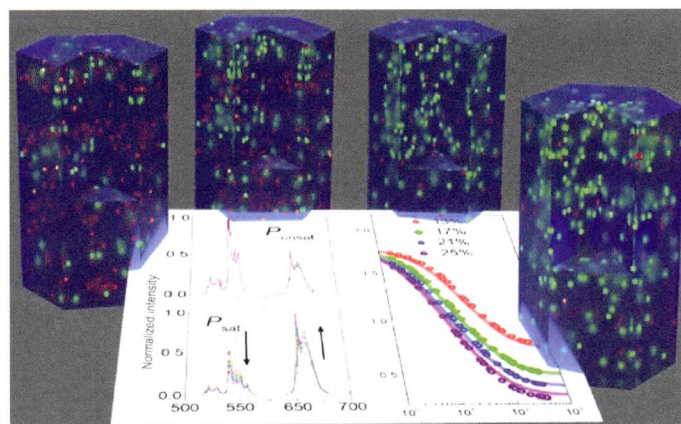
1862–1870

Explaining the influence of dopant concentration and excitation power density on the luminescence and brightness of β -NaYF₄:Yb³⁺,Er³⁺ nanoparticles: Measurements and simulations

Martin Kaiser¹, Christian Würth¹, Marco Kraft¹, Tero Soukka², and Ute Resch-Genger^{1,*}

¹ Federal Institute for Materials Research and Testing (BAM), Germany

² University of Turku, Finland



We systematically assessed the influence of the Yb³⁺ and Er³⁺ dopant ion concentration on the relative spectral distribution of the upconversion luminescence and its quantum yield for a series of similarly sized (33 nm) oleate-capped NaYF₄:Yb³⁺,Er³⁺ nanoparticles dispersed in toluene at broadly varied excitation power densities. The interpretation of the results was supported by a nine-level Er³⁺ rate equation model.

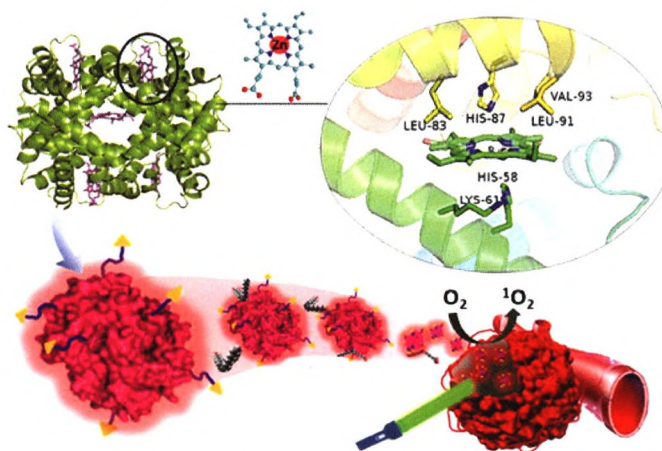
1871–1879

Zinc-substituted hemoglobin with specific drug binding sites and fatty acid resistance ability for enhanced photodynamic therapy

Yiting Xu¹, Jiamei Xu¹, Xiaoxiao Hu¹, Xin Xia¹, Qian Dong¹, Zhangkun Liu¹, Zhuo Chen^{1,*}, and Weihong Tan^{1,2}

¹ Hunan University, China

² University of Florida, USA



Zinc-substituted hemoglobin with natural strong and specific porphyrin binding ability is highly stable against fatty acid and extremely efficient for photodynamic therapy *in vivo*.

1880–1887

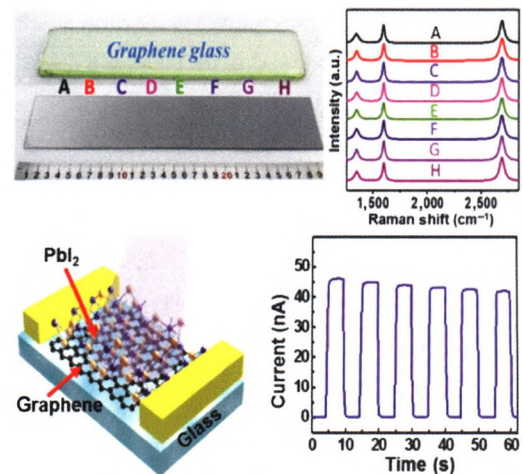
Growth of 12-inch uniform monolayer graphene film on molten glass and its application in Pbl₂-based photodetector

Zhaolong Chen^{1,2}, Haina Ci^{1,2}, Zhenjun Tan^{1,2}, Zhipeng Dou¹, Xu-dong Chen¹, Bingzhi Liu^{1,2}, Ruojuan Liu^{1,2}, Li Lin^{1,2}, Lingzhi Cui^{1,2}, Peng Gao^{1,3}, Hailin Peng^{1,2,3}, Yanfeng Zhang^{1,3,*}, and Zhongfan Liu^{1,2,3,*}

¹ Peking University, China

² Beijing National Laboratory for Molecular Sciences, China

³ Beijing Graphene Insititue (BGI), China



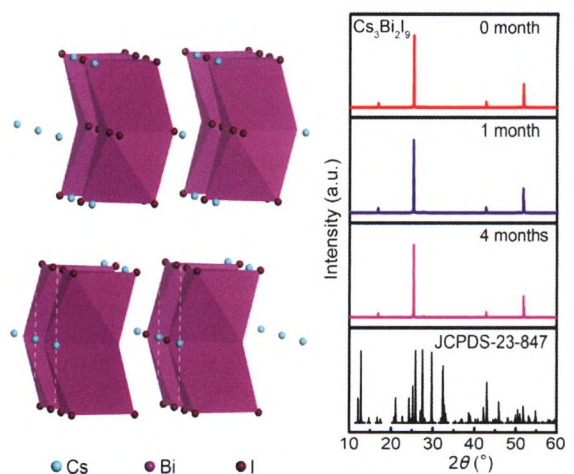
Large area uniform (up to 30 cm × 6 cm) graphene film is directly grown on molten state soda-lime glass via a facile chemical vapor deposition method. The use of molten glass eliminates the chemically active sites, and improves the mobility of carbon precursors compared with insulating solids, leading to the formation of highly uniform monolayer graphene. The obtained graphene glass serves as perfect substrates for synthesizing high-quality Pbl₂ films and constructing high performance photodetectors.

1888–1893

Highly stable lead-free Cs₃Bi₂I₉ perovskite nanoplates for photodetection applications

Zhaoyang Qi, Xianwei Fu, Tiefeng Yang, Dong Li, Peng Fan, Honglai Li, Feng Jiang, Lihui Li, Ziyu Luo, Xiujuan Zhuang, and Anlian Pan*

Hunan University, China



Highly stable lead-free Cs₃Bi₂I₉ perovskite nanoplates are successfully synthesized through a facile solution-processed method. Photodetectors are constructed based on these nanoplates demonstrating stable and decent photosensing performance.

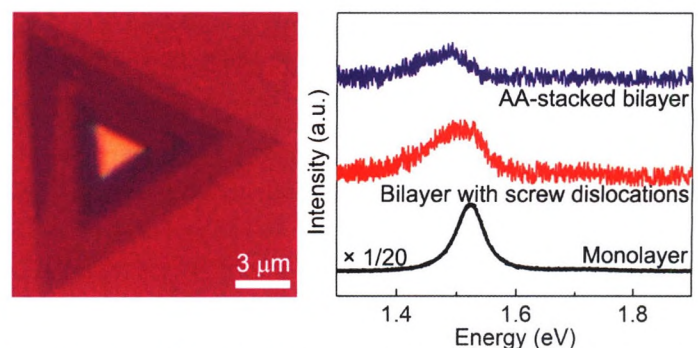
1894–1899

Weakened interlayer coupling in two-dimensional MoSe₂ flakes with screw dislocations

Xiangzhuo Wang¹, Huixia Yang¹, Rong Yang², Qinsheng Wang¹, Jingchuan Zheng¹, Lu Qiao¹, Xianglin Peng¹, Yongkai Li¹, Dongyun Chen¹, Xiaolu Xiong¹, Junxi Duan¹, Guangyu Zhang², Jie Ma¹, Junfeng Han^{1,*}, Wende Xiao^{1,*}, and Yugui Yao¹

¹ Beijing Institute of Technology, China

² Institute of Physics, Chinese Academy of Sciences, China



Two-dimensional (2D) MoSe₂ flakes with screw dislocations are grown on amorphous SiO₂ substrates by chemical vapor deposition (CVD). Our work demonstrates that the interlayer coupling of 2D transition metal dichalcogenides (TMDCs) flakes can be tuned by the induction of screw dislocations.

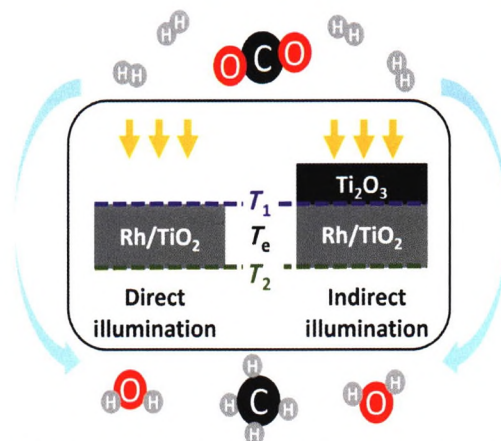
1900–1905

Confirming nonthermal plasmonic effects enhance CO₂ methanation on Rh/TiO₂ catalysts

Xueqian Li¹, Henry O. Everitt^{1,2,*}, and Jie Liu^{1,*}

¹ Duke University, USA

² Aviation & Missile Center, USA



Direct and indirect illumination of Rh/TiO₂ photocatalysts for CO₂ methanation distinguishes thermal and nonthermal light effects in plasmon-enhanced catalysis.

1906–1911

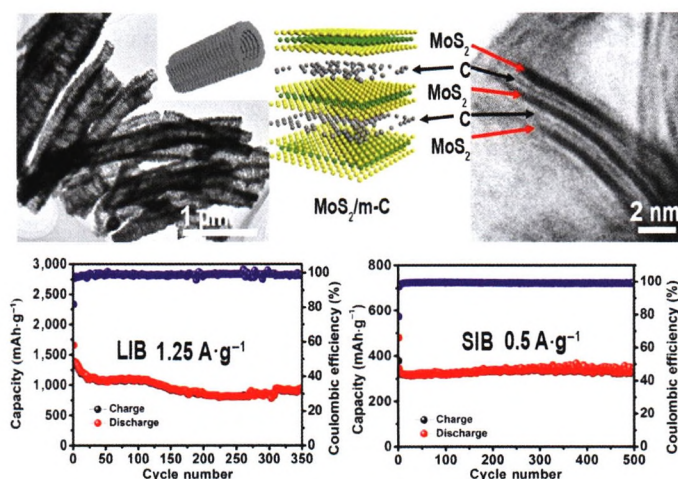
Porous-hollow nanorods constructed from alternate intercalation of carbon and MoS₂ monolayers for lithium and sodium storage

Laiying Jing¹, Gang Lian^{1,*}, Junru Wang¹, Mingwen Zhao¹, Xizheng Liu², Qilong Wang¹, Deliang Cui^{1,*}, and Ching-Ping Wong^{3,*}

¹ Shandong University, China

² Tianjin University of Technology, China

³ Georgia Institute of Technology, USA



MoS₂ porous-hollow nanorods with expanded interlayer spacing due to alternate intercalation of N-doped carbon monolayers between the adjacent MoS₂ monolayers possess excellent lithium ion battery (LIB) and sodium ion battery (SIB) performance.

1912–1920

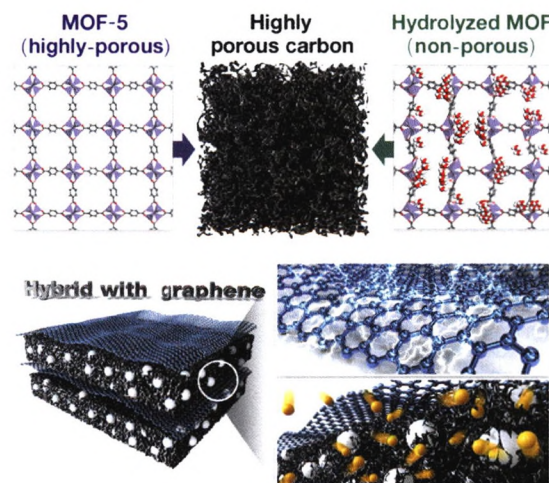
Function-regeneration of non-porous hydrolyzed-MOF-derived materials

Yo Chan Jeong¹, Jin Weon Seo², Jae Ho Kim¹, Seunghoon Nam³, Min Chang Shin², Young Shik Cho¹, Jin Syul Byeon², Chong Rae Park^{1,*}, and Seung Jae Yang^{2,*}

¹ Seoul National University, Republic of Korea

² Inha University, Republic of Korea

³ Andong National University, Republic of Korea



By revisiting the long-held axiom that hydrolyzed non-porous metal-organic frameworks (MOFs) are impractical materials due to the severe structural change, the potential of hydrolyzed MOFs as a useful precursor for MOF-derived materials is revealed.

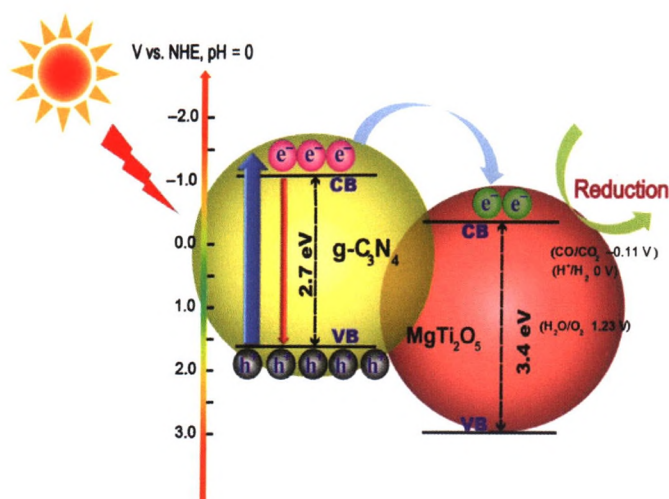
1921–1930

Modulating the photoelectrons of g-C₃N₄ via coupling MgTi₂O₅ as appropriate platform for visible-light-driven photocatalytic solar energy conversion

Jiaxin Shen¹, Yanzhen Li¹, Haoying Zhao¹, Kai Pan¹, Xue Li^{1,*}, Yang Qu^{1,*}, Guofeng Wang^{1,*}, and Dingsheng Wang²

¹ Heilongjiang University, China

² Tsinghua University, China



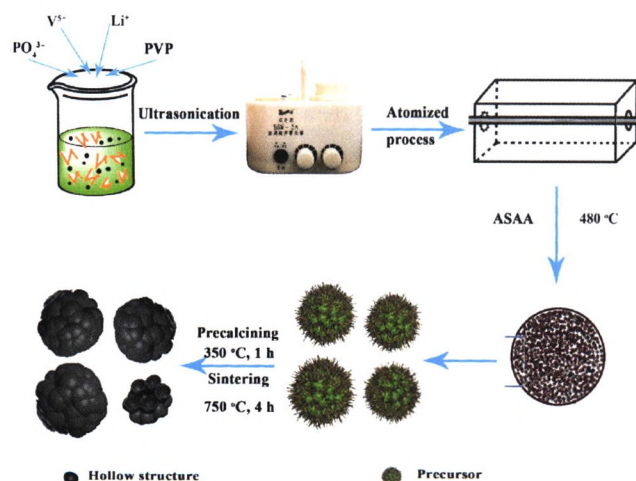
MgTi₂O₅ with wide bandgap and very negative conduction band was utilized as a platform for accepting the visible-light excited photoelectrons from g-C₃N₄, resulting in the enhanced charge separation, maintained thermodynamic energy of the electrons and the promoted photoactivity for solar energy conversion.

1931–1936

Vesicular Li₃V₂(PO₄)₃/C hollow mesoporous microspheres as an efficient cathode material for lithium-ion batteries

Hongxia Sun, Haoran Du, Mengkang Yu, Kuangfu Huang, Nan Yu, and Baoyou Geng*

Anhui Normal University, China



Vesicular Li₃V₂(PO₄)₃/C hollow mesoporous microspheres are synthesized through a facile approach. The composites display a high discharge capacity of 207.6 mAh·g⁻¹ (100 mA·g⁻¹), 204.1 mAh·g⁻¹ (200 mA·g⁻¹), and 180.9 mAh·g⁻¹ (400 mA·g⁻¹) and maintain at 156.1, 146.9, and 131.3 mAh·g⁻¹, respectively, after cycling for 200 times.

1937–1942

In situ fabrication of organic electrochemical transistors on a microfluidic chip

Jianlong Ji^{1,2}, Mangmang Li¹, Zhaowei Chen³, Hongwang Wang¹, Xiaoning Jiang², Kai Zhuo¹, Ying Liu¹, Xing Yang⁴, Zhen Gu³, Shengbo Sang^{1,*}, and Yang Shu^{5,*}

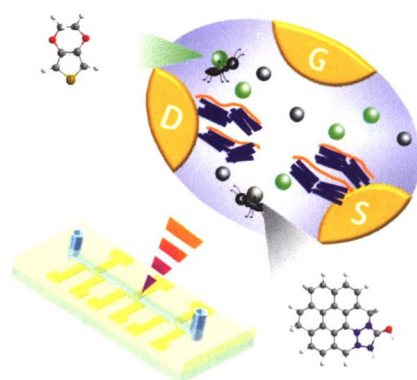
¹ Taiyuan University of Technology, China

² North Carolina State University, USA

³ University of California, Los Angeles, USA

⁴ Tsinghua University, China

⁵ Northeastern University, China



Poly(3,4-ethylenedioxythiophene):poly(4-styrenesulfonate)/graphene quantum dots (PEDOT:PSS/GQDs) organic electrochemical transistors (OECTs) with the channel length of about 8 μm and the channel height of about 200 nm were fabricated *in situ* on the microfluidic chip by alternating current (AC) electrodeposition. *In situ* characterizations further demonstrated that the maximum transconductance, the on/off current ratio and the threshold voltage were 1.58 ms, 246, and 0.269 V, respectively.

1943–1951

Construction of RNA nanotubes

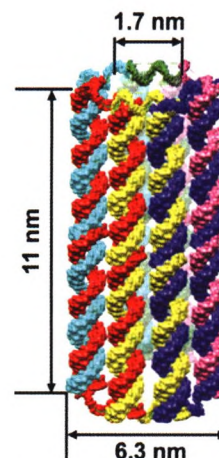
Hui Li^{1,†}, Shaoying Wang^{1,‡}, Zhouxiang Ji¹, Congcong Xu¹,
Lyudmila S. Shlyakhtenko², and Peixuan Guo^{1,*}

¹The Ohio State University, USA

²College of Pharmacy University of Nebraska Medical Center,
USA

[†] Present address: University of California, San Francisco, USA

[‡] Present address: P&Z Biological Technology, USA



We successfully designed, constructed and assembled RNA nanotubes. The insertion of RNA nanotubes into lipid membrane resulted in current jumps and was used for peptide sensing.

1952–1958

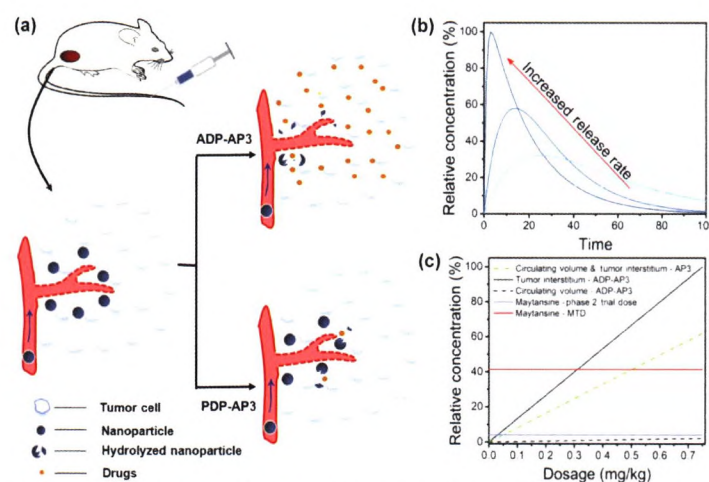
Encapsulating maytansinoid in pH-sensitive nanocarriers: The importance of using extremely potent cytotoxic agents and fast release for nanomedicine to achieve tumor elimination

Bo Dai¹, Xingyu Wu¹, Christopher J. Butch², Jianquan Wang²,
Ziyang Wang², Yisheng Wang², Shuming Nie^{2,3}, Qian Lu^{2,*},
Yiqing Wang^{2,*}, and Yitao Ding^{1,*}

¹ Nanjing Medical University, China

² Nanjing University, China

³ University of Illinois at Urbana-Champaign, USA



An *in vivo* murine model demonstrates that the combination of extremely potent cytotoxic maytansinoids with fast-release pH sensitive nanoparticles creates a system capable of delivering fatal concentrations of compound to the tumor environment, while other tissues are protected from harmful concentrations as supported by experimental and modelling evidence.

1959–1966

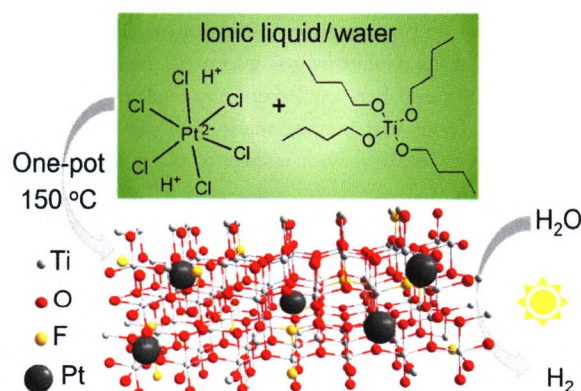
Ionic liquids produce heteroatom-doped Pt/TiO₂ nanocrystals for efficient photocatalytic hydrogen production

Xiuniang Tan^{1,2}, Jianling Zhang^{1,2,3,*}, Dongxing Tan^{1,2}, Jinbiao Shi^{1,2}, Xiuyan Cheng^{1,2}, Fanyu Zhang^{1,2}, Lifei Liu^{1,2}, Bingxing Zhang^{1,2}, Zhuizhui Su^{1,2}, and Buxing Han^{1,2,3}

¹ Institute of Chemistry, Chinese Academy of Sciences, China

² University of Chinese Academy of Sciences, China

³ Huairou National Comprehensive Science Center, China



Here we demonstrate for the first time an ionic liquid-assisted one-pot synthesis route for heteroatom-doped Pt/TiO₂ nanocrystals, which exhibits high activity and stability for photocatalytic hydrogen production under simulated solar irradiation.

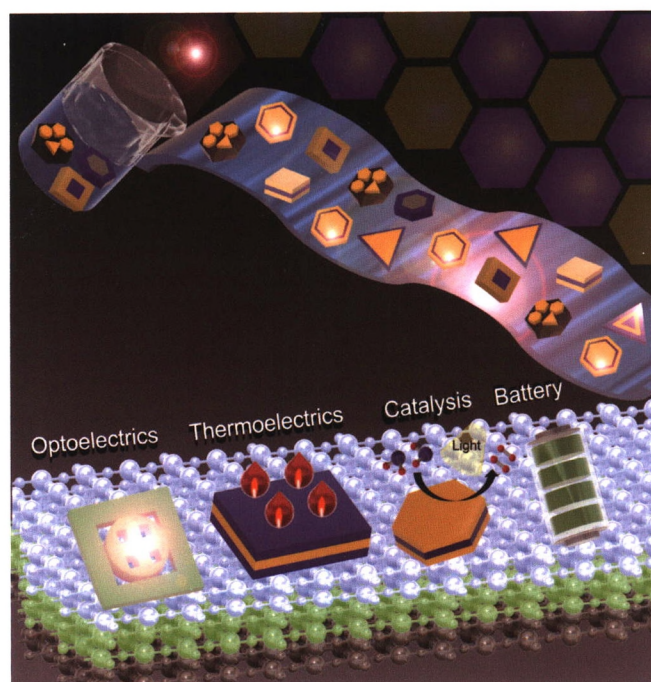
1967–1972

Erratum to: Highly active zigzag-like Pt-Zn alloy nanowires with high-index facets for alcohol electrooxidation
(<https://doi.org/10.1007/s12274-019-2374-z>)

1973

ISSN 1998-0124
CN 11-5974/O4

Nano Research
Volume 12 · Number 8 · August 2019
(Monthly, started in 2008)



纳米研究 (英文版) (月刊, 2008年创刊) 第12卷 第8期 2019年8月出版

Editors-in-Chief Hongjie Dai, Yadong Li

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 & www.springer.com/journal/12274

Online Manuscript Submission, Review and Tracking System 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 戴宏杰 李亚栋

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

