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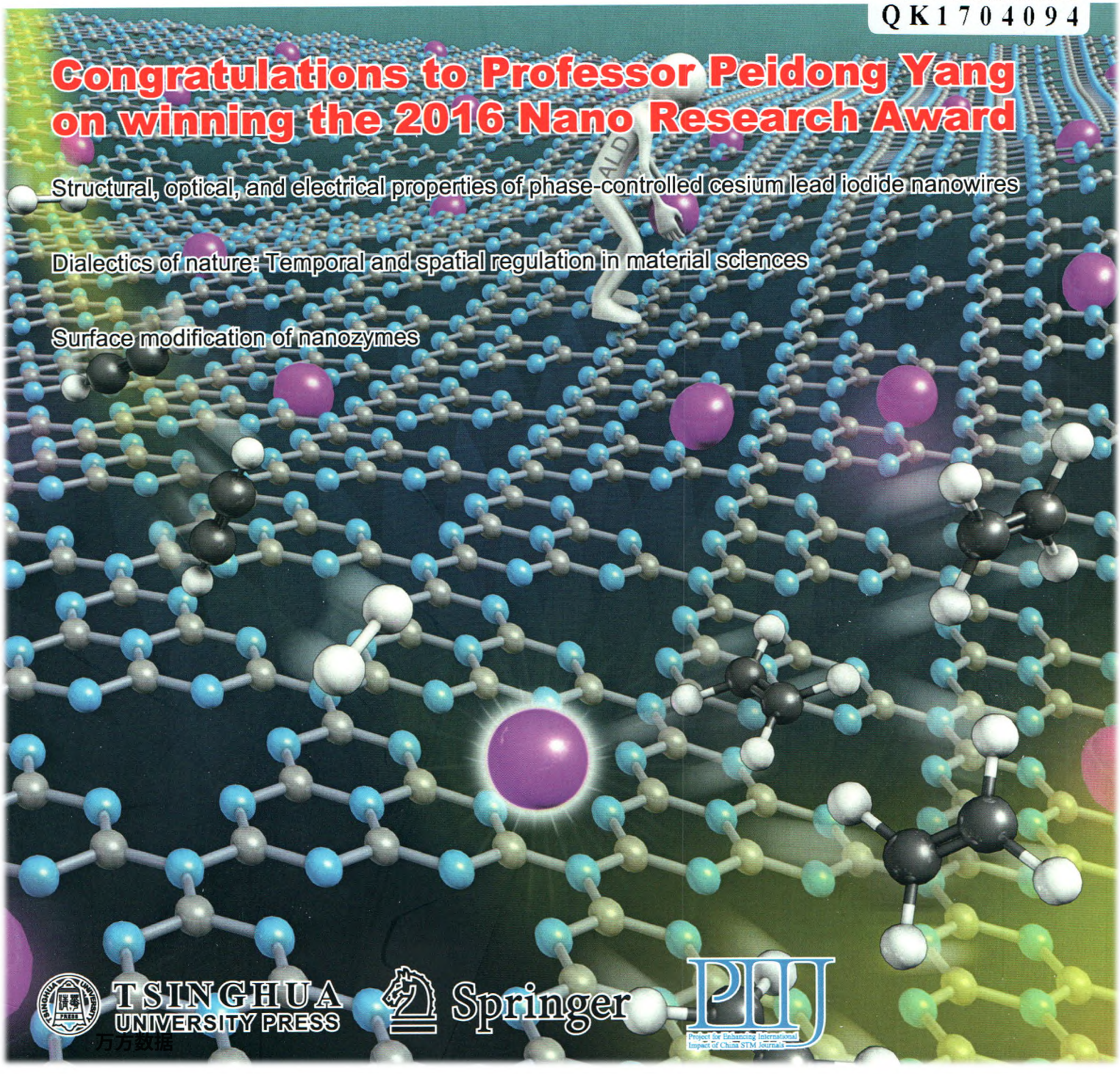

Congratulations to Professor Peidong Yang on winning the 2016 Nano Research Award

Structural, optical, and electrical properties of phase-controlled cesium lead iodide nanowires

Dialectics of nature: Temporal and spatial regulation in material sciences

Surface modification of nanozymes

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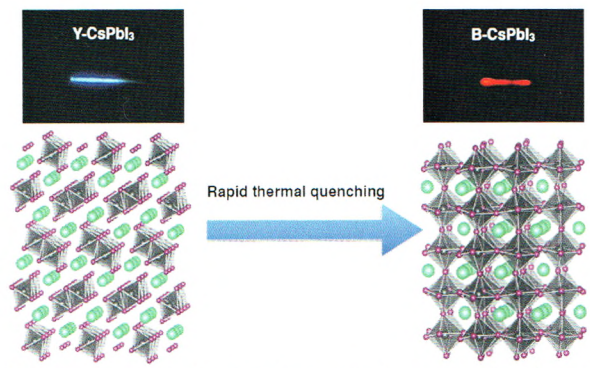
Contents

Research Article

Structural, optical, and electrical properties of phase-controlled cesium lead iodide nanowires

Minliang Lai[1], Qiao Kong[1], Connor G. Bischak[1], Yi Yu[1,2], Letian Dou[1,2], Samuel W. Eaton[1], Naomi S. Ginsberg[1,2,3], and Peidong Yang[1,2,3,*]

[1] University of California, Berkeley, USA
[2] Lawrence Berkeley National Laboratory, USA
[3] Kavli Energy Nanosciences Institute, USA



$CsPbI_3$ nanowires undergo a structural phase transition from the yellow non-perovskite phase to the black perovskite phase during rapid thermal quenching. Perovskite phase $CsPbI_3$ nanowires exhibited good optoelectronic properties for photovoltaic applications.

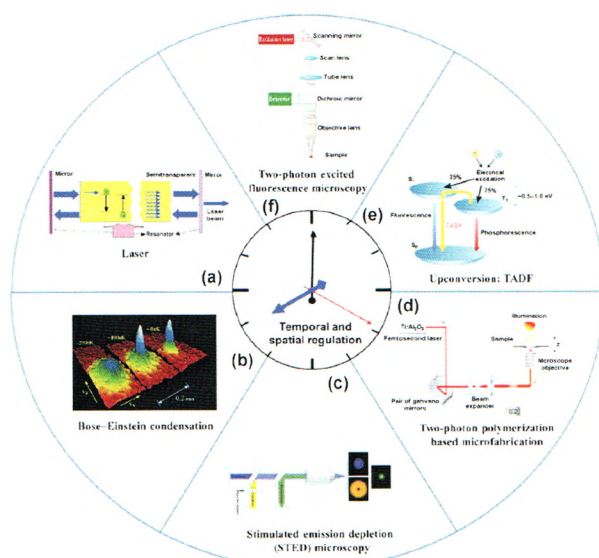
1107–1114

Review Articles

Dialectics of nature: Temporal and spatial regulation in material sciences

Jianlong Xia[1] and Lei Jiang[2,*]

[1] Wuhan University of Technology, China
[2] Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China



Temporal and spatial regulation has received significant attention in modern material sciences. Here, we highlight recent advances in the temporal regulation of organic semiconductors and spatial regulation of nanocrystals.

1115–1124

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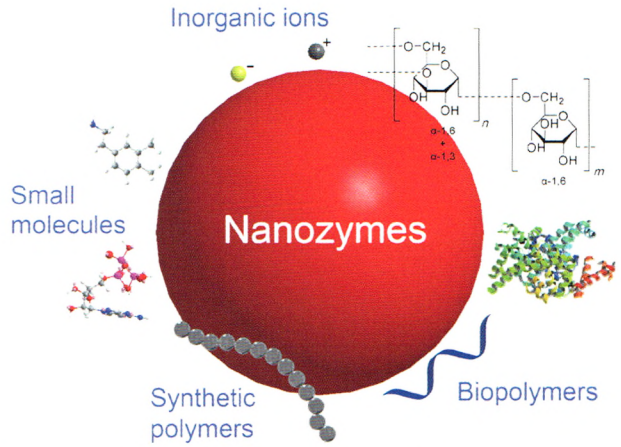
Surface modification of nanozymes

Biwu Liu and Juewen Liu*

University of Waterloo, Canada



The enzyme-like activities of nanomaterials (nanozymes) can be tuned by controlling the surface chemistry with various modification strategies. Progress over the last several years is summarized.

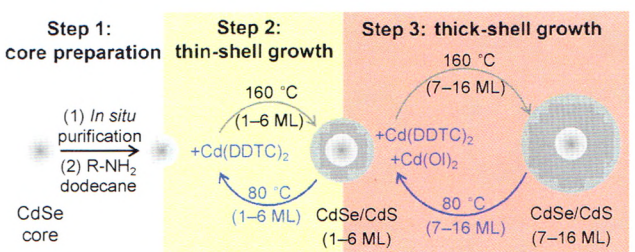
1125–1148

Research Articles

One-pot/three-step synthesis of zinc-blende CdSe/CdS core/shell nanocrystals with thick shells

Yuan Niu, Chaodan Pu, Runchen Lai, Renyang Meng, Wanzhen Lin, Haiyan Qin, and Xiaogang Peng*

Zhejiang University, China



An optimized, systematic synthetic scheme for fabricating zinc-blende CdSe/CdS core/shell nanocrystals with thick shells was successfully developed.

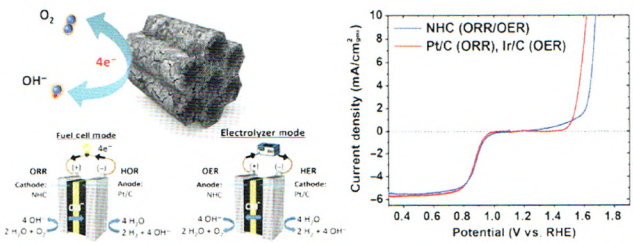
1149–1162

High-performance oxygen reduction and evolution carbon catalysis: From mechanistic studies to device integration

John W. F. To[1], Jia Wei Desmond Ng[1,2], Samira Siahrostami[1], Ai Leen Koh[1], Yangjin Lee[3], Zhihua Chen[1], Kara D. Fong[1], Shucheng Chen[1], Jiajun He[4], Won-Gyu Bae[1], Jennifer Wilcox[5], Hu Young Jeong[3], Kwanpyo Kim[3], Felix Studt[5,6,*], Jens K. Nørskov[1,5,*], Thomas F. Jaramillo[1,*], and Zhenan Bao[1,*]

[1] Stanford University, USA
[2] Agency for Science, Technology and Research, Singapore
[3] Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
[4] Colorado School of Mines, USA
[5] SUNCAT Center for Interface Science and Catalysis SLAC National Accelerator Laboratory, USA
[6] Karlsruhe Institute of Technology, Germany

1163–1177



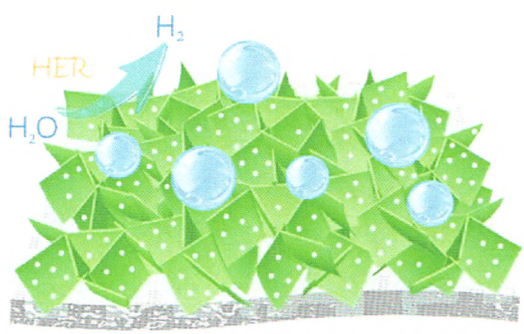
The development of high-performance and low-cost oxygen reduction and evolution catalysts that can be easily integrated into existing devices is crucial for the wide deployment of energy storage systems that utilize O_2-H_2O chemistries, such as regenerative fuel cells and metal-air batteries. Herein, we report an NH_3-activated N-doped hierarchical carbon catalyst that exhibits good performance for both the oxygen reduction reaction and the oxygen evolution reaction, as demonstrated by means of electrochemical studies of its integration into the oxygen electrode of a regenerative fuel cell, and through theoretical calculation using density functional theory.

Defect-rich MoS_2 nanowall catalyst for efficient hydrogen evolution reaction

Junfeng Xie[1,2,*], Haichao Qu[1], Jianping Xin[1], Xinxia Zhang[1], Guanwei Cui[1], Xiaodong Zhang[2], Jian Bao[2], Bo Tang[1], and Yi Xie[2,*]

[1] Shandong Normal University, China
[2] University of Science and Technology of China, China

1178–1188



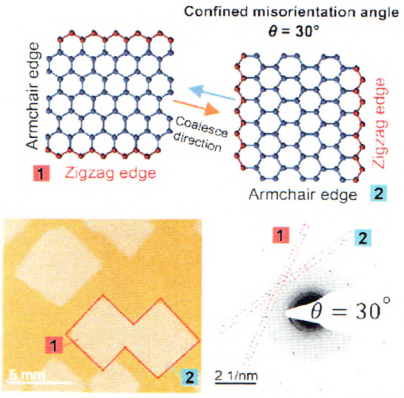
Defect-rich molybdenum disulfide nanowall electrocatalysts were successfully fabricated and exhibited robust and efficient performance in the hydrogen evolution reaction.

Rapid growth of angle-confined large-domain graphene bicrystals

Huaying Ren, Huan Wang, Li Lin, Miao Tang, Shuli Zhao, Bing Deng, Manish Kumar Priydarshi, Jincan Zhang, Hailin Peng*, and Zhongfan Liu*

Peking University, China

1189–1199



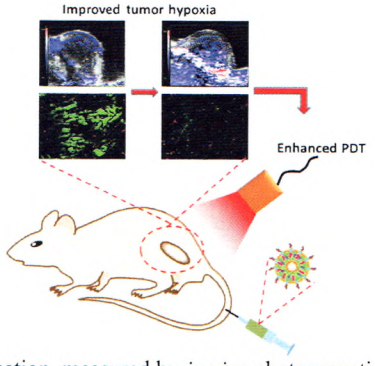
We develop a facile graphene-misorientation strategy to obtain angle-confined graphene bicrystals that contain only two lattice orientations with a tilt angle of 30°. The size of each graphene domain before coalescence is tuned from sub-centimeter (6 mm) to micrometer size using an efficient cooperative passivation strategy with a high growth rate.

Liposomes co-loaded with metformin and chlorin e6 modulate tumor hypoxia during enhanced photodynamic therapy

Xuejiao Song, Liangzhu Feng, Chao Liang, Min Gao, Guosheng Song, and Zhuang Liu*

Soochow University, China

1200–1212



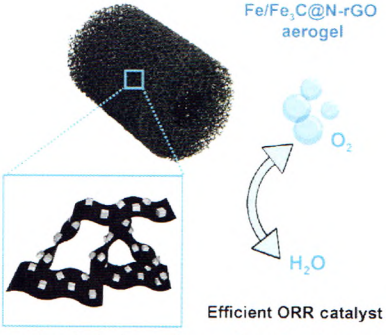
Tumor oxygenation, measured by *in vivo* photoacoustic imaging and *ex vivo* immunofluorescence staining, was markedly improved by the intravenous administration of liposomes co-loaded with the photosensitizer hydrophobic chlorin e6 and the diabetes drug, metformin. Subsequently, the therapeutic efficacy of *in vivo* photodynamic treatment using the liposomes was shown to be superior to that of conventional photodynamic therapy without metformin.

A Prussian blue route to nitrogen-doped graphene aerogels as efficient electrocatalysts for oxygen reduction with enhanced active site accessibility

Yayuan Liu[1], Haotian Wang[1], Dingchang Lin[1], Jie Zhao[1], Chong Liu[1], Jin Xie[1], and Yi Cui[1,2,*]

[1] Stanford University, USA
[2] SLAC National Accelerator Laboratory, USA

1213–1222



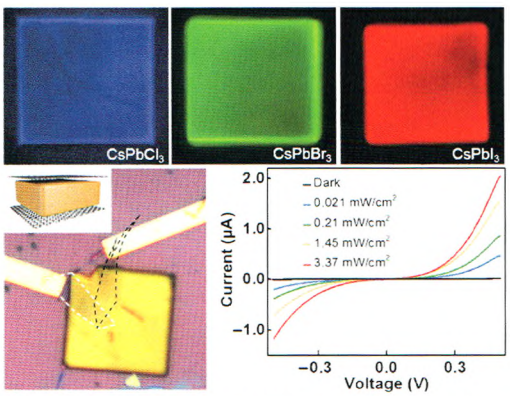
We report the rational design of a catalyst for the oxygen reduction reaction with highly active catalytic centers and enhanced active site accessibility. The catalyst was obtained via a facile Prussian blue nanoparticle approach and displayed outstanding catalytic activity on par with the state-of-the-art Pt/C catalyst at the same mass loading in alkaline media, good performance in acidic media, and excellent stability and crossover tolerance.

Chemical vapor deposition growth of single-crystalline cesium lead halide microplatelets and heterostructures for optoelectronic applications

Yiliu Wang[1], Xun Guan[2,3], Dehui Li[1], Hung-Chieh Cheng[1], Xidong Duan[2,*], Zhaoyang Lin[1], and Xiangfeng Duan[1,*]

[1] University of California, Los Angeles, USA
[2] Hunan University, China
[3] University of Science and Technology Beijing, China

1223–1233



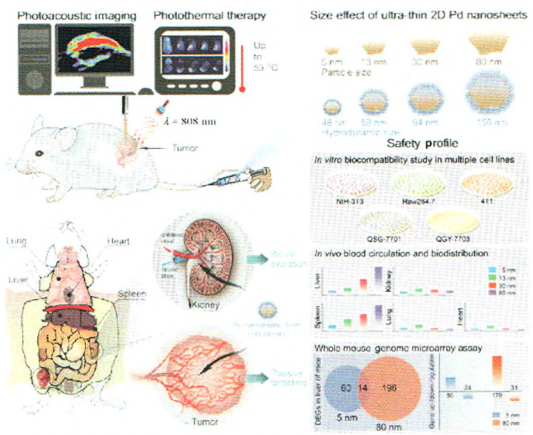
A chemical vapor deposition approach is used to grow all-inorganic cesium lead halide perovskite microplatelets and heterostructures with tunable optical and electronic properties for optoelectronic applications.

Safety profile of two-dimensional Pd nanosheets for photothermal therapy and photoacoustic imaging

Mei Chen[1], Shuzhen Chen[1,2], Chengyong He[1], Shiguang Mo[1], Xiaoyong Wang[1], Gang Liu[1,*], and Nanfeng Zheng[1,*]

[1] Xiamen University, China
[2] Xiamen Medical College, China

1234–1248



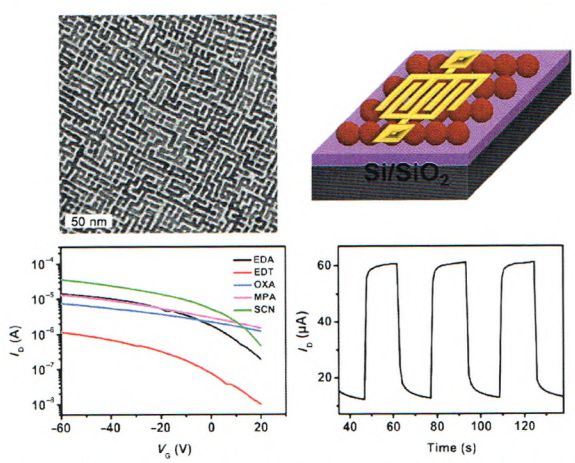
In vitro and *in vivo* biological behaviors of ultrathin two-dimensional (2D) Pd nanosheets with diameters ranging from 5 to 80 nm were systemically studied, including their photothermal and photoacoustic effects, pharmacokinetics, and toxicity.

Ligand effects on electronic and optoelectronic properties of two-dimensional PbS necking percolative superlattices

Man Zhao[1], Defang Ding[1], Fangxu Yang[3], Dawei Wang[1], Jiawei Lv[1], Wenping Hu[3], Chenguang Lu[1,2,*], and Zhiyong Tang[1,2,*]

[1] National Center for Nanoscience and Technology, China
[2] University of Chinese Academy of Sciences, China
[3] Tianjin University & Collaborative Innovation Center of Chemical Science and Engineering, China

1249–1257



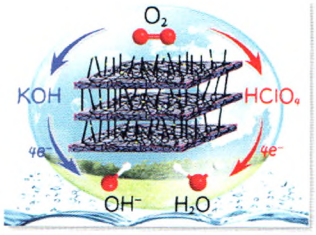
A unique PbS structure with necking percolative superlattices was used to study the effects of ligands on the electronic and optoelectronic properties of nanocrystal (NC) solids in order to elucidate the relationship between the NC surface and the properties.

Organic-acid-assisted synthesis of a 3D lasagna-like Fe-N-doped CNTs-G framework: An efficient and stable electrocatalyst for oxygen reduction reactions

Xiaobing Bao, Yutong Gong, Jiang Deng, Shiping Wang, and Yong Wang*

Zhejiang University, China

1258–1267



An easily operated, oxalic acid-assisted method was developed for the *in-situ* fabrication of a three-dimensional (3D) lasagna-like Fe-N-doped carbon nanotubes and graphene hybrid (CNTs-G) framework from a precursor designed at the molecular level. The impressive oxygen reduction reaction performances in both alkaline and acidic conditions confirm the catalytic significance of this technically favorable morphological structure. This work further advances the construction of novel 3D carbon architectures via practical and economic routes.

Understanding of the capacity contribution of carbon in phosphorus-carbon composites for high-performance anodes in lithium ion batteries

Jiantie Xu[1,3], In-Yup Jeon[2], Jianmin Ma[1], Yuhai Dou[1], Seok-Jin Kim[2], Jeong-Min Seo[2], Huakun Liu[1], Shixue Dou[1,*], Jong-Beom Baek[2,*], and Liming Dai[3,*]

[1] University of Wollongong, Australia
[2] Ulsan National Institute of Science and Technology (UNIST), Republic of Korea
[3] Case Western Reserve University, USA

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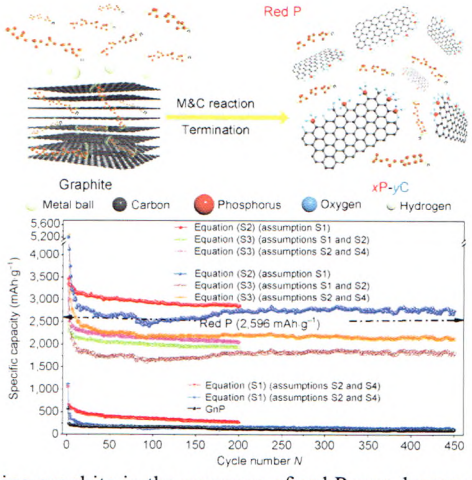


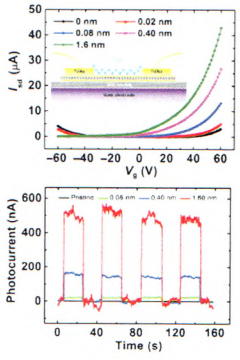
Ball-milling graphite in the presence of red P was demonstrated to produce a series of P-C composites. The capacity contributions from P and C in the P-C composites were discussed.

Significantly enhanced optoelectronic performance of tungsten diselenide phototransistor via surface functionalization

Bo Lei[1], Zehua Hu[1], Du Xiang[1], Junyong Wang[1], Goki Eda[1], Cheng Han[1,2,*], and Wei Chen[1,2,3,*]

[1] National University of Singapore, Singapore
[2] Shenzhen University, China
[3] National University of Singapore (Suzhou) Research Institute, China

1282–1291



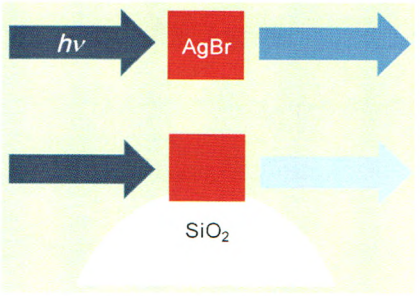
This article demonstrates the significant enhancement in the optoelectronic performance of WSe_2 phototransistors, via *in situ* surface functionalization with cesium carbonate. The electron mobility of WSe_2 was increased by nearly one order of magnitude, while the photoresponsivity and the external quantum efficiency (EQE) were enhanced by almost three orders of magnitude after Cs_2CO_3 modification.

Enhanced optical absorption in semiconductor nanoparticles enabled by nearfield dielectric scattering

Kowsalya D. Rasamani[1], Jonathan J. Foley IV[2], Brittney Beidelman[1,3], and Yugang Sun[1,*]

[1] Temple University, USA
[2] William Paterson University, USA
[3] Bryn Mawr College, USA

1292–1301



An increased absorption cross section in semiconductor AgBr nanoparticles is achieved by placing them on dielectric SiO_2 nanospheres that generate enhanced scattering nearfields.

Enhancing both selectivity and coking-resistance of a single-atom Pd_1/C_3N_4 catalyst for acetylene hydrogenation

Xiaohui Huang, Yujia Xia, Yuanjie Cao, Xusheng Zheng, Haibin Pan, Junfa Zhu, Chao Ma, Hengwei Wang, Junjie Li, Rui You, Shiqiang Wei, Weixin Huang, and Junling Lu*

University of Science and Technology of China, China

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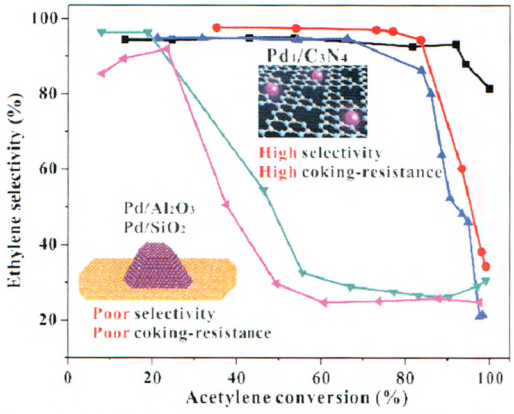


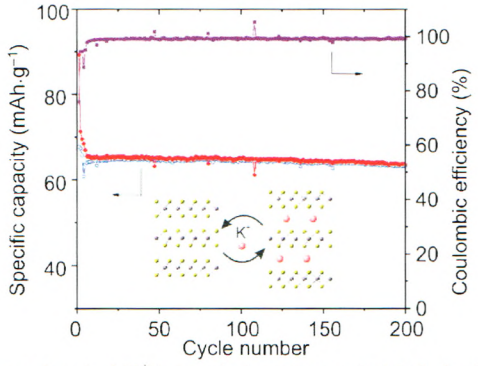
A single-atom Pd_1/C_3N_4 catalyst showed a remarkably high ethylene selectivity and excellent durability by effectively suppressing coke formation during selective hydrogenation of acetylene in excess ethylene.

MoS_2 as a long-life host material for potassium ion intercalation

Xiaodi Ren, Qiang Zhao†, William D. McCulloch, and Yiying Wu*

The Ohio State University, USA
† Present address: Sichuan University, China

1313–1321



The electrochemical K^+ intercalation process in MoS_2 is shown in this study. MoS_2 has a long life for repetitive K^+ intercalation and de-intercalation.

Wet-chemistry synthesis of cobalt carbide nanoparticles as highly active and stable electrocatalyst for hydrogen evolution reaction

Siwei Li[1], Ce Yang[1], Zhen Yin[1,2], Hanjun Yang[1], Yifu Chen[1], Lili Lin[1], Mengzhu Li[1], Weizhen Li[1], Gang Hu[3], and Ding Ma[1,*]

[1] Peking University, China
[2] Tianjin Polytechnic University, China
[3] Israel Chemicals Limited, China

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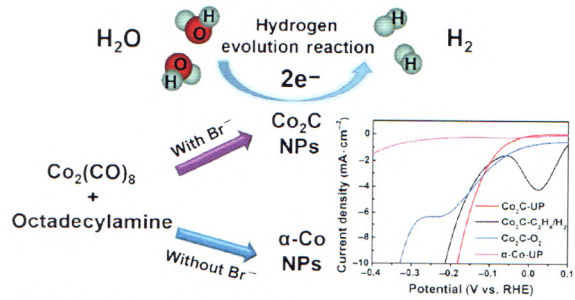

We developed a bromide-induced wet-chemistry synthesis method for Co_2C nanoparticles, which were a highly active and stable electrocatalyst for the hydrogen evolution reaction.

Green light-emitting diodes based on hybrid perovskite films with mixed cesium and methylammonium cations

Junjie Si[1], Yang Liu[1], Nana Wang[2], Meng Xu[2], Jing Li[1], Haiping He[1,*], Jianpu Wang[2,*], and Yizheng Jin[1,*]

[1] Zhejiang University, China
[2] Nanjing Tech University (NanjingTech), China

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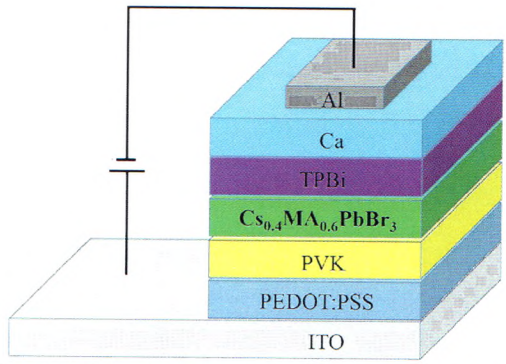

Partially replacing the organic methylammonium cations by inorganic Cs^+ results in perovskite thin films that provide nearly full surface coverage and much higher photoluminescence quantum efficiency due to the greater radiative recombination rate and the smaller nonradiative recombination rate. These films are therefore ideal for electroluminescence applications.

Realization of vertical and lateral van der Waals heterojunctions using two-dimensional layered organic semiconductors

Yuhan Zhang[1], Zhongzhong Luo[1], Fengrui Hu[1], Haiyan Nan[2], Xiaoyong Wang[1], Zhenhua Ni[2], Jianbin Xu[3,1], Yi Shi[1,*], and Xinran Wang[1,*]

[1] Nanjing University, China
[2] Southeast University, China
[3] The Chinese University of Hong Kong, China

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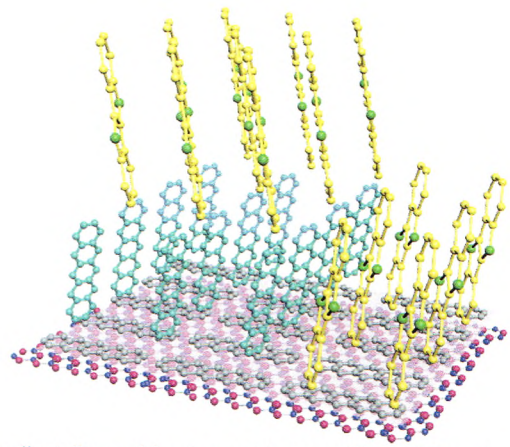

Using dioctylbenzothienobenzothiophene (C_8-BTBT) and pentacene as building blocks, two-dimensional vertical and lateral molecular van der Waals heterojunctions with clean and sharp interfaces are prepared via a highly controllable physical vapor transport (PVT) process.

Near-infrared (NIR) controlled reversible cell adhesion on a responsive nano-biointerface

Haijun Cui[1,2], Pengchao Zhang[2,3], Wenshuo Wang[1,2], Guannan Li[2,3], Yuwei Hao[2,3], Luying Wang[2,3], and Shutao Wang[1,2,*]

[1] Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China
[2] University of Chinese Academy of Sciences, China
[3] Institute of Chemistry, Chinese Academy of Sciences, China

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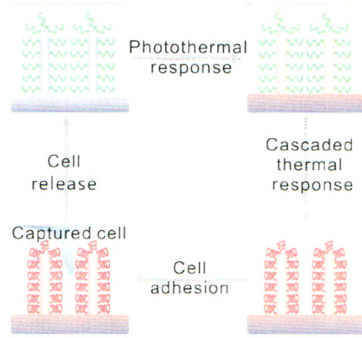

Near-infrared (NIR)-controlled cell adhesion: We constructed an NIR-responsive nano-biointerface by introducing a thermal responsive polymer onto a silicon nanowire array with photothermal property. The prepared nano-biointerface showed NIR-controlled reversible cell adhesion and release without the assistance of photosensitive moieties.

A carbon-based 3D current collector with surface protection for Li metal anode

Ying Zhang[1], Boyang Liu[1], Emily Hitz[1], Wei Luo[1], Yonggang Yao[1], Yiju Li[1], Jiaqi Dai[1], Chaoji Chen[1], Yanbin Wang[1], Chunpeng Yang[1], Hongbian Li[2], and Liangbing Hu[1,*]

[1] University of Maryland, USA
[2] National Center for Nanoscience and Technology, China

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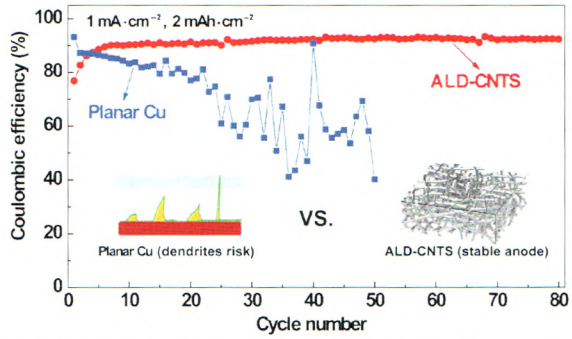


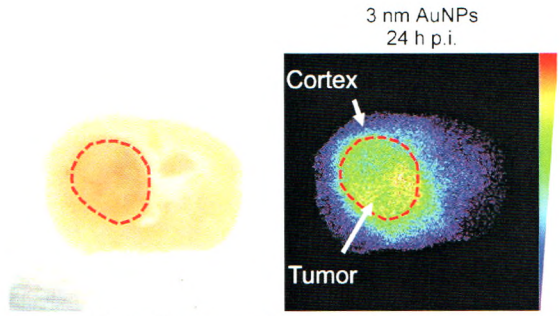
The stability of Li@atomic layer deposition (ALD)-carbon nanotube sponge (CNTS) electrodes relies on both the high-surface-area conductive framework and the robust ALD-Al_2O_3 surface protection layer, which decreases the effective areal current density and stabilizes the electrode/electrolyte interface for Li nuclei, respectively.

Targeting orthotopic gliomas with renal-clearable luminescent gold nanoparticles

Chuanqi Peng[1], Xiaofei Gao[2], Jing Xu[1], Bujie Du[1], Xuhui Ning[1], Shaoheng Tang[1], Robert M. Bachoo[2], Mengxiao Yu[1], Woo-Ping Ge[2,*], and Jie Zheng[1,*]

[1] The University of Texas at Dallas, USA
[2] UT Southwestern Medical Center, USA

1366–1376

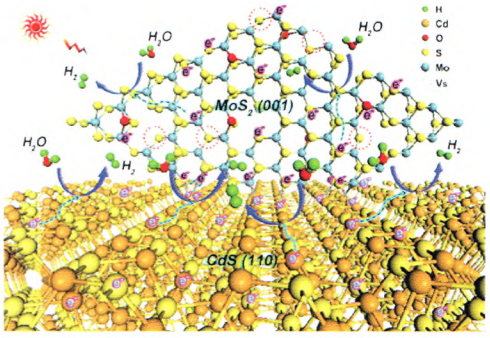


Renal-clearable gold nanoparticles can effectively target gliomas, the most common brain tumors, which generally exhibit poor permeability, through the enhanced permeability and retention (EPR) effect.

Multi-node CdS hetero-nanowires grown with defect-rich oxygen-doped MoS_2 ultrathin nanosheets for efficient visible-light photocatalytic H_2 evolution

Haifeng Lin[1], Yanyan Li[2], Haoyi Li[1], and Xun Wang[1,*]

[1] Tsinghua University, China
[2] Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, China



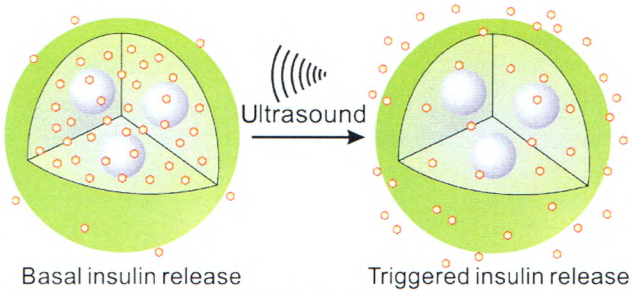
Without using noble metals as co-catalysts, multi-node CdS hetero-nanowires (NWs) were grown with defect-rich O-incorporated MoS_2 ultrathin nanosheets (NSs). The hetero-NWs exhibited abundant catalytic active sites, substantially improved electric conductivity, and significantly enhanced separation of charge carriers, resulting in superior visible-light photocatalytic properties compared with Pt/CdS NWs, pure CdS NWs, and MoS_2 NSs, as well as their physical mixtures.

1377–1392

Ultrasound-triggered noninvasive regulation of blood glucose levels using microgels integrated with insulin nanocapsules

Jin Di[1,2], Jicheng Yu[1,2], Qun Wang[3], Shanshan Yao[4], Dingjie Suo[4], Yanqi Ye[1,2], Matthew Pless[4], Yong Zhu[4], Yun Jing[4,*], and Zhen Gu[1,2,*]

[1] University of North Carolina at Chapel Hill and North Carolina State University, USA
[2] University of North Carolina at Chapel Hill, USA
[3] Iowa State University, USA
[4] North Carolina State University, USA



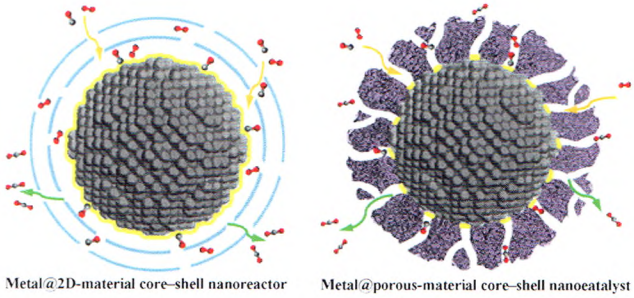
An injectable microgel formulation was developed by integrating a chitosan-based microgel with poly(lactic-co-glycolic) acid (PLGA) based nanocapsules loaded with insulin for focused ultrasound (FUS)-triggered noninvasive regulation of blood glucose levels.

1393–1402

Catalysis under shell: Improved CO oxidation reaction confined in Pt@h-BN core–shell nanoreactors

Mengmeng Sun[1], Qiang Fu[1,*], Lijun Gao[1,2], Yanping Zheng[3], Yangyang Li[3], Mingshu Chen[3], and Xinhe Bao[1]

[1] Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China
[2] University of Science and Technology of China, China
[3] Xiamen University, China



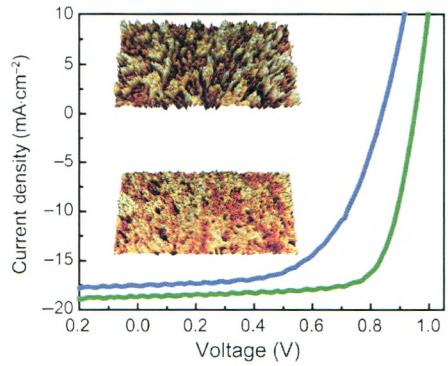
Pt@hexagonal boron nitride (h-BN) core–shell nanostructures function as nanoreactors, in which CO oxidation reactions with improved activity, selectivity, and stability occur at the core–shell interfaces. The confinement effect exerted by the h-BN shells promotes the Pt-catalyzed reactions.

1403–1412

Moisture-driven phase transition for improved perovskite solar cells with reduced trap-state density

Swaminathan Venkatesan[1], Fang Hao[1], Junyoung Kim[1], Yaoguang Rong[1], Zhuan Zhu[1], Yanliang Liang[1], Jiming Bao[1], and Yan Yao[1,2,*]

[1] University of Houston, USA
[2] Texas Center for Superconductivity at the University of Houston, USA



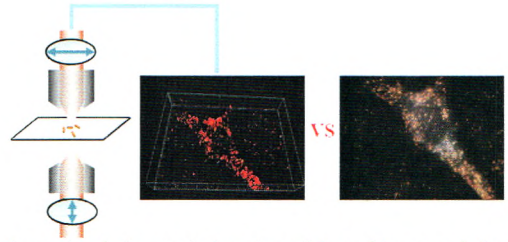
The moisture-enabled phase transition of a precursor intermediate to the perovskite phase for enhancing the photovoltaic efficiency is demonstrated. The moisture assists in decoupling the conversion and grain growth to enable the formation of active-layer films with a low defect density.

1413–1422

Background-free three-dimensional selective imaging of anisotropic plasmonic nanoparticles

Xiaodong Cheng[1,3], Xuan Cao[1], Bin Xiong[1], Yan He[1,2,*], and Edward S. Yeung[1]

[1] Hunan University, China
[2] Tsinghua University, China
[3] Wenzhou Medical University, China



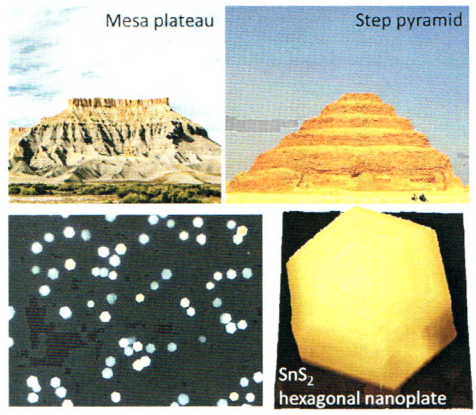
Three-dimensional plasmonic imaging of the gold-nanorod distribution inside cells with a high resolution and high contrast was achieved via orientation-dependent localization microscopy.

1423–1433

Controlled growth and photoconductive properties of hexagonal SnS_2 nanoflakes with mesa-shaped atomic steps

Yi Hu[1], Tao Chen[1], Xiaoqi Wang[1], Lianbo Ma[1], Renpeng Chen[1], Hongfei Zhu[1], Xin Yuan[1], Changzeng Yan[1], Guoyin Zhu[1], Hongling Lv[1], Jia Liang[1], Zhong Jin[1,*], and Jie Liu[1,2,*]

[1] Nanjing University, China
[2] Duke University, USA



We demonstrate the controlled growth of two-dimensional (2D) hexagonal tin disulfide (SnS_2) nanoflakes with stacked monolayer atomic steps.

1434–1447

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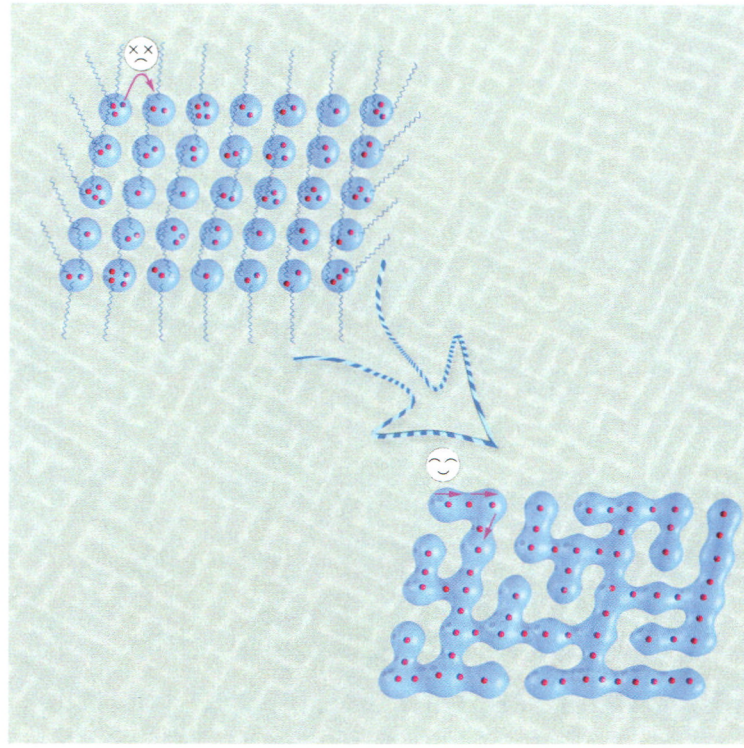

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