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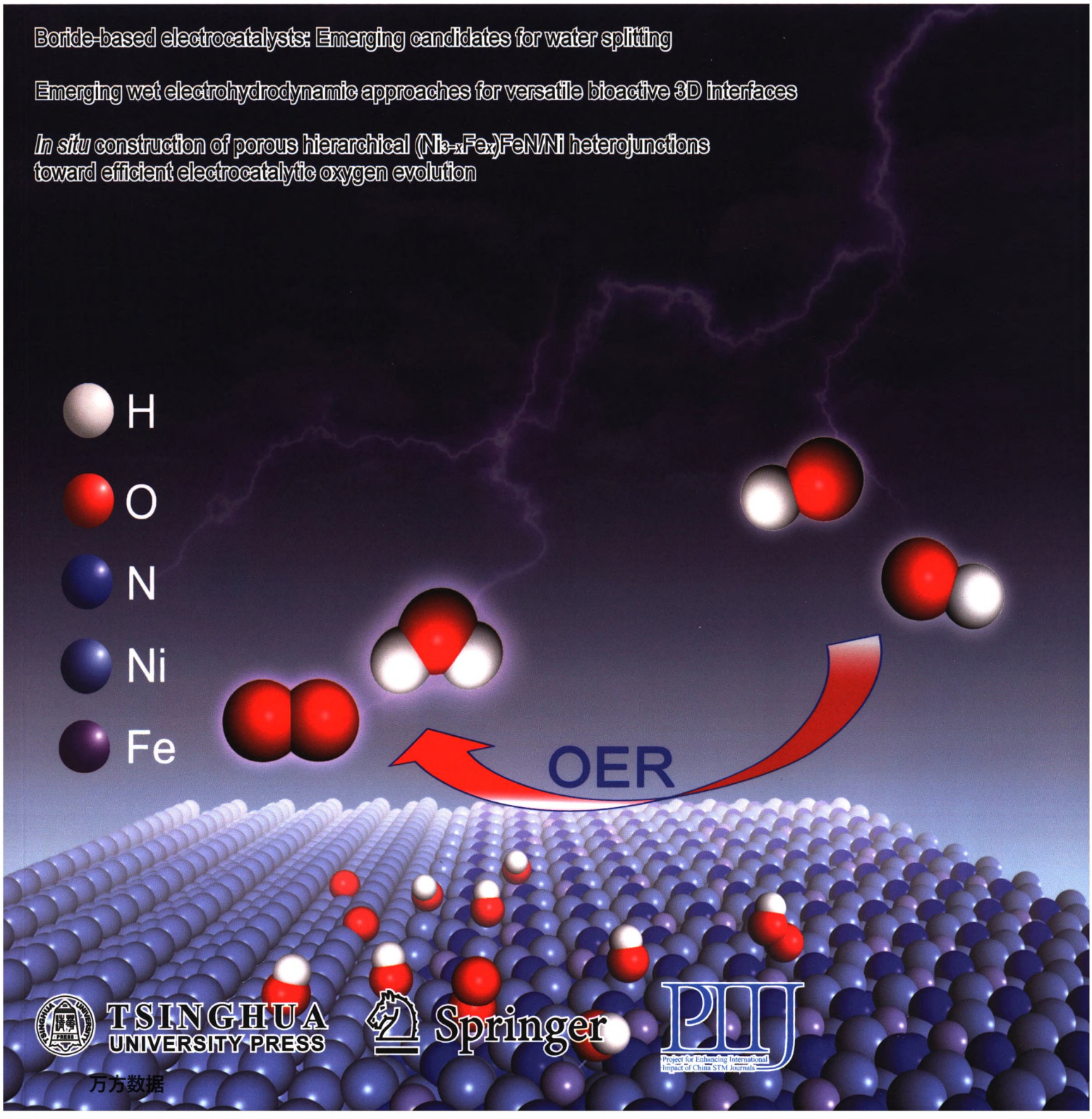
Nano Research

Boride-based electrocatalysts: Emerging candidates for water splitting

Emerging wet electrohydrodynamic approaches for versatile bioactive 3D interfaces

In situ construction of porous hierarchical $(Ni_{3-x}Fe_x)FeN/Ni$ heterojunctions toward efficient electrocatalytic oxygen evolution



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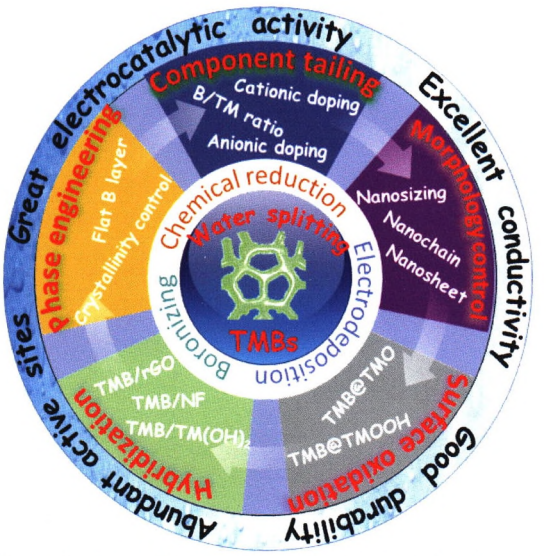
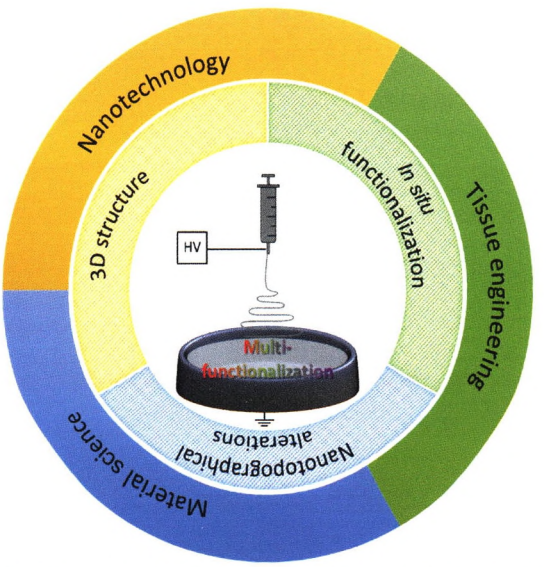
Review Articles



In this work, the authors reviewed the recent development of transition metal borides-based electrocatalysts for water splitting.



Wet electrohydrodynamics is an emerging technique that enables multi-functionalization of submicron fibers as 3D macrostructures with tunable nano-topography and homogeneous chemical modifications in one single step.

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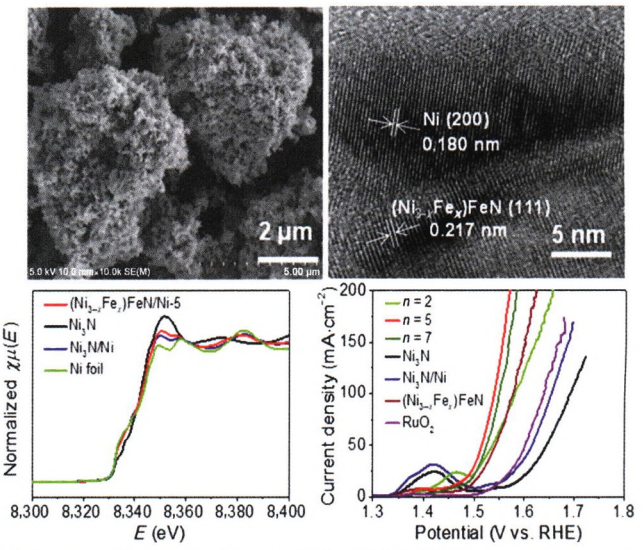
Research Articles

In situ construction of porous hierarchical $(Ni_{3-x}Fe_x)FeN/Ni$ heterojunctions toward efficient electrocatalytic oxygen evolution

Minglei Yan[1], Kun Mao[1], Peixin Cui[2], Chi Chen[3], Jie Zhao[1], Xizhang Wang[1], Lijun Yang[1], Hui Yang[3], Qiang Wu[1,*], and Zheng Hu[1,*]

[1] Nanjing University, China
[2] Institute of Soil Science, Chinese Academy of Sciences, China
[3] Shanghai Advanced Research Institute, Chinese Academy of Sciences, China



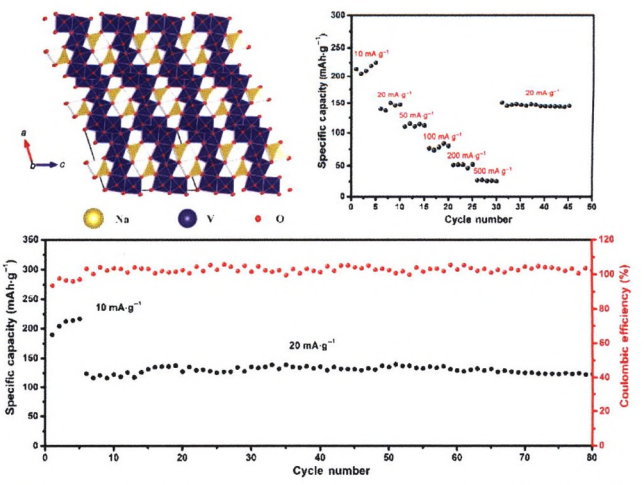
The porous hierarchical hetero-$(Ni_{3-x}Fe_x)FeN/Ni$ composites are *in situ* constructed for the efficient electrocatalytic oxygen evolution reaction (OER), and the optimized catalyst exhibits an excellent performance with a low overpotential of 223 mV@10 $mA{\cdot}cm^{-2}$, a small Tafel slope of 68 $mV{\cdot}dec^{-1}$, high Faradaic efficiency of 97.6% as well as a high stability.

328–334

NaV_6O_{15}: A promising cathode material for insertion/extraction of Mg^{2+} with excellent cycling performance

Dongzheng Wu[1], Jing Zeng[1], Haiming Hua[1], Junnan Wu[1], Yang Yang[2,*], and Jinbao Zhao[1,*]

[1] Xiamen University, China
[2] Guangdong University of Technology, China



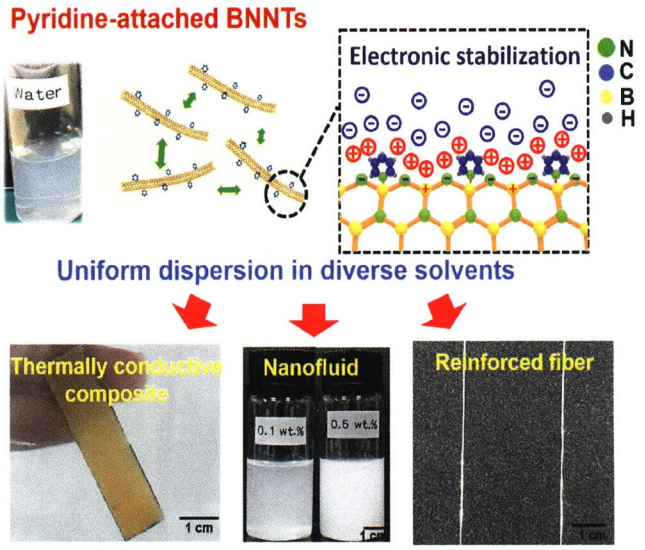
Herein, we have prepared the enlarged layer spacing NaV_6O_{15} with many vacancies for the Mg^{2+} insertion. The NaV_6O_{15} not only exhibits high discharge capacity (119.2 $mAh{\cdot}g^{-1}$ after 100 cycles at the current density of 20 $mA{\cdot}g^{-1}$), but also expresses the good rate capability.

335–343

Electrostabilized homogeneous dispersion of boron nitride nanotubes in wide-range of solvents achieved by surface polarity modulation through pyridine attachment

Mi Se Chang[1,2], Min-Sun Jang[1], Sangsun Yang[1], Jihun Yu[1], Taehoon Kim[1], Sedong Kim[3], Hyomin Jeong[3], Chong Rae Park[2,*], and Jae Won Jeong[1,*]

[1] Korea Institute of Materials Science, Republic of Korea
[2] Seoul National University, Republic of Korea
[3] Gyeongsang National University, Republic of Korea



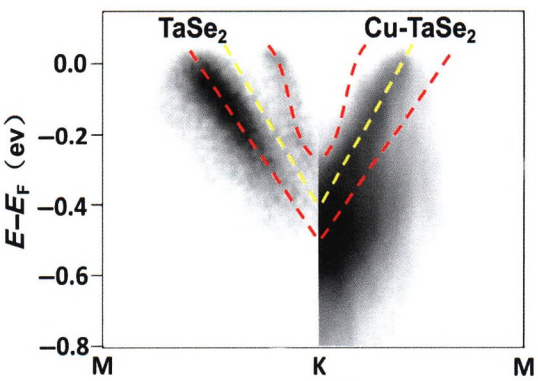
This study demonstrates the dispersion of boron nitride nanotubes (BNNTs) in diverse solvents with the use of pyridine for applications in thermally conductive composite, nanofluid, and reinforced fiber.

344–352

A non-rigid shift of band dispersions induced by Cu intercalation in 2H-$TaSe_2$

Pengdong Wang[1], Rashid Khan[1], Zhanfeng Liu[1], Bo Zhang[1], Yuliang Li[1], Sheng Wang[1], Yunbo Wu[1], Hongen Zhu[1], Yi Liu[1], Guobin Zhang[1], Dayong Liu[2], Shuangming Chen[1,*], Li Song[1,*], and Zhe Sun[1,3,*]

[1] University of Science and Technology of China, China
[2] Institute of Solid State Physics, Chinese Academy of Sciences, China
[3] CAS Center for Excellence in Superconducting Electronics (CENSE), China



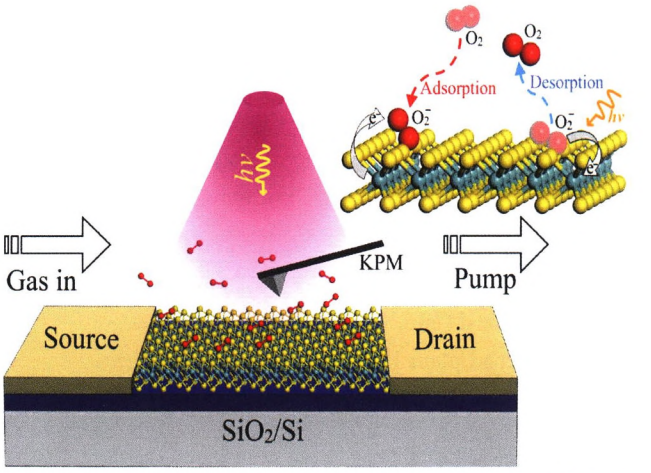
Taking advantage of X-ray absorption fine structure and angle-resolved photoemission spectroscopy, we studied how Cu intercalation influences the host $TaSe_2$ layers in $Cu_{0.03}TaSe_2$ crystals. By examining the changes of band dispersions, we show that the variation of electronic structures is related to the bonding and charge transfer between intercalated Cu and Se atoms.

353–357

UV illumination enhanced desorption of oxygen molecules from monolayer MoS_2 surface

Yuhang Wang[1,*], Zhiquan He[1], Jinbing Zhang[1], Hao Liu[1], Xubo Lai[2], Boyang Liu[2], Yibao Chen[2], Fengping Wang[1,*], and Liuwan Zhang[2,*]

[1] University of Science and Technology Beijing, China
[2] Tsinghua University, China

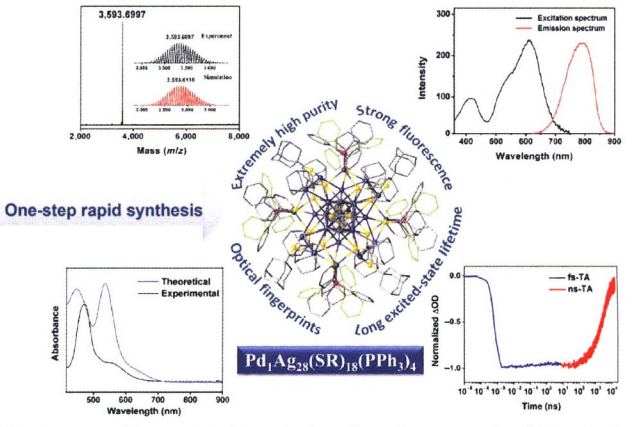


The ultraviolet (UV) illumination enhanced O_2 desorption on monolayer MoS_2 is demonstrated by electrical, optical and Kelvin probe techniques. The photo-excited charge transfer photodesorption model is proposed.

One-step rapid synthesis, crystal structure and 3.3 microseconds long excited-state lifetime of Pd_1Ag_{28} nanocluster

Xinzhang Lin[1,4], Hengjiang Cong[2], Keju Sun[3], Xuemei Fu[1,4], Wanchao Kang[5], Xiuli Wang[5], Shengye Jin[6], Ren'an Wu[7], Chao Liu[1,*], and Jiahui Huang[1,*]

[1] Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China
[2] Wuhan University, China
[3] Yanshan University, China
[4] University of Chinese Academy of Sciences, China

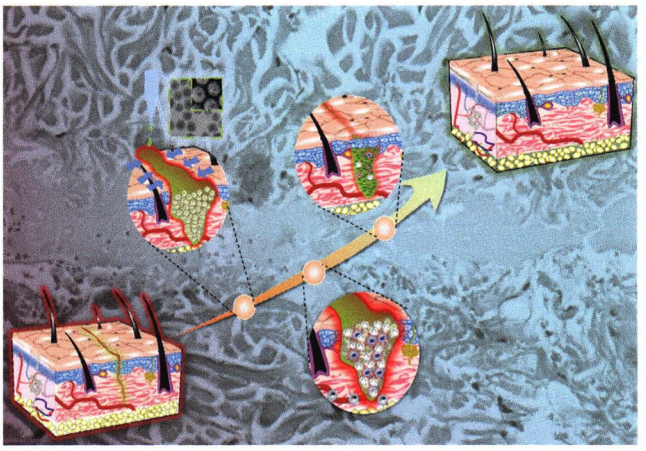


One-step rapid protocol was developed to synthesize novel Pd-doped Ag nanocluster with high yield. The prepared $[Pd_1Ag_{28}(S\text{-}Adm)_{18}(PPh_3)_4]^{2+}$ nanocluster exhibits intriguing crystal structure, high purity, strong near infrared (NIR) fluorescence, unique optical fingerprint and unexpectedly long excited-state lifetime.

Activating proper inflammation for wound-healing acceleration via mesoporous silica nanoparticle tissue adhesive

Zhao Pan[1], Kai-Run Zhang[3], Huai-Ling Gao[1], Yong Zhou[3], Bei-Bei Yan[1], Chi Yang[2], Zhi-Yuan Zhang[2], Liang Dong[1], Si-Ming Chen[1], Rui Xu[3], Duo-Hong Zou[2,3,*], and Shu-Hong Yu[1,*]

[1] University of Science and Technology of China, China
[2] Shanghai Jiao Tong University School of Medicine, China
[3] Anhui Medical University, China

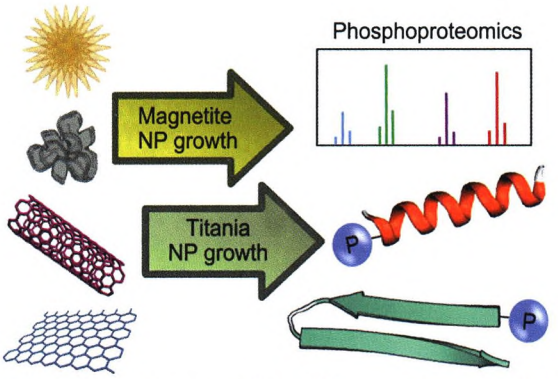


Mesoporous nanoparticles were used as tissue adhesive to reconnect the wounded tissues. Due to unique structure, the elimination of mesoporous nanoparticles occurred synchronously with tissue rebuilding, which prevents persistent inflammation and allows accelerating healing.

Carbon nanostructure morphology templates nanocomposites for phosphoproteomics

Susy Piovesana[1], Daniel Iglesias[2], Manuel Melle-Franco[3], Slavo Kralj[4], Chiara Cavaliere[1], Michele Melchionna[2], Aldo Laganà[1,5], Anna L. Capriotti[1,*], and Silvia Marchesan[2,*]

[1] Sapienza Universitadi Roma, Italy
[2] Universita di Trieste, Italy
[3] University of Aveiro, Portugal
[4] Jožef Stefan Institute, Slovenia
[5] University of Salento, Italy

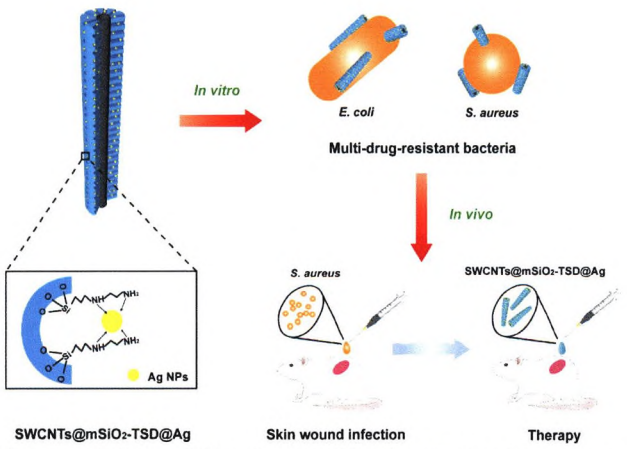


Nanocomposites are prepared from different carbon nanostructure scaffolds for magnetite and titania nanoparticle nucleation and growth. Their performance surpasses the commercial reference in NanoHPLC-MS/MS analysis of cancer cell lysates for phosphopeptide enrichment and detection.

Silver nanoparticles-decorated and mesoporous silica coated single-walled carbon nanotubes with an enhanced antibacterial activity for killing drug-resistant bacteria

Yu Zhu, Jia Xu, Yanmao Wang, Cang Chen, Hongchen Gu, Yimin Chai*, and Yao Wang*

Shanghai Jiao Tong University, China

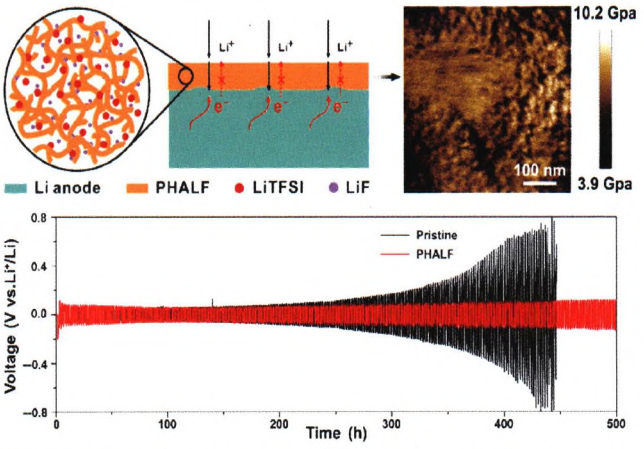


The nanoplatform of silver nanoparticles-decorated and mesoporous silica coated single-walled carbon nanotubes (SWCNTs@mSiO$_2$-TSD@Ag) exhibits much enhanced antibacterial properties against multi-drug-resistant Gram-negative bacteria of *Escherichia coli* (*E. coli*) and Gram-positive bacteria of *Staphylococcus aureus* (*S. aureus*) *in vitro*, and remarkably improved abilities of bacterial clearance and wound healing promoting *in vivo*.

In situ fluorinated solid electrolyte interphase towards long-life lithium metal anodes

Shan-Min Xu[1,2], Hui Duan[2,3], Ji-Lei Shi[2,3], Tong-Tong Zuo[2,3], Xin-Cheng Hu[2,3], Shuang-Yan Lang[2,3], Min Yan[2], Jia-Yan Liang[2,3], Yu-Guo Yang[1], Qing-Hua Kong[1,*], Xing Zhang[2,3,*], and Yu-Guo Guo[2,3,*]

[1] Beijing Jiaotong University, China
[2] Institute of Chemistry, Chinese Academy of Sciences, China
[3] University of Chinese Academy of Sciences, China

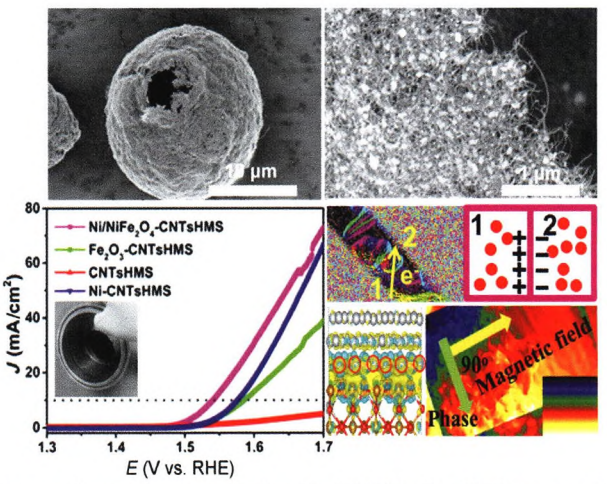


PHALF solid electrolyte interface (SEI) composed of flexible polymer substrate and inorganic LiF is constructed by one-step *in situ* photopolymerization serving as an artificial SEI, which is stiffness-enough to suppress dendrites growth and stable to protect lithium metal anodes from side reactions in high operating voltage systems.

Hierarchical coupling effect in hollow Ni/$NiFe_2O_4$-CNTs microsphere via spray-drying for enhanced oxygen evolution electrocatalysis

Xuefeng Yu[1], Guanyu Chen[1], Yizhe Wang[2], Jiwei Liu[3], Ke Pei[1], Yunhao Zhao[1], Wenbin You[1], Lei Wang[1], Jie Zhang[1], Linshen Xing[1], Jingjun Ding[1], Guangzhou Ding[1], Min Wang[1,*], and Renchao Che[1,*]

[1] Fudan University, China
[2] Shanghai University, China
[3] Hangzhou Dianzi University, China

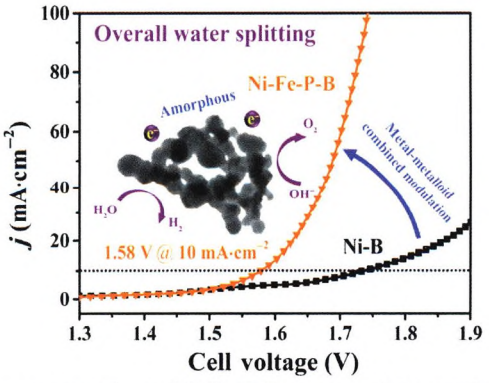


The novel nanostructure design for Ni/$NiFe_2O_4$-CNTs composite microsphere (< 14 μm) forcibly-assembled by zero-dimensional nanoparticles units (< 16 nm) and one-dimensional self-supporting CNTs has endowed the composite with enriched polarized hetero-junction interface and hierarchal conductive network, which thus have facilitated greatly catalytic activity and conductivity, ultimately improving the oxygen evolution reaction (OER) performance.

Boosting electrocatalytic water splitting via metal-metalloid combined modulation in quaternary Ni-Fe-P-B amorphous compound

Wukui Tang, Xiaofang Liu*, Ya Li, Yanhui Pu, Yao Lu, Zhiming Song, Qiang Wang, Ronghai Yu*, and Jianglan Shui*

Beihang University, China

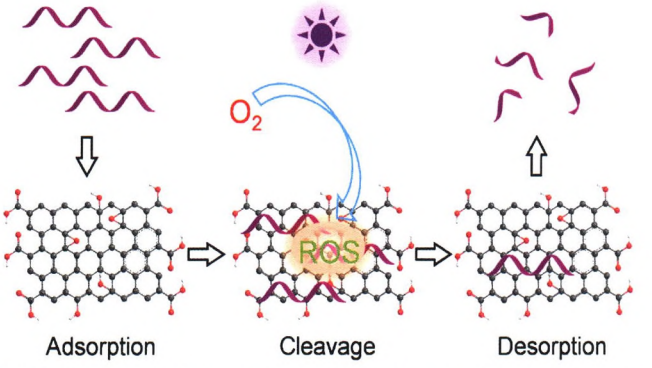


Quaternary amorphous Ni-Fe-P-B nanoparticle catalyst was synthesized by a facile, green and scalable wet-chemical reduction method. The metal-metalloid combined modulation endows Ni-Fe-P-B enhanced bifunctional activities towards both hydrogen evolution reaction (HER) and oxygen evolution reaction (OER), giving rise to considerably improved water splitting performance in comparison with binary Ni-B.

Graphene oxide as a photocatalytic nuclease mimicking nanozyme for DNA cleavage

Jinyi Zhang[1], Shihong Wu[2], Lingzi Ma[1], Peng Wu[2,*], and Juewen Liu[1,*]

[1] Waterloo Institute for Nanotechnology, Canada
[2] Sichuan University, China

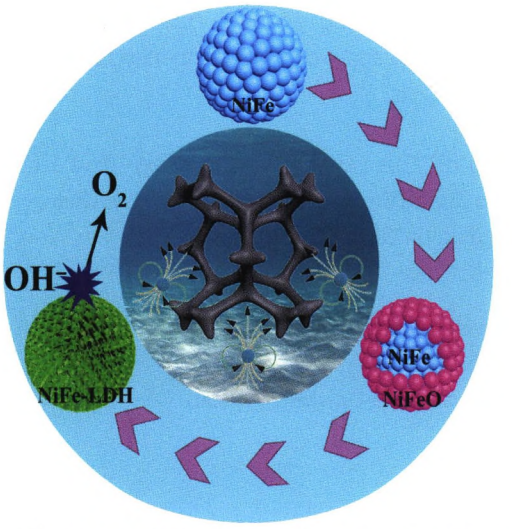


DNA oligonucleotides are first adsorbed on graphene oxide and then cleaved by the light induced reactive oxygen species followed by the desorption of short product fragments to complete a nanozyme catalytic cycle.

Self-magnetic-attracted $Ni_xFe_{(1-x)}$@$Ni_xFe_{(1-x)}O$ nanoparticles on nickel foam as highly active and stable electrocatalysts towards alkaline oxygen evolution reaction

Zuobo Yang and Xin Liang*

Beijing University of Chemical Technology, China

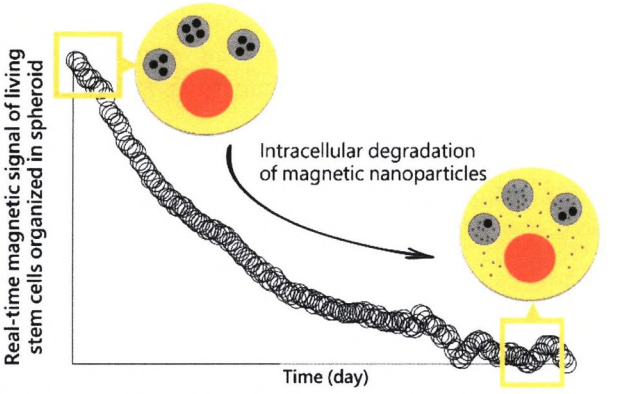


A facile self-magnetic-attracted approach was developed to construct $Nif_xFe_{(1-x)}$@$Ni_xFe_{(1-x)}O$/NF with excellent performance towards alkaline oxygen evolution reaction.

Real-time *in situ* magnetic measurement of the intracellular biodegradation of iron oxide nanoparticles in a stem cell-spheroid tissue model

Aurore Van de Walle[1,*], Alexandre Fromain[1], Anouchka Plan Sangnier[1,2], Alberto Curcio[1], Luc Lenglet[3], Laurence Motte[2,*], Yoann Lalatonne[2,4,*], and Claire Wilhelm[1,*]

[1] CNRS & University of Paris, France
[2] Laboratory for Vascular Translational Science, France
[3] Normafin Sàrl, France
[4] Hôital Avicenne Assistance Publique-Hôitaux de Paris, France

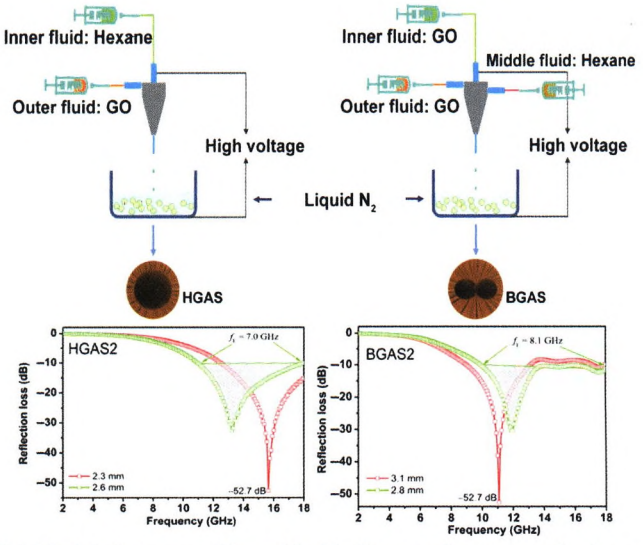


The internalization and progressive degradation of magnetic nanoparticles within stem cells is assessed at the single spheroid level, in real-time, in the biological environment, on alive samples, using a benchtop-size magnetic sensor, without impacting cell functionality.

Multiaxial electrospun generation of hollow graphene aerogel spheres for broadband high-performance microwave absorption

Tian Li[1], Dandan Zhi[1], Yao Chen[1], Bing Li[2], Zuowan Zhou[1], and Fanbin Meng[1,*]

[1] Southwest Jiaotong University, China
[2] Shandong Qiangjunwei Intelligent Equipment Co. LTD., China

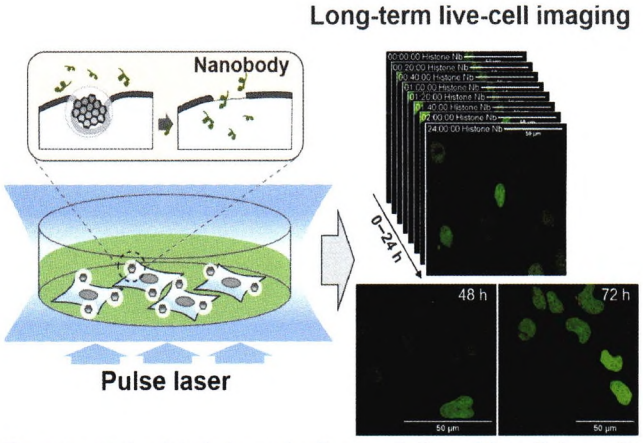


Multiaxial electrospun hierarchical hollow graphene aerogel spheres exhibit high-performance microwave absorption.

Long-term live-cell microscopy with labeled nanobodies delivered by laser-induced photoporation

Jing Liu[1], Tim Hebbrecht[1], Toon Brans[1], Eef Parthoens[1,2], Saskia Lippens[1,2], Chengnan Li[3], Herlinde De Keersmaecker[1], Winnok H. De Vos[4], Stefaan C. De Smedt[1], Rabah Boukherroub[3], Jan Gettemans[1], Ranhua Xiong[1], and Kevin Braeckmans[1,*]

[1] Ghent University, Belgium
[2] VIB, Belgium
[3] Univ. Lille, France
[4] University of Antwerp, Belgium

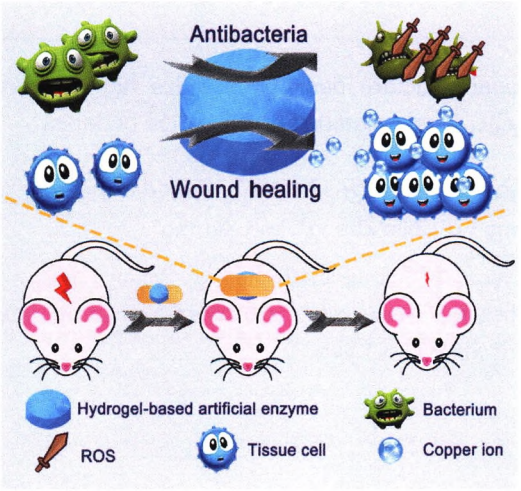


Fluorescent dye labeled nanobodies are delivered into living cells by nanoparticle-assisted laser-induced photoporation for specific subcellular labeling. Long-term live-cell fluorescence microscopy imaging is performed up to 72 h.

Hydrogel-based artificial enzyme for combating bacteria and accelerating wound healing

Hao Qiu[1,2], Fang Pu[1,*], Zhengwei Liu[1,3], Xuemeng Liu[1,2], Kai Dong[1], Chaoqun Liu[1], Jinsong Ren[1,2,*], and Xiaogang Qu[1,2,*]

[1] Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China
[2] University of Science and Technology of China, China
[3] University of Chinese Academy of Sciences, China

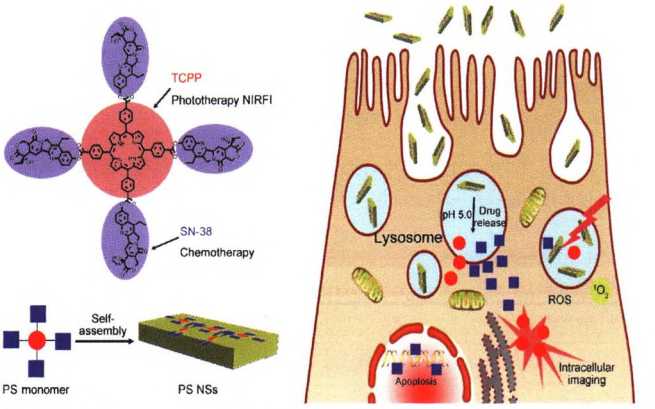


The hydrogel-based artificial enzyme can effectively combat bacteria and improve wound healing by stimulating angiogenesis and collagen deposition.

Excipient-free porphyrin/SN-38 based nanotheranostics for drug delivery and cell imaging

Ye Yuan[1,2], Ruonan Bo[2,3], Di Jing[2,4], Zhao Ma[2], Zhongling Wang[2,5], Tzu-yin Lin[2], Lijie Dong[1], Xiangdong Xue[2,6,*], and Yuanpei Li[2,*]

[1] Wuhan University of Technology, China
[2] University of California Davis, USA
[3] Yangzhou University, China
[4] Central South University, China
[5] Shanghai Jiao Tong University School of Medicine, China
[6] Northwest University, China

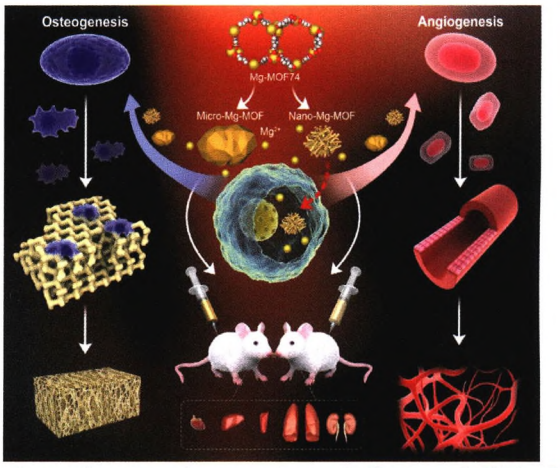


Excipient-free porphyrin/7-ethyl-10-hydroxy-camptothecin (SN-38) based nanotheranostic was self-assembled by a porphyrin–SN-38 conjugate, which could fluorescently indicate the drug release and cell uptake in a spatiotemporal manner with synergetic effect.

Micro or nano: Evaluation of biosafety and biopotency of magnesium metal organic framework-74 with different particle sizes

Zhou Zhu, Shaokang Jiang, Yanhua Liu, Xiaomeng Gao, Shanshan Hu, Xin Zhang, Chao Huang, Qianbing Wan, Jian Wang*, and Xibo Pei*

Sichuan University, China

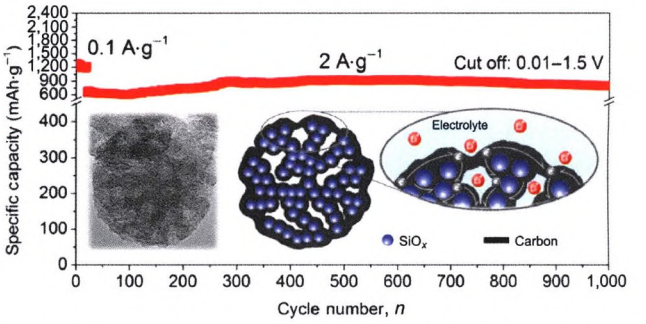


The microscale magnesium metal organic framework-74 (m-Mg-MOF74) and its nano-modified particles (n-Mg-MOF74) were successfully synthesized. The n-Mg-MOF74 exhibited better biocompatibility and could act simultaneously inside and outside the cell while m-Mg-MOF74 only stayed extracellularly. Further, *in vitro* and *in vivo* angiogenic and osteogenic studies of m/n-Mg-MOF74 were evaluated and provided evidence that n-Mg-MOF74 was worthy of applications in tissue engineering.

Rational structure design to realize high-performance SiO_x@C anode material for lithium ion batteries

Zhaolin Li[1], Hailei Zhao[1,2,*], Jie Wang[1,2], Tianhou Zhang[1], Boyang Fu[1], Zijia Zhang[1], and Xin Tao[1]

[1] University of Science and Technology Beijing, China
[2] Beijing Key Municipal Laboratory of New Energy Materials and Technologies, China



A well-engineered porous nanostructure is designed to realize the wet-chemistry preparation of a high-performance SiO_x@C nanocomposite.

Catalytically active interfaces in titania nanorod-supported copper catalysts for CO oxidation

Wasim U. Khan[1], Season S. Chen[2], Daniel C. W. Tsang[2], Wey Yang Teoh[3], Xijun Hu[4], Frank L. Y. Lam[4,*], and Alex C. K. Yip[1,*]

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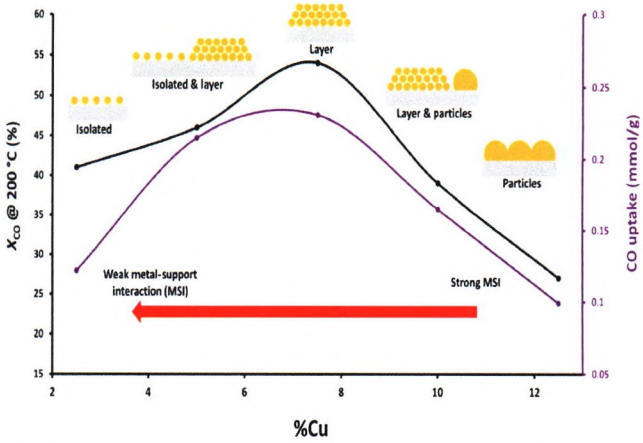
[2] The Hong Kong Polytechnic University, Hong Kong, China
[3] The University of New South Wales, Australia
[4] The Hong Kong University of Science and Technology, Hong Kong, China

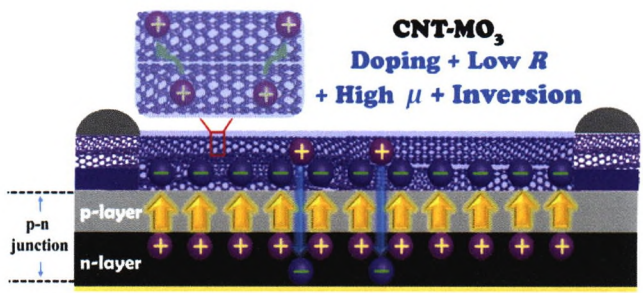


The interfaces between copper nanoparticles and one-dimensional titanium dioxide nanorods (TNRs) support can be tailored with different interfacial site activities for CO oxidation through changing the metal loading and the degree of reduction. The interfacial site activity is highly dependent on the morphology of the titanium dioxide support.

Improving CNT-Si solar cells by metal chloride-to-oxide transformation

Huaisheng Wu[1], Xuewei Zhao[1], Yizeng Wu[1], Qinghuan Ji[1], Linxiu Dai[1], Yuanyuan Shang[2], and Anyuan Cao[1,*]

[1] Peking University, China
[2] Zhengzhou University, China

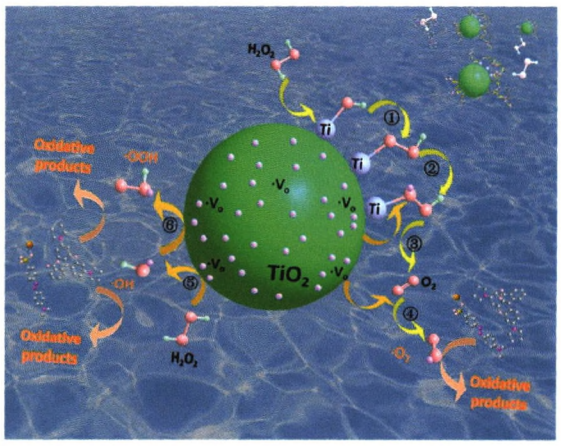


Taking advantage of transformation from transition metal chloride to oxide, the carbon nanotube (CNT)-Si solar cells have been significantly improved by p-doping effect combined with enhanced carrier mobility and inversion layer formation within Si, and achieved 16% cell efficiency based on metal chloride/oxide optimization.

Synergetic catalysis enhancement between H_2O_2 and TiO_2 with single-electron-trapped oxygen vacancy

Zhijiao Wu[1], Kai Guo[1,2], Shuang Cao[1,*], Wenqing Yao[3,*], and Lingyu Piao[1,2,*]

[1] National Center for Nanoscience and Technology, China
[2] University of Chinese Academy of Sciences, China
[3] Tsinghua University, China

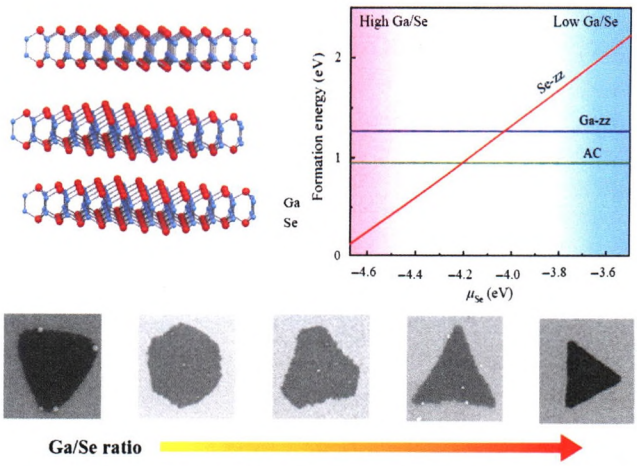


TiO_2 nanoparticles (NPs) with single electron-trapped oxygen vacancy (SETOV, V_O·) combined with H_2O_2 exhibiting excellent oxidative performance for tetracycline, RhB, and MO even without light irradiation. Systematically mechanism investigation confirms that H_2O_2 can be activated by SETOVs derived from the TiO_2 NPs through direct contribution of electrons, producing both $\cdot O_2^-$/·OOH and ·OH, which are responsible for the excellent reactivity of TiO_2-H_2O_2 system.

Effective shape-controlled synthesis of gallium selenide nanosheets by vapor phase deposition

Lilan Tan[1], Qingbo Liu[1], Yufeng Ding[1], Xiaogang Lin[2], Wei Hu[2,*], Meng-Qiu Cai[1,3], and Hong Zhou[1,*]

[1] Hunan University, China
[2] Chongqing University, China
[3] Hunan Normal University, China

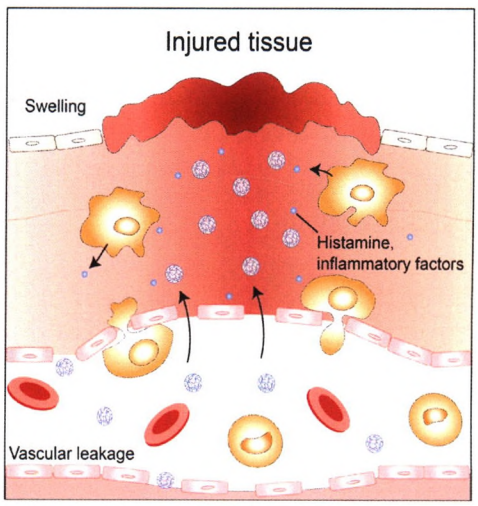


The use of gallium in precursor is demonstrated to control the shape evolution of monolayer GaSe crystals with variation from curved triangular, hexagonal to regular triangular geometries. Shape evolution behavior of GaSe flakes can be elucidate by the change of Ga/Se ratio in the precursors influence on the kinetic growth dynamics of edges.

The enhanced permeability and retention effect based nanomedicine at the site of injury

Yingjun Liu[1], Dongdong Sun[2], Qin Fan[1], Qingle Ma[1], Ziliang Dong[1], Weiwei Tao[2], Huiquan Tao[1], Zhuang Liu[1], and Chao Wang[1,*]

[1] Soochow University, China
[2] Nanjing University of Chinese Medicine, China

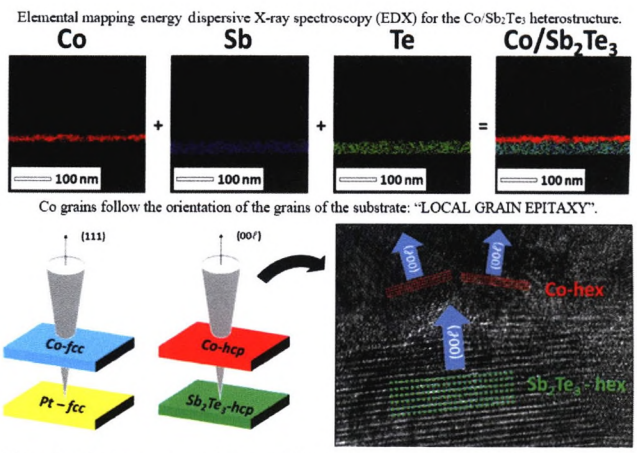


The released histamine can cause the small blood vessels to become dilated and leaky, resulting in the increase in vascular permeability and allowing more fluid, macromolecules, immune cells as well as nanoparticles to reach the injured tissue by passing out of the small blood vessels.

ALD growth of ultra-thin Co layers on the topological insulator Sb_2Te_3

Emanuele Longo[1,2], Roberto Mantovan[1,*], Raimondo Cecchini[1], Michael D. Overbeek[3], Massimo Longo[1], Giovanna Trevisi[4], Laura Lazzarini[4], Graziella Tallarida[1], Marco Fanciulli[2], Charles H. Winter[3], and Claudia Wiemer[1,*]

[1] CNR-IMM, Italy
[2] Università degli Studi di Milano-Bicocca, Italy
[3] Wayne State University, USA
[4] CNR-IMEM, Italy

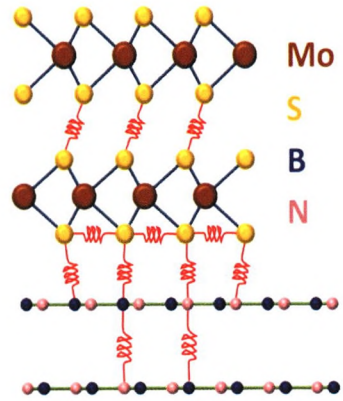


The atomic layer deposition of Co on top of Sb_2Te_3 and Pt substrates evidences the substrate selectivity of such a deposition process, also achieving a local epitaxy and an extremely high conformality of the Co thin films.

Probing temperature-dependent interlayer coupling in a MoS_2/h-BN heterostructure

Hamin Park, Gwang Hyuk Shin, Khang June Lee, and Sung-Yool Choi*

KAIST, Republic of Korea

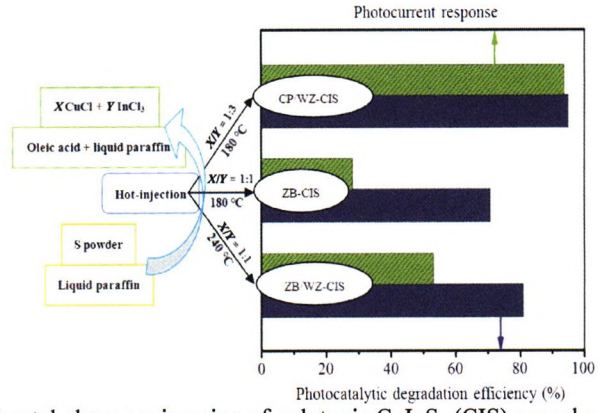


We investigated the interlayer coupling of the van der Waals (vdW) heterostructure of MoS_2 and hexagonal boron nitride (h-BN) over a wide range of temperatures using Raman scattering and photoluminescence.

Engineering crystal phase of polytypic $CuInS_2$ nanosheets for enhanced photocatalytic and photoelectrochemical performance

He Li[1], Wenjiang Li[1,*], Wei Li[1], Minfang Chen[1], Rony Snyders[2,3], Carla Bittencourt[2], and Zhihao Yuan[1,*]

[1] Tianjin University of Technology, China
[2] University of Mons (UMONS), Belgium
[3] Materia Nova Research Centre, Belgium

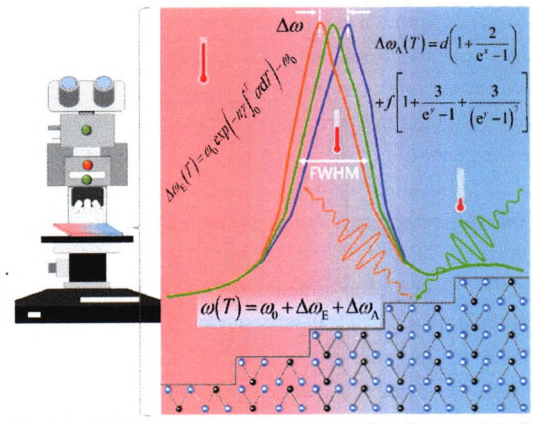


Crystal phase engineering of polytypic $CuInS_2$ (CIS) nanosheets (chalcopyrite/wurtzite and zincblende/wurtzite) was the first time achieved using oleic acid and liquid paraffin as the low-cost and environmental-friendly hot-injection system. The essential relationship between the polytypic structure and the photocatalytic/ssphotoelectrochemical properties was lighted.

Temperature-dependent Raman spectroscopy studies of 1–5-layer WSe_2

Zhonglin Li[1], Yingying Wang[1,*], Jie Jiang[1], Yao Liang[2], Bo Zhong[1], Hong Zhang[1], Kai Yu[1], Guangfeng Kan[1], and Mingqiang Zou[3,*]

[1] Harbin Institute of Technology at Weihai, China
[2] Dalian Jiaotong University, China
[3] Chinese Academy of Inspection and Quarantine (CAIQ), China



The anharmonic behaviors of phonons in WSe_2 flakes with different thicknesses are obtained from temperature-dependent Raman spectroscopy studies.

Erratum to: Carbon nanostructure morphology templates nanocomposites for phosphoproteomics (https://doi.org/10.1007/s12274-020-2620-4)

Erratum to: Novel fibronectin-targeted nanodisk drug delivery system displayed superior efficacy against prostate cancer compared with nanospheres (https://doi.org/10.1007/s12274-019-2488-3)

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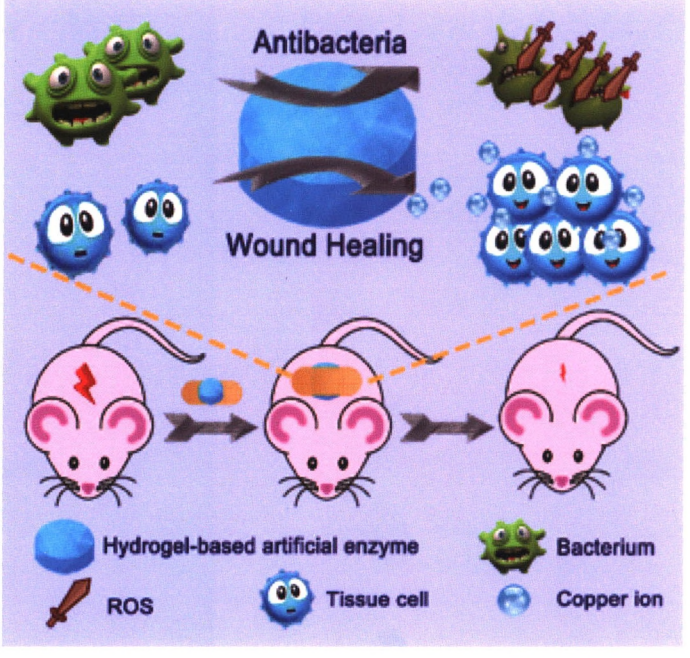

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