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Mild metal-organic-gel route for synthesis of stable sub-5-nm metal-organic framework nanocrystals

Amorphous nickel-iron oxides/carbon nanohybrids for an efficient and durable oxygen evolution reaction

Confined reaction inside nanotubes: New approach to mesoporous g-C₃N₄ photocatalysts



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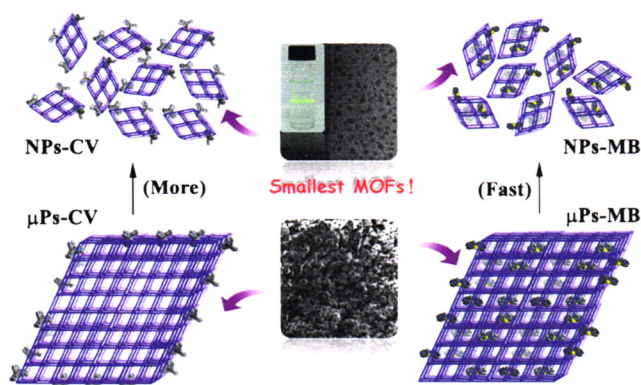
Contents

Research Articles

Mild metal-organic-gel route for synthesis of stable sub-5-nm metal-organic framework nanocrystals

Yue Qi, Chun-Ting He, Juntao Lin, Shuping Lin, Jin Liu, Jinghong Huang, Wei Xue, Guicheng Yu, Hsiu-Yi Chao, Yexiang Tong, and Zhengping Qiao*

Sun Yat-Sen University, China



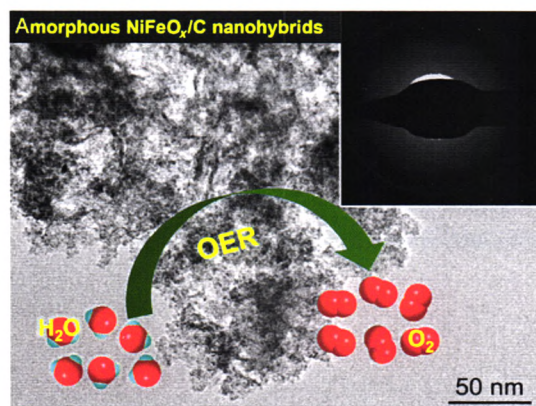
By using a mild metal-organic-gel method, sub-5 nm HKUST-1 was synthesized for the first time and employed to investigate the size-dependent adsorption thermodynamics and kinetics of dyes.

3621–3628

Amorphous nickel-iron oxides/carbon nanohybrids for an efficient and durable oxygen evolution reaction

Bo Li, Shuangming Chen, Jie Tian, Ming Gong, Hangxun Xu*, and Li Song*

University of Science and Technology of China, China



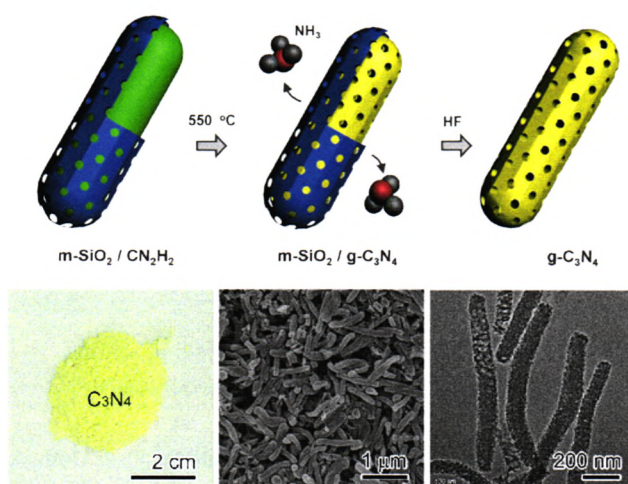
We demonstrate a novel sonochemical method for synthesizing amorphous NiFeO_x/C nanohybrids as highly active and durable electrocatalysts toward the oxygen evolution reaction. The amorphous NiFeO_x/C nanohybrids with optimal composition exhibit a low overpotential of 290 mV at $10 \text{ mA}\cdot\text{cm}^{-2}$ and a Tafel slope of $31 \text{ mV}\cdot\text{decade}^{-1}$ in a 0.1 M KOH electrolyte, outperforming the benchmark RuO_2 catalyst. The origins of the excellent electrocatalytic performance of the amorphous mixed oxide catalysts were investigated using advanced X-ray spectroscopic methods.

3629–3637

Confined reaction inside nanotubes: New approach to mesoporous g-C₃N₄ photocatalysts

Xueteng Liu, Fei Pang, Mingyuan He, and Jianping Ge*

East China Normal University, China



Mesoporous g-C₃N₄ nanorod photocatalysts are synthesized through the nano-confined thermal condensation of cyanamide in silica nanotubes with porous shells. The proposed method for the synthesis of mesoporous materials is an alternative to the traditional templating method.

3638–3647

The study of the interactions between graphene and Ge(001)/Si(001)

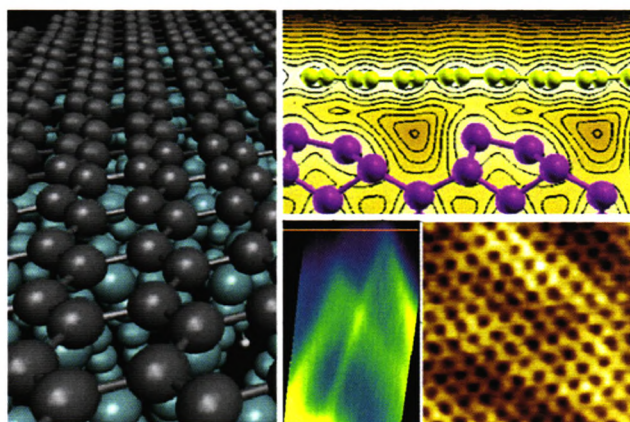
Pawel Dabrowski^{1,*}, Maciej Rogala¹, Iwona Pasternak², Jacek Baranowski², Włodzimierz Strupinski², Marek Kopciuszynski⁴, Ryszard Zdyb⁴, Mieczysław Jalochocki⁴, Iaroslav Lutsyk^{1,3}, and Zbigniew Klusek¹

¹ University of Lodz, Poland

² Institute of Electronic Materials Technology, Poland

³ Yuriy Fedkovych Chernivtsi National University, Ukraine

⁴ Maria Curie-Skłodowska University, Poland



The electronic and morphological properties of graphene grown on Ge(001)/Si(001) were examined both at the nano- and macroscale level. The present approach allowed the description of the influence of the germanium substrate on the energy bands of graphene and the electronic properties of the graphene layer.

3648–3661

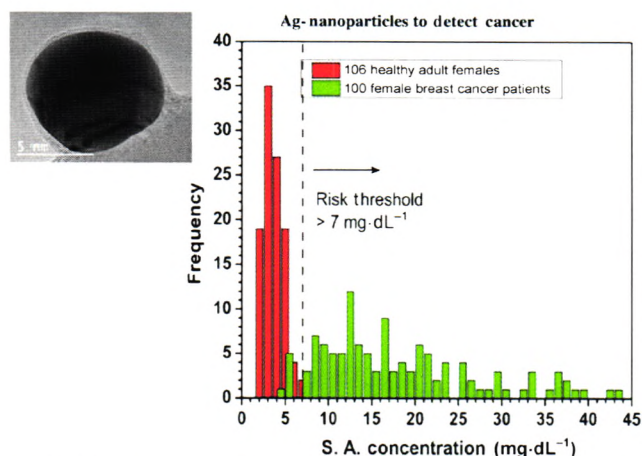
Diagnosis of breast cancer by analysis of sialic acid concentrations in human saliva by surface-enhanced Raman spectroscopy of silver nanoparticles

Aida Hernández-Arteaga¹, José de Jesús Zermeño Nava², Eleazar Samuel Kolosovas-Machuca¹, J. Jesús Velázquez-Salazar³, Ekaterina Vinogradova³, Miguel José-Yacamán^{1,3}, and Hugo Ricardo Navarro-Contreras^{1,*}

¹ Universidad Autónoma de San Luis Potosí, México

² Zona Universitaria, México

³ University of Texas at San Antonio, USA



Sialic acid (SA) levels in saliva are different between healthy women (red) and patients with breast cancer (green). In this work, the SA concentrations in saliva were determined by surface-enhanced Raman spectroscopy of citrate-covered silver nanoparticles; figure on the left: a noninvasive test, regardless of age or density of breast tissue.

3662–3670

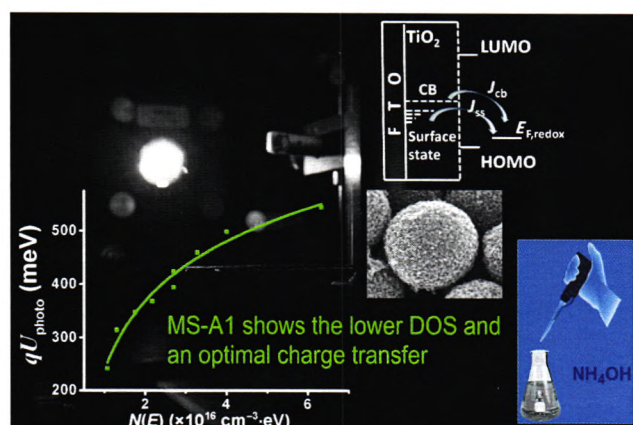
Surface states in TiO₂ submicrosphere films and their effect on electron transport

Jiawei Zheng^{1,2}, Li'e Mo¹, Wangchao Chen¹, Ling Jiang¹, Yong Ding^{1,3}, Zhaoqian Li¹, Linhua Hu^{1,*}, and Songyuan Dai^{1,3,*}

¹ Hefei Institutes of Physical Science, Chinese Academy of Sciences, China

² University of Science and Technology of China, China

³ North China Electric Power University, China



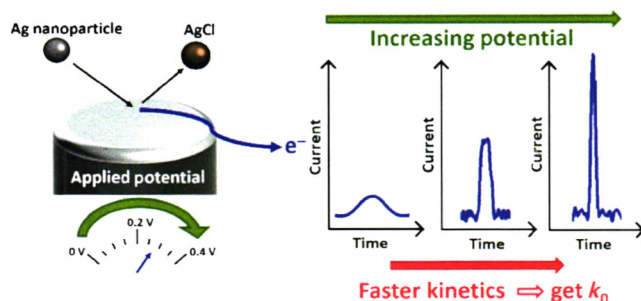
The surface state energy distribution and electron transfer kinetics of four TiO₂ submicrospheres with different crystallinity were investigated. The discussion not only provides new insight on the surface states of TiO₂ submicrospheres, but also exploits the influence of the locations of surface states and the band-edge shift on electron transfer and recombination.

3671–3679

Time-resolved impact electrochemistry for quantitative measurement of single-nanoparticle reaction kinetics

En Ning Saw, Markus Kratz, and Kristina Tschulik*

Ruhr-University Bochum, Germany



Time-resolved nanoelectrochemistry is demonstrated as a new tool to determine the reaction kinetics and reaction mechanism at a single nanoparticle.

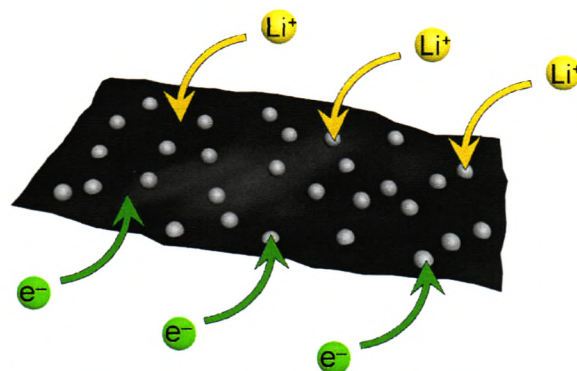
3680–3689

Reduced graphene oxide decorated with $\text{Bi}_2\text{O}_{2.33}$ nanodots for superior lithium storage

Haichen Liang¹, Xiyan Liu², Dongliang Gao², Jiangfeng Ni^{1,*}, and Yan Li^{2,*}

¹ Soochow University, China

² Peking University, China



Reduced graphene oxide decorated with $\text{Bi}_2\text{O}_{2.33}$ nanodots exhibits stable and robust Li storage.

3690–3697

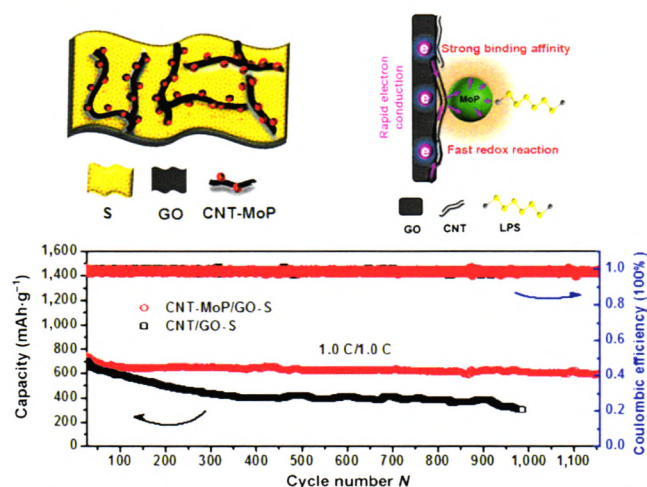
High-performance Li-S battery cathode with catalyst-like carbon nanotube-MoP promoting polysulfide redox

Yingying Mi^{1,2}, Wen Liu^{1,*}, Xiaolin Li^{1,3}, Julia Zhuang¹, Henghui Zhou², and Hailiang Wang^{1,*}

¹ Yale University, USA

² Peking University, China

³ Chongqing University, China



Catalyst-like carbon nanotube-MoP can effectively promote lithium polysulfide redox and thus enhance the electrochemical performance of Li-S batteries.

3698–3705

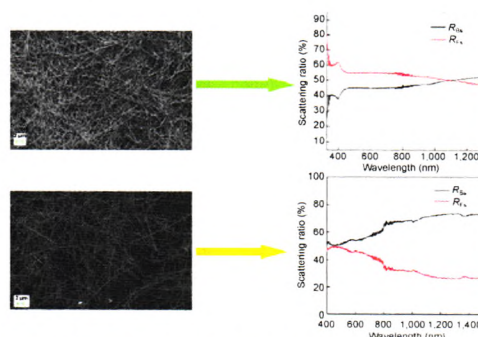
Optical properties of conductive silver-nanowire films with different nanowire lengths

Xiaoming Yu¹, Xuan Yu^{1,*}, Jianjun Zhang², Liqiao Chen¹, Yunqian Long¹, and Dekun Zhang²

¹ Zhejiang Ocean University, China

² Nankai University, China

3706–3714



Optical forward scattering and backscattering and the scattering ratio of the long-nanowires (L-NWs) and short-nanowires (S-NWs) were investigated. The scattering ratio was highly dependent on the mesh size and the nanowire length. S-NWs exhibited a nearly uniform scattering ratio for forward scattering and backscattering, and the L-NWs exhibited continually increasing backscattering. We also formulated a reflection-haze equation for evaluation of performance of the Ag NWs in optoelectronic devices.

Redox switch of ionic transport in conductive polypyrrole-engineered unipolar nanofluidic diodes

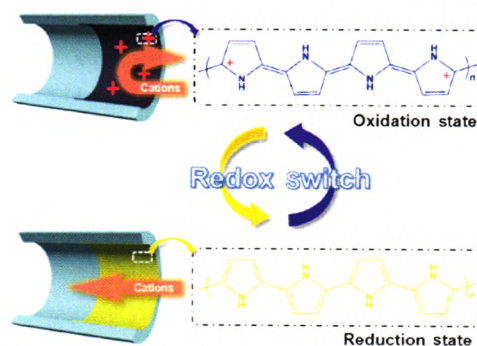
Qianqian Zhang¹, Zhen Zhang², Hangjian Zhou¹, Zhiqiang Xie¹, Liping Wen³, Zhaoyue Liu^{1,*}, Jin Zhai^{1,*}, and Xungang Diao¹

¹ Beihang University, China

² Institute of Chemistry, Chinese Academy of Sciences, China

³ Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China

3715–3725



Redox-active polypyrrole (PPy) polymers are introduced into an anodic aluminum oxide nanochannels to construct unipolar nanofluidic diodes exhibiting redox-switchable ionic transport behaviors. Based on the asymmetric component and the remarkable charge variation of PPy between oxidation and reduction state, the ion rectification and ion gating levels could be switched reversibly and dynamically.

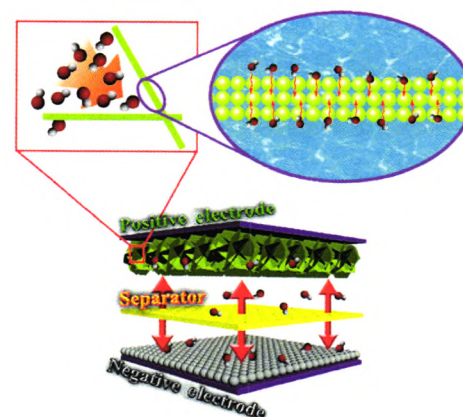
Construction of hierarchical three-dimensional interspersed flower-like nickel hydroxide for asymmetric supercapacitors

Wutao Wei¹, Weihua Chen^{2,*}, Luoyi Ding¹, Shizhong Cui¹, and Liwei Mi^{1,*}

¹ Zhongyuan University of Technology, China

² Zhengzhou University, China

3726–3742



Three-dimensional interspersed flower-like nickel hydroxide was prepared via the exfoliation of cetyl trimethylammonium bromide (CTAB), together with the addition of carbon nanotubes (CNTs), which endowed N-4-CNT//active carbon (AC) supercapacitor devices with a high specific capacitance and excellent cycle stability.

Microstructuring of carbon/tin quantum dots via a novel photolithography and pyrolysis-reduction process

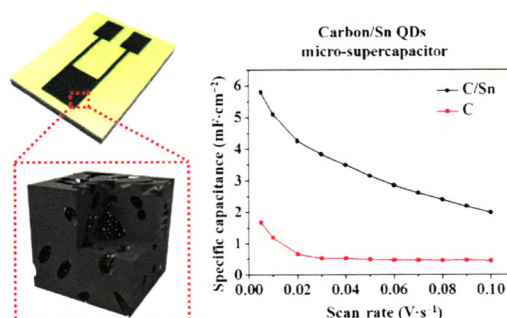
Xufeng Hong¹, Liang He^{1,2,*}, Xinyu Ma¹, Wei Yang¹, Yiming Chen¹, Lei Zhang¹, Haowu Yan¹, Zhaohuai Li¹, and Liqiang Mai^{1,3,*}

¹ Wuhan University of Technology, China

² Rice University, USA

³ University of California, Berkeley, USA

3743–3753



A novel microfabrication process based on optimized photolithography combined with pyrolysis-reduction is proposed to fabricate interdigital porous carbon/tin quantum dots (C/Sn QDs) microelectrodes with uniform dispersion of Sn QDs (diameter of ~ 3 nm) in the carbon matrix. The as-fabricated C/Sn QDs micro-supercapacitor exhibits a high areal specific capacitance (5.79 mF·cm⁻²) and desirable cycling stability (93.3% capacitance retention after 5,000 cyclic voltammetry cycles).

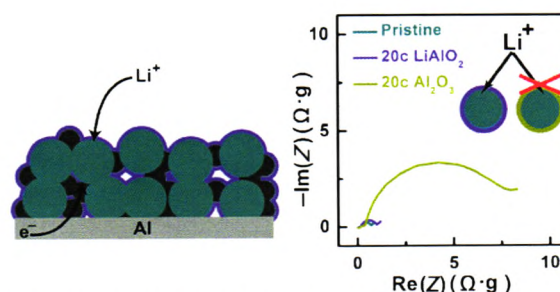
Engineering the surface of LiCoO₂ electrodes using atomic layer deposition for stable high-voltage lithium ion batteries

Jin Xie¹, Jie Zhao¹, Yayuan Liu¹, Haotian Wang¹, Chong Liu¹, Tong Wu¹, Po-Chun Hsu¹, Dingchang Lin¹, Yang Jin¹, and Yi Cui^{1,2,*}

¹ Stanford University, USA

² SLAC National Accelerator Laboratory, USA

3754–3764



Chemically inert and ionically conductive LiAlO₂ interfacial layers were deposited on LiCoO₂ electrodes via atomic layer deposition. During prolonged cycling at high-voltage, the LiAlO₂ coating not only prevented interfacial reactions between LiCoO₂ electrode and electrolyte, as confirmed by electrochemical impedance spectroscopy and Raman characterizations, but also allowed lithium ions to freely diffuse into LiCoO₂ without sacrificing the power density.

Efficient and 1,8-diiodooctane-free ternary organic solar cells fabricated via nanoscale morphology tuning using small-molecule dye additive

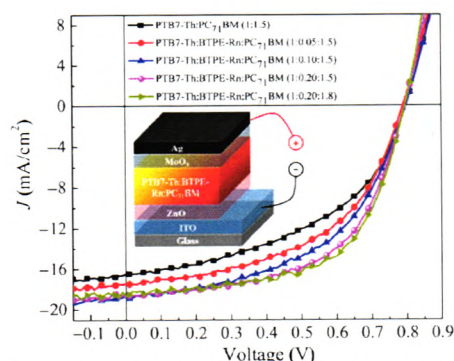
Shuhua Zhang¹, Muhammad Naeem Shah¹, Feng Liu^{2,*}, Zhongqiang Zhang¹, Qin Hu³, Thomas P. Russell³, Minmin Shi¹, Chang-Zhi Li^{1,*}, and Hongzheng Chen^{1,*}

¹ Zhejiang University, China

² Shanghai Jiao Tong University, China

³ Lawrence Berkeley National Laboratory, USA

3765–3774



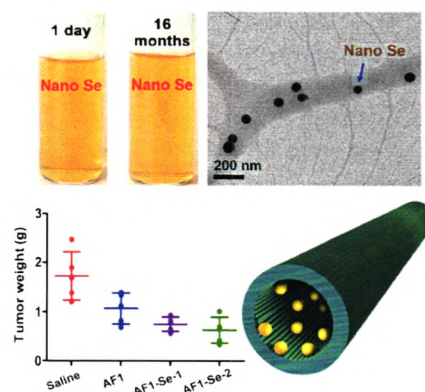
Incorporation of a small-molecule dye into poly[4,8-bis(5-(2-ethylhexyl)thiophen-2-yl)benzo[1,2-b:4,5-b']dithiophene-co-3-fluorothieno[3,4-b]thiophene-2-carboxylate] (PTB7-Th):[6,6]-phenyl C₇₁ butyric acid methyl ester (PC₇₁BM) blends leads to more efficient and stable organic solar cells. Energy transfer between components and electron-mobility improvement of the optimized nanoscale morphology are simultaneously achieved via the dye incorporation, leading to a stable 1,8-diiodooctane-free ternary device with 8.87% efficiency.

Construction of highly stable selenium nanoparticles embedded in hollow nanofibers of polysaccharide and their antitumor activities

Zhaohua Ping, Ting Liu, Hui Xu, Yan Meng, Wenhua Li, Xiaojuan Xu*, and Lina Zhang*

Wuhan University, China

3775–3789



Highly stable selenium nanoparticles (SeNPs) embedded in hollow nanofibers of polysaccharide exhibit excellent anticancer activities and biocompatibilities.

Generic synthesis and versatile applications of molecularly organic–inorganic hybrid mesoporous organosilica nanoparticles with asymmetric Janus topologies and structures

Guiju Tao^{1,2}, Zhengyuan Bai¹, Yu Chen^{1,*}, Heliang Yao¹, Meiyong Wu^{1,†}, Ping Huang¹, Luodan Yu¹, Jiamin Zhang³, Chen Dai⁴, and Long Zhang^{1,*}

¹ Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

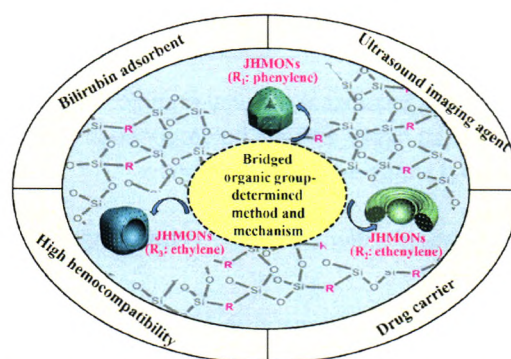
² Sinopec Shanghai Research Institute of Petrochemical Technology, China

³ Shanghai Institute of Blood Transfusion, China

⁴ the East Hospital Affiliated to Tongji University, China

[†] Present address: Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

3790–3810



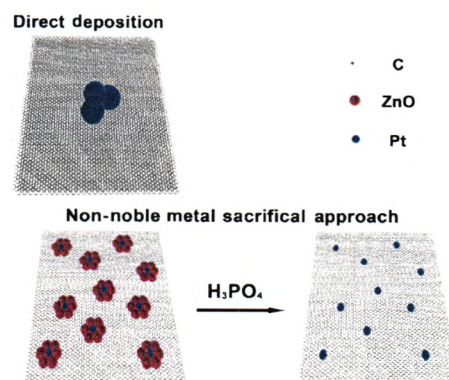
A general bridged organic group-determined growth strategy was developed for the synthesis of molecularly organic–inorganic hybrid mesoporous organosilica nanoparticles (MONs) with multifarious Janus morphologies, and their formation mechanism was discussed. The hybrid framework, porous structure, hollow cavity, adaptive particle size, and Janus morphology endow these MONs with excellent pH-responsive drug release properties, high bilirubin-adsorption capacities, enhanced ultrasonography characteristics, and high hemocompatibilities.

Monodispersed Pt nanoparticles on reduced graphene oxide by a non-noble metal sacrificial approach for hydrolytic dehydrogenation of ammonia borane

Yao Chen, Xinchun Yang, Mitsunori Kitta, and Qiang Xu*

National Institute of Advanced Industrial Science and Technology (AIST), Japan

3811–3816



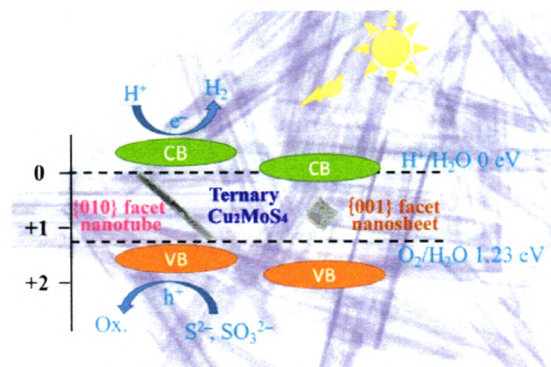
Monodispersed Pt nanoparticles on reduced graphene oxide (RGO) were prepared by a non-noble metal sacrificial approach for the hydrolytic dehydrogenation of ammonia borane; these monodispersed particles showed a turnover frequency value 2.6 times that of Pt/RGO prepared by direct deposition.

Active {010} facet-exposed Cu_2MoS_4 nanotube as high-efficiency photocatalyst

Ke Zhang¹, Yunxiang Lin¹, Zahir Muhammad¹, Chuanqiang Wu¹, Shuang Yang¹, Qun He¹, Xusheng Zheng¹, Shuangming Chen^{1,*}, Binghui Ge^{2,*}, and Li Song^{1,*}

¹ University of Science and Technology of China, China

² Institute of Physics, Chinese Academy of Sciences, China



We demonstrate a novel facile hydrothermal method to successfully synthesize a {010} facet-exposed Cu_2MoS_4 nanotube, which shows greatly enhanced performance for both photodegradation and water splitting compared with {001} facet-exposed nanosheets. Theoretical calculations and experiments based on synchrotron radiation were performed to explain the high efficiency of Cu_2MoS_4 nanotubes.

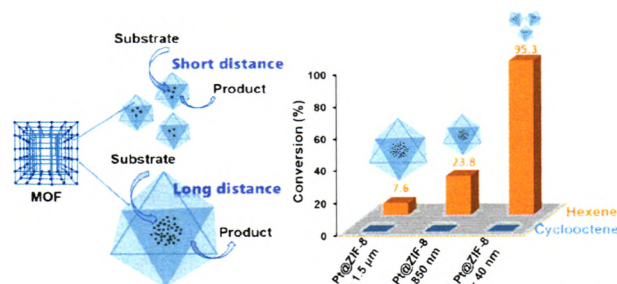
3817–3825

Nanoparticles@nanoscale metal-organic framework composites as highly efficient heterogeneous catalysts for size- and shape-selective reactions

Bingqing Wang¹, Wenxian Liu¹, Weina Zhang², and Junfeng Liu^{1,*}

¹ Beijing University of Chemical Technology, China

² Nanjing Tech University (Nanjing Tech), China



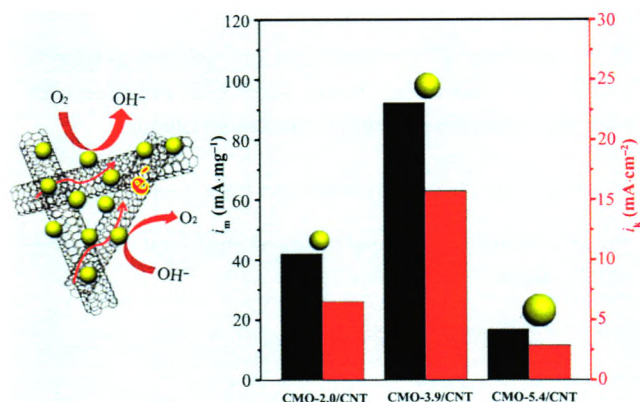
Nanosized composites of metal-organic frameworks (MOFs) and metal nanoparticles (NPs) were fabricated by a controlled strategy aimed at reducing the size of MOF crystals grown around the NPs during their encapsulation process. This approach improved the catalytic performances of these compounds. As host matrices, the present nanoscale MOFs provided a shorter diffusion path and led to excellent size selectivity and higher catalytic activity of the Pt@nano-MOF composites compared to their larger-sized counterparts.

3826–3835

Synthesis of size-controlled CoMn_2O_4 quantum dots supported on carbon nanotubes for electrocatalytic oxygen reduction/evolution

Jiajia Shi, Kaixiang Lei, Weiyi Sun, Fujun Li, Fangyi Cheng*, and Jun Chen

Nankai University, China



CoMn_2O_4 quantum dots of different sizes, selectively synthesized and supported on carbon nanotubes, showed a strongly size-dependent electrocatalytic performance in the oxygen reduction/evolution processes.

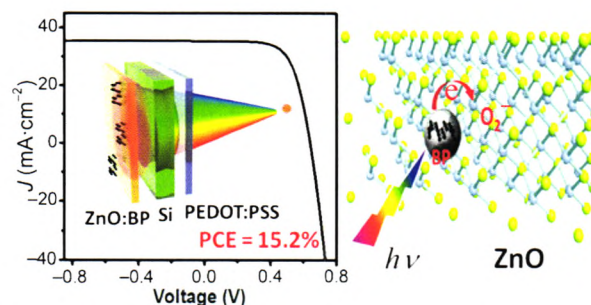
3836–3847

Black phosphorus induced photo-doping for high-performance organic-silicon heterojunction photovoltaics

Zhouhui Xia¹, Pengfei Li¹, Yuqiang Liu¹, Tao Song¹, Qiaoliang Bao², Shuit-Tong Lee¹, and Baoquan Sun^{1,*}

¹ Soochow University, China

² Monash University, Australia



A new strategy was developed to improve Si/metal contacts in organic-Si heterojunction solar cells. It uses black phosphorus induced photo-doping of zinc oxide, and achieves a remarkable power conversion efficiency of 15.2%.

3848–3856

Tribotronic transistor sensor for enhanced hydrogen detection

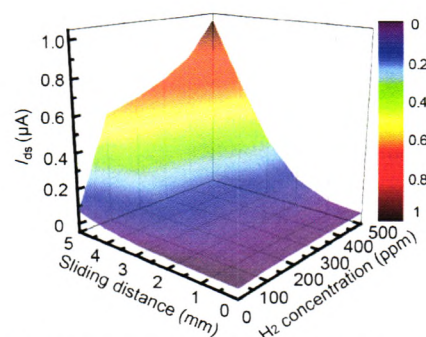
Yaokun Pang^{1,2,3}, Libo Chen^{1,2,3}, Guofeng Hu^{1,2,3}, Jianjun Luo^{1,2,3}, Zhiwei Yang^{1,2,3}, Chi Zhang^{1,2,*}, and Zhong Lin Wang^{1,2,4,*}

¹ Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China

² National Center for Nanoscience and Technology (NCNST), China

³ University of Chinese Academy of Sciences, China

⁴ Georgia Institute of Technology, USA



A novel ZnO tribotronic transistor sensor is developed by coupling a ZnO field effect transistor and triboelectric nanogenerator in free-standing mode. By applying an external mechanical force to the device for sliding electrification, the detection sensitivity and resolution of the ZnO tribotronic transistor sensor are improved.

3857–3864

Remarkable enhancement in failure stress and strain of penta-graphene via chemical functionalization

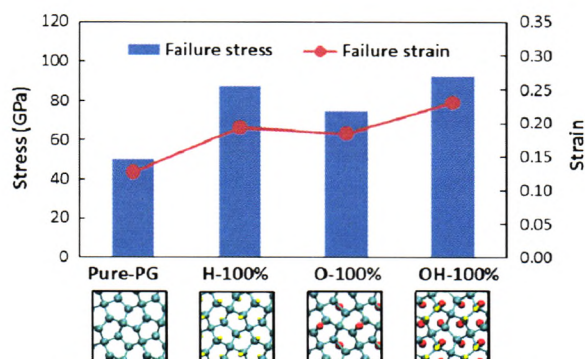
Yingyan Zhang¹, Qingxiang Pei^{2,*}, Zhendong Sha³, Yongwei Zhang², and Huajian Gao^{4,*}

¹ Western Sydney University, Australia

² A*STAR, Singapore

³ Xi'an Jiaotong University, China

⁴ Brown University, USA



Using molecular dynamics simulations, we demonstrate that chemical functionalization with H, O, and OH can significantly enhance the failure stress and strain of penta-graphene (PG).

3865–3874

Quasi-freestanding, striped WS_2 monolayer with an invariable band gap on Au(001)

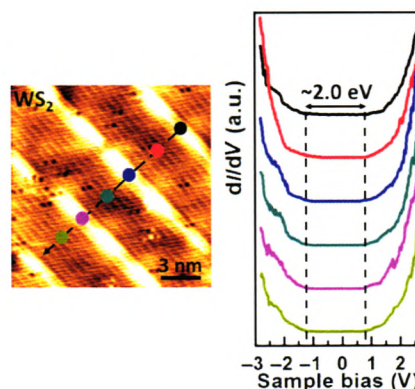
Min Hong¹, Xiebo Zhou¹, Jianping Shi¹, Yue Qi¹, Zhepeng Zhang¹, Qiyi Fang¹, Yaguang Guo¹, Yajuan Sun², Zhongfan Liu¹, Yuanchang Li³, Qian Wang¹, and Yanfeng Zhang^{1,*}

¹ Peking University, China

² ENN Group Co., Ltd., China

³ National Center for Nanoscience and Technology, Chinese Academy of Sciences, China

3875–3884



We reveal the atomic-scale structure and quasiparticle band gap of chemical vapor deposition-grown monolayer WS_2 on Au foil via scanning tunneling microscopy/spectroscopy (STM/STS). Due to the weak interfacial interactions between WS_2 and the Au substrate, the band gap of WS_2 preserves its relatively intrinsic features on the Au(001) facet, and is not modulated by the striped superstructures that are formed.

Dual function of a high-contrast hydrophobic–hydrophilic coating for enhanced stability of perovskite solar cells in extremely humid environments

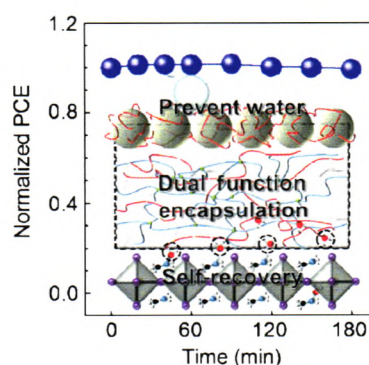
Jin Sun Yoo¹, Gill Sang Han², Seongha Lee², Min Cheol Kim³, Mansoo Choi³, Hyun Suk Jung^{1,*}, and Jung-Kun Lee^{2,*}

¹ Sungkyunkwan University, Republic of Korea

² University of Pittsburgh, USA

³ Seoul National University, Republic of Korea

3885–3895



The multi-layer coating consisting of hydrophilic and hydrophobic layers successfully protects perovskite solar cells under extremely humid environment. The poly(methyl methacrylate) (PMMA)-polyurethane (PU)- SiO_2 layer successfully expels water and the moderately hydrophilic PMMA layer promotes the recovery of the perovskite layer that contains a small amount of water.

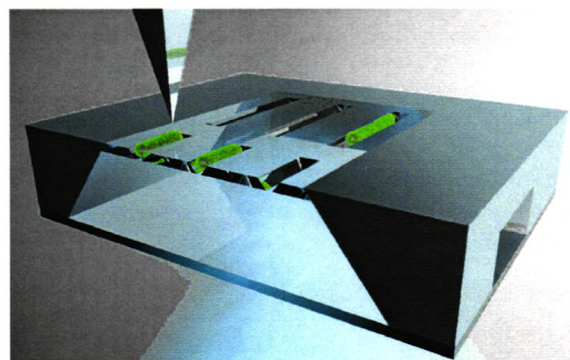
Microfluidic bacterial traps for simultaneous fluorescence and atomic force microscopy

Oliver Peric, Mélanie Hannebelle, Jonathan D. Adams[†], and Georg E. Fantner^{*}

EPFL, Switzerland

[†] Present address: Department of Biosystems Science and Engineering, Switzerland

3896–3908



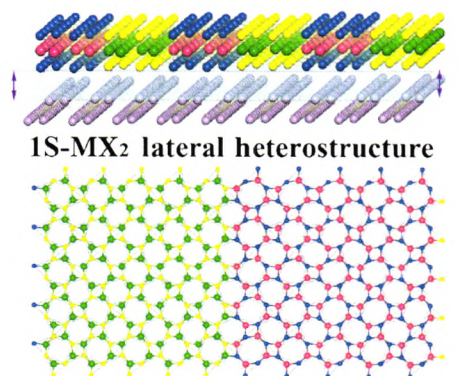
We solve the current limitations of the buffer-medium-independent bacterial immobilization of rod-shaped bacteria for atomic force microscopy.

Two-dimensional square transition metal dichalcogenides with lateral heterostructures

Qilong Sun, Ying Dai*, Na Yin, Lin Yu, Yandong Ma, Wei Wei, and Baibiao Huang

Shandong University, China

3909–3919



1S-MX₂ lateral heterostructures demonstrate the successful construction of heterojunctions with excellent stability and properties based on new “building blocks”. Black phosphorus can serve as a potential substrate and the hybrid bidirectional heterostructures possess distinguishable type-II band alignment.

Multi-shelled TiO₂/Fe₂TiO₅ heterostructured hollow microspheres for enhanced solar water oxidation

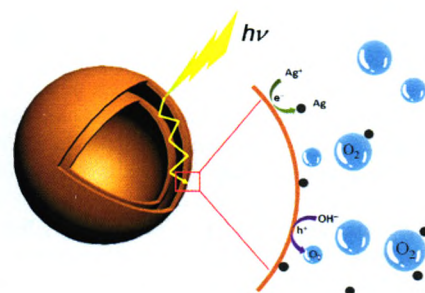
Muhammad Waqas^{1,3}, Yanze Wei^{1,2}, Dan Mao^{1,*}, Jian Qi¹, Yu Yang¹, Bao Wang^{1,*}, and Dan Wang^{1,*}

¹ Institute of Process Engineering, Chinese Academy of Sciences, China

² University of Science & Technology Beijing, China

³ University of Chinese Academy of Sciences, China

3920–3928



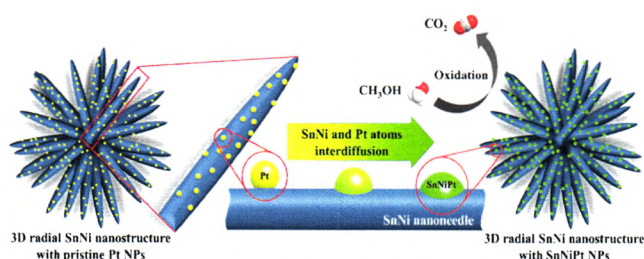
We designed and fabricated heterostructured TiO₂/Fe₂TiO₅ hollow microspheres with single-, double-, closed-double-, triple-, and core-shell structures and different Fe/Ti molar ratios using a facile sequential templating approach. When tested as oxygen evolution reaction materials for water splitting, the closed-double-shelled TiO₂/Fe₂TiO₅ hollow microspheres with 35% Fe exhibited the highest oxygen evolution reaction rate up to 375 $\mu\text{mol}\cdot\text{g}^{-1}\cdot\text{h}^{-1}$ and good stability for 5 h, which is competitive among most Ti-Fe-based photocatalysts.

SnNi nanoneedles assembled 3D radial nanostructure loaded with SnNiPt nanoparticles: Towards enhanced electrocatalysis performance for methanol oxidation

Hao Fang, Yuting Chen, Ming Wen*, Qingsheng Wu, and Quanjing Zhu

Tongji University, China

3929–3940



Metal atom diffusion between Pt nanoparticles and a SnNi support (under appropriate conditions) formed SnNiPt ternary alloys on the surface of an assembled three-dimensional (3D) radial nanostructure composed of SnNi nanoneedles. Combining the all-orientation accessibility of the 3D nanostructure and the advantages of the alloy catalyst, a desirable methanol oxidation electrocatalyst was well-designed with higher activity, better CO poisoning resistance, lower onset potential, and favorable stability.

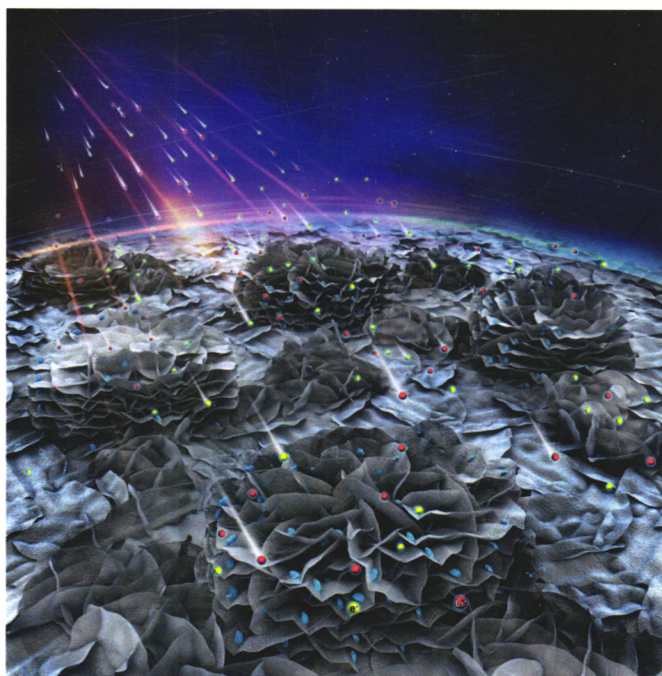
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