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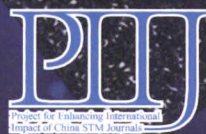


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Contents

Review Articles

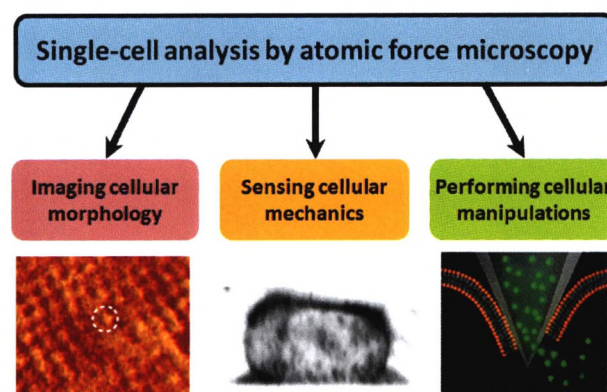
Advances in atomic force microscopy for single-cell analysis

Mi Li^{1,2,*}, Ning Xi³, Yuechao Wang^{1,2}, and Lianqing Liu^{1,2,*}

¹ Shenyang Institute of Automation, Chinese Academy of Sciences, China

² Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, China

³ The University of Hong Kong, Hong Kong, China



Recent advances in atomic force microscopy-based single-cell analysis for physiochemical assays and biomedical applications are reviewed. The directions for future progression are discussed.

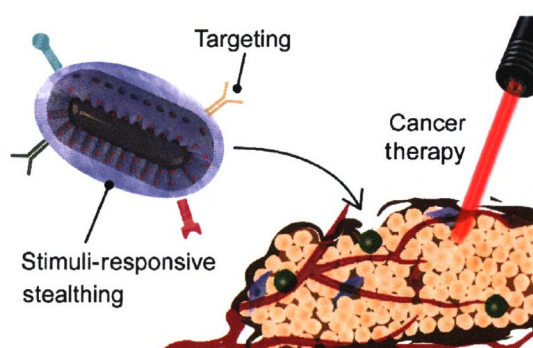
703–718

Functionalization of AuMSS nanorods towards more effective cancer therapies

Carolina F. Rodrigues¹, Telma A. Jacinto¹, André F. Moreira¹, Elisabete C. Costa¹, Sónia P. Miguel¹, and Ilídio J. Correia^{1,2,*}

¹ Universidade da Beira Interior, Portugal

² Universidade de Coimbra, Portugal



The modifications performed to improve the gold-core mesoporous silica shell nanorods application in cancer therapy are overviewed, highlighting the practical approaches that enhance the gold-core mesoporous silica shell nanorods targeting, responsiveness to different stimuli, and blood circulation time.

719–732

Research Articles

Polychromic carbon black: Laser galvanized multicolour fluorescence display

Sharon Xiaodai Lim¹, Kae Lin Wong², Zheng Zhang³, Antonio H. Castro Neto¹, and Chorng-Haur Sow^{1,*}

¹ National University of Singapore, Singapore

² Universiti Tunku Abdul Rahman, Malaysia

³ Institute of Materials Research Engineering, A*Star (Agency for Science, Technology and Research), Singapore



Laser initiated formation of multicolour fluorescing recovered carbon black powder. By controlling the environment in which the patterning process takes place, multicolour fluorescence and multicoloured visual display from recovered carbon black (rCB) can be achieved.

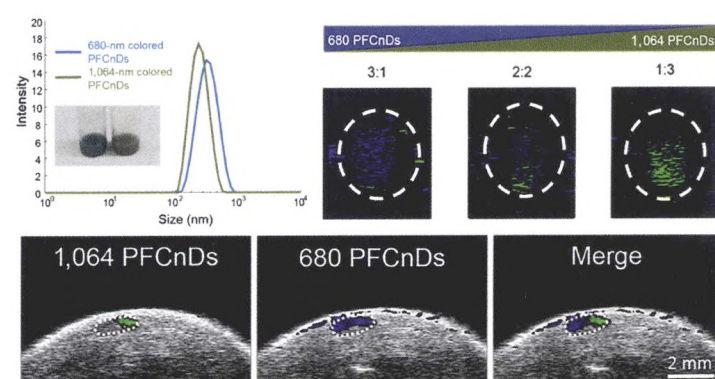
733–740

Color-coded perfluorocarbon nanodroplets for multiplexed ultrasound and photoacoustic imaging

Daniela Y. Santiesteban¹, Kristina A. Hallam^{1,2}, Steven K. Yarmoska¹, and Stanislav Y. Emelianov^{1,2,*}

¹ Georgia Institute of Technology and Emory University, USA

² Georgia Institute of Technology, USA



Multiplexed ultrasound and photoacoustic imaging is achieved through the use of color-coded perfluorocarbon nanodroplets. Specifically, distinct subpopulations of laser-activated perfluorocarbon nanodroplets produce optical wavelength-selective ultrasound and photoacoustic signals. The dynamic ultrasound and photoacoustic contrast produced by these agents allow the simultaneous acquisition and discrimination of quantitative spatial information from distinct biological targets, which were tested and demonstrated *in vivo*.

741–747

Infrared fluorescence imaging of infarcted hearts with Ag₂S nanodots

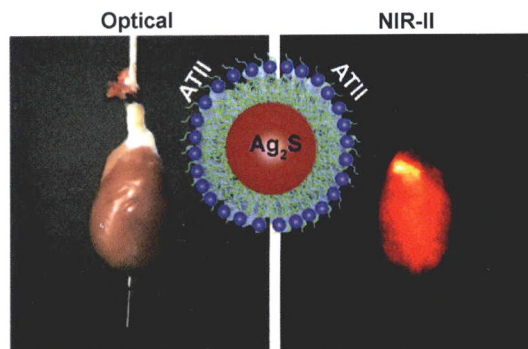
Dirk H. Ortgies^{1,2}, Ángel Luis García-Villalón², Miriam Granado², Sara Amor², Emma Martín Rodríguez^{1,2}, Harrison D.A. Santos^{2,3}, Jingke Yao², Jorge Rubio-Retama⁴, and Daniel Jaque^{1,2,*}

¹ Instituto Ramón y Cajal de Investigación Sanitaria, Spain

² Universidad Autónoma de Madrid, Spain

³ Universidade Federal de Alagoas, Brazil

⁴ Universidad Complutense de Madrid, Spain



A silver lining for myocardial infarction: Ag₂S nanodots surface-functionalized with the angiotensin II peptide demonstrated their excellent capability to visualize selectively the location and extent of myocardial infarcts after partial and global ischemia in a modified Langendorff system (*ex vivo* heart of a rat). The results were obtained through 360° infrared imaging, also making proof-of-concept whole-body imaging possible.

749–757

Physical activation of graphene: An effective, simple and clean procedure for obtaining microporous graphene for high-performance Li/S batteries

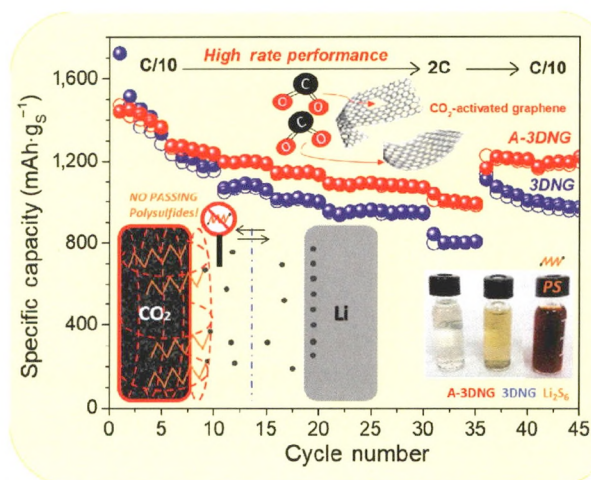
Almudena Benítez¹, Alvaro Caballero¹, Julián Morales^{1,*}, Josef Hassoun^{2,*}, Enrique Rodríguez-Castellón³, and Jesús Canales-Vázquez⁴

¹ Universidad de Córdoba, Spain

² University of Ferrara, Italy

³ Universidad de Málaga, Spain

⁴ Universidad de Castilla-La Mancha, Spain



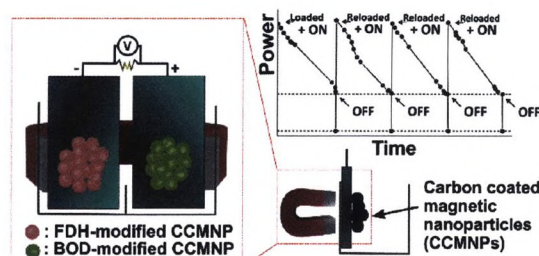
Physical activation of graphene is a simple, clean, and fast method, in particular if compared to chemical activation methods, and leads to even better performance in Li-S battery. Used as cathode in these batteries, the activated three-dimensional (3D) graphene-/S composite displayed a high specific capacity, good rate capability, and cycling stability.

759–766

Extending the operational lifetimes of all-direct electron transfer enzymatic biofuel cells by magnetically assembling and exchanging the active biocatalyst layers on stationary electrodes

Katharina Herkendell*, Andreas Stemmer, and Ran Tel-Vered*

ETH Zurich, Switzerland



External magnetic fields assist inducing direct electron transfer bioelectrocatalysis and extend the operational lifetimes of enzymatic biofuel cells.

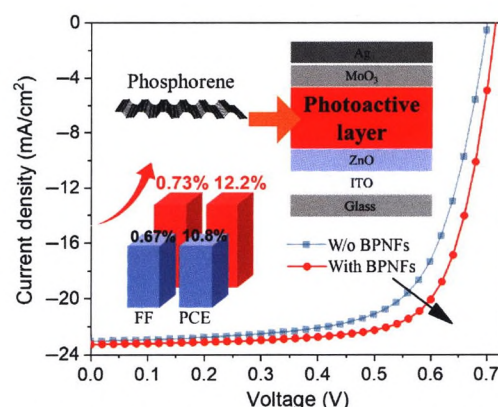
767–775

Black phosphorus nanoflakes as morphology modifier for efficient fullerene-free organic solar cells with high fill-factor and better morphological stability

Weitao Yang¹, Long Ye², Fenfa Yao¹, Chuanhong Jin¹, Harald Ade², and Hongzheng Chen^{1,*}

¹ Zhejiang University, China

² North Carolina State University, USA



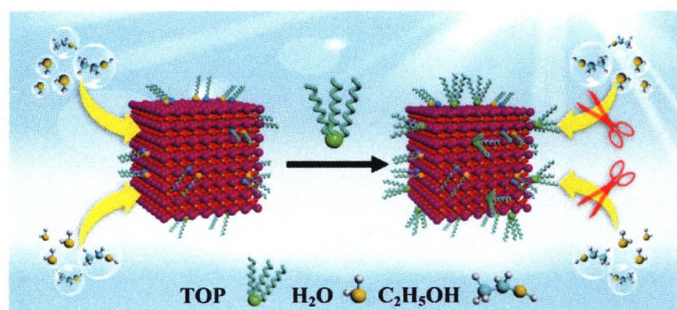
The performance of PTB7-Th:IEICO-4F based organic solar cell are significantly improved via incorporation of black phosphorus nanoflakes, contributing to more ordered π - π stacking and promoted domain purity of the blend.

777–783

Highly luminescent and stable CsPbBr₃ perovskite quantum dots modified by phosphine ligands

Yan Li*, Xiaoyan Wang, Weinan Xue, Wei Wang, Wei Zhu, and Lianjing Zhao

East China University of Science and Technology, China



Highly luminescent and stable CsPbBr₃ quantum dots were synthesized by introducing phosphine ligands into Cs-oleate solutions.

785–789

Thermal bridging of graphene nanosheets via covalent molecular junctions: A non-equilibrium Green's functions–density functional tight-binding study

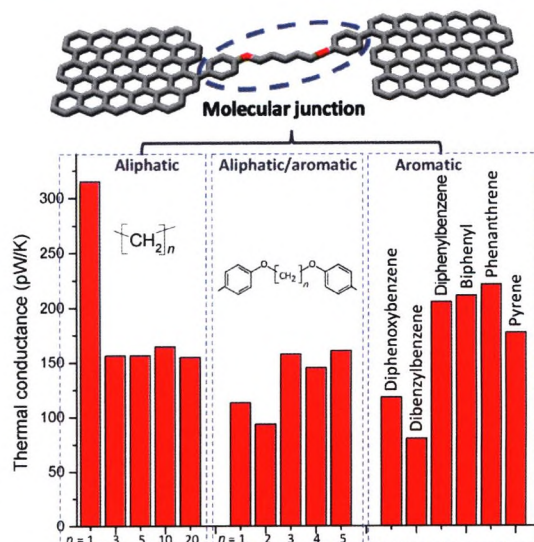
Diego Martinez Gutierrez¹, Alessandro Di Pierro¹, Alessandro Pecchia², Leonardo Medrano Sandonas³, Rafael Gutierrez³, Mar Bernal¹, Bohayra Mortazavi⁴, Gianauelio Cuniberti³, Guido Saracco¹, and Alberto Fina^{1,*}

¹ Politecnico di Torino, Italy

² Consiglio Nazionale delle Ricerche, Italy

³ TU Dresden, Germany

⁴ Bauhaus-Universitat Weimar, Germany



The thermal conductance and phonon spectra of several different aliphatic and aromatic molecular junctions between graphene contacts are calculated, by application of density functional tight-binding and Green's functions formalism.

791–799

Self-supporting, eutectic-like, nanoporous biphas bismuth-tin film for high-performance magnesium storage

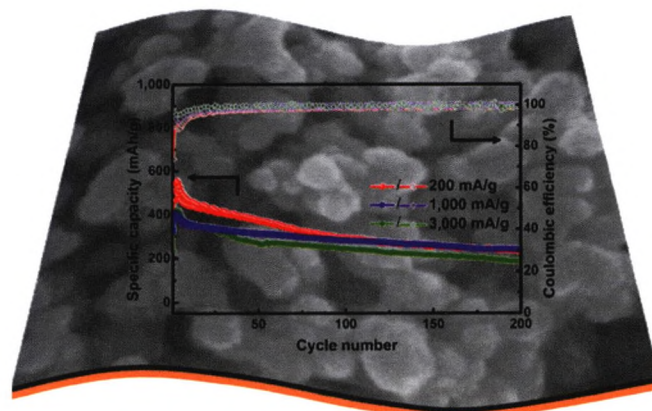
Meijia Song¹, Jiazhen Niu¹, Kuibo Yin², Hui Gao¹, Chi Zhang³, Wensheng Ma¹, Fakui Luo¹, Zhangquan Peng⁴, and Zhonghua Zhang^{1,*}

¹ Shandong University, China

² Southeast University, China

³ Wuyi University, China

⁴ Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China



Flexible, self-supporting, eutectic-like biphas Bi-Sn film with hierarchically porous structure exhibits excellent electrochemical performance as advanced anode for magnesium ion batteries.

801–808

Trap and $1/f$ -noise effects at the surface and core of GaN nanowire gate-all-around FET structure

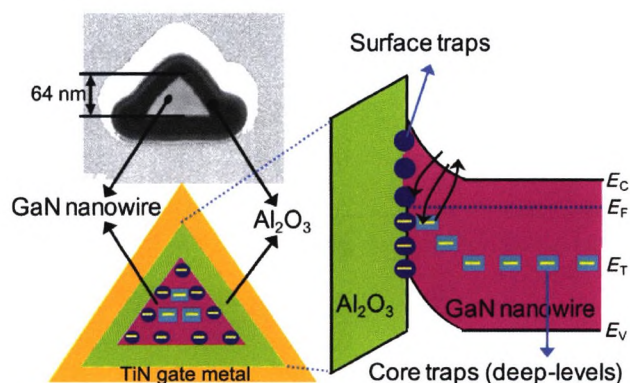
Mallem Siva Pratap Reddy¹, Ki-Sik Im^{2,*}, Jung-Hee Lee^{1,*}, Raphael Caulmione³, and Sorin Cristoloveanu⁴

¹ Kyungpook National University, Republic of Korea

² Kumoh National Institute of Technology, Republic of Korea

³ SOITEC, France

⁴ Minattec, France



Trap and $1/f$ -noise effects at the surface and core of GaN nanowire gate-all-around field effect transistor (FET) are fabricated via a top-down approach and its electrical and frequency-dependent properties are analyzed. The device shows high performance, such as a high I_{on}/I_{off} ratio of 10^8 and a subthreshold swing of $70 \text{ mV} \cdot \text{dec}^{-1}$. The interface state density is low: $1.9 \times 10^{11} \text{ cm}^{-2} \cdot \text{eV}^{-1}$ at 1 MHz.

809–814

Red/orange dual-emissive carbon dots for pH sensing and cell imaging

Miaoran Zhang¹, Rigu Su¹, Jian Zhong^{2,3}, Ling Fei⁴, Wei Cai¹, Qingwen Guan¹, Weijun Li¹, Neng Li⁵, Yusheng Chen⁶, Lulu Cai^{2,*}, and Quan Xu^{1,*}

¹ China University of Petroleum (Beijing), China

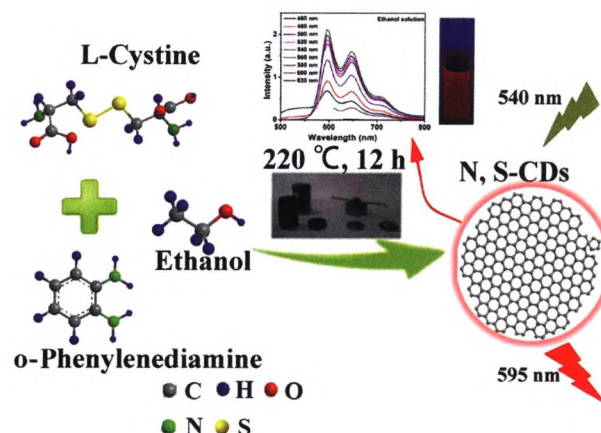
² University of Electronic Science and Technology of China, China

³ North Sichuan Medical College, China

⁴ University of Louisiana at Lafayette, USA

⁵ Wuhan University of Technology, China

⁶ University of Akron, USA



The dual-emissive N, S co-doped carbon dots (N, S-CDs) with a long emission wavelength were synthesized via solvothermal method. The N, S-CDs possess relatively high photoluminescence (PL) quantum yield (QY) (35.7%) towards near-infrared fluorescent peak up to 648 nm.

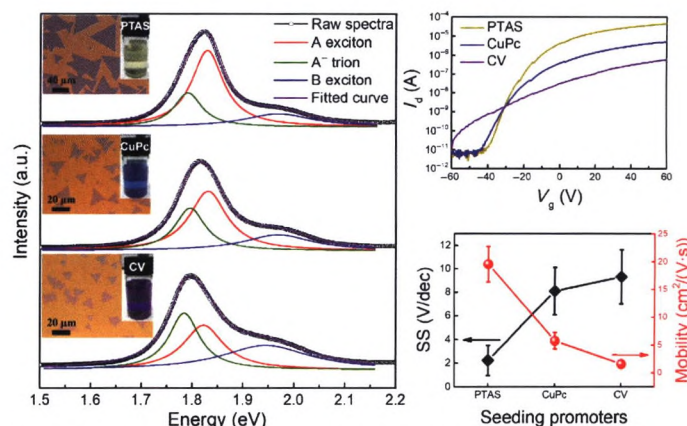
815–821

Influence of seeding promoters on the properties of CVD grown monolayer molybdenum disulfide

Peng Yang¹, Ai-Guo Yang¹, Lingxiu Chen², Jing Chen¹, Youwei Zhang¹, Haomin Wang², Laigui Hu¹, Rong-Jun Zhang¹, Ran Liu¹, Xin-Ping Qu^{1,*}, Zhi-Jun Qiu^{1,*}, and Chunxiao Cong^{1,*}

¹ Fudan University, China

² Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China



The influence of different seeding promoters on both optical and electrical properties of as-grown monolayer MoS₂ is systematically investigated, which is of guiding significance in modifying the properties of as-grown monolayer MoS₂ and other two-dimensional (2D) transition metal dichalcogenides in seeding promoters-assisted synthesis process.

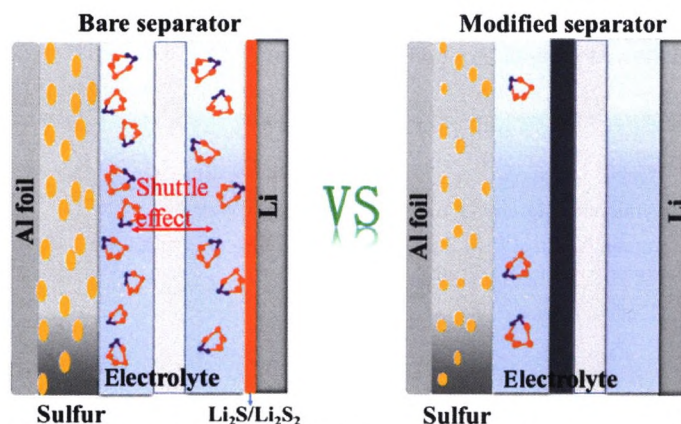
823–827

Ni@N-doped graphene nanosheets and CNTs hybrids modified separator as efficient polysulfide barrier for high-performance lithium sulfur batteries

Xintao Zuo¹, Mengmeng Zhen^{1,2,*}, and Cheng Wang^{1,*}

¹ Tianjin University of Technology, China

² Hebei University of Technology, China



When using the Ni@N-doped graphene nanosheets and carbon nanotubes (CNTs) hybrids as a modified separator in lithium sulfur batteries, the battery delivers excellent cycling performances.

829–836

Critical size limit of biodegradable nanoparticles for enhanced lymph node trafficking and paracortex penetration

Gregory P. Howard^{1,2}, Garima Verma^{3,4}, Xiyu Ke², Winter M. Thayer⁵, Timothy Hamerly⁴, Victoria K. Baxter^{1,3}, John E. Lee⁶, Rhoel R. Dinglasan^{3,4,*}, and Hai-Quan Mao^{1,2,7,*}

¹ Johns Hopkins School of Medicine, USA

² Johns Hopkins University, USA

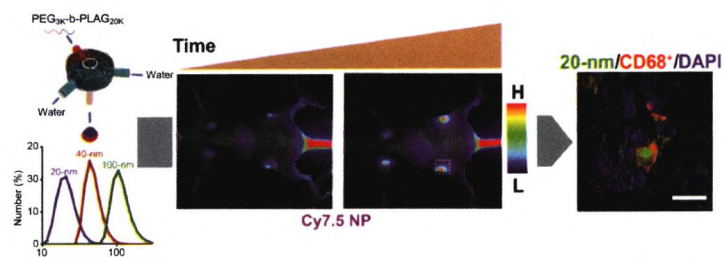
³ Johns Hopkins Bloomberg School of Public Health, USA

⁴ University of Florida, USA

⁵ Johns Hopkins School of Nursing, USA

⁶ Yale University, USA

⁷ Johns Hopkins University School of Medicine, USA



Biodegradable PEG-b-PLGA nanoparticles with narrow size distributions were screened for lymph node targeting, demonstrating that 20-nm nanoparticles have enhanced drainage and retention in the major draining lymph nodes over a 24-h period.

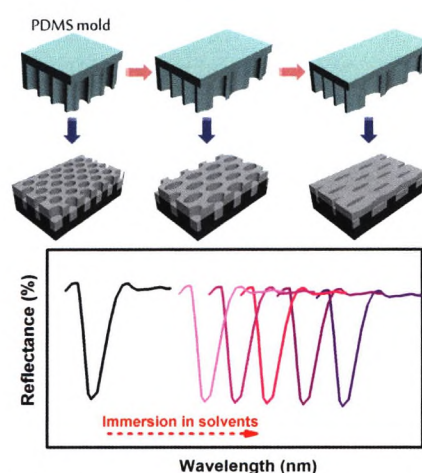
837–844

Deep-elliptical-silver-nanowell arrays (d-EAgNWAs) fabricated by stretchable imprinting combining colloidal lithography: A highly sensitive plasmonic sensing platform

Xueyao Liu¹, Wendong Liu², and Bai Yang^{1,*}

¹ Jilin University, China

² Max Planck Institute for Polymer Research, Germany



Deep-elliptical-silver-nanowell arrays (d-EAgNWAs) with highly tunable aspect ratio from 1.7 to 5.0 were fabricated by stretchable imprinting combining colloidal lithography. The optical and sensing performances of d-EAgNWAs were gradually optimized to sensitivity of 1,414.1 nm/RIU through regulation of polarization direction and various structural parameters.

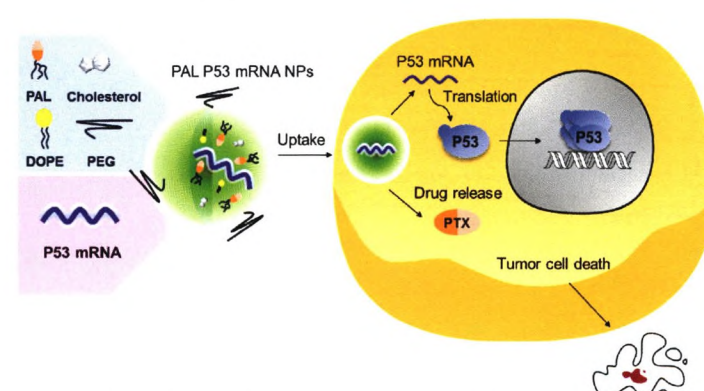
845–853

Chemotherapy drugs derived nanoparticles encapsulating mRNA encoding tumor suppressor proteins to treat triple-negative breast cancer

Chengxiang Zhang, Xinfu Zhang[†], Weiyu Zhao, Chunxi Zeng, Wenqing Li, Bin Li, Xiao Luo, Junan Li, Justin Jiang, Binbin Deng, David W. McComb, and Yizhou Dong*

The Ohio State University, USA

[†] Present address: Dalian University of Technology, China



Graphical illustration of chemotherapy drugs derived nanoparticles with an example of paclitaxel amino lipid (PAL) P53 mRNA nanoparticles (NPs). The PAL P53 mRNA NPs are assembled via a microfluidic device. Upon internalized by triple negative breast cancer (TNBC) cells, the P53 mRNA is translated to P53 protein, functioning as a tumor suppressor. The released paclitaxel and translated P53 protein induce tumor cell death.

855–861

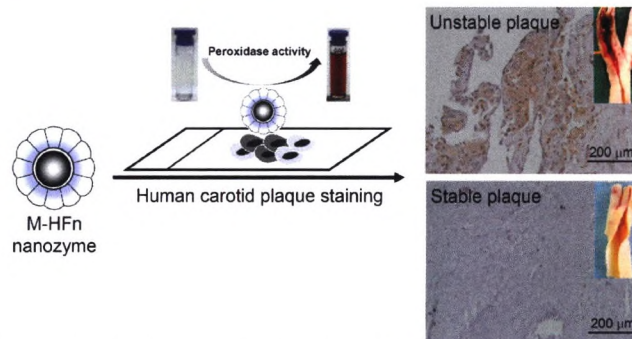
Bioengineered magnetoferritin nanozymes for pathological identification of high-risk and ruptured atherosclerotic plaques in humans

Tao Wang¹, Jiuyang He^{2,3}, Demin Duan³, Bing Jiang³, Peixia Wang³, Kelong Fan³, Minmin Liang^{3,*}, and Xiyun Yan^{3,*}

¹ Peking University Third Hospital, China

² University of Chinese Academy of Sciences, China

³ Institute of Biophysics, Chinese Academy of Sciences, China



Magnetoferritin nanozymes catalyze the oxidation of colorimetric substrates to give a color reaction that visualizes the recognized unstable plaques for one-step pathological identification of plaque vulnerability.

863–868

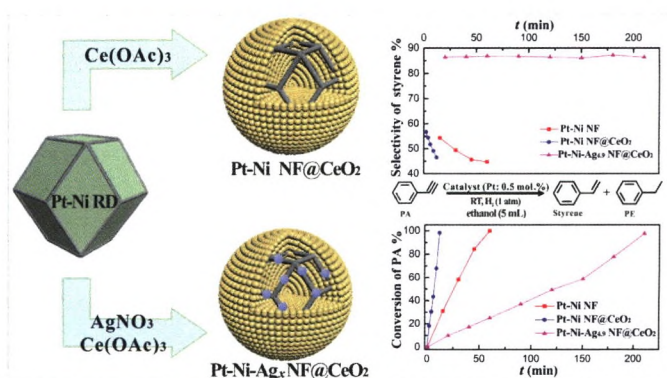
Construction of trace silver modified core@shell structured Pt-Ni nanoframe@CeO₂ for semihydrogenation of phenylacetylene

Yan Long^{1,2}, Jian Li^{1,3}, Lanlan Wu^{1,*}, Qishun Wang^{1,3}, Yu Liu^{1,2}, Xiao Wang¹, Shuyan Song^{1,*}, and Hongjie Zhang¹

¹ Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China

² University of Chinese Academy of Sciences, China

³ University of Science and Technology of China, China



It developed a series of core@shell structured Pt-Ni(-Ag_x) nanoframe@CeO₂ composites with good stability, high activity, and high selectivity for semihydrogenation of phenylacetylene.

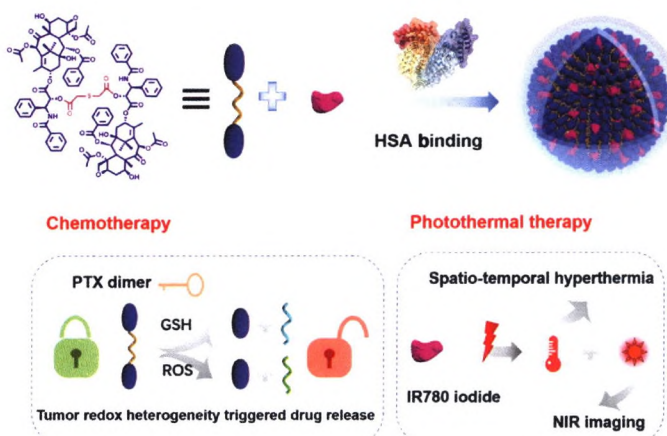
869–875

Albumin-bound paclitaxel dimeric prodrug nanoparticles with tumor redox heterogeneity-triggered drug release for synergistic photothermal/chemotherapy

Qing Pei^{1,2}, Xiuli Hu^{1,*}, Xiaohua Zheng^{1,2}, Rui Xia^{1,2}, Shi Liu¹, Zhigang Xie^{1,*}, and Xiabin Jing¹

¹ Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China

² University of Science and Technology of China, China



Biomimic albumin-bound paclitaxel dimeric prodrug nanoparticles were prepared by co-precipitating human serum albumin (HSA) with a paclitaxel dimer bridged with thioether linker and photosensitizer IR780 iodide. The described technology unifies the biomimetic trait of HSA, high drug loading, triggered drug release, and synergistic photothermal and chemotherapy into one formulation.

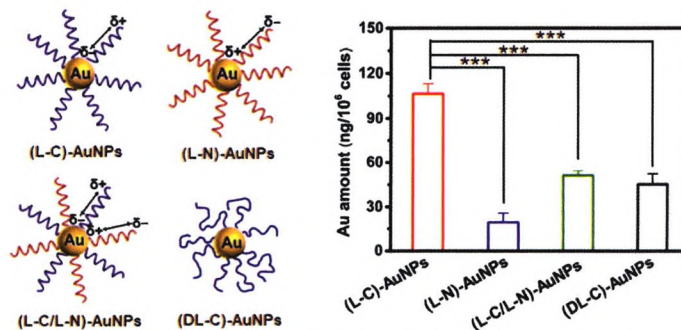
877–887

Regulation of the cellular uptake of nanoparticles by the orientation of helical polypeptides

Chong Zhang¹, Jianhua Lu¹, Falin Tian², Lindong Li¹, Yingqin Hou¹, Yaoyi Wang¹, Lingdong Sun^{1,*}, Xinghua Shi^{2,*}, and Hua Lu^{1,*}

¹ Peking University, China

² National Center for Nanoscience and Technology, China



Regulation of nanoparticle (NP) cellular uptake is achieved via the helical conformation and orientation of the anchoring polypeptides. Our results found that the helical polypeptide anchoring its C-terminus to the surface of the NPs gave rise to significantly higher cellular internalization than all other control groups.

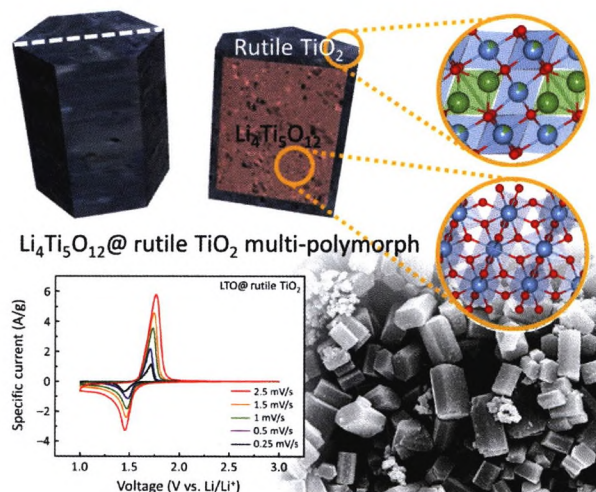
889–896

Polygonal multi-polymorphed $\text{Li}_4\text{Ti}_5\text{O}_{12}$ @rutile TiO_2 as anodes in lithium-ion batteries

Chang Hyun Hwang¹, Hee-eun Kim¹, Inho Nam^{2,*}, and Jin Ho Bang^{1,*}

¹ Hanyang University, Republic of Korea

² Chung-Ang University, Republic of Korea



Multi-polymorph structured, polygonal $\text{Li}_4\text{Ti}_5\text{O}_{12}$ -rutile TiO_2 is designed to mitigate the limitations of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ in lithium-ion battery applications. This new nanostructure offers higher battery performance and improved stability because of its unique interfacial structure and structural benefits.

897–904

Illuminating phase transformation dynamics of vanadium oxide cathode by multimodal techniques under operando conditions

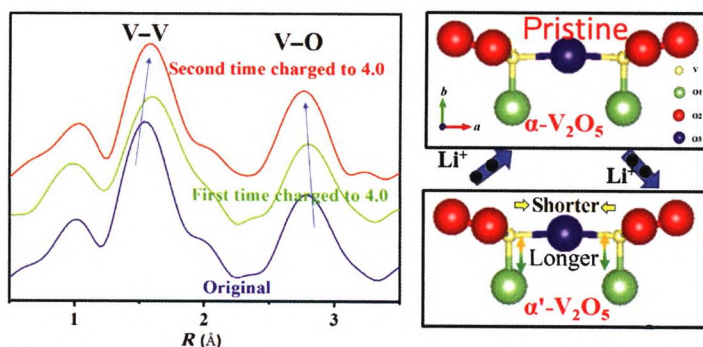
Guobin Zhang¹, Tengfei Xiong¹, Xuelei Pan¹, Yunlong Zhao^{2,3,*}, Mengyu Yan^{4,*}, Haining Zhang¹, Buke Wu¹, Kangning Zhao¹, and Liqiang Mai^{1,*}

¹ Wuhan University of Technology, China

² University of Surrey, UK

³ National Physical Laboratory, UK

⁴ University of Washington, USA



The insertion of lithium enlarges the V–O bond in V_2O_5 , which further weakens the V–O skeleton. Also, it shortens the V–V bond, which makes the V–O polyhedra more quenched.

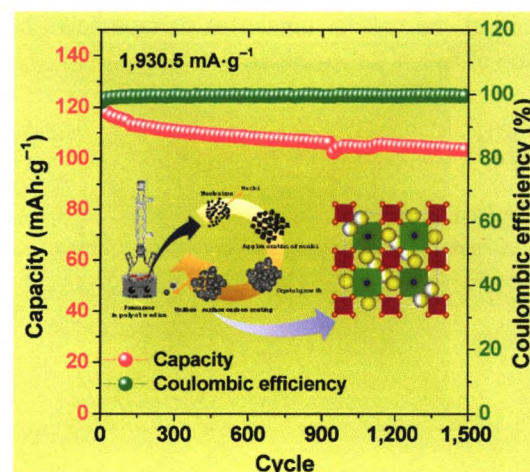
905–910

Phase-pure $\text{Na}_3\text{V}_2(\text{PO}_4)_2\text{F}_3$ embedded in carbon matrix through a facile polyol synthesis as a potential cathode for high performance sodium-ion batteries

Sohyun Park¹, Jinju Song², Seyeon Kim¹, Balaji Sambandam¹, Vinod Mathew¹, Sungjin Kim¹, Jeonggeun Jo¹, Seokhun Kim¹, and Jaekook Kim^{1,*}

¹ Chonnam National University, Republic of Korea

² Korea Institute of Energy Research (KIER), Republic of Korea



Nanocrystalline carbon-coated $\text{Na}_3\text{V}_2(\text{PO}_4)_2\text{F}_3$ by polyol process registered excellent stable cyclability about 88% of the initial capacity at 15 C ($1,930.5 \text{ mA}\cdot\text{g}^{-1}$) after a prolonged cycle life span of 1,500 cycles.

911–917

Hexagonal boron nitride nanosheet for effective ambient N_2 fixation to NH_3

Ya Zhang¹, Huitong Du², Yongjun Ma³, Lei Ji¹, Haoran Guo⁴, Ziqi Tian⁴, Hongyu Chen¹, Hong Huang¹, Guanwei Cui⁵, Abdullah M. Asiri⁶, Fengli Qu^{3,*}, Liang Chen^{4,*}, and Xuping Sun^{1,*}

¹ University of Electronic Science and Technology of China, China

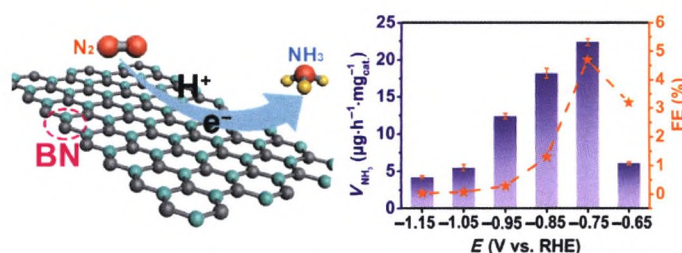
² Qufu Normal University, China

³ Southwest University of Science and Technology, China

⁴ Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, China

⁵ Shandong Normal University, China

⁶ King Abdulaziz University, Saudi Arabia



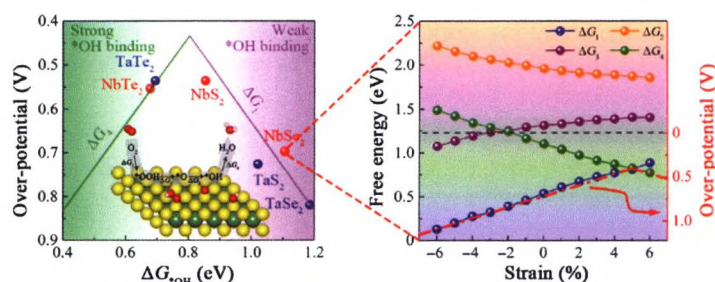
Hexagonal boron nitride nanosheet (h-BNNS) acts as a metal-free electrocatalyst for high-performance artificial N_2 fixation to NH_3 , which attains a high NH_3 formation rate of $22.4 \mu\text{g}\cdot\text{h}^{-1}\cdot\text{mg}_{\text{cat}}^{-1}$ and a high Faradic efficiency of 4.7% at -0.75 V vs. RHE in 0.1 M HCl. Density functional theory calculations reveal that the unsaturated boron at the edge site of h-BNNS can activate inert N_2 molecule and dramatically reduce the energy barrier for NH_3 formation.

919–924

Group VB transition metal dichalcogenides for oxygen reduction reaction and strain-enhanced activity governed by p-orbital electrons of chalcogen

Shuyang Zhao, Ke Wang, Xiaolong Zou*, Lin Gan*, Hongda Du, Chengjun Xu, Feiyu Kang, Wenhui Duan, and Jia Li*

Tsinghua University, China



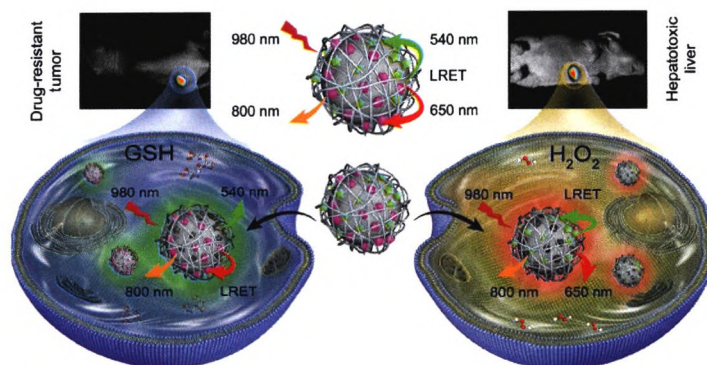
Transition metal dichalcogenides (TMDs) represent a large family of layered two-dimensional materials. This work reveals that NbS_2 and TaTe_2 are the most effective oxygen reduction reaction (ORR) catalysts with over-potential of 0.54 V among the studied TMDs and the ORR activity of NbS_2 can be tuned effectively by the strain.

925–930

Synchronous detection of glutathione/hydrogen peroxide for monitoring redox status *in vivo* with a ratiometric upconverting nanoprobe

Judun Zheng, Yunxia Wu, Da Xing*, and Tao Zhang*

South China Normal University, China



A new ratiometric nanoprobe (UCNP-TB) possessing synchronous detectability of redox couple glutathione/hydrogen peroxide (GSH/H₂O₂) was developed based on a multi-spectral upconverting nanoporphosphor as the luminescence resonance energy transfer (LRET) donor and two dye molecules as the acceptors. We can utilize it to elucidate the redox status within the drug-resistant tumor and the drug-induced hepatotoxic liver via the ratiometric upconversion luminescence (UCL) imaging.

931–938

Analysis of structural distortion in Eshelby twisted InP nanowires by scanning precession electron diffraction

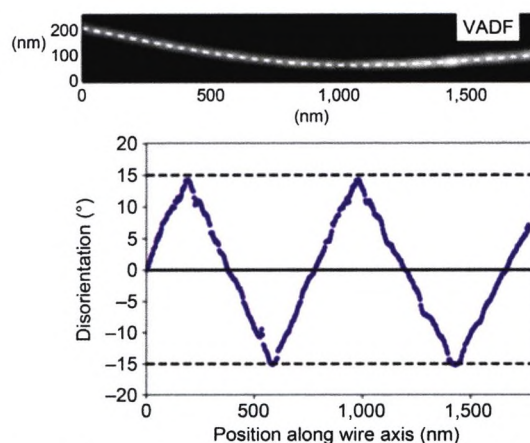
Daniel Ugarte^{1,2,*}, Luiz H. G. Tizei³, Monica A. Cotta¹, Caterina Ducati², Paul A. Midgley², and Alexander S. Eggeman^{2,4,*}

¹ Universidade Estadual de Campinas-UNICAMP, Brazil

² University of Cambridge, UK

³ Univ. Paris Sud, France

⁴ University of Manchester, UK



Ultra-high precision structural mapping in the transmission electron microscope is used to study the nanometre strain distribution in an indium phosphide nanowire containing a screw dislocation. The Eshelby twist rate is shown to be an inaccurate method to determine the dislocation displacement, however radial strain analysis confirms the correct dislocation structure.

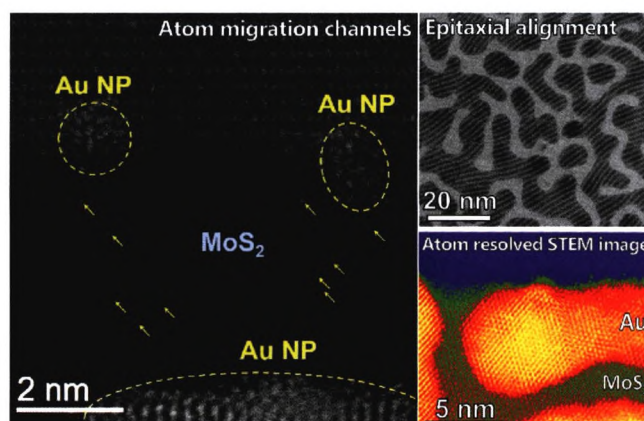
939–946

Direct observation of epitaxial alignment of Au on MoS₂ at atomic resolution

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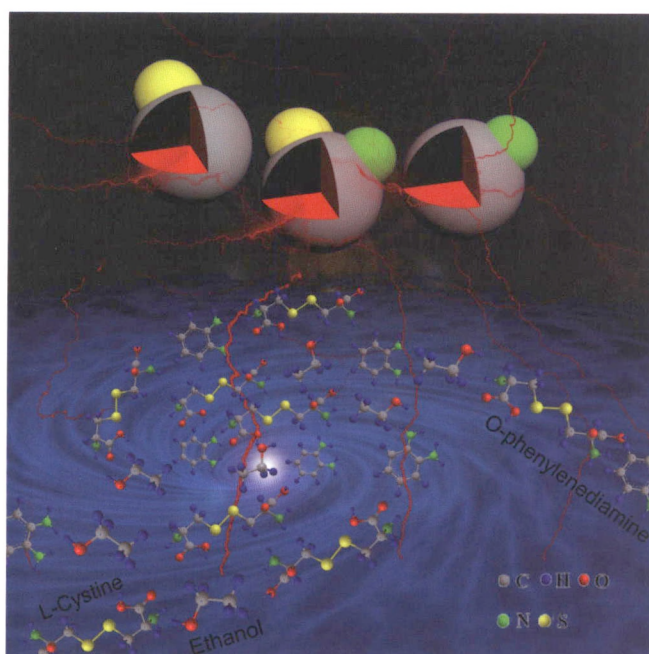
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In situ transmission electron microscopy (TEM) observation shows that the migration channels of Au atoms on MoS₂ and the coalescence of adjacent nanoparticles may lead to the formation of Au dendrites, in which the epitaxial alignment between Au and MoS₂ lattices is verified by the periodic Moiré patterns and selected-area electron diffraction patterns.

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