The 6th China-Australia Joint Symposium On Energy & Biomedical Materials

January 6-9, 2016, Suzhou, China

Scientific Program

Organized by
Beihang University, China

Sponsored by
National Natural Science Foundation of China

NSFC

BEIHANG University

SEU Monash University

University of WOLLONGONG

Welcome Letter

Dear Colleagues,

The 6th China-Australia Joint Symposium on Energy and Biomedical Materials Supported by National Natural Science Foundation of China (NSFC), Beihang University, Monash University, Southeast University, and University of Wollongong, will be held at the Monash-Southeast University Joint Research Institute, Suzhou, on January 6-9, 2016. The Institute is located in the Suzhou Industrial Park (SIP) adjacent to Shanghai. SIP has been designed as the most important State 'Nanotech' Cluster in China to support the growth of nanotechnology and its enabling industries covering advanced materials, electronics, opto-electronics, biomedicine, manufacturing and energy/environment.

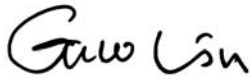
The 6th China-Australia Joint Symposium will bring together scientists and engineers in materials science and engineering. This multidisciplinary symposium will cover topics including nano-scale, energy, superconducting, electronic, biomedical, magnetic, and environmental materials.

The main goal of the forum is to promote National and International cooperation and partnership between world leaders in materials science and engineering. We are certain that your expertise and knowledge will bring enormous benefit to the quality and standing of this event.

Sincerely,

Professor Lei Jiang

Professor Lin Guo



School of Chemistry and Environment
Beihang University
XueYuan Road No.37, HaiDian District, Beijing, China

Symposium Chair

Lei Jiang	Chair	Beihang University, China
Aibing Yu	Chair	Monash University, Australia
Yibing Cheng	Co-chair	Monash University, Australia
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Xuchuan Jiang	Secretary	Monash University, Australia
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Yibing Cheng	Monash University, Australia
Min Gu	Swinburne University, Australia
Gaoqing (Max) Lu	University of Queensland, Australia
Aibing Yu	Monash University, Australia

Academic Program of CASEBM-2016

Time	Jan 6th	Jan 7th	Jan 8th	Jan 9th
8:30-9:00	Registration *Hall of the hotel*	Opening Ceremony	Plenary Lecture	Plenary Lecture
9:00-12:00		Plenary Lecture		
12:00-13:00		Lunch *Buffet*	Lunch *Buffet*	Lunch *Buffet*
13:30-18:00		Session A&B	Session A&B	Leave

Plenary Lecture: The morning of Jan. 7th, 2016

Plenary Lecture: the2th floor, Tang Palace		
8:30-9:00	Opening Ceremony	Chair: Prof. Lei Jiang
9:00-9:30	Prof. Zhongfan Liu	
9:30-10:00	Prof. Huiming Cheng	
10:00-10:30	*Coffee Break and Group Photo*	
10:30-10:50	Prof. Shilun Qiu	Chair: Prof. Zhongfan Liu
10:50-11:10	Prof. Changsheng Liu	
11:10-11:30	Prof. Shuhong Yu	
11:30-11:50	Prof. Huijun Zhao	

12:00-13:00 Lunch: Buffet at first floor cafeteria

Session Lecture A: The afternoon of Jan. 7th, 2016

Session A: the2th floor, Zhou Palace		
13:30-13:45	Prof. Xingyu Jiang	Chair: Prof. Changsheng Liu
13:45-14:00	Prof. Yuansheng Yang	
14:00-14:15	Prof. Guoxiu Wang	
14:15-14:30	Prof. Shutao Wang	
14:30-14:45	Prof. Zhuang Liu	
14:45-15:00	Prof. Bin Su	
15:00-15:15	Prof. Yu Chen	
15:15-15:35	*Coffee Break*	
15:35-15:50	Prof. Chuanlai Xu	Chair: Prof. Lin Guo
15:50-16:05	Prof. Haimin Zhang	
16:05-16:20	Prof. Hua Wang	
16:20-16:35	Prof. Renjie Chai	
16:35-16:50	Prof. Shaohua Shen	
16:50-17:05	Prof. Hongjian Zhou	
17:10-18:00	Slam Poster	

18:00-21:00 Dinner: Banquet at 2nd floor Tang palace

Session Lecture B: The afternoon of Jan. 7th, 2016

Session B : the 2th floor, Song Palace		
13:30-13:45	Prof. Liwei Chen	Chair: Prof. Shuhong Yu
13:45-14:00	Prof. Xiaozhou Liao	
14:00-14:15	Prof. Zhixiang Wei	
14:15-14:30	Prof. XiaoLin Wang	
14:30-14:45	Prof. Rongming Wang	
14:45-15:00	Prof. Shanqing Zhang	
15:00-15:15	Prof. Yuan Zhang	
15:15-15:35	*Coffee Break*	
15:35-15:50	Prof. Yanglong Hou	Chair: Prof. Shilun Qiu
15:50-16:05	Prof. Yan Xiang	
16:05-16:20	Prof. Qiuming Gao	
16:20-16:35	Prof. Le He	
16:35-16:50	Prof. Huiqiong Zhou	
16:50-17:05	Prof. Xiaohua Zhang	
17:10-18:00	Slam Poster	

18:00-21:00 Dinner: Banquet at 2nd floor Tang palace

Plenary Lecture: The morning of Jan. 8th, 2016

Plenary Lecture: the 2th floor, Tang Palace		
8:30-8:45	Opening speech	Chair: Prof. Yibing Cheng
8:45-9:10	Prof. Max Lu	
9:10-9:35	Prof. Lei Jiang	
9:35-10:00	Prof. Min Gu	
10:00-10:10	*Coffee Break*	
10:10-10:35	Prof. Yibing Cheng	Chair: Prof. Lin Ye
10:35-11:00	Prof. Lin Ye	
11:00-11:25	Prof. Gang Wei	
11:25-11:50	Prof. Xiaodong Chen	
11:50-12:15	Prof. Aibing Yu	

12:00-13:00 Lunch: Buffet at first floor cafeteria

Session Lecture A: The afternoon of Jan. 8th, 2016

Session A: the 2th floor, Zhou Palace		
13:30-13:45	Prof. Mingyuan Gao	Chair: Prof. Huanting Wang
13:45-14:00	Prof. Zhongze Gu	
14:00-14:15	Prof. Zhiyong Tang	
14:15-14:30	Prof. Shaomin Liu	
14:30-14:45	Prof. Yong Zhao	
14:45-15:00	Prof. Qunfeng Cheng	
15:00-15:15	Prof. Jian Liu	
15:15-15:35	*Coffee Break*	
15:35-15:50	Prof. Huanting Wang	Chair: Prof. Zhiyong Tang
15:50-16:05	Prof. Taolei Sun	
16:05-16:20	Prof. Zhen Li	
16:20-16:35	Prof. Chuanqi Feng	
16:35-16:50	Prof. Yi Chen	
16:50-17:05	Prof. Ying Ma	
17:05-17:20	Dr. Zhigang Chen	
17:20-17:35	Dr. Yi Du	

18:00-21:00 Dinner: Banquet at 2nd floor Tang palace

Session Lecture B: The afternoon of Jan. 8th, 2016

Session B: the 2th floor, Song Palace		
13:30-13:45	Prof. Jin Zou	Chair: Prof. Jin Zhang
13:45-14:00	Prof. Dan Li	
14:00-14:15	Prof. Zheng Hu	
14:15-14:30	Prof. Zaiping Guo	
14:30-14:45	Prof. Dan Wang	
14:45-15:00	Prof. Yanwei Ma	
15:00-15:15	Prof. Jiatao Zhang	
15:15-15:35	*Coffee Break*	
15:35-15:50	Prof. Jin Zhang	Chair: Prof. Jin Zou
15:50-16:05	Prof. Huagui Yang	
16:05-16:20	Prof. Quanhong Yang	
16:20-16:35	Prof. Weichang Hao	
16:35-16:50	Prof. Junying Zhang	
16:50-17:05	Prof. Xuchuan Jiang	
17:05-17:20	Prof. Yuzhou Liu	
17:20-17:35	Prof. Yanbing He	
17:35-17:50	Prof. Chengzhong Yu	

18:00-21:00 Dinner: Banquet at 2nd floor Tang palace

Plenary Lecture: The morning of Jan.9th, 2016

Plenary Lecture: the 2th floor, Tang Palace		
9:00-9:30	Prof. Jinghai Li	Chair : Prof. Lei Jiang
9:30-10:00	Prof. Dongyuan Zhao	
10:00-10:30	*Coffee Break*	
10:30-11:30	*Poster Awards and Closing Ceremony*	

12:00-13:00 Lunch: Buffet at first floor cafeteria

Hotel Information: Wyndham Garden (苏州温德姆花园酒店)

Hotel Address: No.818 Ganjing East, Gusu District, Suzhou (姑苏区干将东路 818 号)

This hotel has another name: Marco Polo Suzhou(苏州玄妙马哥孛罗酒店)

Time	Lecture
Jan.7th 2016 9:00-9:30	2-D Nanocarbons: Attraction, Reality and Future [Plenary] **Prof. Zhongfan Liu** (Peking University)
Jan.7th 2016 9:30-10:00	CVD Growth on Metals: Graphene and Beyond [Plenary] **Prof. Huiming Cheng** (Institute of Metal Research, CAS)
Jan.7th 2016 10:30-10:50	Metal Organic Frameworks (MOF) Membrane:Gas Adsorption & Separation [Plenary] **Prof. Shilun Qiu** (Jilin University)
Jan.7th 2016 10:50-11:10	Bioinspired Architecture-mediated Cell Response and Tissue Regeneration [Plenary] **Prof. Changsheng Liu** (East China University of Science and Technology)
Jan.7th 2016 11:10-11:30	Macroscopic Nanoparticle Assemblies: Integration, Functionalization and Applications [Plenary] **Prof. Shuhong Yu** (University of Science and Technology of China)
Jan.7th 2016 11:30-11:50	Unlocking Catalytic Potentials of Earth Abundant Materials for Energy Applications [Plenary] **Prof. Huijun Zhao** (Griffith University)
Jan.7th 2016 13:30-13:45	Microfluidic-based Approaches for Controllable Synthesis of Nanoparticles [Session A] **Prof. Xingyu Jiang** (National Center for Nanoscience and Technology)
	Rational Design of Cathode Structure for High-Performance Li-S Batteries [Session B] **Pro. Liwei Chen** (Suzhou Institute of Nano-Tech & Nano-Bionics, CAS)
Jan.7th 2016 13:45-14:00	Preparation, mechanical properties and corrosion resistance of bio-magnesium materials [Session A] **Prof. Yuansheng Yang** (Institute of Metal Research, Chinese Academy of Sciences)
	Ferroelectric Domain Manipulation via External Stimuli [Session B] **Prof. Xiaozhou Liao** (The University of Sydney)
Jan.7th 2016 14:00-14:15	Rechargeable Batteries to Power a Sustainable Future [Session A] **Prof. Guoxiu Wang** (University of Technology Sydney)

	High performance ternary organic solar cells [SessionB] **Prof. Zhixiang Wei** (National Center for Nanoscience and Technology)
Jan.7th 2016 14:15-14:30	Engineering Biointerface with Controlled Cell Adhesion towards Cancer Diagnostics [Session A] **Prof. Shutao Wang** (The Technical Institute of Physics and Chemistry, CAS)
	Grand design of new electronic materials and properties [Session B] **Prof. XiaoLin Wang** (University of Wollongong)
Jan.7th 2016 14:30-14:45	Nanotechnology for enhanced cancer radiation therapy [Session A] **14:45-15:00 Prof. Zhuang Liu** (Soochow University)
	Interface Structure of Magnetic Nanomaterials [Session B] **Prof. Rongming Wang** (University of Science and Technology)
Jan.7th 2016 14:45-15:00	Liquid-bridge-directed 1D self-assembly of diverse nanoscale building blocks [Session A] **Prof. Bin Su** (Monash University)
	Reforming electrode fabrication process via the design of binders [Session B] **Prof. Shanqing Zhang** (Griffith University)
Jan.7th 2016 15:00-15:15	To be announced [Session A] **Prof. Yu Chen** (Shanghai Institute of Ceramics, Chinese Academy of Sciences)
	Temperature Tunable Self-Doping in Stable Diradicaloid Thin-Film Devices [Session B] **Prof. Yuan Zhang** (Beihang University)
Jan.7th 2016 15:35-15:50	DNA-driven Self-nanoassemblies for Bioapplications [Session A] **Prof. Chuanlai Xu** (Jiangnan University)
	Nanostructured Hybrid Materials for Lithium-based Batteries [Session B] **Prof. Yanglong Hou** (Peking University)
Jan.7th 2016 15:50-16:05	Carbon-based Materials for Energy Conversion Applications [Session A] **Prof. Haimin Zhang** (Institute of Solid State Physics, Chinese Academy of Sciences)
	Efficient Proton Transport and Photovoltaic Conversion in Rhodopsins Biohybrid Nanomaterials and Systems [Session B] **Prof. Yan Xiang** (Beihang University)

Jan.7th 2016 16:05-16:20	Nature-Inspired Energy-storage Materials and Devices [Session A] **Prof. Hua Wang** (Beihang University)
	Preparation, Structure and Electrochemical Energy Storage Property on Inorganic Porous Materials [Session B] **Prof. Qiuming Gao** (Beihang University)
Jan.7th 2016 16:20-16:35	The structural development of primary cultured hippocampal neurons on a graphene substrate [Session A] **Prof. Renjie Chai** (Southeast University)
	Functional Optical/Photonic Nanostructures: Self-assembly, Properties and Applications [Session B] **Prof. Le He** (Soochow University)
Jan.7th 2016 16:35-16:50	One-dimensional Metal Oxides for Solar Water Splitting [Session A] **Prof. Shaohua Shen** (Xi'an Jiaotong University)
	Interfacial Engineering on organic solar cells [Session B] **Prof. Huiqiong Zhou** (National Center for Nanoscience and Technology)
Jan.7th 2016 16:50-17:05	Multifunctional Magnetoplasmonic Nanomaterials and Their Biomedical Applications [Session A] **Prof. Hongjian Zhou** (Institute of Solid State Physics, Chinese Academy of Sciences)
	Bio-Inspired Design on the Assembly Structure and Adhesion Ability of Carbon Nanotube Composites [Session B] **Prof. Xiaohua Zhang** (Suzhou Institute of Nano-Tech & Nano-Bionics, CAS)
Jan.7th 2016 17:10-18:00	[Session A & B] **Slam Poster**
Jan.8th 2016 8:45-9:10	Research excellence and culture of scientific integrity [Plenary] **Prof. Max Lu** (University of Queensland)
Jan.8th 2016 9:10-9:35	Bio-Inspired Interfacial Materials with Super-Wettability [Plenary] **Prof. Lei Jiang** (Beihang University)
Jan.8th 2016 9:35-10:00	Graphene oxide composites for cancer treatment, energy storage, and displaying [Plenary] **Prof. Min Gu** (Swinburne University of Technology)
Jan.8th 2016 10:10-10:35	Microstructure and Property Comparison between Planar and Mesoscopic Perovskite Solar Cells [Plenary] **Prof. Yibing Cheng**

	(Monash University)
Jan.8th 2016 10:35-11:00	Biocompatibility of Plasma Immersion Ion Implantation Treated Shape Memory Polyurethane [Plenary] **Prof. Lin Ye** (The University of Sydney)
Jan.8th 2016 11:00-11:25	Australia – China Science and Technology Innovation, Collaboration and Positive Impact [Plenary] **Prof. Gang Wei** (CSIRO Manufacturing)
Jan.8th 2016 11:25-11:50	To be announced [Plenary] **Prof. Xiaodong Chen** (Soochow University)
Jan.8th 2016 11:50-12:15	To be announced [Plenary] **Prof. Aibing Yu** (University of New South Wales)
Jan.8th 2016 13:30-13:45	Functional Nanoparticles for Tumor Imaging [Session A] **Prof. Mingyuan Gao** (Institute of Chemistry, CAS)
	Towards the Growth of High-quality Epitaxial InAs Nanowires in Molecular Beam Epitaxy [Session B] **Prof. Jin Zou** (University of Queensland)
Jan.8th 2016 13:45-14:00	Bioinspired photonic materials for biomedical application [Session A] **Prof. Zhongze Gu** (Southeast University)
	Graphene-based soft materials for nanoionics [Session B] **Prof. Dan Li** (Monash University)
Jan.8th 2016 14:00-14:15	Inorganic Nanoparticle-Metal Organic Framework Core- Shell Nanostructures: A Novel Multifunctional Platform [Session A] **Prof. ZhiyongTang** (National Center for Nanoscience and Technology)
	Carbon-based Nanostructures for Energy Conversion and Storage: Synthesis, Performance and Mechanism [Session B] **Prof. Zheng Hu** (Nanjing University)
Jan.8th 2016 14:15-14:30	Dual phase ceramic membranes for air separation and high temperature oxidations [Session A] **Prof. Shaomin Liu** (Curtin University)
	Boosted Charge Transfer in Sn-based Heterostructures: Toward High Rate Capability for Sodium-Ion Batteries[Session B] **Prof. Zaiping Guo** (University of Wollongong)

Jan.8th 2016 14:30-14:45	Multi-scale Nanofibers Films with Special Wettability [Session A] **Prof. Yong Zhao** (Beihang University)
	Multi-shelled Hollow Micro-/Nanostructures: From Art of Structures to Realistic Applications [Session B] **Prof. Dan Wang** (Institute of Process Engineering, CAS)
Jan.8th 2016 14:45-15:00	Bioinspired Graphene-based Nanocomposites Through Synergistic Effect [Session A] **Prof. Qunfeng Cheng** (Beihang University)
	High Performance Flexible, Solid-state Supercapacitors [Session B] **Prof. Yanwei Ma** (Institute of Electrical Engineering, CAS)
Jan.8th 2016 15:00-15:15	Design of Nanoporous Carbon Spheres for Energy Conversion and Storage [Session A] **Prof. Jian Liu** (Curtin University)
	Cation Coordination Reactions on Nanocrystals: Surface/Interface, Doping Control and Applications [Session B] **Prof. Jiatao Zhang** (Beijing Institute of Technology)
Jan.8th 2016 15:35-15:50	Zeolitic imidazolate framework membranes for molecular sieving separations [Session A] **Prof. Huanting Wang** (Southeast University)
	CVD Growth of Single-Walled Carbon Nanotubes with Controlled Structures [Session B] **Prof. Jin Zhang** (Peking University)
Jan.8th 2016 15:50-16:05	Chiral Polymeric Biointerface Materials [Session A] **Prof. Taolei Sun** (Wuhan University of Technology)
	Atomically Engineered Materials for Hydrogen Evolution Reaction [Session B] **Prof. Huagui Yang** (East China University of Science and Technology)
Jan.8th 2016 16:05-16:20	Ultrasmall Inorganic Nanoparticles for Molecular imaging [Session A] **Prof. Zhen Li** (Soochow University)
	Commercial Carbon Molecular Sieves as a High Performance Anode for Sodium-Ion Batteries [Session B] **Prof. Quanhong Yang** (Tianjin University)
	Self-assembled $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ nanosheets cathode with high

Jan.8th 2016 16:20-16:35	electrochemical performance [Session A] **Prof. Chuanqi Feng** (Hubei University)
	Tuning the Electronic Structure of BiOX under Strain [Session B] **Prof. Weichang Hao** (Beihang University)
Jan.8th 2016 16:35-16:50	Soft Plasmene Nanosheets as Surface-Attachable SERS Substrates with High Signal Uniformity [Session A] **Prof. Yi Chen** (Southeast University)
	Photo-functional materials for clean energy, environment remedy and biological application [Session B] **Prof. Junying Zhang** (Beihang University)
Jan.8th 2016 16:50-17:05	The Controllable Assembly of a Perylenediimide Molecule with Photoswitching Property [Session A] **Prof. Ying Ma** (Shenyang Jianzhu University)
	Engineering Vanadium Oxide Nanoparticles for Smart Window Coatings [Session B] **Prof. Xuchuan Jiang** (Monash University)
Jan.8th 2016 17:05-17:20	To be announced [Session A] **Dr. Zhigang Chen** (University of Queensland)
	Designing Hydrogen Bonded Crystals[Session B] **Prof. Yuzhou Liu** (Beihang University)
Jan.8th 2016 17:20-17:35	Quasi-Free-Standing Epitaxial Silicene on Ag(111) by Oxygen Intercalation [Session A] **Dr. Yi Du** (University of Wollongong)
	Combining fast Li-ion battery cycling with large volumetric energy density through high tap density $Li_4Ti_5O_{12}$ anode [Session B] **Prof. Yanbing He** (Tsinghua University)
Jan.8th 2016 17:35-17:50	Silica Nano-pollens: Nature-inspired Carriers for Advanced Antimicrobial Delivery [Session B] **Prof. Chengzhong Yu** (University of Queensland)
Jan.9th2016 9:00-9:30	Mesoscience: Enabling Realtime Simulation of Chemical Engineering [Plenary] **Prof. Jinghai Li** (Institute of Process Engineering, CAS)
Jan.8th 2016	Spherical Mesoporous Architectures: Interfacial Assembly from Single- to

9:30-10:00	Multi-Level and Their Applications [Plenary] **Prof. Dongyuan Zhao** (Fudan University)
Jan.8th 2016 **10:30-11:30**	**Poster Awards and Closing Ceremony**

Upconversion Nanoparticles-based Nanotheranostics for Overcoming Tumor Hypoxia

Wenbo Bu*

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Abstract: Tumors are always very difficult to be completely eradicated, which is mainly attributed to a great number of hypoxic cells within solid tumors. Tumor hypoxia is strongly associated with tumor propagation/progression and vascular abnormalities, and has become one of the most unmanageable obstacles in the solid tumor treatment. What is worse, most hypoxic tumors developed resistance to chemotherapy and other oxygen-dependent therapies, thus leading to the treatment failure of solid tumors as well as the induction of cancer invasion/metastasis. Therefore, the accurate diagnosis and efficient treatment of solid tumors by overcoming tumor hypoxia is the premise for winning the war against cancer.

In this talk, I will focus on the latest progresses made by our group on the developments of upconversion nanoparticles(UCNPs)-based nanomedicines for overcoming tumor hypoxia. Recently, our group developed a non-invasive oxygen assessing method by designing a NIR-excited ultrasensitive nanosensor based on the combination of UCNP and commercial oxygen indicator $[Ru(dpp)3]^{2+}Cl_2$.[1] This novel NIR-excited nanosensor could reversibly detect the oxygen changes and sensitively estimate the hypoxic levels both in cancerous cells and in living zebrafish, which provided an accurate method for sensing hypoxia in vitro and in vivo. Besides accurate diagnosis of hypoxic tumors, a series of strategies have been proposed for overcoming tumor hypoxia, which include the following strategies: overcoming hypoxia (photothermal therapy/radiotherapy.[2] oxygen-elevated synergetic PDT/radiotherapy[3]); utilizing hypoxia (PDT/bioreductive chemotherapy);[4] evading hypoxia (X-ray-excited synchronous PDT/radiotherapy,[5] NO gas-elevated synergetic therapy[6]). We hope these UCNPs based nanotheranostics can greatly contribute to achieving successful theranostics and fulfilling our “one drug fits all” dream.

References:

1. J. Liu, Y. Liu, W. Bu, J. Bu, Y. Sun, J. Du, J. Shi, *J. Am. Chem. Soc.* **2014**, *136*,9701-9709.
2. Q. Xiao, X. Zheng, W. Bu, W. Ge, S. Zhang, F. Chen, H. Xing, Q. Ren, W. Fan, K. Zhao, *J. Am. Chem. Soc.* **2013**, *135*,13041-13048.
3.W. Fan, W. Bu, B. Shen, Q. He, Z. Cui, Y. Liu, X. Zheng, K. Zhao, J. Shi, *Adv. Mater.* **2015**, *27*,4155-4161.
4.Y. Liu, Y. Liu, W. Bu, C. Cheng, C. Zuo, Q. Xiao, Y. Sun, D. Ni, C. Zhang, J. Liu, *Angew. Chem. Int. Ed.* **2015**, *54*, 8105 – 8109.
5. C. Zhang, K. Zhao, W. Bu, D. Ni, Y. Liu, J. Feng, J. Shi, *Angew. Chem. Int. Ed.* **2015**, *127*,1790-1794.
6. W. Fan, W. Bu, Z. Zhang, B. Shen, H. Zhang, Q. He, D. Ni, Z. Cui, K. Zhao, J. Bu, *Angew. Chem. Int. Ed. 127*,14232-14236.

Author Biography

Wenbo Bu received his Ph.D. in 2002 from Nanjing University of Technology (NJUT). He then worked as a postdoctoral researcher at Shanghai Institute of Ceramics, Chinese Academy of Sciences (SICCAS) from 2002 to 2004, as an assistant professor at SICCAS from 2004 to 2005 and as an associate professor at SICCAS from 2005 to 2008. He has been working as a full professor at SICCAS since 2008. His current research interests include the design and synthesis of multifunctional rare-earth based nanomaterials for future cancer imaging and therapeutic applications.

The structural development of primary cultured hippocampal neurons on a graphene substrate

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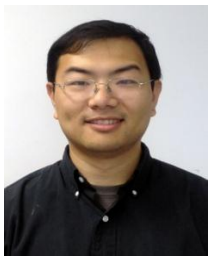
Abstract: Graphene-based nanomaterials have many biomedical applications. However, their potential as a neural interfacing material for neural repair and regeneration remains poorly understood. In the present study, the response to the graphene substrate by neurons was determined in a hippocampal culture model. The results revealed that graphene has excellent biocompatibility and has great potential as a neural interfacing material because the growth and maturation of hippocampal cultures were improved compared to the tissue culture polystyrene substrate used in most commercial applications. Graphene promoted growth cone growth and microtubule formation inside filopodia 24 h after seeding as evidenced by a higher average number of filopodia emerging from growth cones, a longer average length of filopodia, and a larger growth cone area. Graphene also significantly boosted neurite sprouting and outgrowth. The dendritic length, the number of branch points, and the dendritic complex index were significantly improved on the graphene substrate during culture. Moreover, the spine density was enhanced and the maturation of dendritic spines from thin to stubby spines was significantly promoted on graphene at 21 days after seeding. Lastly, graphene significantly elevated the synapse density in the hippocampal culture starting from 7 days after seeding. The present study highlights graphene's potential as a neural interfacing material for neural repair and regeneration and provides insight into the future biomedical applications of graphene-based nanomaterials.

Author Biography



Renjie Chai received his B.Sc. degree at University of Science and Technology of China (2004), and obtained Ph.D. degree at Baylor University (2004-2009). From 2009 to 2013, he worked in Stanford University as a Postdoctoral Research Fellow. In 2013, he joined Southeast University as professor at institute of life sciences. His research interest focuses on taking advange of advance materials to promote the regeneration of hair cell and auditory neuron from stem cells.

Rational Design of Cathode Structure for High-Performance Li-S Batteries

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Abstract: As one of the most intensely investigated technologies in the electrochemical energy storage beyong Lithium-ion, lithium-sulfur (Li-S) batteries have observed rapid improvements in their properties in recent years. This presentation reports recent progresses in the understanding and development of Li-S cathode design.

One of the technological bottlenecks in Li-S batteries is the insulating nature of elementary sulphur and the discharging products Li2S2 and Li2S. The slow charge transfer process in the cathode structure thus imposes restrictions on the degree of sulfur utilization, initial capacity and the rate performance.The nano-size effect in Li-S cathodic charge transfer has been thoroughly investigated. S nanoparticles with diameters below 50 nm were fabricated via a membraneassisted precipitation method. With conductive PEDOT coating, these S nanoparticles show high specific capacity and improved cycle stability. The study indicated that nanosized sulfur required shorter charge diffusion distance and thus showed higher capacity (Sci.Rep.2013,3,1910). Further understanding of the nano-size effect needs better size-controlled S materials, which were obtained using the sulfur-amine chemistry recently developed (Chem. Commun., 2014,50,1202). A series of mono-dispersed S nanoparticles with diameters ranging from 5 nm to 150 nm were employed to investigate the size-dependent charge transfer process and the influence on device performance. Experimental results revealed much improved specific capacity, rate performance and cycle stability upon the reduction of S nanoparticle size. Importantly, the 5 nm S particles showed an initial capacity of 1670 mAh/g, which is the theoretical limit of sulfur (Nano Lett. 2015, 15, 798). This work demonstrates that the high theoretical performance can indeed be realized. The understanding of S cathode charge transfer will help future cathodic design in the Li-S technology.

Author Biography

Liwei Chen is a Professor of Physical Chemistry at Suzhou Institute of Nanotech and Nanobionics (SINANO), Chinese Academy of Sciences. He received his B. S. from University of Science and Technology of China, M. S. from Peking University, and Ph. D. in Chemistry from Harvard University (Prof. C. M. Lieber). He then worked as postdoctoral research fellow at Columbia University (Prof. L. E. Brus) and taught at Ohio University as an assistant professor from 2004 -2008. He joined SINANO in 2009. His current research program focuses on the materials and interfaces in energy nanotechnology.

Soft Plasmene Nanosheets as Surface-Attachable SERS Substrates with High Signal Uniformity

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Abstract: Building plasmene nanosheets enables new class of 2D optical metamaterials, which are free-standing, one-particle-thick, supracrystalline structures constituted by metallic nanocrystals.[1] Such novel plasmene nanosheets can generate enhanced electromagnetic fields *via* localized surface plasmon resonance and coupling effects between nanoparticles, which holds a great promise as an advanced suite for ultrasensitive detection of chemicals and food contaminants on real-world topologically complex surfaces.

Herein, we present a new class of SERS substrates – soft plasmene nanosheets fabricated *via* polymer-based bottom-up self-assembly approach. Such nanosheets were ultrathin, mechanically flexible, optically translucent, enabling their attachment to real-world topologically complex surfaces for reproducible and sensitive detection of chemicals.[2] The excitation wavelengths and SERS enhancement of nanosheets could be fine-tuned by adjusting sizes and shapes of constituent building blocks, as demonstrated by both experiment and simulation. Hence, excitation wavelength-specific SERS hotspots could be generated in a highly controlled manner. In addition, plasmene nanosheets exhibited high structural homogeneity. This will enable their use as universal and unique SERS substrates with highly uniform Raman hotspot distributions across large areas for rapid and sensitive multi-phase detection of chemical species in multiphase, and even on topologically complex solid surfaces. Finally, we will discuss the possible application trends for those plasmonic nanoarchitectures, and present our perspectives on the opportunities and challenges in this emerging field.

Acknowledgements:

Y. Chen acknowledges Dr. Kae Jye Si and Dr. Debabrata Sikdar for their collaborative contribution to this work.

References:

1. Si, K. J.; Sikdar, D.; Chen, Y.; Xu, Z.; Tang, Y.; Xiong, W.; Guo, P.; Zhang, S.; Lu, Y.; Bao, Q.; Zhu, W.; Premaratne, M.; Cheng, W. L., *ACS Nano* **2014**, *8*, 11086-11093.
2. Chen, Y.; Si, K. J.; Sikdar, D.; Tang, Y.; Premaratne, M.; Cheng, W. L., *Adv. Opt. Mater.* **2015**, *3*, 919-924.

Author Biography

Yi Chen received his *B.Eng.* from East China University of Science and Technology in 2007, and *M.Sci.* from Shanghai Jiao Tong University in 2010. In 2014, he earned his PhD from Monash Univeristy and then joined Southeast University. He is currently an associate professor at School of Biological Science and Medical Engineering, Southeast University. His research interest lies at the Bio-Nano Interface, particularly flexible plasmonic superlattices with ultrasensitive detection and nanoparticle/polymer composites for anticancer theranostics.

Bioinspired Graphene-based Nanocomposites Through Synergistic Effect

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Abstract: Graphene with extraordinary properties, strongest and stiffest material ever measured and the best-known electrical conductor, could have promising applications in many fields. However, processing graphene into high performance nanocomposites is very difficult. So far, graphene-based nanocomposites exhibit rather poor properties. It is a great challenge to assemble these micro-scale nanosheets into macro-sized nanocomposites for practical applications, for example, in aerospace, as flexible supercapacitor electrodes, artificial muscle, and tissue engineering. Where might one seek inspiration for making something new and original?

Nacre, the gold standard for biomimicry, provides an excellent example and guidelines for assembling two-dimensional nanosheets into high performance nanocomposites. The inspiration from nacre overcomes the bottleneck of traditional approaches for constructing nanocomposites, such as poor dispersion, low loading, and weak interface interactions. Graphene-based nanocomposites have been such a "hot topic" of late. Herein, we will focus on how to construct high-performance integrated graphene-based bioinspired nanocomposites through synergistic effect from interface interactions and building blocks based on our recent works.[1-3] Meanwhile we will also focus on a perspective of the dynamic area of bioinspired graphene-based nanocomposites, commenting on whether the concept is viable and practical, on what has been achieved to date, and most importantly what is likely to be achieved in the future.

Acknowledgements:

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References:

1. S. Wan, Y. Li, J. Peng, H. Hu, Q. Cheng, L. Jiang, *ACS Nano* **2015**, *9*, 708-714.
2. Q. Cheng, J. Duan, Q. Zhang, L. Jiang, *ACS Nano* **2015**, *9*, 2231-2234.
3. W. Cui, M. Li, J. Liu, B. Wang, C. Zhang, L. Jiang, Q. Cheng, *ACS Nano* **2014**, *8*, 9511-9517.

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Qunfeng Cheng received his B.Sc. degree at Henan University (2003), and obtained Ph.D. degree at Zhejiang University (2003-2008). From 2008 to 2009, he worked in Tsinghua University and Florida State University as a Postdoctoral Research Fellow. In 2010, he joined BeiHang University. He is currently a Professor at School of Chemistry and Environment, BeiHang University. His research interest focuses on high performance bioinspired polymer nanocomposites.

Microstructure and Property Comparison between Planar and Mesoscopic Perovskite Solar Cells

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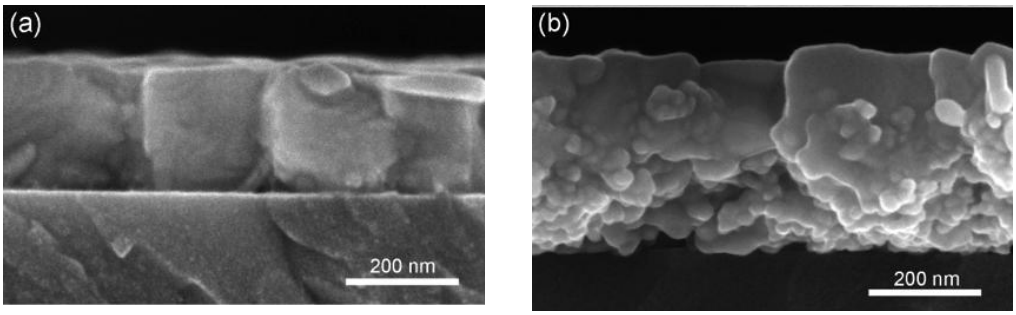
Abstract: Methylammonium lead iodide perovskite has shown very promising optoelectronic properties and produced solar cells with extraordinary efficiency improvement in just a few years. Microstructure of the perovskite film has a critical role to play in controlling the performance of the solar cell. Perovskite solar cells have two common device structures, planar and mesoscopic architectures. In the present study we characterize the relative benefits of the two most prominent $CH_3NH_3PbI_3$ solar cell morphologies, primarily through time-resolved microwave conductivity (TRMC) and time-resolved photoluminescence (TRPL) measurements. The comparatively large perovskite grains, typical of planar assemblies, exhibited higher charge mobilities and slower trap-mediated recombination compared to the mesoscopic architectures. These findings reveal the injurious influence of grain boundaries on both charge transport and recombination kinetics, and suggest an innate advantage of planar morphologies. However, through impedance spectroscopy (IS) measurements, mesoscopic architectures were found to limit the interfacial recombination at the transparent conductive oxide (TCO) substrate. The lessons learnt through the characterization measurements were subsequently utilized to produce an optimized cell morphology, resulting in a maximum conversion efficiency of 16%.



Cross sections of (a) planar and (b) mesoscopic perovskite solar cells

Author Biography

Yi-Bing Cheng is a professor in materials science and engineering at Monash University, Australia and an elected Fellow of the Australian Academy of Technological Sciences and Engineering. He has been a Thousand Talent professor in the State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology since 2015.

Quasi-Free-Standing Epitaxial Silicene on Ag(111) by Oxygen Intercalation

Yi Du

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Abstract: Silicene is single layer of silicon atoms arranged in a honeycomb structure with massless Dirac fermions characteristics, similar as graphene[1-2]. It ensures development of silicon-based multifunctional nanoelectronic and spintronic devices operated at room temperature due to strong spin-orbital coupling. However, silicene can be only epitaxial grown on conductive substrates till now. The strong silicene-substrate interaction may depress its superior electronic properties[3,4]. Here, we report the quasi-free-standing silicene layer that is successfully obtained through oxidization of the bilayer silicene on Ag(111) surface. The oxygen atoms intercalate in the underlayer of silicene, which can isolate the top layer of silicene from substrate. On the consequence, the intercalated silicene exhibits 1×1 lattice and hosts the massless Dirac fermions due to much less interaction with the substrate. Furthermore, the oxidized silicon (SiO_x) buffer layer is expected to serve as an ideal dielectric layer for electric gating in electronic devices. We believe our findings are relevant for the future design and application of silicene-based nanoelectronic and spintronic devices.

Acknowledgements:

This work was financially supported by Australian Research Council through the Discovery Project (DP140102581).

References:

1. Y. Du, J. Zhuang, H. Liu, X. Xu, S. Eilers, K. Wu, P. Cheng, J. Zhao, X. Pi, K. W. See, *ACS Nano* **2014,** *8,*10019-10025.
2. J. Chen, Y. Du, Z. Li, W. Li, B. Feng, J. Qiu, P. Cheng, S. X. Dou, L. Chen, K. Wu, *Sci. Rep.* **2015,** *5*.13590.
3.X. Xu, J. Zhuang, Y. Du, H. Feng, N. Zhang, C. Liu, T. Lei, J. Wang, M. Spencer, T. Morishita, X. L. Wang and S. X. Dou, *Sci. Rep.* 2014.*4*, 7543.

4.J. Zhuang, X. Xu, Y. Du, K. Wu, L. Chen, W. Hao, J. Wang, W. K. Yeoh, X. L. Wang, and S. X. Dou, *Phys. Rev. B (Rapid Communications).*2015 *91*, 161409.

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Yi Du received his Bechalor's and Master's degree at Beihang University, and obtained Ph.D. degree at the University of Wollongong. From 2012 to 2013, he worked in the University of Wollongong as a Vice-Chancellor's Postdoctoral Fellow. Currently, he is a research fellow and the lab supervisor of STM Lab in the Australian Institute for Innovative Materials (AIIM) at the University of Wollongong (UOW). His research interests are in the field of two-dimensional (2D) materials and surface physics and chemistry.

Electrode Architecture Design and Fabrication for Rapid Mass Transport Property with Application in Biosensor Devices.

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Abstract: Via mimicking the top morphologies of natural non-wetting surface, artificial substrates with super-hydrophobicity have been created and are opening applications in many areas. When these substrates is in contact with an aqueous solution, air pockets will be trapped underneath and a solid-liquid-air three-phase interface will form. This offers us an opportunity to address the gas-deficit problem of many reaction system. In our work, we solved the long-standing oxygen-deficit problem in oxidase-based biosensor by developing an oxygen-rich enzyme electrode based on superhydrophobic conducting substrate. Such enzyme-electrode has a solid-liquid-air three-phase assay interface, where oxygen is supplied via air phase with orders of magnitude higher diffusion coefficient than that through liquid phase. This makes the oxidase kinetic no longer oxygen level limited and enables us to detect glucose, a model test analyte, linearly up to 150 mM with good sensitivity. Moreover, the electrode output is insensitive to the significantly fluctuant oxygen level in analyte solutions. Such electrode model is generally applicable to the fabrication of other biosensor, given the availability of a wide variety of oxidase, assay approaches, superhydrophobic substrates and H_2O_2 catalysts. The results indicate that the superhydrophobic surface offers a unique route to address the gas-deficit problem of many reaction systems.

Author Biography

Xinjian Feng is a full professor at College of Chemistry, Soochow University. In 2006, he received Ph.D degree from the Institute of Chemistry CAS under the supervision of Professor Lei Jiang. In 2011, he was selected as part of the "Youth Thousand Talents Program of China". His research interests focus on the electrode architecture design and fabrication for rapid mass and charge transport with applications in solar cells, photocatalysis and biosensor devices.

Self-assembled $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ nanosheets cathode with high electrochemical performance

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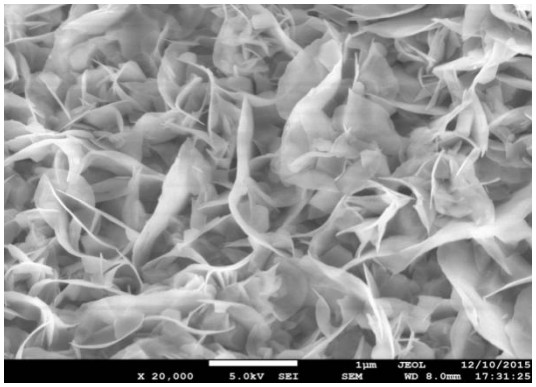
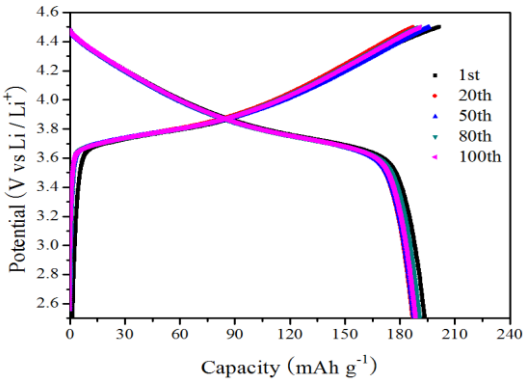
Abstract: $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ nanosheets were prepared via a facile co-precipitation combined hydrothermal method. The structure and morphology of expected compound were mainly depended on conditions (reaction time and temperature). As a cathode material, The $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ nano-sheets behave outstanding electrochemical performances. The initial specific capacities is 193 mAh g^{-1}, it maintains at 189 mAh g^{-1} after 100 cycles at 0.2C and 155 mAh g^{-1} after 400 cycles at 1C.

The as-prepared 1D $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ nanosheets have an efficient contact with electrolyte and short Li^+ diffusion paths as well as sufficient void spaces to accommodate large volume variation [1] The $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ synthesized by this method is a promising cathode for Li-ion battery application.





References:

1. L. Peng, Y. Zhu, U. Khakoo, D.H. Chen, *Nano Energy* 2015, *17*, 36-42.

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Feng Chuanqi received his B.Sc. degree at Hubei University (1982.1), and obtained Ph.D. degree at Wuhan University (2000.6-2003.6). From 1996 to 2004, he worked in Hubei University of Technology as a professor. In 2004, he joined Hubei University. He is currently a Professor at College of chemistry and chemical engineering, Hubei University. His research interest focuses on synthesis and designs of novel materials for application in electrochemical Energy Conversions and lithium Ion Battery. E-mail: cfeng@hubu.edu.cn

Bioinspired Graphene-based Nanocomposites Through Synergistic Effect

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Abstract: vanadium sourced nanoparticles (e.g., vanadium oxide nanoparticles, vanadium oxide based nanocomposites, and vanadate nanoparticles), due to their excellent electrical and catalytical properties, have exhibited attractive performances in the applications of sensing, photocatalysis, batteries, and catalyst. Recently, vanadium oxide and vanadate nanoparticles with excellent sensing performances for organic amines and other volatile organic compounds (VOCs) attract increasing attention, because they show some properly potential use in food and medicine industries, such as, disease diagnose. However, it is still challenging to develop a sensing material with low detection limit, high sensitivity and selectivity. In nanoscale, it is well-accepted that the effect factors of particles on sensing are not only dependent on composition but also morphologies. Based on this realization, we developed several vanadium oxide and vanadate nanoparticles with novel morphologies as sensing materials to detect VOCs.[1,2] Meanwhile, some interesting applications of vanadium oxide (e.g., induced synthesis of Ag nanowires and Ag-Au bimetallic nanowires) were also achieved.[3,4] China possesses large amount of vanadium resources (11.6% of the world), therefore, the development of the downstream vanadium products, particularly as functional nanomaterials is of significance.

Acknowledgements:

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References:

1. H. Fu, X. Yang, X. Jiang, A. Yu, *Sensors and Actuators B: Chem.* **2014**, *203*,705-711.
2. X. Wang, H. Han, X. Liu, X. Gu, K. Chen, D. Lu, *J. Nanopart. Res.* **2012**, *14*,1-10.
3. H. Fu, X. Yang, X. Jiang, A. Yu, *Langmuir* **2013**, *29*,7134-7142.
4. H. Fu, X. Yang, A. Yu, X. Jiang, *Particuology* **2013**, *11*,428-440.

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Haitao Fu obtained PhD in 2014 from the University of New South Wales (Australia), and received his B.Sc. Degree and M.Eng. Degree in the School of Chemistry and Chemical Engineering at China University of Petroleum (Huadong). He currently works in the School of Metallurgy at Northeastern University (China). His research interests include synthesis of metal oxide nanomaterials for gas sensing, photocatalysis, and catalysis.

Functional Nanoparticles for Tumor Imaging

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Abstract: Through either passive or active targeting, functional nanoparticles have shown great potentials in visualizing tumors in vivo. In this presentation, we will present our recent results on tiny tumor imaging, tumor micrometastasis imaging and the visualization of tumor microenvironment as well, apart from the synthesis and surface functionalization of versatile inorganic nanoparticles.

References:

1. Liu, Y. Qi, R. Qiao, Y. hou, K. Chan, Z. Li, J. Huang, L. Jing, J. Du*, and M. Y. Gao*, *Nanoscale* in press.
2. Jiao, J. Zeng, L. Jing, C. Liu, and M. Y. Gao*, *Chem. Mater.* **2015**, *27*, 1299.
3. Hou, J. Zhou, Z. Gao, X. Sun, C. Liu, D. Shangguan, W. Yang, and M. Y. Gao*, *ACS Nano* **2015**, *9*, 3199.
4. Qiao, C. Liu, M. Liu, H. Hu, C. Liu, Y. Hou, K. Wu*, Y. Lin, J. Liang, M. Y. Gao*, *ACS Nano* **2015**, *9*, 2120.
5. Jing, S. V. Kershaw, T. Kipp, S. Kalytchuk, K. Ding, J. Zeng, M. Jiao, X. Sun, A. Mews, A. L. Rogach, and M. Y. Gao*, *J. Am. Chem. Soc.* **2015**, *137*, 2073.
6. Zeng, L. Jing, Y. Hou, M. Jiao, R. Qiao, Q. Jia, C. Liu, F. Fang, H. Lei, and M. Y. Gao*, *Adv. Mater.* **2014**, *26*, 2694.
7. Zeng, B. Jia, R. Qiao, C. Wang, L. Jing, F. Wang and M. Y. Gao*, *Chem. Commun.* **2014**, *50*, 2170
8. Liu, Z. Gao, J. Zeng, Y. Hou*, F. Fang, Y. Li, R. Qiao, L. Shen, H. Lei, W. Yang, and M. Y. Gao*, *ACS Nano* **2013**, *7*, 7227.
9. Hou, R. Qiao, F. Fang, X. Wang, C. Dong, K. Liu, C. Liu, Z. Liu, H. Lei*, F. Wang, and M. Y. Gao*, *ACS Nano* **2013**, *7*, 330.
10.Qiao, Q. Jia, S. Hüwel, R. Xia, T. Liu, F. Gao*, H.-J. Galla*, and M. Y. Gao*, *ACS Nano* **2012**, *6*, 3304.
11.Jia, J. Zeng, R. Qiao, L. Jing, L. Peng, F. Gu*, and M. Y. Gao*, *J. Am. Chem. Soc.* **2011**, *133*, 19512.

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Mingyuan Gao received his BSc (1989) and PhD (1995) in Polymer Chemistry and Physics at Jilin University. He worked as research assistant and associate in Germany from 1996 to 2002 and was AvH fellow between 1996 and 1998. He became a full Professor upon 'Hundred-talent Program' of CAS in 2001. He received the 'National Science Fund for Distinguished Young Scholars' from NSFC in 2002. He has published ~110 peer-reviewed articles and holds 17 patents. His research focuses on the synthesis and biological, biomedical applications of functional nanomaterials. More details can be found at http://www.gaomingyuan.com.

Preparation, Structure and Electrochemical Energy Storage Property on Inorganic Porous Materials

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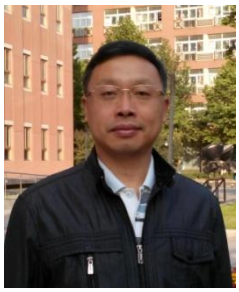
Abstract: Inorganic porous materials are quite important as the electrodes of supercapacitors and lithium ion batteries. Many kinds of inorganic materials possessing of advanced pore structures and textures were prepared by using suitable chemical and/or physical methods such as bio-inspired, hydrothermal and ultrasound techniques as well as calculation and activation. Those porous materials have obviously high electrochemical energy storage properties. For example, 2D microporous carbon AC-SPN-3 obtained by pyrolysis of natural waste pistachio nutshells with KOH activation shows large areal capacitance of 29.3/20.1 mF cm^{-2} and high energy density of 10/39 Wh kg^{-1} at power of 52/286 kW kg^{-1} in 6 M KOH aqueous electrolyte and 1 M $TEABF_4$ in EC-DEC organic electrolyte system, respectively.[1] Beehive-like porous carbon BHNC synthesized by carbonizing the industrial waste of bamboo-based by-product exhibits a high specific capacitance of 301 F g^{-1} at 0.1 A g^{-1}, still maintaining a value of 192 F g^{-1} at 100 A g^{-1}.[2] 1D nickel cobaltite nanowires prepared by hydrothermal technique has the specific capacitance of 722 F g^{-1} at 1 A g^{-1} with 79% capacitance preserved at 20 A g^{-1}.[3] Hierarchical porous nanofibers H2@Co_3O_4 with oriented Co_3O_4 (220) facets on the human hair-derived carbon matrix prepared by the solvothermal and calcination approach show the first discharge capacity of 1368 mAh g^{-1} at the current density of 0.1 A g^{-1}. A high reversible capacity of 916 mAh g^{-1} was obtained over 100 cycles at 0.1 A g^{-1}.[4] These promising results open the window of the amazing world on the porous energy storage materials and more and more interesting results will be explored.

References:

1. J. Xu, Q. Gao, Y. Zhang, Y. Tan, W. Tian, L. Zhu, L. Jiang, *Sci. Rep.* **2014**, *4*, 5545.
2. W. Tian, Q. Gao, Y. Tan, K. Yang, L. Zhu, C. Yang, H. Zhang, *J. Mater. Chem. A* **2015**, *3*, 5656-5664.
3. H. Wang, Q. Gao, L. Jiang, *Small*, **2011**, *7*, 2454-2459.
4. Y. Tan, Q. Gao, C. Yang, K. Yang, W. Tian, L. Zhu, *Sci. Rep.* **2015,** *5*, 12382.

Author Biography



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Graphene oxide composites for cancer treatment, energy storage, and displaying

Min Gu[1,2]

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Abstract: Graphene has emerged as an important nanomaterial in nanophotonic applications including plasmonic photonics and photovoltaitic devices. Graphene oxides have played a significant role in functional photonic devices because their intrinsic optical property can be tailored by direct laser writing. This important feature can significantly modify the property of light propagation ranging from absorption, reflection, refraction, polarisation, chirality, and topology of light, forming an entirely new ground for addressing the bottleneck issues in solar energy harvesting, and biomedical sensing and optical information technology, In this talk, we will discuss our recent progress on the use of laser reduced graphene oxides for manipulating optical beams for cancer treatment, energy storge and displaying.

Author Biography

Professor Gu is Distinguished Processor and Associate Deputy Vice-Chancellor, Royal Melbourne Institute of Technology University. He is an author of four standard reference books and has over 450 publications in nano/biophotonics. He is an elected Fellow of the Australian Academy of Science as well as the Australian Academy of Technological Sciences and Engineering. He is also an elected fellow of the Australian Institute of Physics, the Optical Society of America, the International Society for Optical Engineering, the Institute of Physics (UK), and the International Institute of Electric and Electronic Engineers. He was President of the International Society of Optics within Life Sciences and Vice President of the Bureau of the International Commission for Optics (ICO) (Chair of the ICO Prize Committee, Galileo Galilei Award Committee) anda Director of the Board of the Optical Society of America. He was awarded the Einstein Professorship of the Chinese Academy of Science (2010, Laureate Fellowship of the Australian Research Council (2010), the W. H. (Beattie) Steel Medal of the Australian Optical Society (2011), the Ian Wark Medal and Lecture of the Australian Academy of Science (2014), and the Boas Medal of the Australian Institute of Physics (2015).

Bioinspired photonic materials for biomedical application

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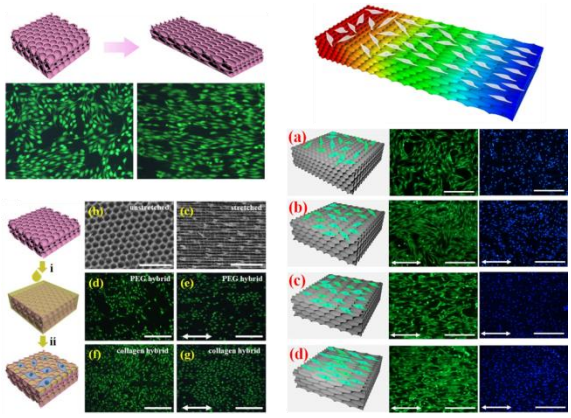
Abstract: In biological research, the interaction of biomolecules, cells and materials is an eternal topic. Self-assembly technologies have attracted increasing interest due to their advantages in constructing three-dimensional micro-and nano- hierarchical structure of materials. Several biological and biological materials, such as DNA and proteins, as well as colloidal particles, have been successfully used as the basic elements to self-assemble the nano- and micro-structured biomaterials. However, it is still a challenge to combine the artificially controllable self-assembly biomaterials and the complicated biomolecular interaction and cell living unit, and thus to realize the regulation and control of the cell culture by using the self-assembly materials. Moreover, it is necessary to develop a biotechnology for cell research to real-time and accurately monitor the interaction of the biomolecules and cells and the self-assembly biomaterials, which could effectively reveal the biological mechanism of the cell behavior. In this point, we proposed to carry the out biomedical research based on the self-assembly hierarchical structured photonic materials. We have investigated the interaction between a series of biomolecules and the bioinspired photonic biomaterials, and sensing mechanism of the biomaterials in the biomolecules. Based on these researches, we have focused on the construction of novel photonic material platforms with the function of real-time monitoring cells for the study of the interaction between cells and biomaterials.



Author Biography

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Boosted Charge Transfer in Sn-based Heterostructures: Toward High Rate Capability for Sodium-Ion Batteries

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Abstract: Constructing hetero-nanostructures can endow nanomaterials with fascinating performance in high-speed electronics, optoelectronics, and other applications because of the built-in charge transfer driving force, which is of benefit to the specific charge-transfer kinetics. Rational design and controllable synthesis of nano-heterostructure anode materials with high-rate performance, however, still remains a great challenge. Here, ultrafine Sn-based heterostructures were successfully fabricated and thus lead to boosted charge transfer within the nanocrystals. The mobility enhancement is attributed to reduction of the charge center scattering and the interface effect of heterostructures, which induces an electric field within the nanocrystals, giving them much lower ion diffusion resistance and facilitating interfacial electron transport. The enhancement of the electrochemical performance is reflected by the excellent cycling stability and high rate capability of the heterostructures. It can be envisaged that optimization of anode materials with heterostructures could lead to advanced next-generation Li/Na-ion batteries.

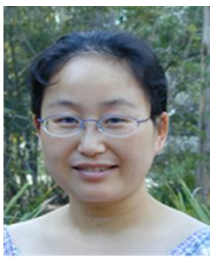
Acknowledgements:

Financial support provided by the Australian Research Council (ARC) through an ARC Discovery project (DP1094261) is gratefully acknowledged.

References:

1. Zhou, T., Pang, W. K., Zhang, C., Yang, J., Chen, Z., Liu, H. K., & Guo, Z. *ACS Nano* **2014**, *8*, 8323-8333.
2. L. Li, K.H. Seng, Y.Y. Xia, H.K. Liu, Z.P. Guo, *Nano Research* **2014**, *7*, 1466.

Author Biography



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Tuning the Electronic Structure of BiOX under Strain

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Abstract: Being a new two dimensional layered compounds, the tunable indirect-direct band transformation of BiOX(X=Cl,Br) can be realized by introducing the biaxial tensile or compressive strains. A phase transformation of bilayer BiOCl and metallic characteristic for all are observed under large tensile and compressive strains, respectively. In addition, bond length, interlayer spacing and band decomposed charge density are calculated to analyze the mechanism behind these phenomena. The results indicate that the band structure transformation is primarily related to the competitions between two kinds of intra-layer and inter-layer Bi-O bonds and hybridizations between atoms under strains. BiOBr nanosheets with highly reactive {001} facets exposed were selectively synthesized by a facile hydrothermal method. The inner strain in the BiOBr nanosheets has been tuned continuously by the pH value. The photocatalytic performance of BiOBr in dye degradation can be manipulated by the strain effect. The low-strain BiOBr nanosheets show improved photocatalytic activity. Density functional calculations suggest that strain can modify the band structure and symmetry in BiOBr. The enhanced photocatalytic activity in low-strain BiOBr nanosheets is owing to improved charge separation due to a highly dispersive band structure with an indirect band gap.

Acknowledgements:

This work was financially supported by National Natural Science Foundation of China (51472016，51272015).

References:

1. H Feng, et al., *ACS Appl. Mater. Interface* 2015, revised.
2. J. Shang, W. Hao, X. Lv, T. Wang, X. Wang, Y. Du, S. Dou, T. Xie, D. Wang, J. Wang, *ACS Catalysis* **2014**, *4*,954-961.

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Functional Optical/Photonic Nanostructures: Self-assembly, Properties and Applications

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Abstract: Self-assembly of colloidal building blocks provides an effective route to the construction of functional nanostructures with new optical/photonic properties determined by the ordering, orientation and periodicity. The properties of these nanostructures can be conveniently tuned through the adjustment of the building blocks, size, shape, and ordering of the assemblies. Herein we focus on how to construct photonic nanostructures via self-assembly strategies and demonstrate the dynamic tuning of their photonic properties in response to external stimuli. For example, a magnetic field can be used to rapidly and reversibly induce the assembly of colloidal particles into photonic nanostructures and tune the structural colour in the assemblies. These functional nanostructures represent a novel type of smart optical materials which will find broad applications in diverse fields, such as reflective display, colour printing, anti-counterfeiting.

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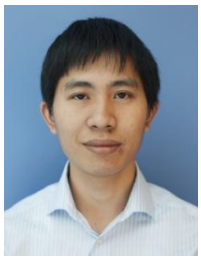
Author Biography



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Dr. Xiaohong Zhang received BASc and MASc from Beijing University of Aeronautics and Astronautics at 1989 and 1992, and obtained Ph.D.from Beijing University of Technology at 1996. He then worked as Post-Doc. at Institute of Photographic Chemistry of Chinese Academy of Sciences (CAS) during1996-1998,SeniorVisiting Scholar at City University of Hong Kong during 1998-2000. He is currently a professor of Institute of Functional Nano & Soft Materials,SoochowUniversity.Dr. Zhang's research interests include (1) Synthesis andCharacterizationofOrganic Optoelectronic Materials;(2)Synthesis and Funcitionalization of Semiconductor Nano-Materials; and (3) Optoelectronic Devices.

Combining fast Li-ion battery cycling with large volumetric energy density through high tap density $Li_4Ti_5O_{12}$ anode

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Abstract: The relatively poor safety, inferior high rate charge and poor low temperature properties are often considered as the most critical issues of LIBs to be solved. Conventional carbon-based anodes lead to accumulative formation of irreversible lithium dendrites on the carbon electrode surface, especially upon fast charging and low temperature charging conditions. One of the most promising alternative anode materials for high-rate LIBs is spinel $Li_4Ti_5O_{12}$ (LTO) based on its excellent cyclic reversibility, high safety and good Li-ion kinetics at low temperatures. However, the poor electronic and ionic conductivities of LTO have initiated the development of many types of nanostructured LTO materials aiming at larger reaction surface areas and shortened Li-ion and electron transport lengths. The nanostructured LTO materials compromises the tap density of the LTO powder.

Herein, high tap density LTO materials are prepared via a simple process and displaying exceptionally stable long-term high rate cyclic performance [1-3]. Densely-packed $Li_4Ti_5O_{12}$ (LTO) sub-microspheres are prepared *via* a self-assembly process resulting in very high tap densities (1.2 g cm^{-3}). The specific capacities at a (dis)charge rate of 10 and 20 C reach 148.6 and 130.1 $mAhg^{-1}$, respectively. No obvious capacity reduction is found even after 8000 cycles at 30C in a full $LiFePO_4$/LTO battery. The abundant presence of grain boundaries between the nano-crystallites in the spheres can create a 3D interconnected network, which allows very fast Li-ion and electron transport. In addition, monodisperse LTO nanospheres with an average diameter of 120 nm are prepared via the use of titanium nitride (TiN) as a titanium source. Sheets of LTO with high crystallinity are coated with nitrogen-doped carbon (NC-LTO) using a hydrothermal reaction followed by chemical vapor deposition (CVD).

Acknowledgements:

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References:

1. C. Wang, S. Wang, Y.-B. He, L. Tang, C. Han, C. Yang, M. Wagemaker, B. Li, Q.-H. Yang, J.-K. Kim, *Chem. Mater.* **2015,** *27*,5647-5656.
2. C. Han, Y. B. He, B. Li, H. Li, J. Ma, H. Du, X. Qin, Q. H. Yang, F. Kang, *ChemSusChem* **2014,** *7*,2567-2574.
3. C. Wang, S. Wang, L. Tang, Y. –B. He, Z. Lin, F. Kang, et al. *Nano Energy*, In press

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Yan-Bing He received his Ph.D. degree from the Department of Applied Chemistry, Tianjin University in 2010. He worked as a post-doctoral fellow at Graduate School at Shenzhen, Tsinghua University from 2010 to 2012 and a visiting scholar at Hong Kong University of Science and Technology from 2012 to 2013. He is currently an associate professor of Graduate School at Shenzhen, Tsinghua University. His research interests mainly focus on lithium ion power batteries and related materials.

Nanostructured Hybrid Materials for Lithium-based Batteries

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Abstract: Presently, safe energy storage is one of the most demanding technologies by the developing society. In this regard, lithium-based batteries (LBs) have got tremendous attention due to their high energy and power densities; have been considered as promising power source for future electric vehicles (EVs). Thus, most of the present research is focused to develop new electrode materials that can bring the realization of these devices for EVs. However, structural disintegration, limited access to redox sites and loss of electrical contact have long been identified as primary reasons for capacity loss and poor cyclic life of these materials. Although nanotechnology plays critical role by developing nanostructures but simple reduction in size introduce new fundamental issues like side reactions and thermally less stable. Thus, a careful design that can inhibit the side reaction by surface protection, make all redox sites accessible by increasing the intrinsic conductivity of the active materials, maintain a continues network for ionic and electronic flow and keeps the structural integrity, resulting improved performance and excellent capacity retention with long cyclic life to meet the requirements set by USABC for electrode materials to use them in EVs. Here, we have developed different hybrid nanostructures of metal oxides, nitrides, sulfides, hydroxides and metal alloys with doped graphene to control above mentioned problems and to achieve the goals set by USABC. All these composites possess extraordinary performances as electrodes of LBs with long cyclic stability and excellent rate capability. The high performance of the composites based on the synergistic effect of several components in the nanodesign. These strategies to combine the different property enhancing factors in one composite with engineered structures will bring the realization of these devices in road market.

Acknowledgements: This work was financially supported by NSFC (51125001,51172005), NSFC-RGC(51361165201).

References:

1. N. Mahmood, J. Zhu, S. Rehman, Q. Li, Y. Hou, *Nano Energy* **2015,** *15*,755-765.
2. N. Mahmood, M. Tahir, A. Mahmood, J. Zhu, C. Cao, Y. Hou, *Nano Energy* **2015,** *11*,267-276.
3. N. Mahmood, Y. Hou, *Adv. Science* **2014,** *1*.
4. C. Zhang, N. Mahmood, H. Yin, F. Liu, Y. Hou, *Adv. Mater.* **2013,** *25*,4932-4937.
5. N. Mahmood, C. Zhang, J. Jiang, F. Liu, Y. Hou, *Chem.-Eur. J.* **2013,** *19*,5183-5190.
6. N. Mahmood, C. Zhang, Y. Hou, *Small* **2013,** *9*,1321-1328.
7. N. Mahmood, C. Zhang, F. Liu, J. Zhu, Y. Hou, *ACS Nano* **2013,** *7*,10307-10318.
8. N. Mahmood, C. Zhang, H. Yin, Y. Hou, *—J. Mater. Chem.A* **2014,** *2*,15-32.
9. H. Yin, C. Zhang, F. Liu, Y. Hou, *Adv. Funct. Mater.* **2014,** *24*,2930-2937.

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Yanglong Hou obtained his Ph.D. in Materials Science from Harbin Institute of Technology (China) in 2000. After a short post-doctoral training at Peking University, he worked at University of Tokyo from 2002-2005 as JSPS foreign special researcher and also at Brown University from 2005-2007 as postdoctoral researcher. He joined the Peking University in 2007, and now is the Chang Jiang Chair Professor of Materials Science. His research interests include the design and chemical synthesis of functional nanoparticles and graphene, and their biomedical and energy related applications.

Carbon-based Nanostructures for Energy Conversion and Storage: Synthesis, Performance and Mechanism

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Abstract: Fuel cells, supercapacitors and lithium-sulphur batteries are the typical energy conversion and storage devices of great significance in which carbon-based nanostructures could play irreplaceable role. The functionalized carbon-based nanostructures could be applied to fuel cells to lower Pt loading by highly dispersing and immobilizing Pt-based nanoparticles, or to totally get rid of Pt with the metal-free electrocatalytic ability themselves. The abundant nanostructures and morphologies, tunable compositions, high surface area, good conductivity, small volume expansion, as well as the low cost and environmental benignity make the carbon-based nanostructures have great potential as electrode materials of supercapacitors and lithium-sulphur batteries. In this talk I will give a brief introduction to the progressive advancements in our group about the synthesis, performance and mechanism of carbon-based nanostructures, especially the nanocages, for this kind of energy conversion and storage.[1-10] Special attention will be paid to the carbon-based nanomaterials doped with electron-rich N,[2] electron-deficient B,[3] and the both,[4] as well as to the dopant-free carbon nanomaterials,[5] to elucidate the correlation of performance with electronic configuration, which is a general interesting issue in developing the advanced carbon-based energy materials.

References:

1. Y. Tian, Z. Hu, Y. Yang, X. Wang, X. Chen, H. Xu, Q. Wu, W. Ji, Y. Chen, *J.Am.Chem,Soc.* **2004,** *126*,1180-1183.
2. S. Chen, J. Bi, Y. Zhao, L. Yang, C. Zhang, Y. Ma, Q. Wu, X. Wang, Z. Hu, *Adv. Mater.* **2012,** *24*,5593-5597.
3. L. Yang, S. Jiang, Y. Zhao, L. Zhu, S. Chen, X. Wang, Q. Wu, J. Ma, Y. Ma, Z. Hu, *Angew. Chem. Int. Ed.* **2011,** *123*,7270-7273.
4. Y. Zhao, L. Yang, S. Chen, X. Wang, Y. Ma, Q. Wu, Y. Jiang, W. Qian, Z. Hu, *J.Am.Chem,Soc.* **2013,** *135*,1201-1204.
5. Y. Jiang, L. Yang, T. Sun, J. Zhao, Z. Lyu, O. Zhuo, X. Wang, Q. Wu, J. Ma, Z. Hu, *ACS Catalysis* **2015,** *5*,6707-6712.
6. S. Jiang, Y. Ma, G. Jian, H. Tao, X. Wang, Y. Fan, Y. Lu, Z. Hu, Y. Chen, *Adv. Mater.* **2009,** *21*,4953.
7. Y. Ma, S. Jiang, G. Jian, H. Tao, L. Yu, X. Wang, X. Wang, J. Zhu, Z. Hu, Y. Chen, *Energy Environ. Sci.* **2009,** *2*,224-229.
8. J. Zhao, H. Lai, Z. Lyu, Y. Jiang, K. Xie, X. Wang, Q. Wu, L. Yang, Z. Jin, Y. Ma, *Adv. Mater.* **2015**.
9. K. Xie, X. Qin, X. Wang, Y. Wang, H. Tao, Q. Wu, L. Yang, Z. Hu, *Adv. Mater.* **2012,** *24*,347-352.
10. Z. Lyu, D. Xu, L. Yang, R. Che, R. Feng, J. Zhao, Y. Li, Q. Wu, X. Wang, Z. Hu, *Nano Energy* **2015,** *12*,657-665.

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Zheng Hu received his BS (1985) and PhD (1991) degrees in physics from Nanjing University. After two-year's postdoctoral research in Department of Chemistry, he became an associate professor in 1993, and subsequently acquired the professor position in 1999, and Cheung Kong Scholar in 2007. As a guest scientist, he spent two years in Research Center of Karlsruhe, University of Cambridge, and MIT. Hu has mainly worked in the research field of physical chemistry of energy nanomaterials. As the principal scientist, he has finished more than 15 research projects with honor and published more than 200 papers in peer-reviewed journals, and is the principal inventor of 20 Chinese patents.

Engineering Vanadium Oxide Nanoparticles for Smart Window Coatings

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Abstract: Energy and environment have been the most challengeable issues faced by human beings in 21st century. Energy efficient materials for smart window coatings have been the research focus in many areas. Among them, thermochromic vanadium dioxide (VO_2) has been one of the most attractive energy-saving materials, because of its unique and rapid phase-transfer temperature (~68 ℃), as well as exemplary solar modulating capabilities for smart window applications. This presentation is going to talk about how to synthesize VO_2 nanoparticles with scale-up production using a facile hydrothermal method, and then deposit such nanoparticles on glass via casting or spray method for fabricating VO_2 nanofilms with controllable thickness, roughness, colour and heat block ability for potential industrial applications. In this talk, the development of synthesis strategy and mimic house test, as well as the potential bench market will be discussed.

Short Biography

Prof/Dr. Xuchuan Jiang, at Monash University (Australia), has fully devoted to the study on synthesis, self-assembly and functional applications of nanoparticles since the award of his PhD in 2001 from University of Sci. & Tech. of China. Dr. Jiang has been working in various academic research environments, such as University of Washington (USA) University of Paris (France), and University of New South Wales (Australia). He has published over 100 papers in *Nano Lett, J. Am. Chem. Soc., Adv. Mater. Nanoscale* and others, with SCI citations over 4500 times, and *H*-index 30. He has been awarded Australia Research Council (ARC) Future Fellow (*Same as Chinese Distinguished Young Scholar*) and ARC Queen Elizabeth II Fellow in 2009.

Microfluidic-based Approaches for Controllable Synthesis of Nanoparticles

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Abstract: Lipid-covered polymeric nanoparticles (NPs) have been widely used in drug delivery because of their high efficiency and low risk for side effects. Conventional approaches such as emulsion-solvent evaporation, nanoprecipitation and polymerization are either too complex to manipulate or resulting in nanoparticles with a wide size distribution. The rapid mixing and precise control of fluids in the microfluidic chip are helpful to generate nanoparticles of narrow size distribution. We are developing a microfluidic platform that can assemble NPs with a lipid shell and polymeric core in a single-step and applying them to study the mechanisms of the biological effects of nanomaterials. Latest results about the controllable synthesis of lipid-polymeric nanoparticles with microfluidic platform will be presented in this talk.

References:

1. J. Sun, Y. Xianyu, M. Li, W. Liu, L. Zhang, D. Liu, C. Liu, G. Hu, X. Jiang, *Nanoscale* **2013**, *5*,5262-5265.
2. J. Wang, W. Chen, J. Sun, C. Liu, Q. Yin, L. Zhang, Y. Xianyu, X. Shi, G. Hu, X. Jiang, *Lab on a Chip* **2014**, *14*,1673-1677.
3. J. Sun, L. Zhang, J. Wang, Q. Feng, D. Liu, Q. Yin, D. Xu, Y. Wei, B. Ding, X. Shi, *Adv. Mater.* **2015**, *27*,1402-1407.
4. L. Zhang, Q. Feng, X. Shi, J. Wang, J. Sun, X. Jiang , *Angew. Chem. Int. Ed.* 2015, DOI: 10.1002/anie.201500096R1.

Author Biography

Xingyu Jiang, a Professor at the National Centre for Nanoscience and Technology of China (NCNST, located in Beijing), which is an affiliate of the Chinese Academy of Sciences. He obtained his BS at the University of Chicago and PhD at Harvard University. He joined the NCNST in 2005 and has remained there since. His current research interests include gold nanoparticle-based materials for applications in molecular analysis and medicine, microfluidics and its application in biomedicine. Prof. Jiang has more than 170 papers published in peer-reviewed journals, more than 100 patents (41 of which have been licensed), 1 edited book, and 7 book chapters. Prof. Jiang is a “Hundred Talents Plan” Professor and his work was recognized by the Human Frontier Science Program (Young Scientist Award) and the National Natural Science Foundation of China (National Distinguished Young Scholar Award).

Graphene-based soft materials for nanoionics

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Abstract: Nanoionics is the study and application of properties, phenomena, and mechanisms of ion transport and storage in nanoscale systems. Despite being the key to a myriad of indispensable technologies in energy, water and biomedicine, our experimental understanding of confined ion transport at length scales below 10 nm, particularly below 2 nm, has so far been limited in terms of scale itself, but also of materials investigated. This talk will present how the layered graphene hydrogel membranes developed in my group in the past years could open up exciting opportunities for advancing the field of nanoionics and enable new nanoionic devices for energy storage and conversion, water purification and biomedical areas.

References:

1. C. Cheng, G. Jiang, C. Garvey, Y. Wang, G. Simon, J. Liu & D. Li, *Science Adv.*, In press.
2. Y. Wang, S. Chen, L. Qiu, K. Wang, H. Wang, G. P. Simon, D. Li, *Adv. Funct. Mater.* **2015**, *25*,126-133.
3. X. Yang, C. Cheng, Y. Wang, L. Qiu, D. Li, *Science* **2013,** *341*,534-537.
4. C. Cheng, D. Li, *Adv. Mater.* **2013**, *25*,13-30.
5. W. Guo, C. Cheng, Y. Wu, Y. Jiang, J. Gao, D. Li, L. Jiang, *Adv. Mater.* **2013**, *25*,6064-6068.
6. L. Qiu, J. Z. Liu, S. L. Chang, Y. Wu, D. Li, *Nat. Commun.* **2012**, *3*,1241.
7.X. Yang, L. Qiu, C. Cheng, Y. Wu, Z. F. Ma, D. Li, *Angew. Chem. Int. Ed.* **2011**, *50*,7325-7328.
8. X. Yang, J. Zhu, L. Qiu, D. Li, *Adv. Mater.* **2011**, *23*,2833-2838.

Author Biography

Professor Dan Li is currently a professor of Materials Science and Engineering at Monash University and co-Director of Monash Centre for Atomically Thin Materials. He received his PhD degree in Materials Physics and Chemistry from University of Electronic Science and Technology of China in 1999. After several years as a Research Fellow at Nanjing University of Science and Technology, University of Washington, University of California Los Angles, and University of Wollongong, he joined Monash University as an associate professor in 2008 and was promoted to full professor in 2012. He received the ARC Queen Elizabeth II Fellowship in 2006, the Scopus Young Researcher of the Year Award (Engineering and Technology) in 2010, ARC Future Fellowship in 2011, Dean's Award for Excellence in Research in 2012. He was named in the list of Thomson Reuters' Highly Cited Researchers in the category of Materials Science in 2014-15. His current research interests are centred on synthesis and properties of graphene-based soft materials and their applications in nanoionics, energy storage and conversion, membrane separation, sensing, bionics and environmental protection.

Nickel nanoparticles for hydrogen production by catalytic supercritical water gasification of biomass

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Abstract: Supercritical water gasification (SCWG) could convert wet biomass or organic wastewater into gaseous products rich in hydrogen. Low-cost nickel-based catalysts greatly enhance the efficiencies of SCWG to save the heat input and capital cost of the high pressure process. After screening of a series of supported nickel catalysts, dispersion of nickel was found to be closely correlated with its activity, and three oxide supports (Al_2O_3, TiO_2 and ZrO_2) were selected for further modification. Mg additive promoted the anti-sintering and anti-coking abilities of Ni/Al_2O_3 due to the formation of spinel $MgAl_2O_4$ instead of $NiAl_2O_4$ during the co-precipitating process for the catalyst preparation. Nickel crystalline of about 9 nm was obtained when its loading was 28.4 wt.%, which was stable during the continuous operation at 460˚C even though sintering of the mesoporous $Ni/MgO-Al_2O_3$ compound occurred, and the high catalytic activity was maintained as a result. $Ni/rutile-TiO_2$ nanoparticles (20-50nm) were obtained using a sol-gel $NiTiO_3$ as the precursor. However, sintering (formation of $NiTiO_3$) and coking of $Ni/rutile-TiO_2$ occurred during the long-term continuous operation at 460˚C. In supercritical water, part tetragonal ZrO_2 of a sol-gel Ni/ZrO_2 precursor transformed into stable monoclinic phase. Increase of the catalytic activity with the increased running time was observed, and complete gasification of 9wt% glycerol was achieved during 80h's continuous running.

Totally, it is suggested that strong interaction (high dispersion) of the active nickel and the supports facilitates its catalytic activity and anti-sintering ability under high pressures. It is also noteworthy that under supercritical water conditions, in-site remediation of the pre-prepared nickel nanoparticles may occur and affect the properties and activity of the catalyst.

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References:

1.S. Li, C. Zhu, L.J. Guo, S.M. Guo, *RSC Adv.* **2015**, *5*, 81905-81914.
2. S. Li, L. Guo, C. Zhu, Y. Lu, *Int. J. Hydrogen Energy* **2013**, *38*,9688-9700.
3.S. Li, Y. Lu, L. Guo, *Int. J. Hydrogen Energy* **2011**, *36* 14391-14400.

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Ultrasmall Inorganic Nanoparticles for Molecular imaging

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Abstract: When the size of inorganic particles is reduced to nano scale or sub-nanometer scale, they exhibit novel properties in comparison with their bulk analogues. [1] One example is magnetic iron oxide nanoparticles (MIONs), which show superparamagnetism when their size is below the critical size (e.g. 20 nm for Fe_3O_4 particles) where they turn from ferromagnetic into superparamagnetic.[2-4] Further decrease of their size into ultrasmall range (D < 5.0 nm) leads to transition of superparamagnetism into paramagnetism. The strong size-dependent property makes MIONs ideal contrast agents for T_1- and T_2-weighted magnetic resonance imaging (MRI).[5-7] Another example is metal nanoparticles which display strong fluorescence when their size is reduced to sub-nanometer. These fluorescent metal nanoclusters have shown great potential in cell labeling and imaging as alternatives to fluorescent QDs. Here I will introduce our work on ultrasmall inorganic nanoparticles for molecular imaging.

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References:

1. Z. Li, Q. Sun, Y. Zhu, B. Tan, Z. P. Xu, S. X. Dou, *J. Mater. Chem. B* **2014**, *2*, 2793-2818.
2. Z. Li, Q. Sun, M. Gao, *Angew. Chem. Int. Ed.* **2005,** *44*,123-126.
3. Z. Li, H. Chen, H. Bao and M. Gao, *Chem. Mater.* **2004**, *16*, 1391-1393.
4. Z. Li, B. Tan, M. Allix, A. Cooper and M. Rosseinsky, *Small* **2008**, *4*, 231-239.
5. Z. Li, L. Wei, M. Gao and H. Lei, *Adv. Mater*.**2005**, *17*, 1001-1005.
6. Z. Li, P. Yi, Q. Sun, H. Lei, H. Zhao, Z. Zhu, S. Smith, M. Lan and G. Lu, *Adv. Funct. Mater.* **2012**, *22*, 2387-2393.
7. Z. Li, S. Wang, Q. Sun, H. Zhao, H. Lei, M. Lan, Z. Chen, X. Wang, S. Dou and G. Lu, *Adv. Healthcare Mater.* **2013**, *2*, 958.

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Zhen Li received his PhD degree from the Institute of Chemistry (Chinese Academy of Sciences) in 2005, and then worked in University of Liverpool (UK), University of Siegen (Germany), University of Queensland (Australia), and University of Wollongong (Australia) for 9 years sucessively. He joined Medical College of Soochow University in 2014 as a professor. His research is focused on multifunctional nanotheranostic agents for detection and treatment of cancer. Prof. Li has received several prestigious fellowships and awards, including Alexander von Humboldt Fellowship, Queensland Smart Futures Fellowship, and First Prize of Beijing Science and Technology Award.

Ferroelectric Domain Manipulation via External Stimuli

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Abstract: With their electrically switchable nature of polarization, ferroelectric materials are important for various types of electronic applications. The interest in these materials comes from not only their unique intrinsic piezoelectric and pyroelectric properties but also the ability of precise manipulation and control of their ferroelectric domains to the micro- or even nano-scale. Ferroelectric domains can be manipulated through applying external stimuli to force atomic re-displacement that offsets the original polarization. These external stimuli can be temperature, electric field or mechanical stress. Although extensive investigations have been conducted to understand the mechanisms of ferroelectric domain switching, there are still outstanding issues to be addressed. In this presentation, we will discuss our recent in-situ transmission electron microscopy investigation results on the ferroelectric domain switching via the electron beam and combined mechanical stress and electrical bias stimulation.Mechanisms behind the observed domain switching will be discussed.

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Author Biography

Xiaozhou Liao is a full professor in the University of Sydney (USyd). He received his PhD degree from USyd in 2000. He was offered an Australian Postdoctoral Fellowship after his PhD. He moved to USA taking up a Director Funded Postdoctoral Fellowship in Los Alamos National Lab in 2001 and was a research scientist in the University of Chicago from 2004 to 2006. He returned to USyd in June 2006 as a lecturer. He was an ARC Queen Elizabeth II fellow from 2007 to 2011 and an ARC Future Fellow from 2012 to 2015. His research focuses on electron microscopy characterisation of advanced structural and functional materials. He has published ~ 200 journal articles which have been collectively cited over 7,000 times.

Bioinspired Architecture-mediated Cell Response and Tissue Regeneration

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Abstract: Critical size bone defects raise great demands for efficient bone substitutes. Mimicking the hierarchical porous architecture and specific biological cues of natural bone has been considered as an effective strategy to facilitate bone regeneration.

Herein, porous scaffolds with hierarchical structure and loading of bioactive molecules was developed. These structure not only mimic the morphology and function of nature bone, but also can effectively entrap bioactive growth factors and reach the required efficacy in bone healing. At nanoscopic scale, size matching between pore size and the molecular diameter plays a key role in achieving loading efficiency and stability of bioactive growth factors. At microscopic scale, evidence is accumulating that the microporous within 0.5-10 μm has a strong impact on osteogenic outcomes and have a beneficial effect in enhance attachment, proliferation, differentiation of anchorage-dependent bone forming cells. At macroscopic level, highly interconnected macroporous networks have been testified important to facilitate cellular migration, tissue ingrowth and molecule transportation [1-2]. Altogether, the multi-scaled transportation "highways" perform different biologic functions in the bone regeneration process and enhance bone regeneration.

Acknowledgements:

This work was financially supported by National Natural Science Foundation of China (31330028, 31271011) and National Basic Research Program of China (973 Program, No. 2012CB933600).

References:

1. CL. Dai, H. Guo, JX Lu, JL. Shi, J Wei, CS Liu, *Biomaterials* **2011**, *32*, 8506-8517.
2. J. Zhang, HJ. Zhou, D.Lin, HS. Shi, Y. Yuan, W. Tang, JC. Qian, CS. Liu, *Biomaterials* **2015**, *53*, 251-264.

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Changsheng Liu obtained his Ph.D. degree at East China University of Science and Technology in 1996. From then on, he has devoted into fundamental and application research of biomedical materials and has obtained a series of outstanding achievements in the field of bone regeneration, including more than 170 SCI articles, and receiving the Second-prize of National Award twice. In 2012, He won an international Fellow of Biomaterials Science and Engineering.

Design of Nanoporous Carbon Spheres for Energy Conversion and Storage

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Abstract: We have developed and synthesized various nanoporous carbon spheres (NCSs) (including novel microporous carbon spheres, mesoporous carbon spheres, core shell and yolk shell carbon spheres with hierarchical porous structures) with high monodispersity, defined size and orientation of pores, tunable surface area, and controlled surface properties and structural ordering.[1] Specifically, (i) We developed a strategy to synthesise monodisperse polymer spheres from resorcinol–formaldehyde (RF) resin and carbon "Stöber" spheres. (ii) In addition, modified carbon spheres have been prepared through a bottom up self-assembly by using different functional precursors, or post-synthesis modification method. Furthermore, we have applied this method to produce uniform carbon core–shell spheres with adjustable shell thickness, carbon@metal, carbon@silica, metal@carbon, silica@carbon, or metal oxide@carbon materials. (iii) We also extended the synthesis method of mesoporous silica nanospheres to enable the preparation of ordered mesoporous resorcinol formaldehyde nanospheres with particle size from 80 to 400 nm and mesopores of ~3.5 nm in diameter.[2] (iv) A general strategy was developed for the synthesis of versatile carbon nanospheres impregnated with highly monodispersed metal nanoparticles including (Au, Pt, Rh, Ru, Ag, Pd, Ir, Fe and Cu), testing these metal-loaded carbon particles as catalysts for the hydrogenation of benzaldehyde showed outstanding performance.[3] Our synthesis strategies provide a new benchmark for fabricating well-defined porous carbonaceous nanospheres with a great promise for energy storage and conversion applications.

References:

1. J. Liu, N. P. Wickramaratne, S. Z. Qiao, M. Jaroniec, *Nature Mater.* **2015**, *14*, 763-774.
2. J. Liu, T. Yang, D.-W. Wang, G. Q. M. Lu, D. Zhao, S. Z. Qiao, *Nat. Commun.* **2013**, *4*, 2798.
3.T.Yang, H. Ling, J. Lamonier, M. Jaroniec, J, Huang, M, Monteiro, J, Liu, *NPG Asia Mater.* **2016**, *8, in press*.

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Dual phase ceramic membranes for air separation and high temperature oxidations

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Abstract: Mixed ionic-electronic conducting (MIEC) ceramic membrane is a highly active research topic given its potential to replace the conventional high cost oxygen production method by a novel cost-effective membrane separation technology. MIEC ceramic membranes have been majorly classified into single phase perovskite oxides and dual phase membranes. These perovskite membranes are successfully developed for pure oxygen production solely due to the relatively mild operating conditions for air separation. Unfortunately, the stability of these perovskite membranes is weak and cannot be applied in atmosphere containing reducing or acidic gases like CH_4, H_2, CO and CO_2 due to the reactions of the perovskites and these gases thus they cannot be more economically applied in recently emerging markets-clean energy technologies and syngas synthesis. The robust dual phase ceramic membrane with strong chemical stability has the potentials to fill up this gap. This presentation will be focusing on the working principles of dual phase membranes and design strategies to address the issues of membrane stability and gas permeation flux rates. Hopefully, the present talk can provide new understanding towards the long-standing ambition to realize robust membranes or membrane reactors for clean environment and greener chemical synthesis.

Author Biography

Shaomin Liu is an ARC Future Fellow and Professor in the Department of Chemical Engineering at Curtin University. Liu received his Ph.D. degree from the National University of Singapore in 2002, and then worked as a postdoctoral research fellow in Chemical Engineering at the California Institute of Technology from 2002 to 2005. From the end of 2008, he has been working in Curtin University, Australia. He is the recipient of an ARC Future Fellowship (2013-2016) and an ARC Australian Research Fellowship (2008-2012). His research interests include inorganic membranes for gas separation, membrane reactors for gas reaction, nanoporous materials, solid oxide fuel cells, bioceramics, nanoparticles for antimicrobial property and water treatment. He has published over 200 journal papers.

Designing Hydrogen Bonded Crystals

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Abstract: The design and synthesis of crystalline organic materials (aka crystal engineering) largely relies on empirical strategies that combine molecular symmetry, metric complementarity, and structure-directing interactions to guide assembly of molecular components into preordained solid-state structures. Modular approaches based on the interchange of topologically similar components are promising, but these often can be thwarted by the delicate and noncovalent nature of the intermolecular forces responsible for crystal packing. We demonstrated that this obstacle can be surmounted in molecular frameworks built from a structurally robust two-dimensional hydrogenbonded network of guanindinium ions and the sulfonate moieties of a wide range of organomonosulfonates or disulfonates. These frameworks display a remarkable capacity to behave as crystalline hosts, forming inclusion compounds for numerous combinations of organosulfonates and guest molecules. [1-2].

References:

1. **Y. Z. Liu**, W. C. Xiao, J. J. Yi, C. H. Hu, S. J. Park, M. D. Ward* *J. Am. Chem. Soc.* 2015, *137*, 3386.
2. **Y. Z. Liu**, C. H. Hu, A. Comotti, M. D. Ward* *Science* 2011, *333*, 436-440.

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Nanotechnology for enhanced cancer radiation therapy

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Abstract: Nanomaterials especially functional inorganic nanomaterials exhibit a range of unique inherent physical and chemical properties useful in biomedicine. Starting from 2009, our research group has been working on the development of functional nanomaterials including sp2 carbon nanomaterials), rare earth up-conversion nanoparticles (UCNPs), organic nanoparticles, natural biomaterials, and multifunctional composite nanostructures for applications in multimodal biomedical imaging, drug and gene delivery, as well as novel photo-therapies of cancer. In this talk, I will introduce our latest efforts on the development of nanotechnology to enhance the efficacy of cancer radiation therapy (RT), which is one of three mainstream cancer treatment methods used in the clinic. We have uncovered that certain types of inorganic nanomaterials could absorb X-ray, and thereby concentrate a great deal of ionization energy locally in the tumor to enhance the efficacy of RT. With the help of nanotechnology, we could also change the tumor microenvironment (e.g. tumor hypoxia) to overcome hypoxia-associated RT resistance by tumors. In addition, functional tumor-homing nanoparticles could be labelled with radioactive isotopes to enhance internal RT in cancer treatment. Therefore, we work highlights that nanotechnology and rationally designed nano-agents may have great potential to enhance the therapeutic outcomes of radiation cancer therapy.

Author Biography

Dr. Zhuang Liu is a professor at Soochow University in China. He received his BS degree from Peking University (China) in 2004 and PhD degree from Stanford University (USA) in 2008. In 2009, Dr. Liu joined Institute Functional Nano & Soft Materials (FUNSOM) at Soochow University. He is now working in the field of nanomedicine to develop various functional nanomaterials for cancer theranostics. Dr. Liu has authored over 160 peer-reviewed papers, which have received a total citation of > 18,000 times and given him an H-index at 63 (based on Web-of-Science search). He was listed as one of the 'Most Cited Chinese Researchers' by Elsevier in 2014, as well as one of '2015 Highly Cited Researchers' by Thomson Reuters. He has been invited to be the Fellow of the Royal Society of Chemistry (FRSC) in 2015. Now he is serving as an associated editor for *Biomaterials*, and as editorial board members for several journals including *Scientific Reports* and *Nano Research*.

2-D Nanocarbons: Attraction, Reality and Future

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Abstract: Carbon element has a great number of allotropes, covering the traditional three dimensional (3-D) diamond and graphite, 2-D graphene, 1-D carbon nanotubes and 0-D fullerenes. Recently, graphyne, a new 2-D carbon allotrope family formed by *sp* and sp^2 hybridization carbon atoms also comes into the stage. Theoretical calculations further indicate that there may exist a *penta*-graphene, formed by a huge number of carbon pentagons in a 2-D fashion instead of the hexagon structure of graphene. Therefore, 2-D nanocarbons including graphene, graphyne, etc have created a new category of carbon allotropes which attract increasing attentions. We have been working on the controlled synthesis of 2-D nanocarbons for many years. Systematic studies have been done on the chemical vapor deposition (CVD) of high quality graphene on various solid substrates ranging from metals (Cu, Ni, Cu-Ni alloy, Pt, Ru, Rh, Ir, Pd), groups IV-VI early transition metal carbides, to dielectric substrates (*h*-BN, STO, glass, NaCl). We also made a great effort for the controlled synthesis of graphdiyne, a representative member of the graphyne family. A brief overview will be made in the talk following a general concept of CVD process engineering by highlighting the catalyst design, super graphene glass and scalable production techniques of graphene and various applications as well as the Glaser-Hay coupling synthesis of graphdiyne nanowalls on Cu foils and foams.

Orderly ultrathin films based on 8-anilino-1-naphthalenesulfonate assembled with layered double hydroxide nanosheets: a potential fluorescent biosensor

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Abstract: Fluorescent dye 8-anilino-1-naphthalenesulfonate (ANS) is a kind of widely used fluorescent probe molecule, which has wide range of applications in biological analysis. This work reported that the fabrication of orderly ultrathin films 8-anilino-1-naphthalenesulfonate/layered double hydroxide nanosheets $(ANS/LDH)_n$ via the layer-by-layer technique, and its application as an optical biosensor about selective fluorescence response of protein biomolecules and reversible fluorescence response of different polarity environment. The composite ultrathin film achieved the immobilization of ANS, and the obtained $(ANS/LDH)_n$ UTFs show uniform and long-range-ordered periodic layered structure and exhibit selective fluorescence enhance of protein biomolecules, moreover, the rate of fluorescence enhancement with the protein concentration is significantly different before and after the critical micelle concentration (CMC) of protein. At the same time, fluorescence intensity of the $(ANS/LDH)_n$ UTFs decreases with increasing of the sol vent polarity, and the maximum emission wavelength caused red shift with the increasing of the solvent polarity, and that after five cycles by alternatively treatment with petroteum ether and pure water, the UTFs still keep well fluorescence property. Therefore, the $(ANS/LDH)_n$ UTF is potential to be a novel type of biological sensor material.

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References:

1. W. Guan, W. Zhou, J. Lu, C. Lu. *Chem. Soc. Rev.* **2015**, *44*, 6981-7009.
2. Y. Qin, P. Zhang, L. Lai, Z. Tian, S. Zheng, J. Lu. *J. Mater. Chem. C*. **2015**, *3*, 5246–5252.
3. M. C. Morris and M. Blondel. *Biotechnol. J.* **2014**, *9*, 171–173.

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Jun Lu was awarded the degree of PhD (2004) by the University of Science and Technology of China. He worked as a postdoctoral fellow in the Department of Chemistry at Hong Kong University (2005–2007). He was promoted to full professor of the State Key Laboratory of Chemical Resource Engineering, Beijing University of Chemical Technology in 2011, and Tutor for Doctor in 2012. His research includes the optical, electrical and magnetic functional properties of supramolecular intercalation. He has published over 70 papers. In 2011, he was selected to participate in the 'New Century Outstanding Talent' scheme of the Ministry of Education. In 2013, he was supported by National Natural Science Foundation for Excellent Young Scholars.

High Performance Flexible, Solid-state Supercapacitors

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Abstract: With the rapid progress of wearable electronics, the demand is increasing for portable power sources that are light-weight and featuring miniaturisation and mechanical flexibility. Currently, the wearable electronic gadgets are all notably powered by conventional batteries and capacitors with a coin cell or soft-packing configuration. To further facilitate wearability and satisfy various substrates, the development of mechanical flexible power devices is especially required. However, it is still a large challenge to obtain a flexible battery/supercapacitor with high performance.

A flexible supercapacitor is usually composed of two flexible film electrodes and a polymer gel film as electrolyte in-between, which areal capacitance is still un-satisfied due to the diffusion limits of the gel electrolytes in a thick electrode. Besides, the multilayers stacked configuration of the device produces the unavoidable relative displacement among the multilayers during the bending or stretching cycles that cause delamination of these multilayers. Herein, we will present our recent progress on exploring a new conceptual high performance flexible supercapacitor prototype, whereas the main components are integrated into a single chemical hydrogel film (all-in-one device) that differs to a conventional laminated device configuration.[1-2]. With the unique design, this supercapacitor demonstrates large areal capacitance, excellent cyclic stability and bendable properties. Given its superior performance, this novel conceptual flexible supercapacitor presents important potential as the next generation flexible power source for wearable electronics.

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References:

1. K. Wang, X. Zhang, C. Li, H.T. Zhang, X.Z. Sun, Y.W. Ma, *J. Mater. Chem. A* **2014**, *2*, 19726-19732.
2. K. Wang, X. Zhang, C. Li, X.Z. Sun, Q.H. Meng, Y.W. Ma, Z.X. Wei, *Adv. Mater.* **2015**, doi:10.1002/ adma.201503543.

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The Controllable Assembly of a Perylenediimide Molecule with Photoswitching Property

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Abstract: Self-assembly of functional materials into one-dimensional nano- and microstructures have attracted increased interest in recent years, due to their promising applications in photoelectronic devices, such as phtodetectors, optical switches, sensors, and so on. [1] Among the various materials, organic molecules have been aroused more and more attention for their low cost, good stimuli-responsive properties, and versatility in molecular design. They have been suggested as promising candidates for future molecular electronics. [2] The shapes, size and surface structure of the obtained aggregation can significantly affect their optoelectric and optical properties, which is benificial for the potential application in organic electronics. [3] Therefore, the rational design and controllable self-assembly of organic molecules into nano- and microstructures are still a great challenge.

By using an electron donor-acceptor molecule that consists of a perylenediimide (PDI) core bonded with two ferrocene (Fc) units, well-defined nanorods, nanowires and microwires of PDI-Fc were formed through simply adjusting the initial concentration of PDI-Fc in dichloromethane or CH_2Cl_2. Moreover, the two-ended devices based on individual microwire were fabricated. Highly reproducible and sensitive photo response characteristics were demonstrated in the microwire through controlling the white light on and off with different light intensities. The assembly strategy *via* complementary donors and acceptors is of significance for constructing photoconductive systems and developing novel functional devices.

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References:

1. B. Su, Y. Wu, L. Jiang, *Chem. Soc. Rev.* **2012**, *41*,7832-7856.
2. Y. S. Zhao, H. Fu, A. Peng, Y. Ma, Q. Liao, J. Yao, *Acc. Chem. Res.* **2009**, *43*,409-418.
3. L. Jiang, Y. Fu, H. Li, W. Hu, *J. Am. Chem. Soc.* **2008**, *130*,3937-3941.

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Metal Organic Frameworks (MOF) Membrane:Gas Adsorption & Separation

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Processing of MOF as membranes is a new area that has recently been initiated due to their well-defined porosity and tunable chemical functionality, which make them extremely attractive for potential applications in molecular separation, gas selective separation and storage, membrane reactors, chemical sensors and catalysis, etc. So far a number of MOF materials have been converted in to membranes with encouraging separation results.

Herein we discuss the strategies of MOF membrane preparations such as in-situ synthesis,by using “double metal source” method, electronspinning procedure, polymer grafting, etc. The selective separations of hydrogen, carbon dioxide and methane over other gases were discussed.

Recently, we reported a series of tailor-made structure MOF membranes with L-aspartic acid , and bipy (1) or pyrazine (JUC150) respectively. By using pervaporation process under different temperature and pressure, the former (1) showed ee value of 0.33 for separation pure racemic mixture. The JUC-150 shows that its ultramicropore system can be an outstanding canal for sieving, recycling and reuse of hydrogen.

References:

1. S. Qiu, M. Xue, G. Zhu, *Chem. Soc. Rev.* **2014,** *43*,6116-6140.

2. Z. Kang, M. Xue, L. Fan, L. Huang, L. Guo, G. Wei, B. Chen, S. Qiu, *Energy Environ. Sci.* **2014**.

One-dimensional Metal Oxides for Solar Water Splitting

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Abstract: In the past decades, numerous semiconducting materials, especially oxide semiconductors, have been investigated as potential photoelectrodes in photoelectrochemical (PEC) system with a view to efficient light-induced water splitting for solar-hydrogen conversion.

Compared to other metal oxide semiconductors, α-Fe_2O_3 (hematite) has the advantage such as the small band gap energy of ~2.0 eV, which enables it to absorb most of the photons of solar spectrum. Unfortunately, the ultrafast recombination of the photogenerated carriers and the poor minority charge carrier mobility lead to a short hole diffusion length in α-Fe_2O_3, which severely limits the overall photocurrents produced by solar light. ZnO, as a wide band gap semiconductor, has many attractive material properties, including non-toxicity, low cost, large excitation binding energy, high electronic conductivity. However, either ZnO particles or nanostructured ZnO films have a wide band gap of ~3.2 eV, suggesting that only ultraviolet (UV) light could be utilized.

Effective and controlled doping with metal or non-metal ions is a very common method to modify the electronic and optical properties for metal oxides semiconductors. It was demonstrated that engineered doping with metal or nonmetal ions displayed positive effects on the efficiency of α-Fe_2O_3 and ZnO nanorod photoanodes. In this presentation, some successful examples of engineered doping (Ta bulk doping, Ag surface engineering and N gradient doping) will be introduced, and related mechanisms for enhanced PEC water splitting will be discussed in detail.

References:

1. K. Sun, S. Shen, Y. Liang, P. E. Burrows, S. S. Mao, D. Wang, *Chem. Rev.* **2014**, *114*,8662-8719.
2. S. S. Mao, S. Shen, *Nature Photon.* **2013**, *7*, 944-946.
3.C. Kronawitter, I. Zegkinoglou, S.-H. Shen, P. Liao, I. Cho, O. Zandi, Y.-S. Liu, K. Lashgari, G. Westin, J.-H. Guo, *Energy Environ. Sci.* **2014**, *7*,3100-3121.
4. S. Shen, J. Zhou, C.-L. Dong, Y. Hu, E. N. Tseng, P. Guo, L. Guo, S. S. Mao, *Sci. Rep.* **2014**, *4*, 6627.
5. S. Shen, J. Jiang, P. Guo, C. X. Kronawitter, S. S. Mao, L. Guo, *Nano Energy* **2012**, *1*,732-741.
6. S. Shen, C. X. Kronawitter, J. Jiang, S. S. Mao, L. Guo, *Nano Res.* **2012**, *5*,327-336.
7. M. Wang, F. Ren, J. Zhou, G. Cai, L. Cai, Y. Hu, D. Wang, Y. Liu, L. Guo, S. Shen, *Sci. Rep.* **2015**, *5*.12925.

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Liquid-bridge-directed 1D self-assembly of diverse nanoscale building blocks

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Abstract: A powerful liquid-bridge-directed 1D self-assembly approach has been developed to fabricate 1D assembly of diverse nanoscale building blocks by using superhydrophobic/superhydrophilic pillar-structured surfaces. These textured structures can generate direction-controlled liquid bridge arrays when placing an aqueous droplet upon these surfaces. Following inward shrinkage of three phase contact line of droplet, strictly oriented liquid bridges have been generated connecting neighboring micropillars. These well-define 1D liquid bridges will restrict the alignment of inner guests (building blocks) after water evaporation. Small molecule, polymer, silver NPs or microspheres can all be arrayed in one direction along a long distance.

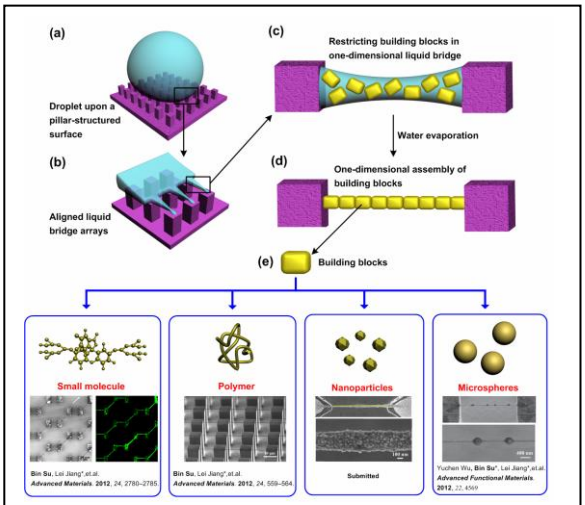

Figure. 1. Well-define liquid bridges induced by superhydrophobic pillar arrays will restrict 1D alignment of inner stuffs (building blocks) after water evaporation. (a-d) Directional shrinkage of droplet yields oriented liquid bridge arrays. (e) Small molecule, polymer, silver NPs or microspheres can be arrayed in one direction in a large scale.

References:

1. B. Su, Y. Wu, L. Jiang, *Chem. Soc. Rev.* **2012**, *41*,7832-7856.
2. Y. Wu, J. Feng, X. Jiang, Z. Zhang, X. Wang, B. Su, L. Jiang, *Nat. Commun.* **2015**, *6*.
3. B. Su, C. Zhang, S. Chen, X. Zhang, L. Chen, Y. Wu, Y. Nie, X. Kan, Y. Song, L. Jiang, *Adv. Mater.* **2014**, *26*, 2501-2507.

Author Biography

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Chiral Polymeric Biointerface Materials

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Abstract: Life is a typical chiral system, and chiral phenomena are ubiquitous in nature from macroscopic to molecular levels. For example, small natural biomolecules are mostly chiral molecules which show distinct chiral preference, e.g. L-amino acids, D-sugars, L-phospholipids, *etc.*. They integrate together via multiple chemical bonding or weak molecular interactions to form biomacromolecules with special steric conformations and functions, which further assemble to form organelles, cells, tissues, and organs. The chiral preference is one important secrete for the study of origin-of-life, which inspires us to introduce surface chirality into the study of biointerface materials, leading to the generation of a new research direction--chiral biointerface materials.

Through introducing the surface chirality into the study of polymeric biointerface materials, we firstly reported the chiral effect on biointerface at the cell level and the biomacromolecule level. In the study of mechanism analysis by both the experimental and the theoretical studies, we found that the stereo-selective hydrogen bonding and hydrophobic interactions are the most important driving force the chiral effect on biointerface, which differs much according to different kinds of biomacromolecules. We further combined the chiral effect on biointerface with the study of smart biointerface materials, and successfully realized the transformation of chiral signals of biomolecules and the chiral interaction into macroscopic changes of materials surface, e.g. wettability switching, morphological change, *etc*. Above results may not only help to better understand the high selectivity of chirality in biosystems, but also are important for designing the next generation of high-performance biomaterials and devices.

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Author Biography

Prof. Taolei Sun received his PhD in Technical Institute of Physics and Chemistry, Chinese Academy of Science (CAS) in 2002. In 2006, he was awarded the prestigious Sofja Kovalevskaja by Alexander von Humboldt Foundation and the Federal Ministry of Education and Research of Germany, and got funding support to build an independent research group in Muenster University. In late 2009, he joined Wuhan University of Technology, China, and was appointed as the ‘‘Chang-Jiang Scholar’’ distinguished professor. In 2013, he got the China National Funds for Distinguished Young Scientists, and also was selected as the “Leading talents for Science and Technology Innovations”.

Inorganic Nanoparticle-Metal Organic Framework Core-Shell Nanostructures: A Novel Multifunctional Platform

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Abstract: Inorganic nanoparticles possess unique optical, electrical, magnetic, mechanical and catalytic properties owing to high specific surface area and strong quantum confinement effect, which offer broad research and application prospects in many fields such as physics, biology, chemistry and materials science. However, it is well known that free inorganic nanoparticles have high surface energies and tend to aggregate and fuse, and thus the intriguing properties registered in the nanoparticles are degraded or even disappeared, leading to difficulty in long-term storage, processing and applications. So, it is imperative to develop novel strategies to stabilize inorganic nanoparticles. Recently, we demonstrate that the metal-organic frameworks could be selected as a coating layer to stabilize inorganic nanoparticles. Inorganic nanoparticle@metal-organic framework core-shell nanostructures, in which a single inorganic nanoparticle core is coated with a uniform metal-organic framework shell, have been fabricated through self-assembly method. Furthermore, the functionality of the core-shell nanostructures has been regulated by adjusting the size, morphology, structure, composition, etc. of the inorganic nanoparticle core and the metal-organic framework shell. The corresponding applications of these novel composite nanomaterials in the fields of sensing, catalysis, bioimaging and drug delivery have been explored.

References:

1. Y. Liu, Z. Tang, *Adv. Mater*. **2013**, *25*, 5819-5825.
2. L. He, Y. Liu, J. Liu, Y. Xiong, J. Zheng,; Y. Liu, Z. Tang, *Angew. Chem. Int. Ed.* **2013**, 52, 3741-3745.
3. M. Zhao, K. Deng, L. He, Y. Liu, G. Li, H. Zhao, Z. Tang, *J. Am. Chem. Soc.* **2014**, *136*, 1738–1741.
4. X. Liu, L. He, J .Zheng, J. Guo, F. Bi, X. Ma, K. Zhao, Y. Liu, R. Song, Z. Tang, *Adv. Mater*. **2015**, DOI: 10.1002/adma.201405583.

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Multi-shelled Hollow Micro-/Nanostructures: From Art of Structures to Realistic Applications

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Abstract: Great progress has been made in the preparation and application of multi-shelled hollow micro-/nanostructures during the past decade. However, the synthetic methodologies and potential applications of these novel and interesting materials have not been reviewed comprehensively in the literatures. In this paper we will describe different synthetic methodologies for multi-shelled hollow micro-/nanostructures as well as their compositional and geometric manipulation and then review their applications in energy conversion and storage, sensor, phtotocatalysis, drug delivery. The correlations between the geometric properties of multi-shelled hollow micro-/nanostructures and their specific performance are highlighted in different applications, including dye-sensitized solar cells (DSSCs), lithium ion batteries, supercapacitors, sensors, photocatalysis and drug delivery. These results demonstrate that the geometry has a direct impact on the properties and potential applications of such materials. Finally, the emergent challenges and future developments of multi-shelled hollow micro-/nanostructures are further discussed..

References:

1. J. Qi, X. Lai, J. Wang, H. Tang, H. Ren, Y. Yang, Q. Jin, L. Zhang, R. Yu, G. Ma, *Chem. Soc. Rev.* **2015**, *44*,6749-6773. (Front Cover)
2. Z. Dong, H. Ren, C. M. Hessel, J. Wang, R. Yu, Q. Jin, M. Yang, Z. Hu, Y. Chen, Z. Tang, *Adv. Mater.* **2014**, *26*,905-909.
3. S. Xu, C. M. Hessel, H. Ren, R. Yu, Q. Jin, M. Yang, H. Zhao, D. Wang, *Energy Environ. Sci.* **2014**, *7*,632-637.
4. H. Ren, R. Yu, J. Wang, Q. Jin, M. Yang, D. Mao, D. Kisailus, H. Zhao, D. Wang, *Nano Lett.* **2014**, *14*,6679-6684.
5. J. Wang, H. Tang, H. Ren, R. Yu, J. Qi, D. Mao, H. Zhao, D. Wang, *Adv. Sci.* **2014**, *1*,1400011.
6. J. Wang, N. Yang, H. Tang, Z. Dong, Q. Jin, M. Yang, D. Kisailus, H. Zhao, Z. Tang, D. Wang, *Angew. Chem. Int. Ed.* **2013**, *125*,6545-6548.
7. Z. Dong, X. Lai, J. E. Halpert, N. Yang, L. Yi, J. Zhai, D. Wang, Z. Tang, L. Jiang, *Adv. Mater.* **2012**, *24*,1046-1049.
8. X. Lai, J. E. Halpert, D. Wang, *Energy Environ. Sci.* **2012**, *5*,5604-5618.
9. J. Du, J. Qi, D. Wang, Z. Tang, *Energy Environ. Sci.* **2012**, *5*,6914-6918.
10.X. Lai, J. Li, B. A. Korgel, Z. Dong, Z. Li, F. Su, J. Du, D. Wang, *Angew. Chem. Int. Ed.* **2011**, *123*,2790-2793.

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Dan Wang received his B.Sc. and M. Sc. degree at Jilin University (1994 and 1997), and obtained Ph.D. degree at Yamanashi University (2001). From 2001 to 2004, he worked in RITE and Kyoto University as a Postdoctoral Research Fellow. In 2004, he joined Institute of Process Engineering, CAS as Professor. His research interest focuses on high performance inorganic materials.

Rechargeable Batteries to Power a Sustainable Future

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Abstract: Global warming and climate change have induced the urgent adoption of electric vehicles and renewable energies. In this talk, I will report the development of advanced lithium-ion batteries, lithium-sulfur batteries, lithium-air batteries and sodium-ion batteries. Graphene nanosheets, tin-graphene and silicon-graphene nanocomposites have been prepared by various techniques. When applied as anode materials in lithium-ion batteries, they demonstrated enhanced electrochemical performances.[1]

Lithium-air battery is one of the most promising systems for meeting today's stringent requirements as the power source for electric vehicles. The theoretical specific energy of the Li-O_2 battery is 3,505 Wh kg^{-1}, which is almost ten times higher than that of Li-ion batteries (387 Wh kg^{-1}). Porous graphene with different pore size architectures were synthesized as cathode catalysts for lithium-air batteries. Porous graphene exhibited significantly higher discharge capacities than that of non-porous graphene. Moreover, the Ru nanocrystal decorated porous graphene exhibited an excellent catalytic activity with a high reversible capacity, low charge/discharge over-potential, and long cycle life.[2] Sodium-ion batteries are being considered as a promising system for stationary energy storage and conversion, owing to natural abundance of sodium. Several 2D electrode materials were synthesized as either cathode materials or anode materials for lithium-ion batteries and sodium-ion batteries.[3-5]

References:

1. S. Chen, P. Bao, G. Wang, *Nano Energy* **2013**, *2*,425-434.
2. B. Sun, X. Huang, S. Chen, P. Munroe, G. Wang, *Nano Lett.* **2014**, *14*,3145-3152.
3. D. Su, G. Wang, *ACS Nano* **2013**, *7*,11218-11226.
4. H. Liu, D. Su, R. Zhou, B. Sun, G. Wang, S. Z. Qiao, *Adv. Energy Mater.* **2012**, *2*,970-975.
5. D. Su, S.X. Dou, G.X. Wang, *Adv. Energy Mater.* **2015,** *5*, 1401205.

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Professor Guoxiu Wang is a Distinguished Professor and Director of the Centre for Clean Energy Technology at University of Technology Sydney (UTS), Australia. He is an expert in materials chemistry, electrochemistry, energy storage and conversion, and nanomaterial synthesis and characterization. Professor has published over 330 refereed journal papers. His publications have attracted more than 13000 citations with an h-index of 59 (Web of Science). His research interests include lithium-ion batteries, lithium-air batteries, sodium ion batteries, lithium-sulfur batteries, supercapacitors, graphene, and chemical functionalisation of graphene.

Nature-Inspired Energy-storage Materials and Devices

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Abstract: Currently, tremendous efforts are being devoted to develop high-performance energy-storage materials and devices. Conventional energy-storage systems are confronted with great challenges to achieve high energy density, long cycle-life, excellent biocompatibility and environmental friendliness. In nature, its energy conversion and storage systems have been evolved for billions of years, and spawned highly efficient and well suited cellular respiration machineries in living organisms for external energy assimilation, metabolism and distribution. Herein, we will focus on how to construct high-performance energy-storage materials and devices through taking inspirations from the natural energy metabolism systems with high efficiency, sophisticated regulation, clean and environmental friendliness features. For example, inspired by the electron shuttles functioning in extracellular electron transfer *via* reversible redox-cycling, man-made electrode materials with similar active functional groups have been explored. Further, by mimicking some natural process, *e.g.*, self-healing ability of skin, the advanced supercapacitor devices with similar features have been obtained.

Acknowledgements:

This work was financially supported by National Natural Science Foundation of China (21471013, 73011701).

References:

1. H. Wang, P. F. Hu, J. Yang, G. M. Gong, L. Guo, *Adv. Mater.* **2015**, *27*, 2348–2354.
2. H. Wang, B. W. Zhu, W. C. Jiang, Y. Yang, W. R. Leow, H. Wang, X. D. Chen, ***Adv. Mater.*** **2014**, *26*, 3638-3643.
3. H. Wang, H. B. Feng, J. H. Li, S***mall*** **2014**, *10*, 2165–2181.

Author Biography

Hua Wang received his Ph.D. degree from Beihang University in 2012. Then, he worked as a research fellow at Nanyang Technological University (NTU) for 2 years. Currently, he is an Associate Professor in the School of Chemistry and Environment at Beihang University. His research interest is the development of advanced nanomaterials for energy conversion and storage, including lithium-ion/sodium-ion batteries, photocatalytic water splitting and water purification.

Zeolitic imidazolate framework membranes for molecular sieving separations

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Abstract: Zeolitic imidazolate framework (ZIF) membranes are very attractive for many molecular sieving separation applications, but the fabrication of high-selectivity, high-flux ZIF membranes remains a challenge. We have recently made significant efforts in developing new strategies for the fabrication of defect-free ZIF membranes. In particular, ultrathin ZIF-8 membranes with a thickness of around 200 nm were prepared by chemical vapour modification of surface chemistry and nanopores of asymmetric bromomethylated poly(2,6-dimethyl-1,4-phenylene oxide) (BPPO) substrate. The resulting ZIF-8 membranes exhibited exceptional H_2 permeance as high as 2.05×10^{-6} $mol.m^{-2}.s^{-1}.Pa^{-1}$ with high H_2/N_2 and H_2/CO_2 selectivities. Defect-free zeolitic imidazolate framework-8 (ZIF-8)/graphene oxide (GO) membrane with a thickness of 100 nm was also prepared using two-dimensional (2D) ZIF-8/GO hybrid nanosheets as seeds. 2D hybrid nanosheets with a suitable amount of ZIF-8 nanocrystals were essential for producing a uniform seeding layer that facilitates fast crystal intergrowth during the membrane formation. Moreover, the seeding layer acts as a barrier between two different synthesis solutions, and self-limits crystal growth and effectively eliminates defects during the contra-diffusion process. The resulting ultrathin membranes show excellent molecular sieving gas separation properties, such as with a high CO_2/N_2 selectivity of 7.0. This new 2D nano-hybrid seeding strategy can be readily extended to the fabrication of other defect-free and ultrathin MOF or zeolite molecular sieving membranes for a wide range of separation applications.

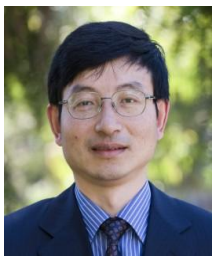
Acknowledgements:

This work was financially supported by the Australian Research Council (Huanting Wang, Future Fellowship).

References:

1. E. Shamsaei, Z. X. Low, X. C. Lin, A. Mayahi, H. Y. Liu, X. W. Zhang, L. Zhe, H. T. Wang, *Chem. Commun.* **2015**, 51, 11474-11477.
2. X. Hu, J. Wei, Y. Liang, H. C. Zhang, X. W. Zhang, W. Shen, H. T. Wang, *Angew. Chem. Int. Ed.* **2015**, DOI: 10.1002/anie.201509213.

Author Biography



Huanting Wang is a professor in the Department of Chemical Engineering at Monash University. He received his Ph.D. degree in materials science and engineering from the University of Science and Technology of China in 1997, and then worked as a postdoctoral researcher at the California Institute of Technology and the University of California Riverside from 1998 to 2002. He was awarded an ARC QEII Fellowship in 2004 and an ARC Future Fellowship in 2010. His current research interests focus on nanoporous materials and composite membranes for gas separation, fuel cells, water treatment and desalination..

Interface Structure of Magnetic Nanomaterials

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Abstract: Magnetic nanomaterials have aroused increasing attention in the past few years for their superior properties and potential applications in energy, electronic, biomedical, magnetic, and environmental areas. Their innovative applications based on the synergy of two distinct parts require an atomistic understanding and control of key structural factors like combination types, interface structures, and surface oxidization states. In situ high resolution transmission microscopy (HRTEM) and scanning transmission electron microscopy (STEM) can give atomic structure of the nanoparticles dynamically.

Various magnetic bimetallic NPs (NiPt hollow spheres, nanochains, Au@$Ni_{12}P_5$ crystals, etc.) have been developed. Nanodevices with considerably improved energy storage and optical property have been developed. The high loading Pt_1/α-Fe_2O_3 single atom catalysts with Pt atom density as high as 1.20 atoms nm^{-2} were obtained by simple adsorption method. Characterization method to reveal 3D atomic structure of surface and interface of materials has been developed. Layer resolved structural relaxation and reconstruction at the surface of magnetic FePt NPs have been discovered. Atom migrations and evolution mechanisms at the surface of Pt/NiPt and NiAu NPs have been investigated.

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Prof. Rongming Wang has published over 140 scientific papers in SCI Journals including Phys. Rev. Lett., Adv. Mater., J. Am. Chem. Soc. etc. and presented over 40 invited talks. The papers have been cited over 4500 time citations by SCI journals and citation H factor of 37. He has won several awards including National Prize for Natural Sciences (second class), Scientific Chinese Prize for People of the Year 2012, etc.

Engineering Biointerface with Controlled Cell Adhesion towards Cancer Diagnostics

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Abstract: Circulating tumor cells (CTCs) have become an emerging "biomarker" for monitoring cancer metastasis and prognosis. Although there are existing technologies available for isolating/counting CTCs, the most common of which using immunomagnetic beads, they are limited by their low capture efficiencies and low specificities. By introducing a three-dimensional (3D) nanostructured substrate – specifically, a silicon-nanowire (SiNW) array coated with anti-EpCAM – we can capture CTCs with much higher efficiency and specificity. The conventional methods of isolating CTCs depend on biomolecular recognitions, such as antigen-antibody interaction. Unlikely, we here proposed that nanoscaled local topographic interactions besides biomolecular recognitions inspired by natural immuno-recognizing system. This cooperative effect of physical and chemical issues between CTCs and substrate leads to increased binding of CTCs, which significantly enhance capture efficiency. Recently, we have developed a 3D cell capture/release system triggered by enzyme, electrical potential and temperature as well as magnetic field, which is effective and of "free damage" to capture and release cancer cells. In addition, immune cells have also been employed as living template for greatly improving the limitation of traditional immunomagnetic beads. Furthermore, the potential pollution from biochip waste can be successfully disposed by employing self-cleaning substrates. Therefore, these bio-inspired interfaces open up a light from cell-based disease diagnostics to subsequent safety treatment of biomedical waste.

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References:

1. X. Liu, S. T. Wang*, *Chem. Soc. Rev*. **2014**, *43*, 2385-2401.
2. C. Huang, G. Yang, Q. Ha, J. Meng, S. T. Wang*, *Adv. Mater*. **2015**, *27*, 310-313.

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Grand design of new electronic materials and properties

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Abstract: Discovery of new classes of materials with new functionalities or significantly improved performance has always been the driving force for the advance of modern science and technology, and the improvement of our daily lives. Searching for new class of materials with exotic properties has always been challenging because of the complexity of both the theoretical and the experimental approaches developed so far. This talk will present a number of new strategies we have developed for the design of new materials and properties. It is expected to show how complicated science and materials design could be made simple and enjoyable. A new concept, the codes of matter/materials based on the three ubiquitous and paramount attributes of all existing matter/materials, charge, spin, freedom of motion will be introduced. We will discuss the principles of the codes and their applications in material and property design. Many new types of materials with exotic properties and their possible experimental realizations will be discussed.

This work was financially supported by Australian Research Council through ARC discovery projects and Future Fellowship project.

References:

1. X.-L. Wang, *Science Bulletin* **2015,** *60,*1661-1673.
2. X.-L. Wang, S. X. Dou, C. Zhang, *NPG Asia Mater.* **2010,** *2,*31-38.
3. X. Wang, *Phys. Rev. Lett.* **2008,** *100,*156404.

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Australia – China Science and Technology Innovation, Collaboration and Positive Impact

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The talk will focus on a snapshot of Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) – including our purpose, where we are, some facts on our revenue, staff, publications, our achievements, and the areas of impact of our research.

It will also describe how we work towards becoming a research enterprise with global reach – through talent, impact and networks.

The talk will focus on CSIRO's collaborations with China particularly in the area of green car and rail research, advance materials, biomaterials and technologies, followed by some thoughts on future opportunities.

Author Biography

Gang Wei a Senior Principal Research Scientist and Director of China Engagement for CSIRO Manufacturing and Mineral Resources. He received a PhD degree in chemistry in 1997 from the University of Newcastle. Following his postdoctoral/research fellow work at the University of Sydney, he joined CSIRO in 2002. He is a Fellow of the Royal Australian Chemical Institute, Adjunct Professor at the University of Queensland, and Honorary Associate at the University of Sydney. He also holds ten professorships in Chinese universities and institute. His current research interests are in the field of synthesis and characterization of novel nanoscale compounds and materials, molecular electronics and sensors.

High performance ternary organic solar cells

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Abstract: Significant progress has been achieved recently in the production of bulk heterojunction organic solar cells (OSCs) based on binary active layer composed of donor–acceptor (D-A)-type polymers or small molecules as donors and fullerene derivatives (e.g. PCBM) as acceptor.[1,2] Compared with binary OSCs, ternary systems containing two donors and one acceptor (or one donor and two acceptors) can broaden the absorption range of active layers through complementary absorption of two donors, thereby providing a potentially effective route in achieving high Jsc and thus high efficiency. In this presentation, a ternary OSC is designed and fabricated, which contains a D–A-type polymer and a high-crystaline small molecule as donors and fullerene derivatives as acceptor. The small molecules increase the crystallinity of the donor phase, whereas the ratios of small molecules to polymers can tune the domain size of the ternary system. The PCE of the ternary OSCs is higher than that of binary systems based on small molecules or polymers.[3] By a further optimization of the ternary system, a PCE of 10.5% was obtained, which is among the highest values for OSCs.[4] A hierarchical alloy model is proposed to explain the working mechanism of ternary system, which may lead to a further improvement of the performance of the organic solar cells.

References:

1.Y. Zhang, D. Deng, K. Lu, J. Zhang, B. Xia, Y. Zhao, J. Fang, Z. Wei, *Adv. Mater.* **2015**, *27*, 1071-1076.
2. D. Deng, Y. Zhang, L. Yuan, C. He, K. Lu, Z. Wei, *Adv. Energy Mater.* **2014**, *4*,1400538.
3.Y. Zhang, D. Deng, K. Lu, J. Zhang, B. Xia, Y. Zhao, J. Fang, Z. Wei, *Adv. Mater.* **2015**, *27*,1071-1076.
4. J. Q. Zhang, Y. J. Zhang, J. Fang, K. Lu, Z. Y. Wang, W. Ma, and Z. X. Wei, *J. Am. Chem. Soc.*2015, DOI: 10.1021/jacs.5b03449.

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Prof. Zhixiang Wei's research interest is focused on organic functional nanomaterials and flexible devices. He received a BSc in 1997 and MSc in 2000 from Xi'an Jiaotong University. He received his PhD in 2003 from the Institute of Chemistry, Chinese Academy of Science (CAS). He then undertook postdoctoral research at the Max-Planck-Institute of Colloid and Interfaces (Germany) and University of Toronto. In 2006 he joined the National Center for Nanoscience and Technology of China as a professor supported by the "Hundred Talents Program" of CAS. Prof. Wei has published more than 100 papers in peer review scientific journals, which have been cited more than 4000 times. Dr. Wei has been awarded various honors, including Chinese Academy of Science President Award in 2003, Hundred Talents Program of Chinese Academy of Sciences in 2006, Youth Chemist of Chinese Chemical Society in 2009, Outstanding Young Scientist Award of NSFC in 2011, First Prize of Beijing Science and Technology Award in 2011 and Second Prize of National Natural Science Award in 2014.

Efficient Proton Transport and Photovoltaic Conversion in Rhodopsins Biohybrid Nanomaterials and Systems

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Abstract: Efficient and directional proton transport is a very necessary energy conversion step whatever in biochemical process and artificial electrochemical energy systems. Microbial rhodopsins photosynthesis is an extremely simple but efficient natural light-driven proton pump energy conversion system. With advanced materials science and manufacturing engineering, the biohybrid nanosystems based on microbial rhodopsins and functional materials have been paid much attention.

In past five years, we devote ourselves on hybrid nanosystem through the integration of proton pump microbial rhodopsin, bacteriropoin(bR) and proteorhodopsin (pR), with functional materials for energy conversion, sensoring and artificial version studies. We focus on the artificial use of bR and pR photoelectric energy conversion through enhancing photocurrent density and enriching photocurrent waveform. Surface plasmonic effect of Au nanoparticles and proton conductor assisted 3D proton transfer have successfully improved bR and pR photocurrent, and greatly ameliorate the photoelectric performance.[1, 2] Inspired by the plasma membrane capacitor-like behavior, we developed a pR bio-capacitor system and regulated photocurrent duration time (PDT) through nanochannel resistance. Consequently, pR original transient photocurrent has been transformed into square-like waveform, which would be of broad use in further nanoenergy conversion.[3, 4] Taking advantage of pR pH-dependent photoelectric characteristics, a pR-hybrid pH sensor has achieved real-time pH detection with quick response and high sensitivity.[5] bR and pR frequency-responsive characterization was identified in the as prepared photoelectric system and further introduced to construct artificial vision. Moreover, particular effort has been paid on the cooperation and adjustment between bio-components and functional materials. These original findings improve the perception on rhodopsin protein and provide mechanism insights from pure biophysical studies into the design and regulation of artificial biohybrid devices.

References:

1.Z. Guo, D. Liang, S. Rao, Y. Xiang, *Nano Energy* **2015,** *11*,654-661.
2.S. Rao, Z. Guo, D. Liang, D. Chen, Y. Li, Y. Xiang, *Adv. Mater.* **2015,** *27*,2668-2673.
3.S. Rao, S. Lu, Z. Guo, Y. Li, D. Chen, Y. Xiang, *Adv. Mater.* **2014,** *26*,5846-5850.
4.S. Rao, K. J. Si, L. W. Yap, Y. Xiang, W. Cheng, *ACS Nano* **2015,** *9*,11218-11224.
5.S. Rao, Z. Guo, D. Liang, D. Chen, Y. Wei, Y. Xiang, *Phys. Chem. Chem. Phys.* **2013,** *15*,15821-15824.

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DNA-driven Self-nanoassemblies for Bioapplications

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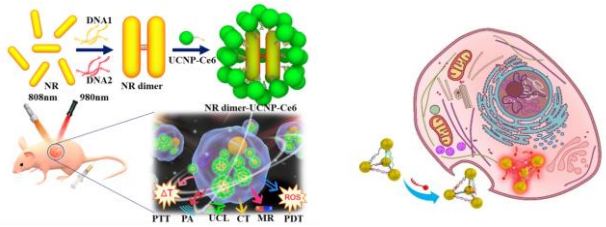
1. DNA-driven hierarchical core-satellite nanostructures with plasmonic gold nanorod (NR) dimers and upconversion nanoparticles have been fabricated. Combined photothermal therapy and photodynamic therapy were carried out under the guidance of multimodal imaging techniques such as magnetic resonance imaging (MRI), upconversion luminesce (UCL), X-ray computed tomography (CT) and photoacoustics (PA), and the results demonstrated that the nanostructures displayed significant tumor-targeting properties. Importantly, the photothermal efficiency of the NR dimer core-satellite architecture reached 42.3% when irradiated with an 808-nm laser, which is two-fold than that of the single NR assembly. Furthermore, tumors treated with the NR dimer assemblies were completely eliminated *in vivo*, which expands the programmed nanoassemblies options for clinical application.



2. DNA-driven nanoparticle self-assembling pyramid encoding a Raman reporter (Cy5) was developed to detect telomerase *in live cells*. In the presence of the target, the telomerase primer was extended and the inner DNA chain was then replaced, leading to simultaneous reductions in the surface-enhanced Raman scattering (SERS) signal and the recovery of the fluorescent signal. The SERS signal had a linear range for the detection of telomerase *in situ* of 1×10^{-14} to 5×10^{-11} IU, with a limit of detection of 6.2×10^{-15} IU. The fluorescent signal was used to confirm the intracellular telomerase activity, demonstrating the efficacy of the designed pyramid probe. This biosensing strategy provides a reliable and ultrasensitive protocol for the quantification of biomarkers in living cells.

References:

1. S. Li, L. Xu, W. Ma, X. Wu, M. Sun, H. Kuang, L. Wang, C. Xu, N. A. Kotov, *J. Am. Chem. Soc.***2015**. **DOI:** 10.1021/jacs.5b10309.
2.L. Xu, W. Yan, W. Ma, H. Kuang, X. Wu, L. Liu, Y. Zhao, L. Wang, C. Xu, *Adv. Mater.* **2015,** *27*,1706-1711.
3.X. Wu, L. Xu, W. Ma, L. Liu, H. Kuang, W. Yan, L. Wang, C. Xu, *Adv. Funct. Mater.* **2015,** *25*,850-854.
4. X. Wu, L. Xu, W. Ma, L. Liu, H. Kuang, W. Yan, L. Wang, C. Xu, *Adv. Funct. Mater.* **2015,***25*,850-854.
5. M. Sun, L. Xu, W. Ma, X. Wu, H. Kuang, L. Wang, C. Xu, *Adv. Mater.* **2015**.
6. C. Xu et al, *Adv. Funct. Mater*.2015, DOI: 10.1002/adfm.201504587.
7. S. Li, L. Xu, W. Ma, H. Kuang, L. Wang, C. Xu, *Small* **2015**.

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Atomically Engineered Materials for Hydrogen Evolution Reaction

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Abstract: The growing energy crisis and environmental issues are driving the development of clean and sustainable energy sources. In particular, solar energy as one of the best sources of renewable energy has attracted significant attention as a promising way to solve these problems. Herein, we studied various atomically engineered catalytic materials to enhance the solar-driven water splitting. First of all, using polymer ligands to control the size and valence state of platinum monoxide clusters, we found that Pt in a higher oxidation has remarkable hydrogen oxidation reaction suppression ability, while its H2 evolution capacity is still comparable to that of the benchmark of conventional Pt cocatalyst.[1] Moreover, we explored the active sites of Pt/TiO2 photocatalyst on atomic level by a collaborative analysis from both experimental and theoretical work; metallic Pt0 nanoparticles have little contribution to the activity of solar water splitting and by contrast, oxidized species Ptδ+ truly take the role of the catalytic active sites.[2] In addition, we designed and synthesized a surface H-bonding network decorated g-C3N4 photocatalyst with high efficiency of visible-light-driven H2 production. According to NMR and theoretical modeling, the H-bonding bridge can effectively shorten the distance between water molecules and g-C3N4, provide multiple channels for the transition between protons and the excited electrons on g-C3N4, stabilize the anionic intermediate and transition states, and restrain charge recombination.[3] Furthermore, we anchored isolated Pt atoms on TiO2 and this photocatalyst exhibits a high solar-driven hydrogen evolution performance compared with Pt nanoparticles or clusters. The configurations of the isolated Pt atoms and their catalytic hydrogen evolution activity were calculated by large-scale periodic DFT analysis.[4] Additionally, we found that the photoreactivity of hydrogen generation can be correlated with the cluster size of the oxidized platinum cocatalyst as function, and the maximum turnover frequency is found on the smallest-sized cocatalyst.[5] These results would open a door for rethinking of the detailed principles of photocatalysis, and may also stimulate novel ideas for the design and optimization of heterogeneous photocatalysts.

References:

1. Y. H. Li, J. X., Z. J. Chen, Z. Li, F. Tian, L. R. Zheng, H. F. Wang*, P. Hu, H. J. Zhao, H. G. Yang*, *Nat. Commun.* 2013, *4*, 2500.
2. J. Xing, H. B. Jiang, J. F. Chen, Y. H. Li, L. Wu, S. Yang, L. R. Zheng, H. F. Wang*, P. Hu, H. J. Zhao, H. G. Yang*, *J. Mater. Chem. A* 2013, *1*, 15258. (Cover story)
3. X. L. Wang, W. Q. Fang, H. F. Wang, H. Zhang, H. Zhao, Y. Yao*, H. G. Yang*, *J. Mater. Chem. A* 2013, *1*, 14089. (Cover story)
4. J. Xing, J. F. Chen, Y. H. Li, W. T. Yuan, Y. Zhou, L. R. Zheng, H. F. Wang*, Y. Wang, H. J. Zhao, Y. Wang, H. G. Yang*, *Chem. Eur. J.* 2014, *20*, 2138. (Cover story)
5. Y. H. Li, J. X., X. H. Yang, H. G. Yang*, *Chem. Eur. J.* 2014, *20*, 12377.

Commercial Carbon Molecular Sieves as a High Performance Anode for Sodium-Ion Batteries

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Abstract: Sodium-ion-based energy storage devices have attracted great interest due to the worldwide abundance of sodium and the low cost of sodium-precursors. In our recent studies, we demonstrate two typical sodium storage devices. On the one hand, the folded-graphene electrodes by three-dimensional densification are demonstrated as promising candidates for high-density sodium-ion capacitors (SIC) with a record high volumetric capacity of 132 mA h/cm^3. On the other hand, we for the first time demonstrate the excellent Na ion storage performance of the commercial carbon molecular sieve (CMS), which is the best among current commercially available materials for sodium-ion battery (SIB) and much better than most hard carbons reported with complex microstructures. The CMS shows a high reversible capacity of 284 mAh/g at a relatively high current density of 100 mA/g, and a very high initial Coulombic efficiency of up to 73.2 %. Such good performance is due to its unique pore structure that only allows the insertion of Na ions while rejecting the electrolyte. This work clearly demonstrated the carbon molecular sieve basically meets the demand for commercial anode materials for a SIB and will greatly promote the commercialization of SIB, as the graphite does for Li-ion batteries.

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References:

1. J. Zhang, W. Lv, Y. Tao, Y.-B. He, D. W. Wang, C. You, B. Li, F. Y. Kang, Q.-H. Yang, *Energy Storage Mater.* **2015**, *1*, 112-118.
2. S. W. Zhang, W. Lv, C. Luo C. You, J. Zhang, Z. Pan, F. Y. Kang, Q.-H. Yang, *Energy Storage Mater.* **2016**, DOI 10.1016/j.ensm.2015.12.004.

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Preparation, mechanical properties and corrosion resistance of bio-magnesium materials

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Abstract: Magnesium and its alloys have attracted great attention as biomaterials due to their bioactivity and biodegradability. This paper studied two kinds of bio-magnesium materials with preparation processing, deformed high-purity Mg (99.99wt.%) and directionally solidified (DSed) Mg-xZn alloys, and focuses on improvement of their mechanical properties and corrosion resistance.

It was found that the hot-extrusion and the further cold-drawing could effectively improve both the mechanical properties and corrosion resistance of high-purity Mg. For the as-extruded high-purity Mg, the yield strength (YS), ultimate tensile strength (UTS) and elongation (EL) were 108.3MPa, 152.7MPa and 27.0%, respectively, and the mass-loss rate in 0.9wt.% NaCl solution was $0.25g \cdot m^{-2} \cdot h^{-1}$. Attributed to the further refined grains by cold-drawing, the YS, UTS and EL of the as-drawn high-purity Mg were increased to 134.1MPa, 199.4MP and 15.3%, respectively, and the mass-loss rate was reduced to $0.12g \cdot m^{-2} \cdot h^{-1}$.

The DSed Mg-xZn (x=2,4,6) alloys were fabricated under different growth rates. The directional microstructures were composed of fine cellular or columnar dendritic grains depended on the Zn content and growth rate. The UTS and EL were 187.5MPa and 11.1% for Mg-2Zn alloys with fine cellular structures. For Mg-4Zn and Mg-6Zn alloys with fine columnar dendrites, the UTS and EL were 207.3MPa, 15.7% and 209.9MPa, 12.3%, respectively. The corrosion resistances of DSed Mg-Zn alloys with cellular and finer dendritic structure were superior as compared with those of cast Mg-Zn alloy with same Zn content, for fewer grain boundaries and defects in the DSed Mg-Zn alloys. The corrosion rate in 0.9wt.% NaCl solution was 0.58mm/y for Mg-2Zn alloy with fine cellular structure, 0.74mm/y and 0.70mm/y for Mg-4Zn and Mg-6Zn alloys with columnar dendrite, respectively.

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Biocompatibility of Plasma Immersion Ion Implantation Treated Shape Memory Polyurethane

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Abstract: Shape memory polymers (SMP) are promising materials for biomedical implantation applications with the ability of recovering the original shape upon external stimulus with potentially excellent biocompatibility. Previous studies on Polyurethane (PU) shape memory polymer elements have suffered from a combination of the lack of appreciation on their actual biological aplications and a failure to optimise their biocompatible surface prior to implantation. In this study, plasma-based surface treatment was conducted to increase biocompatibility Polyurethane (PU) shape memory polymers. The treated surface was analysed using surface energy, ATR-FTIR and XPS. Immune responses of treated PU was observed via in vivo tests. Inflammatory cell infiltration and collagen deposition were assessed using histopathology and immunohistochemistry. The results indicate the treated PU surfaces interact optimally with biological systems, which provides a useful step for the further development of the technology. The outcomes can be extendable to a full range of implantable device applications, including vascular repair, tissue replacement and wound healing.

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Silica Nano-pollens: Nature-inspired Carriers for Advanced Antimicrobial Delivery

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Abstract:The intriguing nature systems have inspired remarkable advances in the development of functional materials with versatile applications. The distinct rough topologies observed in nature ranging from micrometer to nanometer scale exhibit fascinating properties. It is well-known that superhydrophobicity and self-cleaning property can be created by having a micro-nanotextured surface on lotus leaf. Pollen grains exhibit distinct spiky surfaces, which enable adhesion towards hairy insects for easy pollination. Some viruses, equipped with nanoscale surface spikes, form multiple 'entry claws' binding to the cell membrane during virus invasion for high viral infectivity. Indeed, surface roughness enhanced hydrophobicity and adhesion has been applied in daily life. However, limited progress has been made using this nature-derived principle to engineer nanoparticles for various drug delivery applications.

Herein, we report the unique surface hydrophobicity and enhanced bacterial adhesion property of mesoporous silica hollow spheres by engineering nanoscale surface roughness.[1, 2] By shaping silica nanoparticles with a hydrophilic composition and controlled surface roughness, hydrophobic properties can be observed which lead to improved adsorption of a range of hydrophobic molecules and controlled release of hydrophilic molecules. The rough nanospheres loaded with vancomycin exhibits an enhanced antibacterial effect. Furthermore, a facile approach is developed to fabricate silica nano-pollens (hollow spheres with hairy surfaces), which shows enhanced adhesion towards bacteria surface comparing to silica hollow spheres with smooth surfaces. By loading antimicrobial protein of lysozyme, potent antimicrobial activity and long-term total bacterial inhibition (up to 3 days) can be achieved towards *Escherichia coli*. Our strategy provides a novel pathway in the rational design of nano-carriers for efficient drug delivery.

References:

1. Y. Nor, Y. Niu, S. Karmakar, L. Zhou, C. Xu, J. Zhang, H. Zhang, M. Yu, D. Mahony, N. Mitter, M. Copper, C. Yu, *ACS Cent. Sci.* **2015**, *1*, 328-334.
2. (1) Australian Provisional Patent (2015901379); (2) H. Song, Y. Nor, M. Yu, Y. Yang, J. Zhang, H. Zhang, C. Xu, N. Mitter, C. Yu, *in preparation.*

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Macroscopic Nanoparticle Assemblies: Integration, Functionalization and Applications

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Abstract: The huge diversity of hierarchical micro-/nano- rigid structures existing in biological systems is increasingly becoming a source of inspiration of materials scientists and engineers to create next generation advanced functional materials. Recently, accompanied with the development of nanotechnology, some biologically hierarchical rigid structures have been duplicated and mimicked in artificial materials through hierarchical organization of micro-/nanosized building blocks. Although the properties of nanomaterials are frequently superior to those of their bulk counterparts, translating the unique characteristics of individual nanoscale components into macroscopic functional devices still remains a challenge.

In this lecture, we discuss how to assemble nanoscale building blocks into ordered assemblies as well as their functionalities, and how to integrate them with already existing macroscopic structures and realize their functionalization. A family of nanowire or nanoplate assemblies in form of thin films or 3D integrated structures can be generated, demonstrating that it is possible to access a variety of high quality hybrid materials with tunable mechanical property and other multifunctionalities. These assembled structures show enormous application potential in diverse fields such as electronics, elastomeric conductors, electrocatalysis, and super adsorbents.

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Amorphous $Li_4Ti_5O_{12}$ Thin Film with Enhanced Lithium Storage Capability and Reversibility for Lithium-Ion Batteries

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Abstract: As an alternative to traditional carbonaceous materials for anodes, $Li_4Ti_5O_{12}$ has attracted more attention as a promising anode material for Li-ion batteries because it exhibits excellent reversibility during the insertion/extraction process of Li ions with nearly zero volume change and a relatively high operating voltage (1.55 V vs. Li/Li+), both of which ensure additional safety by avoiding lithium dendrites. One of the drawbacks of the rate capability of $Li_4Ti_5O_{12}$ is that it is relatively low because of its poor electronic conductivity and sluggish lithium-ion diffusion.

Our work focus on how to improve the electronic conductivity and lithium-ion diffusivity of $Li_4Ti_5O_{12}$ thin films, which present a serious constraint to the development of the solid-state lithium-ion batteries. Given this understanding, we have found that creating amorphous structural features and hierarchical channels of thin films form a very simple yet effective approach to solve the problem. [1] The unique structural features and high electrical conductivity of the as-prepared thin films result in high capacity (283.5 $mAhg^{-1}$ at 10 $mAcm^{-2}$) and good cyclic stability (≈3% capacity loss after 100 cycles at 10 $mAcm^{-2}$). These important findings could open up new opportunities for $Li_4Ti_5O_{12}$ in constructing high-performance binder-free energy storage devices.

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References:

1. Z. Yu, G. Zhu, H. Xu, A. Yu, *Energy Technol.* **2014**, *9-10*, 767-772.

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Spherical Mesoporous Architectures: Interfacial Assembly from Single- to Multi-Level and Their Applications

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Functional mesoporous materials have uniform large pore size, unique ordered mesostructure, high surface area and large pore volume, showing great potential applications on catalysis, adsorption, separation petroleum oil industry, especially in drug delivery and biomedicines. Here we present the development and progress of the synthesis of the spherical mesoporous materials from surfactant assembly approach for the drug carriers, fluorescence detection and diagnosis. We focus on the development of new synthesis approaches, including the liquid-liquid biphase synthesis, evaporation induced aggregation assembly (EIAA), and interface driven orientation arrangement to create novel mesoporous nanospheres with one-level and multi-level architectures, such as the core-shell, yolk-shell structures for silica, TiO_2, carbon spheres and hemispheres, Janus particles. These spherical materials with uniform large pore channels (> 3.0 nm), high surface area (~ 1150 m^2/g), large pore volume (1.5 ~ 3.5 cm^3/g) and open frameworks are non-toxic, easy degradation, and can be used to remove body toxin, and as carriers for controlling release of drugs. And these functional mesoporous materials show super performance as hyperthermia infrared imaging (elevated temperature as high as 85 ℃ at 808 nm).

References:

1. Y. Wan, D. Zhao, *Chem. Rev.* **2007,** *107*,2821-2860.
2. Y. Deng, D. Qi, C. Deng, X. Zhang, D. Zhao, *J. Am. Chem. Soc.* **2008,** *130*,28-29.
3. Y. Fang, D. Gu, Y. Zou, Z. Wu, F. Li, R. Che, Y. Deng, B. Tu, D. Zhao, *Angew. Chem. Int. Ed.* **2010,** *49*,7987-7991.
4. W. Li, J. Yang, Z. Wu, J. Wang, B. Li, S. Feng, Y. Deng, F. Zhang, D. Zhao, *J. Am. Chem. Soc*.**2012,** *134*,11864-11867.
5. W. Li, Q. Yue, Y. Deng, D. Zhao, *Adv. Mater.* **2013,** *25*,5129-5152.
6. Y. Fang, G. Zheng, J. Yang, H. Tang, Y. Zhang, B. Kong, Y. Lv, C. Xu, A. M. Asiri, J. Zi, *Angew. Chem. Int. Ed.* **2014,** *126*,5470-5474.
7. X. Li, L. Zhou, Y. Wei, A. M. El-Toni, F. Zhang, D. Zhao, *JACS* **2014,** *136*,15086-15092.
8.D. Shen, J. Yang, X. Li, L. Zhou, R. Zhang, W. Li, L. Chen, R. Wang, F. Zhang, D. Zhao, *Nano Lett.* **2014,** *14*,923-932.
9. Y. Fang, Y. Lv, F. Gong, Z. Wu, X. Li, H. Zhu, L. Zhou, C. Yao, F. Zhang, G. Zheng, *J. Am. Chem. Soc.* **2015,** *137*,2808-2811.
10. W. Li, F. Wang, Y. Liu, J. Wang, J. Yang, L. Zhang, A. A. Elzatahry, D. Al-Dahyan, Y. Xia, D. Zhao, *Nano Lett.* **2015,** *15*,2186-2193.
11. L. Zhou, R. Wang, C. Yao, X. Li, C. Wang, X. Zhang, C. Xu, A. Zeng, D. Zhao, F. Zhang, *Nat. Commun.* **2015,** *6*.
12. Y. Liu, R. Che, G. Chen, J. Fan, Z. Sun, Z. Wu, M. Wang, B. Li, J. Wei, Y. Wei, *Science Adv.* **2015,** *1*,e1500166.
13. X. Li, L. Zhou, Y. Wei, A. M. El-Toni, F. Zhang, D. Zhao, *J. Am. Chem. Soc.***2015, *137*,5903–5906**.
14. B. Kong, J. Tang, Y. Zhang, C. Selomulya, X. Gong, Y. Liu, W. Zhang, J. Yang, W. Wang, X. Sun, *J. Am. Chem. Soc.* **2015,** *137*,4260-4266.

Unlocking Catalytic Potentials of Earth Abundant Materials for Energy Applications

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Abstract: The photo- and electrocatalysts play a critical role in clean energy generation and conversion technologies. Although the precious metal-based materials are widely recognized as superior catalysts for energy applications, their large-scale commercial use has been hindered by their expensive and scarcity nature. The development of high performance, plentiful and cheap nonprecious-metal catalysts is therefore vital for the commercial viability of clean energy future. Unfortunately, the most of nonprecious metal materials in their pristine forms possess little or no catalytic activity. As such, the unlocking the catalytic potential of nonprecious and earth abundant materials has become a paramount scientific task of the research field, nevertheless, highly challenging.

This presentation intends to report few widely applicable approaches to unlock the catalytic activities of transition metal oxides and graphitic carbon materials, including surface atomistic manipulation, crystal facet control and heteroatom doping. A number of examples from our recent investigations will be used to demonstrate the effectiveness and applicability of such approaches.[1-4]

Acknowledgements:

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References:

1. S. Yang, B. X. Yang, L. Wu, Y. H. Li, P. Liu, H. Zhao, Y. Y. Yu, X. Q. Gong, H. G. Yang, *Nat. Commun.* **2014**, *5*, 5355.
2. Y. Li, H. Zhang, Y. Wang, P. Liu, H. Yang, X. Yao, D. Wang, Z. Tang, H. Zhao, *Energy Environ. Sci.* **2014**, *7*,3720-3726.
3. Y. Li, H. Wang, H. Zhang, P. Liu, Y. Wang, W. Fang, H. Yang, Y. Li, H. Zhao, *Chem. Commun.* **2014,** *50*,5569-5571.
4. S. Yang, Y. Wang, P. Liu, Y. Bing Cheng, H. Zhao, H. Yang , *Nature Energy* **2015**,Accepted.

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Multi-scale Nanofibers Films with Special Wettability

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Abstract: Transportation of liquid in a desired manner is of significance in broad applications. We fabricated a series of anisotropic nanofibers films by electrospinning and investigated their applications in wettablility. We fabricated superhydrophobic, superhydrophilic films with tunable surface structures and composition. Then we made responsive film that could switch between superhydrophobic and superhydrophilic state. Moreover, we created a hydrophobic and hydrophilic composite film that exhibited novel unidirectional water penetration property. Above mentioned materials have found applications in removing oil pollution from water, smart water penetration film, and water collection.

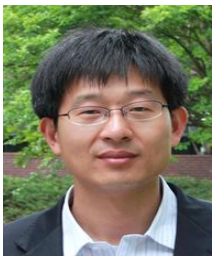
Acknowledgements:

This work was financially supported by National Natural Science Foundation of China (21222309, 21134003) and the 863 Program (2013AA032203).

References:

1. J. Wu, N. Wang, Y. Zhao, L. Jiang, *Nanoscale* **2015,** *7*,2625-2632.
2. J. Wu, N. Wang, Y. Zhao, L. Jiang, *J. Mater. Chem. A* **2013,** *1*,7290-7305.
3. J. Gao, X. Yao, Y. Zhao, L. Jiang, *Small* **2013,** *9*,2515-2519.
4. M. Jin, J. Wang, X. Yao, M. Liao, Y. Zhao, L. Jiang, *Adv. Mater.* **2011,** *23*,2861-2864.

Author Biography



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Carbon-based Materials for Energy Conversion Applications

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Abstract: Development of high performance, plentiful and cheap carbon-based materials is highly desired for energy conversion applications, such as fuel cells, solar cells, and water splitting to generate H_2 and O_2. However, most studies on carbon-based energy conversion materials to date are almost exclusive use of petroleum products as precursors to produce by complex fabrication processes. Herein, we developed some facile methods such as self-sponsored doping pyrolysis approach and two-phase chemical reaction route to one-step fabricate heteroatom (*e.g.*, S, N) doped/co-doped three-dimensional graphitic carbon network and metal oxide/graphitic carbon nanosheets (*e.g.*, $CoCr_2O_4$/carbon nanosheets) nanocomposite, respectively.[1] These fabricated carbon-based materials as electrocatalysts exhibited superior electrocatalytic activities toward oxygen reduction reaction (ORR) and oxygen evolution reaction (OER), promising for substitute of precious and scarce noble metal catalysts (*e.g.*, Pt). Additionally, we have also developed a simple and environmentally friendly hydrothermal method without need of additional chemicals to fabricate high performance natural nitrogen (N) doped graphitic carbon materials directly using raw biomass (*e.g.*, grass, shrimp shell). These N-doped carbon materials can not only be used as electrocatalysts for oxygen reduction reaction (ORR), but also as sensitizer for solar cell study, exhibiting superior electrocatalytic activity and great potential as low-cost and abundant photosensitizer for solar cell. The findings in our works demonstrated the feasibility of directly transforming raw biomass into high performance carbon-based energy materials.

Acknowledgements:

This work was financially supported by the CAS Pioneer Hundred Talents Program and the CAS/SAFEA International Partnership Program for Creative Research Teams of Chinese Academy of Sciences, China.

References:

1.Y. Li, H. Zhang, Y. Wang, P. Liu, H. Yang, X. Yao, D. Wang, Z. Tang and H. Zhao. *Energy Environ. Sci.* **2014**, *7*,3720.
2.H. Zhang, Y. Wang, D. Wang, Y. Li, X. Liu, P. Liu, H. Yang, T. An, Z. Tang, H. Zhao. *Small* **2014**, *10*, 3371.
3.H. Zhang, Y. Wang, P. Liu, Y. Li, H. Yang, T. An, P. Wong, D. Wang, Z. Tang and H. Zhao. ***Nano Energy*** 2015, *13*, 124.

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Temperature Tunable Self-Doping in Stable Diradicaloid Thin-Film Devices

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Abstract: Although open shell organic molecules (free radicals) are of fundamental interest, with few exceptions, they are generally reactive and unstable. In this work, we report solution-processed stable diradicaloids with temperature tunable electrical conductivity via a mechanism of self-doping, a result that is promising for advanced device applications. Electrical measurements show a remarkable electrical self-doping for the diradicaloids at room temperature (RT) with the doping strength highly tunable and reversible with temperature (T), attributed to the formation of radical ion species within the solid state. The self-doping in diradicaloids is confirmed by intentional doping with an external dopant and T-dependent X-ray photoelectron spectroscopy that shows an increase of the nitrogen cations accompanied with a stoichiometric change of the nitrogen in the triazinyl rings at higher temperatures. Future work may be focused on achieving higher electrical conductivity and wider tunability windows through rational molecular design of diradicaloids. The demonstrated electrical tunability in association with the spin properties opens an avenue for advanced optoelectronic device applications with low fabrication cost based on organic diradicals.

References:

1. Y. Zhang, Y. Zheng, H. Zhou, M.S. Miao, F. Wudl, T.Q. Nguyen, *Adv. Mater.* **2015**, *27*, 7412–7419.
2. Y. Zheng, M.S. Miao, G. Dantelle, N. D. Eisenmenger, G. Wu, I. Yavuz, M. L. Chabinyc, K. N. Houk, F. Wudl, *Adv.Mater.* **2015**, *27*, 1718–1723

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Optical Performances of YAG:Re^{3+} (Re=Ce, Eu) Phosphor Films with Tb^{3+} as Energy transfer sensitizer

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Abstract: Yttrium aluminum garnet ($Y_3Al_5O_{12}$, YAG) with high chemical stability, low electrical conductivity as well as high resistance to creep are widely used in optical applications as structural and engineering materials and as host for solid-state laser and phosphors. The optical performance of a phosphor depends strongly on the host lattice, type and concentration of activator ion, crystallinity, particle size as well as surface morphology. However, the conventional route to achieve pure phase of YAG need a high temperature over 1600^{o}C; the as-achieved produces are heterogeneous and large in size, and irregular in shape, which inevitability bring some disadvantages for its application.

In compared to YAG phosphor powders used in conventional displays, YAG phosphor films (PFs) are known to hold a number of merits for optical application, such as small size particles, higher degree of uniformity, better adhesion, and especially, low scattering losses. YAG PFs show potential applications in a large variety of solid-state optical devices; for instance, they are of great technological interest as radiation to visible light converters in medical imaging and as phosphors for white LEDs or display system. But, due to its small photon–solid interaction volume, a PF would display an insufficient absorption ability, which results in a much lower emission property than those of micro-powder phosphors. Herein, we will focus on improvement of the absorption ability of YAG PFs via a co-doping an energy transfer sensitizer, which can be accommodated in the matrix with a high concentration without causing deteriorations in the matrix structure and luminescence properties of the activators based on our recent works.[1-2] Meanwhile, we will also focus on optical performances and the mechanism of energy transfer from Tb^{3+} to Re^{3+} of the as-prepared YAG PFs.

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References:

1. Y. Zhao, H. Xu, X. Zhang, G. Zhu, D. Yan, and A. Yu, *J. Eur. Ceram. Soc.* **2015**, *35*, 3761-3764.
2. Y. Zhao, H. Xu, X. Zhang, G. Zhu, Y. Yao, S. Lu, and A. Yu, *J. Am. Ceram. Soc.* **2015**,*98*, 1043-1046.

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Interfacial Engineering on organic solar cells

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Abstract: Bulk heterojunction (BHJ) solar cells comprising conjugated polymer donor and fullerene acceptor offer promising advantages such as low cost, light weight, and flexibility.[1] In addition to new materials design and morphology optimization, interface engineering on BHJ solar cells is fundamentally important to enhance the power conversion efficiency (PCE) and device stability.[2] To improve the charge selectivity at the electrodes and minimize the energy barrier for charge extraction, a hole-transporting layer (HTL) with electron-blocking properties is inserted between the anode and BHJ active layer, and an electron-transporting layer (ETL) with hole-blocking properties is inserted between the cathode and BHJ active layer. The metallic polymer PEDOT:PSS is the most commonly used HTL material for organic BHJ solar cells, because of its solution processability, work function, sufficient conductivity, and high optical transparency in the visible-NIR regime.[3] However, the intrinsic acidic nature of poly(3,4-ethylenedioxythiophene):poly (styrenesulfonate) (PEDOT:PSS) hole-transporting layer (HTL) induces interfacial protonation and limits the device performance in organic solar cells based on basic pyridylthiadiazole units. By utilizing a pH neutral, water/alcohol soluble conjugated polyelectrolyte CPE-K as the HTL in p-DTS($PTTh_2$)$_2$:$PC_{71}BM$ solar cells, a 60% enhancement in PCE has been obtained with an increased Vbi, reduced Rs, and improved charge extraction. These effects originate from the elimination of interfacial protonation and energy barrier compared with the PEDOT:PSS HTL.

References:

1.G. Yu, J. Gao, J. C. Hummelen, F. Wudl, A. J. Heeger, *Science* 1995, *270*, 1789-1790.
2. L. M. Chen, Z. Xu, Z. R. Hong, Y. Yang, *J. Mater. Chem.* 2010, *20*, 2575-2598.
3. H. L. Yip, A. K. Y. Jen, Energ. *Environ. Sci.* 2012, *5*, 5994-6011.

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Cation Coordination Reactions on Nanocrystals: Surface/Interface, Doping Control and Applications

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Abstract: Including the shape and size effect, the controllable doping, hetero-composite and surface/interface are the prerequisite of colloidal nanocrystals for exploring their optoelectronic properties, such as fluorescence, plasmon-exciton coupling, efficient electron/hole separation, and enhanced photoelectric conversion. By controlling soft acid-base coordination reactions between cation molecular complexes and colloidal nanostructures, we showed that chemical thermodynamics could drive nanoscale monocrystalline growth of the semiconductor shell on metal nano-substrates and the substitutional heterovalent doping in semiconductor nanocrystals. We have demonstrated evolution of relative position of Au and II-VI semiconductor in Au-Semi from symmetric to asymmetric configuration, different phosphines initiated morphology engineering, oriented attachment of quantum dots into micrometer nanosheets with synergistic control of surface/interface and doing, which can further lead to fine tuning of plasmon-exciton coupling. Therefore, different hydrogen photocatalytic performance, enhanced photovoltaic and electrical properties have been achieved further which lead to the fine tuning of plasmon-exciton coupling. Substitutional heterovalent doping here enables the tailoring of optical, electronic properties of semiconductor nanocrystals, such as the luminescence and electronic impurities (p-, n-type doping).

References:

1. J. Gui, M. Ji, J. Liu, M. Xu, J. Zhang, H. Zhu, *Angew. Chem. Int. Ed.* **2015,** *127,* 3754-3758.
2.Q. Zhao, M. Ji, H. Qian, B. Dai, L. Weng, J. Gui, J. Zhang, M. Ouyang, H. Zhu, *Adv. Mater.* **2014,** *26,*1387-1392.
3. J. Liu, Q. Zhao, J. L. Liu, Y. S. Wu, Y. Cheng, M. W. Ji, H. M. Qian, W. C. Hao, L. J. Zhang, X. J. Wei, *Adv. Mater.* **2015,** *27,*2753-2761.
4. H. Qian, Q. Zhao, B. Dai, L.Guo, J. Zhang, J. Liu, J. Zhang, H. Zhu, *NPG Asia Mater.* **2015,** *7,*e152.
5. S. Lim, W. Shen, Z. Gao, *Chem. Soc. Rev.* **2015,** *44,*362-381.
6. J. Zhang, Y. Tang, K. Lee, M. Ouyang, *Science* **2010,** *327,* 1634-1638.
7. J. Zhang, Y. Tang, K. Lee, M. Ouyang, *Nature* **2010,** *466,* 91-95.

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CVD Growth of Single-Walled Carbon Nanotubes with Controlled Structures

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Abstract: Single-walled carbon nanotube (SWNT) based electronics have been regarded as one of the most promising candidate technologies to replace or supplement silicon based electronics in the future. These applications require high density horizontally aligned SWNT arrays. During the past decade, significant efforts have been directed towards growth of high-density SWNT arrays. However, obtaining SWNT arrays with suitable density and quality still remains a big challenge. This talk covers the progress of our lab in controlling the orientation, density, length, density, diameter, metallicity, and chirality of SWNTs directly synthesized on surfaces by chemical vapor deposition, together with a session presenting the characterization method of the chirality of SWNTs.

References:

1.Y. Hu, L. Kang, Q. Zhao, H. Zhong, S. Zhang, L. Yang, Z. Wang, J. Lin, Q. Li, Z. Zhang, *Nat. Commun.* **2015,** *6*, 6099.
2.Y. Chen, Z. Shen, Z. Xu, Y. Hu, H. Xu, S. Wang, X. Guo, Y. Zhang, L. Peng, F. Ding, *Nat. Commun.* **2013,** *4*, 2205.
3. Y. Yao, Q. Li, J. Zhang, R. Liu, L. Jiao, Y. T. Zhu, Z. Liu, *Nature Mater.* **2007,** *6*,283-286.
4. Y. Chen, J. Zhang, *Acc. Chem. Res.* **2014,** *47*,2273-2281.

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Professor Jin Zhang received his PhD from Lanzhou University in 1997. After a two year postdoctoral fellowship at the University of Leeds, UK, he returned to Peking University where he was appointed Associate Professor (2000) and promoted to Full Professor in 2006. In 2013, he was appointed as Changjiang professor. He also is the Fellow of RSC. His research focuses on the controlled synthesis and spectroscopic characterization of carbon nanomaterials. Dr. Zhang has received the National Science Foundation of China for Distinguished Young Scholars in 2007 and 2nd grade of the State Natural Science Award in 2008 (2nd contributor). Dr. Zhang has published over 180 peer-reviewed journal articles. And he now is the editor of Carbon.

Photo-functional materials for clean energy, environment remedy and biological application

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Abstract: Photo-functional materials, roughly divided into four kinds, have found wide applications in the fields of clean-energy production, environment remedy, lighting and display, green-plant growth and biology, etc. We focus on researches of photocatalysts and luminescent materials, investigating the relationship among morphology, electronic structure and photo-activities both using experiment and first-principles calculation. We found that the exposed facets determine, to large extent, the photocatalytic activity of the materials. For example, Cu_2O microcrystal with {110} surfaces perform well in releasing hydrogen from formaldehyde.[1] Point-defects greatly affect the electronic structures and hence influence the luminescent properties and also the photocatalytic activity. By adjusting the calcination process and doping strategy, plentiful excitation and emission phenomena can be realized in self-activated Y_2WO_6.[2,3] By introducing Cl ions into 2D WS_2, blue shift could be achieved because of n-type doping. For nano-sized C_3N_4, reducing particles size intensifies the blue-shifted photoluminescence, promoting its application for white-lighting and photodynamic therapy.[4]

Acknowledgements:

This work was financially supported by National Natural Science Foundation of China (91222110, 51472013).

References:

1. H. Gao, J. Zhang, R. Wang, M. Wang, *Applied Catalysis B: Environ.* **2015,** *172*,1-6.
2. B. Ding, C. Han, L. Zheng, J. Zhang, R.Wang, Z.Tang, *Sci. Rep.* **2015**, *5*, 9443.
3. B. Ding, H. Qian, C. Han, J. Zhang, S.-E. Lindquist, B. Wei, Z. Tang, *J. Phys. Chem.C* **2014,** *118*,25633-25642.
4. H. Guo, J. Zhang, L. Ma, J. L. Chavez, L. Yin, H. Gao, Z. Tang, W. Chen, *Adv. Funct. Mater*. **2015,** *25*,6826-6826.

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Band Bending: a Double-edged Sword for Overall Water Splitting in Co_3O_4 Quantum Dots System

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Abstract: Photocatalytic overall water splitting for H_2 and O_2 production has been considered as an ideal solution to the world's energy problem. However, A fundamental bottleneck in this field is to choose a suitable system with high energy conversion efficiency, chemical inertness and low cost at the same time. In our previous work, we synthesized Co_3O_4 quantum dots by a facile reverse micelle method, and realized splitting pure water into O_2 and H_2 stoichiometrically under visible-light irradiation (λ> 420 nm) without any cocatalyst.[1] Meanwhile, we found that Co_3O_4 quantum dots performed high and stable photocatalytic activity for water reduction and hydrogen production mainly due to the effect of energy band bending.[2]

In this work, we studied the relationship between energy band bending and photocatalytic activity in Co_3O_4 quantum dots system, and found the "double-edged sword effect of band bending", i.e., the photocatalytic hydrogen production enhanced but the photocatalytic oxygen production reduced with the degree of energy band bending increasing. Furthermore, we analysed the relationship between energy band bending and photocatalytic overall-water-splitting activity of Co_3O_4 quantum dots system, and found that due to the coupling action of band bending and band structure, the photocatalytic overall-water-splitting activity of Co_3O_4 quantum dots system increased and then decreased with the degree of energy band bending increasing. By changing degree of energy band bending, an optimized overall-water-splitting system of Co_3O_4 quantum dots was achieved, which performed the average rate of H_2 and O_2 evolation at 1.05 $\mu mol \cdot h^{-1}$ and 0.56 $\mu mol \cdot h^{-1}$, respectively.

Acknowledgements:

This work was supported by the National Natural Science Foundation of China (Nos. 51236007, 51121092).

References:

1. N. Zhang, J. Shi, S. S. Mao, L. Guo, *Chem. Commun.* **2014**, *50*, 2002-2004.
2. N. Zhang, J. Shi, F. Niu, J. Wang, L. Guo, *Phys. Chem. Chem. Phys.* **2015**, *17*, 21397-21400.

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Reforming electrode fabrication process via the design of binders

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Abstract: A series of novel green electrode manufacturing technologies are developed by adopting and functionalizing sustainable natural polymers in order to improve the conductivity and mechanical strength for high performance and long life lithium ion batteries [1, 2]. As an example, the naturally occurring binder sodium alginate (SA) is functionalized with 3,4-propylenedioxythiophene-2,5-dicarboxylic acid (ProDOT) via a one-step esterification reaction in a cyclohexane/dodecyl benzene sulfonic acid (DBSA)/water micro-emulsion system, resulting in a multi-functional polymer binder i.e., SA-PProDOT. With the synergetic effects of the functional groups (e.g., carboxyl, hydroxyl and ester groups), the resultant SA-PProDOT polymer not only maintains the outstanding binding capabilities of sodium alginate, but it also enhances the mechanical integrity and lithium ion diffusion coefficient in the $LiFePO_4$ (LFP) electrode during the operation of the batteries. Due to the conjugated network of the PProDOT and the lithium doping under the battery environment, the SA-PProDOT becomes conductive and matches the conductivity needed for LiFePO4 LIBs. Without the need of conductive additives such as carbon black, the resultant batteries have achieved the theoretical specific capacity of LiFePO4 cathode (ca. 170 mAh/g) at C/10 and ca. 120 mAh/g at 1C for more than 400 cycles.in a multi-functional polymer binder i.e., SA-PProDOT. With the synergetic effects of the functional groups (e.g., carboxyl, hydroxyl and ester groups), the resultant SA-PProDOT polymer not only maintains the outstanding binding capabilities of sodium alginate, but it also enhances the mechanical integrity and lithium ion diffusion coefficient in the $LiFePO_4$ (LFP) electrode during the operation of the batteries. Due to the conjugated network of the PProDOT and the lithium doping under the battery environment, the SA-PProDOT becomes conductive and matches the conductivity needed for LiFePO4 LIBs. Without the need of conductive additives such as carbon black, the resultant batteries have achieved the theoretical specific capacity of LiFePO4 cathode (ca. 170 mAh/g) at C/10 and ca. 120 mAh/g at 1C for more than 400 cycles.

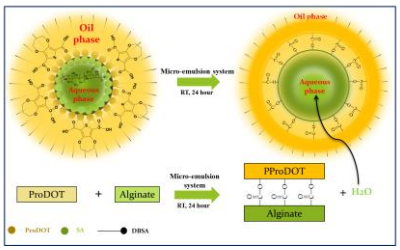

Figure 1, Functionalization of alginate

Reference:

1. M. Ling, J. Qiu, S. Li, C. Yan, M. J. Kiefel, G. Liu, S. Zhang, *Nano Lett.* **2015,** *15*,4440-4447.
2. M. Ling, Y. Xu, H. Zhao, X. Gu, J. Qiu, S. Li, M. Wu, X. Song, C. Yan, G. Liu, *Nano Energy* **2015,** *12*,178-185.

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Prof. Shanqing Zhang obtained his PhD degree in electrochemistry in 2001 at Griffith University, Australia. Since then, he has been working on synthesis, modification, characterisation of nanostructured materials for sensing, energy conversion and energy storage devices. As a core inventor, Prof. Zhang has developed a series of patented and commercialized photoelectrochemical sensors for environmental monitoring based on the functional nanomaterials. He was awarded Australia Research Council Future Fellow in photoelectrocatalysis for 2009-2013. Currently, Prof. Zhang is leading his group in research on energy conversion, energy storage and environmental monitoring. He has made substantial contribution in functionalizing binders for low cost, sustainable and high capacity energy storage devices.

Bio-Inspired Design on the Assembly Structure and Adhesion Ability of Carbon Nanotube Composites

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Abstract: Carbon nanotubes (CNTs) possess extremely high mechanical properties and are widely used in developing high-performance composites. Towards the ideal composite structure where all individual CNTs are uniformly distributed among polymer matrix to maximize interfacial shear transfer, the easy CNT aggregation has become one of the most difficult problems. By adapting a bio-inspired idea, polymer molecules were infiltrated into a film containing entangled CNTs to obtain a uniform distribution of CNT among the polymers. Then, by "practicing" the composite film with a multi-step stretching method, the CNTs became super-aligned and, more importantly, all the CNTs well maintained the unaggregation feature as they were already separated by the polymer. This is a big step to approach the ideal composite structure. The composite film had a tensile strength even up to 6.27--6.94 GPa.

In application, it is also important to develop the adhesion ability of high strength CNT composites with various substrates. To make the CNT films attachable to other surfaces, biological attachment devices can provide useful suggestions to design the surface structure and functionality of the CNT film. Here we develop an infiltration-based surface structure design to realized high adhesion ability. Long-chain polymers were used as the polymer backbone might get entangled with the CNTs after the infiltration. On the other hand, the functionalized segment of the polymer stayed on the film surface and thus provided the enhanced van der Waals interaction with the substrates.

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Author Biography

Xiaohua Zhang obtained Ph.D degree at Fudan Unversity in 2007, and worked in the International School for Advanced Studies (SISSA) and Suzhou Institute of Nano-Tech and Nano-Bionics (SINANO) during 2007--2011. He is now a professor at SINANO. His research interest focuses on the structure design and fabrication of nano-carbon-based composite materials.

Multifunctional Magnetoplasmonic Nanomaterials and Their Biomedical Applications

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Abstract: Multifunctional magnetoplasmonic (Fe_3O_4-Au) nanomaterials is characterized with some features of iron oxide and gold, as surface chemistry, special optical properties, and superparamagnetic properties, which have helped to draw much attention in biomedical application area. The specific plasmonic and magneto-optical properties in magneto-plasmonic nanoparticles are introduced, which would shed light on future development of multifunctional magnetoplasmonic nanomaterials. The magnetic core provides a particle which allows for a small size with significant magnetic moment. In addition, the magnetoplasmonic nanomaterials can establish a good platform for further conjugation of biomolecules. With the multifunctional properties of magnetoplasmonic nanomaterials, a variety of applications such as biosensor, bioseparation, multimodal imaging, and therapeutics is highlighted here. This opens up a new avenue for advanced multifunctional nanomaterials applications on biomedical field.

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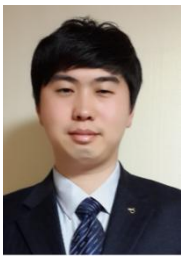
References:

1. H. Zhou, J. H. Bahng, N. A. Kotov, J. Lee, *Adv. Funct. Maters.* **2014**, *24*, 1439-1448.
2. H. Zhou, F. Zou, K. Koh, J. Lee, *J. Biomed. Nanotechnol.* **2014**, *10*, 2921-2949.
3. H. Zhou, F. Zou, D. Y. Hwang, J. Lee, *ACS Appl. Mater. Interfaces* **2014**, *6*, 19680-19689.
4. V. T. Tran, H. Zhou, J. Lee, *ACS Appl. Mater. Interfaces* **2015**, *7*, 8650-8658
5. H. Zhou, F. Zou, V. T. Tran, J. Lee, *RSC Adv.* **2015**, *5*, 81753-81758

Author Biography



Hongjian Zhou received his Ph.D. degree at Pusan National University (2010-2014). From 2014 to 2015, he worked in Pusan National University as a Postdoctoral Research Fellow. In 2015, he joined Institute of Solid State Physics, Chinese Academy of Sciences. He is currently an Associate Professor at Institute of Solid State Physics, Chinese Academy of Sciences. His research interest focuses on multifunctional nanomaterials.

Towards the Growth of High-quality Epitaxial InAs Nanowires in Molecular Beam Epitaxy

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Abstract: III-V semiconductor nanowires have attracted extensive attentions in the recent decades due to their distinct physical properties and hence potential applications in nanoelectronics and optoelectronics. As a key III-V semiconductor, InAs has attracted tremendous research interest due to its narrow bandgap, high electron mobility, small electron effective mass, and low-resistance ohmic contact. The combination of these unique features and the distinct characteristics of thin nanowire have made InAs nanowires a promising candidate for applications in many fields, such as single-electron transistors, resonant tunnelling diodes, and ballistic transistors.

In general, epitaxial III-V nanowires can be grown either by metal-organic chemical vapor deposition or molecular beam epitaxy through the so called vapor-liquid-solid mechanism or vapor-solid-solid mechanisms. From their structural point of view, although the zinc-blende structure is energetically favorable for the III-V bulk materials, III-V nanowires can adopt the wurtzite structure as well due to its low surface energy. Consequently, III-V nanowires tend to contain planar defects due to their small energetic differences of the stacking sequences in zinc-blende and wurtzite structures along their growth directions of $<111>_B/<000\bar{1}>$. For nanowires to be practically useful, it is critically important to control their structural quality.

In this presentation, our recent achievements in growing defect-free InAs epitaxial nanowires will be summarised.

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Professor Jin Zou is the Chair of Nanoscience in the University of Queensland, Since his PhD, Professor Zou has been engaged his research in understanding the semiconductor nanostructures using electron microscopy. After gained his PhD from Sydney University, Professor Zou worked there for 10 years with various prestigious fellowships, including ARC Postdoctoral Fellowship and Queen Elizabeth Fellowship. In the second half of 2003, Professor Zou moved to the University of Queensland and continued his research is the field of semiconductor nanostructures, where advanced electron microscopy is an essential tool. In 2009, he has been awarded an ARC Future Fellowship (FT3). So far, Professor Zou has published over 540 SCI journal papers, which have been cited for over 11,600 times and led to h-index of 53.