

Xiamen Forum on Soft Matter and Interface

Nov. 29 – Dec. 01, 2013

Xiamen, China

Program

November 29, 2013		
Whole Day		Pick-up from the airport & registration at the conference site
Afternoon	14:00 - 17:00	City tour
	19:00	Dinner
November 30, 2013		
Morning	8:15 - 8:30	Opening remarks
		Chair: Prof. Alan E. Rowan
	8:30 - 9:05	Talk 1: Bio-inspired, Smart, Multiscale Interfacial Materials with Super-Wettability
		Prof. Lei Jiang, Institute of Chemistry, CAS
	9:05 - 9:40	Talk 2: Photonics: Controlling Light with Matter and Matter with Light
		Prof. Theo Rasing, Radboud University Nijmegen
	9:40 - 9:55	Group Photo
	9:55 - 10:10	Coffee Break
		Chair: Prof. Lei Jiang
	10:10 - 10:45	Talk 3: 'Strain Stiffening' the Key to Biomimetic Cytoskeletal Materials
		Prof. Alan E. Rowan, Radboud University Nijmegen
	10:45 - 11:20	Talk 4: Electrostatically Regulated Self-Assembly of Nanoparticles
		Prof. Dayang Wang, University of South Australia
	11:20 - 11:55	Talk 5: Chiral Polymeric Biointerface Materials
		Prof. Taolei Sun, Wuhan University of Technology
	11:55 - 12:25	Special Talk: Publishing in Wiley Materials Science Journals-How to Maximize Your Success
		Dr. Yan Li, Small Editor

Noon	12:25 - 13:30	Lunch
Afternoon	Chair: Prof. Theo Rasing	
	13:30 - 14:05	Talk 6: Nanostructured Materials Based on Colloidal Crystals And Mesocrystals
		Prof. Limin Qi, Peking University
	14:05 - 14:40	Talk 7: Inorganic Nanostructure with Sizes down to 1nm: a Macromolecule Analogue
		Prof. Xun Wang, Tsinghua University
	14:40 - 15:15	Talk 8: On Biosynthesis of CdSe Quantum Dots in Live Yeast Cells: Initiative, Mechanism (partial) and Beyond
		Prof. Dai-Wen Pang, Wuhan University
	15:15 - 15:50	Talk 9: Magnetic Nanoparticles for Molecular Imaging of Tumors
		Prof. Mingyuan Gao, Institute of Chemistry, CAS
	15:50 - 16:10	Coffee Break
	Chair: Prof. Dayang Wang	
	16:10 - 16:45	Talk 10: Hierarchical Networks in Soft Materials: From Understanding to Construction
		Prof. Xiang Yang Liu, Xiamen University
	16:45 - 17:20	Talk 11: Self-Assembled Supramolecular Gels based on Amphiphilic amino acids: Regulation of the Self-assembled Nanostructures, Chirality and Functions
		Prof. Minghua Liu, Institute of Chemistry, CAS
	17:20 - 17:55	Talk 12: Recent Progress in Understanding Polymer Brushes
		Prof. Holger Merlitz, Xiamen University
Evening	18:30 - 21:00	Conference Banquet
December 1, 2013		
Morning	Chair: Prof. Shu-Hong Yu	
	8:00 - 8:35	Talk 13: Elastic Theory of Fluid Membranes of Helfrich Model and its Application in Other Soft Matters
		Prof. Zhong-can Ou-Yang, Institute of Theoretical Physics, CAS
	8:35 - 9:10	Talk 14: DNA Smart materials
		Prof. Dongsheng Liu, Tsinghua University
	9:10 - 9:45	Talk 15: Novel aligned carbon nanotube/polymer composites: sensing and electronic applications
		Prof. Huisheng Peng, Fudan University
	9:45 - 10:15	Coffee Break
	Chair: Prof. Zhong-can Ou-Yang	
	10:15 - 10:50	Talk 16: Ultrathin nanowires: an emerging motif for macroscopic assemblies

		Prof. Shu-Hong Yu, Univ. of Science and Technology of China
	10:50 - 11:25	Talk 17: Structures and properties of non-IPR fullerenes captured by chlorination/hydrogenation
		Prof. Su-Yuan Xie, Xiamen University
	11:25 - 12:00	Talk 18: Learning from The Viral Journey and Development of an Effective Gene Delivery System
		Prof. Lei Ren, Xiamen University
Noon	12:00 - 13:30	Lunch
Afternoon		Chair: Prof. Huisheng Peng
	13:30 - 14:05	Talk 19: Unexpected Hydrophobic Behavior of the Solid Surfaces with Charge Dipoles at Room Temperatures
		Prof. Haiping Fang, Shanghai Institute of Applied Physics, CAS
	14:05 - 14:40	Talk 20: Identification and Use of Molecular Self-assembly of Multilevel Aggregates within Stable Aqueous Three-phase Surfactant Systems
		Prof. Jingcheng Hao, Shandong University
	14:40 - 15:15	Talk 21: Rapid Detection and Disinfection of Viruses Using Graphene Oxide Nanomaterial
		Prof. Rui-Kang Tang, Zhejiang University
	15:15 - 15:50	Talk 22: Chemical Design and Textural Engineering of Graphitic Carbon Nitride Semiconductors for Artificial Photosynthesis
		Prof. Xinchun Wang, Fuzhou University
	15:50 - 16:10	Coffee Break
		Chair: Prof. Rui-Kang Tang
	16:10 - 16:45	Talk 23: Understanding the Complex Organization and Interaction of Living Soft Matter
		Prof. Yu-qiang Ma, Nanjing University
	16:45 - 17:20	Talk 24: Target-Responsive “Sweet” Hydrogel with Glucometer Readout for Portable and Quantitative Detection of Non-Glucose Targets
		Prof. Chaoyong Yang, Xiamen University
	17:20 - 17:55	Talk 25: Construction of 3D Ordered Functional Materials and their Applications
		Prof. Yao Li, Harbin Institute of Technology
	17:55 - 18:30	Talk 26: Quantum Dots for Sensing
		Prof. Jun-Jie Zhu, Nanjing University
	18:30 - 18:35	Conclusive Remarks
Evening		TBD

Abstracts and CVs

Talk 1

Bio-Inspired, Smart, Multiscale Interfacial Materials with Super-Wettability

Prof. Lei Jiang, Institute of Chemistry, Chinese Academy of Sciences

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Learning from nature, we have built a series kinds of bio-inspired, smart, multiscale interfacial materials following the five-step strategy: selection of a unique property found in biology; understanding of the correlation between multiscale structure and macroscopic properties; design and synthesis of suitable target molecules; design of a two-way response using bistable states; construction of a binary cooperative complementary interface.

Starting from the superhydrophobic lotus leaves, we revealed that a super-hydrophobic surface with both a large CA and small sliding angle needs the cooperation of micro- and nanostructures. Further studies on other natural interfaces such as rice leaves, butterfly wings, water strider legs and mosquito eyes, have proved that the arrangement and orientation of micro and nano structure can directly affect the surface wettability and water movement trends. Recently, inspired by the self-cleaning fish scales underwater, we extended the three phase system from liquid/air/solid to the liquid/liquid/solid. The hydrophilic compositions together with the micro/nano structures endowing the fish scale with superoleophobicity underwater, which prevent them from pollution. By choosing hydrophilic hydrogel material and using the fish scales as templates, artificial fish scales have been fabricated, and the mechanical strength of the materials could be enhanced by integrating with nanoclay.

Based on the micro/nano structured interfaces with special wettability, kinds of basic chemical reactions could be done within a small water drop. Crystal arrays could also been prepared based on the superhydrophobic pillars. Furthermore, since the superhydrophobic pillar-structured surfaces can generate direction-controlled liquid bridge arrays when placing an aqueous droplet upon the surfaces, no matter small molecule, polymer, silver NPs or microspheres can be arrayed in one direction along a long distance.

The four states of wettability (superhydrophilicity, superhydrophobicity, superoleophilicity and superoleophobicity) can switch between each other under certain circumstances by combination of surface micro- and nanostructures and surface modification of smart molecules. Besides the two

dimensional interface, we recently extended the cooperation concept into the one dimensional system. The first example is bio-inspired artificial ion channel. Using shape controlled polymeric single nanochannel, whose ion transport properties are determined by the surface wettability, surface charge and the physical diameters, artificial ion channels with smart gating properties under external stimuli have been fabricated by integrating smart molecules into the nanochannels. These intelligent nanochannels could be used in energy-conversion system, such as photoelectric conversion system inspired by rhodopsin from retina or bR, and concentration-gradient-driven nanofluidic power source that mimic the function of the electric eels.

The other one dimensional system is the artificial spider's silk. In the moist morning, we always see small water drops hanging on the spider's web. The energy of surface interaction and pressure differences induced by the periodic spindle knots on the spider's silk can drive liquid drops in a specific direction that can collect water from moist air. Further, we prepared artificial spider's silk based on dip-coating method. Droplets of water on the artificial spider's silk behaved similarly to those on its biological counterparts.

After discovering the directional water collection ability of spider silk for the first time in the world, inspired by the cactus surviving in the most drought desert, we probed into the relationship of the structure-function of cactus (*Opuntia microdasys*) and found that the cactus had evolved a multi-structural and multi-functional integrated continuous fog collection system, which is superior to that found on the spider silk and can collect water more efficiently.

Learning from nature is a constant principle because nature provides us numerous mysterious properties that have developed over millions of years of evolution. Inspired by nature, the constructed smart multiscale interfacial materials system not only presents new knowledge, but also has great applications in various fields, such as self-cleaning glasses, superhydrophobic textile, water/oil separation, anti-biofouling interfaces, water collection system and also green printing technique.

Reference:

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2. Y. M. Zheng *et al.*, Directional water collection on wetted spider silk. *Nature* **463**, 640 (2010).
3. M. J. Liu, Y. M. Zheng, J. Zhai, L. Jiang, Bioinspired Super-antiwetting Interfaces with Special Liquid-Solid Adhesion. *Acc. Chem. Res.* **43**, 368 (Mar, 2010).
4. X. Hou, W. Guo, L. Jiang, Biomimetic smart nanopores and nanochannels. *Chem. Soc. Rev.* **40**, 2385 (2011).
5. J. Ju *et al.*, A multi-structural and multi-functional integrated fog collection system in cactus. *Nat*

Commun **3**, 1247 (2012).

6. B. Su, Y. Wu, L. Jiang, The art of aligning one-dimensional (1D) nanostructures. *Chem. Soc. Rev.* **41**, 7832 (2012).



Lei Jiang received his B.S. degree in solid state physics (1987), and M.S. degree in physical chemistry (1990) from Jilin University of China. From 1992 to 1994, he studied in Tokyo University of Japan as a China-Japan joint course Ph.D. student and received his Ph.D. degree from Jilin University of China with Tiejin Li. Then, he worked as a postdoctoral fellow in Akira Fujishima's group in Tokyo University. In 1996, he worked as researcher in Kanagawa Academy of Sciences and Technology, Hashimoto's project. In 1999, he joined Institute of Chemistry, Chinese Academy of Sciences (ICCAS) as Hundred Talents Program. Since then, he has been the professor in ICCAS. In 2009, he has been elected as an Academician of the Chinese Academy of Sciences. In 2012, he has been elected as the TWAS member. His scientific interest is focused on the bio-inspired surface & interfacial materials with special wettability and over 400 papers have been published, the works have been cited more than 20000 times, the H factor is 68.

Talk 2

Photonics: controlling light with matter and matter with light

Prof. Theo Rasing, Radboud University Nijmegen

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Future communication and information technologies will rely more and more on photons instead of electrons, which requires the development of novel multifunctional photonic materials as building blocks for light generation, propagation, amplification, and modulation as well as the development of novel approaches of controlling material properties by light. Materials with highly efficient nonlinear optical (NLO) properties such as second harmonic generation and two-photon-absorption play a crucial role in modern technology, with wide applications ranging from light frequency conversion, optical telecommunications, information processing to data storage. Currently, most photonic components are based on inorganic NLO materials, though organic materials have their intrinsic advantages in their high hyperpolarizabilities, diverse tailor-made architectures, and ease of processability. The ultimate goal will be the manipulation of such material properties by light, to achieve control of photon by photons or all-photonic devices. In this talk our recent progress in the development of micro-/nano- scale fibre structures with combined second- and third- order NLO properties as potential optical building blocks for applications in optical devices, as well as recent progress in manipulating material properties with light will be discussed.



Theo Rasing is full professor of Experimental Physics at Radboud University Nijmegen, elected member of the Royal Dutch Academy of Arts and Sciences (KNAW) and the Academia Europa, Knight of the Order of the Dutch Lion and founder and Director of the Nijmegen Centre for Advanced Spectroscopy.

Rasing is world renowned for his pioneering research on the manipulation of magnetism using light, where he demonstrated that short (less than 100 femtosecond) optical pulses can generate equally short effective magnetic field pulses of several

Tesla, that form a unique tool for the study and control of ultrafast magnetization and spin dynamics.

Main current research interests: Opto-Magnetism, Femto-Magnetism, Molecular Photonics

Talk 3

‘Strain Stiffening’ the Key to Biomimetic Cytoskeletal Materials

Maarten Japers, Zaskia Eksteen Akeroyd, Matthieu Koepf, Vincent A.A. Le Sage, Chris Wilson Eduardo Mendes, Paul H.J. Kouwer, and Prof. Alan E. Rowan, Radboud University Nijmegen

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Numerous synthetic gels have been developed as mimics of the extracellular matrix, in the hope of understanding how cells respond to the mechanical properties of the tissue microenvironment. In contrast to most gels used the extracellular matrix proteins such as collagen type I, and fibrin, display nonlinear mechanical properties such as strain stiffening and negative

normal stress [1]. In these materials the elastic modulus of the gel increases by several orders of magnitude as the applied strain increases such that the resistance that a cell feels is strongly depended of the strain that it applies. In this presentation I will demonstrate the unique cytomimetic properties of hydrogels based on oligo(ethylene glycol) grafted polyisocyanopeptides [2]. These extremely stiff helical polymers [3] form gels upon **warming** at concentrations as low as 0.005 %-wt polymer, with materials properties almost identical to these of intermediate filaments and extracellular matrices. The macroscopic behaviour of these gels can be described in terms of the molecular properties of the basic stiff helical polymer and a multi-step hierarchical self-assembly, which results in strain stiffening [4]. The study of these gels and their application in cell growth and drug therapeutics will be discussed.

References

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Alan Rowan completed his PhD in physical organic chemistry in 1991 at the University of Liverpool, England. After a period of postdoctoral research at the University of Otago, Dunedin, New Zealand, he returned to Europe and became an assistant professor at the Radboud University Nijmegen in the group of Roeland Nolte. In 2004, he became a full professor in molecular materials. His scientific interests are in the design and construction of supramolecular assemblages possessing catalytic and electronic properties. He is also a member of the editorial advisory board for the RSC New Journal of Chemistry, member of the New Journals Advisory Board of the Royal Society of Chemistry and a member of the International Advisory Board of Chemistry World.

Talk 4

Electrostatically Regulated Self-assembly of Nanoparticles

Prof. Dayang Wang, Ian Wark Research Institute, University of South Australia,

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In this presentation, we will discuss an interesting but non-negligible contribution of the electrostatic repulsion that, albeit usually being regarded as isotropic, can enforce anisotropy of self-assembly of charged nanoparticles (NPs) in the presence of anisotropic interaction. Stepwise adjusting long-range electrostatic repulsion between charged nanoparticles (NPs) leads to linear chains with defined length. This electrostatic repulsion – controlled NP chain growth shows a noticeable dependence on the sizes of constituent NPs; the number of NPs per chain is inversely proportional to the NP sizes. This also allows integration of differently-sized NP chains to composite linear chains – mesoscopic analogues of block copolymers, while configurations are strongly correlated with large-to-small NP size ratios.

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2. H. Xia, G. Su, and D. Wang, *Angew. Chem. Int. Ed.* 2013, 52, 3726.



Dayang Wang was born in Liaoning, China, in 1972. He studied chemistry at Jilin University, Changchun, China, where he obtained a B. Eng. in 1993 and a PhD in 1998 under co-supervision of Profs. Xinyi Tang, Tiejun Li, and Yubai Bai. In 1999 he worked as a postdoctoral fellow in the group of Prof. D. Lam in Dept. Mech. Eng. at Hong Kong University of Science and Technology, Hong Kong. Later in 1999 he joined the research group of Prof. F. Caruso, as a postdoctoral fellow, at the Dept. Interfaces, headed by Prof. H. Möhwald, at the Max Planck Institute of Colloids and Interfaces (MPIKG), Potsdam, Germany. In 2000 he received an Alexander von Humboldt Research Fellowship. Since July 2003 he became a group leader at the Dept. Interfaces, MPIKG. In July 2010 he took up a tenured professor position at the Ian Wark Research Institute, University of South Australia, Adelaide, Australia. He has published 100 articles in international peer-reviewed journals in Chemistry and Material Science. His current research interests include surface and interface (adsorption, adhesion, translocation, and phase transfer), gas and ion adsorption and transportation, crystallization, self-assembly, hydrogel, drug delivery, and nanomedicine.

Representative publications:

1. Xia, H.; Su, G.; Wang, D.; “Size-Dependent Electrostatic Chain Growth of pH-Sensitive Hairy Nanoparticles” *Angew. Chem. Int. Ed.* 52 (2013), 3726–3730.
2. Stocco, A., Chanana, M., Su, G., Cernoch, P., Binks, B. P., Wang, D.; “Bidirectional nanoparticle crossing of oil-water interfaces induced by different stimuli: in-depth insight to phase transfer” *Angew. Chem. Int. Ed.* 51 (2012) 9647-9651.
3. Wu, C.; Bai, S.; Ansorge-Schumacher, M.; Wang, D.: “Nanoparticle Cages for Enzyme Catalysis in Organic Media” *Adv. Mater.* 23 (2011), 5694-5699
4. Bai, S., Nguyen, T.-L., Mulvaney, P., Wang, D.: “Using Hydrogels to Accommodate Hydrophobic Nanoparticles in Aqueous Media via Solvent Exchange” *Adv. Mater.* 22(2010), 3247-3250
5. Xia, H.; Bai, S.; Hartmann, J.; Wang, D.: “Synthesis of Monodisperse Quasi-Spherical Gold Nanoparticles in Water via Silver (I) – Assisted Citrate Reduction” *Langmuir* 26(2010) 3585-3589
6. Zhang, H., Wang, D.: “Controlling Chain Growth of Charged Nanoparticles Using Interparticle Electrostatic Repulsion” *Angew. Chem. Int. Ed.* 47(2008) 3984-3987

Talk 5

Chiral Polymeric Biointerface Materials

Prof. Taolei Sun, Wuhan University of Technology

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Life is a typical chiral system, and chiral phenomena are ubiquitous in nature from macroscopic to molecular levels.¹ 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 secret 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.²

Through introducing the surface chirality into the study of polymeric biointerface materials, we firstly reported the chiral effect on biointerface at the cell level^{3,4} and the biomacromolecule level.^{5,6} 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,⁷ 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.*⁸⁻¹⁰ 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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Prof. Taolei Sun received his PhD in Technical Institute of Physics and Chemistry, Chinese Academy of Science (CAS) in 2002. After two-year postdoctoral research in Institute of Chemistry, CAS, he worked in Physics Institute of Muenster University, Germany, as an Alexander Von Humboldt Fellow. 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 of 1 million Euro to build an independent research group in Muenster University to perform frontier research on functional biointerface materials. In late 2009, he joined Wuhan University of Technology, China, and was appointed as the “Chang-Jiang Scholar” distinguished professor. Since 2011, he served as the Chair Professor of the Materials Science and Engineering discipline in Wuhan University of Technology. In 2013, he got the China National Funds for Distinguished Young Scientists. Until now, he published more than fifty scientific papers, more than 20 of which are on top journals like *Angew. Chem.*, *JACS*, *Adv. Mater.*, *Chem. Soc. Rev.*, and received citations more than 2800 times.

Representative Publications:

1. G. Qing, T. Sun, *Angew. Chem. Int. Ed.* **2013**, in press, DOI: 10.1002/anie.201306660.
2. M. Zhang, G. Qing, C. Xiong, R. Cui, D. Pang, T. Sun, *Adv. Mater.* 2013, 25, 749.
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Special Talk

Publishing in Wiley Materials Science Journals - How to Maximize Your Success

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This presentation will cover Wiley Online Library, the peer-review process and the global team of Wiley materials science. We will also introduce several recently founded journals, including Advanced Energy Materials, Advance Healthcare Materials, Advanced Optical Materials and Advanced Materials Interface.



Yan Li obtained his BSc from Tianjin University in 2004, and PhD from Tsinghua University in 2009. He subsequently carried out postdoctoral studies at University of Houston and then at Wageningen University. He joined Wiley in 2012, and is the editor of several Wiley materials science journals.

Talk 6

Nanostructured materials based on colloidal crystals and mesocrystals

Prof. Limin Qi, Peking University

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The controlled synthesis of nanostructured materials with tailored morphologies and patterns has attracted considerable attention because the properties and performances of nanomaterials are largely dependent on the shape and structure of the primary building blocks and the way how the building blocks are assembled or integrated. As two typical kinds of self-assembled structures, colloidal crystals and mesocrystals have stimulated intense interest in recent years, and a wide variety of nanostructured materials based on colloidal crystals and mesocrystals have been produced through colloidal self-assembly, controlled growth, and deliberate replication. This presentation summarizes our recent progress in the colloidal approaches towards tunable nanostructures based on monolayer colloidal crystals (MCCs) and mesocrystals. Firstly, various two-dimensionally ordered nanostructures with controlled patterns, such as nanonets, nanobowl arrays, and nanostar arrays were fabricated or assembled using MCCs as templates. A general approach towards free-standing, high-quality nanonets and nanobowl arrays of various inorganic materials based on nanosphere lithography at solution surface (NSLSS) was established. The potential applications of the produced Ag and ZnS nanobowl arrays as plasmonic crystal-based or photonic crystal-based sensors were demonstrated. Moreover, MCC-assisted self-assembly of uniform star-shaped nanocrystals into ordered arrays with controllable patterns was realized by evaporation induced assembly. Secondly, the solution-phase synthesis of the mesocrystals of various functional metal oxides, such as titanium dioxide, tin dioxide, and hematite, has been realized through both bottom-up and top-down approaches. Unique spindle-shaped nanoporous anatase TiO₂ mesocrystals with a single-crystal-like structure and tunable sizes were fabricated through mesoscale assembly using acetic acid as the coordinating solvent without any additives. Mesocrystalline TiO₂ and SnO₂ nanorod arrays grown on Ti substrate were facilely synthesized by kinetics-controlled growth processes. Novel hematite mesocrystals with tunable morphologies including microcones and microdiscs were synthesized by selective etching of pre-fabricated hematite pseudocubes. Furthermore, the potential applications of the metal oxide mesocrystals in lithium ion batteries, antireflection, photocatalysis, and wastewater treatment were explored.

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Limin Qi received his PhD degree in Physical Chemistry from Peking University in 1998. He then went to the Max Planck Institute of Colloids and Interfaces to work on biomimetic mineralization as a postdoctoral fellow. In 2000, he joined the College of Chemistry at Peking University, where he has been a full professor since 2004. His research interests include colloidal chemistry, nanomaterials, self-assembly, biomineralization, biomimetic synthesis, and energy-related materials. He has published more than 140 refereed papers and currently his h-index is 50. He is an

editorial board member of *Chinese Journal of Chemistry* and *Chinese Science Bulletin*, and an advisory board member of *Advanced Functional Materials* and *ACS Applied Materials & Interfaces*. His current research is focused on the controlled synthesis and hierarchical assembly of functional micro- and nanostructures by colloidal chemical methods and bio-inspired approaches, with particular attention paid to their applications in energy conversion and molecular sensing.

Representative Publications

1. J. Cai, J. Ye, S. Chen, X. Zhao, D. Zhang, S. Chen, Y. Ma, S. Jin,* L. Qi,* “Self-cleaning, broadband and quasi-omnidirectional antireflective structures based on mesocrystalline rutile TiO₂ nanorod arrays”, *Energy Environ. Sci.* **2012**, 5, 7575
2. X. Ye, L. Qi,* “Two-dimensionally patterned nanostructures based on monolayer colloidal crystals: Controllable fabrication, assembly, and applications”, *Nano Today* **2011**, 6, 608
3. J. Ye, W. Liu, J. Cai, S. Chen, X. Zhao, H. Zhou, L. Qi,* “Nanoporous anatase TiO₂ mesocrystals: additive-free synthesis, remarkable crystalline-phase stability, and improved lithium insertion behavior”, *J. Am. Chem. Soc.* **2011**, 133, 933.

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Talk 7

Inorganic Nanostructure with Sizes down to 1nm: a Macromolecule Analogue

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The past thirty years have witnessed the blossom of nanoscience due to the fascinating properties related to the reduction of dimension of inorganic materials. However, scientists have to hybrid these nanomaterials with various polymers to harvest the unique features of polymer or macromolecule like plasticity, viscoelasticity, etc. which are inherently determined by the flexible conformation of the polymeric chains and missing in conventional inorganic nanomaterials. Here we demonstrate the synthesis of ultrathin nanowires and nanoribbons with diameter/thickness less than 1 nm, a size comparable to that of a polymer chain. We found that the size reduction of the inorganic nanostructures brought them great similarity to macromolecules: the ultrathin nanowires mimicked the polymeric molecules in chain entanglement, non-Newton rheological behavior, gelation phenomenon and electrospinning viability; the ultrathin nanoribbons demonstrated interesting conformational diversity through energy balance among organic ligand, inorganic structure and solvent which can be compared to the conformational variety in biomacromolecules. Our study shows that quasi-1D inorganic materials will possess macromolecule-like properties when their size and dimension were carefully controlled within ultrathin region, which may contribute to the design of new kind of hybrid material by combining the intrinsic properties of inorganic substrate and the polymer.

Further endeavor has also been made to expand the synthetic strategy to other ultrathin systems, including ultrathin nanosheets (Pt-Cu alloy and MoS₂) with thickness~1nm, 1-D and 2-D helical heteronanostructures, etc. Interesting self-assembly behaviors have been observed and further analyzed in these systems.



Diplomas

July 1998: B. S. Northwest University, China

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Research Activities

2004-2005 Assistant Professor, Department of Chemistry, Tsinghua University

2005-2007 Associate Professor, Department of Chemistry, Tsinghua University

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2011- Editorial board member *Chinese Science Bulletin*

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Talk 8

On Biosynthesis of CdSe Quantum Dots in Live Yeast Cells: Initiative, Mechanism (partial) and Beyond

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With bioapplication of nanotechnology there is an urgent requirement for rational design and controllable synthesis of nanomaterials with superior properties. With the development of human cognition to the nature, many biological systems have been found to have great potentials to synthesize and assemble inorganic nanomaterials. These findings will promote the development of materials science via the intercross between chemistry and biology, offering opportunities for controllable synthesis of nanomaterials. We have put forward a new strategy of “Live Cell Synthesis by Space-Time Coupling” of intracellular unrelated biochemical reactions to controllably synthesize nanomaterials for biolabeling and accurately tune their “structure-property” during the synthesis^{1,2}. By such a new strategy we have successfully and controllably realized the desired synthesis of CdSe nanocrystals with diverse monocolours of fluorescence that can never occur in live cells in nature. We also have successfully extended such a strategy/principle from the intracellular to mimetic systems, i.e. to construct quasi-biosystems for synthesis, and established multiple methods to synthesize nanomaterials for biolabeling under mild conditions, such as water-dispersible ultrasmall near-infrared Ag₂Se₃, near-infrared PbSe nanocube and nanocage QDs⁴, Au nanoparticles, Au-Ag alloy nanoparticles, Au clusters⁵, and so on. An inspiration from the present work can be drawn that we can make more opportunities to control the synthesis of nanomaterials by changing the synthetic system from simple to complicated. Overall, our work has clearly demonstrated that biosystems can be skillfully utilized to controllably realize unnatural biosynthesis, which does not exist in nature, of nanomaterials, offering new insights into the control of synthesis. In this presentation we will give a brief introduction of our initiative, partial

mechanism for live cell synthesis of CdSe quantum dots in the *Saccharomyces cerevisiae* and related extension.

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Dr. Dai-Wen Pang is professor of chemistry at Wuhan University (China), director of the Key Laboratory of Analytical Chemistry for Biology and Medicine (MOE, China), member of the National Steering Committee for Nanotechnology (China), member of the National Key Scientific Program of Nano Research (China), head of the Creative Research Group (NSFC), 973 Chief Scientist, and member of editorial boards of 13 peer-reviewed scholarly journals. He is also the Technical Founder of Wuhan Jiayuan Quantum Dots Co., Ltd. He was the Dean of the College of Chemistry and Molecular Sciences, Wuhan University, China from 2001 to 2005. His main interests focus on the development of new nanobioprobes and nanobioprobes-based methodologies for biomedical research and clinical diagnosis, especially quantum dots-based dynamic biotracking and bioimaging for virus invasion, tumor metastasis and cancer diagnosis. He and his coworkers put forward a new strategy of ‘Space-Time Coupling’, namely, in time and space, coupling intracellular irrelevant biochemical reactions to controllably synthesize nanomaterials in live cells, by which color-tunable fluorescent CdSe nanocrystals can be controllably prepared in live cells. His group solved the problems for safe, high-efficiency and low-cost preparation of fluorescent core/shell CdSe/ZnS semiconductor QDs in a large scale. They have also established multiple methods, e.g. quasi-biosystems, for synthesis of near infrared QDs such as Ag₂Se, Ag₂S, PbS, PbSe and so on. His group proposed a new strategy for electrochemical tuning of luminescent carbon nanodots, by which the size, surface oxidation state and corresponding luminescence properties of carbon nanodots can be tuned. They have found that surface states are the key to the luminescence of carbon nanodots. Accordingly, they constructed a variety of QD-based nanobioprobes, such as multicolor fluorescent-magnetic-biotargeting multifunctional nanobioprobes etc., for diverse biomedical applications. He has been an author for over 260 research publications in peer-reviewed journals, 23 authorized patents and one national standard for quantum dots. He has delivered 113 invited lectures. He has been awarded the National Science Fund for Distinguished Young Scholars in 2000 by the National Natural Science

Foundation of China, and the First Award of the Natural Science Prize of the Ministry of Education of China (Dec. 2006) etc.. The achievement on “Synthesis of nanomaterials such as quantum dots in live cells” was officially selected and showcased at the Exhibition (7-13 Mar 2011, Beijing) on Major National Science & Technology Achievements of China during the “11th Five-year Plan” Period (2006-2010).

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Talk 9

Magnetic Nanoparticles for Molecular Imaging of Tumors

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Superparamagnetic iron oxide nanoparticles have received great attention owing to their applications as contrast agents for magnetic resonance imaging (MRI). Unfortunately, the productions of iron oxide particle-based IV contrast agents, e.g., Feridex and Combidex, have been ceased recently. Nevertheless, the investigations on the preparation of high quality magnetic nanoparticles towards MRI applications such as molecular imaging of malignant tumors have never been stopped. This presentation will summarize the state-of-the-art progress on the preparation and *in vivo* applications of iron oxide and rare-earth nanoparticles for tumor imaging.

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Dr Mingyuan Gao is currently a full Professor in the Institute of Chemistry, the Chinese Academy of Sciences. His main research interests include: synthesis of nanocrystals with novel properties, unusual shapes, and structures; synthesis of organic/inorganic hybrid materials; biological, biomedical, and environmental applications of functional nanomaterials. He took his current position upon the ‘Hundred-talent Program’ from CAS in 2001. He received the ‘National Science Fund for Distinguished Young Scholars’ from NSFC in 2002. He was an AvH fellow between 1996 and 1998. So far, he has published over 100 peer-reviewed articles and holds 14 patents. More details can be found at <http://www.gaomingyuan.com>

Talk 10

Crystal Networks in Soft Materials: From Understanding to Construction

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While traditional “hard” materials, crystals, remains to be important in developing robust devices and technologies in modern electronic and IT industries, soft materials are replacing a large number of traditional “hard materials” as they often display multi-functionality, smartness/responsiveness and ultra-performance. The two classes of seemingly unrelated materials are found to be correlated in many cases in terms of crystal networks. High preferment soft functional materials consisting of interconnecting network become increasingly important in both sciences and technologies. It has been shown that in many cases, the hierarchical networks structures give rise to much more superior properties than singles crystals themselves. For instance, the special crystal network structure of amino acids in spider silk leads to the tensile strength several magnitude higher than single chains of amino acids. Due to these facts, our interests are shifted from the control of single crystals, such as size and shape of single crystals to the engineering the crystal network. In this contribution, new understandings on the formation kinetics of crystal network, and the between the network structure and the properties of the systems will be presented. I will introduce the latest development in the kinetics of fiber network formation, the correlation between the structures of biological functional materials and the in use properties, and the application to megascopic engineering. This includes the engineering of nano phase and ultra-functional soft-materials.



Prof. XY Liu received his Ph.D. degree with the *cum laude* title from the Radboud University Nijmegen (Netherlands), in 1993. Prof. Liu is the tenured full Professor in NUS, and currently the State Distinguished Professor for the 1000 Talents Program, Chair Prof. of the Changjiang Scholars Program. His research interests range from biomimetics, crystallization, soft matters, etc. He has authored numerous books, and about 200 peer prestige papers, ie. *Nature*, etc., many cited by the top webs and journals, etc. His international stand can be substantiated by his delivery of over 90 plenary/keynote or invited talks in the international conferences, organization of > 20 international conferences/symposia, numerous Awards, and the 5th President of the Asia Association for Crystal Growth and Crystal Technology, the councilor of the International Organization of Crystal Growth, the guess-Editor of J Crystal Growth, etc. Due to his outstanding contributions to the international academic communities, Professor Liu has received numerous international awards.

Selected Publications:

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Talk 11

Self-Assembled Supramolecular Gels based on Amphiphilic amino acids: Regulation of the Self-assembled Nanostructures, Chirality and Functions

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Supramolecular gel, as one of the important soft materials, is getting great interest recently due to their easiness in the design of gelator molecules, controllability in the self-assembly manner and the regulation of the functions. While the design of the gelator molecules is still paid much attention, more focuses have been shifted to the functionalities of the supramolecular gels. Based on the L- or D-glutamic acid, we have designed a series of gelator molecules and developed several unique gels, such as the gel that could gel most organic solvents and co-assembly many other molecules, and the gel that could form nanotubes in many organic solvents and encapsulate many kinds of other molecules including polymers, biomacromolecules. We have also developed some new chiral functions for the supramolecular gels that single molecule could not show. These include the chiral recognition, chiroptical switch and the chiral nanostructure for asymmetry catalysis.

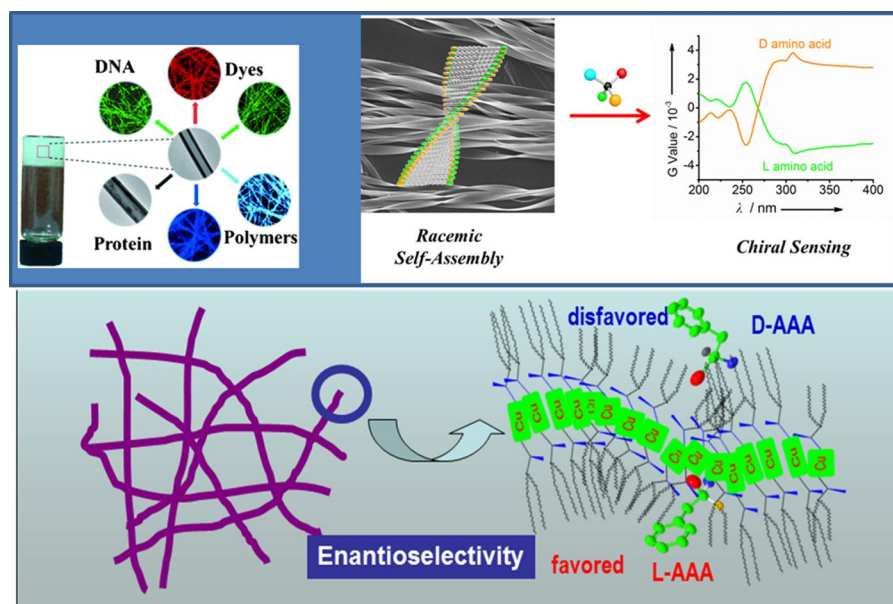


Figure. 1 (Top) Nanotube with good encapsulation capacity, nanoassemblies for racemic amphiphiles for chiral recognition and the metallogel (bottom) for chiral recognition.

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Minghua Liu was born in Jiangsu, China, in 1965. He studied chemistry at Nanjing University, Nanjing, China, where he obtained a Bachelor degree in 1986. Then he entered into the Master course in Nanjing University in 1986 and was selected as one of the students to Japan by Ministry of Education. He went to Saitama University, Japan and received a PhD in 1994 under the supervision of Prof. Kiyoshige Fukuda. In 1994-1997 he worked as a postdoctoral fellow in the group of Prof. K.Kira in the research institute of Physics and Chemistry (RIKEN). Since February of 1998, he has joined the Institute of Photographic Chemistry and then Institute of Chemistry, the Chinese Academy of Sciences. He has published more than 230 articles in international peer-reviewed journals in Chemistry and Material Science. His current research interests include colloid and interface science, supramolecular gel, Langmuir-Blodgett films, self-assembly, supramolecular chirality and chiral functional materials.

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Talk 12

Recent progress in understanding polymer brushes

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Polymer brushes are highly flexible layers made of polymers that are end-grafted onto a substrate. Once the density of grafted polymers exceeds their overlap density, the chains begin to stretch away from the substrate to form a highly flexible and durable layer. The particular choice of the polymer allows to engineer functional, even switchable surface layers with characteristic properties. Polymer brushes have been applied to modify surface friction (lubrication), to engineer textiles with switchable super-hydrophobic properties, or to store and release proteins or drugs in pharmaceutical applications.

In recent years, our research group has conducted a series of computational studies, combined with scaling theory, self-consistent field theory and Flory-type mean-field theory in order to study the peculiar properties of these polymer brushes. I am going to offer an overview of the various results we have achieved since then.



2009-present Professor at the Department of Physics, Xiamen University

2008-present Guest Scientist, Leibniz-Institute for Polymer Research, Dresden, Germany; novel functional nano-materials through polymer brushes

2006-2009 Associate Professor at the Department of Physics, Xiamen University;
computational soft-matter and biophysics

2005-2006 Guest Scientist at Department of Physics, Xiamen University; computational soft-matter and biophysics

2000-2005 Junior Scientist at Institute of Nanotechnology, Karlsruhe Research Center; software development for computer aided drug design

1998-2000 Visiting Fellow Indian Institute of Astrophysics, Bangalore, nonaccelerator particle physics group; computation of parity nonconserving effects in atoms

1995-1997 Doctoral thesis Heidelberg University and Max-Planck Institute of Nuclear Physics; simulation of pion correlations in heavy ion collisions

1994-1995 Research Assistant at the DKFZ Heidelberg, group of J. Langowski; simulation of DNA supercoiling dynamics

1988-1994 Study of physics at Heidelberg University; thesis: Bose-Einstein correlations of p-ions in heavy ion collisions

Teaching

Polymer theory, cosmology, quantum computing

Recent Publications

1. H. Merlitz, W. Cui, C.-X. Wu and J.-U. Sommer, Semianalytical Mean-Field Model for Starlike Polymer Brushes in Good Solvent, *Macromolecules* 46, 1248(2013)
2. H. Merlitz, C.-X. Wu and J.-U. Sommer, Inclusion Free Energy of Nanoparticles in Polymer Brushes, *Macromolecules* 45, 8494(2012)
3. D. Romeis, H. Merlitz and J.-U. Sommer, A new numerical approach to dense polymer brushes and surface instabilities, *J. Chem. Phys.* 136, 044903(2012)
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Talk 13

Elastic Theory of Fluid Membranes of Helfrich Model and its Application in Other Soft Matters

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Shape problems stemmed from real bio- and abiotic materials in nature initial many nice theories in sciences. The observation of law of constant angle of crystal planes by N. Stensen (1669) leads to G. Wulff construction for convex crystal shape (1901). The beautiful shapes of soap films observed by J. Plateau (1803) emerges a “golden age” in the study of minimal surface. The investigation on the rise of a liquid in a capillary tube generates T. Young (1805) and P.S. Laplace (1806) theory on a surface of constant mean curvature which predicts liquid bubble to be sphere only (Alexandrov (1950's)). However, a long-standing problem in physiology, why the red blood cells (RBCs) in human bodies are always in a rotationally symmetric and biconcave shape, has puzzled peoples for more than 100 years. It is finally solved by W. Helfrich (1973) who recognized membrane being a liquid crystal (LC) film and derived from curvature elastic theory of LC a free energy of fluid membranes. The variation with the energy leads a generalized Young-Laplace shape equation (Ou-Yang and Helfrich, 1987). In this talk some progress of our study following Helfrich model for 25 years are reported. We found that the shape equation predicts not only the exact solution for RCB shape but also a special kind of torus vesicle which have soon afterwards confirmed by experimental observations. Especially, the Helfrich model was successfully extended to investigate the complex structures in other soft matters such as the formation of focal conic domains in smectic LC, helical carbon nanotubes, the tube to sphere transition in peptide nanostructures, and Icosahedral self-assemblies in virus capsids.



Prof. Zhong-can Ou-Yang, a theoretical physicist, was born on Jan. 25, 1946, in Quanzhou, Fujian Province of China. He received his Ph.D. in Tsinghua University, in 1984, and worked the next two years in the Institute of Theoretical Physics, Chinese Academy of Sciences (ITP-CAS) as postdoctoral fellow. From 1987 to 1988 he worked with Prof. W. Helfrich at FU Berlin as an Alexander von Humboldt Foundation fellow. In 1989 he joined ITP-CAS, first as an associated professor and then (1992) as a full professor. He has been serving as the Director of the institute from 1998 to 2007. He has made distinguished contributions to a number of theoretical subjects in soft condensed matter physics, nanostructure formation, and biophysics. He has been awarded several renowned prizes, and elected as an academician of Chinese Academy of Sciences in 1997, a member of Third World Academy of Sciences in 2003.

Talk 14

DNA Smart Materials

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The reversible responsiveness of DNA secondary structures to environmental stimuli has enabled to facilitate responsive devices and materials based on pure DNA or hybrid systems. Based on sequence and structure design, we have prepared kinds of pure or hybrid DNA supramolecular hydrogels, which could be formed under physiological condition within a minute at room temperature and without using any organic solvents. By tailoring the length of “sticky ends” of DNA linker, mechanical property of the hydrogel could be varied from hundreds to thousands Pa (G' , storage modulus); we also found that the viability of cell in a 4 mm diameter hydrogel is nearly 100% after 24 hours incubation from top in plastic tubes. Additionally, the hydrogels show an excellent multiple responsiveness including pH, DNA restriction enzymes, protease digesting, temperature etc., which enable easy removal after cell culture. We believe these hydrogels have great potential in tissue engineering, especially for 3D cell printing.

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Prof. Liu graduated from University of Science and Technology of China with a B.S. degree in 1993. After working in the Institute of Chemistry, CAS for six years, he went to the Hong Kong Polytechnic University and finished his Ph.D there in 2002. He then worked as a postdoc research associate in Cambridge University for two years. In 2005, he joined the National Centre for NanoScience and Technology, China as a principle investigator. In June 2009, He moved to Tsinghua University as a full professor in the department of Chemistry. Now he is Advisory broad member of Soft matter and co-editor of *Biointerphases*. He received National Science Fund for Distinguished Young Scholars of China (2007) and 1st RSC-CCS Young Chemist Award (2008) for his research on DNA nanosciences. Now his researches are mainly focused on using biomolecules to fabricate nanostructures and nanodevices.

Talk 15

Novel aligned carbon nanotube/polymer composites: sensing and electronic applications

Xuemei Sun, Xuli Chen, Xing Lu, Prof. Huisheng Peng, Fudan University

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Due to the unique structure and excellent mechanical and electrical properties, carbon nanotubes have been widely incorporated into polymer to synthesize functional composite materials. At this point, it is critically important to realize the high alignment of nanotubes for a high performance. Herein, we have mainly discussed our recent work on the preparation of highly aligned nanotubes and development of responsive polymer composites from the aligned nanotubes. Specifically, novel sensing composite materials based on chromatic polydiacetylenes and deformable azobenzene-containing liquid crystalline polymers will be carefully discussed.¹⁻⁴ To further power the sensing materials for various electronic devices and facilities such as miniature robots, a new family of wire-shaped solar cells, electrochemical supercapacitors and lithium ion batteries will be also studied.⁵⁻⁷ Compared with the conventional planar structure, such wire-shaped cells exhibit many unique and promising advantages including lightweight and weaveable, and may be scaled up by the well-developed textile technology.

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Huisheng Peng was born in Shaoyang, China, in 1976. He received his Ph.D. degree in Chemical Engineering from Tulane University in USA in 2006, M.S. degree in Polymer Science from Fudan University in 2003, and B.S. degree in Polymer Materials from Donghua University in 1999. Prof. Peng worked at Los Alamos National Laboratory (2006-2008), US Department of Energy, before joining Fudan University. He is currently a professor and associate chair at Department of Macromolecular Science of Fudan University. His work centers on the aligned carbon nanotube materials and their electronic applications including sensors, solar cells, supercapacitors and batteries.

Talk 16

Ultrathin Nanowires: an Emerging Motif for Macroscopic Assemblies

Jian-Wei Liu, Hai-Wei Liang, Prof. Shu-Hong Yu, University of Science and Technology

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In this talk, we report a multiplex templating process for controlled synthesis of a huge family of functional ultrathin nanowires and their macroscopic assemblies, and applications. We first introduce ultrathin Te nanowires (Te NWs) and their advantages as a templating material. A family of 1D nanostructures including noble metals, metal oxides, semiconductors, carbon, polymers, their binary and multiple hybrids can be prepared through this multiplex templating process. The reactivity and stability of ultrathin Te nanowires will be discussed. In addition, a series of macroscopic assemblies of nanowires, including free-standing membranes, films, hydrogels, and aerogels can be fabricated, which exhibit enormous potential for attractive applications, such as liquid filtration and separation, continuous-flow catalysis, electrocatalysis, electronic devices, super adsorbent, elastomeric conductors, and polymer-based nanocomposites. The versatility of this templating process, scalable assembling process as well as the large-scale synthesis can together enhance the application reliability of these functional 1D nanostructures.

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Shu-Hong Yu received his Bachelor degree from Hefei University of Technology, and Ph.D. in Inorganic Chemistry in 1998 from the University of Science and Technology of China (USTC). He worked with Prof. Masahiro Yoshimura in Materials and Structures Laboratory, Tokyo Institute of Technology, as a Postdoctoral Research Fellow (1999-2001), and an Alexander von Humboldt Research Fellow with Prof. Markus Antonietti and Prof. Helmut Cölfen at the Max Planck Institute of Colloids and Interfaces (2001-2002), respectively. He is the Deputy Dean of the School of Chemistry & Materials, and Director of Division of Nanomaterials and Chemistry, Hefei National Laboratory for Physical Sciences at Microscale, USTC. He was appointed as a full professor in 2002 at the USTC, and the Cheung Kong Professorship in 2006 by the Ministry of Education of China. His research interests include synthesis of nanostructures, self-assembly of nanoscale building blocks, nanocomposites, their related properties and applications. He has authored or co-authored 350 refereed journal publications, and 16 invited book chapters. His work has been citation 11,730 times, and H index = 59. He serves as an associate editor for *CrystEngComm* (2011-2013) and *Materials Research Bulletin* (2010-), and an advisory board member of journals *Chemical Science*, *Materials Horizons*, *Chemistry of Materials*, *Nano Research*, *Part. Part. Syst. Charact.* and *Current Nanoscience*. His recent awards include Chem. Soc. Rev Emerging Investigator Award (2010) and Roy-Somiya Medal of the International Solvothermal and Hydrothermal Association (ISHA) (2010). His group homepage: <http://staff.ustc.edu.cn/~yulab/>

Talk 17

Structures and properties of non-IPR fullerenes captured by chlorination/hydrogenation

Prof. Su-Yuan Xie, Xiamen University

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Numerous fullerenes with even-numbered C_n ($n > 20$ but with exception of 22) were shown in the original gas-phase laser vaporization experiment conducted by Kroto, Curl, Smalley, et al.¹. However, only a few fullerenes (e.g., I_h -symmetric C_{60} and D_{5h} -symmetric C_{70}) survive the ambient conditions and have been isolated in the forms of bare hollow fullerenes. The instability of other fullerenes is due to their violation to the Isolated Pentagon Rule (IPR) proposed by Kroto.² Outside the gas phase, all the pure fullerene molecules synthesized to date strictly obey this rule. Topologically, however, the number of non-IPR fullerene isomers is awesomely larger than that of IPR-satisfying ones for a given cluster size. For example, there are 1811 non-IPR C_{60} isomers and only one satisfactory to IPR. Specifically, all the fullerenes smaller than C_{70} (with exception of I_h - C_{60}) are IPR defied. Facing the huge number of non-IPR fullerenes that are therefore unstable, chemists are challenged to bring them into reality.

Non-IPR fullerenes can be derivatized readily and, in turn, stabilized as exohedral derivatives. The stability of non-IPR exohedral fullerenes can be rationalized primarily by both the “strain-relief principle” and the “local aromaticity principle”.³ Tens non-IPR fullerenes, such as $^{#271}C_{50}$, $^{#540}C_{54}$, $^{#864}C_{56}$, $^{#913}C_{56}$, $^{#1,809}C_{60}$, $^{#1,804}C_{60}$, $^{#1,911}C_{64}$, $^{#4,169}C_{66}$, $^{#6094}C_{68}$, $^{#18,917}C_{76}$, $^{#11,188}C_{72}$ and $^{#23,863}C_{78}$ have been stabilized and fully identified by exohedral chlorination or hydrogenation in arc-discharge,³ quartz ampoules,⁴ high-frequency furnace,⁵⁻⁷ as well as combustion⁸ in different groups. The availability of these unprecedented non-IPR fullerenes provides significant, creative experimental opportunities for scientists from a wide of variety of disciplines to expand their insight into the new world of non-IPR fullerenes. For example, $^{#271}C_{50}H_{10}$ shows 0.34 eV higher LUMO level than those of I_h - C_{60} hydrides, with implication of non-IPR fullerenes potentially applicable as excellent electron acceptors in high efficient organic solar cells.⁸

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Su-Yuan Xie was born in 1968 and grew up in Fujian, China, where he studied chemistry at Fujian Normal University, Fuzhou, from 1984 to 1988. During 1988-1991, he studied at Central South University (Changsha) and then at Kunming Research Institute of Noble Metal (Kunming) for his Master's degree. He joined the group of Professor Lan-Sun Zheng at Xiamen University to pursue his Ph.D in 1996, and continued to work at Xiamen University as a faculty after

receiving his Ph.D diploma in 1999. As a visiting scientist, he had been working at Clemson University, USA, during 2003-2005. He is now a professor in chemistry at Xiamen University.

He received the Young Chemist Award from Chinese Chemistry Society (2001), the Chinese University Natural Science Award from the Ministry of Education of China (2001, 2012), and the National Natural Science Award from Chinese government (2006). He was chaired as "New century key talent of China" (2007) and "Chang-jiang Scholar" by the Ministry of Education (2009).

Research Interest:

1. Synthesis, isolation, and functionalization of non-classical fullerenes;
2. Structures and formation mechanism of fullerenes;
3. Applications of fullerenes in photovoltaics;
4. Synthesis, isolation, and functionalization of carbon nanotubes and boron nitride nanotubes;
5. Mass spectrometry (such as desorption electrospray ionization mass spectrometry) for direct and rapid analysis of various compounds in solid surfaces free from redundant sampling procedure.

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Talk 18

Learning from the viral journey and development of an effective gene delivery system

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Viruses are considered smart living organisms because they have the ability to invade intracellular organelles and effectively infect host cells. Once viruses enter the body of a potential host, they penetrate mucus layers, move through the bloodstream, disperse with the help of motile cells and neuronal pathways, and replicate in living host cells. Recently the discovery of short peptides, which are derived from virus and can transfer large biologically active molecules to inside the cells, has attracted a lot of attention in the field of drug and gene delivery. For example, a truncated HIV HIV-1 Tat protein basic domain is believed to play a dominant role in cellular uptake; N-terminal domain of influenza virus hemagglutinin-2 (HA2) could induce lysis of membranes at a low pH, and insert itself into the endosomal membrane, thus mediating the lyso-endosome escape. Herein we fabricated gelatin–silica nanohybrids (GSNPs) by a two-step sol–gel procedure. To improve the transfection efficacy, different fusion peptides (Tat, HA2, R8, Tat/HA2, and Tat/R8) modified GSNPs were prepared for particle size, zeta potential, cellular uptake, hemolysis activity at physiological pH (7.0) or acidic pH (5.0), and condensation of plasmid DNA (pGL3). The current results suggest that GS-peptide conjugates exhibited low cytotoxicity against Hela cells; the synergistic effects of cell penetrating peptide Tat and fusogenic peptide HA2 could promote the efficient cellular internalization, endosome escape, and nuclear targeting of the therapeutics nucleic acid, hence delivering genes efficiently.



Lei Ren is currently a professor at Department of Biomaterials of Xiamen University (China). Dr Ren received her PhD from Okayama University (Japan) in 2003. She has previously worked at Institute of Biomedical Engineering, Chinese Academy Medical Sciences, as well as in the research group of Chow Gan-moog at National University of Singapore. Her research covers materials for biomedical applications, focusing on drug/gene delivery systems and the interaction between materials and cells/tissues.

Representative publications:

1. Shen LH, Bao JF, Wang D, Wang YX, Chen ZW, **Ren L***, Zhou X, Ke XB, Chen M, Yang AQ. One-step synthesis of monodisperse, water-soluble ultra-small Fe₃O₄ nanoparticles for potential bio-application, *Nanoscale*, 2013; 5: 2133-41.
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Talk 19

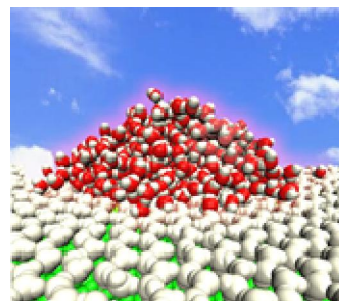
Unexpected Hydrophobic Behavior of the Solid Surfaces with Charge Dipoles at Room Temperatures

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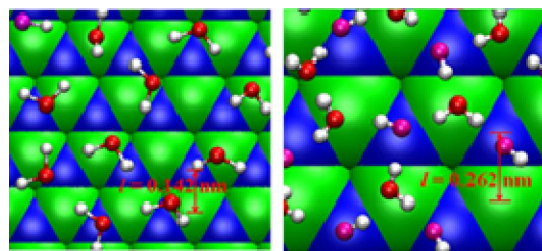
Email: fanghaiping@sinap.ac.cn

Dynamic wetting phenomenon on surface is of fundamentally important where physics, chemistry, biology are crossing. Conventionally, the surface with charges or charge dipoles is hydrophilic, whereas the non-polar surface is hydrophobic. In this report, we will show that surfaces still show hydrophobic or apparent hydrophobic behavior even when there are charge dipoles on the solid surface at room temperature, using molecular dynamics simulation.

We first show the unexpected phenomenon of “water that does not completely wet water monolayer”, i.e., water droplets on the water monolayer above a solid surface with charge dipoles, at room temperature [1]. This indicates that this solid surface shows apparent hydrophobicity. In this system, the charge dipole patterns on the solid surface make the water of the first layer on the solid surface have the ordered monolayer, which greatly enhances the numbers of H-bonds inside the monolayer, in turn reducing the likelihood of H-bond formation between the water molecules inside this monolayer and other molecules. Thus, the water on the monolayer displays droplets. Very recently, this theoretical prediction has been demonstrated experimentally recently [2] and observed in various surfaces.



We then show that, counter to intuition, the solid surface still exhibits hydrophobic behavior when the dipole length is less than the critical value, indicating that the water molecules on the solid surface seemed not to “feel” attractive interactions from the charge



dipoles on the solid surface [3]. Those observations result from the collective interactions between the water molecules and charge dipoles on the solid surface, where the steric exclusion effect between water molecules prevents those hydrogen atoms of water molecules from staying very

close to the negative charge and those oxygen atoms of water molecules from staying very close to the positive charge, reducing the interactions between the water molecules and the charge dipoles. When the length of the charge dipoles on the solid surface is larger than the critical length, the surface with a larger charge is more hydrophilic, which is consistent with conventional theory. The steric exclusion effect is also important for surfaces with charge dipole lengths greater than this critical length; the wetting property of the surface significantly depends on the dipole length; the surface becomes more hydrophilic as the length increases. Part of this theoretical prediction has been demonstrated experimentally recently [4].

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confined in nanochannels, stability and dynamics of nanobubbles and nanobubble-protein interactions, and liquid water anomalies. He has more than 100 peer-reviewed papers published in scientific journals including *Nature Nanotechnology*, *Proc. Natl. Acad. Sci. USA*, *Phys. Rev. Lett.*, *J. Am. Chem. Soc.*, *Angew. Chem. Int. Ed.* and *Energy Environ. Sci.* together with 3 patents. He won the 100 Talents Program of the Chinese Academy of Sciences in 2002, National Science Fund for Distinguished Young Scholars in 2008, and Shanghai Leading Academic Discipline Project in 2009. He serves as the Editorial Board Member of Scientific Reports.

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Talk 20

Identification and Use of Molecular Self-assembly of Multilevel Aggregates within Stable Aqueous Three-phase Surfactant Systems

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Aqueous *three-phase* surfactant systems (A3PS) are important, multicomponent, stable three-phase equilibria with coexisting forms in a single colloid system, but have been largely ignored regarding further characterization and application. Mixing simple, commercially available, single-tailed anionic/nonionic or anionic/cationic surfactants in water can spontaneously produce stable A3PS with coexisting multiscale self-assembled structures including discs, lamellas, micelles, and vesicles. The phase behavior, phase volume and aggregate structure may be readily adjusted by variation of surfactant ratios, concentrations, or temperature. As with conventional aqueous *two-phase* systems (A2PS), A3PS may be applied in partition and extraction processes, and may also serve as a template for the synchronized, mild synthesis of CdS crystals with multiple morphologies and scales. We expect that this present work can expand recognition of A3PS for use in theoretical and applied studies.



Professor Jingcheng Hao received his PhD from Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences (CAS), Lanzhou, P. R. China in 1995. Subsequently, Dr. Hao had a series of postdoctoral research positions at Lanzhou Institute, Nagoya University (Japan) as a Daiko Foundation Fellow, Bayreuth University (Germany) as an Alexander von Humboldt Foundation Fellow, and finally at SUNY-Stony Brook (USA) as a Research Specialist. In Dec. 2002, he joined Shandong University, Jinan, P. R. China, where he is currently Full-Professor and Director of the Key Laboratory of Colloid and Interface Chemistry, Ministry of Education.

His research focuses on colloid and interfacial sciences, including surfactants in solution and self-assembly at all scales in bulk solutions and at surfaces. He has obtained National Outstanding Youth Funds (2006), Changjiang Scholars Award (2007), Lectureship Award of Japan Research Institute of Material Technology (2008), A Contribution Award to the Advancement of Asian Society of Colloid and Interface Sciences (2009), Chinese Chemical Society-BASF Innovation Prize (2009), Scientific Research Outstanding Achievement Awards for Universities (Science and Technology)-the 1st (2012), Asian stars in Chemistry (2013), and other scientific awards. He currently is an Adjunct professor at Lanzhou Institute and serves as Editorial Board Members for *Langmuir*, *Advances in Colloid and Interface Sciences*, *Journal of Colloid and Interface Sciences*, and *Colloids Surf. A*, etc. and has published over 170 articles including original papers, reviews, books and book chapters.

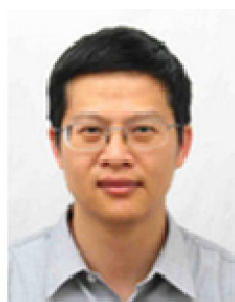
Talk 21

Rapid Detection and Disinfection of Viruses Using Graphene Oxide Nanomaterial

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Graphene-based materials have been attracted more and more attentions in biomedical fields. It has been demonstrated that graphene derivatives could reduce the viability of bacteria by inducing the degradation of cell membranes. However, the potential health and environmental applications of graphene-based materials have not been fully exploited. Since viruses lead to high pandemics and mortality rate, it is of fundamental importance to detect and disinfect viral infection for preventing viral disease. Here we endeavor to examine the potential effect of graphene oxide (GO) on viruses. We find that GO nanowalls can trap various viruses to form GO/virus complexes. Notably, the dispersions of unstable GO/virus aggregates can precipitate automatically from the solution and this effect can clean viral particles from the aquatic environment. Heat treatment of GO/virus complex leads to a complete viral genome leakage to the supernatant, which results in rapid viral RNA isolation and detection without additional laboratory RNA extraction step. Furthermore, our experiments demonstrate that GO also exhibits significant disinfection effect on enteric viruses, including avian influenza virus H9N2 and Enterovirus 71 (EV71) etc. We suggest that the oxidative stress produced by GO under thermal treatment contributes to virus disinfections and viral protein destruction. The current study provides a novel and efficient protocol to ensure the safety and efficiency of viral detecting, cleaning and disinfection, cleaning and detection, which would benefit for the further development of materials for virus diseases control.



Ruikang Tang studied chemistry at Nanjing University (China) and completed Ph.D in 1998. Then, he went to the state University of New York at Buffalo for a post-doctoral research. He is currently a professor at Department of Chemistry of Zhejiang University and a member of Qiushi Academy for Advanced Studies of Zhejiang University. His research focuses on biomineralization and their biomedical applications.

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Talk 22

Chemical Design and Textural Engineering of Graphitic Carbon Nitride Semiconductors for Artificial Photosynthesis

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The production of hydrogen from water using a catalyst and sunlight is an ideal future energy source, independent of fossil reserves. During the past 40 years, various inorganic semiconductors and molecular assemblies have been developed as catalysts for hydrogen production from water under visible light illumination. However, for an economical utilization of water and solar energy, catalysts that are sufficiently efficient, stable, cheap, and capable of harvesting the abundant visible light are required. We have found that an abundant material, polymeric carbon nitride, can activate hydrogen production from water under visible light irradiation. Graphitic carbon nitride (g-C₃N₄) is the most stable phase of covalent carbon nitride and the facile synthesis of the melon substructure from simple liquid precursors and monomers allows easy engineering of carbon nitride materials to achieve better photocatalytic performance via several processing routes and methods, like doping, templated synthesis, copolymerization, hot-fluid annealing, and heterojunction design. The results represent an important step in photosynthesis of chemical fuels where artificial conjugated polymer semiconductors could be used as energy transducers.



Dr. Xincheng Wang is a professor at Fuzhou University, Fuzhou, P. R. China. He obtained his Ph.D. degree in Environment Science from The Chinese University of Hong Kong in 2005. After a JSPS postdoctoral fellowship with prof. Domen at The University of Tokyo in 2007 he moved to Germany as an AvH research fellow with profs. Thomas and Antonietti at the Max Planck Institute of Colloids and Interfaces. Since 2008, he is the head of the international joint laboratory of artificial photosynthesis between Fuzhou University and the Max Planck Institute of Colloids

and Interfaces. His current research interests include artificial photosynthesis, green catalysis, organic energy polymer and carbon nitride chemistry.

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Talk 23

Understanding the complex organization and interaction of living soft matter

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In this talk, I first present a simple review of self-organization and interaction behaviors in living soft matter, and then examine in detail the physical mechanism of structural organization and dynamic behaviors in living soft matter on the basis of some examples of our recent works on the cell – nanomaterials interactions and nonequilibrium self-organization in cellular cytoskeleton and self-propelled particles.



Professor Yu-qiang Ma received his Ph.D. in Physics from Nanjing University in 1993. From 1995, he becomes a professor at Department of Physics of Nanjing University, and currently he is also the director of center for soft condensed matter and interdisciplinary research in Soochow University. In 1999, Prof Ma received the National Science Fund for Distinguished Young Scholars in China, and in 2001, he was appointed as a Chang-Jiang Professor by the Ministry of Education in China. Prof Ma's current research interests are in the area of soft matter and biophysics. His recent

projects include the cell – nanomaterials interactions, phase transitions and dynamics in complex fluids such as colloid and polymers, and nonequilibrium self-organization in living soft matter such as cellular cytoskeleton and self-propelled particles.

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Talk 24

Target-Responsive “Sweet” Hydrogel with Glucometer Readout for Portable and Quantitative Detection of Non-Glucose Targets

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Portable devices with the advantages of rapid, on-site, user-friendly, and cost-effective assessment are widely applied in daily life. However, only a limited number of quantitative portable devices are commercially available, among which the personal glucose meter (PGM) is the most successful example and has been the most widely used. However, PGMs can detect only blood glucose as the unique target. Here we describe a novel design that combines a glucoamylase-trapped aptamercross-linked hydrogel with a PGM for portable and quantitative detection of non-glucose targets. Upon target introduction, the hydrogel collapses to release glucoamylase, which catalyzes the hydrolysis of amylose to produce a large amount of glucose for quantitative readout by the PGM. With the advantages of low cost, rapidity, portability, and ease of use, the method reported here has the potential to be used by the public for portable and quantitative detection of a wide range of non-glucose targets such as ATP, flavacin, microRNA, and proteins etc.



Professor Chaoyong Yang received his B.S. (1998) and M. S. (2001) from Xiamen University, China. He studied for this PhD in the Department of Chemistry at the University of Florida from 2001 to 2006. After completing his PhD dissertation, he conducted his postdoctoral research at the University of California, Berkeley. In 2008, he became a faculty member of Xiamen University and now is the Lu Jiaxi Professor of Chemistry in the Department of Chemical Biology at Xiamen University. He won a Chinese Government Award for Outstanding Students Abroad (2005) and is the recipient of American Chemical Society DAC Graduate Fellowship in 2005, CAPA Distinguished Faculty Award in 2012 and NSFC National Outstanding Young Investigator Award in 2013. His current research is particularly focused on molecular engineering, molecular recognition, high throughput evolution, single cell analysis and microfluidics.

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Talk 25

Construction of 3D Ordered Functional Materials and their applications

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We present the recent experimental investigation of 3D ordered structures, or photonic crystals (PCs) based on the functional materials, which are inhomogeneous materials whose dielectric properties vary periodically in space on a macroscopic scale. These ordered materials have novel and interesting properties concerning both basic physics and technological applications. For three dimensional photonic crystals, various techniques have been used including photolithography and etching techniques. Some of these techniques are already commercially available. To circumvent nano technological methods with their complex machinery, alternate approaches have been followed to grow photonic crystals as self-assembled structures from colloidal crystal. After a brief description of the main properties of photonic crystals, we present the self-assembly methods for the construction of photonic crystals with inverse opal structures by using colloidal crystal templates. The 3D PCs can be built with different building blocks and different materials, including semiconductors, alloys, metals, metal oxides and polymers. All these materials are very attractive for practical applications because it is possible to govern of their optical properties with the unique structure.



Dr. Yao Li is the author or co-author of over 100 papers, 35 patents, and two books in the fields of materials science and engineering and materials processing. His research interests are focused on: Construction and preparation of advanced functional composite and the control of their optical and thermal properties; ordered structured functional materials and their applications; preparation and analysis of new high-performance polymer nanocomposites.

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Talk 26

Quantum Dots for Sensing

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Quantum dots (QDs) have come to the forefront of nanoscience since the turn of this century. QDs possess outstanding optical properties, which make them advantageous over traditional fluorophores for biosensing applications. Besides, QDs are well recognized as electroactive species for electrochemiluminescence sensing. Using energy tunable CdSeTe/CdS/ZnS double shell QDs and gold nanorods (GNRs) as the donor and acceptor, respectively, we present a sensitive electrochemiluminescence energy transfer (ECL-ET) based immunosensor for the detection of tumor markers [1]. Firstly a facile microwave-assisted strategy for the synthesis of green- to near-infrared-emitting CdSeTe/CdS/ZnS QDs with time- and component-tunable photoluminescence was proposed. And, on the basis of the adjustable optical properties of both CdSeTe/CdS/ZnS QDs and GNRs, excellent overlap between donor emission and acceptor absorption could be obtained to ensure effective ECL-ET quenching, thus improving the sensing sensitivity. Besides, the use of mesoporous SiO₂ coated carbon nanotubes (mCNTs)-QDs nanocomposites as matrices for the immobilization of protein could also greatly improved the sensitivity. This approach provides a sensitive response to carcinoembryonic antigen (CEA) in a wide range. CdSeTe/ZnS-SiO₂ was also prepared and used for ECL biosensing. The CdSeTe@ZnS-SiO₂ QDs with two different sizes were used as donor-acceptor pair because of their tunable energy and low biotoxicity. The graded-gap CdSeTe@ZnS-SiO₂ QDs bilayers were fabricated by layer-by-layer assembly of two differently sized CdSeTe@ZnS-SiO₂ QDs on the glutaraldehyde-activated electrode. Benefiting from the short interlayer distance and perfect spectral overlap in the graded-gap QDs bilayers, a highly efficient ECL resonance energy transfer-based energy funneling was observed for the detection of carcinoembryonic antigen.

Graphene quantum dots (GQDs), which are edge-bound nanometer-sized graphene pieces, have fascinating optical and electronic properties. But the facile aqueous synthetic route to high-quality GQDs in large scale is still imminently desired. With the assistance of microwave irradiation, greenish yellow-luminescent GQDs (gGQDs) could be successfully prepared via cleaving graphene oxide (GO) under acid condition. The cleaving and reduction process could be accomplished simultaneously through microwave treatment without any additional reducing agent. When the gGQDs were further reduced with NaBH₄, bright blue-luminescent GQDs (bGQDs) could be obtained. Both GQDs showed

well-known excitation-dependent PL behavior. Electrochemiluminescence (ECL) was observed from the GQDs. A novel sensor for Cd^{2+} was proposed based on Cd^{2+} induced ECL quenching with cysteine (Cys) as the masking agent. Using graphene quantum dots, we also developed a rapid and sensitive fluorescence sensor for melamine based on charge transfer quenching in the presence of Hg^{2+} . The synthesized GQDs were strongly luminescent with predominant aromatic sp^2 domains. Melamine could coordinate with mercury through its nitrogen atoms in both amine and triazine groups and bring more Hg^{2+} to the surface of GQDs through π - π stacking, leading to the quenching of GQDs fluorescence.

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