The 8th China Australia Symposium on Science & Technology:

Green Materials and Recycling Economy

Program

5-9 November 2011

Chinese Academy of Sciences

Australian Government
Department of Innovation
Industry, Science and Research

Australian Academy of Science

ATSE
Australian Academy of Technological Sciences and Engineering (ATSE)

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Welcome Message

Professor Chunli Bai,President,Chinese Academy of Sciences

On behalf of the Chinese Academy of Sciences, I am delighted to welcome the delegation from Australia who will participate in the 8th China-Australia Symposium on Science and Technology: Green Materials and Recycling Economy in Shanghai and Suzhou ,5-9 November 2011.

The Australian delegation is being led by Professor Suzanne Cory, President of the Australian Academy of Science and Professor Robin Batterham, President of the Australian Academy of Technological Sciences and Engineering.

The Chinese Academy of Sciences value the Australian Academy of Science (AAS), the Australian Academy of Technological Sciences and Engineering(ATSE) and the Australian Government Department of Innovation, Industry, Science and Research(DIISR)'s strong involvement in, and continuous support of, all the joint Academy symposia which have been held annually since 2004 in China and Australia on topics of mutual interest and strategic importance to China and Australia's sustainable development, such as energy, water, biotechnology, nanotechnology, sustainable global ecosystems and remote sensing technologies for sustainable development.

This Symposium has plenary sessions as well as three breakout workshops where Australian and Chinese presenters will discuss research on Green Materials and Recycling Economy, focusing on the following three specific themes:

- Biomedical materials and devices-the development and handling of biomaterials and devices, especially at the nanoscale
- Recycling hard and liquid waste - initiatives to recycle hard and liquid waste from industry, including mining
- Materials for clean energy- new materials in battery, solar and other clean energy technologies

These workshops will lead to better and clearer understandings of the interests and capabilities of Australia and China in the areas of Green Materials and Recycling Economy. It is expected that the conclusions reached by the participants will provide a platform for the identification of major opportunities of collaboration & cooperation in critical areas of common interest, and for the development of new or enhanced partnerships between the two countries.

The Chinese Academy of Sciences is very pleased to be hosting this event and would like to thank the Australian academies for their sustained efforts in co-organizing this joint symposium. I would also like to thank the Australian Department of Innovation, Industry, Science and Research and the Ministry of Science and Technology of China for their continued support for funding this bilateral activity. Besides, I wish to acknowledge the involvement and support of the Municipal Government of Shanghai and Suzhou, the Australian Embassy and the Australian Consulate General in China in this important meeting.

I wish the Symposium a great success and each of the participants an enjoyable stay in Shanghai and Suzhou.

BAI Chunli
President, CAS

Contents

Notes

General program

Time	Activity
SATURDAY , 05 NOVEMBER 2011(SHANGHAI)	
10:20	Australian delegation arrives in Shanghai on flight KA802, transfer to accommodation, buffet lunch Hotel: Ceisip Hotel Shanghai 1500 Keyuan Road, Zhangjiang High-tech Park, Shanghai 上海市张江高科技园区科苑路1500号上海信安左城酒店 Telephone: 021-61651111
12:00-14:00	Buffet lunch （TiTian western restaurant on the 1st floor ）
13:00-16:30	Registration Venue: Lobby of Ceisip Hotel Shanghai
16:00-16:45	CAS/AAS/ATSE Academies Leadership Meeting Venue: Da Vinci Multi-functional hall on the first floor Professor Chunli Bai, Academician, President of CAS Professor Suzanne Cory FRS FAA, President of AAS Professor Robin Batterham AO FREng FAA FTSE, President of ATSE Ms Alice Cawte, Australian Consul General in Shanghai Ms Anne-Marie Lansdowne, Branch Manager, National Collaborative Research Infrastructure Strategy, DIISR International Staff of CAS, AAS and ATSE, including: Ms. Nancy Pritchard, Ms. Elizabeth Meier, Ms. Anne Houston Prof. Yonglong Lü, Prof. Jinghua Cao, Mr. Shizhuan Zhang, Mr. Bolun Ning
Opening Ceremony **Venue: Da Vinci Multi-functional hall，host:Professor Jinghua Cao**	
16:55-17:05	Official welcome by Professor Chunli Bai , President of CAS
17:05-17:25	Keynote speeches by Presidents of AAS and ATSE
17:25-17:45	Address by the Australian Consul General in Shanghai, Ms Alice Cawte Address by Branch Manager, National Collaborative Research Infrastructure Strategy, DIISR, Ms Anne-Marie Lansdown
17:45-18:15	Plenary addresses from China Professor Lei Jiang Academician
18:15-18:30	Photo opportunity
18:30-20:00	Welcome banquet hosted by Prof. Bai,President of the Chinese Academy of Sciences
SUNDAY, 06 NOVEMBER 2011 (SUZHOU)	
07:00-08:00	Buffet Breakfast（TiTian western restaurant on the 1st floor ）
08:05	Check out of hotel and meet in lobby
08:20-10:20	Travel to Suzhou
10:20-11:20	Technical Visit to Suzhou Institute of Nanotechnology & Nano-bionics, CAS
11:20-12:00	Registration and Check-in Hotel: Jinling Guanyuan International Hotel（金陵观园国际酒店）

	No.168 Cui Wei Street Suzhou Industrial park， Suzhou （苏州工业园区翠薇街168号）
12:00-13:00	Lunch （ 168 Café on the 1st floor）
13:00-15:00	Commencement of Concurrent Workshops: **- Session 1** WORKSHOP 1) Biomedical materials and devices Venue: Wenhui Function Room on the 1st floor (文汇厅） WORKSHOP 2) Recycling hard and liquid waste Venue: Wenzong Function Room on the 1st floor(文宗厅） WORKSHOP 3) Materials for clean energy Venue: Wenyuan Function Room on the 1st floor (文源厅）
15:00-15:15	Wrap up and discussion for Session 1
15:15-15:45	Tea Break
15:45-17:45	Concurrent Workshops Sessions 1,2,3 – **Session 2**
17:45-18:30	Conclusion of Workshop Sessions
18:30-20:00	Banquet（Yong'an Hall 永安厅 on the 1st floor)
MONDAY 7 NOVEMBER 2011(SUZHOU)	
07:00-08:30	Breakfast (168 Café on the 1st floor)
08:30-10:00	Concurrent Workshop Sessions 1,2,3 – Session 3
10:00-11:00	Workshop participants to discuss opportunities for mutual collaboration
11:00-11:15	Tea Break
Closing of symposium **Venue: Wenyuan function room on the 1st floor 文源厅， host: Professor Hui Yang**	
11:15-11:25	Australian and Chinese Convenors to report back on the outcomes from each workshop（each workshop recommend one convenor to report back） Workshop 1
11:25-11:35	Workshop 2
11:35-11:45	Workshop 3
11:45-11:55	Remarks by Professor Suzanne Cory
11:55-12:05	Remarks by Professor Robin Batterham
12:05-12:15	Remarks by Professor Yongguan Zhu
12:15-13:55	Lunch(168 Café on the 1st floor)
13:55	Australian participants meet in lobby
14:00-16:30	Australian Delegation to undertake technical visit to Suzhou Institute of Biomedical Engineering and Technology,CAS Chinese participants (please check out before 12:00) ground transportation to Suzhou railway station or Shanghai Pudong/Hongqiao/Wuxi Airport
18:00-20:00	Australian Delegation Dinner（Taoliju Restaurant）
TUESDAY 8 NOVEMBER 2011 (SHANGHAI)	
07:00-08:30	Breakfast(168 Café on the 1st floor)
8:30	Australian participants to meet in lobby
8:35-11:00	Cultural visit programs for Australian participants in Suzhou
11:30-12:00	Check-out
12:00-13:55	Lunch(168 Café on the1st floor)
13:55	Australian participants to meet in lobby
14:00-16:00	Australian Delegation departs Suzhou for Shanghai, dinner and accommodation

	at Shanghai Hotel: Ceisip Hotel Shanghai, 1500 Keyuan Road, Zhangjiang High-tech Park, Shanghai 上海市张江高科技园区科苑路1500号上海信安左城酒店 Phone: +86 (0)21-61651111
18:00-20:00	Buffet Dinner （TiTian western restaurant on the 1st floor）
WEDNESDAY, 09 NOVEMBER 2011 (SHANGHAI)	
7:30-8:30	Buffet Breakfast（TiTian western restaurant on the 1st floor）
8:55	Meeting in the Lobby and leaving for Shanghai Light Source
9:00-10:00	Visting Shanghai Light Source
10:10-11:10	Visiting Shanghai Advanced Research Institute（SARI）
11:20-13:30	1 Buffet Lunch at Hotel 2.Noon break 3.Checking out(who will leave in the afternoon)
13:45	Meeting in the lobby and Leaving for Shanghai Institute of Ceramics（SICCAS）
14:30-16:00	Visiting SICCAS

Workshop programs

Workshop 1 :Biomedical materials and devices Conveners: Prof. Peter Gray Prof. Xingyu Jiang Venue： Wenhui Function room			
Session	Time	Speaker	Topic
Sunday,06 November			
Session 1 5 presentations	13:00-13:25	Prof. Chengzhong Yu	Functional Nanoporous Materials in Biomedical Applications
	13:25-13:50	Prof. Shanhong Xia	Biomedical and Chemical Sensors Based on Micro/Nano Technologies
	13:50-14:15	**Dr Ben Muir**	Nanostructured Nanoparticles of Amphiphile Self-Assembly Materials for Biomedical Applications
	14:15-14:40	Prof. Yilin Cao	Tissue Engineering Research: from bench to bedside
	14:40-15:05	Prof. Tanya Monro	Nanobiophotonics: new photonics based approaches to liquid sensing
	15:05-15:15	Wrap up and discussion for Session 1	
	15:15-15:45	Tea Break(Workshop participants have individual roundtable discussion on possible areas of cooperation)	
Session 2 5presentations	15:45-16:10	Prof. Xiaogang Qu	Targeting Polymorphic Nucleic Acids: Modulate Their Biological Functions and Utilize These Controllable Conversions
	16:10-16:35	Prof. Martina Stenzel	Nanoparticle design using polymers- a solution for every drug delivery problem
	16:35-17:00	Prof. Kaiyong Cai	Construction of nano-biointerfaces on titanium substrates
	17:00-17:25	Dr. Angus Johnston	Targeted Drug Delivery: Understanding cellular binding and uptake of Nanoengineered capsules
	17:25-17:50	Prof. Lingwen Zeng	Application of nano-materials in molecular diagnostics
	17:50-18:30	Conclusion of Workshop Sessions	
Monday， 07 November			
Session 3； 3presentations	08:30-08:55	Prof.Xingyu Jiang	Micro/Nano-scale tools for biochemical analysis
	08:55-09:20	Dr. Michael Higgins	Nanobionics Interface
	09:20-09:45	Prof. Jianlin Shi	Preparation and Biocompatibility of Hollow Mesoporous Silica Nanospheres
	09:45-11:00	Workshop participants to discuss opportunities for mutual collaboration	

Workshop 2 : Recycling hard and liquid waste
Conveners: Mr Ron Hardwick Prof. Yong-Guan Zhu
Venue： Wenzong function room

Session	time	speaker	topic
Sunday，06 November			
Session 1；4presentations	13:00-13:05	Prof. Yong-Guan Zhu	Chinese Perspectives
	13:05-13:35	Mr Ron Hardwick	Overview on Australia: Recycling-the way of the future
	13:35-14:05	Prof.Feng Zhao	Application of bio- electrochemistry techniques in wastewater recycle
	14:05-14:35	Prof. Ravi Naidu	Solid and liquid waste management-current state of play and innovative solutions
	14:35-15:05	Prof.Guoying Zhao	Cleaner catalysis in Ionic Liquids
	15:05-15:20	Wrap up and discussion for Session 1	
	15:20-15:45	Tea Break (Workshop participants have individual roundtable discussion on possible areas of cooperation)	
Session 2 4presentations	15:45-16:15	Scientia Professor Veena Sahajwalla	Recycling Plastics and Rubber Tyres as a Resource for EAF Steelmaking
	16:15-16:45	Prof.Jianxiong Zeng	Optimisation of value added product from waste fermentation via metabolic strategy
	16:45-17:15	Mr David Singh	Household Waste–the Urban Mine
	17:15-17:45	Prof.Guangwen Xu	Utilization of Industrial Biomass Waste for Energy and Porous Carbon Material
	17:45-18:30	Conclusion of Workshop Sessions	
Monday，07 November			
Session 3 3presentations	08:30-09:00	Prof.Yujie Feng	Key Materials and Performance of MFCs for Wastewater Treatment
	9:00-9:30	Dr Habib Zughbi	Recycling of solid waste streams At Port Kembla steelworks (PKSW)
	09:30-10:00	Prof.Fushen Zhang	Nano-materials developed from e-waste
	10:00-11:00	Workshop participants to discuss opportunities for mutual collaboration	

Workshop 3 : Materials for clean energy
Conveners: Prof. Chennupati Jagadish Prof. Hui Yang
Venue： Wenyuan function room

Session	Time	Speaker	Topic
Sunday，06 November			
Session 1 3presentations	13:00-13:30	Prof. Paul Meredith	Organic solar cells: Beyond the shockley-queisser limit
	13:30-14:00	Prof. Ning Dai	Thin film solar cells: an overview of existing problems
	14:00-14:30	Associate Professor Gavin Conibeer	Advanced photovoltaic approaches for low cost per watt solar cells
	14:30-15:15	Wrap up and discussion for Session 1	
	15:15-15:45	Tea Break(Workshop participants have individual roundtable discussion on possible areas of cooperation)	
Session 2 4presentations	15:45-16:15	Prof. Yi-Bing Cheng	Processing of flexible dye sensitized solar cells on plastic substrates
	16:15-16:45	Prof. Jianrong Dong	High-efficiency multiple junction solar cells
	16:45-17:15	Associate Professor Lianzhou Wang	New nanostructured materials for efficient photo-electrochemical energy conversion
	17:15-17:45	Prof. Xudong Xiao	Recent progress of Cu(InGa)Se2 solar cells in CUHK/SIAT
	17:45-18:30	Conclusion of Workshop Sessions	
Monday，07 November			
Session 3 3presentations	08:30-09:00	Prof. Hua Kun Liu	Nanomaterials for next generation lithium rechargeable batteries
	09:00-09:30	Prof. Honghe Zheng	Interactions between active material, conductive nano-carbon and polymeric binder in lithium-ion battery cathode laminate
	09:30-10:00	Prof. Yuguo Guo	Nanocable-like electrode materials for better lithium-ion batteries
	10:00-11:00	Workshop participants to discuss opportunities for mutual collaboration	

Presidents

Professor Chunli Bai

Prof. Chunli BAI, a well-known chemist and leading scientist in nano-science, is the President of the Chinese Academy of Sciences (CAS).

Prof. Chunli BAI has been Executive Vice-President of CAS since 2004. He has also served as Vice-President of the China Association for Science and Technology (CAST), President of the Graduate University of CAS (GUCAS), Director of the Academic Division of Chemistry and Member of the Executive Committee of the Presidium of the Academic Divisions of CAS.

Prof. BAI graduated from the Department of Chemistry, Peking University in 1978 and received his M.Sc. and Ph.D. degrees from the CAS Institute of Chemistry in 1981 and 1985 respectively. From1985-1987, he worked with the California Institute of Technology, U.S.A., in the field of physical chemistry as a post-doctorate associate and visiting scholar. After he returned to China in 1987, he continued his research at the CAS Institute of Chemistry. From 1991 to 1992, he worked as a visiting professor at Tohoku University in Japan.

His research areas include the structure and properties of polymer catalysts, X-ray crystallography of organic compounds, molecular mechanics and EXAFS research on electro-conducting polymers. In the mid-1980s, he shifted his research to the fields of scanning tunneling microscopy and molecular nanotechnology.

Prof. BAI has a long list of scientific publications and has won more than twenty prestigious awards and prizes for his academic achievements. Because of his academic achievements, he was elected a Member of CAS and Fellow of the Academy of Sciences for the Developing World (TWAS) in 1997. He is also a Foreign Associate of the US National Academy of Sciences (NAS) and Foreign Member of Russian Academy of Sciences (RAS), Honorary Fellow of the Royal Society of Chemistry and Honorary Fellow of the Indian Academy of Sciences (IAS), and honorary doctor or professor of several foreign universities. Prof. BAI also serves as the Chief Scientist for the National Steering Committee for Nanoscience and Technology and was the Founding Director of China National Center for Nanoscience and Technology.

Prof. BAI is also the Vice President of TWAS, Member of the Executive Committee of IUPAC (2008-2009), and Member of the International Editorial Advisory Board of JACS, Angewandte Chemie, Advanced Materials and Chemical Physics Letters.

Professor Suzanne Cory AC FAA FRS
President
Australian Academy of Sciences
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Professor Suzanne Cory is one of Australia's most distinguished molecular biologists. She was born in Melbourne, Australia and graduated in biochemistry from The University of Melbourne. She gained her PhD from the University of Cambridge, England and then continued studies at the University of Geneva before returning to Melbourne in 1971, to a research position at the Walter and Eliza Hall Institute of Medical Research. She was Director of the Walter and Eliza Hall Institute and Professor of Medical Biology of The University of Melbourne from 1996 to 2009. She is currently a Professorial Research Fellow in the Molecular Genetics of Cancer Division of the Walter and Eliza Hall Institute and a Vice-Chancellor's Fellow of The University of Melbourne. Professor Cory was elected President of the Australian Academy of Science in May 2010.

Cory's research has had a major impact in the fields of immunology and cancer. Her scientific achievements have attracted numerous honours and awards, including the Burnet Medal of the Australian Academy of Science, the Australia Prize (joint recipient), the Charles S. Mott Prize (joint recipient) of the General Motors Cancer Research Foundation in 1998, a L'Oréal-UNESCO Women in Science Award in 2001 and the Royal Medal of The Royal Society in 2002. She was elected a Fellow of the Australian Academy of Science in 1986, a Fellow of the Royal Society in 1992, a Foreign Member of the US National Academy of Sciences of the US in 1997, a Foreign Member of the American Academy of Arts and Sciences in 2001, an Associate Foreign Member of the French Academy of Sciences in 2002, an Academician of the Pontifical Academy of Sciences in 2004 and an Associate Member of the European Molecular Biology Organization in 2007. In 1999 she was appointed Companion in the General Division of the Order of Australia and in 2009 she was awarded the French decoration of Chevalier de l'Ordre de la Légion d'Honneur.

Professor Robin J Batterham AO FREng FAA FTSE
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Professor Robin Batterham is Kernot Professor of Engineering at the University of Melbourne. He is also President of the Australian Academy of Technological Sciences and Engineering and until recently was Group Chief Scientist, Rio Tinto Limited. He has had a distinguished career in research and technology, in the public and private sectors in areas such as mining, mineral processing, mineral agglomeration processes, and iron making.

Professor Robin Batterham was Chief Scientist to the Australian Federal Government from 1999 to 2005 and remains on the Prime Ministers Science, Engineering and Innovation Council.

He has been President of the Institution of Chemical Engineers and the International Network for Acid Prevention and is President of the International Mineral Processing Congress as well as chairing the Australia India Collaborative Research Fund. He chairs the International Energy Agency Expert Group on Science for Energy. He is an elected Fellow (or Foreign Fellow) of the Royal Academy of Engineering, the National Academy of Engineering, the Swiss Academy of Technological Sciences, the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering as well as Fellow of several learned societies.

Previous roles within Rio Tinto included Vice President Resource and Processing Developments as well As Managing Director for Research and Development. In these roles he worked closely with geoscientists to develop and apply new measurement techniques and to better understand and delineate ore bodies. He was also responsible for some years for early stage delivery of major new mining projects covering all aspects, from detailed understanding of the geology, mine planning, ore processing, economic evaluation, and pre-marketing.

Plenary Speaker

Professor Lei Jiang

Institute of Chemistry, Chinese Academy of Sciences

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Bio-inspired Interfacial Materials – Toward Green Materials and Recycling Economy

Learning from nature, we revealed that a super-hydrophobic surface needs the cooperation of micro- and nanostructures. Considering the arrangement of the micro- and nanostructures, the surface structures of the water-strider's legs were studied in detail. Accordingly, a series of super-hydrophobic surfaces have been fabricated. Under certain circumstances, a surface wettability can switch between superhydrophilicity and superhydrophobicity, Most recently, we developed a superoleophobic and controllable adhesive water/solid interface which opens up a new strategy to control self-cleaning properties in water. To expand the "switching" concept of the smart 2D surface, we also did a lot of interesting work in 1D system. For example, we discovered the water collection ability of capture silk of the cribellate spider Uloborus walckenaerius and then prepared artificial spider silk. In addition, we developed the novel biomimetic ion channel systems with a variety of intelligent properties, which were controlled by our designed biomolecules or smart polymers responding to the single external stimulus, provided an artificial counterpart of switchable protein-made nanochannels. These smart materials could be widely used in green materials and recycling economy, such as super-amphiphobic textiles, self-cleaning glass, water/oil separation, green printing, ship anti-fouling coating, biomimetic novel energy, water collection, etc.

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. His scientific interest is focused on the bio-inspired surface & interfacial materials with special wettability and over 400 papers have been published.

Five relevant publications

1. X. Hou, W. Guo, and L. Jiang, Chem. Soc. Rev.2011, 40, 2385-2401.

2. Y.M. Zheng, H. Bai, Z.B. Huang, X.L. Tian, F.Q. Nie, Y. Zhao, J. Zhai and L. Jiang, Nature, 2010, 463, 640-643;
3. M.J. Liu, Y.M. Zheng, J. Zhai and L. Jiang, Acc. Chem. Res., 2010, 43, 357-367;
4. L.P. Wen, X. Hou, Y. Tian, F.-Q. Nie, Y.L. Song, J. Zhai and L. Jiang, Adv. Mater., 2010, 22, 1021–1024;
5. W. Guo; L. X. Cao; J. C. Xia; F. Q. Nie; W. Ma; J. M. Xue; Y. L. Song; D. B. Zhu; Y. G. Wang; L. Jiang, , Adv. Funct. Mater. 2010, 20, 1339-1344.

Symposium convenors

Professor Peter Gray FTSE

Australian Convenor – Workshop 1
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Professor Peter Gray was appointed the inaugural director of the Australian Institute of Bioengineering and Nanotechnology (AIBN) at the University of Queensland in 2003.

Previously he was Professor of Biotechnology and Director of the Bioengineering Centre at UNSW, and a Senior Principal Research Fellow at the Garvan Institute of Medical Research in Sydney.

Professor Gray has had commercial experience in the USA working for Eli Lilly and Co and for Cetus Corporation as well as holding academic positions at University College London, and at the University of California, Berkeley.

His research interests are focussed on engineering mammalian cells to produce the complex proteins called biopharmaceuticals which are gaining rapid acceptance as human therapeutics, and on developing human stem cells bioprocesses suitable for clinical application.

Professor Gray was one of the founders and a past president of the Australian Biotechnology Association, AusBiotech. He is a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE) and the Australian Institute of Company Directors, and has been named as one of Australia's 100 Most Influential Engineers.

He is a member of the Boards of ATSE, Biopharmaceuticals Australia Pty Ltd, ACYTE Biotechnology Pty Ltd, ECI Inc, New York, and serves on a number of State and Federal Government Councils and Committees.

Mr Ron Hardwick FTSE

Australian Convenor – Workshop 2

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Presentation title: "Overview on Australia: Recycling – the way of the future"

A unique approach to closed-loop materials recycling and manufacturing has been developed over the past 30 years by a large, privately owned corporation with operations in Australia and the United States. The corporation, operating as Visy Industries in Australia and Pratt Industries in the USA, has implemented the approach in more than 100 of its manufacturing locations. It includes the following elements:

- *i. Manufacturing processes for production of consumer packaging materials specially configured for reducing waste, particularly in energy and water use*
- *ii. The systematic recovery of household and commercial waste paper as a feedstock for recycled paper manufacture. This commenced in Australia in 1983, and in the United States in 1992*
- *iii. The development of efficient manufacturing processes for producing high volumes of packaging grade paper using 100 per cent post-consumer waste fibre*
- *iv. The extension of waste paper collections to the collection and separation of "co-mingled" recyclables (glass, plastics, metals and paper) from households and commercial premises, through development of centralised Materials Recovery Facilities (MRFs)*
- *v. The separation, through high-volume physical and optical sorting techniques, of various grades of plastics for further value-adding of the recyclables stream*
- *vi. The remanufacture of Polyethylene Terephthalate (PET) and High Density Polyethylene (HDPE) containers from the recovered, separated plastics stream to a food grade standard*

The next wave of innovation, currently under development, includes:

- *i. Separation of valuable fuels from those parts of the municipal and industrial waste stream that cannot be further recycled, and the generation of clean energy from those fuels*
- *ii. Application of new technologies to support the recovery and re-use of the waste stream's remaining complex components*
- *iii. The continuous improvement of closed-loop manufacturing systems towards a vigorous "circular economy" – an approach proposed for China in its new Five Year Plan (Chapter 23)*

Mr Ron Hardwick is currently Group Technical Consultant at Visy Pulp and Paper and has overseen energy and paper mill developments in Australia, the USA and Europe for over 20 years. This includes recycling and virgin fibre paper mills. Energy innovations have included installation and operation of cogeneration plants and gasifiers.

Ron is also a Director and Founder of AVT Services Pty Ltd, which serves the industrial and scientific vacuum industry, and a Director of Netra Holdings Pty Ltd which installs automated home systems.

He was formerly Managing Director of Associated Minerals Pty Ltd, a mining company in the mineral sands industry in Australia and the USA, who were significant consumers of electricity.

Prior to that Ron was a Director and Chief Executive of the Industrial Gases Division of CIG (now BOC), a company which was a major supplier of industrial gases both liquefied and compressed.

Visy Industries operating in Australia and USA is a packaging manufacturer specialising in collection of waste and converting paper and plastics to new products. The industry has waste streams from recycling paper and pulp mills as well as waste from recycling collection operations. The company has been developing gasifiers over 14 years to convert waste to steam and electricity after recovery of recyclables.

Professor Chennupati Jagadish FAA FTSE

Australian Convenor – Workshop 3
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Professor Chennupati Jagadish is an Australian Laureate Fellow, Distinguished Professor and Head of Semiconductor Optoelectronics and Nanotechnology Group in the Research School of Physics and Engineering, Australian National University. He is also Convener of the Australian Nanotechnology Network and Director of Australian National Fabrication Facility, ACT Node. He served as *President of the IEEE Nanotechnology Council (NTC) during 2008, 2009 and Vice-President of IEEE Lasers and Electro-Optics Society during 2006, 2007*. He is an Editor of IEEE Electron Device Letters, Progress in Quantum Electronics, an Associate Editor of Journal of Physics D: Applied Physics and serves on editorial boards of 12 other journals. He is an Editor of Springer Series in Materials Science, Springer Series in Nano-Optics and Nano-Photonics, Semiconductors and Semimetals Book series published by Academic Press/Elsevier.

His research interests include quantum dots, nanowires, quantum dot lasers, quantum dot photodetectors, quantum dot photonic integrated circuits, photonic crystals, plasmonics, photovoltaics, metamaterials, THz photonics. He has published more than 660 research papers (440 journal papers), 11 invited/review papers, 9 book chapters, holds 5 US patents, co-authored a book, co-edited 3 books and edited 12 conference proceedings and 6 special issues of journals. He won the 2000 IEEE Millennium Medal and received Distinguished Lecturer awards from IEEE Nanotechnology Council, IEEE Photonics Society and IEEE Electron Devices Society. He is a Fellow of the Australian Academy of Science, Australian Academy of Technological Sciences and Engineering, IEEE, APS, MRS, OSA, AVS, ECS, SPIE, AAAS, IoP (UK), IET (UK), IoN (UK) and the AIP. He received Federation Fellowship in 2004 and Laureate Fellowship in 2009 from the ARC and Peter Baume Award from the ANU in 2006, the Quantum Device Award from ISCS in 2010, IEEE Photonics Society Distinguished Service Award in 2010, IEEE NTC Distinguished Service Award in 2011 and 2010 Top Supervisor Award from the ANU.

Relevant publications:

1. H.J. Joyce, Q. Gao, J. Wong-Leung, Y. Kim, H.H. tan and C. Jagadish, Tailoring GaAs, InAs and InGaAs nanowires for optoelectronic device integration, IEEE Journal of Selected Topics in Quantum Electronics 17, 766-778 (2011).
2. Y.B. Wang, H.J. Joyce, Q. Gao, X.Z. liao, H.H. Tan, J. Zou, S.P. Ringer, Z.W. Shan and C. Jagadish, Self-healing of fractured GaAs Nanowires, Nano Lett. 11, 1546-1549 (2011).

3. H.F. Lu, L. Fu, G. Jolley, H.H. Tan, S.R. Tatavarti and C. Jagadish, Temperature dependence of dark current properties of InGaAs/GaAs quantum dot solar cells, Appl. Phys. Lett. 98, 183508 (2011)
4. P.J. Reece, W.J. Toe, F. Wang, S. Paiman, Q. Gao, H.H. Tan and C. Jagadish, Characterization of semiconductor nanowires using optical tweezers, Nano Lett. 11, 2375-2381 (2011).
5. G. Jolley, H. Lu, L. Fu, H.H. Tan and C. Jagadish, Electron-hole recombination properties in InGaAs/GaAs quantum dot solar cells and the influence on the open circuit voltage, Appl. Phys. Lett. 97, 123505 (2010).

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Micro/Nano-scale tools for biochemical analysis

I hope to introduce a few tools based on gold nanoparticles (Au NPs) and microfluidics that allows improved efficiency in biochemical analysis.

In the first example, we developed a method for the detection of Cu2+ ions by azide and terminal alkyne-functionalized Au NPs aqueous solutions using click chemistry. We labeled the 2nd antibody with CuO NP, used Cu released as to indirectly detect for antibody/antigen in immunoassays, with higher sensitivity than conventional ELISA. This colorimetric Au NPs system got rid of complex instrument, providing effective tools for Point of Care.

The second example tries to improve the efficiency of the western blot assay, because is a costly, time-consuming, and labor intensive process. We develop a novel method for Western blot based on microfluidics, incorporating the internal molecular weight marker, loading control, and antibody titration in the same protocol. Compared with the conventional method, the microfluidic Western blot could analyze at least 10 proteins simultaneously from a single sample, and it requires only about 1% of the amount of antibody used in conventional Western blot.

The third example I hope to give is the precise positioning of multiple types of cells. It is well known that the microenvironment of cells in the body is dominated by the interactions between multiple types of cells. We developed a series of methods to pattern multiple types of cells.

Xingyu Jiang is a principle investigator in the National Center for NanoScience and Technology of China (NCNST). His research interests include surface chemistry, microfluidics, micro/nano-fabrication, cell biology and immunoassays. Born and raised in Chengdu (China), Xingyu obtained his Bachelor's Degree at The University of Chicago (1999), followed by an A.M. (2001) and a Ph. D. (2004) from Harvard University (Chemistry), working with Professor George Whitesides on microfluidics and cell patterning. After a short postdoctoral fellowship with Professor George Whitesides, he joined NCNST in 2005.

Relevant publications:

1. Visual detection of copper(II) by azide- and alkyne-functionalized gold nanoparticles using click chemistry. Zhou, Y., Wang, S.X., Zhang, K., **Jiang, X.Y.**, ***Angew. Chem. Int. Ed.***, 47 (39), 7454-7456 (**2008**).
2. Copper-mediated amplification allows readout of immunoassays by the naked Eye, Qu,W., Liu, Y., Liu, D., Wang, Z, **Jiang X.** ***Angew. Chem. Int. Ed.*** 50, 3442-3445(**2011**).
3. Microfluidic Western Blot. Pan, W.Y., Chen, W., **Jiang, X.Y.**, ***Anal. Chem.***, 82, 3974–3976 **(2010)**.

4. A method for patterning multiple types of cells by using electrochemical desorption of self-assembled monolayers within microfluidic channels. Li, Y., Yuan, B., Ji, H., Han, D., Chen, S.Q., Tian, F., **Jiang, X.Y.**, ***Angew. Chem. Int. Ed.***, 46(7), 1094-1096 (**2007**).
5. Patterning multiple types of mammalian cells for modeling three types of naturally occurring cell-cell interactions. Chen, Z.L., Li, Y., Liu, W.W., Zhang, D.Z., Zhao, Y.Y., Yuan, B., **Jiang, X.Y.**, ***Angew. Chem. Int. Ed.***, 48(44), 8303-8305 (**2009**).

Professor Yong-Guan Zhu

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Yongguan (Y-G) Zhu, Professor of Soil Environmental Sciences and Environmental Biology, currently works in the Chinese Academy of Sciences, he is the director general of the Institute of Urban Environment in Xiamen. He has been working on soil-plant interactions, with special emphasis on rhizosphere microbiology, metal biogeochemistry and plant phosphorus nutrition. Before joined CAS in 2002, he was working in The University of Adelaide, Australia. He obtained his BSc in soil science from the former Zhejiang Agricultural University in 1989, and MSc in soil science from the Institute of Soil Science, CAS in 1992, and then a PhD in environmental biology from Imperial College, London in 1998.

Dr Zhu has been offered the Royal Fellowship Award from The Royal Society, London in January 1994; Best presentation award and the postgraduate student of the year 1998 from the Institution of Nuclear Engineers, UK, April 1998; Outstanding young scientist from National Natural Science Foundation of China, October 2002; Achievement award from the state government of China for overseas returnees, September 2003; National Young Scientist Award, July 2006; “Top Ten Youth” of the Chinese Academy of Sciences, April 2007 and National Natural Science Award in 2009. Professor Zhu has published extensively in the last ten years, so far over 150 papers have been published in international journals, has attracted more than 3000 citations with an *H-index* of 30.

Dr Zhu serves as a Member, Standing Advisory Group of Nuclear Applications, International Atomic Energy Agency (IAEA); Associate Editor, Environmental Pollution; *Advisory Editorial Board,* Trends in Plant Science; *Marschner Reviews Editor*, Plant and Soil; *Advisor,* New Phytologist and *Editorial board,* Environment International.

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Professor Hui Yang is Director of Suzhou Institute of Nano-tech and Nano-bionics (SINANO), Chinese Academy of Sciences, in Suzhou, China. He received his Bachelor's degree from Peking University in 1982. Then he continued his graduate studies and received his M.Sc and Ph.D. degrees from the Institute of Semiconductors, Chinese Academy of Sciences, in 1985 and 1991, respectively.

Professor Yang worked as postdoctoral researcher from 1993 to 1996 at the Paul Drude-Institute for Solid State Electronics in Berlin, Germany. Afterwards, he joined the faculty of Institute of Semiconductors, Chinese Academy of Sciences, as the leader of the laboratory for ultra-thin epitaxial growth at the National Research Center for Optoelectronic Technology in Beijing, investigating the MOCVD growth processes of III-V semiconductors for ptoelectronic devices and fabricating low threshold current density QW lasers and high power QW laser arrays.

Professor Yang had received numerous awards and honors including the Prize for Young Scientists of Chinese Academy of Sciences (1993), the Prize for Outstanding Young Scholar of Chinese Academy of Sciences (2000), and the award for the high-level innovation and entrepreneurial talent of Jiangsu Province(2007). He was the member of expert group in Optoelectronic Materials and Devices Division, Chinese High-Tech Plan(1998-2004) and International Advisory Committee(2002, 2004). He is also the Editor of Chinese Physics Letter.

Professor Yang is now the Chief Scientist of National Basic Research Program (also called 973 Program). He is focused on the spearheading potentionally transformtional research into III-V compound semiconductor materials and devices for high-efficiency solar cells as well as integration of optical system. He and his group have published more than 200 articles in international journals.

Speakers

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Presentation title: Functional Nanoporous Materials in Biomedical Applications.

Controlling the composition, pore structure and surface chemistry of functional nanoporous materials has significant impact for their biomedical applications. Here we show three examples where understanding the synthesis-structure-property correlation is important.

Firstly, we show that we have systematic control over pore size of nanoporous materials in a wide range (1.2 – 100 nm). Moreover, a novel approach has been developed to precisely adjust the pore size stepwise at a step precision of 0.2 nm. Nanoporous materials with very large pore size of ~ 100 nm are ideal hosts for the immobilization of biomolecules and for the enzymatic reaction. By further surface modification, smart nano-devices with high efficiency and selectivity can be fabricated for proteomics and the analysis of post-translational modifications of proteins. On the other hand, nanoporous materials with controlled small pores can be used in the enrichment and bio-analysis of peptides from serum and cell washing buffers. The application of small pore materials in enhancing the solubility of hydrophobic anti-cancer drugs will also be introduced.

Secondly, the morphology of nanoporous materials is another important parameter in their biomedical applications. It is shown that siliceous vesicles with small diameters (~ 25 nm) and cavity (~ 11 nm in diameter) are smart nano-vehicles and possess unique functions in cell imaging, drug delivery and controlled release. In another example, we show that mesoporous silica nanoparticles with small sizes of ~37 nm have a high loading capacity for a hydrophobic photosensitizer (SiPcCl2) and excellent endocytosis property. As a result, the photodynamic therapy efficiency is enhanced by over fourfold.

Finally, the synthesis, structure control and applications of mesoporous bioactive glasses (MBGs) with SiO2-CaO-P2O5 compositions will be introduced. Compared to commercial bioactive glasses, MBGs have different formation mechanism, composition-structure correlation, and superior bone-forming performance, thus possess promising applications in bone repair, dental applications, and bone tissue-engineering.

Professor Chengzhong Yu is a Group Leader in the Australian Institute for Bioengineering and Nanotechnology (AIBN), the University of Queensland. His research focuses on novel nanoporous materials, functional nanocomposites, and their applications in biotechnology, clean energy and environment protection. His research area covers water treatment, biomaterials, biocatalysis, photocatalysis, drug delivery, biomaterials, and energy applications.

Chengzhong has published > 130 journal papers. Most of these journal publications were published in leading international journals, such as Nature Materials, J. Am. Chem. Soc., Angew. Chem. Int. Ed., Small, Adv. Mater., Adv. Funct. Mater., Chem. Mater.; Chem. Commun. hese journal publications have been cited over 4,600 times, resulting in an H-factor of 36. He has attracted 3 DP (CI), 1 Future Fellowship, 1 ARC LIEF and 1 International linkage projects from the Australian Research Council, 12 Independent from China before he joined AIBN in 2010 as a professor at Fudan University. He has received many national awards from both Australia and China, including the Australian Research Council Future Fellowship, the Second prize of the National Science Award of China (Ranked 3/5).

Relevant publications

1. Gu, W.; Yeo, E.; McMillan, N.; Yu, C. Z. Silencing Oncogene Expression in Cervical Cancer Stem-like Cells Inhibits Their Cell Growth and Self-renewal Ability. Cancer Gene Therapy, 2011, doi:10.1038/cgt.2011.58, in press.
2. Zhu, J.; Tang, J. W.; Zhao, L. Z.; Zhou, X. F.; Wang, Y. H.; Yu, C. Z. Ultrasmall, Well-Dispersed, Hollow Siliceous Spheres with Enhanced Endocytosis Properties. Small, 2010, 6(2), 276-282.
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5. Yang, S.; Zhou, X.; Yuan, P.; Yu, M.; Xie, S.; Zou, J.; Lu, G. Q.; Yu, C. Z. Siliceous Nanopods via a Compromised Dual Templating Approach, Angew. Chem.-Int. Edit. 2007, 46(45), 8579-82.

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Director

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Presentation title: Biomedical and Chemical Sensors Based on Micro/Nano Technologies

Biosensors and chemical sensors based on microelectronics and micro/nano technologies have received considerable attention. They have advantages such as miniaturization, low power consumption, low cost, and the potential for mass-fabrication, integration and automation. Nowadays, based on micro/nano science and technology, researches are focused on the strategies of new sensitive materials, new sensing principles, new device structures, new methods of fabrication and new technique of electrode surface modification.

In this paper, novel three-dimensinal micrometer-scale pyramidal micropool array, field effect transistor (FET)-based immunosensor with nanogold modification, copper nano-clusters based microsensor, and cobalt nanostructure-based microelectrodes are reported to demonstrate some fabrication strategies for micro biomedical devices and the nano technologies for sensitive surface modification. The novel microstructure redistributes electric field strength over working electrode surface. The disequilibrium of electric field makes more porous metallic nanoparticles clusters with large effective surface electrode posited at micropool fringer to improve the microelectrode surface modification. Meanwhile, mixed self-assembled monolayer technology was introduced for nanogold modification to make the sensor more stable and the surface is more compatible with biomaterials. Also in order to improve the selectivity and sensitivity of sensor, electro deposition methods for copper nanoclusters and cobalt nanostructures focused on obtaining active surface have been studied.

Shanhong Xia received her B.Sc. degree from the Electronic Engineering Department, Tsinghua University, Beijing, China in 1983, her M.Sc. degree from the Institute of Electronics, Chinese Academy of Sciences (IECAS) in 1986, and her Ph.D. degree in Electrical Engineering from Cambridge University, UK, in 1994. She is now a professor at the IECAS, director of the North Base of the State Key Laboratory of Transducer Technology, senior member of IEEE, member of the IEEE EDS Micro-Electro-Mechanical Systems Technical Committee, and member of the editorial board of several journals. She served as the General Chair and the International Steering Committee Chair of the 16th International Conference on Solid-State Sensors, Actuators and Microsystems (TRANSDUCERS'11) held in Beijing on June 5-9, 2011. Her present research interests are mainly on sensors and micro systems, including wireless network micro sensors, integrated sensors, system-on-chip and so on. She has published more than 200 papers and holds more than 10 patents.

Relevant publications

1. Shanhong Xia, Integrated Micro Biosensor Systems, Key Note Speech, International Conference on Materials for Advanced Technologies, July, 2007, Singapore.
2. Shanhong Xia, Biological and Chemical Microsensors for Health Care and Environment Monitoring, invited talk, The 24th International Technical Conference on Circuits/Systems, Computers and Communications (ITC-CSCC), July 5-8, 2009, Jeju Island, Korea.
3. Jizhou Sun, Yang Li, Chao Bian, Jianhua Tong, Hanpeng Dong, Hong Zhang, Qingyong Chen, Shanhong Xia, 3D Microelectrode Based on Integrated Micro and Nano Architectures, the 16th International Conference on Solid-State Sensors, Actuators and Microsystems, Beijing, China, 2011, 1618-1621.
4. Chao Bian, Jianhua Tong, Jizhou Sun, Hong Zhang, Qiannan Xue, Shanhong Xia. A field effect transistor (FET)-based immunosensor for detection of HbA1c and Hb. Biomedical Microdevices, 2011, 13(2): 345-352(8).
5. Qiannan Xue, Chao Bian, Jianhua Tong, Jizhou Sun, Hong Zhang, Shanhong Xia. A micro potentiometric immunosensor for hemoglobin-A1c level detection based on mixed SAMs wrapped nano-spheres array. Biosensors and Bioelectronics, 2011, Vol. 26(5): p2689-2693.

Dr Ben Muir

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Dr Ben Muir is a Research Scientist at the Commonwealth and Scientific Research Organisation (CSIRO) in Melbourne Australia.

His current research interests lie in the study and use of nanoparticles for therapeutic applications and implementing the use of High-throughput and combinatorial techniques in scientific discovery and development.

He has won a number of awards during his career including the RACI, 'Treloar prize' and has over 30 peer reviewed journal papers and patents.

Prior to working at CSIRO he commercialised a patented antibody binding technology that he invented while working in a biotechnology company for use in ELISA measurements using bead flow cytometry.

Ben has a number of PhD students from academic collaborations and he looks forward to the prospect of potentially starting some new and exciting research collaborations with the esteemed Chinese delegates at this workshop.

Relevant Publications:

1. S.M. Sagnella, X.J. Gong, M.J. Moghaddam, C.E. Conn, K. Kimpton, L.J. Waddington and C.J. Drummond "Nanostructured Nanoparticles of Self-Assembled Lipid Pro-Drugs as a Route to Improved Chemotherapeutic Agents" Nanoscale, 2011, 3, 919-924. DOI: 10.1039/c0nr00781A
2. X.J. Gong, M.J. Moghaddam, S.M. Sagnella, C.E. Conn, X. Mulet, S.J. Danon, L.J. Waddington and C.J. Drummond "Nanostructured Self-Assembly Materials from Neat and Aqueous Solutions of C18 Lipid Pro-Drug Analogues of Capecitabine – a Chemotherapy Agent – Focus on Nanoparticulate Cubosomes of the Oleyl Analogue" Soft Matter, 2011, 7, 5764 - 5776. DOI: 10.1039/c1sm05330b
3. X. Mulet, D.F. Kennedy, C.E. Conn, A. Hawley and C.J. Drummond "High Throughput Preparation and Characterisation of Amphiphilic Nanostructured Nanoparticulate Drug Delivery Vehicles" International J. Pharmaceutics, 395, 2010, 290-297. DOI: 10.1016/j.ijpharm.2010.05.029
4. M.J. Moghaddam, L. de Campo, L.J. Waddington and C.J. Drummond "Chelating Phytanyl-EDTA Amphiphiles: Self-Assembly and Promise as Contrast Agents for Medical Imaging"Soft Matter, 6, 2010, 5915-5929. DOI: 10.1039/c0sm00586j

5. C.E. Conn, X. Mulet, M.J. Moghaddam, C. Darmanin, L.J. Waddington, S.M. Sagnella, N. Kirby, J.N. Varghese and C.J. Drummond "Enhanced Uptake of an Integral Membrane Protein, the Dopamine D2L Receptor, by Cubic Nanostructured Lipid Nanoparticles Doped with Ni Chelated EDTA amphiphiles" Soft Matter, 2011, 7, 567-578. DOI: 10.1039/c0sm00790k

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Presentation title: Tissue Engineering Research: from bench to bedside

Tissue engineering is the specialty that applies the techniques of biology and engineering to the generation of new tissues. During the past 15 years, tissue engineering research has advanced so rapidly that generation of human tissue for tissue repair has become a reality.
In our tissue engineering center, most works performed in recent years focused on the construction of different types of tissues in large animal models for tissue repair. These works include tissue engineered bone to repair sheep cranial bone defect, goat femoral bone defect and dog mendibular bone defect with successful results. Using isolated autologous chondrocytes, articular cartilage defect was successfully repaired with tissue-engineered hyaline cartilage in a porcine model using bone marrow stem cells. Following successful engineering of tendon tissue in a hen model using isolated tenocytes, we now are able to engineer tendon using isolated dermal fibroblasts in a porcine model. In recent year, we have successfully engineered blood vessel, tendon, skin and cartilage tissue in vitro. In addition, we have also applied engineered bone tissue for clinical bone defect repair with success. Our experience in tissue construction and clinical application indicates that tissue engineering has great potential for tissue repair and tissue regeneration and will become a new therapy approach in plastic and reconstructive surgery.

Dr. Yilin Cao is a Professor of Plastic Surgery at Shanghai Jiao Tong University, School of Medicine. He graduated from Shanghai Second Medical University with a MD degree in 1975 and with a PhD degree in 1991. In 1992, he joined Dr. Jay Vacanti's Laboratory as a research fellow for tissue engineering research at Children Hospital, Harvard Medical School. His major contribution is the creation of cartilage in the shape of human ear in nude mouse, and thus he received James Barrett Brown Award in 1998 at the meeting of American Association of Plastic Surgeons.

Relevant publications

1. A sandwish model for engineering cartilage with acellular cartilage sheets and chondrocytes Yi Yi Gong, Ji Xin Xue, Wen Jie Zhang, Guang Dong Zhou, Wei Liu, Yilin Cao,Biomaterials 2011.03，32(9)，pp:2265-2273
2. In vitro engineering of human ear-shaped cartilage assisted with CAD/CAM technology Yu Liu, Lu Zhang, Guangdong Zhou, Qiong Li, Wei Liu, Zheyuan Yu, Xusong Luo, Ting Jiang, Wenjie Zhang, Yilin Cao Biomaterials 2010.03.,31(8),pp:2176-2183
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Ting Jiang, Wei Liu, Xioajie Lv, Hengyun Sun, Lu Zhang, Yu Liu, Wenjie Zhang, Yilin Cao, Guangdong Zhou Biomaterials 2010.05.,31(13),pp:3564-3571

4. In vivo engineering of a functional tendon sheath in a hen model Liang Xu, Dejun Cao, Wei Liu, Guangdong Zhou, Wenjie Zhang, Yilin Cao Biomaterials 2010.05.,31(14),pp:3894-3902
5. The impact of low levels of collagen IX and pyridinoline on the mechanical properties of in vitro engineered cartilage Dan Yan, Guangdong Zhou, Xu Zhou, Wei Liu, Wen Jie Zhang, Xusong Luo,Lu Zhang, Ting Jiang, Lei Cui, Yilin Cao, Biomaterials 2009,30（5）,pp: 814-821

Professor Tanya Monro FTSE

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Presentation title “**Nanobiophotonics: new photonics based approaches to liquid sensing”**

The capacity to structure optical fibres on the scale of the wavelength of light opens up new opportunities for getting the light guided by the fibre “out” of the glass and making it available to interact with materials. This opens up the possibly of creating new types of sensing devices capable of measuring specific chemicals or biomolecules of interest. This brings together novel optical fibre concepts with the capacity to functionalise the glass surfaces within these fibres with metals, fluorophores, or antibodies. Novel sensing architectures, including label-free sensors for viruses and biomarkers, dips sensor capable of sensing within nano-liter scale samples, a distributed chemical sensor and a new approach to dosimetry will be presented.

Professor Tanya Monro is an ARC Federation Fellow and Director of the Institute for Photonics & Advanced Sensing (IPAS) at The University of Adelaide. IPAS pursues a transdisciplinary research agenda, bringing together physics, chemistry and biology to create knowledge at the discipline interfaces and create disruptive technologies for health, defence, the environment and agriculture. She is also the Director of the Centre of Expertise in Photonics, which, in partnership with DSTO, develops new optical fibres for defence, sensing, nonlinear optics and fibre lasers.

Tanya is a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE), a member of Australia’s Future Manufacturing Industry Innovation Council (FMIIC), a member of the Australian Academy of Science’s National Committee for Physics, a member of the SA Premier’s Science & Research Council and an inaugural Bragg Fellow of the Royal Institution of Australia. Tanya is currently South Australia’s “Australian of the Year” for 2011 and has won many awards including 2010 South Australian Scientist of the Year, and winner of the 2008 Prime Minister’s Malcolm McIntosh Prize for Physical Scientist of the Year.

Tanya obtained her PhD in physics in 1998 from The University of Sydney, for which she was awarded the Bragg Gold Medal for the best Physics PhD in Australia in that year. In 2000, she received a Royal Society University Research Fellowship at the Optoelectronics Research Centre at the University of Southampton in the UK. She has published over 400 papers in refereed journals and conference proceedings, and has raised >$70M for research.

Relevant publications

1. E.P. Schartner, H. Ebendorff-Heidepriem, S.C. Warren-Smith, R.T White, T.M. Monro, “Driving down the Detection Limit in Microstructured Fiber-Based Chemical Dip Sensors”, Sensors 11, 2961-2971 (2011).
2. S.C. Warren-Smith, S. Heng, H. Ebendorff-Heidepriem, A.D. Abell, T.M. Monro “Fluorescence-Based Aluminum Ion Sensing Using a Surface-Functionalized Microstructured Optical Fiber”, Langmuir 27 (9), pp 5680–5685 (2011).

3. A. Francois, J. Boehm, S.Y. Oh, T. Kok, T.M. Monro, “Collection mode surface plasmon fiber sensors: a new biosensing platform" Biosensors and Bioelectronics 26, 3154-3159 (2011).
4. T.M. Monro, S.C. Warren-Smith, E.P. Schartner, A. François, S. Heng, H. Ebendorff-Heidepriem, S. Afshar V., “Sensing with suspended-core optical fibers”, Optical Fibre Technology 16 (6), 343-356 (2010).
5. S.C. Warren-Smith, H. Ebendorff-Heidepriem, T.C. Foo, R. Moore, C. Davis, T.M. Monro, “Exposed-core microstructured optical fibers for real-time fluorescence sensing”, Optics Express 17 (21), 18533-18542, September 2009

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Targeting Polymorphic Nucleic Acids: Modulate Their Biological Functions and Utilize These Controllable Conversions

Nucleic Acid is polymorphic and exists in diverse conformations. Conversion of different conformation can switch on/off their biological functions. Therefore, targeting polymorphic DNA is important for rational drug design and for developing structural probes of DNA conformation and DNA artificial devices. In this report, we summarize our recent advances on ligand-induced structural transitions, biological effects, and their applications.

This work was supported by NSFC, 973 Project, Funds from the Chinese Academy of Sciences and Jilin Province.

Education、Research Experience

2002 - Present Professor of Chemistry, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences

2006.12-2007.5 Visiting Professor, University of California at Santa Barbara with *Nobel Laureate Prof. Alan J. Heeger*

2000-2002 NSF Laboratory for Molecular Sciences, California Institute of Technology with *Nobel Laureate Prof. A. H. Zewail*

1996-2000 Department of Biochemistry, School of Medicine, UMC with *Prof. J. B. Chaires*

1989-1995 PhD Candidate, President's Award of the Chinese Academy of Sciences (1995), Changchun Institute of Applied Chemistry, Chinese Academy of Sciences

Research Interests:

Design and synthesize nucleic acids- and related protein-binding ligands, and study their interaction mechanisms and biological effects

1) Bioinorganic Chemistry ; 2) Chemical Biology;

3) Medicinal Chemistry and Physical Biochemistry;

4) Bio-nano engineering, Molecular design and Drug Delivery

Relevant publications

1. J. Geng, M. Li, E. J. Ren, Wang, X. Qu, (Cover Article) *Angew. Chem. Int. Ed.,* **2011**, 50, 4184.
2. C. Chen, J. Geng, F. Pu, X. Yang, J. Ren, X. Qu, *Angew. Chem. Int. Ed.,* **2011,** 50, 882.
3. C. Zhao, K. Qu, C. Xu, J. Ren, X. Qu, *Nucleic Acids Res.,* **2011**, *39*, 3939.
4. Y. Song, W. Wei, X. Qu, *Adv. Mater.,* **2011**, 23, 4215.
5. Y. Song, L. Feng, J. Ren, X. Qu, *Nucleic Acids Res.,* **2011**, 39, 6835.

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Presentation title: "Nanoparticle design using polymers – a solution for every drug delivery problem"

Micelles and vesicles have long been proposed as carriers for low molecular weight molecules including drugs. Especially micelles are found to be useful for the encapsulation of hydrophobic drugs in the core while maintaining the water solubility of the system with the hydrophilic shell. In addition, their sizes between 20 – 100 nm makes them perfect to target the drug passively to the tumour. Despite their high stability, micelles still tend to break up upon dilution once they reached their lower critical aggregation concentration. Several approaches have been undertaken to stabilise these structures using the crosslinking of the core or shell.

Encapsulation of a drug via physical entrapment can be maximised using compatibility calculations between drug and polymer as a tool. Using compatibility calculations, we showed that depending on the chemicals nature of the polymer, drug loading and drug release can be influenced. The toxicity of these micelles and the cellular uptake was investigated using different cell lines. Physical entrapment of drugs is however not always suitable. Especially, metal containing drugs such as platinum drugs require the conjugation to the polymer backbone to prevent early release of the drug. We developed a drug delivery system that is also suitable for metal-based drugs by incorporating ligands into the polymer structure.

The nanoparticles created are usually biocompatible due to their RGD structure. We also explore pathways to decorate these nanoparticles with functional moieties such as folates and peptides to enhance tumour targeting and cell-uptake.

Professor Martina Stenzel studied chemistry at the University of Bayreuth, Germany, before completing her PhD in 1999 at the Institute of Applied Macromolecular Chemistry, University of Stuttgart, Germany. After receiving a DAAD scholarship (German Academic Exchange Service), she started working as a postdoctoral Fellow at the UNESCO Centre for Membrane Science and Technology at the University of New South Wales (UNSW), Sydney, Australia. In 2002, she took on a position as a lecturer at the University of New South Wales and worked within the Centre for Advanced Macromolecular Design (CAMD) on complex polymer architectures via RAFT polymerization and honeycomb structured porous films. In 2007, she was promoted to Associate Professor.

In 2008, Martina obtained a prestigious ARC Future Fellowship. Her research interest is focused on the synthesis of functional polymers with complex architectures such as glycopolymers and other polymers for biomedical applications, especially polymers with in-build metal complexes for the delivery of metal-based anti-cancer drugs.

Martina Stenzel has published more than 160 peer reviewed papers mainly on RAFT polymerization and 5 book chapters. She is currently the chair of the Polymer division of the Royal Australian Chemical Institute (RACI) and editor of the Australian Journal of Chemistry. She received a range of awards including the 2011 Le Fèvre Memorial Prize of the Australian Academy of Science.

Relevant Publications:

1. Vien T. Huynh, Gaojian Chen, Paul de Souza and Martina H.Stenzel, “Thiol-yne and thiol-ene “click” chemistry as a tool for a variety of platinum drug delivery carriers, from statistical copolymers to crosslinked micelles”, Biomacromolecules 2011, 12, 1738-1751.
2. Yoseop Kim, Mohammad H Pourgholami, David L. Morris, Martina H Stenzel, J. Mater , “Triggering the fast release of drugs from crosslinked micelles in an acidic environment”, Chem 2011, 21, 12777
3. S. R. Simon Ting, Eun Hee Min, Per B. Zetterlund, and Martina H. Stenzel, “Controlled/Living *ab Initio* Emulsion Polymerization via a Glucose RAFT*stab*: Degradable Crosslinked Glyco-Particles for Concanavalin A/*Fim*H Conjugations for clustering of E.Coli bacteria”, Macromolecules 2010, 43, 5211–5221.
4. S. R. Simon Ting, Gaojian Chen and Martina H. Stenzel, “Synthesis of glycopolymers and their multivalent recognitions with lectins”, Polymer Chemistry 2010, 1, 1392-1412 (REVIEW ARTICLE)
5. Martina H. Stenzel, “RAFT polymerization: an avenue to functional polymeric micelles for drug delivery”, Chemical Communications 2008, 30, 3486-3503. (REVIEW ARTICLE)

Professor Kaiyong Cai

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Presentation title: Construction of nano-biointerfaces on titanium substrates

Biomaterials play essential role in regenerative medicine and tissue engineering, which providing a provisional three-dimensional microenvironments to regulates complex cellular process of tissue formation, function and regeneration. The ultimate fates of cells are highly directed by combined signals derived from the extracellular microenvironments, including chemical signals, biochemical signals, physical signals and soluble signals.

For specific application of a biomaterial, cells initially come into contact with its surface. Thus, to control the surface properties of biomaterials is critically important for the regulation of interactions between cell and biomaterials, including cell adhesion, migration, proliferation and differentiation as well as apoptosis. Surface matters of biomaterials attract more and more attention in recent years. Commercial pure titanium (cpTi) and its alloys have been extensively used in orthopaedic fields for manufacturing medical devices, such as artificial joints. For a specific prosthetic application, however, titanium implants can only passively integrate with bone so far. Various strategies have been employed to engineer titanium implant surface to improve its osseointegration property.

Herein, we report several strategies to construct microenvironmtal biointerfaces on titanium substrates for the regulation of biological behaviours of cells (osteoblasts and mesenchymal stem cells) and bone formation in vivo. We constructed desirable nano-biointerfaces on titanium substrates to regulate the behaviours of bone marrow derived stem cells (MSCs). We found that gene containing multilayered structures stimulated the proliferation and differentiation of MSCs. More importantly, such biointerface onto titanium substrates could bilaterally regulate the communication between cells and titanium substrates. Nanotopography and bioactive molecules could synergistically promote the differentiation of MSCs. In another study, we fabricated nano-reservoir type drug-delivery system onto titanium substrates and confirmed that surface mediated drug delivery could maintain bone homeostasis. In short, all our efforts focus on the development of biofunctionalized titanium implants.

Education and employment

Since 2007 Professor, Bioengineering College, Chongqing University, China

2005-2007 Associate professor, Bioengineering College, Chongqing University, China

2002-2005 Postdoctoral Fellow, Institute of Materials Science and Technology, Friedrich-Schiller-University Jena, Germany

1999-2002 Ph. D candidate, Research Institute of Polymeric Materials, Tianjin University, China.

Research

Dr. Kaiyong Cai's main research interest focuses on tissue inducing titanium and its alloys, gene functionalized bioactive materials based on layer by layer technique, and micro-/nano-reservoir type drug delivery system. He is the board member of Advanced Biomaterials, guest editor of Advanced Engineering Materials. He has published more than 40 papers in peer reviewed international journals. He is also the peer reviewer for more than 40 international journals.

Relevant publications

1. Min Lai, **Kaiyong Cai*,** Li Zhao, Xiuyong Chen, Yanhua Hou, Zaixiang Yang. Surface functionalization of TiO_2 nanotubes with bone morphogenetic protein 2 and its synergistic effect on the differentiation of mesenchymal stem cells. ***Biomacromolecules***. 2011, 12 (4): 1097-1105.
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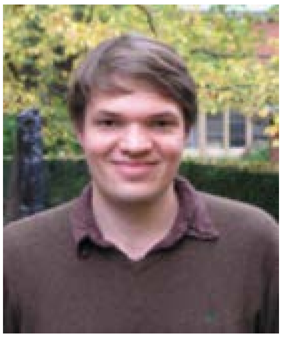

Dr Angus Johnston

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Presentation title: "Targeted Drug Delivery: Understanding cellular binding and uptake of nanoengineered capsules"

Targeted delivery of drugs to specific cells in the body has the potential to revolutionise the treatment of many diseases. An emerging technique to deliver drugs is to immobilise the drug inside a nanocapsule, whereby the body is protected from potentially harmful side effects of a drug, while also preventing the drug from being degraded by the body. This technique has potential to treat a range of diseases, from HIV to cancer.

To achieve this goal a number of key areas must be addressed in the design of the drug carrier, including the loading and release of drugs, as well as functionalisation with targeting molecules. Such nanoengineered capsules can be assembled using the layer-by-layer (LbL) deposition of interacting polymers onto a sacrificial template particle. This technique allows for fine control over the properties of the capsule by altering the number of layers deposited, the material deposited at each layer, and also by controlling the assembly conditions. We have demonstrated that a number of therapeutics, such as DNA, proteins, peptides and anti-cancer drugs, can be encapsulated within the LbL polymer shell and released in an active form, both in vitro and in vivo.

One major challenge in this field is understanding how the nanoengineered capsules interact with cells. We have recently developed a 'click' chemistry approach to functionalise capsules with targeting molecules, such as antibodies (Ab). Using these capsules we have demonstrated that Ab-functionalised capsules specifically bind to cancer cells, even when the target cells are less than 0.1% of the total cell population.

This precise targeting and control over capsule internalisation offers significant promise for drug delivery applications.

Dr Angus Johnston is a research fellow in the Department of Chemical and Biomolecular Engineering at the University of Melbourne. After completing his PhD in 2006 on the preparation of novel materials for rapid DNA sequencing from the University of Queensland, Angus moved to Melbourne to work in the Nanostructured Interfaces and Materials Group. His current research investigates targeted drug delivery systems, utilising nano-capsules to specifically deliver chemotherapy drugs and gene knock-down constructs to cancer cells. His other reseach interests include nanoengineered thin films and molecular sensing techniques.

Angus has received a number of awards for his research, including the 2010 Young Tall Poppy Science Award from the Australian Institute of Policy and Science.

Relevant Publications:

1. **Johnston, A. P. R.**; Read, E. S.; Caruso, F. "DNA Multilayer Films on Planar and Colloidal Supports: Sequential Assembly of Like-Charged Polyelectrolytes." *Nano Lett.* **2005**, *5*, 953. (*ISI Citations: 99, Journal Impact Factor: 12.2*)
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Professor Lingwen Zeng

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Presentation title: Application of nano-materials in molecular diagnostics

The convergence of materials and life sciences is taking place on many fronts, which is improving diagnostics, therapy, implant materials, imaging and drug delivery. With unique optical properties, nanomaterials, such as gold nanoparticles and quantum dots, push away the limitations of traditional diagnostic techniques. Gold nanoparticles based disposable devices are being developed for cheap, fast and convenient assays at home and in the doctor's office. Compare to organic fluorescent dyes, quantum dots show great potentials for high throughput multiplex assay. Nanomaterials are playing important roles in biomedicine and health.

Education and employment

2004 – present Principle Investigator, Guangzhou Institutes of Biomedicine and Health, CAS.
2003-2004 Deputy Director, Pharmaceutical Institute, Tsinghua University.
2001 – 2003 Chief Scientist, National Research Center for Biochip, Beijing, China.
1999 - 2001 Project Manager，Genetics Computer Group Inc.
1997 □1999 Scientist, Scios Inc., Sunnyvale, CA.
1997 - 1997 Scientist, Quest Diagnostics, San Juan Capistrano, CA.
1994 - 1997 Research Associate, The University of Chicago, Chicago, IL.
1988 - 1993 Teaching Assistant, Department of Biology, McMaster University, Hamilton, Ontario, Canada.
Ph.D. (1993) Genetics,Department of Biology, McMaster University, Canada
B.Sc.(1984) Agronomy, Agronomy Department, Huazhong Agricultural University, P.R.C.

Relevant publications

1. Jiekai Chen, Jing Liu, Jiaqi Yang, You Chen, Jing Chen, Su Ni, Hong Song, **Lingwen Zeng**, Ke Ding and Duanqing Pei. BMPs functionally replace Klf4 and support efficient reprogramming of mouse fibroblasts by Oct4 alone. Cell Research (2011) 21:205–212.(8.151)
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Professor Xingyu Jiang

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Presentation title: Micro/Nano-scale tools for biochemical analysis

I hope to introduce a few tools based on gold nanoparticles (Au NPs) and microfluidics that allows improved efficiency in biochemical analysis.

In the first example, we developed a method for the detection of Cu2+ ions by azide and terminal alkyne-functionalized Au NPs aqueous solutions using click chemistry. We labeled the 2nd antibody with CuO NP, used Cu released as to indirectly detect for antibody/antigen in immunoassays, with higher sensitivity than conventional ELISA. This colorimetric Au NPs system got rid of complex instrument, providing effective tools for Point of Care.

The second example tries to improve the efficiency of the western blot assay, because is a costly, time-consuming, and labor intensive process. We develop a novel method for Western blot based on microfluidics, incorporating the internal molecular weight marker, loading control, and antibody titration in the same protocol. Compared with the conventional method, the microfluidic Western blot could analyze at least 10 proteins simultaneously from a single sample, and it requires only about 1% of the amount of antibody used in conventional Western blot.

The third example I hope to give is the precise positioning of multiple types of cells. It is well known that the microenvironment of cells in the body is dominated by the interactions between multiple types of cells. We developed a series of methods to pattern multiple types of cells.

Xingyu Jiang is a principle investigator in the National Center for NanoScience and Technology of China (NCNST). His research interests include surface chemistry, microfluidics, micro/nano-fabrication, cell biology and immunoassays. Born and raised in Chengdu (China), Xingyu obtained his Bachelor’s Degree at The University of Chicago (1999), followed by an A.M. (2001) and a Ph. D. (2004) from Harvard University (Chemistry), working with Professor George Whitesides on microfluidics and cell patterning. After a short postdoctoral fellowship with Professor George Whitesides, he joined NCNST in 2005.

Relevant publications:

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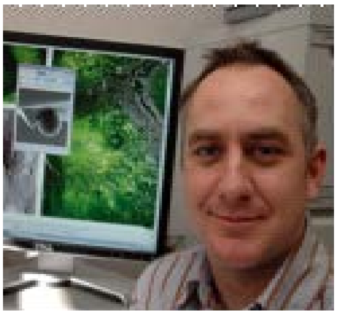
3. Microfluidic Western Blot. Pan, W.Y., Chen, W., **Jiang, X.Y.**, ***Anal. Chem.***, 82, 3974–3976 **(2010)**.
4. A method for patterning multiple types of cells by using electrochemical desorption of

self-assembled monolayers within microfluidic channels. Li, Y., Yuan, B., Ji, H., Han, D., Chen, S.Q., Tian, F., **Jiang, X.Y.**, ***Angew. Chem. Int. Ed.***, 46(7), 1094-1096 (**2007**).

5. Patterning multiple types of mammalian cells for modeling three types of naturally occurring cell-cell interactions. Chen, Z.L., Li, Y., Liu, W.W., Zhang, D.Z., Zhao, Y.Y., Yuan, B., **Jiang, X.Y.**, ***Angew. Chem. Int. Ed.***, 48(44), 8303-8305 (**2009**).



Dr Michael Higgins
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Presentation title: "Nanobionics Interface"

To effectively communicate with single living cells, we need to interface, or "plug-in", the artificial circuitry to molecular components of the cell such as lipid membranes, ion channels and protein-receptors. This will require a deep understanding of the cellular–electrode interface. A way forward will be to use nanometer-sized probes to measure the electrical signals, chemical interactions, and forces responsible for transmitting information at the interface. With organic conductors such as conducting polymers emerging as electrode materials in biological environments, the prospect of interrogating their interactions with living cells at nanoscale dimensions is very exciting. The presentation will give an overview of Nanobionics research and, in particular, highlight the design and fabrication of protein functionalized probes and conducting polymer nanoelectrodes integrated into Atomic Force Microscope (AFM) tips, which have been used to resolve molecular interactions at the bio-electrical interface. This work will greatly benefit the design and electrical stimulation parameters required for interfacing nanoelectrodes, transistors and biosensors based on conducting polymers in neural stimulation/recording, bioelectronics and neuro-nanotechnology applications.

Dr Michael Higgins completed his PhD at the University of Melbourne, Australia and then moved onto a Research Fellow position in the Centre for Research on Adaptive Nanodevices and Nanostructures (CRANN), Trinity College Dublin, Ireland (2002). He then spent a period as Senior Research Fellow at the Institute of Biomolecular and Biomedical Research at University College Dublin, Ireland, before returning to Australia in the Intelligent Polymer Research Institute (IPRI), University of Wollongong (2007).

He is currently a Senior Research Fellow and was recently awarded a prestigious 5 ARC Australian Research Fellowship Award. His main interest and research has focused on the cellular-material interface and application of AFM to study biological systems, including living cells, model lipid membranes, single ligand-receptor interactions, individual protein unfolding, fundamental surface-force interactions, as well as being involved in AFM instrument development. He now has over 15 years experience with AFM in the field of Biointerfaces and Biophysics.

Relevant publications:

1. M. Higgins; A. Gelmi; S.T. McGovern; G.G. Wallace "Electrochemical AFM: Understanding the Electromaterial-Cellular Interface" G.I.Y/ Imaging & Microscopy 2/2009;

2. X. Liu; J. Chen; K.J. Gilmore; M.J. Higgins; Y.Liu; G.G. Wallace, “Guidance of neurite outgrowth on aligned electrospun polypyrrole/poly(styrene-β-styrene) fiber platforms” Wiley InterScience, 2010;
3. X. Liu; Z. Yue; M.J. Higgins; G.G. Wallace “Conducting Polymers with immobilized fibrillar collagen for enhanced neural interfacing” Biomaterials 32 (2011) 7309-7317;
4. T. Fukuma; M.J. Higgins; S.P. Jarvis, “Direct Imaging of Individual Intrinsic Hydration Layers on Lipid Bilayers at Angstrom Resolution” Biophysical Journal, Volume 92, May 2007, 3603-3609;
5. T. Fukuma; M.J. Higgins; S.P. Jarvis, “Direct Imaging of Lipid-Ion Network Formation under Physiological Conditions by Frequency Modulation Atomic Force Microscopy”, Physical Review Letters, 2007.

Professor Jianlin Shi

Shanghai Institute of Ceramics, Chinese Academy of Science

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Presentation title: Preparation and Biocompatibility of Hollow Mesoporous Silica Nanospheres

Mesoporous silica nanoparticles (MSNs) with hollow interior (HMSNs) shows much enhanced drug delivery capacity and easy multi-functionalization. Herein we report the preparation of monodispersed HMSNs, its biocompatibility, drug delivery, and multifunctionalization for simultaneous imaging/drug delivery.

(1) A structural difference induced selective etching strategy has been developed to successfully convert a solid silica core/mesoporous silica shell structure to hollow/rattle-type mesoporous silica spheres. Two selective etching routes were developed leading to the complete or partial removal of the silica core with the mesoporous silica shell remaining almost intact. The obtained hollow mesoporous silica exhibited high loading capacity and sustained release properties. The pore sizes in the shell of HMSNs have been well-tuned by a mild alkaline etching from 3.2 nm to larger than 10 nm by a novel surfactant directing plus alkaline etching (SDAE) strategy. The large pore-sized hollow silica nanocapsules exhibit excellent siRNA loading capability and intracellular transfection efficienc

(2)Based on the above HMSNs, a potential platform for simultaneous drug delivery and imaging has been demonstrated by uniform hollow inorganic core/shell structured nanocapsules which are composed of inorganic (Fe_3O_4, Au, etc.) nanocrystals as cores, a thin mesoporous silica shell and a huge cavity in between them. The prepared core/shell structured mesoporous nanocapsules show high loading capacity (20%) and efficiency (~100%) for doxorubicin simultaneously. Besides, the hollow Fe_3O_4@$mSiO_2$ nanocapsules was demonstrated as contrast agents of MRI both in vitro and in vivo.

(3) HMSNs were successfully used as carrier in co-encapsulating and co-delivering hydrophobic (CPT) and hydrophilic (doxorubicin, DOX) anticancer drugs simultaneously. The co-delivery of multi-drugs in the same carrier and the intracellular release of the drug combinations enable the drug delivery system of efficient synergistic chemotherapeutic effect for drug-resistance MCF-7/ADR cancer cells.

Jianlin Shi obtained his Ph.D degree in 1989 in Shanghai Institute of Ceramics, Chinese Academy of Sciences. His recent research interest mainly include: mesoporous silicamaterials with controlled hollow structure and magnetic core/mesoporous shell structures for bioapplications; biocampatibility and bio-safety of mesoporous nanostructure; hierarchically micro/mesoporous zeolite for large molecule involved catalytic applications; host-guest mesoporous nanocomposites. More than 290 papers and three books (in Chinese) have been published, and the publications were cited by others for more than 5200 times with an H-index of 35. Prof.Jianlin Shi is now the director of the Institute and also the director of the State Key Lab. of High Performance Ceramcis and Superfine Microstructure.

Mr Ron Hardwick FTSE

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"Overview on Australia: Recycling – the way of the future"

A unique approach to closed-loop materials recycling and manufacturing has been developed over the past 30 years by a large, privately owned corporation with operations in Australia and the United States. The corporation, operating as Visy Industries in Australia and Pratt Industries in the USA, has implemented the approach in more than 100 of its manufacturing locations. It includes the following elements:

- vii. *Manufacturing processes for production of consumer packaging materials specially configured for reducing waste, particularly in energy and water use*
- viii. *The systematic recovery of household and commercial waste paper as a feedstock for recycled paper manufacture. This commenced in Australia in 1983, and in the United States in 1992*
- ix. *The development of efficient manufacturing processes for producing high volumes of packaging grade paper using 100 per cent post-consumer waste fibre*
- x. *The extension of waste paper collections to the collection and separation of "co-mingled" recyclables (glass, plastics, metals and paper) from households and commercial premises, through development of centralised Materials Recovery Facilities (MRFs)*
- xi. *The separation, through high-volume physical and optical sorting techniques, of various grades of plastics for further value-adding of the recyclables stream*
- xii. *The remanufacture of Polyethylene Terephthalate (PET) and High Density Polyethylene (HDPE) containers from the recovered, separated plastics stream to a food grade standard*

The next wave of innovation, currently under development, includes:

- iv. *Separation of valuable fuels from those parts of the municipal and industrial waste stream that cannot be further recycled, and the generation of clean energy from those fuels*
- v. *Application of new technologies to support the recovery and re-use of the waste stream's remaining complex components*
- vi. *The continuous improvement of closed-loop manufacturing systems towards a vigorous "circular economy" – an approach proposed for China in its new Five Year Plan (Chapter 23)*

Mr Ron Hardwick is currently Group Technical Consultant at Visy Pulp and Paper and has overseen energy and paper mill developments in Australia, the USA and Europe for over 20 years. This includes recycling and virgin fibre paper mills. Energy innovations have included installation and operation of cogeneration plants and gasifiers.

Ron is also a Director and Founder of AVT Services Pty Ltd, which serves the industrial and scientific vacuum industry, and a Director of Netra Holdings Pty Ltd which installs automated home systems.

He was formerly Managing Director of Associated Minerals Pty Ltd, a mining company in the mineral sands industry in Australia and the USA, who were significant consumers of electricity.

Prior to that Ron was a Director and Chief Executive of the Industrial Gases Division of CIG (now BOC), a company which was a major supplier of industrial gases both liquefied and compressed.

Visy Industries operating in Australia and USA is a packaging manufacturer specialising in collection of waste and converting paper and plastics to new products. The industry has waste streams from recycling paper and pulp mills as well as waste from recycling collection operations. The company has been developing gasifiers over 14 years to convert waste to steam and electricity after recovery of recyclables.

Professor Feng Zhao

Institute of Urban Environment, CAS

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Presentation title: Application of bio- electrochemistry techniques in wastewater recycle

Biofilm plays an important role in efficiency and process optimisation of resource recovery from wastewater/waste. Insight into extracellular electron transfer (EET) of biofilm is important for the understanding of bioremediation, bio-corrosion and biogeochemical cycles as well as bio-electrochemical systems. Our research efforts at Institute of Urban Environment have focused on developing an understanding of the fundamental EET mechanisms that occur in wastewater treatment systems. Through bio-electrochemistry techniques, the specific issues including how electrons transfer at the bacteria/solid interface and how the bacterial species and environmental factors affect the wastewater recycle will be discussed.

Feng Zhao received his doctorate degree in chemistry at Changchun Institute of Applied Chemistry, Chinese Academy of Sciences in 2004; then spent two years as a postdoc. at the University of Greifswald in Germany working on the development of low-cost microbial fuel cells for wastewater treatment. In 2007, Dr. Zhao came to the University of Surrey in U.K. as a senior research officer, and there his research focused on the development of bio-electrochemical systems for wastewater treatment and renewable energy generation. He was awarded a research grant through the prestigious "Hundred Talents Program" of Chinese Academy of Sciences and moved to Institute of Urban Environment in 2010. His papers in peer-reviewed journals have been cited more than 1100 times in the past 6 years, and one is the most cited article of Electrochemistry Communications in 2005-2009; he is the inventor of 8 patents. His scientific interests are in the areas of bio-energy & environmental technology; recycling wastewater/waste using bio-electrochemical systems.

Relevant publications:

1. X. Wu, F. Zhao*, N. Rahunen, J. R. Varcoe, C. Avignone-Rossa, A. E. Thumser, R. C. T. Slade. A Role for Microbial Palladium Nanoparticles in Extracellular Electron Transfer, *Angew. Chem. Int. Ed*., **2011**, 50, 427.
2. F. Zhao*, R. C. T. Slade, J. R. Varcoe, Techniques for the study and development of microbial fuel cells: an electrochemical perspective, *Chem. Soc. Rev*., **2009**, 138, 1926.
3. H. Deng, Z. Chen, F. Zhao*, Energy from plants and microorganisms: the progress in plant-microbial fuel cells, *ChemSusChem*, cssc.201100257, 2011, In press.
4. F. Zhao, N. Rahunen, J. Varcoe, A. Chandra, C. Avignone-Rossa, A. Thumser, R. Slade, Activated carbon cloth as anode for sulphate removal in a microbial fuel cell, *Environ. Sci. Technol*., **2008**, 42, 4971.
5. F. Zhao, F. Harnisch, U. Schröder, F. Scholz, P. Bogdanoff, I. Herrmann, Challenges and Constraints of Using Oxygen Cathodes in Microbial Fuel Cell, *Environ. Sci. Technol*., **2006**, 40, 5193

Professor Ravi Naidu

Managing Director
CRC for Contamination Assessment & Remediation of the Environment
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AUSTRALIA
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Presentation title: "Solid and liquid waste management - current state of play and innovative solutions"

The dictionary definition of waste is "anything unused or not used to full advantage" or "anything discarded by an individual, household or organization". Thus, waste is often a complex mixture of different substances, some of which are intrinsically hazardous to health. Given the large volume of wastes generated by cities, industries, companies and individual households today the health and environmental effects of both waste itself and its management are the subject of a vast body of research.

It is now widely accepted that, no matter how good the waste management practices adopted by cities and industries worldwide, world demand for new products and food will result in massive increases in both solid and liquid waste streams. Urbanization in particular is leading to far greater volumes of solid waste. According to Beede & Bloom, (1995) about 1.3 billion metric tons of municipal solid waste was generated globally in 1990 and this has now grown to around 2 billion metric tonnes per year. In most countries, the total volume of municipal waste is more than doubled by the inclusion of industrial liquid and solid wastes. While developed countries invest significant resources in managing these wastes, the most common method of waste disposal in developing countries is to dump it on land and into water bodies. This is leading to major degradation of both land and water environments. In the early 1990s it is estimated the Asian countries alone spent about US$25 billion on solid waste management per year, a figure expected to rise to around US$50 billion by 2025 (Hoornweg & Thomas, 1999). This suggests that solid waste management (SWM) has become a large, complex and costly industry in its own right. Solid Waste Management (SWM) is the discipline associated with the control of generation, storage, collection, transfer, processing and disposal of municipal solid waste. At the same time both cities and industries generate liquid wastes. While some countries have developed complex technologies to remediate municipal effluents, many developing countries are facing rising community anger over the potential risks arising from unknown bio and chemi hazards. This indicates that successful waste management strategies also need to incorporate significant public consultation. Indeed, following the 1992 United Nations Earth Summit in Rio de Janeiro, some countries formally adopted information dissemination and public consultation on projects focussing on environment. The environmentally sound management of waste was a major example of this. Principle 10 of the Rio Declaration states:

"Environmental issues are best handled with the participation of all concerned citizens, on a relevant level. On a national basis, each individual should have appropriate access to information concerning the environment that is held by public authorities, including

information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States should facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy should be provided."
In this paper, I will present an overview of CRC CARE projects focussing on solid and liquid waste recycling together with strategies employed to achieve their adoption both by industries and local communities. Case studies include:
(a) waste water containing perfluoro surfactants;
(b) red mud;
(c) highly contaminated soils; and
(d) chlorinated hydrocarbon contaminated ground water will be presented.

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Beede, D. N., Bloom, D.E., The economics of municipal solid waste. World Bank Research Observer, 10(2) (1995).
Hoornweg, D., Thomas, L., What a waste: Solid waste management in Asia. Washington, DC, USA:World Bank Urban waste management working paper series no.1 (1999).

Professor Ravi Naidu is the Managing Director of the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment - a Centre that he initiated and won industry and Commonwealth funding. Ravi is also the inaugural Director of the Australian Research Centre for Environmental Risk Assessment and Remediation that he established in 2003 at the University of South Australia. Since its inception the Centre has grown from one person to over 80 researchers and PhD students. He has researched environmental contaminants, toxicology, bioavailability, and remediation for over 20 years. Ravi has co-authored over 500 technical publications (230 journal publications) and co-edited 10 books in the field of soil and environmental sciences including field remediation of contaminated sites. He has also supervised 20 PhD students and those graduated have received jobs internationally and in Australia.

His current research focuses on the remediation of contaminated soil, water and potential impacts of contaminants to environmental and human health. In particular Ravi is focusing on innovative technologies (including nano technologies) for contaminant assessment, speciation and bioavailability in soil and ground water, remediation technologies and strategies to minimize further contamination of our fragile environment. During the last 10 years Ravi has won in excess of $150 million dollars (cash of $130 million industry and Commonwealth- CRC CARE) in research grants from industries and government agencies. In recognition of his contribution to environmental research he was presented Gold award in environmental science in 1998 by Tamil Nadu Agricultural University, elected to Fellow of Soil Science Society America in 2000 (3rd Fellow in Australia and only 0.03% of members elected), Fellow of Soil Science Society of New Zealand in 2004 and Fellow of Agronomy Society of America in 2006. He was also one of three finalist for the South Australian Government's Research Leadership award in 2006. Listed in the whos who of South Australia Ravi is the Chair of the Standards Australia Technical Committee on Sampling and

Analyses of Contaminated Soils, Chair of the International Committee on Bioavailability and Risk Assessment, Chair of the of International Union of Soil Sciences' Commission for Soil Degradation Control, Remediation and Reclamation, is the past President of the International Society on Trace Element Biogeochemistry and sitting member of the Victorian EPA Contaminated Sites Auditor panel.

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Associate Professor Guoying Zhao

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Presentation title: Cleaner catalysis in Ionic Liquids

Ionic Liquids, collective names for chemical Compounds exclusively consisting of mobile ions, bridge the gap of molten salts and molecular compounds. Due to its Unique Properties, Ionic Liquids are becoming a novel Green Transformation Platform in a broad of academic and industrial fields. Catalysis in Ionic Liquids is an important sub-branch among them, where mainly used as ligands, solvents and catalysts. Alkylation of isobutane and light olefins (C3-C5) is an important unit in petroleum industry to produce a mixture of highly branched paraffin, a highly desired clean blending component. However, the established commercial catalysts are serious polluting concentrated sulfuric acid and hydrogen fluoride, much effort is to develop safer, cleaner and more cost-effective catalyst. Strong Acidic ionic Liquids are believed to one of the most potential cleaner catalyst for isobutane alkylation. In last decades, many attentions from big petroleum companies and related institutes such as IFP, BP, Chevron and so on, haves focused on Chloroaluminated –based ionic liquids as alternative to the traditional catalyst. Herein, novel classes of acidic ionic liquids were shown to catalyze effectively isobutane alkylation. High-quality alkylates with up to 80% desired trimethylpentane (TMP) selectivity and 95 research octane number (RON) were produced under the optimal condition. We quantitatively determined the acidity of the ionic liquids using C^{13}NMR with an unsaturated acetone as molecular probe. The results indicated that the nature and composition of acidic ionic liquids significantly affected its acidity, and therefore its catalyst activity.

Dr. Guoying zhao, Associate Professor, Ionic Liquids Cleaner Process, Institute of Process Engineering, Chinese Academy of Sciences(CAS). Her Main studies focus on Greener chemical engineering and clean energy. 2001-2004, PhD studies on chemical reaction in supercritical carbon dioxide and ionic liquids, Institute of Chemistry, CAS. 2004-2005, Visiting research fellow in St Andrews University, supported by Royal Society of Chemistry-British Petroleum.2005-2007, Senior researcher in University of St Andrews, University of Debrecen, supported by Marie Curie Fellowships of the European Union.2007-2009, Senior researcher in University of Stockholm, Supported by CODRECT centre and Berzelli EXSElENT Centre. Nov. 2009, Assistant Professor in Institute of Process Engineering, CAS. Jul. 2010, Associate Professor in Institute of Process Engineering, CAS. She has contributed 45 publications in conferences and Journals, cited more than 600 times by other SCI papers.

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5. Zhao, GY, Ferenc JOO. Free Formic Acid by Hydrogenation of Carbon Dioxide in Sodium Formate Solutions; Catalysis Communications, 14,74–76,2011

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Presentation title: "Recycling Plastics and Rubber Tyres as a Resource for EAF Steelmaking"

Veena Sahajwalla[1], Magdalena Zaharia[1], Somoyote Kongkarat[1], Rita Khanna[1], Muhamad Rahman[1], N. Saha-Chaudhury[1], Paul O'Kane [2], Jon Dicker[2], Catherine Skidmore[2] and David Knights[2]

[1] Centre for Sustainable Materials Research & Technology (SMaRT@UNSW),University of New South Wales, Sydney, Australia; [2] OneSteel, Rooty Hill, Sydney, Australia

The steel industry uses different carbon based materials. Metallurgical coke is a conventional material used as an inject material in EAF steelmaking. However, coke consumption needs to be reduced due to problems associated with green house gas (GHG) emissions. In this direction different carbon bearing materials could replace the conventional materials. Research on use of waste polymeric materials is one of the solutions for developing environmentally friendly recycling processes for steelmaking. Different polymeric materials (i.e. rubber, high density polyethylene (HDPE) and polyethylene therephtalate (PET) which have different chemical structure and composition were selected for this study as carbon resources. The rapid heating to high temperatures provided during steelmaking will breakdown the polymeric chains and reactions with liquid slag will enable gas formation.

In EAF steelmaking, a foamy slag produces substantial savings such as: decreasing electricity consumption, protecting the equipment, as well as reducing the arc noise. Slag foaming involves the expansion of molten slag by CO gas bubbles evolving from chemical reactions.

Dynamic changes in the volume of the slag droplet while in contact with polymer/coke substrates are measured. Significant levels of gas generation and entrapment have resulted in enhanced slag foaming compared to coke. Our studies have established fundamentals of the interactions of polymers/coke blends with slag occurring in EAF steelmaking process.

The addition of end-of-life rubber tyres and plastics in electric arc furnace (EAF) steelmaking has been studied in detail by our research group at University of New South Wales [1-6]. We use blends of different proportions of rubber/plastics and coke as slag foaming agents. The use of rubber and coke blend is no longer considered a trial at OneSteel plants and is instead standard practice [1].

Industrial implementations showed enhanced slag foaming performance for polymers compared to coke. Carbon additions have been reduced by 56-73kg/heat, while the FeO percentage in the slag was reduced slightly. Reduction in the electrical energy usage from 424 KWh/t when coke alone was used to 412.4KWh/t in case of rubber blend, reaching 406 KWh/t when HDPE blend was injected.

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Scientia Professor Veena Sahajwalla is the leader of research into Sustainable Materials as the Director of Sustainable Materials Research & Technology (SMaRT@UNSW) at the University of New South Wales. She is an Australian Research Council (ARC) Future Fellow at the University of New South Wales in Sydney, Australia.

Veena's research interests include sustainability of materials and processes with an emphasis on environmental and community benefits. Through this interest, Veena has invented an environmentally friendly process of recycling plastics and rubber tyres in steelmaking. Veena is an international award winning scientist and engineer who has presented on her research and experiences throughout the world. She has collaborated with Australian companies and overseas companies/institutions. She has established excellent working relationships and a deep knowledge of industrial processes and issues/problems. She has published in excess of 200 papers in journals and conference proceedings.

As the Director of UNSW's Centre for Sustainable Materials and Research and Technology (SMaRT), she has provided leadership in the research programs on sustainable materials a strong emphasis on the skills and knowledge that are urgently needed to enhance sustainability. Central to this have been her insights into the fundamental theory of high-temperature reactions, from the molecular level to industrial-scale applications, and the strong collaborative relationships she has established with industry in Australia and internationally. In 2005, she received Eureka Prize for Scientific Research. She also received the 2006 Environmental Technology Award from Association of Iron & Steel Technology in the United States for her research into recycling waste plastics in steelmaking. She was elected as a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE) in 2007. In 2011, she received the Pravasi Bharatiya Samman Award given by the Government of India for her outstanding achievement in the field of Science and in recognition of her valuable contribution in promoting the honour and prestige of India. She was also named to India's highest honour for Overseas Indians, the Pravasi Bharatiya Samman in 2011. In 2011 she gave talk at Tedx Sydney event: http://www.youtube.com/watch?v=4wMbdwfplBk and she is one of judges for the Google Science Fair.

She received BTech, Metallurgical Engineering, Indian Institute of Technology, Kanpur, India; MASc, Metals and Materials Engineering, University of British Columbia, Canada and PhD, Materials Science and Engineering, University of Michigan, USA.

Veena is passionate about science and engineering. She encourages young people to consider science and engineering as a career path; and is very active in communicating her ideas to students. She is one of the judges on the ABC TV show, "The New Inventors"

Relevant Publications:

1. Sahajwalla V, Zaharia M, Kongkarat S, Khanna R, Saha-Chaudhury N and O'Kane P (2010), "Recycling Plastics as a Resource for Electric Arc Furnace (EAF) Steelmaking: Combustion and Structural Transformations of Metallurgical Coke and Plastic Blends" Energy and Fuels, Vol.: 24, pp: 379-391 .
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Professor Raymond J Zeng

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Presentation title: Optimisation of value added product from waste fermentation via metabolic strategy

Mixed culture fermentation (MCF) is a sustainable approach to produce value added chemicals from waste. Due to its inherence of diver metabolites, it is hard to control the metabolism of waste fermentation. In this presentation, a structured metabolic model of glucose fermentation is proposed based on maximum energy yield and electron bifurcation reaction. The modeling results from glucose fermentation in continuous stirred tank reactor (CSTR) show that the metabolite distribution is consistent to literature: acetate, butyrate and ethanol are main products at acidic pH, while the production shifts to acetate and propionate at neutral pH. Upon on further digging into the metabolic model, several metabolic strategies will be discussed for desired product steering:

1. *acetate oxidation for hydrogen production is a thermodynamic unfavorable process. However, experimental results show that* $^{13}CO_2$ *is generated from added* ^{13}*acetate during glucose fermentation, strongly suggesting electron bifurcation reaction would likely be the only explanation.*
2. *homoacetogenesis is normally ignored during waste digestion. However, it could capture hydrogen and* CO_2 *from fermentation to produce acetate. We demonstrate up to 7 g/L acetate production via this process in a hollow fiber membrane system. Furthermore, C4, C6, even C8 fatty acids can be generated accordingly from it. It opens a new window for long chain fatty acid production from homoacetogenesis.*
3. *Hydrogen over-saturation in fermentation is underestimated. We find out 2 time hydrogen oversaturation is very common even in CSTR system, and this phenomenon highly relates to substrate concentration and stirring speed. Consequently, it would affect the ORP in the system and results in more reduced products generation, like ethanol.*

Lactic acid is an important industrial chemical. In fermentation, it normally appears as an intermediate product during the transition period. We demonstrate that more that 90% glucose turns to lactic acid as final product when encountering 10mM butyrate in the system. It would be highly desirable if starch wastewater can be metabolized to lactic acid only.

Dr. Raymond J Zeng graduated from South China University of Technology in 1991 and then worked 7 years in Hoechst China Ltd and in Dow Chemical Pacific Ltd before studying his PhD in Advanced Water Management Centre (AWMC), The University of Queensland (Australia). His PhD study was about the role of intracellular storage products in biological nutrient removal in wastewater treatment. Dr. Zeng obtained his PhD degree in 2002 and then worked as postdoctoral fellow in AWMC on the optimization of enhanced biological phosphorus removal (EBPR) systems. In 2004 he moved to Technical University of Denmark as assistant professor and started the research in biohydrogen production and microbial fuel cells (MFC). He came back to AWMC in 2006 as research fellow, focusing on Denitrifying anaerobic methane oxidation (DAMO) process. In 2009 he joined the chemistry department at University of Science and Technology of China as a Bairen professor of Chinese Academy of Science. Currently his research covers DAMO process, optimization of metabolic products from mixed culture fermentation, nutrient recovery, N_2O emission from water system and MFC.

Relevant publications:

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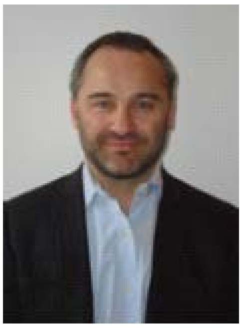

Mr David Singh

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Presentation title: "Household Waste – the Urban Mine"

The presentation will raise key points on:

- *Household waste is a resource for recovery and recycling , reuse and/or remanufacture not disposal by landfill or incineration*
- *There are a range of options for processing household waste including source segregation, mechanical sorting, optical sorting, anaerobic digestion, aerobic composting etc.*
- *It is possible to produce high quality organic products without source segregation of household waste*
- *Energy recovery by combustion is only part of the solution for household waste and should be targeted at the inorganic and non-recyclable materials i.e. textiles, contaminated paper, wood waste and the like*
- *Each community requires a bespoke solution to its household waste, there are no silver bullet solutions*
- *The range of materials which can be either recycled, reused and/or remanufactured from household waste is increasing all the time with new technology, better separation and cleaning systems and higher secondary resource prices*

Mr David Singh has been the driving force behind the development of Global Renewables (GRL); propelling the company from just an idea in the late nineties, to its current status as an international exemplar in sustainable waste management with a presence in both hemispheres.

David oversaw the contracting and financing of the Eastern Creek Project in Sydney, Australia, following completion of a three-year global search for the most effective and most sustainable waste treatment technologies. The pick of those technologies were combined into the UR-3R Process® (Urban Resource – Reduce, Recover, Recycle) in a purpose-built facility which immediately attracted the praise of environmentalists across the world and was cited in the Greenpeace report "Cool Waste Management" as one of the most environmentally virtuous waste treatment methods available.

Eastern Creek began treating Sydney's household waste in 2004 and, shortly afterwards, David became Global Renewable's Director of Development with a remit to establish GRL in the UK where emerging EU legislation was creating a buoyant waste market as local authorities searched for alternatives to landfill.

Having been in the UK slightly less than a year, Global Renewables was appointed preferred bidder in the US$4B Lancashire Waste PFI Contract – establishing the company as not just the newest entrant to the UK market, but arguably the most envied; having secured the largest UK waste PFI deal to date. In March 2007 the project was financed by 5 leading international banks and earlier this year commenced full service.

In 2009, David with the support of private equity acquired the Global Renewables Business (excluding the UK business) from GRD Limited. Since this time David has been based in Australia and has led the expansion of the Eastern Creek UR-3R Facility to 220,000 tpa and to the achievement of a 66% diversion rate.

David is a keen advocate of waste being treated as a resource and is involved in a range of organizations and committees that are helping drive Australia to a resource efficient future.

David holds a Bachelor of Mechanical Engineering and an MBA both from the University of Western Australia, and a Graduate Diploma in Finance from the Australian Securities Institute.

Relevant Publications:

1. Steve La Brooy; David Singh; John Lawson; "The UR-3R Facility: A fully integrated approach to municipal solid waste management", Proceedings of ORBIT, 2003
2. David Singh; Steve La Brooy; John Lawson; "Hybrid Resource Recovery and the Demise of AWT", 2003

Professor Guangwen Xu

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Presentation title: Utilization of Industrial Biomass Waste for Energy and Porous Carbon Material

Industrial biomass wastes refer to the biomass produced in the industrial processes using agriculture products as the feedstock, including various light industries for food, drinking, medicine, sugar, paper and bio-chemicals based on physical processing, fermentation, pulp making and so on. There are many different industrial biomass wastes or residues. In addition to the rice husk and saw dust that are generally referred to, they include further the distilled spirit lees, vinegar lees, debris of antibiotics, Chinese herb residues and so on. The wastes are collected already and amounted to about 300 million tons per year in China (not including sewage sludge). However, most of them contain water of up to 80% and sometimes organic acids and salt, thus representing a kind of industrial or city pollutants as well. Comprehensive utilization of industrial biomass wastes is the requirement not only for energy and resource saving but also for environmental protection. The authors treat the biomass wastes from the industrial processes as another kind of biomass resource that has the equivalently big amount with the agriculture biomass wastes, and has worked systematically on developing the utilization technologies for the industrial biomass wastes rich in cellulose. Taking the distilled spirit lees to represent the wastes rich in cellulose, the so-called circulating fluidized bed decoupling combustion technology was developed to convert the wastes into energy, while the a process integrating carbonization and activation was developed to produce porous carbon material using the lees. Both the technologies have accomplished their pilot tests and are under the process of executing the industrial demonstration. This report is to provide a summary on the industrial biomass waste resource and a highlight on the fundamental studies and engineering developments in IPE.

Guangwen Xu, male, professor, Research group leader. He graduated from Tsinghua University in 1991 for his bachelor degree and from Institute of Process Engineering (IPE), Chinese Academy of Sciences (CAS) in 1996 for his doctor degree. He has worked in Japan and Germany between 1996 and 2006, in succession, as a visiting scholar in Gunma University, NEDO industrial technology researcher in National Institute of Industrial Science and Technology (AIST), Alexander von Humboldt (AvH) research fellow in Technical University Hamburg-Harburg (TUHH) and senior research scientist in IHI Corporation Ltd. He has become a professor and the Leader of a research group in IPE since 2006 through the “hundred-talent program”, and was the Technology director of a joint venture between BP and CAS, Shanghai Bike Clean Energy Corporation in 2008-2011. He is now also an adjunction professor of Curtin University, Senior Guest Research Scientist of IHI Corporation

Ltd., Member of China Particuology Society Council, Deputy director of Board Council and member of expert committee of China Technology Innovation Alliance for Municial Biomass Fuel Gas. His current research interests cover the utilization of industrial biomass wastes (process residue), thermochemical conversion of coal for pyrolysis liquid and fuel gas, flue gas cleaning catalysts and process and innovative gas-solid reaction analysis instruments. He has published more than 150 papers, applied for more than 40 patents and delivered about 30 invited keynotes in various academic conferences.

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Professor Yujie Feng

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Presentation title: Key Materials and Performance of MFCs for Wastewater Treatment

Microbial fuel cells (MFCs) were proposed to be an effective wastewater treatment method in recent years. They are devices using bacteria as biocatalysts to obtain electrical energy from wastes with simultaneous oxidation of organic pollutants. MFCs are usually constructed with an anode, a cathode and the electrolyte between them. Electrons were effused from the bacteria attached on the anode and transferred along the external circuit, finally reacted with protons and oxidants in cathode compartment. Less expensive materials are very important for the potential application of this new technologies and many research also indicated that a rational configuration play importance to increase power output of MFCs. An inexpensive carbon mesh material was examined here as a substantially less expensive alternative to these materials for the anode in an MFC. Pretreatment method was established to ensure adequate MFC performance. Heating the carbon mesh in a muffle furnace (450°C for 30 min) resulted in a maximum power density of 922 mW/m^2 (46 W/m^3) with this heat-treated anode, which was 3% more power than that produced using a mesh anode cleaned with acetone (893 mW/m^2;45 W/m^3)。A low-cost catalyst (N)-doped carbon powders (NDCP) was invented to microbial fuel cells. It was concluded that the total cost of the cathode was reduced by 78.1% when similar power density was achieved. We also invented a new binder by mixing of Nafion and PTFE in different ratios and used as binders of Pt/C catalyst in MFC tests. By using the new materials, the total cost of MFC was decreased over 80% and showed perspective future.

Yujie Feng, Ph.D & Prof. Deputy Head of the State Key Laboratory of Urban Water Resource and Environment (HIT) of MOST (Ministry of National Science & Technology) and the Director of Dept Applied Biology, Harbin Institute of Technology, Visiting Professor of Penn State University, USA, Winner of the National Science Foundation for Distinguished Young Scholars.

She got her Ph.D, M.Phil and Bachelor degree from Harbin Institute of Technology and Tianjing University. She has been working in Harbin Institute of Technology since 1994, as a Lecture (1994-1998), Associate Professor (1998-2002) and Professor (since 2002-). She got the special funding for Excellent Young Scientist in Heilongjiang Province in 2002 and was also awarded the top 100 Excellent Young Teachers in Universities in China in 2003. In 2004, she was rewarded the top 10 Excellent Young in Heilongjiang Province in china. In 2005, she was awarded Excellent Scholars of New Century in China. Her research interest includes combined technology of phys-chemical & Biological process for toxic waste water treatment, sustainable bio-energy harvesting simultaneously wastes treatment, Environmental electrochemistry and Electrochemical Biological System (EBS), Environmental Risk Assessment in Urban Water System et al.

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Presentation title: "Recycling of solid waste streams at Port Kembla steelworks (PKSW)"

This presentation discusses ways of handling solid waste streams at Port Kembla Steelworks (PKSW). Many waste streams are found in any integrated steelworks and these include filter cake from basic oxygen steelmaking (BOS) and blast furnaces (BF), dust streams from BOS and BFs and mills scales streams. Some of these streams are rich in undesirable components such as the high zinc (Zn) content of the BOS filtercake. High Zn concentration in the sinter feed reduces the strength of the sinter and consequently limited amounts of streams containing high zinc are directly recycled in the sinter feed.

Consequently, some solid waste streams need further treatment through processes such as a rotary hearth furnace (RHF), where the high Zn is recovered as a by-product (ZnO). The impact of such processes on the steelworks overall material and energy consumption and CO_2 emissions is evaluated using an Integrated Steelworks Energy and Emissions Model (ISEEM). This model is based on mass and energy balances and covers the energy consumption and CO_2 emissions from gate-to-gate in PKSW.

This effort is a part of a larger project titled 'Process Integration'. In this context, it should be mentioned that BSL is participating in an international project (annex) through the International Energy Agency (IEA) Industrial Energy-related Technologies and Systems (IETS). This project is called "Process Integration in the Iron and Steel Industry" and runs for three years. Steel companies and/or universities from Sweden, Finland, Italy, France, Korea, Japan and Australia are members in this annex.

Dr Habib Zughbi has a PhD in Chemical Engineering from the University of New South Wales. He is a Senior Research Engineer with BlueScope Steel Research. He has been with the company since 2006. His interests include applications of process integration to reduction of energy consumption and CO_2 emissions. Dr Zughbi also applies process integration to waste streams recycling, improving energy efficiencies and handling of trace elements. Dr Zughbi also applies Computational Fluid Dynamics to solve a wide range of fluid flow and heat transfer with or without chemical reactions problems across the steelworks with an emphasis on primary operations, i.e. iron and steelmaking.

Prior to joining BlueScope Steel, Dr Zughbi worked for twelve years as an Associate Professor at the School of Chemical Engineering at King Fahd University of Petroleum and Minerals in Saudi Arabia. He completed a number of research projects funded by various bodies including Saudi oil and petrochemical companies. One of his focus research topics was jet mixing.

Habib also worked as a scientist for seven years at CSIRO Division of Minerals in Melbourne and worked for a couple of years in oil refining (Caltex refinery in Sydney) and oil production (Esso Australia).

Relevant Publications:

1. **H. Zughbi** and Paul Zulli, "Modelling of Energy Consumption and CO_2 Emissions in PORT Kembla Steelworks", First International Conference on Energy Efficiency and CO2 Reduction in the Steel Industry, EECRsteel, June 27-30, 2011, Düsseldorf, Germany.

2. **H. Zughbi** and P. Zulli, "Energy Consumption and CO_2 Emissions Benchmarking And Modelling in Port Kembla Steelworks", CHEMECA, September 2011, Sydney, Australia.

3. K. M. Komiyama, B. Y. Gou, **H. Zughbi**, P. Zulli and A. B. Yu, " Parametric Studies of Titanium Particle Formation in the Blast Furnace Hearth", CHEMECA, September 2011, Sydney, Australia.

4. **H. Zughbi,** Mathieson, J. G., and Zulli P.: Modelling of Energy Consumption and CO_2 Emissions in Port Kembla Steelworks, Scanmet III, June 8-11, (2008), Lulea, Sweden

5. **H. D. Zughbi,** and M. A. Rakib, "Mixing in a Fluid Jet Agitated Tank: Effects of Jet Angle and Elevation and Number of Jets", *Chemical Engineering Science*, Vol. 54, No. 4, pp. 829-842, 2004.

6. A. Kareeri, **H. D. Zughbi** and H. H. Al-Ali, "Simulation of Flow in a Radial Flow Fixed Bed Reactor (RFBR)", *Industrial and Engineering Chemistry Research*, 45(8), 2862-2874, 2006

7. **H. Zughbi**, D. Maldonado, P. Christy, A. Weidner, P. Zulli, P. Card, and J. leary, "Effects of Geometry on Slurry Separation in a Settling Tank, ANSYS Users Conference, December 2008, Sydney Australia

Professor Fu-Shen Zhang

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Presentation title: Nano-materials developed from e-waste

Waste electric and electronic equipments (WEEE) contain heterogeneous materials including polymers, multiple types of metals and glass fiber, thus it is difficult to effective recycle this type of wastes. In the present study, silver and lead nanoparticles were successfully synthesized using waste PCBs and waste CRTs as raw materials. For silver nanoparticles synthesis, the PCBs were first subjected to supercritical water treatment so as to decompose most of the organic components, then Ag was separated and Ag microparticles as precursors were prepared by calcination method. X-ray diffraction and transmission electron microscopy measurements indicated that the particle sizes of the precursors greatly affected the formation of nano Ag particles in supercritical water. When the precursors were in the sizes of <1 µm, they could be destroyed and Ag nanoparticles could be formed. On the other hand, for lead nanoparticles synthesis, lead oxide in the CRT funnel glass was firstly reduced to elemental lead, and evaporated rapidly in vacuum circumstance, then quenched and formed nano-size particles on the surface of the cooling device. Experimental results showed that temperature，pressure and argon gas flow rate were the major parameters controlling lead evaporation rate and the morphology of lead nanoparticles. The maximum lead evaporation rate was 96.8% and particles of 4-34 nm were successfully obtained. Toxicity characteristic leaching procedure (TCLP) results showed that lead leaching from the residue glass met the USEPA threshold.

Fu-Shen ZHANG, PhD, is Research Professor and head of Resource Recovery from solid waste lab at Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. He went to Japan in 1998 as a Japanese government scholarship student, and he got his PhD in the field of environmental engineering from Tohoku University (Japan). He also carried out post-doctoral research at the University of Michigan (USA) and Nagoya University (Japan). His recent research addresses effective recycling of solid wastes, including valuable matters recovery and functional materials development from various solid wastes, such as municipal solid waste, electronic waste, bio-fuel generation from organic waste.

Relevant publications:

1. Mingfei Xing, Fu-Shen Zhang. Nano-lead particle synthesis from waste cathode ray-tube funnel glass. Journal of Hazardous Materials. 2011, 194, 407–413.
2. Zhengang Liu, Fu-Shen Zhang. Nano-zerovalent iron contained porous carbons developed from waste biomass for the adsorption and dechlorination of PCBs. Bioresource Technology. 2010, 101, 2562–2564.

3. Kai Li, Fu-Shen Zhang. A novel approach for preparing silver nanoparticles under electron beam irradiation. Journal of Nanoparticle Research. 2010, 12:1423–1428.
4. Neng-min Zhu, Yi-Li, Fu-Shen Zhang. Catalytic dechlorination of polychlorinated biphenyls in subcritical water by Ni/Fe nanoparticles. Chemical Engineering Journal. 2011, 171, 919– 925.
5. Fu-Rong Xiu, Fu-Shen Zhang. Materials recovery from waste printed circuit boards by supercritical methanol. Journal of Hazardous Materials. 2010, 178, 628–634.

Professor Paul Meredith

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Presentation title: "Organic Solar Cells: Beyond the Shockley-Queisser Limit"

Organic solar cells are widely believed to be one of the key next generation photovoltaic technologies. Organic PV promises low $/watt solar power with efficient material utilization and short energy production payback times. Organic solar cells can also be made flexible over very large surface areas and respond well to low light conditions. These properties make them ideal for indoor or portable power and architectural applications. Recently, power conversion efficiencies in lab-scale devices have increased dramatically with verified and published figures of > 7% and unverified industrial lab efficiencies of > 10% reported. However, even 10% is somewhat short of the maximum single junction efficiency defined by the thermodynamic or Shockley-Queisser limit (33.7% for c-Si). In my talk I will examine the factors that currently limit organic solar cell efficiencies. I will also describe the strategies that we work with at the Centre for Organic Photonics and Electronics to overcome these limitations with the objective of making module-scale devices competitive with inorganic thin film technology.

Professor Paul Meredith is a Professor of Physics at the University of Queensland, a Vice Chancellors Senior Research Fellow and co-director of the Centre for Organic Photonics and Electronics. He is also co-founder and Vice President Materials Development of the solar coatings companies XeroCoat and Brisbane Materials Technology. Between 2007 and 2010 he was a Queensland Smart State Senior Fellow and in 2010 was appointed to the Premier of Queensland's Climate Change Council and the Queensland Smart State Council Working Group on Evolving Energy Policy.

His research focuses on next generation sustainable high tech materials and specifically materials for solar energy. He has published > 200 scientific articles, papers and patents and also has a broader interest in solar energy development and deployment. In this context he leads several solar major infrastructure projects including the deployment of a large 1.2MW PV array at UQ and the University's Solar Flagship activities. He is a passionate advocate of renewable energy and policy reform and in this context also leads the University of Queensland Global Change Institute Renewable Energy Focal Area.

He was educated in the United Kingdom at the University of Wales, Heriot-Watt University and Cambridge University and also spent 6 years working as a senior scientist with the Proctor and Gamble Company before moving to UQ in 2001.

Relevant publications:

1. "Extraction of photogenerated charge carriers by linearly increasing voltage in the case of Langevin recombination", G. Juška, N. Nekrašas, V. Valentinavičius, P. Meredith & A. Pivrikas, In Press, *Physical Review B* (accepted September 2011).
2. "Synthesis and self-assembly of donor-acceptor-donor based ologothiophenes and their optoelectronic properties", R.B.K. Siram, K. Tandy, M. Horecha, P. Formanek, M. Stamm, S. Gevorgyan, F.C. Krebs, A. Kiriy, P. Meredith, P.L. Burn, E.B. Namdas & S. Patel , *J. Phys. Chem. C*, 115, 14309-14313 (2011).
3. "Morphology dependent electron transport in a new electron accepting solution processable small molecule for solar cell applications", K.B. Kruger, K. Gui, P.E. Schwenn, A. Pivrikas, P.L. Burn & P. Meredith, *APL*, 98, 083301 (2011); also selected for *APL: Organic Electronics and Photonics* on-line highlights February 2011.
4. "A small molecule non-fullerene electron acceptor for organic solar cells", P.E. Schwenn, K. Gui, A. Nardes, K. Kruger, K.E. Lee, K. Mutkins, H.R. Rubinstein-Dunlop, P.E. Shaw, N. Kopidakis, P.L. Burn & P. Meredith, *Adv. Energ. Mater.*, 1, 73 (2011); also selected for the first issue of *Adv. Energ. Mater*. as a Frontispiece article.
5. "Morphology of an all solution processed organic solar cell", K.E. Lee, P.E. Schwenn, A.R.G. Smith, H. Cavaye, P.E. Shaw, M. James, K. Kruger, I'R. Gentle, P.L. Burn & P. Meredith, *Adv. Mater*., 23, 766-770 (2011).

Professor Ning Dai

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Presentation title: Thin Film Solar Cells: an Overview of Existing Problems

As second generation photovoltaic technology, thin film solar cells (TFSCs) are expected to succeed wafer-based Si solar cells to dominate the manufacture, since they offer a promising approach for cost reduction and large scale production, and allow for a wide variety of choices related to device design. The current TFSCs, however, have rather low conversion efficiencies, while the prices of TFSCs and wafer-based Si solar cells are comparable. Although TFSCs have the versatility of allowing tailoring and engineering of the layers and the device structures, which might lead to improvement of device performance, the thin film materials suffer the problems of low material quality related to high density of dangling bonds, dislocations, and defects. Improving the thin film quality requires proper control over the entire process sequence and, as a result, investigation on thin film deposit equipments with strong in situ characterization ability is necessary. A variety of substrates and different growth techniques (such as PVD, PECVD, ECD, etc.) offers great flexibility of depositing different layers. With such a flexibility, deep understanding of thin-film deposition processes is therefore possible and essential to achieve high conversion efficiency of the large area devices. It is believed that, with research and development advances, TFSCs would have good future when, specially, TFSCs are combined with other technologies such as nano technology.

Professional Preparation

PhD 1993, University of Notre Dame, Physics

MS 1984, Shanghai Institute of Technical Physics, CAS, Physics

BS 1982, Shanghai University of Science and Technology, Physics

Appointment

2001 – Present, Professor, National Laboratory for Infrared Physics, Shanghai Institute of Technical Physics, Shanghai, China

1997 – 2001, Visiting Research Associate, Department of Physics, The University of Oklahoma, Norman, Ok, USA

1994 – 1997, Associate Professor, Department of Physics, Fudan University, Shanghai, China

1993 – 1994, Post-doctoral Research Associate, Center for Advanced Technology, The City University of New York, New York, USA

1984 – 1987, Research Scientist, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, Shanghai, China

Relevant publications:

1. Yufeng Liu, Meiying Ge, Yang Yue, Yan Sun, Yizheng Wu, Xin Chen, and Ning Dai, "Colloidal Cu_2ZnSnS_4 Nanocrystals Generated by a Facile Route Using Ethylxanthate Molecular Precursors," *Phys. Status Solidi RRL* **5**, 113(2011).
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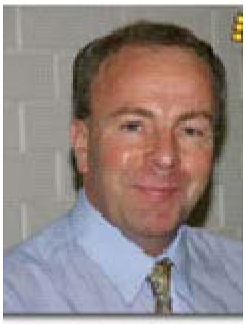
5. T. Zhang, G. J. Hu, H. J. Bu, J. Wu, J. H. Chu, and N. Dai, "Evolution of Microstructure and Related Properties of $PbZr_{0.4}Ti_{0.6}O_3$ Films on F-doped Tin Oxide with Annealing Temperature," *J. Appl. Phys.* **107**, 084103(2010).



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"Advanced Photovoltaic Approaches for Low Cost per Watt solar cells"

In order to tackle the twin problems of climate change caused by emission of greenhouse gasses and approaching fuel shortages caused by peak oil, we need to transition to sustainable energy systems based on renewable energy resources.

The modularity, lack of required maintenance and direct electricity generation of photovoltaics makes it the main renewable energy generator of choice. But in order to realise truly large scale implementation it is essential to reduce its cost per Watt of generating power whilst using earth abundant, non-toxic and sustainable materials and processes. This requires high efficiency devices which convert a large fraction of incident solar energy to electricity but which also use low cost and low energy input deposition and fabrication processes. Multiple energy level devices using thin film low energy deposition on foreign and cheap substrates offer the potential for this. There are a number of routes to such 'third generation photovoltaics, including: tandem solar cells; intermediate band solar cells; up or down conversion of the incident spectrum and hot carrier cells. These will be discussed and their potential to radically decrease costs per Watt investigated.

With such cheap yet efficient photovoltaics, will there be any need to offset the intermittency of solar energy production with chemical storage of energy? The intermittency of the diurnal cycle can be addressed by battery storage and small scale hydro storage. Schemes such as the use of electric vehicles as a default store offer a potential means to achieving this. But are they sufficient?

The longer term storage issue to deal with summer / winter intermittency is more of a challenge. Spreading of supply across a range of renewable energy generators has strong potential to reduce the impact of this intermittency. The generation of fuels for transport or for long term storage is another possible option, provided such generation has a fully closed-loop sustainability. Approaches to doing this will be surveyed.

Associate Professor Gavin Conibeer received his BSc degree from Queen Mary College, London University in Materials Science; MSc from the University of North London in Polymer Science; and PhD from Southampton University, UK, in III-V semiconductors for tandem PV cells. Conibeer has held research positions at Monash, Southampton, Cranfield and Oxford Universities and moved to his current location at the University of New South Wales, Sydney in 2002. He has worked on III-V, II-VI, group IV and nanostructure materials for solar cells as well as PV systems and policy.

He has published more than 100 refereed papers and been successful in securing more than A$10M of research funding. Conibeer is currently Deputy Director of the Photovoltaics Centre of Excellence at the University of New South Wales and leads the Third Generation Photovoltaics group.

Relevant publications:

1. G. Conibeer, S. Huang, International Journal of Nanoparticles, ed Chang Hui Ye, "Nanomaterials for Third Generation Photovoltaics", accepted Feb 11, in press.

2. G. Conibeer, M.A. Green, D. Konig, I. Perez-Wurfl, S. Huang, X. Hao, D. Di, L. Shi, S. Shrestha, B. Puthen-Veettil, Y. So, B. Zhang and Z. Wan, "Silicon quantum dot based solar cells: doping, voltage and transport", Progress in Photovoltaics: Res. Appl. 18 (2010), DOI:10.1002/pip.1045

3. G.J. Conibeer, N. Ekins-Daukes, D. König, E-C. Cho, C-W. Jiang, S. Shrestha, M.A. Green, Solar Energy Materials and Solar Cells, 93 (2009) 713-719, "Progress on Hot Carrier solar cells".

4. G. Conibeer, M. Green, E-C. Cho, D. König, Y-H. Cho, T. Fangsuwannarak, G. Scardera, E. Pink, Y. Huang, T. Puzzer, S. Huang, D. Song, C. Flynn, S. Park, X. Hao, D. Mansfield, "Silicon quantum dot nanostructures for tandem photovoltaic cells", Thin Solid Films, 516 (July **2008**) 6748-6756.

5. G. Conibeer, Materials Today, "Third-Generation Photovoltaics" 10 (Nov 2007) 42-50.

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Presentation title: "Processing of flexible dye sensitized solar cells on plastic substrates"

One of the major challenges for making dye sensitised solar cells (DSC) on plastic substrates is the difficulty in making good quality porous TiO2 films. Cold isostatic pressing (CIP) is a powder compaction technique that applies an isostatic pressure to a sample in all directions. Nanocrytalline TiO2 films with excellent mechanical stability were prepared on ITO coated plastic substrates in the absence of organic binders by the CIP technique. The morphology and the physical properties of the TiO2 films can be controlled by changing the parameters of the CIP process. The results show that the CIP process can significantly improve the conversion efficiency (CE) of DSC cells. Electrochemical impedance spectroscopy (EIS) analysis indicates a clear correlation between the CE enhancement and the resistivity reduction in TiO2 films after the CIP compression. Porosity reduction and possibly localized joints between some TiO2 nano-particles in the CIP process are assumed to be responsible for the resistivity reduction of the TiO2 working electrode films. This room-temperature processing technique has led to an important technical breakthrough in producing high efficiency flexible DSCs.

Professor Yi-Bing Cheng is a Professor in materials engineering at Monash University, Australia and an elected Fellow of the Australian Academy of Technological Sciences and Engineering.

He completed his undergraduate (1978) and Master (1983) studies at Wuhan University of Technology, China and received a PhD degree from University of Newcastle-upon-Tyne, U.K. in 1989. He joined Monash University in 1991 after three years of postdoctoral research in the U.K. and worked through as a Lecturer, Senior Lecturer, Reader and Professor at Monash University. He specialises in inorganic materials and composites. His recent work on dye sensitised solar cells has been focused on the development of nanoporous working and counter electrodes and manufacturing of flexible solar cell devices, which has received significant funding from the Australian government and industries. His work has received a number of awards in Australia and overseas. He has published over 300 research papers and is an inventor of 16 patents.

Professor Cheng has developed strong research collaborations with Chinese researchers since 1993. He received a number of joint research grants from the Chinese National Nature Science Foundation and was a recipient of the Outstanding Overseas Chinese Scholars Award of the Chinese Academy of Sciences between 2001-2003. He has jointly published over 70 research papers with Chinese researchers. He currently holds a “One Thousand Talent Professor” position at Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology in Wuhan, where he is Director of the Michael Gratzel Center for Mesoscopic Solar Cells.

Relevant Publications:

1. Fuzhi Huang, Dehong Chen, Lu Cao, Rachel A. Caruso, Yi-Bing Cheng, Flexible dye-sensitized solar cells containing multiple dyes in discrete layers, Energy Environ. Sci., 4, 2803-6, 2011
2. Nattestad, A. J. Mozer, M. K. R. Fischer, Y.-B. Cheng, A. Mishra, P. Bäuerle, U. Bach, Highly efficient photocathodes for dye-sensitized tandem solar cells, Nature Materials, 9, 31-35, 2010
3. Fuzhi Huang, Dehong Chen, Xiao Li Zhang, Rachel A. Caruso, Yi-Bing Cheng, Dual-Function Scattering Layer of Submicrometer-Sized Mesoporous TiO2 Beads for High-Efficiency Dye-Sensitized Solar Cells, Adv. Funct. Mater. 20, 1–5, 2010
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Presentation title: High-efficiency multiple junction solar cells

High efficiency solar cells have attracted a lot of attention since they produce electrical energy in a clean way to ease the energy shortage and environmental pollution caused by overuse of the fossil energy sources. Compound semiconductor multiple junction solar cells keep the record conversion efficiency because of the high internal quantum efficiency of the semiconductor materials and the multiple junction structures which absorb and convert the solar energy in segments of energy by different junctions stacked in series. We have designed a solar cell configuration based on beam splitting where a dichroic mirror is used to split the solar spectrum at 870 nm (1.42 eV) into two bands, and GaInP/GaAs and InGaAsP/InGaAs dual junction cells are employed to absorb the short and long wavelength bands, respectively. This structure not only covers most of the solar spectrum, but also converts the solar energy below 1.42 eV more efficiently compared with that of the widely used GaInP/GaAs/Ge triple junction cells. The dual junction cells GaInP/GaAs and InGaAsP/InGaAs are grown by low pressure metal-organic chemical vapor deposition, and the fabricated devices show that the efficiency of GaInP/GaAs and InGaAsP/InGaAs cells are 25.5% and 8.9%, respectively, at one sun AM1.5D and room temperature. The efficiency of InGaAsP/InGaAs cell under 200x concentration reaches 12.9% resulting from the significant increase of the open circuit voltage and slight improvement in fill factor under concentration. A conversion efficiency of more than 43% under concentration has been achieved for GaInP/GaAs+InGaAsP/InGaAs four junction cells.

Obtaining his B.E. and M. E. degrees in microelectronics and solid-state electronics from Xidian University in 1989 and 1992, respectively, and Ph D degree in semiconductor physics and semiconductor devices from Institute of Semiconductors, CAS, in 1996, Dong Jian Rong joined Institute of Semiconductors as a Research Associate focusing on MBE growth of GaAs-based HEMTs and InAs/GaAs. He continued his research career as a Research Associate and later Research Scientist with Institute of Materials Research and Engineering (IMRE), A-STAR, Singapore, from September 1997 to January 2008, and his research interests covered MOCVD growth of InP- and GaAs-based semiconductor materials, materials characterization and devices, including 650, 808, 980 and 1550nm lasers, photo-detectors, optical switches/waveguides and MEMS. He demonstrated the first room temperature cw 670 nm GaInP/AlGaInP quantum well lasers grown by tertiarybutylphoshine. He joined Suzhou Institute of Nano-tech and Nano-Bionics, CAS, as a professor in 2008. Currently, he is working on III-V semiconductor based multijunction high-efficiency solar cells and system. He has authored and coauthored 60 journal papers and filed more than 10 patents.

Relevant publications:

1. C.K. Chia, J R. Dong, B.K. Ng, “Anisotropic optical response of InAs/InP quantum dot avalanche photodiodes”, Appl. Phys. Lett. 94(5), 053512(2009).
2. W. He, S. L. Lu, J. R. Dong, Y. M. Zhao, X. Y. Ren, K. L. Xiong, B. Li, H. Yang, H. M. Zhu and X. Y. Chen, and X. Kong, “Structural and optical properties of GaInP grown on Germanium by metal-organic chemical vapor deposition”, Appl. Phys. Lett. 97(12), 121909(2010).
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Presentation title: "New Nanostructured Materials for Efficient Photo-electrochemical Energy Conversion"

The increasing concerns over the climate change and exhausting fossil fuels have seen great effort being directed toward the development of new energy generation /conversion systems. Innovative materials for energy conversion hold the key for renewable energy production. The ability to design these nanomaterials with tailored structures and functionalised properties is an important challenge that researchers strive to meet. Aimed at developing new nanostructures for efficient photocatalytic energy conversion, we have recently developed the synthesis, band-gap modification, and self-assembly of several types of transition metal oxides including layered titanate, clays, tantalates and niobate-based pervoskites. The doping and exfoliation of these layered structures led to the formation of colloidal suspensions containing exfoliated nanosheets. These unique nanosheets can be structural modified into ideal two-dimensional building blocks for new nano-architecture fabrication. The self-assembly and flocculation of nanosheets led to multilayer ultrathin films and restacked nanoporous structures, which exhibited excellent visible light photocatalytic performances.

Associate Professor Lianzhou Wang is currently an Associate Professor in School of Chemical Engineering, the University of Queensland (UQ). Before joining UQ in 2004, he has worked at two leading national research institutions (NIMS and AIST) of Japan as a research fellow for five years. A/Prof. Wang is now leading an active research group at UQ with focuses on the synthesis, characterisation and application of functional nanomaterials for use in cleaner and more efficient energy conversion/storage systems, including photocatalytsts, rechargeable lithium batteries, and water treatment membranes.

In the last five years' time, as a Chief Investigator, he has succeeded in winning 9 Australian Research Council (ARC) grants, two CSIRO Flagship Cluster projects, one major Queensland Government fund and a number of UQ grants (totally over $11 millions). A/Prof. Wang has contributed more than 120 peer-reviewed journal publications (including top ranking journals such as *Angew. Chem., Adv. Mater., J. Am Chem. Soc., Adv. Funct. Mater., ACS Nano,* etc.), 11 patents and over 80 presentations, which have been cited around 2000 times with a H-index of 25. He also won several prestigious Fellowships/awards including the STA Fellowship of Japan, Alexander von Humboldt Fellowship of Germany, ARC Queen Elizabeth

II Fellowship of Australia, UQ Research Excellence Award of 2008, and most recently the Scopus Young Researcher Award of 2011 (Engineering and Technology Category, Australian Universities).

Relevant publications:

1. X. Wu, GQ Lu, **LZ Wang**, Shell-in-Shell TiO_2 Hollow Spheres Synthesized by One-Pot Hydrothermal Method for Dye-Sensitized Solar Cell Application, ***Energy and Environmental Science***, 2011, 4, 3565-3572. (IF: 9.446).
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3. X. Wu, ZG Chen, GQ Lu, **LZ Wang**, Nanosized anatase TiO_2 single crystals with tunable exposed (001) facets for enhanced energy conversion efficiency of dye-sensitized solar cell, ***Advance Functional Materials***, 2011, 10.1002/adfm.201100828.
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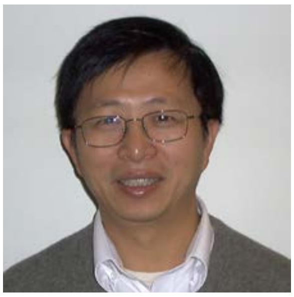

Professor Xudong Xiao

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Presentation title: Recent Progress of Cu(InGa)Se2 Solar Cells in CUHK/SIAT

While many thin film solar cells have considerably lower efficiency than crystalline silicon solar cells, the conversion efficiency of Cu(InGa)Se2 (CIGS) solar cell is comparable to that of polycrystalline silicon solar cell. The total fabrication cost of CIGS solar cell is about ½ of crystalline silicon solar cells. It is estimated by NREL that CIGS will be the most cost competitive solar cell when mass production technology becomes mature and widely adopted. As the most efficient thin-film solar cell, the commercialization potential of CIGS-based solar cells has attracted intensive interest both from research groups and commercial companies, mostly in USA, Germany and Japan.

To develop domestic CIGS production lines and promote the second generation photovoltaic industry in China, we started the CIGS project in 2008 both in the Chinese University of Hong Kong (CUHK) and in the Shenzhen Institute of Advanced Technology (SIAT), which is jointly supported by the Chinese Academy of Sciences (CAS), the Shenzhen City government, and CUHK. The best efficiency we achieved is 17% for small size solar cells, which is the highest among the greater China region, and 12.6% for 10cmX10cm mini-modules. In the laboratory we are continuing to improve the conversion efficiency by investigating many fundamental issues of CIGS solar cells.

Prof. Xiao received his Ph. D. degree in physics with optical technique to study surface diffusion at the University of California at Berkeley in 1992. After his further training in surface science with scanning probe microscopy in Lawrence Berkeley National Laboratory as a post doctorate, he joined the Department of Physics at the Hong Kong University of Science and Technology in 1994, where he directed his research in surface science and nano science with both optical techniques and scanning probe microscopies. In 2007, Prof. Xiao moved to the Chinese University of Hong Kong and expanded his research to photovoltaic solar energy. He is a recipient of the Outstanding Yong Scientist Fund, Chinese National Science Foundation, 2004 and an awardee of “Thousand Talents Scheme”, China, 2010. Prof. Xiao has made various contribution to surface science and nano science, including inventing linear optical diffraction method for detecting submonolayer surface diffusion, discovery of room temperature “ice-like” water structure, developing quantitative tribology at nanoscales, experimentally demonstrating quantum capacitance of nano-junctions, and discovery of pseudogap state in the nano-island of conventional superconductors. Concurrently, Prof. Xiao is leading a team to develop equipments and production lines to manufacturing $Cu(InGa)Se_2$ thin film solar cell in China.

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Presentation title: "Nanomaterials for next generation lithium rechargeable batteries"

Lithium rechargeable batteries are important for electrochemical energy storage and conversion. In order to meet global requirements for clean emissions, it is necessary to develop new materials and better technologies for electric and hybrid electric vehicles, as well as for other energy storage applications. The electrochemical performance of lithium ion batteries strongly depends on the cathode materials, anode materials, and electrolytes. Nanomaterials have a critical role to play in achieving high electrochemical performance in rechargeable lithium batteries due to their special properties, which differ from those of their bulk material counterparts. The Energy Materials Research Program at ISEM, the UOW focuses on developing advanced materials and innovative technologies for a new generation of energy storage devices with high energy density, long life cycle and low cost. This talk will highlight our recent efforts in developing new approaches to control the structure, chemistry, shape, and functionality of nanostructures for applications in lithium rechargeable batteries. Examples presented will include carbon coated Si nanoparticles, Si-Graphene, self-catalysis-grown SnO_2 *nanowires, high surface area, hollow-structured* α-Fe_2O_3*/carbon nanocomposite, nanostructured* V_2O_5*, and* $LiFePO_4$-Fe_2P-*C nanocomposite as electrode materials for next generation lithium rechargeable batteries.*

Professor Hua Kun Liu has been a co-ordinator of the energy materials research program, Institute for Superconducting and Electronic Materials (ISEM), University of Wollongong (UOW) since 1995. She was awarded ARC Senior Research Fellowship (1994-1999), Australian Professorial Fellowship (1999-2003), and Australian Professorial Fellowships within ARC Centre of Excellence for Nanostructured Electromaterials (2003-2005) and within ARC Centre of Excellence for Electromaterials Science (2006-2010). She initiated the energy materials research program, which focuses on developing innovative technology for a new generation of energy storage devices such as lithium rechargeable batteries, supercapacitors, hydrogen storage and fuel cells. The energy materials research program has attracted many brilliant young researchers to form an energy materials research team consisting of 8 well established researchers, 20 PhD students and a number of visiting fellows for innovative research, which has been recognized both nationally and internationally. The research topics cover the materials science and engineering, and electrochemistry. She has published 10 review and 500 refereed papers with 9500 citations, h-index 45, as well as 1 USA Patent and 10 Innovation Provisional Patents. She has supervised 45 PhD and 15 Masters to completion and a number of postdoctoral and visiting fellows. These PhD graduates and fellows are very well spread within the fields of science, technology, and industry worldwide, and have made significant contributions in the energy field. Her major contributions to the energy field include a number of the first and important breakthroughs which had a significant impact to the field of materials science and technology.

Relevant publications:

1. J. Wang, C. Zhong, D. Wexler, N.H. Idris, Z. Wang, L. Chen, H.K. Liu, Graphene-Encapsulated Fe3O4 Nanoparticles with 3D Laminated Structure as Superior Anode in Lithium Ion Batteries, Chem. Eur. J. 2011, 17, 661 – 667 (IF: 5.382)
2. M.M. Rahman, .J. Wang, Z. Chen, H.K. Liu, Nanocrystalline porous α-LiFeO2–C composite—an environmentally friendly cathode for the lithium-ion battery, Energy & environmental science, 2011, 4(3) 952 (IF: 8.5)
3. H.K. Liu, Z. Guo, J. Wang, K. Konstantinov, Si-based anode materials for lithium rechargeable batteries, (invited highlight paper), J. Mater. Chem., 20, 10055–10057 (2010) (IF: 4.795)
4. M.S. Park, G.X. Wang, Y.M. Kang, D. Wexler, S.X. Dou and H.K. Liu, Preparation and electrochemical properties of SnO2 nanowires for application in lithium-ion batteries, Angew. Chem, Int. Ed. 46 (5), 750-753, (2007) (IF 10.879).
5. S. Ng, J. Wang, D. Wexler, K. Konstantinov, Z. Guo, H.K. Liu, Highly reversible lithium storage in spheroidal carbon-coated silicon nanocomposites as anodes for lithium-ion batteries, Angew. Chem. Int. Ed., 45 (2006) 6896-6899. (IF: 10.879)

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Presentation title: Interactions between active material, conductive nano-carbon and polymeric binder in lithium-ion battery cathode laminate

Within lithium ion cells, electrode laminate is a composite of active material, conductive Nano-carbon additive(s) and polymeric binder. Each component plays a unique role and the role of anyone element is influenced or even refrained by the others. Therefore, the interactions between the different electrode components are critical determining the physical and electrochemical properties of the electrode. In this study, the physical and electrochemical properties of a $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$ *cathode were investigated as a function of the contents of the electrode elements. The results illustrate that interactions between the electrode elements significantly influence the physical and electrochemical properties of the cathode. The electrode porosity, electronic conductivity and ionic conductivity of the cathode laminate were found associated with the level of polyvinylidene difluoride (PVDF) binder and acetylene black (AB) within the electrode. The effects of the inactive material content on the electrode rate performance depend on the PVDF/AB ratio. At PVDF/AB ratio of 5:4, the rate performance is enhanced with increasing inactive material content, whereas at PVDF/AB ratio of 5:1 and 5:2, the rate performance is improved with decreasing AB/PVDF loading. At the PVDF/AB ratio of 5:3, the rate performance is not considerably affected by the content of the inactive materials. The results were explained by the competition between the ion-blocking effect of PVDF and the electronic conducting effect of the nano-carbon material.*

Honghe Zheng finished his Ph.D studies in Materials Science and Engineering at Hunan University in 2001. After working at Henan Normal University for 3 years, Zheng was sent to Japan supported by China Scholarship council. He worked under the supervision of Prof. Zempachi Ogumi at Kyoto University. In 2006, Zheng was invited to work under the supervision of Prof. John Newman and Dr. Vince Battaglia at Lawrence Berkeley National Laboratory as a guest scientist. He was transferred to be a career Scientist in 2009 based on his excellent performance in the lab. He got the Best Poster Award in IMLB Meeting, Tianjin (2008). One of his papers published in Carbon journal was Nominated for the top 25 Paper. In 2010, Zheng quitted his job at LBNL and joined School o f Energy, Soochow University. He is now the dean of School of Energy and the director of the Low Carbon Economy Institute of Suzhou.

Relevant publications:

1. Honghe Zheng,et al. Film-Forming Properties of Propylene Carbonate in the Presence of a Quaternary Ammonium Ionic Liquid on Graphite Anode. J. Phys. Chem.C 114: 6182–6189, 2010

2. Honghe Zheng et al. Cathode Performance as a Function of Inactive Material and Void Fractions. J. Electrochem. Soc. 157:1060-1066, 2010
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5. Honghe Zheng et al. Temperature Effects on the Electrochemical Behavior of Spinel $LiMn_2O_4$ in Quaternary Ammonium- Based Ionic Liquid Electrolyte, J. Phys. Chem. B 109:13676-13684, 2005

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Presentation title: Nanocable-Like Electrode Materials for Better Lithium-Ion Batteries

The demand for sustainable energy sources to power electrical devices has become a serious issue since traditional energy sources such as fossil fuel cannot satisfy the fast growing demands alone and the carbon emission associated with the use of them has caused great environmental concerns. Among all the electrochemical energy storage devices under research, lithium-ion battery (LIB) is proved to be among the most promising ones due to its inherent merits such as high energy density, low-cost, and environmental-friendliness. The exploitation of advanced electrode materials is essential to the application of LIB in electrical devices because only when the electrochemical performances (capacity, rate performance, cycling stability, etc.) of LIB meet all the demands of the devices can the application of LIB be possible. The development of nanotechnology has greatly advanced the frontier of LIB research. Recently, it was realized that the application of nanocable-like structure in the design of electrodes can significantly improve the properties of LIBs. Here we give an overview of the design, synthesis, and applications of such structures in LIBs and highlight some of the latest achievements in this area. To fulfill the potential of such structure, the clarification of these 'nanocable' materials and further intensive researches about them are highly desired. It is exciting that the future of LIBs is quite bright in view of the high specific capacity, much improved rate performance, as well as superior cycling stability brought by the nanocable-like electrode materials.

Prof. Yu-Guo Guo received his Ph.D. in Physical Chemistry from Institute of Chemistry, Chinese Academy of Sciences (ICCAS) in 2004. He worked at the Physical Chemistry Department of Prof. Joachim Maier, Max Planck Institute for Solid State Research at Stuttgart (Germany) first as a Guest Scientist (Postdoc) and then a Staff Scientist from 2004 to 2007. He joined ICCAS as a full professor in 2007.

Prof. Guo authored/co-authored more than 70 scientific papers in refereed journals (*Nat. Mater.*, *Adv. Mater.*, *Adv. Funct. Mater.*, *JACS*, *Angew. Chem.*, *Chem. Mater.*, *Chem. Commun.*, *J. Electrochem. Soc.*, etc.), 18 patents in the field of physical chemistry and electrochemistry of nanostructured materials. His major research field is materials chemistry, nanoelectrochemistry, and nanoionics. His current research is devoted to nanostructured materials for advanced energy conversion (e.g., CIS solar cells, fuel cells) and storage devices (e.g., Li(ion) batteries, supercapacitors), the size-dependent properties of these energy materials and ion/electron transport in nanoscaled systems.

Prof. Guo was honored with the “Chinese Society of Electrochemical Prize for Young Scientists” (2011), the “MIT Technology Review’s TR35 Award” (2011), the “Gold Medal of SCOPUS Seeking Future Star of Science Award” (2009), the “Chinese Chemical Society Prize for Young Scientists (2008)” and the “Distinguished Young Scholar of ICCAS” (2007). He received the award of the CAS Top 50 Ph.D. Dissertations (2005), and the National Excellent Doctoral Dissertation nominee (2006). He served as a referee for the international journals such as *JACS*, *Adv. Mater.*, *Chem. Mater.*, *Electrochem. Commun.*, *Solid State Ion.*, etc. He is a member of ISE, ISSI, and CCS, and serves as a committee member of the Chinese Society for Solid State Ionics.

Relevant publications:

1. F.-F. Cao, Y.-G. Guo* and L.-J. Wan*, Better lithium-ion batteries with nanocable-like electrode materials, ***Energy. Environ. Sci.***, **2011**, 4, 1634-1642. (*Invited Perspective, Back Cover*)
2. Jian-Jun Wang, Yong-Qing Wang, Fei-Fei Cao, Yu-Guo Guo* and Li-Jun Wan*, ynthesis of Monodispersed Wurtzite Structure $CuInSe_2$ Nanocrystals and Their Application in High Performance Organic-Inorganic Hybrid Photodetectors, ***J. Am. Chem. Soc.***, **2010**, 132, 12218-12221
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4. Yu-Guo Guo, Jin-Song Hu and Li-Jun Wan*, Nanostructured Materials for Electrochemical Energy Conversion and Storage Devices, ***Adv. Mater.***, **2008**, 20, 2878-2887. (*Invited Progress Report*)
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Notes