

PCCP Asian Symposia 2012

28 September 2012

Institute of Chemistry of Chinese Academy of Science (ICCAS), Beijing, China

1 October 2012

WPI - MANA, National Institute for Materials Science, Tsukuba, Japan

4 October 2012

Seoul National University, Korea



Welcome address

I would like to extend my warmest welcome to all speakers and attendees at the PCCP Asian Symposia.

These three international symposia – in Beijing, Tsukuba and Seoul - are an opportunity to showcase outstanding physical chemistry research, and underline the strong and vital links between PCCP and the research communities PCCP serves both in Asia and beyond.

PCCP goes from strength to strength, and is currently enjoying record levels of submissions. Since launch in 1999, PCCP has grown in both size and impact to become the premier journal spanning the broad physical chemistry research fields. A truly international journal, PCCP continues to enjoy very low publication times, offering rigorous yet fair peer review to researchers from all countries.

These symposia underline the broad diversity of research in PCCP, and the journal's strong connections with Asia. PCCP is a Society journal, co-owned by seventeen national Societies and published for the benefit of the scientific community. I am especially delighted to welcome the Korean Chemical Society (KCS) as the newest co-owner of PCCP.

My sincerest thanks naturally go to the local organisers, sponsors and co-sponsors, whose dedication, generosity and hard work has enabled the three symposia to come to fruition.

Of course, PCCP exists and thrives because of the support of authors, readers, referees, Editors, Board members and the wider physical chemistry research community. I am truly grateful for your support of PCCP and these symposia, and hope you enjoy participating.

With my best wishes,



Philip Earis
Managing Editor
PCCP

Welcome to PCCP-ICCAS Symposium

As one stop of the PCCP Asian symposia, ICCAS-PCCP symposium will open in Beijing on Friday, 28th of September. On behalf of the Institute of Chemistry, Chinese Academy of Sciences (ICCAS) and local organisers, I warmly welcome your participation! We are honoured that ten invited speakers will give their interesting talks and more poster presentations will show brilliant results in the symposium. A delicate schedule is ready for all participants to visit ICCAS, taste Chinese culture and enjoy Beijing's beautiful autumn scenery. ICCAS-PCCP symposium would be a wonderful chance for scientists working in PCCP or related fields to exchange recent academic information, meet old friends and make new friends. You must have a pleasant journey in Beijing of China.

Li-jun Wan

Director, *Institute of Chemistry The Chinese Academy of Sciences (ICCAS)*

Welcome to PCCP-MANA Symposium

What is PCCP? It is obvious. Everyone knows it. It is the best research journal for fields of Physical Chemistry and Chemical Physics published by the Royal Society of Chemistry (RSC)

What is MANA? I may have to explain it. Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) launched the World Premier International Research Center Initiative (WPI Program) to create several (currently six) frontier research centers in Japan. As one of them, MANA was established at the National Institute for Materials Science (NIMS). MANA is defined by the term MAterials NAnoarchitectonics. Nanoarchitectonics is a technology system aimed at arranging nanoscale structural units in an intended configuration that creates a novel functionality through mutual interactions among those nanoscale structural units.

As the results of fusions of PCCP and MANA, PCCP-MANA Symposium on Nanotechnology, Materials and Physical Chemistry will be held in Tsukuba in Japan that is the best science-focused city in Japan. Forefront research topics will be discussed with talks by internationally well-recognised scientists.

Katsuhiko Ariga

Principal Investigator, *MANA-NIMS*

Welcome to PCCP-KCS Symposium

Welcome to the PCCP-KCS Symposium on Interfaces in Physical Chemistry! This symposium marks the occasion of the Korean Chemical Society joining the Owner Society of PCCP in what is destined to help foster research activities and communications among the global leaders of science working in physical chemistry, chemical physics, and biophysical chemistry. These areas have become ever more important in themselves as well as in the recent advances in nanoscience and biotechnology. Korea is also a country where science and scientific publications are fast becoming among the top national interests. It is therefore timely and compelling that we get together here in Korea to witness what kinds of exciting advances are made at the interfaces of physical chemistry by top scientists of varied nationalities and subdisciplines. I hope everyone enjoys this one-day symposium as a festive celebration for the global partnership and mutual admiration of scientists.

Seong Keun Kim

Professor of Biophysics & Chemical Biology, Professor of Chemistry,
Seoul National University



PCCP-ICCAS Symposium: Frontiers of physical chemistry

28 September 2012

Time	Event	
9:30 am	Welcome introduction from Professor Lijun Wan, ICCAS Director	Welcome
9:35 am	Introduction from Philip Earis, PCCP Managing Editor	
9:50 am	<i>Katsuhiko Ariga, NIMS, Japan</i> Hand-operating nanotechnology: how to control molecular machines by our hands	Materials session
10:20 am	<i>Kai Wu, Peking University, China</i> From assembly control to reaction control at surfaces	
10:50 am	Break	
11:20 am	<i>Graham Hutchings, Cardiff University, UK</i> Catalysis by gold	Catalysis session
11:50 am	<i>Buxing Han, ICCAS, China</i> Thermodynamics of green solvents and their application in green chemistry	
12:20 pm	Lunch	
1:50 pm	<i>Eiichi Nakamura, University of Tokyo, Japan</i> How much do we know about nucleation and crystal growth?	University of Tokyo special session
2:30 pm	<i>Hiroshi Nishihara, University of Tokyo, Japan</i> Coordination programming of electro-functional molecular wires and networks	
3:10 pm	Break	
3:45 pm	<i>David Nesbitt, JILA and University of Colorado, USA</i> RNA folding to nanoparticle microscopy: the beauty of one at a time	Nanostructures session
4:15 pm	<i>Minghua Liu, ICCAS, China</i> Supramolecular chirality in the self-assembled system: origin, transfer and functionalisation	
4:45 pm	<i>Marie-Paule Pileni, University Pierre & Marie Curie, France</i> Analogy between mother nature and ordering of atoms in a nanocrystal or of nanocrystals in a supracrystal	
5:20 pm	Closing remarks	



PCCP-MANA Symposium on Nanotechnology, Materials and Physical Chemistry

1 October 2012

Time	Event	
9:40 am	Welcome address from Masakazu Aono, MANA	Welcome
9:50 am	Introduction from Philip Earis, PCCP Managing Editor	
10:00 am	Kazuhiko Maeda, <i>PCCP Prize Winner, Tokyo Institute of Technology, Japan</i> Solar water splitting by modified oxynitride photocatalysts	Session 1 Chair: Principal Investigator Katsuhiko Ariga MANA
10:30 am	Graham Hutchings, <i>Cardiff University, UK</i> Catalysis by gold	
11:00 am	Break	
11:20 am	Jinhua Ye, <i>MANA, Japan</i> Nanoarchitectonics of novel photocatalytic materials	Session 2 Chair: Dr. Jonasan Hill MANA
11:50 am	Takayoshi Sasaki, <i>MANA, Japan</i> Design of functional nanofilms via self-assembly of inorganic nanosheets as a building block	
12:20 pm	Lunch	
1:45 pm	Marie-Paule Pileni, <i>University Pierre & Marie Curie, France</i> Nanocrystallinity and supracrystallinity: a real challenge	Session 3 Chair: Dr. Mitsuhiro Ebara MANA
2:15 pm	Mitsutoshi Masuda, <i>AIST, Japan</i> Organic nanotubes: novel nanocapsules for nanobiomaterials	
2:45 pm	Break	
3:05 pm	David Nesbitt, <i>JILA and University of Colorado, USA</i> RNA folding to nanoparticle microscopy: the beauty of one at a time	Session 4 Chair: Dr. Jun Nakanishi MANA
3:35 pm	Yukio Nagasaki, <i>WPI-MANA and Univ. of Tsukuba, Japan</i> Redox polymer nanoarchitectonics in vivo -novel oral polymer therapeutics-	
4:05 pm	Closing remarks	



PCCP-KCS Symposium on Interfaces in Physical Chemistry

4 October 2012

Time	Event	
9:40 am	Welcome from host	Welcome
9:50 am	Introduction from Philip Earis, PCCP Managing Editor	
10:00 am	Katsuhiko Ariga, <i>NIMS, Japan</i> Hand-operating nanotechnology: how to control molecular machines by our hands	Session 1 Chair: Professor Seonghoon Lee, SNU
10:40 am	Dongho Kim, <i>Yonsei University, Korea</i> Excited-state dynamics of various molecular assemblies probed by ensemble and single molecule spectroscopy	
11:20 am	Photo session and break	
11:40 am	Graham Hutchings, <i>Cardiff University, UK</i> Catalysis by gold	Session 2 Chair: Professor Taek Dong Chung, SNU
12:20 pm	Sang Bok Lee, <i>University of Maryland, USA</i> Fast electrochemistry of nanostructures: from electrochromics to high-to-ultrahigh power energy storage	
1:00 pm	Lunch	
2:30 pm	Marie-Paule Pileni, <i>University Pierre & Marie Curie, France</i> Analogy between mother nature and ordering of atoms in a nanocrystal or of nanocrystals in a supracrystal	Session 3 Chair: Professor Chaok Seok, SNU
3:10 pm	Byung Hee Hong, <i>Seoul National University, Korea</i> Synthesis of large-area graphene for display and energy applications	
3:50 pm	Congratulatory remarks by KCS President Professor Duckhwan Lee (Sogang University)	
3:55 pm	Cake-cutting ceremony	
4:10 pm	Break	
4:30pm	David Nesbitt, <i>JILA and University of Colorado, USA</i> From RNA folding to nanoparticle microscopy: the beauty of one at a time	Session 4 Chair: Professor Seokmin Shin, SNU
5:10 pm	Zee Hwan Kim, <i>Korea University, Korea</i> Plasmonics for single-molecule photochemistry and optical nanoscopy	
5:50 pm	Closing remarks	

Speaker biographies

**Katsuhiko Ariga**

National Institute for Materials Science

Dr Katsuhiko Ariga is the Director of Supermolecules Unit and Principal Investigator of World Premier International (WPI) Research Center for Materials Nanoarchitectonics (MANA), the National Institute for Materials Science (NIMS). He was born in 1962, and received his B.Eng., M.Eng., and PhD degrees from the Tokyo Institute of Technology (TIT). He was Assistant Professor at TIT, worked as a postdoctoral fellow at the University of Texas at Austin, USA, and then served as a group leader in the Supermolecules Project at Japan Science and Technology Agency (JST). Thereafter, Dr Ariga worked as Associate Professor at the Nara Institute of Science and Technology, and then became involved with the ERATO Nanospace Project at JST. In January 2004, Dr Ariga moved to NIMS. He was also appointed Professor at several Universities. His research field is based on supermolecular chemistry and surface science, including the boundary research areas of organic chemistry, physical chemistry, biochemistry, and materials chemistry. His major interests are the fabrication of novel functional nanostructures based on molecular recognition and self-assembly, including Langmuir-Blodgett films, layer-by-layer films, and mesoporous materials. Dr Ariga has published ca. 400 scientific papers and their citation exceeds 13000 times (August, 2012).

**Sang Bok Lee**

University of Maryland

Sang Bok Lee is an Associate Professor at the Department of Chemistry and Biochemistry and the Deputy Director of the DOE-Energy Frontier Research Center, University of Maryland (UMD), College Park, MD, USA. He holds also a WCU Professorship at the School of Nanoscience and Technology, KAIST (Korea Advanced Institute of Science and Technology) running his lab at the interfaces of nano/energy/bio. He received his B.S., M.S., and PhD (1997) in Chemistry from Seoul National University, Korea. He then worked at LG Semicon (now Hynix), for two years as senior research engineer and held a research associate position at the University of Florida (Gainesville, FL), before joining UMD in 2002. His research focuses on the fundamentals of synthesis and control of heterogeneous nanostructures and fast electrochemistry of nanomaterials for the applications from electronics to high power energy storage to nanomedicine such as ultrafast electrochromic displays, supercapacitors biosensors, drug

**Buxing Han**

Institute of Chemistry, Chinese Academy of Sciences

Buxing Han was born in 1957. He is the professor of Institute of Chemistry, Chinese Academy of Sciences, Fellow of Royal Society of Chemistry. Currently, he is the Chairman of IUPAC Sub-Committee on Green Chemistry; Chairman of Chemical Thermodynamics and Thermal Analysis Committee, Chinese Chemical Society.

His current research interests include thermodynamic properties of green solvents (e.g. supercritical fluids, ionic liquids, water) systems and applications of green solvents in green chemistry. He has published more than 400 papers (Including those in *Science*, *Angew. Chem. Int. Ed.*, *J. Am. Chem. Soc.*) and more than 30 patents, and has presented more than 70 invited lectures at international conferences.

**Byung Hee Hong**

Seoul National University

Byung Hee Hong received B.S. (1998), M.S. (2000) and PhD (2002) degrees in chemistry from POSTECH. After spending 3.5 years as a post-doc at Columbia University (Advisor: Philip Kim), he joined the Department of Chemistry, Sungkyunkwan University as an assistant professor in 2007. Now he is an associate professor in the Department of Chemistry at Seoul National University. Professor Hong developed a method of synthesizing large-scale graphene by chemical vapor deposition (CVD), which triggered chemical researches toward the practical applications of graphene. His first report on CVD synthesis of graphene (*Nature* **457**, 706 (2009)) has recorded the world No. 1 citations in chemistry (>1,700) among the papers published since 2009. Professor Hong was invited by Nobel Committee to give a presentation in Nobel Symposium on Graphene, five months prior to the announcement of the Nobel Physics Prize on graphene in 2010. The press release by Royal Swedish Academy has cited Professor Hong's paper as one of the major research achievements contributed to the prize. He received POSCO TJ Park Science Fellowship (2009), SKKU Young Fellowship (2010), Yumin Award of Science (2010), Kyung-Ahm Prize of Natural Sciences (2011), and Excellent Researcher Award in Materials Chemistry (Korean Chemical Society, 2012).

**Graham J Hutchings***Cardiff University*

Professor G J Hutchings FRS has specialised in the synthesis of heterogeneous catalysts throughout the 33 years since his PhD. His early career was with ICI Petrochemicals (1975-81) and AECI Ltd (1981-84). Since 1984 he has worked in academic research holding professorial positions in the Universities of Witwatersrand, Liverpool and Cardiff. His work has focused on catalyst discovery and catalyst preparation publishing >500 papers and 30 patents on topics of heterogeneous catalysis, including 6 papers in *Nature* and *Science* since 2005. He was elected a Fellow of the Royal Society in 2009, a member of Academia Europaea in 2010 and a Founding Fellow of the Learned Society of Wales in 2010. Recent awards include the Francois Gault Lectureship of EFCATS 2005, the IPMI Henry J. Albert Award 2011, the France Great Britain Chemistry Prize 2011, the Dechema Alvin Mittasch Award 2012 and the International Association of Catalysis Societies Heinz Heinemann Award 2012

He is currently the Director of the Cardiff Catalysis Institute and is President of the RSC Faraday Division.

**Zee Hwan Kim***Korea University*

Zee Hwan Kim is an associate professor of Department of Chemistry at Korea University. His PhD thesis research was performed with Richard N Zare at Stanford University in the area of chemical reaction dynamics. As a postdoctoral associate at U. C. Berkeley in 2002-2004, he studied high-resolution near-field microscopy and chemical imaging techniques. His research group at Korea University currently focuses on nano-plasmonics, single molecule spectroscopy, and near-field microscopy.

**Dongho Kim***Yonsei University*

Dongho Kim received his BS (1980) from Seoul National University and PhD (1984) from Washington University. After postdoctoral research at Princeton University, he joined the Korea Research Institute of Standards and Science (1986). In 2000, he moved to Yonsei University as a Professor of Chemistry. He received the Scientist of the Month Award (1999), the Sigma-Aldrich Award (2005), the Korea Science Award in Chemistry (2006) and the Star Faculty Award (2006), and was selected as the Underwood Professor at Yonsei University (2007). He was a recipient of the national research initiatives program (1997-2006) named as "Center for Ultrafast Optical Characteristics Control". Since 2008, he has been leading the Center for Smart Nano-Conjugates through the World Class University Program. His research activity has been focused on the spectroscopic investigations of various pi-conjugated molecular systems such as porphyrin, pyrene, perylenebisimide, thiophene, and their assemblies with a particular interest in excitation energy and electron transfer dynamics both in ensemble and at single-molecule level. He has coauthored more than 370 peer-reviewed articles and about 15 reviews in journals and book publication. He has served as an editorial board member for *Bull. Kor. Chem. Soc., J. Por. & Phthc. and J. Phys. Chem.*

**Minghua Liu***Institute of Chemistry, Chinese Academy of Sciences*

Professor Minghua Liu received his PhD (1994) in Material Science in Saitama University with Professor K Fukuda. He then joined the Institute of physical and chemical research (RIKEN) as a special postdoctoral researcher in RIKEN. He joined the Institute of photographic chemistry, Chinese Academy of Sciences in 1998 and then joined the Institute of Chemistry in 1999, CAS. He served as the international advisory board of *Soft Matter*, and is now the advisory member of *Langmuir*. His research interests covers the colloid and interface, self-assembly and supramolecular chemistry including the Langmuir-Blodgett films, supramolecular gel-based soft materials; supramolecular chirality and chiral functional materials.

**Kazuhiko Maeda***Tokyo Institute of Technology*

Kazuhiko Maeda received his B.Sc. from the Tokyo University of Science (2003), his MSc. from the Tokyo Institute of Technology (2005), and his PhD from The University of Tokyo (2007) under the supervision of Professor Kazunari Domen. From 2008 to 2009, he was a postdoctoral fellow at Pennsylvania State University where he worked with Professor Thomas E. Mallouk. He got back to The University of Tokyo in 2009 as an Assistant Professor. In 2012, he moved to Tokyo Institute of Technology, and promoted to an Associate Professor. Currently, he is also a research fellow of the PRESTO/JST program (Chemical Conversion of Light Energy). His research interests are photocatalytic and photoelectrochemical water splitting using semiconductor particles of (oxy)nitrides, inorganic metal oxide nanosheets, and polymeric carbon nitride, combining nanotechnology and materials chemistry.

**Mitsutoshi Masuda***National Institute of Advanced Industrial Science and Technology*

Mitsutoshi Masuda received his PhD in organic chemistry from Tokyo University of Agriculture and Technology, Japan in 2000. He joined the Research Institute of Polymers and Textiles (a part of research institutes belongs to Ministry of International Trade and Industry) in 1992, then the National Institute of Materials and Chemical Research in 1993, where he worked on the supramolecular self-assembly of bolaamphiphilic glycolipids. After a period of postdoctoral work with Professor EW Bert at Eindhoven University of Technology (The Netherlands) in 2001 on the polymerisation of columnar assemblies, Dr Masuda took a position at the Nano Architectonics Research Center. Since 2008, he has been the group leader of the organic nanotube materials team at the Nanotube Research Center (NTRC). His research focuses on the self-assembly of amphiphilic molecules and their nano-bio applications.

**Yukio Nagasaki***National Institute for Materials Science and University of Tsukuba*

Yukio Nagasaki was born in 1959. He received a B.S. and PhD degrees in Engineering School of Science University of Tokyo in 1982, and 1987. Since 1987, He was working Science University of Tokyo as Research Associate, Assistant Professor, Associate Professor and Professor. In 2004, he moved Graduate School of Pure and Applied Sciences, University of Tsukuba. He hold a concurrent posts of Adjunct Professor, Master's School of Medical Sciences, Graduate School of Comprehensive Human Sciences, University of Tsukuba, Principal Investigator, International Center for Materials Nanoarchitectonics Satellite (WPI-MANA), National Institute for Materials Science (NIMS) and Principal Investigator, Strategic Initiatives (Project type), University of Tsukuba. During last 30 years, he was engaged in materials science especially in the field of biology, pharmaceuticals and medical science. Especially, he was focusing on biointerface, drug delivery system and nanomedicine. He published more than 200 scientific papers. He received the excellent PhD thesis award from Inoue Foundation of Science in 1989, Young Researcher Award from Polymer Society, Japan in 1993 and SPSJ Mitsubishi Chemical Award from Polymer Society, Japan in 2010.

**Eiichi Nakamura***University of Tokyo*

Eiichi Nakamura received his PhD in Chemistry at Tokyo Tech, and is Professor of Chemistry at the University of Tokyo since 1995. He is currently serving as Visiting Professor at Institute of Chemistry, Chinese Academy of Sciences. His honors include Humboldt Research Award (2006), Honorary Foreign Member of the American Academy of Arts and Sciences (2008), The Medal with Purple Ribbon, His Majesty of Japan (2009), and ACS A. C. Cope Scholar Award (2010). Research field: synthesis and physical organic chemistry, nano-science.

**David Nesbitt***University of Colorado at Boulder*

Nesbitt obtained his BA in physics and chemistry at Harvard University. He then taught secondary school science and math for two years at Colorado Academy in Denver, before beginning a PhD at the University of Colorado, Boulder. His thesis work was divided between the theory of liquid phase reaction dynamics and experimental laser initiated photochemical kinetics, for which he was presented the Nobel Laureate Signature Award by the American Chemical Society. Nesbitt was awarded a Miller Fellowship for Basic Research at the University of California, Berkeley where he developed methods for high sensitivity tunable IR detection of ions and radicals. Nesbitt is presently Full Professor Adjoint in the Department of Chemistry and Biochemistry at the University of Colorado, a Fellow of JILA (formerly the Joint Institute for Laboratory Astrophysics), and a Staff Physicist in the Quantum Physics Division, National Institute of Standards and Technology. His experimental research at JILA has involved application of direct absorption IR laser techniques to study i) spectroscopy of weakly bound complexes, ii) transient radicals and molecular ions in slit supersonic jet expansions, iii) state-to-state reactive/energy transfer dynamics in crossed beams, iv) quantum state-resolved inelastic/reactive scattering at gas-liquid interfaces, and v) single molecule fluorescence microscopy/kinetics of quantum dots, nanoparticles and RNA biopolymers.

**Hiroshi Nishihara***University of Tokyo*

Hiroshi Nishihara received his B. Sc. degree in 1977, M. Sc. in 1979 and D. Sc. in 1982 from The University of Tokyo. He was appointed research associate of Department of Chemistry, Faculty of Science and Technology at Keio University in 1982, and he was promoted lecturer in 1990, and associate professor in 1992. Since 1996, he has been a professor of Department of Chemistry, School of Science at The University of Tokyo. He also worked as a visiting research associate of Department of Chemistry at The University of North Carolina at Chapel Hill (1987-1989), and as a researcher of PRESTO, JRDC (1992-1996). His research has been focused on creation of new electro- and photo-functional materials comprising both transition metals and π -conjugated chains, and invention of unidirectional electron transfer systems utilizing molecular layer interfaces. He received Young Scholar's Lectureship, The Chemical Society of Japan in 1994 and The Chemical Society of Japan Award for Creative Work in 2003. He has received Professorship of University of Bordeaux I in 2005 and that of University of Strasbourg in 2009, Docteur Honoris Causa from University of Bordeaux I in 2011, and Distinguished Lectureship of Hong Kong Baptist University in 2012.

**Marie-Paule Pileni***University Pierre & Marie Curie*

M P Pileni is a Distinguished Professor at University P&M Curie, UPMC, Adjunct Professor of chemistry and biochemistry at Georgia Tech, Atlanta, USA. She is a member (1999–present) and chair (2004–2010) of Institut Universitaire de France. She has published around 400 articles with 15,690 citations, and has an h factor of 65.

Professor Pileni's research has been highly interdisciplinary throughout her career. Her major breakthroughs are: (i) A fundamental understanding of the kinetics and mechanisms in colloidal solutions guided me in the preparation of either nanocrystals with different sizes and shapes or the chemical modification of enzymes. (ii) Formation of thermodynamically stable states of self-assemblies either by using surfactant molecules (supraaggregates) or inorganic nanocrystals (supracrystals). (iii) Collective optical and magnetic properties induced by dipolar interactions and due to the nanocrystal arrangements in 1D, 2D and 3D superlattices. (iv) Physical intrinsic properties such as vibrational, magnetic and crystal growth related to the nanocrystals ordering in supracrystals (3D). (v) Chemical intrinsic properties due to nanocrystals ordering.

She received the Langmuir award of the American Chemical Society, the lecture award of the Japanese Chemical Society, the Research Award of the Alexander von Humboldt Foundation, the Descartes-Huygens Prize of the Royal Netherlands Academy of Arts, Science and Emila Valori from the French Academy of Sciences and Catalán-Sabatier Lectureship award from the Royal Society of Chemistry of Spain (RSEQ).

She is an officier in both «l'Ordre National de la Légion d'Honneur and Mérite ».

**Takayoshi Sasaki***National Institute for Materials Science*

Takayoshi Sasaki is a Principal Investigator and a Field Coordinator of Nanomaterials field of MANA in NIMS. He is also a Professor of Graduate School of Pure and Applied Sciences, University of Tsukuba (Collateral office). He received his PhD in Chemistry from the University of Tokyo in 1985. Since 1980, he has worked for the National Institute for Research in Inorganic Materials (NIRIM, now NIMS). In 2009, he was appointed as a NIMS fellow. His recent interest has focused on 2D nanosheets obtained by delaminating layered materials. He has published over 300 original papers and about 80 review articles and book chapters.

**Kai Wu***Peking University*

Kai Wu got his B.S. degree in chemistry from Zhejiang University in 1987 and PhD degree in physical chemistry from Dalian Institute of Chemical Physics (DICP), Chinese Academy of Sciences, in 1991. He then worked at the State Key Laboratory of Catalysis in DICP as an assistant/associate researcher. He was a postdoctoral fellow at Fritz-Haber-Institut der Max-Planck-Gesellschaft in Germany and at Pacific Northwest National Laboratory in USA during 1995-2000. In the end of 2000, he joined Peking University in China where he is currently a Cheung Kong professor in physical chemistry and Dean of College of Chemistry and Molecular Engineering. He serves as an associate editor and editorial or advisory board member for several journals including *Advanced Functional Materials*, deputy secretary-in-general or committee director/members in Chinese Chemical Society and Chinese Physical Society. He has been working in surface and materials science, focusing on controlled preparations of surface structures, surface properties of nanocrystals, activation of molecules at surfaces, surface assemblies and assembly-mediated reactions, and spin-related phenomena. He has co-authored more than 70 publications, owned 4 China patents, co-edited 4 special issues with international and national prestigious journals, and given more than 50 invited talks at various conferences.

**Jinhua Ye***National Institute for Materials Science*

Jinhua Ye received her BSc from Zhejiang University in 1983, and her PhD from the University of Tokyo in 1990. After that, she joined Osaka University as a faculty staff for a year and a half, and then moved to National Research Institute for Metals (former NIMS) from 1991. She is currently the director of the Environmental Remediation Materials Unit, and a Principle Investigator of International Center for Materials Nanoarchitectonics (WPI-MANA), NIMS. She is also an adjunct Professor of Hokkaido University, Japan, and Tianjin University, China. Her current research interests focus on the research and development of photo functional materials and their applications in the fields of environment remediation and new energy production. She has contributed more than 300 high quality journal publications (including top ranking journals such as *Nature*, *Nature Mater.*, *Angew Chem.*, *Adv. Mater.*, *J. Am Chem. Soc.*, *Phys. Rev. Lett.*, etc), which have been cited over 6800 times, and a large number of patents and invited presentations. She has been serving as the Associate Editor of *Science and Technology of Advanced Materials* (STAM) since 2008, and International Organizing Committee (IOC) Member of *International Conference on Photochemical Conversion and Storage of Solar Energy* (IPS) from 2010-2016.

Abstracts

Hand-operating nanotechnology: how to control molecular machines by our hands

Katsuhiko Ariga

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Functional materials have been wisely constructed via bottom-up approaches as seen in preparation of molecular and nano patterns and complexes,¹⁻⁵ organised nanostructures,⁶⁻¹² and function materials.¹³⁻¹⁶ However, novel concepts to bridge nano (molecular) structures and bulk systems now becomes crucial in order to control real nano and molecular functions from our visible macroscopic worlds. Here we propose a novel methodology "hand-operating nanotechnology" where molecular orientation, organisation and even functions in nanometer-scale can be operated by our macroscopic (hand) operation. As shown in the following figure, this concept can be realised at dynamic two-dimensional medium, the air-water interface because this medium possess both features of bulk and molecular dimension. For example, we successfully manipulated molecules at the air-water interface upon bulk (10-100 cm size) motion of the entire monolayer and realised "capture and release" of aqueous guest molecules using molecular machine, steroid cyclophane.^{17,18} In addition, mechanically controlled chiral recognition of amino acid^{19,20} and discrimination of nucleosides²¹ by the supramolecular monolayer was successfully demonstrated. The concept has been also applied to indicator-displacement assay for sensor usage.²²

References

- 1 *J. Am. Chem. Soc.*, **2008**, *130*, 4594-4595.
- 2 *J. Am. Chem. Soc.*, **2009**, *131*, 9494-9495.
- 3 *J. Am. Chem. Soc.*, **2009**, *131*, 11282-11283.
- 4 *J. Am. Chem. Soc.*, **2009**, *131*, 16138-16146.
- 5 *J. Am. Chem. Soc.*, **2010**, *132*, 1212-1213.
- 6 *J. Am. Chem. Soc.*, **2008**, *130*, 2376-2377.
- 7 *Angew. Chem. Int. Ed.*, **2008**, *47*, 7254-7257.
- 8 *J. Am. Chem. Soc.*, **2009**, *131*, 4220-4221.
- 9 *J. Am. Chem. Soc.*, **2009**, *131*, 6372-6373.
- 10 *J. Am. Chem. Soc.*, **2009**, *131*, 18030-18031.
- 11 *Angew. Chem. Int. Ed.*, **2010**, *49*, 9737-9739.
- 12 *J. Am. Chem. Soc.*, **2011**, *133*, 7348-7351.
- 13 *Angew. Chem. Int. Ed.*, **2009**, *48*, 7358-7361.
- 14 *Angew. Chem. Int. Ed.*, **2010**, *49*, 5961-5965.
- 15 *J. Am. Chem. Soc.*, **2010**, *132*, 14415-14417.
- 16 *Angew. Chem. Int. Ed.*, **2010**, *49*, 9737-9739.
- 17 *J. Am. Chem. Soc.*, **2000**, *122*, 7835-7836.
- 18 *Langmuir* **2005**, *21*, 976-981.
- 19 *J. Am. Chem. Soc.*, **2006**, *128*, 14478-14479.
- 20 *Phys. Chem. Chem. Phys.*, **2011**, *13*, 4895-4900.
- 21 *J. Am. Chem. Soc.*, **2010**, *132*, 12868-12870.
- 22 *Angew. Chem. Int. Ed.* in press.

Fast electrochemistry of nanostructures: from electrochromics to high-to-ultrahigh power energy storage

Sang Bok Lee

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Fast electrochemistry of nanostructured materials offers vast gains in electrochemical reaction speed by increasing surface area and reducing path lengths for electron and ion transport. The fast electrochromics will be briefly discussed and demonstrated as a proof of the fast redox reaction. The fast redox reaction is applied to high power energy storage device such as supercapacitor and high-power battery.

Heterogenous nanostructured materials separate the multiple functionalities (large energy storage, rapid ion transport, high electrical conductivity, high mechanical stability) to different materials, realizing a combined material structure with much higher synergistic performance. Both the electrochemical and electrostatic supercapacitors will be discussed as high-to-ultrahigh power energy devices, a newly emerging research area in energy storage research field, especially for power leveling, management, safety, stability, and longevity of battery packs in energy grid system. The electrochemical growth and atomic layer deposition of the heterogeneous composite nanotubes and nanowires will be mainly described with combination of well-controlled porous films.

Thermodynamic properties of green solvent systems and their applications in green chemistry

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Scientists and engineers have paid much attention to clean or environmentally more acceptable solvents, such as supercritical fluid (SCF) and ionic liquid (IL). In recent years, we carried out a series of researches on the chemical thermodynamics of green solvents systems and their applications in chemical reactions, including mainly: 1) phase behavior and intermolecular molecular interaction in complex SCF, IL, and SCF/IL systems; 2) the effect of phase behavior and intermolecular interaction on the properties of chemical reactions in SCF, IL, and SCF/IL; 3) the phase behavior of surfactant systems and creation of the greener microemulsions related with SCF and IL. In this symposium, we will discuss some related work.

Keywords

Phase behavior, intermolecular interaction, green solvents, green chemistry.

Synthesis of large-area graphene for display and energy applications

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Graphene has been attracting tremendous attention owing to its fascinating physical properties including quantum electronic transport phenomena, ultrahigh mobility, superb elasticity, thermal conductivity and mechanical strength. There have been many efforts to utilise these outstanding properties of graphene for macroscopic applications such as transparent conducting films particularly useful for display and energy applications. However, the scale and the quality graphene need to be further enhanced for practical applications by developing more efficient synthesis, transfer and doping methods. In this talk, the recent advances in graphene synthesis and its applications to various display, energy generation, and storage devices will be reviewed, and the future directions of flexible electronics based on graphene will be discussed.

References

- 1 S Bae et al. *Nature Nanotech.* **5**, 574 (2010).
- 2 KS Kim et al. *Nature* **457**, 706 (2009).

Catalysis by gold

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A key discovery in the last two decades has been the identification that gold, when prepared as supported nanoparticles, is exceptionally effective as a redox catalyst. To some extent this observation is counter intuitive since extended gold surfaces do not chemisorb oxygen, nor do they corrode. Gold catalysis has become a well established field of endeavour since the discovery that it is the catalyst of choice for low temperature oxidation of carbon monoxide and the hydrochlorination of acetylene. Much still remains to be discovered but to date a great deal of progress has been made. In this lecture recent preparation strategies to make supported nanoparticles will be described and discussed. These will involve the use of colloidal and impregnation methods. In addition to CO oxidation, three reactions will be discussed to bring out the key features of the catalysis:

- acetylene hydrochlorination¹. In this case gold is found to be the best catalysis for this reaction. Aspects of the reaction mechanism will be discussed.
- direct synthesis of hydrogen peroxide² and alcohol oxidation. Gold palladium alloys are found to be highly effective for this reaction as well as the oxidation of alcohols. Structure activity relationships will be discussed.
- activation of C-H bonds³. Gold palladium nanoparticles are found to be active catalysts for the selective oxidation of primary C-H bonds in hydrocarbon and key reactions by which selective oxidation is observed will be discussed.

References

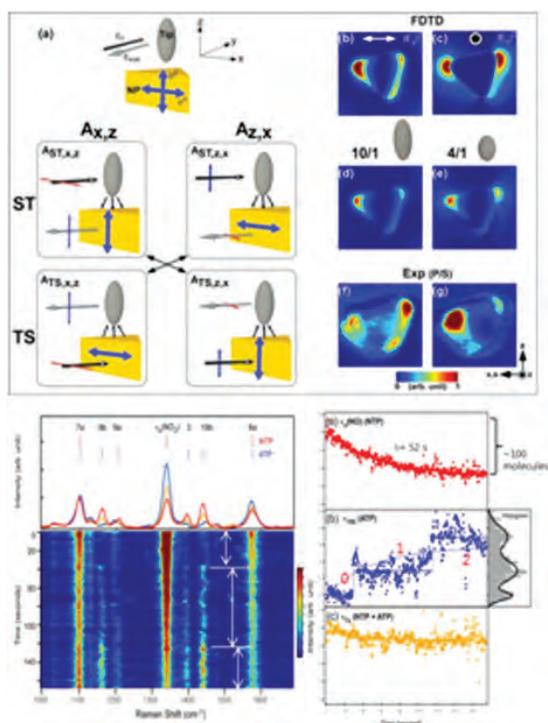
- 1 M Conte, AF Carley, G Attard, AA Herzing, CJ Kiely and GJ Hutchings, *J Catal.*, 257 (2008) 190-198.
- 2 JK Edwards, B Solsona, E Ntainjua N, AF Carley, AA Herzing, CJ Kiely and Graham J Hutchings *Science* 323 (2009) 1037-1041.
- 3 L Kesavan, R Tiruvalam, MH Ab Rahim, MI bin Saiman, DI Enache, RL Jenkins, N Dimitratos, JA.Lopez-Sanchez, SH Taylor, DW Knight, CJ Kiely and GJ Hutchings, *Science* 331 (2011) 195-199.

Plasmonics for single-molecule photochemistry and optical nanoscopy

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I will introduce my group's recent effort on nano-plasmonics and its application to single-molecule kinetics and optical nanoscopy. First, I will present near-field microscopy studies on isolated and dimerised gold nanocubes to directly investigate the strong coupling between two adjacent nanoparticles. The plasmon maps of nanoparticle dimers unambiguously prove that the strong Coulombic attraction between the charges at the interparticle gap dominates over the intra-particle charge oscillations, which is qualitatively different from those expected from dipole-dipole coupling. Secondly, I will demonstrate the use of well-defined gap-plasmons to locally drive a photochemical reaction, and follow the reaction kinetics of individual product molecules using the surface-enhanced Raman scattering (SERS). As a further application of nano-plasmonics, I will demonstrate the use of infrared near-field microscopy to identify two different stacking structures, the rhombohedral (ABC) and Bernal (ABA), of multilayer graphenes at 10 nm spatial resolution.



(top) Polarised tip-sample interaction in the *s*-SNOM of a nanoparticle;
 (bottom) The SERS intensity trajectories of reaction products of *p*-nitrobenzenethiolates.

Excited-state dynamics of various molecular assemblies probed by ensemble and single molecule spectroscopy

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Perylene bisimides (PBIs) are nowadays a prominent class of chromophores due to their outstanding optical and electronic properties that are easily tunable by the introduction of different substituents in the bay area, which makes them predestined not only for artificial light-harvesting systems, but also for a variety of other applications in organic devices such as field effect transistors, light emitting diodes, and biomedical sensors.

Herein, we will present excited-state dynamics of a series of acetylene-linked PBI macrocyles (**C n** : $n = 3, 4, 5,$ and 6), which constitutes the very first example to show a versatility of covalent-linkage in fabricating PBI arrays with cyclic structures. To explore excitation energy transfer (EET) process of **C n** , we have conducted femtosecond transient absorption (TA) and transient absorption anisotropy (TAA) measurements. The pump power-dependent TA decays and fast depolarisation kinetics in the TAA demonstrate that the EET dynamics of **C n** are well interpreted in terms of Förster-type energy hopping process and that there exists size dependency of the EET rates of **C n** .

Another set of PBI arrays that will be accounted for is directly-linked linear PBI (**L3**) and tri(phenyl) benzene-cored trefoil PBI (**T3**) trimers. Dynamic peak shift of single-molecule fluorescence spectra according to sequential photobleaching of PBI moieties reveal the strong interchromophoric interactions in both **L3** and **T3**, which result in coherent excited-state dynamics at the single-molecule level.

Furthermore, defocused wide-field imaging measurements of **T3** afford the determination of three-dimensional distribution of constituent PBI moieties. Statistical analysis reveals that, in the solid state, **T3** can be classified into two classes in terms of conformation and coherent/incoherent excited dynamics of **T3** single-molecule is dependent largely upon its conformation.

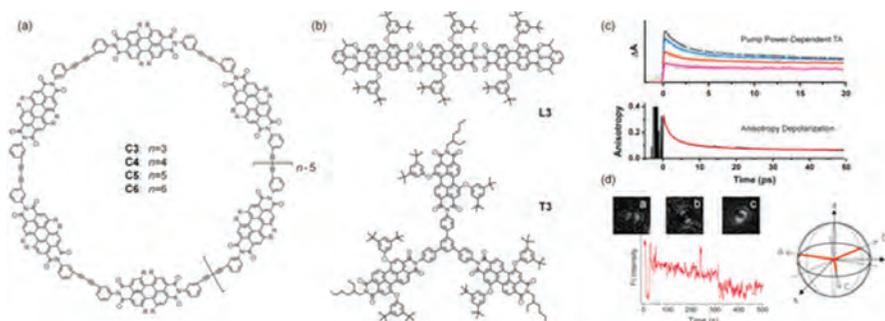


Figure 1. Structures (a) of **C n** and (b) of **L3** and **T3**. (c) Pump power-dependent TA decays (upper) and TAA decay (lower) of **C6**. (d) Single-molecule fluorescence intensity trajectory of **T3** and sequential defocused wide-field images corresponding to each intensity level (left) and schematic of three-dimensional distribution of three transition dipoles derived from the defocused images.

References

- 1 F Schlosser, V Stepanenko and F Würthner, *Chem. Commun.*, 2010, 8350.
- 2 F Schlosser, J Sung, V Stepanenko, P Kim, D Kim and F Würthner, *Chem. Sci.* in press, 2012.
- 3 H Yoo, M Vacha and D Kim, 2012, *submitted for publication*.
- 4 J Lee, IV Scheblykin, F Würthner and D Kim, 2012, *submitted for publication*.

Supramolecular chirality in the self-assembled system: origin, transfer and functionalisation

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Chirality is one of the most fascinating phenomena found in Nature and can be observed at various levels from molecular to supramolecular, microscopic and even in galaxy. Supramolecular chirality is strongly related to the molecular assembly that all kinds of molecules, either chiral or achiral, could be possibly assembled into chiral assemblies through coordination and/or non-covalent bond. In this talk we will focus on the recent results from our laboratory in two aspects. 1) the emergency and its origin of the supramolecular chirality in the organised supramolecular system composed exclusively of achiral molecules. We have systematically investigated the supramolecular chirality of molecular assemblies completely based on the achiral molecules and opened a new way to realise the supramolecular chirality through organisation at the air/water interface. We will discuss the origin of the such kind of supramolecular chirality. 2) transfer of the chirality from molecules through supramolecular to nanoscale chirality. We have designed a series of amphiphiles based on L- or D-glutamic acids and fabricated various organogels as well as hydrogels. In these gels, we have found that the chirality can be transferred to the functional groups attached to the L-glutamic acid, or the assemblies and nanostructures. With this transfer of the chirality, we have realised many functions of the gels such as the chiroptical switch, chiral recognition and asymmetric catalysis.

References

- 1 Yuan J, and M Liu, *J. Am. Chem. Soc.*, **2003**, *125*, 5051.
- 2 Huang X, C Li, et al. *J. Am. Chem. Soc.*, **2004**, *126*, 1322-1323.
- 3 Qiu Y, Chen P, Guo P, Li Y, Liu M, *Adv. Mater.*, **2008**, *20*, 2908-2913.
- 4 Yiqun Zhang, Penglei Chen, Lang Jiang, Wenping Hu and Minghua Liu, *J. Am. Chem. Soc.*, **2009**, *131*, 2756.
- 5 Zhang Y, P Chen, et al. *Chem. Eur. J.*, **2008**, *14*, 1793.
- 6 Cao H, P Duan, et al. *Chem. Eur. J.*, **2012**, *18*, 5546.
- 7 Jin Q, L Zhang, et al. *Chem. Eur. J.*, **2012**, *18*, 4916.
- 8 Zhu X, P Duan, et al. *Chem. Eur. J.*, **2011**, *17*, 3429.
- 9 Wang X, Duan P, and Liu MH, *Chem. Commun.*, **2012**, *48*, 7501.

Solar water splitting by modified oxynitride photocatalysts

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Water splitting to form hydrogen and oxygen over a heterogeneous photocatalyst using solar energy is a promising means of producing hydrogen. Numerous attempts have been made to develop photocatalysts that function under visible light to efficiently utilise solar energy. In general, water splitting over a photocatalyst particle can be achieved by modifying the photocatalyst with a suitable cocatalyst to provide an active redox site. Therefore, the development of active photocatalytic materials has relied on both photocatalysts and cocatalysts. In this presentation, recent progress on the development of oxynitride type photocatalysts will be given, with a focus on how the photocatalysts should be activated toward efficient solar energy conversion.

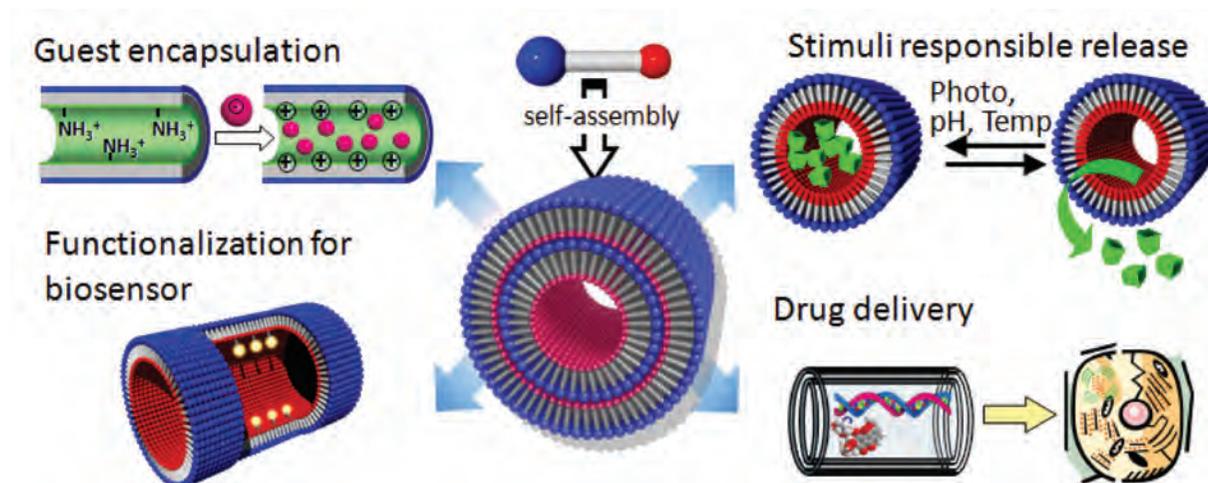
Organic nanotubes: novel nanocapsules for nanobiomaterials

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Organic nanotubes (ONTs) are tubular nanostructures self-assembled from small organic molecules or from macromolecules.¹ Their hollow cylindrical nanospaces are able to capture and release various nanoscale guests such as molecules, proteins, and DNA. In addition, their solid membrane surfaces consisted of natural components, such as sugar and aminoacids should show superior biocompatibility. All these aspects of the ONTs seem to be ideal for nanobioapplication including biosensors and nanocapsules for drug delivery systems, although many issues still remain to be solved: (1) precise dimensional controls of tube diameters and length, (2) efficient guest encapsulation, (3) rational surface functionalisation, and (4) controlled guest release.



Our group has been developing a series of ONTs having distinctive inner/outer surfaces and various diameters for effective and selective encapsulation of small molecules, DNA, and proteins. Several functionalisation methods enabled selective localisation of functional groups only on inner surfaces of ONTs. In this presentation, I will show varieties of ONTs, their unique properties, and functions: efficient encapsulation and stabilisation of guest molecules, properties of their hollow cylinder, and photo responsible or sustainable release of guests.

Reference

- 1 M Masuda et al., *Soft Matter* 7 (2011) 4539.

Redox polymer nanoarchitectonics in vivo -novel oral polymer therapeutics-

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Reactive oxygen species (ROS) are known to play versatile roles on the occasion of many important events *in vivo*. However, excessive production of ROS causes significant adverse effect to living body. Numerous scavengers can be applied to reduce ROS *in vivo*. However, low molecular weight antioxidant can spread non-specifically *in vivo*. Because the living body obtains energy via the mitochondrial electron transport system, an antioxidative drug must not suppress this regular system. In order to improve selective anti-oxidant character *in vivo*, we have designed redox polymer drugs, which possess self-assembling character in aqueous media. The synthesised amphiphilic block copolymer, possessing nitroxide radicals as a side chain of the hydrophilic segment, which spontaneously forms core-shell type self-assembled nanoparticle in aqueous media. The nitroxide radicals installed as a side chain of hydrophobic segment in the block copolymer were compartmentalised in a solid core of the nanoparticle, and named nitroxide radical-containing-nanoparticle (RNP).¹ Because the nanoparticle distribution *in vivo* varies with the size of the nanoparticles, it is believed that they do not suppress the normal oxidation reaction in mitochondria. This may be one of the reasons for the extremely low toxicity of RNPs *in vivo*. Though it is clear that one of the reasons is the compartmentalisation of the redox center (nitroxide radicals) in the core of the nanoparticle, the controlled biodistribution of the RNPs might play an important role. RNP has pH-sensitive disintegration character, thus it disintegrates tumor and inflamed sites because of decrease in pH in this area, which can be utilised as pH-responsive bioimaging and therapy. We have so far employed this particle for cerebral, renal and cardiovascular ischemia-reperfusion, cerebral hemorrhage, cancer-chemotherapy and gene delivery system and confirmed that it is promising as novel redox-polymer therapeutics. In this talk, oral redox polymer therapeutics for intestinal diseases and Alzheimer's diseases will be presented.

Reference

- 1 T Yoshitomi, et al., *Biomacromolecules*, 10(3) 596 (2009), T Yoshitomi, et al., *Bioconjugate Chem.*: 20 1792-1798(2009). A Marushima, et al., *Neurosurgery*, 68, 1418-1426 (2011). T Yoshitomi, et al., *Biomaterials*, 32, 8021-8028 (2011). P Chonpathompikunlert, et al., *Therapeutic Delivery*, 2(5), 585-597 (2011). K Toh, et al., *Science and Technology of Advanced Materials*, 12,065001(2011).

From RNA folding to nanoparticle microscopy: the beauty of one at a time

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One of the traditions of physical chemistry is trying to break down complicated problems into simpler ones that may be more readily tested at the fundamental level by comparison between experiment and theory. This talk will address two recent examples from our group. The first will focus on the conformational dynamics of small RNA biomolecules, exploiting time, color and polarisation correlated single photon counting FRET laser spectroscopy and single molecule confocal fluorescence methods. The beauty of this approach is that permits one to “watch” the folding and unfolding of a single RNA construct in real time, from which one can determine rate constants as a function of cation concentration [Mg^{+2}] or temperature and thereby learn about *kinetics* and *thermodynamics* of single molecules. The second topic involves a novel combination of ultrafast lasers, multiphoton photoelectron spectroscopy and vacuum based microscopy methods for spectral, spatial and temporal imaging of single nanoparticles. In each case, the focus will be on simple physical pictures to try and understand and unravel complex phenomena.

Coordination programming of electro-functional molecular wires and networks

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A goal of molecular electronics which is one of the most imperative targets in nanoscience is to control electron conduction in molecular networks by combining appropriate molecular units. Construction of molecular networks comprising highly conducting molecular wires and introduction of external stimuli responsive molecular units can lead to intelligent molecular circuits. To realise these molecular circuits, evaluation of the total performance of molecular wires is necessary, and thus the electron conduction properties of internal molecular segments as well as the resistivity at the electrode-molecular wire junction must be elucidated. Here present two topics concerning molecular electronics. The first topic concerns the interfacial bottom-up synthesis of π -conjugated redox molecular wires of metal complex oligomers. In this method, molecular wire structures with the controlled number of complex units and designed shapes and hetero-metal sequences can be built on the surface. We have analyzed the electron transport mechanism and kinetics for the redox reaction of the films of linear and branched oligomer wires, long-range electron-transport abilities, and surface junction effects. The second topic is development of bio-photosensors composed of cyanobacterial photosystem I (PSI) and a molecular wire. We have succeeded in photosensing using a combination of PSI, VK1-like molecular wire, Au nanoparticle, and field-effect transistor (FET), and further developed related photoelectronic conversion systems.

Nanocrystallinity and supracrystallinity: a real challenge

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Here we will give an overview on the chemical and physical properties related to ordering of atoms in nanocrystals and nanocrystals ordering in supracrystals. A tentative in referring to what already is known in Nature will be presented.

Design of functional nanofilms via self-assembly of inorganic nanosheets as a building block

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We have exfoliated various layered host compounds into colloidal single layers. The resulting inorganic nanosheets are taken as a unique class of molecularly-thin 2D materials with enhanced optical, photochemical, electronic, and magnetic properties. By taking advantage of these features as well as their monodispersed nature, we organised the nanosheets layer-by-layer into nanostructured films by applying solution-based techniques such as Langmuir-Blodgett deposition. By optimizing deposition parameters, neat tiling of nanosheets into high-quality monolayers was achieved and its repetition enabled the construction of well-ordered multilayer and even superlattice films. The obtained films exhibited a range of useful functionalities depending on the nanosheets and film nanoarchitectures. For example, we found that nanofilms of Ti/Nb oxide nanosheets showed superior photocatalytic and dielectric (ferroelectric) /insulating properties, and those of TaO₃- nanosheet acted as the thinnest solid electrolyte, greatly reducing interfacial resistivity between LiCoO₂/thio-LISICON.

From assembly control to reaction control at surfaces

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Controllability of molecular assemblies at surfaces is one of the top priorities in self-assembly area.¹ Normally, molecular assemblies at surface are the balanced results of various weak interactions. A slight change in the molecular structure or an input of small external energy would drastically break the balance and hence, change the assembling structures. To control the assembling structures, people have developed different approaches. One is to tune the assembling structures at surface in a controlled manner by tweaking physical parameters like surface coverage and substrate temperature. This is sort of like using the same tiles and bricks to build different types of houses. In this presentation, we'll first talk about how to utilise hydrogen bonds to control two-dimensional (2D) molecular porous networks at surface which have attracted intense interests due to their potential applications in host-guest chemistry and surface chemistry. We'll present two case studies, one dealing with the control of the inter-pore distance step by step for the assemblies of trimesic acid (TMA)² and the other, the control of the pore size and shape for the co-assembling structures of TMA and 4,4'-bis(4-pyridyl)biphenyl molecules.³

More interestingly, self-assembly can also be further utilised to precisely mediate surface reactions. The idea is to use the surface assembly to confine the adsorption sites of reactants or reaction intermediates. A case study is the Ullmann reaction, a family of coupling reactions that link aromatics through the C-C bond to yield various coupling products carrying different functional groups, which was initially reported by Ullmann and Bielecki.^{4,5} Two reaction mechanisms have been proposed for this coupling reaction via intermediates of radicals or organometallics.^{6,7} Wang et al.⁸ recently reported an organometallic intermediate, a Cu atom connected by two terphenyl radicals via the C-Cu-C bridge, for the coupling reaction of 4, 4''-dibromo-p-terphenyl on Cu(111) surface. However, it remains unclear whether such an organometallic intermediate exists for the coupling of aromatic halides on other substrates.

To deal with above-mentioned issues, we investigate in detail the Ullmann coupling of 4-bromobiphenyl on Ag(111).⁹ The catalytic cycle involves detaching the bromine atom from the reactant to form an organometallic intermediate which can be confined to either two-fold bridge or three-fold hollow sites at full coverage. The hollow site turns out to be more catalytically active than the bridge one, allowing for sequential control of the reaction from the intermediate to the final coupling product, p-quaterphenyl, at various temperatures. Other possible reaction intermediates are also discussed.

References

- 1 H L Liang et al., *Coord. Chem. Rev.*, 253 (2009) 2959.
- 2 Y C Ye et al., *J. Phys. Chem. C* 111 (2007) 10138.
- 3 H L Liang et al., *Angew. Chem. Int. Ed.*, 50 (2011) 7562.
- 4 F Ullmann, J Bielecki, *Chem. Ber.*, 34 (1901) 2174.
- 5 T D Nelson, R D Crouch, *Org. React.*, 63 (2004) 2655.
- 6 J A Lipton-Duffin et al., *Small* 5 (2009) 592.
- 7 G S McCarty, P S Weiss, *J. Am. Chem. Soc.*, 126 (2004) 16772.
- 8 W H Wang et al., *J. Am. Chem. Soc.*, 133 (2011) 13264.
- 9 X Zhou et al., *to be published*.

Nanoarchitectonics of novel photocatalytic materials

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Nano photocatalytic materials have shown great potentials not only in environmental remediation, but also in solar-chemical conversion by photocatalytic water-splitting as well as CO₂ reduction. Up to now, aiming at realizing a more efficient utilisation of solar energy, we have paid extensive attention on the fundamental research and development of nano-structured photocatalysts which are highly efficient under not only UV but also visible-light irradiation. In this talk, our recent achievements¹⁻¹³ and future prospects in challenging the possibilities of the nano-structured photocatalytic materials by materials nanoarchitectonics will be introduced and discussed, from the view points of new materials development, design and control of surface/interface nano-structures, as well as mechanism study from both experimental and theoretical approaches.

References

- 1 Z Yi, J Ye, N Kikugawa, T Kako, et al., *Nature Mater.* 9, 559-564 (2010).
- 2 S Ouyang and J Ye, *J. Am. Chem. Soc.* 133, 7757-7763 (2011).
- 3 Naoto Umezawa, Ouyang Shuxin, and Jinhua Ye, *Phys. Rev. B* **83**, 035202(2011).
- 4 Y Bi, S Ouyang, N Umezawa, J Cao, J Ye, *J. Am. Chem. Soc.*, 133, 6490-6492 (2011).
- 5 Y Bi, S Ouyang, J Cao, and J Ye, *Phys. Chem. Chem. Phys.* 13, 10071-10075(2011).
- 6 H Tong, N Umezawa, J Ye, *Chem. Commun.* 47, 4219-4221 (2011).
- 7 H Tong, N Umezawa, J Ye, T Ohno, *Energy Environ. Sci.* 4, 1684-1689 (2011).
- 8 K Xie, N Umezawa, N Zhang, J Ye, et al., *Energy Environ. Sci.* 4, 4211-4219 (2011).
- 9 X Chen, J Ye, S Ouyang, T Kako, Z Li, and Z Zou, *ACS Nano*, 5(6), 4310-4328(2011).
- 10 H Tong, S Ouyang, Y Bi, N Umezawa, M Oshikiri, J Ye, *Adv. Mater.*, 24(2), 229-251, (2012).
- 11 S Ouyang, H Tong, N Umezawa, J Cao, P Li, Y Bi, Y Zhang, J Ye, *J. Am. Chem. Soc.*, 134, 1974-1977 (2012).
- 12 Y Bi, H Hu, S Ouyang, Z Jiao, G Lu and J Ye, *J. Mater. Chem.*, 22, 14847-14850(2012).
- 13 G Xi, S Ouyang, P Li, J Ye, et al., *Angew Chem Int. Ed.*, 51, 2395-2399(2012).

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