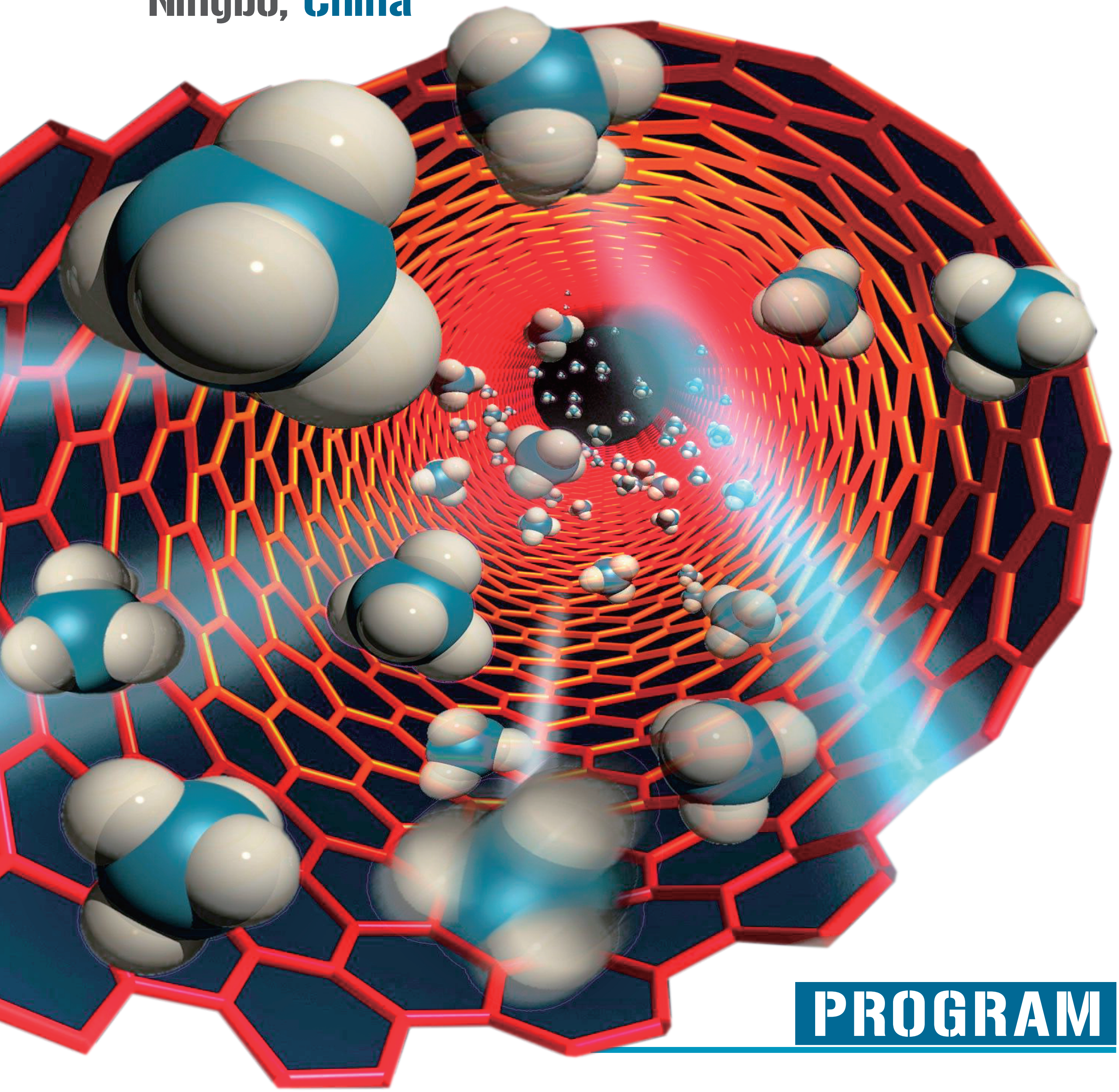
China-Australia Symposium on Advanced Materials

21-22 September 2016
Ningbo, China



PROGRAM

Australian Government

Australian Academy of Science

ATSE

Contents

Welcome Message

On behalf of the Chinese Academy of Sciences (CAS), I would like to warmly welcome all of the participants to the China-Australia Symposium on Advanced Materials in Ningbo, 21-22 September 2016. My special welcome is extended to our Australian colleagues and friends, led by Professor Andrew Holmes, President of the Australian Academy of Science (AAS) and Professor Peter Gray, President of the Australian Academy of Technology and Engineering (ATSE).

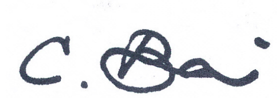
This Symposium is a joint initiative between CAS, AAS and ATSE, and sponsored by the Australian Government represented by the Department of Education and Training and the Department of Industry, Innovation and Science. It has been an important platform to identify mutual interests and major opportunities for collaboration in areas of complementary strengths. The Symposium has been held annually since 2004 in China and Australia on topics of strategic importance to both countries, such as energy, water, biotechnology, nanotechnology, ecosystem, coastal research, remote sensing, health and aging, astronomy, and neuroscience. The China Australia Symposium on Advanced Materials this year introduces another exciting collaborative area where scientists from both sides could interact, collaborate and form strong research links.

Featured themes of this year's Symposium are:

- Advanced Materials Fundamentals
- Advanced Materials Research
- Advanced Materials Industrial Applications

The Symposium will lead to better and clearer understandings of the interests and capabilities of both sides in material sciences. It is expected that discussions and conclusions will in turn generate opportunities for collaboration and cooperation in critical areas of common interests.

It is our great pleasure to host the event and we would like to thank the Australian Academies for their sustained efforts in co-organizing this joint symposium. I also wish to acknowledge the contribution and support of CAS Ningbo Institute of Material Technology and Engineering. I wish the symposium a great success and all the participants an enjoyable stay in Ningbo.



Chunli Bai
President
Chinese Academy of Sciences

China-Australia Symposium on Advanced Materials

General Program

Tuesday, 20 September

10:00 – 22:00 Reception, Hotel Lobby

Wednesday, 21 September
Yong Cheng Hall, Hotel Ground Floor

Opening Remarks and Keynotes
Convener : Jinghua Cao, Deputy Director of International & Cooperation Bureau, CAS

09:00 – 09:30	Official Opening and Welcome by Presidents Chunli Bai、Andrew Holmes、Peter Gray
09:30 – 10:00	Keynote Speaker 1 (China): Qunji Xue Recent Progress on Advanced Materials Research in China
10:00 – 10:30	Keynote Speaker 2 (Australia): Peter Gray Andrew Holmes An Overview of Advanced Materials in the Physical and Biological Sciences in Australia
10:30 – 11:00	Tea Break and Poster Presentation(Group Photo)

Session 1: Advanced Materials Fundamentals
Convener: Murray Scott

11:00 – 11:25	China Speaker 1: Kuiling Ding Atom-economy Transformation of CO_2:A Molecular Solution to a Global Challenge
11:25 – 11:50	Australia Speaker 1: Sean Smith Modulation of Electronic and Vacancy Structure for Enhanced Electrocatalysis
11:50 – 12:15	China Speaker 2: Maochun Hong Solid State Laser Materials and Their Applications
12:15 – 13:30	Lunch Buffet, Cafeteria, Hotel Second Floor
13:30 – 13:55	Australia Speaker 2: Alan Kin tak Lau Nanocomposites at Space Environment
13.:55 – 14:20	China Speaker 3: Zhong Fang Topological Electronic States and Materials
14:20 – 14:45	Australia Speaker 3: Chunhui Wang Modelling Slow Fatigue Crack Growth Behaviour in Composites and Bonded Structures
14:45 – 15:15	Tea Break and Poster Presentation
15:15 – 16:00	Session 1 Wrap up

Session 2: Advanced Materials Research
Convener: Deqing Zhang

16:00 – 16:25	China Speaker 4: Liquan Chen Studies on Room -Temperature Sodium- Ion Battery and Its key Materials
16:25 – 16:50	Australia Speaker 4: Chennupati Jagadish Semiconductor Nanowires for Optoelectronics Applications
16:50 – 17:15	China Speaker (CNITECH): Jin Zhu Research Progress on Bio-based Polymers at CNITECH

End of Symposium Day 1

17:45 – 18:30	CAS/AAS/ATSE Meeting
18:30 – 21:00	Dinner Party Hosted by CAS President Chunli Bai VIP Hall, Hotel Ground Floor AUSTRALIAN DELEGATION & INVITED SPEAKERS ONLY

Thursday, 22 September

09:00 – 09:25	China Speaker 7: Yong Tang Sidearm Approach to Catalysts for Olefin Polymerization: Controllable Synthesis of Polyethylene
09:25 – 09:50	Australia Speaker 5: Adrian Mouritz Bio-Inspired Design of Aerospace Composite Joints
09:50 – 10:15	China Speaker 6: Chen Wang Reflections on Industrial Nanotechnology Development in CAS
10:15-10:40	Tea Break and Poster Presentation
10:40 – 11:05	Australia Speaker 6: Xinhua Wu Selective Laser Melting (or 3D printing) of Aerospace Materials, its Quality Control and Qualification
11:05 – 11:50	Session 2 Wrap up

Session 3: Advanced Materials Industrial Applications
Convener:Ping Cui

11:50 – 12:15	China Speaker 5: Deqing Zhang A Significant Improvement of the Semiconducting Performance for the DPP-Quaterthiophene Conjugated Polymer through Side-Chain Engineering via Hydrogen-Bonding
12:15 – 12:40	Australia Speaker 7: Murray Scott Application of New Fibre Composite Materials Technologies to Advanced Light-Weight Structures
12:40 – 14:00	Lunch Buffet, Cafeteria, Hotel Second Floor
14:00 – 14:25	China Speaker 8: Jian Xu Bio-inspired Polymer Materials and Their Applications by Sol-gel Processing Based on Marine and Nature Organisms
14:25 – 14:50	Australia Speaker 8: Leonie Walsh Advanced Industrial Materials core to Australia's growth and competitiveness
14:50-15:20	Tea Break and Poster Presentation
15:20 – 15:45	China Speaker 9: Rui Yang Development of Net-shape Cast TiAl Low Pressure Turbine Blades and Application in Advanced Aircraft Engines
15:45 – 16:10	Australia Speaker 9: Huijun Zhao Unlocking Catalytic Potentials of Earth Abundant Materials for Energy Conversion and Device Fabrication
16:10 – 16:55	Session 3 Wrap up
16:55 – 17:10	Symposium Wrap up and Close

Friday, 23 September

09:00 – 11:30	Site visit to Ningbo Institute of Industrial Technology (CNITECH) ,CAS

End of Symposium

Keynote speaker 1 (China)

Wednesday, 21 September

09:30 – 10:00

Qunji Xue

Professor Qunji Xue

CAS Academician
Ningbo Institute of Material Technology and Engineering, CAS

Prof. Qunji Xue graduated from Chemistry Department, Shandong University in 1965, received his Master Degree from Lanzhou Institute of Chemical Physics (LICP), CAS in 1967 and worked as a visiting scholar at University of Michigan from 1980 to 1982. He was a professor of LICP, CAS from 1965 to 2015, and the director of LICP, CAS (1999-2003). Currently, he is a professor of the Ningbo Institute of Material Technology and Engineering (CNITECH), CAS. He was elected Academician of the Chinese Academy of Engineering (CAE) in 1997. He is the president of the Academic Committee of the CNITECH, president of the Academic Committee of (LICP), director of the Academic Committee of the State Key Lab of Solid Lubrication, LICP, and director of the Academic Committee of the key lab of Marine Materials and Application Technology of CNITECH.

He published more than 400 papers and 4 monographs and obtained 50 issued patents. He was awarded 4 state prizes and more than 20 other ministerial prizes such as the He-Liang-He-Li Prize of 2002, the Contribution Award in Chemistry in 2009 by the Chinese Chemical Society,

the Supreme Achievement Award in Tribology in 2009, the Contribution Award in Mechanical Engineering in 2010 by CSME and the International Tribology Gold Medal in 2011.

Recent Progress on Advanced Materials Research in China

This keynote speech will briefly introduce the current state of professional institutions engaged in material R. & D. activities in China, and then show an overview of the recent progress made by Chinese scientists in areas such as polymeric photo-electrical materials, graphene, carbon materials, nano-materials, bio-materials, functional crystal, as well as materials surface and interface. The speech will also give suggestions for novel material research and development in China.

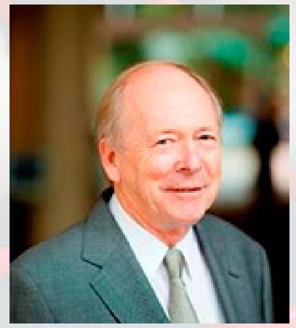
China-Australia Symposium on Advanced Materials

Keynote speaker 2 (Australian)

Wednesday, 21 September

10:00 – 10:30

Peter Gray
Andrew Holmes



Professor Peter Gray

President
Australian Academy of Technology and Engineering

Professor Peter Gray served as the inaugural director of the Australian Institute for Bioengineering and Nanotechnology (AIBN) at the University of Queensland from 2003 until early 2016.

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 the Cetus Corporation as well as previously holding academic positions at University College London, and at the University of California, Berkeley.His research interests are focused on engineering mammalian cells to produce the complex proteins called biologics 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 is a past President of the Australian Biotechnology Association, AusBiotech. He is a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE) and of the Australian Institute of Company Directors, and has been named as one of Australia's 100 Most Influential Engineers.

He has been a Vice-President of ATSE since Jan 2012, and became the interim President in December 2015. He also serves on the Boards of Biopharmaceuticals Australia Pty Ltd, ACYTE Biotechnology Pty Ltd, Stem Cells Ltd, ECI Inc., New York, and a number of State and Federal Government Councils and Committees.

Professor Andrew Holmes

President
Australian Academy of Science

Professor Andrew Holmes is a Laureate Professor of the School of Chemistry at The University of Melbourne. In October 2004 he was appointed ARC Federation Fellow and inaugural VESKI Fellow at the Bio21 Institute at The University of Melbourne and at CSIRO Molecular and Health Technologies. Professor Holmes has been recognised for his groundbreaking work on light-emitting polymers. He has also been the recipient of a long list of awards including the Royal Society's Royal Medal and the Descartes Prize. He was elected to the Academy in 2006 and served as Foreign Secretary from 2010 to 2014. He became President of the Academy in May 2014.

An overview of advanced materials in the physical and biological sciences in Australia

Materials science is at the forefront of driving research, technological and industrial advancements of great strategic importance to both Australia and China. The impact of advanced materials has been felt in a wide range of sectors; information and computer technology, energy, biotechnology and healthcare, transportation, construction and infrastructure, mining and manufacturing.

Considering the range of influence, it's no surprise that this is a field of endeavour that lends itself naturally to collaboration - drawing upon skills from a wide variety of scientific disciplines to design and synthesize new materials, characterise their properties, and thereafter, develop new applications and technologies.The future of materials science and engineering is ripe with possibilities - nanotechnology, composite and graphene/graphene-based materials are a few emerging technologies which offer unprecedented commercialisation opportunities.

An equally vital part of the puzzle but not often recognised is the opportunity offered by material science and engineering to address global societal issues such as environment and energy, well-being and health through strong networks and healthy partnerships, transcending local, national and regional borders.

10:30 – 11:00 Tea Break and Poster Presentation (Group photo)

Session 1:
Advanced
Materials
Fundamentals

Convener
Murray Scott

Professor Murray L Scott

Founder and Chairman
Advanced Composite Structures Australia Pty Ltd
Email: m.scott@acs-aus.com

Prof. Murray Scott is Founder and Chairman of Advanced Composite Structures Australia, the specialist engineering spin-out company of the world renowned Cooperative Research Centre for Advanced Composite Structures, of which he was Chief Executive Officer for over 13 years.

He is an Adjunct Professor of RMIT University and has 35 years' engineering experience working in both industry and academia. He is a Fellow of the Australian Academy of Technology and Engineering, the Royal Aeronautical Society and Engineers Australia, and is also a long-standing World Fellow of the International Committee on Composite Materials, which he served as President in 2001-2003. Since 1994, he has represented Australia on the International Council of the Aeronautical Sciences and has served in various capacities including as President in 2013-2014.

He continues to focus on developing new technologies for the design, manufacture and support of application-critical fibre composite structures in aerospace and other fields.

Session 1: Advanced Materials Fundamentals
Convener: Murray Scott

China-Australia Symposium on Advanced Materials

Professor Kuiling Ding

CAS Academician
Director
Shanghai Institute of Organic Chemistry, CAS
Email: kding@mail.sioc.ac.cn

Dr. Kuiling Ding received a B.S. in chemistry from Zhengzhou University in 1985 before studying physical organic chemistry at Nanjing University, where he received a Ph.D. in 1990 with Professor Yangjie Wu. He became an assistant professor at Zhengzhou University in 1990 and a full professor at the same university in 1995. During 1993-1994, he was engaged in a postdoctoral research with Professor Teruo Matsuura at Ryukoku University in Japan. In the period of 1997-1998, he was a UNESCO research fellow with Professor Koichi Mikami at Tokyo Institute of Technology in Japan. He joined Shanghai Institute of Organic Chemistry, CAS, in Dec of 1998 as a professor of chemistry and has been the director of the institute since 2009. He was a visiting professor during the period of 08-11, 2003 at Nagoya University, Japan, with Professor Masato Kitamura. Dr. Ding received National Natural Science Award of China in 2009, the 1st Yoshida Prize of International Organic Chemistry Foundation (IOCF) Japan in 2015, and Humboldt Research Award in 2016. He was elected a member of Chinese Academy of Sciences in 2013.

Atom-economy Transformation of CO_2: A Molecular Solution to a Global Challenge

From the viewpoint of synthetic chemistry, the utilization of CO_2 as a feedstock for the production of industrial products may be an option for the recycling of carbon.On the other hand, the transformation of chemically stable CO_2 represents a grand challenge in exploring new concepts and opportunities for the academic and industrial development of catalytic processes.Therefore, the development of a new reaction pathway and a practical catalyst system for the production of methanol from CO_2 is in urgent demand.3 In this talk, our preliminary results will be presented on the use of a type of readily available (PNP)RuII catalyst for the homogeneous hydrogenation of cyclic carbonates from readily available CO_2 and epoxides, to give methanol and the corresponding diols under relatively mild conditions with excellent catalytic efficiency.The coupling of the present catalytic system with the process of ethylene carbonate production in the omega process is expected to establish a new bridge from CO_2 and ethylene oxide to methanol and EG in 100% atom economy. Apart from the clean production of diol, a big bonus of the present protocol is the efficient chemical utilization of CO_2, which represents a distinct advantage in terms of sustainability over the omega process, which gives back CO_2.

Session 1:
Advanced
Materials
Fundamentals

speaker 1
(China)

Convener
Murray Scott

Wednesday, 21
September

11:00 – 11:25

Kuiling Ding

Session 1: Advanced Materials Fundamentals

speaker 1 (Australia)

Convener
Murray Scott

Wednesday, 21 September

11:25 – 11:50

Sean Smith

Professor Sean Smith

University of New South Wales
Email: sean.smith@unsw.edu.au

Sean Smith is Professor of Computational Nanomaterials Science and Engineering in the School of Chemical Engineering at UNSW Australia and is foundation Director of the Integrated Materials Design Centre (IMDC). He received his PhD in theoretical chemistry at the University of Canterbury, New Zealand, in 1989. Following an Alexander von Humboldt Fellowship at the University of Göttingen and postdoctoral research at the University of California, Berkeley, he accepted a faculty position at The University of Queensland (UQ), Australia in 1993. At UQ, he became Professor and founding Director of the Centre for Computational Molecular Science at UQ in 2002 and in 2006 his laboratory moved to the Australian Institute for Bioengineering and Nanotechnology. He worked with colleagues in the ARC Center of Excellence for Functional Nanomaterials 2002-2011 as Program Leader (Computational Nanoscience) and Deputy Director (Internationalisation). In 2011, he accepted the position of Director of the US Department of Energy funded Center for Nanophase Materials Sciences (CNMS) at Oak Ridge National Laboratory, one of five major DOE nanoscience research and user facilities in the US. He joined UNSW in 2014, launching the IMDC in 2015. His specific research involves theoretical and computational studies of chemical kinetics; reaction dynamics; catalysis; as well as structure, self-assembly and transport phenomena within nanomaterials, proteins, and hybrid nano-bio systems. He has published over 240 refereed journal papers. In 2006 he was recipient of a Bessel Research Award of the Alexander von Humboldt Foundation in Germany He is an elected Fellow of the American Association for the Advancement of Science (AAAS) and the Institute of Chemical Engineers (ICHEME).

Modulation of Electronic and Vacancy Structure for Enhanced Electrocatalysis

Following our recent work, we report new results from high performance first principle materials simulations that elaborate the role of chemical doping in modulating both electronic structure and vacancy structure for the enhancement of electrocatalyst performance in graphene based and perovskite metal oxide based materials. The first case study involves hybrid semi-conductor (graphitic carbon nitride, g-C_3N_4) / conductor (doped graphene) electrocatalyst systems for the Hydrogen Evolution Reaction (HER). The second case study elaborates the role of Sc and Nb doping of $SrCoO_3$ for the electrocatalytic Oxygen Evolution Reaction (OER) and solid oxide fuel cell Oxygen Reduction Reaction (ORR).

Professor Maochun Hong

CAS Academician
Fujian Institute of Research on the Structure of Matter, CAS
Email: hmc@fjirsm.ac.cn

Professor Maochun Hong graduated from Fuzhou University in 1978 and received his M.Sc. degree from the FIRSM in 1981. He was a research fellow at Department of Chemistry of the Michigan University in 1985-1987, and a visiting scientist at Department of Chemistry of the University of the Newcastle upon Tyne in 1992-1993. He worked as a JSPS visiting professor at the Nagoya University in 1998, where he received his Ph. D degree. He was elected a Member of the Chinese Academy of Sciences in 2003 and elected a Fellow of the Academy of Science for the Developing World (TWAS) in 2005. He successively served as the director of the FIRSM from 2000 to 2013. At the present, he is a professor of the FIRSM, an associate Editor of Crystal Growth & Design, the vice-president of the Chinese Chemical Society. His research interests include nanoclusters and molecular devices, supramoleclar chemistry, and inorganic-organic hybrid functional materials.

Solid State Laser Materials and Their Applications

The increasing demands on functional crystal materials for modern science and technology boosted the crystalline researches, leading to a continuous boom on new crystal material discovery and bulk crystal growth research. On the other hand, the exploration of new functional crystal materials associated with the studies on the relations between crystal structures and optical properties has been carried out and the great achievements had been made on the discoveries of solid state laser crystal materials. Among those, a series of nonlinear optical (NLO) borate crystals pioneered the new optical crystals exploration, which gave a great impetus to the development of laser technology in the UV region.

In the past ten years, efforts were directed continuously toward the research of structure-property relations and high quality crystal growth, which has brought to fruition many fields covering NLO, laser, scintillator, and wide band gap semiconductor crystals. In this contribution, selected research work accomplished by scientists in our institute on crystal growth and design are presented.

12:15 – 13:30 Lunch Buffet, Cafeteria, Hotel Second Floor

Session 1: Advanced Materials Fundamentals

speaker 2 (China)

Convener
Murray Scott

Wednesday, 21 September

11:50 – 12:15

Maochun Hong

Session 1: Advanced Materials Fundamentals

speaker 2 (Australia)

Convener Murray Scott

Wednesday, 21 September

13:30 – 13:55

Alan Kin tak Lau

Professor Alan Kin tak Lau

Pro Vice-Chancellor (Research Performance and Development)
Swinburne University
Email: aklau@swin.edu.au

Professor Lau has taken up the Pro-Vice-Chancellor (research Performance and Development) of Swinburne University of Technology, Australia since April 2016. Prior to this appointment, he was appointed as Alex Wong/Gigi Wong Professor in Product Design Engineering and Associate Dean (Industrial Relation) in the Faculty of Engineering of The Hong Kong Polytechnic University. Professor Lau has received numerous research and teaching awards since 2002. His published articles have received citations over 9300 with the h-index of 47 (web of science is > 4300 with h-index of 33). He is a Fellow of the European Academy of Science and Arts. He is now also the International Vice President of The Institution of Mechanical Engineers (IMechE) and Independent Non-executive Director of Kingsflair International (Holdings) Limited.

Nanocomposites at Space Environment

Polymer-based advanced composites always suffer from degradation at extreme temperatures in the range between 220 and 77 K and low atmospheric pressure. Within this temperature range, composite structures behave very brittle and many micro-cracks are easily formed due to differential thermal coefficients of expansion (CTEs) between polymer matrix and high strength reinforcements. Besides, at the Low Earth Orbit (LEO) environment the structures may also be subject to damages due to micro-meteoroid attack, in which many tiny particles left over from the formation of the solar system and they are travelling at very high speed (hyper-velocity) to cause serious impact and abrasion onto the structures. Out-gassing and high oxidation rate are also problems for polymers using at this environment. In this lecture, an overview on the nanocomposites, their mechanical, thermal and structural properties at different working environments is given. The following key items will also be introduced: (i) design of the heat shield's geometry for re-entry vehicles; (ii) shock wave effect in relation to the heat transmission to the vehicles; (iii) advantage of using Phenolic Resin Carbon Ablator (PICA); (iv) types of nanoparticles for property enhancement for the vehicles and (v) possibility of using nano-particles to enhance the effectiveness of pyrolyzing process of PICA to prolong the heat transfer.

China-Australia Symposium on Advanced Materials

Professor Zhong Fang

Deputy Director
Institute of Physics, CAS
Email: zfang@iphy.ac.cn

Prof. Zhong Fang received his Ph.D of physics from the Hua-Zhong University of Sci. & Tech. of China in 1996, and he continued his researches in the AIST of Japan and ORNL of USA from 1996 to 2003. He returned back to China in 2003, and he is now a distinguished professor and serving as the deputy director of the Institute of Physics, Chinese Academy of Sciences. His research interests are mostly on computational condensed-matter physics, correlated electron systems, and topological electronic states. He is an APS Fellow, and was the recipient of ICTP prize (Italy) in 2008, the Outstanding Achievement Prize of CAS in 2011, and the First Prize of National Natural Science of China in 2013.

Topological Electronic States and Materials

The rapid development of the field of topological states is both due to conceptual theoretical advances, and to the discoveries of realistic materials where these exotic states can be hosted. First principles calculations play important roles in this field. On the theoretical front, the calculations and understanding of Berry curvature and gauge field established the connection between topology and electronic structures. On the experimental side, most of materials discovered up to now in this field are stimulated by computational predictions. In this talk, I will review recent progresses in this field, with focus on topological semimetal, a new state of quantum matters that differ from topological insulators. I will discuss some materials, including Dirac semimetals (Na_3Bi and Cd_3As_2) and Weyl semimetals ($HgCr_2Se_4$ and TaAs), and address some recent theoretical and experimental results.

Session 1: Advanced Materials Fundamentals

speaker 3 (China)

Convener Murray Scott

Wednesday, 21 September

13.:55 – 14:20

Zhong Fang

Session 1: Advanced Materials Fundamentals

speaker 3 (Australia)

Convener
Murray Scott

Wednesday, 21 September

14:20 – 14:45

Chunhui Wang

Professor Chunhui Wang

University of New South Wales
Email: chun.h.wang@unsw.edu.au

Prof. Chunhui Wang joined the University of New South Wales, Australia in 2016 as the next Head of School of Mechanical and Manufacturing Engineering (January 2017). He was the Director of Sir Lawrence Wackett Aerospace Research Centre, RMIT from 2009. Prior to this appointment, he was the Head of the Advanced Composite Technology Group in the Defence Science and Technology Organisation, where he worked for 14 years. He has extensive research experiences in advanced composite materials, bonded repairs, fatigue and fracture mechanics, structural health monitoring, and multifunctional materials systems.

Modelling Slow Fatigue Crack Growth Behaviour in Composites and Bonded Structures

Composites and bonded structures are typically designed to ensure any structural damage do not grow or grow slowly so that the limit load capability is maintained. To address these safety requirements, analysis methods are required to correctly account for the complex process of fatigue crack growth in composites and bonded structures. Recent experimental investigations have revealed that fatigue growth rates, when expressed in terms of existing scaling parameters, are strongly influenced by the load ratio. To develop an appropriate scaling parameter that can correctly capture this load-ratio effects, a new correlating parameter has been developed that is consistent with the similitude requirement, with the aid of finite element modelling to characterise the closure behaviour in composite laminates and bonded joints. This new theoretical model provides a unifying approach that can significantly reduce the burden of experimental tests and pave the way for physics-based predictive tools that can forecast the growth behaviour of disbond and delamination under complex cyclic fatigue loading.

14:45 – 15:15 Tea Break and Poster Presentation

15:15 – 16:00 Session 1 Wrap up

China-Australia Symposium on Advanced Materials

Professor Deqing Zhang

Director
Institute of Chemistry, CAS
Emai: dqzhang@iccas.ac.cn

Prof. Deqing Zhang studied chemistry in Beijing Normal University from 1983 to 1987. He then joined in the Institute of Chemistry, Chinese Academy of Sciences (ICCAS) as a graduate student and obtained his MS. in Organic Chemistry in 1990. He conducted research on electron donor–acceptor cyclophanes at the Max-Planck Institute for Medical Research in Heidelberg (Germany) under the supervision of Prof.Dr H. A. Staab, and received his Doctor degree (DR. RER. NAT.) from Ruprecht-Karls University Heidelberg in 1996.

He is now a research Professor in Institute of Chemistry, Chinese Academy of Sciences (ICCAS) and the director of the Institute. His research interests include development of external stimuli-responsive molecular systems for molecular switches, logic gates and chemical/bio-sensors. He also shows interests in design and synthesis of organic functional materials and organic nanoassemblies. He has published more than 200 papers in refereed journals. He serves as editorial advisory board member of several scientific journals including Adv. Mater., Adv. Funct. Mater., ACS Interface & Appl. Mater., Polymer J., Adv. Sci., Mater. Chem. Frontiers, Sci.-China Chemistry. His is one of the co-editor of ACS Omega.

Session 2: Advanced Materials Research
Convener: Deqing Zhang

Session 2: Advanced Materials Research

Convener
Deqing Zhang

Session 2: Advanced Materials Research

speaker 4 (China)

Convener Deqing Zhang

Wednesday, 21 September

16:00 – 16:25

Liquan Chen

Professor Liquan Chen

CAS Academician
Institute of Physics, CAS
Email: lqchen@iphy.ac.cn

Professor Liquan Chen is an Academician of Chinese Academy of Engineering. Professor Chen's major research areas are new energy materials and technologies, particularly the solid state ionics. His group has heavily involved in secondary lithium battery research and development of the first Chinese national 863 program and made great achievements, paving the way for the production of lithium ion batteries later on. In recent years, He and his students have obtained some world level achievements on nano-sized alloys as lithium storage materials. In addition, Professor Chen was also a leading expert in high Tc superconductor materials at the Institute of Physics in late 80th last century. Professor Chen published more than 250 papers and owns 15 patents. More than 20 students have finished their Ph.D theses under his supervision.

Studies on Room -Temperature Sodium- Ion Battery and Its Key Materials

Large scale energy storage technology is a key technology for the development of renewable energy and smart grid. Compared with other energy storage technologies, room temperature sodium ion battery has a some of advantages: abundant resources, low cost, high energy conversion efficiency, long cycle life, low maintenance cost, etc.. Exploring cheap and excellent performance materials for sodium ion battery is the key to achieve practical application of sodium ion storage battery. In recent years, in the laboratory of solid state ionics, IOP, CAS, we systematically studied the positive electrode materials, negative materials and electrolyte for the sodium ion batteries. Some new materials have been discovered and the properties of sodium ion batteries have been investigated.

In this report, after a brief introduction to the research progress of sodium ion battery in our lab, we only introduce one cathode material and one anode material in more detail.
It was found that in the layer structure materials of sodium ion battery Cu element can achieve Cu^{2+}/Cu^{3+} redox reaction reversibly. Accordingly, we designed and synthesized cathode material $Na_{0.90}[Cu_{0.22}Fe_{0.30}Mn_{0.48}]O_2$. The reversible capacity reaches 100 mAh / g. The stability in ambient condition is very good. Excellent cycling performance was observed.

The experiment found that Na^+ can be inserted into in $Li_4Ti_5O_{12}$ to form $NaLiTi_5O_{12}$, where Li and Ti atoms occupy transition metal positions in the lattice. Similarly, Is it possible to introduce Na^+ ion into $LiTiO_2$ lattice to generate $NaLiTiO_2$? Through theoretical calculation, we designed and synthesized $Na_{0.66}Li_{0.22}Ti_{0.78}O_2$. During the process of charge /discharge the volume change is less than 0.21%. The reversible capacity is 116 mAh/g. The sodium insertion potential is in the range of 0.5-1.2V. After 1200 cycles the capacity maintains 75%.

China-Australia Symposium on Advanced Materials

Session 2: Advanced Materials Research

speaker 4 (Australia)

Convener Deqing Zhang

Wednesday, 21 September

16:25 – 16:50

Chennupati Jagadish

Professor Chennupati Jagadish

Australian National University
Email:cxj109@physics.anu.edu.au

Professor Jagadish is a Distinguished Professor and Head of Semiconductor Optoelectronics and Nanotechnology Group in the Research School of Physics and Engineering, Australian National University. He has served as Vice-President and Secretary Physical Sciences of the Australian Academy of Science during 2012-2016. He is currently serving as President of Australian Materials Research Society. Jagadish is an Editor/Associate editor of 6 Journals, 3 book series and serves on editorial boards of 19 other journals. He has published more than 850 research papers (570 journal papers), holds 5 US patents, co-authored a book, co-edited 10 books and edited 12 conference proceedings and 15 special issues of Journals. He received 2013 Walter Boas Medal, 2015 IEEE Pioneer Award in Nanotechnology, 2015 IEEE Photonics Society Engineering Achievement Award, 2016 MRSI Silver Jubilee Anniversary Medal, 2016 Distinguished Fellow of Chinese Academy of Sciences and 2016 OSA Nick Holonyak Jr Award. He holds Thousand Talents Plan (short term) Professorship at UESTC, Chengdu.

Semiconductor Nanowires for Optoelectronics Applications

Semiconductors have played an important role in the development of information and communications technology, solar cells, solid state lighting. Nanowires are considered as building blocks for the next generation electronics and optoelectronics. In this talk, I will introduce the importance of nanowires and their potential applications and discuss about how these nanowires can be synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties. I will present results on radial heterostructures and how one can engineer the optical properties to obtain high performance lasers, THz detectors and solar cells. Future prospects of the semiconductor nanowires will be discussed.

Session 2: Advanced Materials Research

China Speaker (CNITECH)

Convener Deqing Zhang

Wednesday, 21 September

16:50 – 17:15

Jin Zhu

Professor Jin Zhu

Ningbo Institute of Material Technology and Engineering, CAS
Email: jzhu@nimte.ac.cn

Professor Jin Zhu is a professor and head of Institute of Material Technology in Ningbo Institute of Material Technology and Engineering, Chinese Academy of Sciences (CNITECH). Professor Zhu got his Ph.D. at Marquette University and did postdoctoral study at Cornell University in United States. Prior to returning China in 2009, Professor Zhu had worked at several US companies. His current research interests are on bio-based polymers, flame retardancy and nanocomposites. He has published over 100 research papers and more than 50 granted patents. Professor Zhu is a specialist of China National Thousand Talent Program.

Research Progress on Bio-based Polymers at CNITECH

Bio-based polymers are a class of polymers which were made from renewable resources. Great attention has been paid from both academic and industrial society since they are sustainable and renewable materials. Some progress was made at Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences (CNITECH). This talk will review our research progress on heat resistant foam sheet of polylactic acid (PLA), aromatic bio-based polyesters and soybean based wood adhesives.

End of Symposium Day 1

17:45 – 18:30 CAS/AAS/ATSE Meeting

18:30 – 21:00 Dinner Party Hosted by CAS President Chunli Bai
VIP Hall, Hotel Ground Floor
AUSTRALIAN DELEGATION & INVITED SPEAKERS ONLY

China-Australia Symposium on Advanced Materials

Professor Yong Tang

CAS Academician
Shanghai Institute of Organic Chemistry

Dr. Yong Tang got his BSc at Sichuan Normal University in 1986 and received his Ph. D degree in 1996 at Shanghai Institute of Organic Chemistry (SIOC), Chinese Academy of Sciences. Having spent nearly three years as a postdoctoral researcher in USA, he joined SIOC as an associate Professor in 1999. He was promoted to a full Professor in 2000. His research interests are on the development of new synthetic methodology and new olefin polymerization catalysts, including ylide chemistry in organic synthesis, asymmetric catalysis, and specifically designed organometallic complexes that can engineer macromolecules. Since 2000, he has published over 126 papers and 7 book chapters, and applied over 20 patents as a co-inventor. He was awarded The CAS-Bayer Award (2002), Thieme Chemistry Journal Award (2004), The Second Class Award of National Natural Sciences in China (2012), and Yao-Zheng Huang Award on Organometallic Chemistry (2012), Chinese Chemical Society. He was elected a member of Chinese Academy of Sciences in 2015.

Sidearm Approach to Catalysts for Olefin Polymerization□Controllable Synthesis of Polyethylene

The discovery of new olefin polymerization catalysts is of great fundamental scientific and technological importance. Recently, we designed a number of titanium and nickel complexes by sidearm strategy. These complexes prove to be excellent catalysts in ethylene homo- and co-polymerization and the catalytic behaviour of such complexes could be controlled well by selection of the sidearm. For example, we synthesized tetranuclear nickel complexes. By employing these complexes as precatalysts, bimodal polyethylene can be selected over polyethylenes with narrow dispersity indexes by changing the pendant group. With these titanium and nickel catalysts, PE wax with molecular weight thousands as well as ultra high molecular weight polyethylene (UHMWPE) with Mw millions can be prepared easily. Importantly, both linear and dendritic polyethylenes can be accessible highly efficiently. In the lecture, these results will be presented in details.

Session 2: Advanced Materials Research

speaker 5 (China)

Convener Deqing Zhang

Thursday, 22 September

09:00 – 09:25

Yong Tang

Session 2: Advanced Materials Research

Speaker 5 (Australia)

Convener Deqing Zhang

Thursday, 22 September

09:25 – 09:50

Adrian Mouritz

Professor Adrian Mouritz

RMIT University
Email: adrian.mouritz@rmit.edu.au

Adrian Mouritz is the Executive Dean of Engineering and Professor of Aerospace Materials at RMIT University. He has the following university qualifications: Bachelor of Applied Science (Metallurgy) and Master of Engineering (Metallurgical Engineering) from Royal Melbourne Institute of Technology, Master of Science (History & Philosophy of Science) from University of Melbourne, Doctorate of Philosophy (Materials Science & Metallurgy) and Doctor of Science from University of Cambridge.

Professor Mouritz has been working at RMIT since 2000, and has performed various leadership roles including Discipline Heads for Aerospace & Aviation, Manufacturing & Materials, and Acting Head of School for Aerospace, Mechanical & Manufacturing Engineering. In his current role as Executive Dean, he is committed to improving the teaching quality, student experience, research performance and industry engagement of RMIT Engineering.

Professor Mouritz research has led to significant discoveries on various topics associated with fibre composite materials, including their mechanical, fracture and fatigue properties; impact and explosive blast properties; fire structural properties; non-destructive inspection and smart health monitoring; and damage tolerance using through-thickness reinforcement (orthogonal weaving, stitching, pinning). He has published nearly 200 research articles on composites; which include 3 books, 3 edited books, 15 book chapters, and over 160 journal papers. Dr Mouritz is a Visiting Professor at Bristol University and editorial board member of numerous scientific journals. He has been awarded the following awards: RMIT Prize for Research Excellence – Leadership, 2015 and The Institute of Materials, Minerals & Mining (UK) Award for Composites in 2004 and 2008.

Bio-Inspired Design of Aerospace Composite Joints

This presentation describes a novel approach to improve the mechanical performance of composite joints via material and structural design modifications based on biomimetic science. Biomimetics aims to synthesise design principles from nature and to apply them to engineering materials and structures. The design of tree branch joints at different length scales from the microstructural to the macro-length scale was investigated. Analysis revealed three main features of tree branch joints which provide high structural efficiency: integrated design with the branch embedded into the trunk; three-dimensional fibril lay-up; and variable fibril density.

Research described in this presentation adapts the embedded structural feature and other design aspects of tree joints into a carbon/epoxy T-joint representative of that used in aircraft. Computational modelling and experimental testing revealed that the bio-inspired T-joint design has improved structural properties. This research proves that mimicking tree joints is a novel and effective way of improving the structural performance and safety of composite joints used in aircraft.

Session 2: Advanced Materials Research

speaker 6 (China)

Convener Deqing Zhang

Thursday, 22 September

09:50 – 10:15

Chen Wang

Professor Chen Wang

National Center for Nano Science and Technology, CAS
Email: wangch@nanoctr.cn

Chen Wang received his B.S. degree from University of Science and Technology of China in 1986. After obtaining PhD degree from University of Virginia in 1992, he joined Arizona State University as a postdoctoral associate. In 1994, he became a professor of Central China Normal University. He was a faculty of the Institute of Chemistry, Chinese Academy of Sciences from 1995 to 2004. Since 2004, he is a professor of the National Center for Nanoscience and Technology. Research in the Wang's group focuses on surface physical chemistry and nano-bio interface, including the principle of scanning tunneling microscopy and its applications, molecular self-assembly, etc. In recent years, his group has engaged in studying molecular mechanisms of peptide assemblies relating to disease diagnosis and treatment techniques.

Reflections on Industrial Nanotechnology Development in CAS

The highly promising progresses in basic research of nanoscience have been evident in the continued endeavors on pursuing excellence in academic research and economical impacts. The systematic and fundamental research achievements in this important multi-disciplinary area will be beneficial to the application of nanotechnology in such fields as energy, manufacturing, health and environment. The expectations from the society provide critical inspirations for the future of nanoscience. It can be clearly observed that extensively pursued focuses in the field of nanoscience and nanotechnology are derived from the societal needs, including increasing energy efficiency, developing new treatment methods for fatal diseases, etc. These issues are widely concerned from all society domains around the world.

In addition to the continued endeavors on pursuing excellence in academic research and economical impacts, the growing expectations of meeting societal needs have become evident for developing nanotechnologies. The emerging industrial nanotechnologies in the areas of national and societal needs are crucial for gaining continued public support as well as identifying key technological breakthroughs.

10:15 – 10:40 Tea Break and Poster Presentatio

Session 2: Advanced Materials Research

Speaker 6 (Australia)

Convener Deqing Zhang

Thursday, 22 September

10:40 – 11:05

Xinhua Wu

Professor Xinhua Wu

Monash University
Email: xinhua.Wu@monash.edu

Prof. Xinhua Wu is the founder Director of Monash Centre for Additive Manufacturing and Director for ARC ITRH for high value manufacturing. She is Fellow of Australia Technology, Science and Engineering and IoM3, UK and a world-leading expert in Ti alloys and in advanced powder processing, in particular 3D printing of metals..

Prof. Wu published over 120 refereed papers and is inventor to 12 international patents. She organised 5 international conferences and edited 3 conference proceedings, gave about 30 keynote/invited lectures at leading international conferences.

Prof. Wu was awarded in 2008 the Ti award by IoM3 for her outstanding record of world-class research in titanium and its alloys. In 2014 she received the top innovation award and jury committee award from global aerospace giant Safran following several 3D printed components produced by her team passed the engine test.

Selective Laser Melting (or 3D printing) of Aerospace Materials, its Quality Control and Qualification

Selective Laser Melting, also called 3D printing, of metals is being considered for aerospace and biomedical applications where quality, including consistency and repeatability are essential.

This presentation describes the recent activities in terms of research and development, powder production and the status in achieving international aerospace and biomedical certification for SLM'd parts. Different materials, including Al, Ti and Ni alloys have different issues in the SLM process, due to their metallurgical and crystallographic differences.

Whilst elimination of cracking and retaining high temperature properties are critical for SLM Ni alloys, optimisation of post heat treatment becomes more significant for Al alloys as defined by the nature of the sensitive response of precipitates of Al alloys during heat treatment. Achieving aerospace and biomedical certification requires controlling the quality from powder to SLM'd products as is demonstrated here using Ti64 alloy.

It has been found that using appropriate quality of barstock followed by rigorous control of the atomisation and SLM processes, outstanding mechanical properties coupled with consistency and repeatability have been obtained in SLM'd Ti64 parts and this has led to the qualification of Ti64 powder and SLM'd parts for civil aerospace applications.

11:05 – 11:50 Session 2 Wrap up

China-Australia Symposium on Advanced Materials

Session 3: Advanced Materials Industrial Applications

Convener Ping Cui

Professor Ping Cui

Director
Ningbo Institute of Material Technology and Engineering, CAS
Email:cuiping@nimte.ac.cn

Dr. Ping Cui, an eminent materials scientist, directs research on nano-materials and internal dissipation. Currently, she maintains an active involvement in research on organic / inorganic nano-composite polymer. As the first Director of CNITECH, she has helped to establish CNITECH as a leading center for research in materials with a strong emphasis on fundamental and applied materials research. She was instrumental in the creation of CNITECH's new home in Ningbo, as well as the new regional laboratory for the study of materials.

Prior to joining CNITECH, Dr. Cui spent 9 years in the Institute of Solid State Physics, CAS, where she held several management positions. She served as Director from 2001-2004, Deputy Director from 1995-2001, and Vice President of the Hefei Institutes of Physical Science CAS at the same time. In 1995 she was the CEO of TUOPU High-Tech company. Dr. Cui started her scientific career as the Deputy Chief of the Laboratory of Internal Friction and Defects in Solids, CAS in 1991.

In 1999, Dr. Cui was a Guest Scientist at Kyoto University in Japan; and a Visiting Researcher at International Centre for Theoretical Physics in Italy in 1992. From 1987 to 1988, she worked at the New Material Institute of Saarland University in German for the study of nanomaterials. Dr. Cui holds a number of awards. She was the winner of Science & Technology Advancement Award of CAS in 1986 and the recipient of Natural Science Award in 1993. She won the President Award of CAS for Meritorious Service in 2004 and the Science & Technology Advancement Award of Changzhou City. In 2005 she was honored the Science & Technology Innovation Award of Ningbo City. Dr. Cui earned a number of subsides including President Scholarship of CAS, Special Allowance of State Council, and Special Allowance of Anhui Province.

Dr. Cui is the Deputy Head of the Center of Nano Science and Technology in CAS, and the Chairman of Nano Material Expert Committee in Anhui Province. She received her Bachelor's from Anhui University in 1982, and Ph. D from the Institute of Solid State Physics, CAS in 1990. She has applied for more than 10 patents. As author of more than 40 research papers and a book named Nano Material, she is an influential scientist and outstanding contributor to the field of nanomaterial.

Session 3: Advanced Materials Industrial Applications
Convener: Ping Cui

Session 3: Advanced Materials Industrial Applications

Speaker 7 (China)

Convener Ping Cui

Thursday, 22 September

11:50 – 12:15

Deqing Zhang

Professor Deqing Zhang

Director
Institute of Chemistry, CAS
Emai: dqzhang@iccas.ac.cn

Prof. Deqing Zhang studied chemistry in Beijing Normal University from 1983 to 1987. He then joined in the Institute of Chemistry, Chinese Academy of Sciences (ICCAS) as a graduate student and obtained his MS. in Organic Chemistry in 1990. He conducted research on electron donor–acceptor cyclophanes at the Max-Planck Institute for Medical Research in Heidelberg (Germany) under the supervision of Prof.Dr H. A. Staab, and received his Doctor degree (DR. RER. NAT.) from Ruprecht-Karls University Heidelberg in 1996.

He is now a research Professor in Institute of Chemistry, Chinese Academy of Sciences (ICCAS) and the director of the Institute. His research interests include development of external stimuli-responsive molecular systems for molecular switches, logic gates and chemical/bio-sensors. He also shows interests in design and synthesis of organic functional materials and organic nanoassemblies. He has published more than 200 papers in refereed journals. He serves as editorial advisory board member of several scientific journals including Adv. Mater., Adv. Funct. Mater., ACS Interface & Appl. Mater., Polymer J., Adv. Sci., Mater. Chem. Frontiers, Sci.-China Chemistry. His is one of the co-editor of ACS Omega.

A Significant Improvement of the Semiconducting Performance for the DPP-Quaterthiophene Conjugated Polymer through Side-Chain Engineering via Hydrogen-Bonding

Organic and polymeric semiconductors have received tremendous attentions in recent years because of their applications in thin film field effect transistors and photovoltaic cells. Significant efforts have been made for the design and synthesis of various conjugated frameworks to improve the semiconducting performance. Side alkyl chains are linked to the conjugated backbones to improve their solubilities in organic solvents. However, recent studies indicate that the attractive van der Waals interactions between the alkyl side chains can exert an important influence on the interchain packing and backbone conformation, and as a result the thin film microstructure and charge transporting are affected.

We report a new and efficient strategy for the improvement of semiconducting performance of conjugated polymer by incorporating urea groups in the side alkyl chains. Three DPP-quaterthiophene conjugated polymers pDPP4T-1, pDPP4T-2 and pDPP4T-3, in which the molar ratios of the urea-containing alkyl chains vs branching alkyl chains are 1:30, 1:20 and 1:10, respectively, were prepared and investigated. In comparison with pDPP4T without urea groups in the side alkyl chains and pDPP4T-4 containing both linear and branched alkyl chains, thin films of pDPP4T-1, pDPP4T-2 and pDPP4T-3 exhibit higher hole mobilities; thin film mobility increases in the following order: pDPP4T-1<pDPP4T-2 <pDPP4T-3, and hole mobility of thin film of pDPP4T-3 can reach 13.1 $cm^2 V^{-1} s^{-1}$ after thermal annealing at just 100 °C. The incorporation of urea groups in the side alkyl chains also has an interesting effect on the photovoltaic performances of DPP-quaterthiophene conjugated polymers after blending with $PC_{71}BM$.

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speaker 7 (Australia)

Convener Ping Cui

Thursday, 22 September

12:15 – 12:40

Murray Scott

Professor Murray L Scott

Founder and Chairman
Advanced Composite Structures Australia Pty Ltd
Email: m.scott@acs-aus.com

Prof. Murray Scott is Founder and Chairman of Advanced Composite Structures Australia, the specialist engineering spin-out company of the world renowned Cooperative Research Centre for Advanced Composite Structures, of which he was Chief Executive Officer for over 13 years. He is an Adjunct Professor of RMIT University and has 35 years' engineering experience working in both industry and academia. He a Fellow of the Australian Academy of Technology and Engineering, the Royal Aeronautical Society and Engineers Australia, and is also a long-standing World Fellow of the International Committee on Composite Materials, which he served as President in 2001-03. Since 1994, he has represented Australia on the International Council of the Aeronautical Sciences and has served in various capacities including as President in 2013-14. He continues to focus on developing new technologies for the design, manufacture and support of application-critical fibre composite structures in aerospace and other fields.

Application of New Fibre Composite Materials Technologies to Advanced Light-Weight Structures

The advanced composites research community in Australia has been a strong contributor for more than two decades to the development and application of new production technologies for carbon fibre composite components, particularly for the global aerospace industry. In this presentation a review of current Australian activities in the field will be provided, including the latest on implementing new technologies in a wide range of areas. Particular emphasis will be placed on the transition of collaborative research undertaken in the Cooperative Research Centre for Advanced Composite Structures into production.

Increasing international competitive pressures are creating even greater demand for overall cost and weight reductions of structures, especially in the commercial aerospace sector. Opportunities to achieve the required improvements exist in the design and certification of new components by reducing testing and development lead times through advanced simulation capabilities, replacing labour-intensive fibre lay-up and preforming processes, implementing new liquid moulding technologies, and simplifying assembly by the utilisation of new methods. Experienced engineering development organisations are well positioned to deliver on these opportunities through the application of expertise gained in research programs and associated knowledge of new enabling technologies.

12:40 – 14:00 Lunch Buffet, Cafeteria, Hotel Second Floor

Session 3: Advanced Materials Industrial Applications

Speaker 8 (China)

Convener Ping Cui

Thursday, 22 September

14:00 – 14:25

Jian Xu

Professor Jian Xu

Institute of Chemistry, CAS
Email: jxu@iccas.ac.cn

Jian Xu got his Ph. D. from Sichuan University in 1994, and then worked in Institute of Chemistry CAS, first was a postdoctoral fellow from 1995 to 1996, and then promoted to Associate Professor at 1996 and Full Professor at 1999. He was the Vice Director of ICCAS from 2000 to 2008, the Vice Director of State Key Laboratory of Polymer Physics and Chemistry from 1998 to 2005, the Chief Scientist for Structure Materials in National 863 Program. His research interests include the bionic microstructure and morphology of polymeric materials, and their performance and smart behaviors, the advanced polymer fibers. He has published over 250 papers and awarded more than 90 patents.

Bio-inspired Polymer Materials and Their Applications by Sol-gel Processing Based on Marine and Nature Organisms

Nature and marine always give us inspirations for fabricating functional materials by mimicking the structure design or stimuli-responsive capability of biomaterials. However, the strict preparation conditions, multi-step processes and high cost of the methods to create biomimetic systems at interface and in bulk, limited their practical applications. Therefore, developing simple, cheap but effective method becomes the focus of our research in this field. The amazing properties of biomaterials are the result of evolution for billions of years. Generally, biomaterials are assembled with limited supply of constitutes available to living organism under mild conditions. The surprising properties of biomaterials are largely resulted from the sophisticated hierarchical structures. Following the design principles of nature to prepare manmade materials has drawn great research interests in materials science and engineering. In the past decades, a large number of papers in this field have been published. In this review, the recent progress in the preparation of bio-inspired materials focused on the structure mimicking is summarized. Selected examples from low to high dimension are described with emphasis on the relationship between the structure and the corresponding functions.

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Session 3: Advanced Materials Industrial Applications

speaker 8 (Australia)

Convener Ping Cui

Thursday, 22 September

14:25 – 14:50

Leonie Walsh

Dr. Leonie Walsh

Government Liaison
Australasian Industrial Research Group
Email: leoniewalsh@me.com

Leonie Walsh is an experienced leader and adviser in technological innovation with a background that spans more than 25 years of experience in the areas of technology development and commercialization both locally and internationally across a diverse range of industries and applications.

More recently Leonie completed a 3-year term as Victoria's inaugural Lead Scientist. In this capacity Leonie was a contributing member on the Future Industries Ministerial Advisory Council, provided contributions to the Education State activities and STEM plan via the Tech Schools STEM Future Industries Advisory Panel and the STEM advisory committee, represented Victoria on the Forum of Australian Chief Scientists and participated on a range of advisory committees and funding assessment panels spanning innovation, education and advanced manufacturing. Complementary to the Lead Scientists role Leonie Walsh held the honorary role of President of the Australasian Industrial Research Group (AIRG) from 2011 to 2015. In this position Leonie established international collaborations through a new World Federation of Industrial Research Associations and as a partner of the Australian Governments SME to Researcher collaboration (CAESIE) between Australia and the European Union. Leonie continues to focus on strategic science and technology issues including innovation efficiency, technology commercialization, the future skilled workforce and women in science through a range of related boards, advisory and advocacy activities.

Leonie Walsh has received a BSc and an MSc from Swinburne University, an MBA (Exec) from the Australian Graduate School of Management and is a Fellow of the Academy of Technological Sciences and Engineering. In 2014 Leonie received an Honorary Doctorate (HonDUniv) from Swinburne University of Technology for contributions and leadership in scientific enterprises, innovation and the community.

Advanced Industrial Materials core to Australia's growth and competitiveness

Advancing our science and technology, from fundamental breakthroughs in materials and chemistry to improving manufacturing processes, is critical to our economic growth as the manufacturing sector transitions away from conventional manufacturing capability to more advanced manufacturing processes.

These continual advances in the development of next generation materials have been core to manufacturing and the economy for many decades both with respect to creating new materials, improving existing materials and also finding new combinations of both in new structures. Competitiveness in a breadth of markets such as new energy, textiles, automotive, healthcare, defence and construction will depend on the continual improvements in materials to provide lighter, tougher, temperature resistant, permeable and more cost effective materials with the capability of improved design, processing and customization.

Advanced materials alone will not be enough however in combination with innovative processes and business models can provide Australian industry with opportunities to develop increased international collaborations and new markets.

14:50 – 15:20 Tea Break and Poster Presentation

Session 3: Advanced Materials Industrial Applications

Speaker 9 (China)

Convener
Ping Cui

Thursday, 22 September

15:20 – 15:45

Rui Yang

Professor Rui Yang

Institute of Metal Research, CAS
Email: ryang@imr.ac.cn

Rui Yang obtained his BSc from the Department of Mechanical Engineering, Wuhan Institute of Hydraulic and Electric Engineering in 1984 and read for his MSc in metallic materials at the Institute of Metal Research (IMR), CAS. He obtained a PhD in materials science from the University of Cambridge in 1992 and was elected a Title *A Research Fellow of St John's* College Cambridge 1992-1995. He has been the head of Titanium Alloys Division of IMR since 1997. Under his leadership the laboratory developed a number of titanium based materials, including gamma and orthorhombic titanium aluminides, silicon carbide fibre reinforced titanium matrix composite, low modulus superelastic titanium alloys, as well as near net shape processes of powder metallurgy and investment casting. He has authored and coauthored more than 200 peer-reviewed papers and held more than 30 Chinese patents and 2 US patents. He was a recipient of the Applied Science Award from Zhou Guang Zhao Foundation (2010) and of the Metallurgy and Materials Technology Award from Ho-Leung Ho-Lee Foundation (2011). Dr. Yang was appointed the director of IMR in July 2012.

Development of Net-shape Cast TiAl Low Pressure Turbine Blades and Application in Advanced Aircraft Engines

Modern air travel demands low fuel consumption as well as minimum environmental impact which means reduced emission and take-off noise. A key technology to achieve this goal is to use light-weight high temperature materials such as gamma titanium aluminide to replace superalloys to produce low pressure turbine blades in the aircraft engines. TiAl based materials are hard to deform and difficult to machine compared to conventional alloys, and the high total cost from material to component must be reduced. At IMR we developed a low-cost process of net-shape casting TiAl low pressure turbine blades, removing the necessity of machining the aero-foil and significantly reducing the manufacturing cost of this type of components. Blades produced using this technology have been successfully tested on the Trent XWB engines of Rolls-Royce and application is underway.

China-Australia Symposium on Advanced Materials

Professor Huijun Zhao

Griffith University
Email: h.zhao@griffith.edu.au; hjzhao@issp.ac.cn

Huijun Zhao obtained his PhD in Chemistry (1994) from the University of Wollongong, Australia. He currently is a Professor of the Griffith School of Environment and the Director of the Centre for Clean Environment and Energy of the Griffith University. He also holds a 1000-talent Professorial position and is the Director of the Centre for Environmental and Energy Nanomaterials at the Institute of Solid State Physics, Chinese Academy of Sciences. He has expertise in field-based sensing technologies, aquatic environmental quality assessment, water source control & management and energy & environmental materials.

Unlocking Catalytic Potentials of Earth Abundant Materials for Energy Conversion and Device Fabrication

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

This presentation intends to report few widely applicable approaches to unlock the catalytic activities of transition metal oxides and graphitic carbon materials for energy conversion and device fabrication.

16:10 – 16:55	Session 3 Wrap up
16:55 – 17:10	Symposium Wrap up and Close

Session 3: Advanced Materials Industrial Applications

speaker 9 (Australia)

Convener
Ping Cui

Thursday, 22 September

15:45 – 16:10

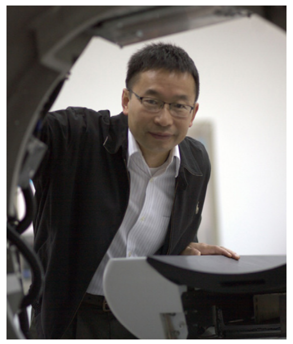
Huijun Zhao

Poster Presentations

Haochuan Jiang

Professor Haochuan Jiang

Ningbo Institute of Material Technology and Engineering, CAS
Email:jianghaochuan@nimte.ac.cn



Dr. Haochuan Jiang is a professor of Materials Science and Engineering in Ningbo Institute of Material Technology and Engineering, CAS. He received his Ph. D. degree from Alfred University in 1998. Then he worked in GE Healthcare till 2012 as Process Engineer, Sr. Project Engineer, Program Manager and Principle Engineer, respectively. While he worked in GE, he managed NPI program and led the technology and process development for Gemstone scintillator. In 2012, Dr. Haochuan Jiang joined the Ningbo Institute of Materials Technology and Engineering. During the past four years, Professor Jiang's group was focusing on the fabrication and performance tuning of GGAG:Ce ceramic scintillators. At present, the GGAG:Ce ceramic scintillators with excellent light yield and afterglow performances have been fabricated, and Professor Jiang is committed to realize the industrialization of this product.

GGAG:Ce Transparent Ceramics for Scintillator Applications

Cerium doped gadolinium gallium aluminum garnet ceramics has the potential of becoming the next generation scintillation material for medical imaging CT detectors, for their superior properties like high light output, fast decay and low afterglow. During the past few years, Jiang's group in CNITECH were focusing on the fabrication and performance tuning of GGAG:Ce ceramic scintillators. In their studies, high-quality GGAG:Ce powders were synthesized by co-precipitation method. Then, the powders were sintered in oxygen atmosphere, and treated with a combination of hot isostatic pressing and annealing treatment afterward. The light yield and energy resolution of GGAG:Ce ceramics under ^{137}Cs excitation achieved 46000±920 photons/MeV and 8.6%, respectively. Scintillation decay time under ^{137}Cs irradiation was about 46 ns. The afterglow decay to below 10-4 within 20 ms after the X-ray was cut off.

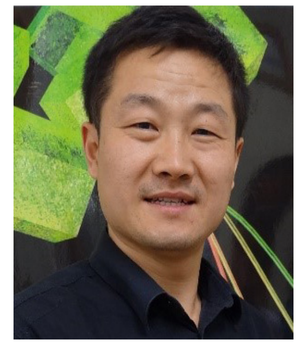
China-Australia Symposium on Advanced Materials

Dayong Jin

University of Technology Sydney
Email: dayong.jin@uts.edu.au

Poster Presentations

Dayong Jin



Professor JIN, Dayong is an ARC Future Fellow in nanotechnology, photonics & medical biotechnology, the Director of Australian Research Council Industry Transformational Research Hub for Integrated Device for End-user Analysis at Low-levels (IDEAL), the Director of UTS research Institute for Biomedical Materials & Devices (IBMD), a Chief Investigator of ARC Centre of Excellence for Nanoscale Biophotonics, and the winner of the Australian Museum Eureka Prize for Interdisciplinary Scientific Research in 2015.

He is a technology developer with expertise covering optics, luminescent materials, nanocrystal growth, sensing, automation devices, nanotechnology, microscopy imaging, and analytical chemistry to enable rapid detection of cells and molecules and engineering of sensors and photonics devices. Since 2008, Prof. Jin established the Advanced Cytometry Labs @ Macquarie University, where he developed a new material library of multi-functional Super Dots® for rapid diagnostics, nanoscale molecular imaging and anti-counterfeiting applications. In 2015, Prof. Jin accepted an offer to join the University of Technology Sydney as a full professor to lead its Materials and Technology research strength and grow the UTS Institute of Biomedical Materials & Devices.

Lanthanide Luminescent Materials and Applications

My presentation will showcase our roadmap for developing a series of novel optical instruments for advanced characterizations and applications of rare earth based luminescent complexes and upconversion nanoparticles. In 2011, we first reported a low-cost time-gated chopper unit, compatible to any fluorescence microscopes. This realizes background-free true-colour imaging of rare cells against the complex bio samples. In 2012, we developed a high speed scanning cytometry for rare-event detection in noisy backgrounds with higher sensitivity.In 2013, we demonstrated a fibre based system and discovered that the concentration quenching is power dependent, which leads to the brightest upconversion nanocrystals developed for sensing. In 2014, we reported a new lifetime scanning technique and a library of luminescent probes with tunable microsecond lifetimes (t) , offering significant advantages in high speed and high throughput sensing of multiple analytes in a single test (multiplexing).
Since we moved to the University of Technology Sydney in 2015, several new advances have been made. In material science, we demonstrated a fabrication technique for producing heterogeneous nanoparticles with desirable size, shape, surface, and composition placements with atomic scale precision. In bio-/nano- interface chemistry, we developed a simple and rapid protein bio-conjugation method based on a one-step ligand exchange using the DNAs as the linker. In instrumentation, we engineered an on-the-fly stage scanning method to achieve precise target pinpointing across the whole slide. Most recently, we developed a time-gated imaging approach for small animal imaging, and a new laser scanning confocal microscopy system for quantitative characterizations of single upconversion nanocrystals.

Professor Nan Jiang

Ningbo Institute of Material Technology and Engineering, CAS
Email: jiangnan@nimte.ac.cn

Nan Jiang is professor and director of Surface Engineering Division, Ningbo Institute of Material Technology and Engineering, CAS. His primary research interests include frontier carbon, thermal management composites and nanotechnology. He is the author of over 100 publications and the inventor of 87 patents. He was granted the *R&D 100 Awards* in 2009 due to successful development of highly thermal conductive carbon composite materials.

The Progress in Synthesis of Large CVD Diamond Single Crystals

Functional Carbon Materials R&D Group at Ningbo Institute of Material Technology and Engineering has achieved a series of technical breakthroughs in synthesis of large-size CVD diamond single crystals. They successfully exploited MPCVD equipment that can generate high-density, stable plasma available for high-speed single crystalline diamond growth. The growth rate reaches 70 μm/h when using H_2 and CH_4 mixture gas, and that can be over 150 μm/h as putting N_2 addition. Also, this group developed proprietary synthesis process that can eliminate the deposition "edge-effect", ensuring single crystalline diamond contiguous growth without formation of polycrystalline particles on the substrate edges. Comparing with conventional technology, the approaches developed has a cost-down over 60% for single crystalline diamond fabrication, and these achievements have been transferred into industry at Ningbo, aiming at accelerating commercialization progress of CVD diamond precision tool and carat-grade diamond jewelry.

Professor Jian Zhang

Fujian Institute of Research on the Structure of Matter, CAS
Email: zhj@fjirsm.ac.cn

Jian Zhang was born in Hunan, China. He graduated from Xiamen University in 2001 and obtained his Ph.D. in 2006 from the Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences (FJIRSM-CAS). After three years of postdoctoral work with Prof. Xianhui Bu at California State University, Long Beach, he came back to FJIRSM-CAS and served as a full research professor in September 2009. He has authored and coauthored more than 200 peer-reviewed papers. In 2014, he won National Science Fund of Distinguished Young Scholars. His current research interest is in the synthesis and application of metal–organic complexes.

Crystal Engineering of Titanium-oxo Clusters and Porous Materials

In this poster, I will show our recent works on titanium-oxo clusters and metal-organic frameworks. The titanium-oxo cluster $[Ti_{42}(\mu_3\text{-}O)_{60}(OiPr)_{42}(OH)_{12}]^{6-}$ (TOF-1) with the first fullerene-like Ti-O shell structure is presented. The $\{Ti_{42}O_{60}\}$ core of this compound exemplifies icosahedral (Ih) symmetry as C_{60}, the highest possible symmetry for molecules.Through the labile coordination sites of a robust phosphonate-stabilized titanium-oxo cluster, 14 O-donor ligands have been successfully introduced without changing the cluster core. The increasing electron-withdrawing effect of the organic species allows the gradually reduction of bandgaps of the $\{Ti_6\}$ complexes. Transition metal ions are then incorporated by the utilization of bifunctional O/N-donor ligands, organizing these $\{Ti_6\}$ clusters into polymeric structures. We report a 3.6 nm Ti_{52}-oxo cluster with precise atomic structure, which presents a largest size record in the family of titanium-oxo clusters (TOCs). The crystal growth of such large Ti_{52} is based on a stepwise inter-layer assembly approach from Ti_6 sub-structures. This work not only represents a milestone in constructing large TOCs with comparable sizes as TiO_2 nanoparticles, also brings significant advances in improving photocatalytic behaviors of TOCs.

Dr. Irene Suarez-Martinez

Curtin University
Email: I.Suarez-Martinez@curtin.edu.au

Poster Presentations

Irene Suarez-Martinez

Dr Irene Suarez-Martinez is a Research Fellow at the Physics Department in Curtin University (Perth, Australia). Originally from Spain, Irene completed her PhD from University of Sussex (UK) in 2007. After a post-doc at the Institute of Materials of Nantes (France), she moved to Curtin University for her second post-doc in 2009. The year after, she obtained an ARC Australian Postdoctoral Fellowship (2010-2014). Her first daughter and her current ARC Future Fellowship award arrived almost at the same time in 2014. Her research career has been mainly dedicated to the atomistic modelling of carbon materials. In collaboration with experimental chemists, physicists and engineers, she has investigated graphite, diamond, amorphous carbons and a range of carbon nanomaterials. She has won multiple prizes for her scientific outreach projects and particularly enjoys creating scientific artistic images.

Graphitization Of Carbon Materials

The conversion of carbon source material into graphite is a complex multi-step process which begins with any carbonaceous substance and concludes with a three dimensional crystal. Given that graphite is the most thermodynamically stable allotrope of carbon, one may expect that heating any carbonaceous materials to high enough temperatures would produce graphite. However, this is not the case and the mechanism of graphitization remains unclear. High temperature treatment of carbonaceous materials leads to a broad range of structures with very different properties. Some materials resemble the crystalline structure of graphite and some are graphite after the heat treatment, while others are remarkably different and are known as non-graphitizing carbons.

The overall aim of this project is to develop a computer-based model for non-graphitizing carbons to be used for the analysis and prediction of their properties. In this poster, I will present results of our modeling of graphitization and explore the relationship with other carbon nanostructures. I will explore the implications of non-graphitization in materials such as carbide derived-carbons (known as nanoporous carbons), activated carbons (often used in filters) and black carbon (the second most important greenhouse-forcing agent).

China-Australia Symposium on Advanced Materials

Professor Junhua Luo

Fujian Institute of Research on the Structure of Matter,CAS
Email: jhluo@fjirsm.ac.cn

Poster Presentations

Junhua Luo

Dr Junhua Luo is Principal Investigator at the Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences. He obtained his PhD in 2003 from the Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences. From 2003 to 2009, he did postdoctoral research in North Carolina State University, University of Florida and Los Alamos National Laboratory, respectively. He received the Distinguished Young Investigator Award, National Science Foundation (China), in 2015. His current research focuses on the study of organic/inorganic hybrid semiconducting materials, molecular ferroelectric and nonlinear optical materials.

Non-Centrosymmetric Structure-Based Optoelectronic Crystalline Materials

Non-centrosymmetric structure-based optoelectronic crystalline materials such as nonlinear optical (NLO), piezoelectric, pyroelectric and ferroelectric materials are of great interest owing to their uses in optical signal processing, sensing, and data storage. Deep UV beryllium-free borates and phosphates NLO materials, NLO switch materials and molecular ferroelectric materials including organic-inorganic hybrid semiconducting ferroelectrics have been successfully constructed, and their optoelectronic properties will be reported.

Poster Presentations

Aiguo Wu

Professor Aiguo Wu

Ningbo Institute of Material Technology and Engineering, CAS
Email: aiguo@nimte.ac.cn

Prof. Aiguo Wu received his B.S. degree from Nanchang University in 1998 with honor and obtained his PhD degree from State Key Laboratory of Electroanalytical Chemistry, Changchun Institute of Applied Chemistry, CAS in 2004. He worked as postdoc at University of Marburg in Germany from 2004 to 2005, and then he joined Prof. Ahmed H. Zewail's (Nobel Prize winner for Chemistry in 1999) group at California Institute of Technology as postdoctoral scholar. During 2006-2009, he worked as research associate in Feinberg School of Medicine, Northwestern University, USA. He returned China in June 2009, and set up his research team in CNITECH, CAS. He worked in University of Marburg as a visiting professor for his sabbatical in 2015. Now, his research interests focus on (1) Contrast agents for magnetic resonance imaging based on metal oxide nanomaterials; (2) Study of TiO_2 based nanocrystals and its applications in biomedical imaging and therapy for cancer; (3) Multifunctional metal oxide nanocomposite materials for visualized therapy for cancer. His group has been supported by many research projects, and the total funds are more than 20 million RMB. He has published more than 110 papers in peer reviewer international journals (Cited >2600 times, H-index=26), and applied 75 Chinese, international and USA patents which has been awarded 43 including 1 US patent. As a co-editor, he published one book named Nanomaterials for Tumor Targeting Theranostics. He serves as editorial board member of several scientific journals including Nanotheranostics, Journal of Bioanalysis & Biomedicine, and Journal of Bioequivalence & Bioavailability. He is the gust editor of Current Medicinal Chemistry.

Contrast Agents in Magnetic Resonance Imaging (MRI) Based on Metal Oxides Nanoparticles for Cancer Imaging and Visualization Therapy

Magnetic resonance imaging (MRI) has its advantages for example no radiation, deep penetration, high spatial resolution and soft-tissue sensitivity compared with other biomedical imaging ways for instance, computed tomography (CT), poistron emission tomography (PET) and optical imaging etc.. Particularly, the use of MRI contrast agents further provides the more precise data, and will greatly help the early diagnosis, visualization therapy, and prognosis evaluation in cancer. Recently, paramagnetic and superparamagnetic inorganic nanoparticles were widely investigated as MRI contrast agents. Moreover, these nanoparticles can be functionalized as visualized nanoprobes for multimodal imaging (MRI, CT, fluorescence, upconversion luminescence (UCL), and PET etc.) and multifunctional therapy (photodynamic therapy (PDT), photothermal therapy (PTT), chemotherapy, and radiotherapy). Therefore, it is very necessary to develop MRI contrast agents based on metal oxide nanoparticles for visualized theranostics in cancers.

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Poster Presentations

Youhong Tang

Dr. Youhong Tang

Flinders University
Email: youhong.tang@flinders.edu.au

Dr. Youhong Tang is a senior lecturer and was an Australian Research Council-Discovery Early Career Researcher (ARC-DECRA) fellow at Flinders University. He is a research leader in Centre for NanoScale Science and Technology (CNST). He obtained his PhD degree in the Hong Kong University of Science and Technology (HKUST) in 2007. He moved to Flinders University in 2012 from Centre for Advanced Materials Technology (CAMT), the University of Sydney. He is a material science and engineering researcher with research interests mainly focused on (1) structure-process-property relation of polymeric nanocomposites and fibre reinforced composites and (2) aggregation-induced emission florescent dyes for various applications. In the last 5 years, he has published >120 SCI journal papers, >50 conference papers, 5 book chapters and 2 books. His group has secured 4 funds from Australia Research Council (ARC), 1 fund from Australian Solar Thermal Research Initiative (ASTRI) and 1 fund from South Australian Government.

Aggregation-induced Emission Florescent Dyes for Medical Applications

A photophysical phenomenon associated with chromogen aggregation is aggregation-induced emission (AIE), which is opposite to the ubiquitous aggregation-caused quenching phenomenon, a common to most aromatic hydrocarbons and their derivatives. In the AIE process, weakly luminescent chromogens are induced to emit efficiently by the aggregate formation. The restriction of intramolecular motion processes mechanistically account for all the AIE systems developed so far. Two cases of AIE for medical applications have been highlighted. (1) Monitor α-synuclein fibrillation in Parkinson's disease. An AIE fluorophore, TPE-TPP, is utilized as a fluorescence probe to monitor the α-Syn fibrillation process. Compared with ThT (the commercial probe), TPE-TPP shows a higher sensitivity in the detection of α-Syn oligomers as well as fibrils with a stronger fluorescence and (2) Point-of-care of chronic kidney disease with smart phone devices. The urine albumin to creatinine ratio (UACR) test is a standard urine test for identifying individuals at high risk of developing progressive kidney disease. IDATPE and BSPOTPE are successfully developed for creatinine and human serum albumin (HSA) quantitation. 3D printed imaging house is attached to a smartphone for quantitatively analyses HSA & creatinine concentration in urine to get UACR is developed. Linear relationship between HSA concentration and light intensity (taken by smartphone) to show the quantitatively analyses HSA concentration in urine by light intensity changing analysed by a custom-built Android App.

Professor Decheng Wu

Institute of Chemistry, CAS
Email: dcwu@iccas.ac.cn

Dr. Decheng Wu (BS and MS, 1998 and 2001 at University of Science and Technology of China; PhD, 2006 at National University of Singapore) is a professor and group leader of the Institute of Chemistry, Chinese Academy of Sciences since 2011. He was a (senior) research engineer in the Institute of Materials Research and Engineering, Singapore from 2005 to 2010. In 2011, he was selected as one of the first *Young Thousand Talents*. He has published 65 research papers in the prestigious international journals, and filed 6 PCT patents (granted) and 15 Chinese patents (5 granted). He is focusing on biomedical polymers, with particular interests in synthesis of POSS and polyketal dendrimers, controlled formation of hydrogels, and fabrication of uniform polylactone microparticles and scaffolds for applications in bioimaging, drug delivery and tissue engineering.

Controlled Fabrication and Biomedical Applications of Stimuli-responsive Hydrogels

Stimuli-responsive hydrogels have been widely developed due to their handily and readily tailored properties under various external stimuli, such as pH, temperature, electricity, redox, and light. However, the customized adjustment on hydrogel properties is still a challenge because of the difficulty in achieving the precise control of crosslinking degree once gelation is initiated. Herein, we present a controlled cross-linking strategy to construct stimuli-responsive hydrogels with adjustable mechanical properties and degradable behaviors. The strategy is achieved by controllably activating and terminating the cross-linking reactions of disulfide-linked core/shell materials with hydrophobic nanoparticle cores and hydrophilic polymer shells via manipulating the pH or light irradiation of the systems. Applications in self-healing, hemorrhage control and infection prevention were discussed in detail. Overall, the controlled cross-linking strategy provides a facile approach to producing hydrogels with adjustable structures and properties, opening up design possibility, flexibility and complexity of hydrogels with customized properties and applications.

China-Australia Symposium on Advanced Materials

Professor Aisheng Huang

Ningbo Institute of Material Technology and Engineering, CAS
Email: huangaisheng@nimte.ac.cn

Poster Presentations

Dr. Aisheng Huang is a full professor of Ningbo Institute of Material Technology & Engineering (CNITECH), Chinese Academy of Sciences (CAS), China. He obtained his Ph. D in Physical Chemistry from Dalian Institute of Chemical Physics of CAS in 2005. After working 3 years at Tongji University in Shanghai, in 2008 he joined in Leibniz University Hannover, Germany, and worked in the group of Prof. Jürgen Caro as Group Leader. In 2012 he joined in CNITECH as a professor and a candidate of *Hundred-Talent Project*. In 2013, Dr. Huang was selected as a candidate of *Young 1000 Talent* sponsored by the Chinese Central Government. His research interests focus on zeolite molecular sieve membranes, metal-organic frameworks membranes, organic-inorganic hybrid material, and membrane catalysis. Until now, as first-author or corresponding author, he has published over 60 peer-reviewed papers in international journals, including Angew Chem, JACS, ChemComm, Chem Mater, and 2 book chapters. Currently, he serves as a referee for more than 20 journals, such as Angew Chem, Coordin Chem Rev, Chem Sci, Adv Mater, Environ Sci Technol.

Efficient synthesis of dimethyl ether from methanol in a bi-functional zeolite membrane catalytic reactor

As a promising and clean alternative to diesel fuel, dimethyl ether (DME) has drawn increasing attention in the recent years. However, the productivity and selectivity of DME are usually limited by the reaction equilibrium, resulting in a big challenge to enhance simultaneously the productivity and selectivity of DME. In the past two decades, attributing to process intensification by combining catalysis and molecular sieving in one apparatus, zeolite-based catalytic membrane reactors (CMRs) have drawn increasing interest for the selective in-situ removal of one or more products during a reaction to overcome an equilibrium limitation and thus increasing the conversion. In the present work, a sandwiched zeolite FAU-LTA dual-layer membrane has been developed and used as catalytic membrane reactor for the synthesis of DME. In the top FAU layer with mild acidity, methanol is dehydrated to DME. The other reaction product water is in-situ removed through a hydrophilic LTA layer, which is located between the porous alumina support and the FAU top layer. The combination of the mild acidity with the continuous removal of water results in high methanol conversions (90.9% at 310 °C) and de facto 100% DME selectivity. Attributing to the selective and continuous removal of the produced water from the reaction system, the reaction is easily shifted to the product side and the deactivation of the catalyst can be helpfully avoided, leading to a high stability of the catalytic membrane reactor.

Dr. Hong Yin

CSIRO
Email: Hong.Yin@csiro.au

Poster Presentations

Hong Yin

Dr. Hong Yin is a Research Scientist at Commonwealth Scientific and Industrial Research Organisation (CSIRO) Manufacturing, Australia. She obtained her PhD in Materials Science and Engineering from National University of Singapore in 2007. She moved to CSIRO Melbourne in 2008 as a postdoctoral fellow, then prompted to Research Scientist in 2012. Dr. Yin's expertise includes synthesis and surface modification of nanoparticles, high-throughput nanomaterials fabrication and characterisation, and in vitro toxicity assessment of nanoparticles. She has played leader roles in several internal and external projects including materials study in nanosafety, correlating of physicochemical properties of ZnO nanoparticles with their toxicological responses using experimental and computational methods, and development of quantum dots sensor for heavy metal detection.

An Experimental and Computational Approach to the Development of ZnO Nanoparticles that are Safe by Design

ZnO nanoparticles have found wide application due to their unique optoelectronic and photocatalytic characteristics. However, their safety aspects remain of critical concern, prompting the use of physicochemical modifications of pristine ZnO to reduce any potential toxicity. However, the relationships between these modifications and their effects on biology are complex and still relatively unexplored. To address this knowledge gap, a library of 45 types of ZnO nanoparticles with varying particle size, aspect ratio, doping type, doping concentration, and surface coating is synthesized, and their biological effects measured. Three biological assays measuring cell damage or stress are used to study the responses to the nanoparticles. These experimental data are used to develop quantitative and predictive computational models linking nanoparticle properties to cell viability, membrane integrity, and oxidative stress. It is found that the concentration of nanoparticles the cells are exposed to, the type of surface coating, the nature and extent of doping, and the aspect ratio of the particles make significant contributions to the cell toxicity of the nanoparticles tested. Our study shows that it is feasible to generate models that could be used to design or optimize nanoparticles with commercially useful properties that are also safe to humans and the environment.

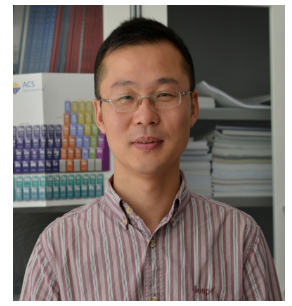
China-Australia Symposium on Advanced Materials

Professor Gang Liu

Institute of Metal Research, CAS
Email: gangliu@imr.ac.cn

Poster Presentations

Gang Liu



Gang Liu received his PhD degree in Materials Science at Institute of Metal Research (IMR), Chinese Academy of Sciences (CAS) in 2009. During his PhD study, he worked at The University of Queensland for 1.5 years in Australia. He was the recipient of the T. S. Kê RESEARCH FELLOWSHIP founded by Shenyang National Laboratory for Materials Science, IMR CAS between 2009 and 2012 before he was promoted to be a research Professor in IMR. Now he is a professor of Materials Science in IMR focusing on photocatalytic materials for solar fuels and an author of over 100 peer-reviewed papers in journals. He is the recipient of NSFC Excellent Young Scientists and The Royal Society-Newton Advanced Fellowship.

Designing Red Semiconductor Photocatalysts for Solar Fuels

Solar-driven photocatalysis is a promising technology of utilizing intermittent solar energy to produce storable chemical fuels from water splitting/CO_2 reduction or to decompose pollutants in environment and water. Developing photocatalysts with the ability of fully harvesting photons in visible light range (400-700 nm) is indispensable in order to reach a satisfactory solar energy conversion efficiency. Most stable metal oxide photocatalysts like TiO_2 suffer from too wide bandgap to absorb visible light. Narrowing the bandgap of these wide-bandgap photocatalysts down to 2 eV has long been targeted. If successful, these photocatalysts usually have a red color. Here, on the basis of different strengths of chemical bonds in materials, we developed a couple of strategies of promoting the introduction of heteroatoms or vacancies in photocatalysts and destroying the long-range order for the bandgap narrowing: 1) For metal oxides with only strong metal-oxygen bonds, the strategy of weakening metal-oxygen bonds by interstitial heteroatoms was developed so that the energy for replacing oxygen with suitable dopants like nitrogen can be greatly reduced. By doing this, a red anatase TiO_2 photocatalyst was produced for the first time. 2) For the materials with both strong chemical bond and weak chemical interaction like hydrogen bonding, selective breaking weak bonds by introducing vacancies can destroy the long-range order. This strategy leads to the production of red carbon nitride photocatalysts with a bandgap of around 2 eV.

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Poster Presentations

Qing Huang

Professor Qing Huang

Ningbo Institute of Material Technology and Engineering, CAS
Email: huangqing@nimte.ac.cn

Qing Huang, born in 1975, member of "One-hundred Talent Program" of Chinese Academy of Sciences, and "One-thousand Talent Program" of Zhejiang Province, full professor in Ningbo Institute of Material Technology and Engineering, Chinese academy of sciences. His research focus on the advanced nuclear material for Accident Tolerant Nuclear Fuel, including SiC fiber reinforced SiC composites and ceramic coatings on Zr cladding. He has undertaken the supports from National Natural Science Foundation of China, the Chinese Academy of Sciences, National Nuclear Energy Leading projects.

SiC Fabrication and Joining Technique for the Next Generation of Nuclear Systems

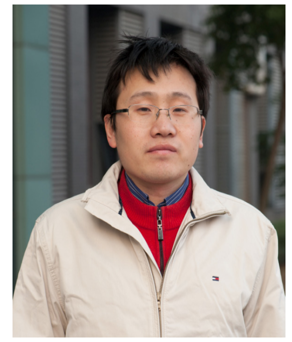
The structural materials become increasingly important for the harsh working condition of formidable corrosion, high dose irradiation and high outlet temperature in the next generation of nuclear systems. The Fukushima nuclear disaster also calls for the much safe and accident tolerant fuel system including the cladding and fuel. Our group aims to provide feasible material design and innovative fabrication process in order to overcome the shortage of current nuclear materials. More specifically, we have carried out the engineering technique research of ceramic precursor and continuous SiC fibers, composite fabrication technique and their joining method, advanced coating technique and their corrosion behavior, structure simulation and genome computation for material prediction. In this section, we introduce a novel sintering concept of carbide composites without aid and at moderate temperature. The non-stoichiometric composition of grain boundary phase controlled the sintering mechanism. Meanwhile, an electrical current auxiliary joining technique was employed to get nuclear-grade bonding of SiC composites which paves the way of the ceramics cladding to the future application.

Poster Presentations

Shiyu Du

Professor Shiyu Du

Ningbo Institute of Material Technology and Engineering,CAS
Email: dushiyu@nimte.ac.cn



Dr. Shiyu Du is a professor of material sciences, Ningbo Institute of Material Technology and Engineering, Chinese Academy of Sciences, Ningbo, Zhejiang, China. He got his Doctor's degree (Ph. D.) from Purdue University, USA. and did his postdoctoral research on computational material science at Los Alamos National Laboratory, USA. Shiyu Du got Award of Thousand Youth Talents Plan when he started his work in Ningbo, China. Now he is working on the Chinese national key research and development plan as the chief scientist. The major research interest of Shiyu Du is on the structural design of materials for various applications including nuclear engineering and electronic devices by the Materials Genome strategy and the multiscale computational method.

The strategy of Materials Genome on the design of new materials for various applications

The Materials Genome Initiative has been widely acknowledged strategy for the development of new materials. In this presentation, we will review the newly raised computational and experimental schemes for material design on the basis of the materials genome concept. As an example, our ongoing project of materials genome will be briefly introduced using both graphs and words. In addition, our recent works on material design for novel low dimensional materials promising to be applied as the next generation of electronic devices and new nuclear structural materials are also discussed as another major part of the poster.

Poster Presentations

Xiuli Sun

Professor Xiuli Sun

Shanghai Institute of Organic Chemistry (SIOC), CAS
Email: xlsun@sioc.ac.cn

Xiuli Sun received her PhD from Nankai University in 2000 and then joined Yong Tang's group in SIOC. She currently is a professor of chemistry at Shanghai Institute of Organic Chemistry. She has been working on the design and synthesis of transition metal complexes, and understanding their catalytic behaviours in ethylene polymerization. She and coworkers developed titanium complexes based on [O-NS] tridentate ligands. The titanium complexes are highly effective in promoting ethylene polymerization. In the presence of α-olefins, cycloolefins (norborene, cyclopentene etc.), and even polar comonomers such as ω-alkenol, ω-alkenoic acid, and pent-4-en-1-ol etc., comonomer was incorporated into PE backbone in high activities and good incorporations. The supported titanium complex has been applied successfully in manufacturing ultrahigh molecular weight polyethylene (UHMWPE). The produced UHMWPE resins were readily processed into UHMWPE fiber, pipe, and irregular parts. Now, they are focusing on developing new nickel catalysts to synthesize highly branched polyethylene efficiently.

Novel α-diol-ß-diimine Tetranickels Catalysts for Olefin Polymerization

Nickel complexes have been tested powerful in promoting ethylene polymerization and ethylene/α-olefins copolymerization. Of the excellent catalysts developed, nickel complexes based on benzoylmethylenetri(2-alkoxylphenyl)phosphorane, α-diimine, salicylaldimine or phosphine sulfonate showed different properties to give versatile polymers. That means the elegant ligand design could have great impact on the polymerization process to tailor the polymer tacticity, molecular weight, and branch content, etc.

Recently, we developed a facile and practical method for the synthesis of robust spiro α-diol-ß-diimine tetranickel complexes. The structure of the complexes were determined by X-Ray crystallographic analysis. Upon activation with MMAO, these tetranickel complexes promote ethylene polymerization smoothly. The activity could reach 1.9 Kg polymer/(mmol Ni)·h under 1 atm of ethylene. The polymers feature high molecular weights (Mw up to 100 $\times 10^4$ g/mol) and moderate branches (20-40 Bra/1000C). The detailed investigation revealed that synergetic effects between the nickels in one molecular likely work in the process of the polymerization. Thus, by a rational design of the complexes, both monodisperse and bimodal polyethylenes can be prepared.

Professor Minghui Yang

Ningbo Institute of Material Technology and Engineering, CAS
Email: myang@nimte.ac.cn

Poster Presentations

Minghui Yang

Prof. Minghui Yang is a professor of Ningbo Institute of Material Technology and Engineering, Chinese Academy of Sciences. He is a graduate of the University of Liverpool and completed his Ph.D. in Materials Chemistry under the supervision of Professor J. Paul Attfield and Professor Amparo Fuertes at University of Edinburgh in 2010. This was followed by a postdoctoral appointment in the Department of Chemistry and Chemical Biology at Cornell University, working on nano-structured functional materials for renewable energy and environmental applications with Professor Francis J. DiSalvo at Energy Materials Center at Cornell.

He received a China National "Thousand Youth Talents" Award for Distinguished Professorship and joined the Dalian National Laboratory for Clean Energy (DNL) at DICP in 2014. He was awarded 'Science Award of Excellent Young Researcher of Shenyang Branch, CAS in 2014. He has 35 publications in top journals including Nature Chemistry, JACS, Energy Environ. Sci., ACS Nano, Chem. Mater., Small and Chem. Comm. He held more than 10 patents and one PCT patent.

Solid State Metal (oxy)nitride Functional Materials

Metal oxynitrides have shown prodigious potential in many fields including photocatalytic water splitting, optical detection and electrochemical applications. This is due to the physical and chemical properties of oxynitrides that can be easily tuned by varying their nitrogen and oxygen contents. Here we present series of our investigations on metal oxynitrides, from crystal structure studies to their applications. The works shown here include the crystal structure and anion ordering studies of metal oxynitrides as well as a simple process for preparing mesoporous transition metal nitrides without the use of nano-patterning or other template. Furthermore, these materials show remarkable properties for the fields of clean energy and sensing applications.

Professor Daokui Xu

Institute of Metal Research, CAS
Email: dkxu@imr.ac.cn

Daokui Xu obtained PhD in material science from the Institute of Metal Research, Chinese Academy of Sciences 2008. He was a research fellow in the ARC Center of Excellence, Design of Light Metals at Monash University from 2008 to 2011. In 2011, he moved back to the Institute of Metal Research, Chinese Academy of Sciences, as a young merit scholar. His research in the past five years mainly focused on the relationship between service behavior (including corrosion, stress corrosion cracking, fatigue, corrosion fatigue and fracture toughness etc) and microstructure of lightweight structural metals such as Mg and Al alloys.

Development of Super Lightweight Mg-Li Alloys with a Good Combination of Service Properties

Due to the addition of lithium, Mg-Li alloys are the lightest metallic materials. Generally, their density is between 1.25 and 1.65 g/cm^3, which is about 1/2 and 3/4 that of Al and Mg alloys, respectively. Moreover, Mg-Li alloys can have some outstanding properties such as high specific strength and elastic modulus, better formability, weak mechanical anisotropy and etc., which attract great interest in the fields of aerospace and military. However, the low absolute strength, poor thermal stability and corrosion resistance greatly restrict their engineering applications and further development. In the past ten years, our group has been developing novel methods for improving the service properties of Mg-Li alloys. Based on the optimized alloying design, we successfully introduced quasicrystalline phase in Mg-Li alloys. After traditional hot extrusion or rolling and heat treatment, we successfully developed the new types of Mg-Li alloys with a good combination of service properties, which effectively solved the bottleneck problems of limiting their engineering applications. This poster will give a brief introduction of our group's progress in the new alloy development.

China-Australia Symposium on Advanced Materials

Professor Yingdan Zhu

Ningbo Institute of Material Technology and Engineering, CAS
Email:y.zhu@nimte.ac.cn

Yingdan Zhu received her Ph.D. degree at the Wuhan University of Technology in 2005. After that she continued to work on polymer composites in the University of Bristol and Imerys Minerals Ltd. in UK from 2006-2010. From December 2010, she joined the Ningbo Institute of Material Technology and Engineering. Now she is the team leader of Intelligent Composite Manufacturing and Equipment. Her current research focuses on the manufacturing of fiber reinforced composites and their automatic processing equipment.

Development of Carbon Fiber Composites in CNITECH

Carbon fiber composites have been widely used in aerospace, automotive, civil engineering and other fields due to their excellent properties. CNITECH has established a first-class Advanced Composites Innovation Center. Our current research interests are focused on polymer chemistry, composite design and simulation, processing, manufacturing equipment, joining, testing and evaluation. Recently, we have specially made a breakthrough in the lightweight carbon fiber composites for vehicles with the cooperation of OEMs.

The poster will show the following progress we have made:

(1) Colored carbon fiber and Interface modification of carbon fiber composites
(2) Structure design and process simulation
(3) Self-developed automatic equipment and facilities
(4) Application examples of carbon fiber composites.

Poster Presentations

Xiaozhang Zhu

Professor Xiaozhang Zhu

Institute of Chemistry, CAS
Email: xzzhu@iccas.ac.cn

Xiaozhang Zhu is Professor at the Institute of Chemistry, Chinese Academy of Sciences. He received his PhD in 2006 from the same institute, which was followed by postdoctoral research at Ulm University in Germany under the support of Alexander von Humbolt Foundation and University of Tokyo in Japan under the support of Japanese Society for the Promotion of Science successively. From 2012, he began his independent faculty career under the support of the Recruitment Program of Global Youth Experts. His current research interest is focused on design and synthesis of new organic □-functional materials and their applications in high-performance organic electronics.

Quinoid-Type Optoelectronic Materials

The potential of quinoid-type molecules featuring unique photoelectric properties has long been unexplored as compared with their aromatic counterparts. We recently focus on the development of thieno[3,4-b]thiophene (T*b*T)-based quinoid-type optoelectronic materials for organic electronic applications. Regioregular thieno[3,4-b]thiophenes prepared by direct C-H arylation were applied to elucidate the quinoid-enhancing effect of TbT on energy bandgaps. Quinoidal fluorophores, diaryl-substituted quinoidal bithieno[3,4-b]thiophenes, were designed and synthesized, which exhibit unusually high near-infrared fluorescence. Two-dimensional π-expanded quinoidal terthiophenes were designed for n-type organic thin-film transistors (OTFT), which exhibit outstanding semiconducting property with a record-high electron mobility up to 5.2 $cm^2 V^{-1} s^{-1}$ among air-stable solution-processable n-channel small-molecule OTFTs. By utilizing the quinoidal effect, we developed new photovoltaic materials, which showed high power conversion efficiencies over 10%.

China-Australia Symposium on Advanced Materials

Professor Shanmu Dong

Qingdao Institute of Bioenergy and Bioprocess Technology, CAS
Email: dongsm@qibebt.ac.cn

Poster Presentations

Shanmu Dong

Shanmu Dong obtained his Ph.D. degree at the Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, in 2012. After that he worked in Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences on highly efficient energy-storage materials. During 2014 to 2015 he came to the University of Oxford as a visiting scholar. His current research focuses on the cathode reaction mechanism of Li–O_2 batteries.

A Polymer Based Sandwich Electrolyte for Quasi Solid State Li-O2 Battery with Superior Stability

Nonaqueous Li-O_2 battery has received rapidly growing attention due to its high theoretical energy density. To achieve high energy density with acceptable stability and reversibility, using redox mediators dissolved in the electrolyte became a promising choice. However, the diffusion of mediators to anode leads to unfavorable reduction of oxidized mediators. Therefore, a single (lithium) ion exchange membrane is needed to separate catholyte and anolyte. Up to date, LISICON type inorganic solid state lithium conductor has been applied as the separator, which is brittle and possesses high interfacial resistance. In this study, we reported a polymer based lithium exchange separator to form a sandwich structure quasi solid state. We use a Li_2O_2 stable polymer containing tiny amount of solvent with redox mediators as catholyte. We demonstrated the cathode reaction can still undergo a solution process with 90% reduction of solvent. For anode side□a room-temperature lithium conducting polymer has been involved to provide a favorable anode/electrolyte interface and suppress the growth of Li dendrite. This sandwich structure quasi solid state electrolyte endorse Li-O_2 cell superior stability. The by-products of cathode reaction has been reduced by 90% compared with a typical liquid electrolyte with the same mediator.

Poster Presentations

Liqiang Zhu

Professor Liqiang Zhu

Ningbo Institute of Material Technology and Engineering, CAS
E-mail: lqzhu@nimte.ac.cn

Prof. Liqiang Zhu received his Ph.D. degree in Condensed Matter Physics from Hefei Institutes of Physical Science, Chinese Academy of Sciences in 2007. From 2007 to 2008, he was a Postdoctoral Fellow at CEA-DSM/IRECAM/SPCSI(CEA-Saclay, France). From 2008 to 2010, he was a Japan Society for the Promotion of Science (JSPS) Postdoctoral Fellow at the Department of Materials Engineering, the University of Tokyo, Japan. Since 2010, he was an associate professor and professor at the Ningbo Institute of Material Technology and Engineering, Chinese Academy of Sciences, Ningbo, China. His current research interests include thin-film transistors, artificial synapses for neuromorphic systems and device physics. He has authored or coauthored more than 70 papers in international peer reviewed SCI journals, such as Nature Communications, Advanced Materials, Progress in Materials Science, Applied Physics Letters, IEEE Electron Device Letters, etc. He has edited one book published in Wiley (Chapter) and has 7 granted patents.

Proton Gated Oxide Electric-double-layer Synaptic Transistors

In 1980s, electric-double-layer effects are observed in ionic liquid and ionic gel electrolyte, which provides an additional method for designing new conceptional devices. In electrolyte gated transistors, the movements of anions/cations within the electrolyte towards positively/negatively charged electrode form an electric-double-layer (EDL) with a thickness of ~1nm at low gate voltage. Such EDL gating will result in short-term changes in channel conductivities, which means that the device has plasticity behaviors. While at high gate voltage, an interfacial electrochemical process is expected. Thus, long-term changes in channel conductivities are expected, which means that the device has memory behaviors. Such ion gating behaviors would have potential applications in neuromorphic systems. Here, we obtained solid-state electrolytes with high proton conductivities in the order of 10^{-4}S/cm and high EDL capacitances above 1μF/cm^2. Oxide EDL transistors gated by such electrolyte were fabricated, exhibiting a low operation voltage of below 1.5V. With the unique ionic/electronic hybrid behaviors, these electrolyte gated EDL transistors have been proposed for artificial synapse applications. Several synaptic functions are mimicked, such as excitatory post-synaptic current (EPSC), short-term plasticity behaviors, synaptic filtering, spatiotemporal dynamic logic, superlinear to sublinear synaptic integration regulation, etc.

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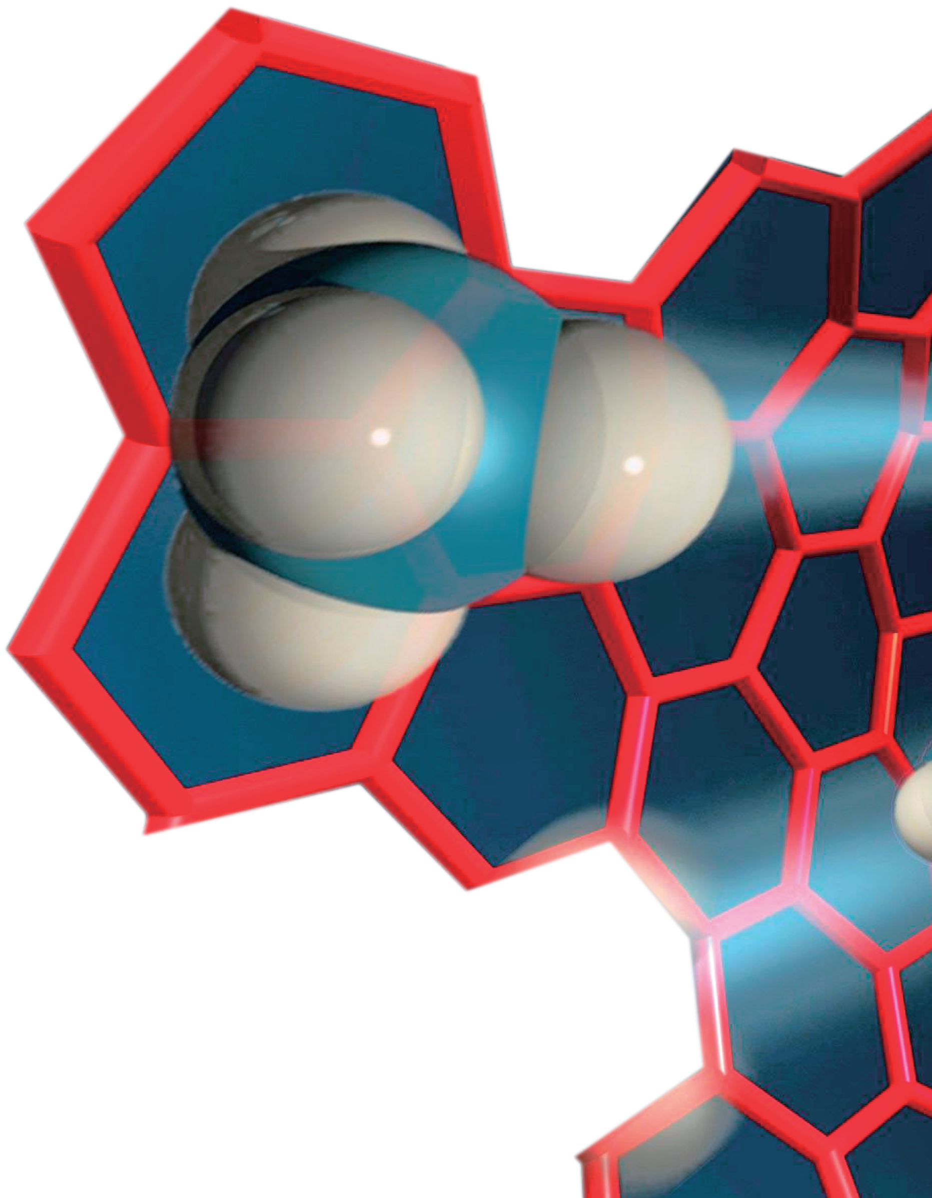

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