USYD – Yonsei Virtual Research Roundtable on "Functional Energy Materials"

Biography of Chairs and Speakers

The University of Sydney

Professor Philip Gale
Head, School of Chemistry, Faculty of Science
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Philip A. Gale received his BA (Hons) in 1992 and his MA and DPhil in 1995 from the University of Oxford before moving to the University of Texas at Austin where he spent two years as a Fulbright Scholar. In 1997 he returned to the Inorganic Chemistry Laboratory at Oxford as a Royal Society University Research Fellow. He moved to a Lectureship at the University of Southampton in 1999 and was promoted to Senior Lecturer in 2002, Reader in 2005 and to a Personal Chair in Supramolecular Chemistry in 2007. From 2010 - 2016, Phil served as the Head of Chemistry at Southampton. In 2014 he was awarded a Doctor of Science degree by the University of Oxford. In January 2017 he moved to the University of Sydney to take up the position of Professor of Chemistry and Head of the School of Chemistry.
Phil is the author or co-author of over 280 publications including an Oxford Chemistry Primer on Supramolecular Chemistry with Paul Beer and David Smith (1999) and an RSC Monograph in Supramolecular Chemistry entitled Anion Receptor Chemistry with Jonathan Sessler and Won-Seob Cho (2006). He is the co-editor in chief (with Jonathan Steed) of an eight-volume reference work published by Wiley entitled Supramolecular Chemistry: from molecules to nanomaterials and of the RSC's Monographs in Supramolecular Chemistry.

Phil's research has been recognised by a number of research awards including the 2018 International Izatt-Christensen Award in Macrocyclic and Supramolecular Chemistry, the RSC 2014 Supramolecular Chemistry Award, a Royal Society Wolfson Research Merit Award (2013), the RSC Corday Morgan medal and prize (2005), the Society/Journal of Porphyrins and Phthalocyanines Young Investigator Award (2004) and the RSC Bob Hay Lectureship (2004).

He was listed by Thomson Reuters as a Highly Cited Researcher in chemistry in both 2014 and 2015 and as a Web of Science Highly Cited Researcher in 2016, 2017, 2018 and 2019.

In 2010 Phil was awarded a JSPS invitation fellowship that he took up at Kyushu University, Japan in 2011. In 2012 he was appointed as a Guest Professor by Xiamen University, China (2012-2014), giving the prestigious Tan Kah Kee chemistry lecture there in 2013. He was awarded a University of Canterbury Erskine Visiting Fellowship and spent two months in Christchurch, New Zealand in 2014.

Dr Lauren Macreadie
School of Chemistry, Faculty of Science
Email: lauren.macreadie@sydney.edu.au

Biographical details

Lauren K. Macreadie received her double degree BBiomed/BSc (Hons) from Monash University in 2011 and then completed her PhD at the CSIRO in 2016. She then moved to Trinity College Dublin in Ireland as a post-doctoral fellow to investigate metal-organic framework (MOF) water splitting catalysts. Following this role she moved back to the CSIRO in 2017 to work on commercial projects with the Defence Scientific and Technology Group (DSTG), followed by some fundamental research into MOFs on a CSIRO OCE Postdoctoral Scheme. This work led to her accepting a position as a Lecturer at Massey University in New Zealand in 2019. In June 2020 she moved to the University of Sydney to accept a role as a PDF working with Prof Phil Gale on supramolecular anion transport systems and MOFs.

Research interests

- Metal-organic frameworks (MOFs)
- Supramolecular chemistry
- Materials chemistry
- X-ray diffraction
- Nanoporous materials

Topic of research presentation

Functional MOF materials for hydrocarbon separations for hydrogen delivery applications

Summary of research presentation

This important project addresses the key question of identifying a solid adsorbent material to safely, and efficiently, store and deliver hydrogen. This project is broken down into 3 aims of identifying a champion material for both catalytic hydrogen formation and storage, then enhancing its heat transfer properties, and verifying its performance within industry. Aim 1: This project will identify MOFs with specialised void spaces for either the selective separation of LOHCs or forming hydrogen from catalytic reactions under ambient conditions. This work will involve chemical synthesis and then testing and characterising the material sorbent properties to identify target, champion candidates. Aim 2: Magnetic nanoparticles can be used to induce thermal energy from within a porous material. Using top-performing MOFs identified in Aim 1, we will form magneto-MOF composites. A magnetic field will be introduced to the material when loaded with a LOHC to generate an in-situ heat source and drive off hydrogen. The separation and adsorption properties of these materials will be compared to the original materials to ensure they maintain their properties.

Associate Professor Deanna D'Alessandro
Professor and ARC Future Fellow, School of Chemistry, Faculty of Science
Email: deanna.dalessandro@sydney.edu.au

Biographical details

BSc (Hons I & Medal), James Cook University, 2001
PhD (cum laude), James Cook University, 2006

Postdoctoral Fellow, Molecular Electronics Group, University of Sydney, 2006
Postdoctoral Fellow, University of California at Berkeley, 2007-2009
Dow Chemical Company Fellow, American-Australian Association, 2007
Royal Commission for the Exhibition of 1851 Research Fellow, 2007-2009
University of Sydney Postdoctoral Research Fellow, 2010
L'Oreal Australia for Women in Science Fellow, 2010
Australian Research Council QEII Fellow, 2010-2016
Sydney Research Accelerator (SOAR) Fellow, 2017-2018
Associate Professor, 2017
Australian Research Council Future Fellow, 2018-2021

Research interests
Metal-Organic Frameworks (MOFs)
Electron and energy transfer in porous organic polymers (POPs) and metal-organic frameworks (MOFs)
New materials for Greenhouse Gas capture and conversion
Technique development: solution- and solid-state electrochemical and spectroelectrochemical methods
Fundamental and applied aspects of Mixed Valency
Synthetic inorganic and materials chemistry

Topic of research presentation
Harnessing Electroactivity in Coordination Frameworks

Summary of research presentation
Electroactive coordination frameworks offer a fundamental platform to explore electron transfer phenomena within 3-dimensional coordination space. At the applied level, these materials have enormous potential as the basis for electrochromic devices, electrocatalysts, porous conductors, batteries and solar energy harvesting systems, amongst numerous other potential applications.

This presentation will detail our latest results in the design and synthesis of electroactive frameworks that integrate molecular components for electron transfer including radical ligands and mixed-valence centers. The insights gained into fundamental charge transfer phenomena of relevance to understanding biological photosynthetic systems and porous semiconductors will be discussed. Key to our investigations have been solid-state AC/DC electrochemical methods in addition to solid-state near-IR/Vis, EPR, FT-infrared and Raman spectroelectrochemical (SEC) techniques that have been developed in our laboratory, providing powerful in situ probes for the optical and electron transfer characteristics of MOFs. These methods are potentially relevant to exploring electroactivity and fundamental charge transfer phenomena in a wide range of other materials (e.g., supramolecular systems, battery materials, etc). Our work on the DFT computational modelling of the electronic and optical properties of these systems will also be described, providing an important link between experiment and theory.

Professor Chris Ling
Associate Head of School (Research), School of Chemistry, Faculty of Science
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Biographical details
BSc, University of Melbourne (1992–1994)
BSc (Hons 1), Australian National University (1995)
PhD, Research School of Chemistry, Australian National University (1996–1999)

Postdoctoral Fellow, Materials Science Division, Argonne National Laboratory, USA (1999-2001)
Physicist, Diffraction Group, Institut Laue-Langevin, France (2001-2004)
Lecturer, School of Chemistry, University of Sydney (2004-2007)
Senior Lecturer, School of Chemistry, University of Sydney (2008-2011)
Associate Professor, School of Chemistry, University of Sydney (2012-2017)
Professor of Solid-state Chemistry, School of Chemistry, University of Sydney (2018-)

Research interests
Solid-state materials chemistry
Magnetic materials
Energy storage and conversion materials
Solid-oxide fuel cells
Batteries
Solid-state ionic conductors
Neutron scattering
Synchrotron X-ray science
Crystallography
Phase transitions
Modulated structures
Crystal growth

Topic of research presentation
In situ/operando X-ray and neutron scattering studies of high-voltage solid-state battery materials at high voltage.

Summary of research presentation
The rational design of functional materials requires knowledge of their crystal structures and how they evolve under operating conditions. This is particularly challenging for solid-state battery electrode materials, because (a) they are a relatively small part of a complex assembly of other materials, and (b) the most important phases only exist under high applied voltages and cannot be quenched and removed. In this talk I will present recent technical advances we have made in the design and execution of in situ/operando X-ray and neutron scattering experiments at the Australian Synchrotron and the Australian Centre for Neutron Scattering, and some scientific results obtained from those experiments.

Professor Brendan Kennedy
Professor of Chemistry, School of Chemistry, Faculty of Science
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Biographical details
B.Ed. Melb. SC
Ph.D. Monash University
Postdoctoral Fellow, Oxford University and ANU
The University of Sydney (1998 to present)

Research interests
Solid State and Materials Chemistry
Crystallography - X-ray and Neutron Scattering
Structure and Bonding in Metal Oxides

Topic of research presentation

Beyond Batteries. Uncoupling local and long-range structures in complex oxides.

Summary of research presentation

The need to transition to a low carbon economy is obvious. What is less obvious is how to generate, store and release energy in a closed carbon economy. Fuel cells, using solar hydrogen, and nuclear energy will be central to any future energy mix. Bizarrely pyrochlore oxides are of interest in both fuel cells and the nuclear fuel cycle. In the former the ability of pyrochlores to conduct oxide ions at relatively low temperatures sees them employed as solid oxide conductors. The resistance of pyrochlores to radiation induced amorphization is of importance in the management of nuclear waste. In this presentation I will briefly review our work that demonstrates the importance of both the long range and local structures for these applications.

Yonsei University

Professor Jinsung Tae
Chair, Department of Chemistry, College of Science
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Biographical details

B.S. Seoul National University, 1990
M.S. Seoul National University, 1993
Ph.D. Ohio State University, 1999
Postdoctoral Fellow, The Scripps Research Institute 1999-2001
Professor, Yonsei University (2001 to present)

Research interests

Total synthesis and Synthetic methods
Fluorescent chemosensors
Photocatalytic artificial photosynthesis

Professor Moonhyun Oh
Department of Chemistry, College of Science
Email: moh@yonsei.ac.kr

Biographical details

Moonhyun Oh received his B.S. and M.S. degrees in chemistry from Sogang University, Korea in 1995 and 1997. He earned Ph.D. degree (2003) in chemistry from Brown University, where he worked with Prof. Dwight A. Sweigart on the self-assembly of supramolecular networks. In 2003, he moved to Northwestern University and works as a postdoctoral fellow with Prof. Chad A. Mirkin until 2005. In 2006, he joined the Faculty of Chemistry at Yonsei University, Korea, where he is presently a Full Professor of Chemistry.

Research interests

Metal-organic frameworks (MOFs)
MOF-on-MOF growth
Coordination polymers

Carbon materials
Metal oxides
Heterogeneous catalysts
Oxygen reduction reaction
Sensing
Material chemistry

Topic of research presentation
Hybrid Metal-Organic Frameworks and Efficient Catalysts for Oxygen Reduction Reaction

Summary of research presentation
The controlled conjugation of metal-organic frameworks (MOFs) to form the hybrid MOFs containing more than two types of MOFs is a noteworthy approach in the MOF development; this is because the management of the component and structure of MOFs is essential for fine tuning their properties and applicability. Here I present the understanding on the precise MOF-on-MOF growth process and so the controlled construction of hybrid MOFs. The work described here will provide a way to access a variety of multi-compositional or multi-structural hybrid MOFs, something that should facilitate their eventual use in practical applications. For example, highly active carbon-based catalysts for oxygen reduction reaction are prepared via a thermal treatment of well-designed core–shell type hybrid MOFs.

Professor Dongil Lee
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Biographical details
B.S. Yonsei University, 1988
M.S. Yonsei University, 1990
Ph.D. University of Cambridge, 1996-2000
Research Scientist, LG Chem, 1990-1996
Postdoctoral Fellow, University of North Carolina, 2000-2003
Assistant Professor, Western Michigan University, 2003-2008
Professor, Yonsei University (2008 to present)

Research interests
Metal Nanoclusters
Electrocatalytic Chemical Conversion
Biological Applications of Metal Nanoclusters

Topic of research presentation
Electrocatalytic CO2 Conversion on Metal Nanoclusters

Summary of research presentation
Development of efficient and selective electrocatalysts is a key challenge to achieve an industry-relevant electrochemical CO2 reduction reaction (CO2RR) to produce commodity chemicals. In this presentation, I report that Au25 clusters with Au-thiolate staple motifs can initiate electrocatalytic reduction of CO2 to CO with nearly zero energy loss and achieve a high CO2RR current density of 540 mAcm-2 in a gas phase reactor. Electrochemical kinetic investigations revealed that the high CO2RR activity of the Au25 originates

from the strong CO2 binding affinity, leading to high CO2 electrolysis performance in both concentrated and dilute CO2 streams.

Assistant Professor Hyun S. Ahn
Department of Chemistry, College of Science
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Biographical details
B.S. Chemistry and Chemical Engineering, University of Washington, 2008
Ph.D. Chemistry, University of California Berkeley (Advisor T. Don Tilley), 2013
Postdoctoral Fellow University of Texas (Advisor Allen J. Bard), 2014-2016

Research interests
Electrochemical Energy Conversion
Nanoelectrochemistry and Electron Transfer Phenomena in Confinement
Electrochemical Synthesis of Nanomaterials

Topic of research presentation
Ruthenium-based Trimetallic μ–oxo Cluster Compounds and Their Application in Redox Flow Batteries

Summary of research presentation

Redox flow battery (RFB) is an energy storage technology garnering much attention of recent. Its unique architecture allowing for the separation of peak power and total amount of energy stored presents RFB as an attractive candidate for modulating load fluctuations in large scale applications such as buildings and power plants. We are developing RFBs based on trimetallic μ-oxo bridged compounds. These class of materials are suitable for RFB application due to their rich and well-defined electrochemistry with wide potential window. Synthesized compounds typically revealed good RFB cycle stability with greater than 1 V output at discharge, with the best discovered combination of materials exhibiting outstanding battery performance with 2.5 V discharge at 4 mAcm-2. Increasing energy density by boosted solubility is currently underway, by means of ligand modifications.

Associate Professor Byeong-Su Kim
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Biographical details
B.S. Chemistry, Seoul National University (1999)
M.S. Organic Chemistry, Seoul National University (2001)
Ph.D. Polymer/Material Chemistry, University of Minnesota-Twin Cities (2007)
Postdoctoral Associate, Massachusetts Institute of Technology (2007-2009)
Assistant and Associate Professor, Ulsan National Institute of Science and Technology (UNIST) (2009-2018)
Associate Professor, Yonsei University (2018-present)

Research interests
Soft and Hybrid Nanomaterials for Energy and Biomedical Applications
Chemistry of nanocarbons (carbon based electrocatalysts and organic catalysts; layer-by-layer assembled electrode)
Polyethers and polymeric therapeutics (Synthesis and characterizations of responsive polyethers, Polymers for biomedical applications)

Topic of research presentation
Designer Carbon Nanodots: Synthesis and Applications in Energy

Summary of research presentation
As the latest addition to the carbon nanomaterials family, carbon nanodots (CDs) have recently received considerable attention by virtue of their interesting physical, optical, and chemical properties, such as their photoluminescence, photostability, and electron transfer behavior. In this presentation, we will first outline the progress of the synthetic approaches of CDs based on various small molecular precursors. Moreover, we will discuss their interesting photo-driven electron transfer behavior within the framework of energy related applications, particularly in the solar-driven photocatalytic production of hydrogen peroxide.

Professor WonHyoung Ryu
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Biographical details
PhD Mechanical Engineering, Stanford University 2006
MS Manufacturing Systems Engineering, Stanford University 2002
MS Aeronautics and Astronautics, Stanford University 2002
BS Mechanical Engineering, Seoul National University 1996

Associate Dean, Office of Research Affairs, Yonsei University, 2020 ~ present
Director, Yonsei Center for Research Facilities, Yonsei University, 2020 ~ present
Director, Center for Research Ethics, Yonsei University, 2020 ~ present
Professor, Department of Mechanical Engineering, Yonsei University, 2018.03 ~ present

Research interests
Microneedles (Drug delivery & Sensing)
Bioenergy Harvesting (Electricity from Plants)
3D Printing (Electronics, Energy, and Biomedical Applications)
EHD printing (Electronics, Sensor, Biomedical Applications)