ACS NANO Summit 2025

Experience the first Southern Hemisphere ACS Nano Summit in Sydney

17 - 18TH NOVEMBER
2025

Location **Amora Hotel**

11 Jamison St, Sydney NSW 2000

Registration: https://www.unsw.edu.au/research/mmfi/news-events/events/acs-nano-summit-2025

Summit Agenda

17th

Morning Session Chair/Moderator: Professor Sean Li

08:30am	**Registration Open** Tea & Coffee
09:00am	**Welcome Address** Professor Dane McCamey, Pro Vice-Chancellor Research, UNSW
09:10am	**Opening Address** Professor Chennupati Jagadish, President, Australian Academy of Science
09:20am	**ACS Nano Address** Professor Anita Ho-Baillie on behalf of Professor Xiaodong Chen, Associate Editor, ACS Nano
09:30am	**Title: Semiconductor Nanostructures for Optoelectronic Applications** Plenary Speaker: Professor Chennupati Jagadish, Australian National University, Australia
10:15am	**Morning Tea Break** Tea, Coffee, Light refreshments, Networking
10:45am	**Title: New Materials for 2D, 3D, and 4D Printing** Plenary Speaker: Professor Shlomo Magdassi, The Hebrew University of Jerusalem, Israel

More Information at https://www.unsw.edu.au/research/mmfi/news-events/events/acs-nano-summit-2025

Summit Agenda

17th

Morning Session Chair/Moderator: Professor Sean Li

11:30am

Title: Future of Catalysis Using the Intelligence of Liquid Metals
Plenary Speaker: Professor Kourosh Kalantar-Zadeh, The University of Sydney, Australia

12:00pm

Title: Rapid Antibiotic Susceptibility Screening by Super-Resolution Microscopy
Keynote Speaker: Professor Dayong Jin, University of Technology Sydney, Australia

12:30pm

Lunch
Lunch - Croft Restaurant Amora

Afternoon Session Chair/Moderator: Dr Jack Yang

02:00pm

Title: Development of Defective Carbon-based Materials for Electrocatalysis
Keynote Speaker: Professor Jun Chen, University of Wollongong, Australia

02:30pm

Title: Recent Developments in SPM Probing of Ferroelectrics: Crackling Noise Microscopy, Phonon-Nanoscopy, and Optical Manipulation
Keynote Speaker: Professor Jan Seidel, The University of New South Wales, Australia

03:00pm

Afternoon Tea Break
Tea, Coffee, Light refreshments, Networking

Summit Agenda

17th

Afternoon Session Chair/Moderator: Dr Jack Yang

03:30pm

Title: Graphene-based chemistry: Plane, but is it simple?
Keynote Speaker: Associate Professor John Stride, The University of New South Wales, Australia

04:00pm

Title: New Forms of Perovskite Oxides for Dielectric Applications
Invited Speaker: Dr. Junjie Shi, The University of New South Wales, Australia

04:25pm

Title: Tungsten Diselenide Quantum Dots: Building Blocks for Next-Generation Optoelectronics
Invited Speaker: Dr. Ashraful Azam, The University of New South Wales, Australia

Summit Agenda

18th

Morning Session Chair/Moderator: Professor Sean Li

09:00am

Title: Advances in lithium and Sodium ion batteries to enable sustainable mass electrification of vehicles
Plenary Speaker: Professor Khalil Amine, Argonne National Laboratory, USA

09:45am

Title: Graphene-Enabled Chemometric Raman Imaging
Plenary Speaker: Professor Andrea Ferrari, University of Cambridge, UK

10:30am

Morning Tea Break
Tea, Coffee, Light refreshments, Networking

11:00am

Title: Carbon-Based Metal-Free Electrocatalysts for Energy and Chemical Conversions
Plenary Speaker: Professor Liming Dai, The University of New South Wales, Australia

11:30am

Title: Mass transport through graphene-based nanopores and nanochannels
Keynote Speaker: A/Prof Rakesh Joshi, The University of New South Wales, Australia

12:00pm

Title: Probing the active site of carbon-based catalysts through EC-STM
Invited Speaker: Dr Qingfeng Zhai, The University of New South Wales, Australia

12:15pm

Title: Rational Design of Novel Carbon Structures for High-performance Energy Storage
Invited Speaker: Dr Shuangyue Wang, The University of New South Wales, Australia

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Summit Agenda

18th

12:30pm

Lunch

Lunch - Croft Restaurant Amora

Afternoon Session Chair/Moderator: Dr. Jack Yang

01:30pm

Title: Photonically Enhanced Fluorescence of Carbon Dots for Ultrasensitive Environmental Sensing

Keynote Speaker: Associate Professor Tushar Kumeria, The University of New South Wales, Australia

02:00pm

Title: Metal Halide Perovskite Optoelectronics

Keynote Speaker: Professor Anita Ho-Baillie, The University of Sydney, Australia

02:30pm

Title: Engineering Nanoparticles for Catalytic Cancer Therapy

Keynote Speaker: Associate Professor Sophia Gu, The University of New South Wales, Australia

03:00pm

Afternoon Tea Break

Tea, Coffee, Light refreshments, Networking

03:15pm

Title: Fabrication of Freestanding Single-Crystalline Perovskite Nanomembranes and Their Optical Properties

Invited Speaker: Dr. Yang Liu, The University of New South Wales, Australia

More Information at https://www.unsw.edu.au/research/mmfi/news-events/events/acs-nano-summit-2025

Summit Agenda

18th

Afternoon Session Chair/Moderator: Dr. Jack Yang

03:35pm

Title: Stability and Conductivity of Ferroelectric Nanoscale Bubbles
Invited Speaker: Dr. Peggy Zhang, CSIRO, Australia

03:55pm

Title: Aberration Corrected Electron Microscopy for Advanced Energy Materials
Invited Speaker: Dr Richard F. Webster, The University of New South Wales, Australia

04:15pm

ACS Nano Editor Forum
Professor Anita Ho-Baillie, Associate Editors, ACS Nano
Professor Kourosh Kalantar-Zadeh, Associate Editors, ACS Applied Nano Materials

Moderator: Professor Sean Li

04:45pm

Conclusion of the Summit
Professor Sean Li, The University of New South Wales, Australia

More Information at https://www.unsw.edu.au/research/mmfi/news-events/events/acs-nano-summit-2025

Presentation Abstracts & Speaker Profiles

Title: Semiconductor Nanostructures 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 present the results on growth of nanowires, nanomembranes and microrings and their optical properties. Then I will discuss theoretical design and experimental results on optoelectronic devices. In particular I will discuss nanowire and micro-ring lasers and integration of nanowires and microrings. I will also present the results on polarization sensitive, broad bandwidth THz detectors operating at room temperature. Nanowire based energy devices such as solar cells and photoelectrochemical (PEC) water splitting will be discussed. I will discuss about Neuro-electrodes to study brain signaling to understand dementia. Future prospects of the semiconductor nanostructures will be discussed.

Professor Jagadish Chennupati – Australian National University (Australia) - Plenary Speaker

Professor Jagadish Chennupati is a Distinguished Professor and Head of the Semiconductor Optoelectronics and Nanotechnology Group at the Australian National University. He is internationally recognised for his pioneering research in optoelectronics, nanotechnology, and photovoltaics, and has published extensively in these fields. He has held senior leadership roles, including President of the IEEE Photonics Society and the Australian Materials Research Society, and was the Founding Director of the Australian National Fabrication Facility ACT node. Jagadish is a Fellow of multiple national and international academies and has received numerous prestigious awards, including appointment as a Companion of the Order of Australia for his contributions to physics, engineering, and education.

Presentation Abstracts & Speaker Profiles

Title: New materials for 2D,3D and 4D printing

Additive manufacturing has revolutionized the fabrication of complex objects and devices through advanced printing processes, profoundly impacting industries ranging from automotive and electronics to aerospace, food, and medicine. A major challenge in this field remains the limited availability of materials with tailored functionalities. Recent advances in the design of organic, ceramic, and hybrid materials for 2D, 3D, and emerging 4D printing technologies will be presented. Particular focus will be given to the integration of nanoparticles, nanocomposites, and plasmonic colloids, which enable novel functionalities and new printing concepts. Examples include conductive nanomaterials for printed electronics, stretchable nanocomposites for soft robotics, printed solar cells, 3D printing with wood-derived nanoparticles and recyclable polymers, water-dispersible nanoparticles for eco-friendly inks, and self-healing nanocomposite systems. In addition, the utilization of plasmonic effects of metallic nanoparticles in stereolithography-based printing will be presented as a frontier example of nanoscale control over light–matter interactions. By highlighting these developments, the lecture will showcase how nanomaterials are driving the transition from conventional printing toward functional, adaptive, and sustainable additive manufacturing.

Prof. Shlomo Magdassi – The Hebrew University of Jerusalem(Israel) - Plenary Speaker

Shlomo Magdassi is a professor of chemistry, at the Casali Center for Applied Chemistry, the Institute of Chemistry and the Center for Nanoscience and Nanotechnology at the Hebrew University of Jerusalem, Israel. Prof. Magdassi holds the Enrique Berman Chair in Solar Energy. His research focuses on colloid science, and in particular on formation, formulation and applications of novel micro and nanoparticles. These particles can be used as active components in functional inks and coating, for example light absorbing particles for solar energy devices, and metal nanoparticles and CNTs for 2D and 3D printing. He is the editor of three books, among them “The chemistry of inkjet inks”. In addition to his scientific publications, he also has various inventions on applications of colloids in industrial products. Based on these inventions, some commercial activities evolved leading to worldwide sales and establishing new companies.

Presentation Abstracts & Speaker Profiles

Title: Future of Catalysis Using the Intelligence of Liquid Metals

Chemical processes account for ~12% of global greenhouse gas emissions and represent a major contributor to worldwide energy use. Contemporary chemical manufacturing largely relies on solid-state catalysts engineered for specific reactions. These catalysts possess rigid atomic arrangements that define their active sites. Although they effectively lower activation energy, the immobility of their atomic frameworks can limit both reaction efficiency and selectivity. By contrast, liquid metals, consisting of metals and alloys that remain liquid at low temperature, feature dynamic atomic interfaces that can reorganise in response to ongoing surface reactions. Such adaptability provides a mechanism for tuning reaction pathways, akin to an intrinsic form of atomic-level intelligence. This 'intelligence' arises from the spontaneous rearrangement of mobile surface atoms to optimise catalytic conditions, promoting energetically favorable routes and potentially enabling chemical transformations beyond the reach of solid-state catalysts.
This presentation discusses the catalytic potential of atomic-level intelligence, with emphasis on dynamic atomic reconfigurations triggered by target analytes, single-atom catalysis, and high-entropy surface effects, all operating within the inherently adaptable interfacial environment of liquid metals.

Professor Kourosh Kalantar-Zadeh, The University of Sydney (Australia) - Plenary Speaker

Kourosh Kalantar-Zadeh is a Professor at the University of Sydney who has the responsibility of Advising on High Impact Initiatives at the Faculty of Engineering. He is also one of the Australian Research Council (ARC) Laureate Fellows of 2018. Prof Kalantar-Zadeh is an Adjunct Prof at UNSW and an Honorary Prof at RMIT.Formerly Prof. Kalantar-Zadeh was a professor of Chemical Engineering at University of New South Wales (UNSW), Sydney, Australia and prior to that was a Distinguished Professor of Electronic Engineering at RMIT, Melbourne, Australia.
Prof. Kalantar-Zadeh is involved in research in the fields of chemical engineering, materials sciences, electronics, and medical devices. He has co-authored >500 scientific papers and books and is also a member of the editorial boards of journals including ACS Sensors, Advanced Materials Technologies, Nanoscale and ACS Nano. He is also an Associate Editor for ACS Applied Nano Materials journal.
Prof. Kalantar-Zadeh has received many international awards including the 2017 IEEE Sensor Council Achievement, 2018 ACS Advances in Measurement Science Lectureship awards and 2020 Robert Boyle Prize for Analytical Science, Royal Society of Chemistry (RSC), UK. His name has also appeared in the Clarivate Analytics most highly cited list since 2018.

Presentation Abstracts & Speaker Profiles

Title: Rapid Antibiotic Susceptibility Screening by Super-Resolution Microscopy

Rapid and accurate antibiotic susceptibility testing (AST) has become critical for effective infection management and antimicrobial resistance (AMR) mitigation. While current clinical methods require more than 72 hours - significantly delaying life-saving treatments - our newly developed HAPA Platform offers an ultra-fast phenotyping solution capable of classifying Gram-negative pathogen susceptibility in just 2-4 hours.

Clinical validation studies demonstrate exceptional performance, with 97% concordance relative to FDA-approved broth microdilution methods across 75 clinical isolates, and a remarkably low 1.51% minor error rate that comfortably surpasses the FDA's stringent <3% threshold.

The HAPA Platform combines multiple key advantages including cost-effectiveness, scalability, automation compatibility, and point-of-care deployment potential. This positions the technology as both a future cornerstone for accelerated diagnostics and a powerful driver of global antimicrobial stewardship initiatives, promising to transform current clinical practice in infection management.

Professor Dayong Jin, University of Technology Sydney, Australia - Keynote Speaker

Dayong Jin is a distinguished professor at UTS, an ARC Laureate Fellow, Fellow of Australian Academy of Technology and Engineering, and a Clarivate Top 0.1% Highly Cited Researcher, with expertise covering biomedical engineering, nanotechnology, microscopy, microfluidics, and analytical chemistry, to enable rapid detection of cells and molecules. He established the UTS Institute for Biomedical Materials & Devices (IBMD) to transform advances in phonics and materials into disruptive biotechnologies. He is the recipient of the 2017 Australian Academy of Science Engineering Science Award, and the 2017 Australian Prime Minister's Prize for Science. He published 300+ papers, including 40+ in Nature and its sister journals.

Presentation Abstracts & Speaker Profiles

Title: Defective carbon-based materials for electrocatalysis

In the past few decades, tremendous efforts have been devoted to developing carbon-based materials to reduce the need for precious metals in the field of electrocatalysis.[1] Thereinto, defective carbon-based electrocatalysts have recently been considered one of the most promising alternatives owing to their irreplaceable advantages, such as environmentally friendly, low cost, and high structural tunability. However, despite remarkable progress has been achieved, grand challenges of their further development remain with the traditional "trial-and-error" approaches, mainly due to the lack of precise synthetic methodologies as well as in-depth understandings of active centres and underlying electrocatalytic mechanisms. Herein, we report some new synthetic strategies to precisely control the carbon defect density or manipulate the targeted migration of metal species on defective carbon substrate, which not only successfully realize the monitoring the structural dynamic evolution of DCMs, but also improve the fundamental understanding of the synthetic and electrocatalytic mechanisms.[5] We believe that the development of synthetic methodologies of DCMs provides plenty of room for expanding the "gene pool" of electrocatalysts and then pushing the DCMs towards industrialization.

Professor Jun Chen, University of Wollongong, Australia - Keynote Speaker

Dr Jun Chen is currently appointed as Senior Professor, Director of Australian Institute for Innovative Materials at University of Wollongong (UOW). His research interests include: Electroactive Materials, Bio-/Electro-Interfaces, Nano/Micro- Materials, 2D/3D Printing and Wearable Electronic Devices. He has authored over 300 peer-reviewed publications in international journals with an h-index of 101. Professor Chen has been identified as Highly Cited Researchers in Cross Field for 7-times 2018-2025. In 2021, Prof. Chen has been admitted as a Fellow of The Royal Society of Chemistry (FRSC).

Presentation Abstracts & Speaker Profiles

Title: Graphene-based chemistry: Plane, but is it simple?

Graphene is all surface and all chemistry occurs at interfaces, so the chemistry of graphene should be simple, should it not? My group at UNSW have been toying with the chemistry of graphene-like materials over several years and yes, using solution-based approaches to attach chemical functionalities to carbon surfaces is straight-forward and well known. But the key issue with graphene - and many other nanostructured materials - is control; how can we ensure that the chemistry occurs where & how we would like it to? If we are to deliver truly bottom-up assembly, then we need to impart effective control over where we add to our substrates and a nominally uniform 2D surface throws up many equivalences. It is chemistry but not as we know it and so we need to develop new ways to think about adding complexity by reducing the symmetry.
This talk will discuss some basic chemistries that we have performed and show some ideas that we have developed toward achieving an additive approach to delivering nanostructured carbon films - the road is long and we are but part way along.

Associate Professor John Stride, The University of New South Wales, Australia - Keynote Speaker

My research interests primarily centre on the use of neutron techniques to probe the nature of molecular and molecule-based materials. Of particular interest are materials displaying novel magnetic interactions and the interactions between molecules in the solid state.

Presentation Abstracts & Speaker Profiles

Title: Recent Developments in SPM Probing of Ferroelectrics: Crackling Noise Microscopy, Phonon-Nanoscopy and Optical Manipulation

I will discuss our recent work on various ferroelectric and multiferroic oxide material systems using scanning probe microscopy (SPM) as the main investigative tool, with a focus on nanoscale functional property measurements of individual topological defects and new SPM instrument capability developments.
The phonon signatures of perovskites have rarely been investigated at the nanoscale. Here, we combine nano-Fourier transform infrared spectroscopy (nano-FTIR) and scattering scanning near-field optical microscopy (s-SNOM) imaging to report on the first direct mid-IR imaging of nanoscale phase variants in mixed-phase BiFeO3 based on their distinct vibrational signatures. The noninvasive optical reading in the infrared, i.e. 'phonon-nanoscopy' can further successfully detect electrical switching of ferroelectricity, providing insight for future infrared photoelectric applications. Our work demonstrates that scanning near-field techniques are versatile and sensitive for probing the structural and physical properties of nanoscale entities with subtle distinctions.
Other types of optical control of polar order in ferroelectric and multiferroic materials include photostriction, i.e. optomechanical coupling in $BiFeO_3$ thin films, which however has been less explored and often requires high optical power. We demonstrate a strong photostrictive response in nanocrystallite $BiFeO_3$ thin films synthesized through cost-effective, scalable spray pyrolysis under relatively low optical power (~1.7 W cm-2). This response is accompanied by synchronous light-driven enhancements in piezoelectricity and polarization switching of the films. The effective separation of photogenerated excitons, facilitated by a high density of domain walls characterized through piezoresponse force mapping, leads to an effective screening of the depolarization field and compensation for the built-in field induced by charged defects. A photostriction coefficient of 4.5×10^{-7} m² W-1 - five times higher than bulk $BiFeO_3$ and comparable to leading halide perovskites - was measured using scanning probe microscopy, offering new opportunities to integrate these materials into innovative wireless optomechanical and optoelectronic devices.

Professor Jan Seidel, The University of New South Wales, Australia
- Keynote Speaker

Jan Seidel is a professor in the School of Materials Science and Engineering, UNSW Sydney. He received his doctorate from TU Dresden, Germany in 2005. Prior to joining UNSW, Jan held positions at UC Berkeley, Lawrence Berkeley National Laboratory, and he was a visiting fellow at the University of Oxford. He has authored over 200 peer-reviewed papers with more than 16,000 citations and he has an h-index of 50.
His group has a focus on advanced scanning probe microscopy for the study of physical properties of novel materials, particularly transition-metal oxides, 2D materials and hybrid halide perovskites, in the forms of thin films, nanomaterials and nanoscale devices. His research targets a wide range of optoelectronic, data storage and energy related technology, including nonvolatile memories, solar cells and nanoelectronics.

Presentation Abstracts & Speaker Profiles

Title: New Forms of Perovskite Oxides for Dielectric Applications

Silicon MOSFETs have long tracked Moore's law but are now constrained in meeting the rising power-density demands of future ICs. Two-dimensional (2D) semiconductors offer a path forward: their atomic thickness enables further scaling of MOSFETs, and their native form factor supports flexible electronics. Yet, reliably integrating high-κ dielectrics with 2D channels—achieving sub-nanometre capacitance-equivalent thickness (CET) while minimising interfacial traps and leakage—remains a central challenge.
We address this by using transferable, ultrahigh-κ, single-crystalline perovskite $SrTiO_3$ (STO) membranes as gate dielectrics for 2D field-effect transistors. We comprehensively analyse device performance and, in parallel, employ a high-efficiency buckling-based method to probe the membranes' elastic properties for flexible-electronics deployment. The STO membranes deliver sub-1-nm CET. The van der Waals gap at the STO/2D interface helps mitigate leakage typically associated with ultra-thin dielectrics. Short-channel devices fabricated from scalable monolayer MoS_2 and STO membranes exhibit steep subthreshold swings down to ~70 mV/dec and ION/IOFF ratios up to 107. Using the buckling method, we statistically evaluate the plane-strain effective Young's modulus of 5 × 5 mm^2 STO membranes from 6.5 to 32.2 nm thickness, revealing a clear thickness dependence from 46.01 to 227.17 GPa.
Overall, STO-membrane dielectrics enable 2D-transistor performance aligned with the latest IRDS low-power targets while their demonstrated elasticity in flexible gate stacks highlights strong potential for high-performance, flexible 2D electronics.

Dr Junjie Shi, The University of New South Wales, Australia
- Invited Speaker

Dr Junjie Shi is a Postdoctoral Fellow in the School of Materials Science & Engineering at UNSW. Her research focuses on low-dimensional materials for next-generation electronics, with core expertise in nanofabrication. Since completing her PhD at UNSW in 2022, she has published a first-author–equivalent article in Nature and filed multiple international patents in collaboration with industry partners. Dr Shi contributes to postgraduate teaching and supervises and mentors HDR and coursework students. Her work aims to translate fundamental advances into scalable, high-impact technologies for transformative research.

Presentation Abstracts & Speaker Profiles

Title: Tungsten Diselenide Quantum Dots: Building Blocks for Next-Generation Optoelectronics

The advancement of next-generation optoelectronic technologies relies critically on the development of novel materials with tunable and stable optical responses. Quantum dots (QDs) offer such potential through quantum confinement–induced, size-dependent electronic and optical properties; however, conventional semiconductor QDs often suffer from photoluminescence quenching at elevated temperatures, limiting their applicability in practical devices. In this presentation, we highlighted tungsten diselenide (WSe_2) quantum dots as an emerging class of temperature-resilient nanomaterials for advanced optoelectronic. Owing to the intrinsic "dark exciton" states in WSe_2, these QDs exhibit enhanced photoluminescence intensity with rising temperature—a phenomenon opposite to that of conventional polar QDs. This unique excitonic behavior positions WSe_2 QDs as promising candidates for robust, high-efficiency light-emitting and excitonic devices. This presentation outlines the colloidal synthesis and controlled growth of WSe_2 QDs, emphasizing on the influence of reaction parameters on size, crystallinity, and optical properties. The correlation between quantum confinement and excitonic dynamics is also explored, highlighting pathways for integrating WSe_2 QDs into scalable optoelectronic architectures for next-generation applications.

Dr. Ashraful Azam, The University of New South Wales, Australia - Invited Speaker

Dr. Ashraful Azam is a postdoctoral research fellow at the School of Materials Science and Engineering, University of New South Wales (UNSW), Australia. He earned his PhD in Materials Science and Engineering from UNSW in 2023. Prior to this, he served as a research scientist at the Korea Advanced Institute of Science and Technology (KAIST) and participated as a project member in the National Graduate Innovation Forum in Australia. Dr. Azam's research centers on the design and development of novel functional nanomaterials, with a focus on 2D materials and quantum dots, to advance renewable energy technologies, including solar cells and hydrogen fuel production.

Presentation Abstracts & Speaker Profiles

Title: Advances in lithium and Sodium ion batteries to enable sustainable mass electrification of vehicles

In order to enable long electric drive range electric vehicle (EVs), there is a need to develop advanced battery systems that offer at least 300Wh/kg energy density or higher. The most significant technical barrier to developing commercially viable (EV) is the energy storage system. The challenge is to develop batteries that can perform the requirements imposed by EV system and yet meet market expectations in terms of cost, life and sustainability. Conventional lithium-ion batteries based on metal oxides and graphite have made significant progress in recent years for HEV applications, however, durability with the EV duty cycle and the ultimate cost and safety of the technology remain key challenges. To achieve a very high all electric drive range, a new battery system with advanced high-capacity cathode materials and stabilized high-capacity anode is needed. In this talk, we will discuss several strategies to increase significantly the energy density of lithium battery through the development of high energy cathode with high Ni and low cobalt with dual mode gradient concept that can cycle very well at voltages as high as 4.7V. In this case, both composition and structure change across each particle take place. We will also disclose a novel advanced PEDOT coating on cathode particle to extend the calendar life of battery, a high voltage and non-flammable fluorinated based electrolytes and Silicon-graphene composite anode including a novel pre-lithiation technology to overcome the irreversible loss of this anode in the first cycle. To reduce further the cost and ensure sustainability, we will describe a new DOE Na-ion initiative run out of Argonne National Laboratory. In this case, our objective is to meet or exceed the energy density of LFP system which power actualy most of EV's in the world.

Professor Khalil Amine, Argonne National Laboratory, USA
- Plenary Speaker

Dr. Khalil Amine is an Argonne Distinguished Fellow and the leader of the Advanced Battery Technology team at Argonne National Laboratory, where he is responsible for directing the research and development of advanced materials and battery systems for HEV, PHEV, EV, grid, satellite, military, and medical applications. Dr. Amine is also the Co-director of the US-German initiative on interface. He serves as a member of the US National Academy of inventors and fellow of the European academy of sciences and committee member of the U.S. National Research Consul at US Academy of Sciences on battery related technologies. He served until recently as an adjunct professor at Stanford University and held a joint appointment as Professor at the University of Chicago Among his many awards, Dr. Amine is 2023 recipient of Kuwait prize, 2019 recipient of the mega global energy prize, a 2003 recipient of Scientific America's Top Worldwide 50 Researcher Award, a 2009 recipient of the US Federal Laboratory Award for Excellence in Technology Transfer, 2013 DOE Vehicle technologies office award and is the six-time recipient of the R&D 100 Award which is considered as the Oscar of technology and innovation. In addition, he was awarded the ECS battery technology and battery research awards, the international battery association award and NAATB lifetime achievement award. Dr. Amine holds 207 patents and patent applications and has 776 publications with google h-index of 172. From 1998-2021, Dr. Amine was the most cited scientist in the world in the field of battery technology with over 102,000 citations. He serves as the executive director and vice President of IMLB. He is also the chairmen of the international automotive lithium battery association, ECS fellow, Fellow of the international association of advanced materials, and associate editor of the journal of Nano-Energy.

Presentation Abstracts & Speaker Profiles

Title: Graphene-Enabled Chemometric Raman Imaging

Graphene is an ideal material for photonics and optoelectronics, where the combination of its optical and electronic properties can be fully exploited, and the absence can be beneficial. Saturable absorption is observed as a consequence of Pauli blocking and can be exploited for mode-locking of a variety of ultrafast and broadband lasers. Stimulated Raman Scattering offers sub-cellular spatial resolution and molecular-specific contrast. It enables label-free chemically-specific imaging by detecting the vibrational properties of tissues. I will overview the development of mode-locked lasers based on graphene and related materials and their application in a broadband coherent Raman platform exploiting an all-fiber dual wavelength self-synchronized laser.

Professor Andrea Ferrari, University of Cambridge, UK
- Plenary Speaker

Andrea C. Ferrari earned a PhD in electrical engineering from Cambridge University, after a Laurea in nuclear engineering from Politecnico di Milano, Italy. He is Professor of nanotechnology and Professorial Fellow of Pembroke College. He founded and directs the Cambridge Graphene Centre and the EPSRC Centre for Doctoral Training in Graphene Technology. He chairs the management panel and is the Science and Technology Officer of the European Graphene Flagship. He is a Fellow of the American Physical Society, Fellow of the Materials Research Society, Fellow of the Institute of Physics, Fellow of the Optical Society and he has been recipient of numerous awards, such as the Royal Society Brian Mercer Award for Innovation, the Royal Society Wolfson Research Merit Award, the Marie Curie Excellence Award, the Philip Leverhulme Prize, The EU-40 Materials Prize. He also received 4 European Research Council Grants.

Presentation Abstracts & Speaker Profiles

Title: Carbon-Based Metal-Free Electrocatalysts for Energy and Chemical Conversions

Carbon-based metal-free electrocatalysts (C-MFECs) have been widely demonstrated for efficient oxygen reduction, oxygen evolution, hydrogen evolution, carbon dioxide reduction, nitrogen reduction, and many other electro-/photo-catalytic reactions. Recent worldwide research efforts have shown great potential for cost-effective applications of C-MFECs in clean energy and chemical conversion processes to reduce or even eliminate greenhouse emissions. Further research and development of C-MFECs could transform clean energy and green chemical technologies. In this talk, I will summarize some of our work on the development of C-MFECs for clean energy and chemical conversions, along with an overview on recent advances, current challenges, and future perspectives in this exciting field.

Professor Liming Dai, The University of New South Wales, Australia
- Plenary Speaker

Professor Liming Dai is a UNSW Scientia Professor, an ARC Laureate Fellow and an Australian Academy of Science Fellow. He is the Director of the ARC Centre of Excellence for Carbon Science and Innovation. He is also Funding Director of the Centre for Advanced Carbon Materials at UNSW. Previously, he was a Principal Research Scientist in CSIRO at Clayton (1992-2002), an Associate Professor of Polymer Engineering at the University of Akron (2002-2004), the Wright Brothers Institute Endowed Chair Professor of Nanomaterials at the University of Dayton (2004-2009), and the Kent Hale Smith Professor in the Department of Macromolecular Science and Engineering at Case Western Reserve University (2009-2019).

Professor Dai's expertise covers the synthesis, functionalization, and device fabrication of conjugated polymers and carbon nanomaterials for energy-related and biomedical applications. Among his many pioneering scientific achievements, he is widely recognised as a pioneer and leading scientist in the research and development of carbon-based metal-free electrocatalysts for renewable energy technologies. He has published more than 500 journal publications with citations over 83,000 and an h-index of 146 (as of Aug 2020, Google Scholar). He has also published a researchonograph on intelligent macromolecules and 5 edited/co-edited books on carbon nanomaterials for advanced energy systems and biomedical applications, including 2-volume edited book on Carbon-based Metal-free Catalysts by Wiley-VCH. He is a Clarivate Analytics World's Highly Cited Researcher (both in Materials and Chemistry). He serves as an Associate Editor of Nano Energy and editorial board member of more than 10 international journals.

Professor Dai has been honoured with many awards and accolades, most recently receiving the 2019 IUMRS-Somiya Award from the International Union of Materials Research Societies, the 2019 Australian Research Council Laureate Fellowship, and the 2018 Advanced Materials Hall of Fame. He also severs as an Advisory Committee Member of the American Carbon Society. He is a Fellow of the Royal Society of Chemistry, Fellow of the American Institute for Medical and Biological Engineering (AIMBE), Fellow of the International Association of Advanced Materials, Fellow of the (US) National Academy of Inventors and Fellow of the European Academy of Sciences.

Presentation Abstracts & Speaker Profiles

Title: Mass transport through graphene-based nanopores and nanochannels

Our work demonstrates how rational interlayer engineering of graphene-based materials controls mass transport within ångström-scale nano-capillaries. We design graphene oxide (GO) membranes with precisely tuned structure and morphology for water purification, selective gas separation and moisture adsorption. By intercalating cations as moisture-attracting sites along GO nanochannels, we show that the slip length decreases exponentially with the hydrated diameter of the cations, establishing a clear structure–transport relationship. These GO membranes efficiently remove natural organic matter, humic substances, chloramines and other contaminants while sustaining stable flux, with flat-sheet and hollow-fibre formats retaining performance over at least four weeks, confirming their robustness for long-term operation. Extending this approach, we fabricate reduced graphene oxide laminates intercalated with MgAl-layered double hydroxide nanosheets to prevent restacking and create well-defined nano-capillaries, achieving nearly ideal electric double-layer behaviour with specific capacitance up to 410 F g^{-1} at 1 A g^{-1}. Together, these results establish a unified nanochannel and interlayer design strategy for 2D materials with strong potential for scalable industrial applications.

A/Prof Rakesh Joshi, The University of New South Wales, Australia - Keynote Speaker

Rakesh Joshi* is an Associate Professor at the School of Materials Science and Engineering, leading the Graphene Research Group (www.teamgraphene.org). Before joining UNSW, he was a Marie Curie International Fellow with Nobel Laureate Sir Andre Geim at the University of Manchester. A/Prof Joshi is currently leading various industry-funded research projects on the application of graphene. He has ~$2.0 million of industry funding as Principal Investigator (Lead Chief Investigator) and over $4.0 million as Chief Investigator (CI) on ARC projects. Rakesh Joshi has over 100 journal articles (and 4 international patents), with over 80 articles as the first/corresponding author.

Presentation Abstracts & Speaker Profiles

Title: Probing the active site of carbon-based catalysts through EC-STM

Active sites in catalysts play key roles in determining their efficiency and reaction pathways in electrochemical reactions. Probe and confirm the active sites in catalyst is important to design and synthesize the high-efficient catalysts for specific applications. Electrochemical scanning tunneling microscopy (EC-STM) offers a direct, atomic-scale method to probe these active sites, enabling real-time observation of surface structures and electronic properties under operational conditions. In my study, I utilize EC-STM to explore the active sites of carbon-based catalysts, revealing the key structure-activity relationships. Further, it can provide critical insights into the mechanism of electrochemical processes, advancing the rational design of carbon-based materials for various applications.

**Dr Qingfeng Zhai, The University of New South Wales, Australia
- Invite Speaker**

Dr Qingfeng Zhai is currently a Lecturer and ARC DECRA Fellow at the Australia Carbon Materials Centre (A-CMC), School of Chemical Engineering, UNSW Sydney. His research focuses on carbon-based materials for electrocatalysis and sensing applications.

Presentation Abstracts & Speaker Profiles

Title: Rational Design of Novel Carbon Structures for High-performance Energy Storage

Monolithic three-dimensional (3D) graphene-aligned carbon nanotube (G-ACNT) foams with hierarchical porous structures have attracted increasing research interests. In these architectures, individual CNTs are vertically integrated with graphene layers, fully exposing their surfaces. Such 3D structures exhibit hierarchical pore structures with an interconnected conductive network and a high specific surface area. These features significantly enhance mass and electron transport, providing numerous accessible active sites beneficial for various applications, including catalysis, capacitors, sensing and sorption. However, the controlled fabrication of a 3D architecture consisting of highly aligned CNT arrays covalently bonded to graphene layers remains challenges and has not yet been well accomplished. In this presentation, we introduce sevral novel strategies for fabricating an interconnected, covalently-bonded graphene-ACNT structures. The unit structures features vertically aligned CNTs with open-end tips that are seamlessly integrated with a holey graphene layer. When used as a cathode in batteries, overcomes traditional compromises, achieving ultrahigh energy and power densities simultaneously with an enhanced mass transport and accelerated kinetics.

Dr Shuangyue Wang, The University of New South Wales, Australia - Invite Speaker

Dr Shuangyue Wang earned his PhD degree from the University of New South Wales (UNSW) in 2022, under the guidance of Prof Sean Li. He is currently serving as a Postdoctoral Research Fellow in the School of Chemical Engineering at UNSW, supervised by Prof Liming Dai. During his PhD studies, he focused primarily on the growth of advanced 2D materials and the deposition of ultrathin metal films. Currently, his research is directed towards the fabrication of multifunctional and multidimensional carbon materials and their applications in energy conversion and storage. Dr Wang has demonstrated significant capabilities and gained extensive experience in the growth of carbon materials and the design of 3D carbon structures. His ongoing projects aim to develop innovative cathode carbon materials for advanced energy storage systems and novel metal-free electrocatalysts for energy conversion.

Presentation Abstracts & Speaker Profiles

Title: Photonically Enhanced Fluorescence of Carbon Dots for Ultrasensitive Environmental Sensing

Toxic industrial vapours (TICs) such as organophosphates and other volatile chemicals pose severe health and environmental risks, particularly in conflict zones and industrial accidents. Ammonia (NH_3), a widely used industrial chemical and common pollutant, is classified as a TIC due to its corrosive and neurotoxic effects at high concentrations. Conventional analytical methods, though highly sensitive, are expensive, slow, and non-portable, making them unsuitable for rapid, on-site detection. Rapid, on-site detection of ammonia is critical for industrial safety and environmental monitoring, yet conventional analytical techniques remain costly, bulky, and unsuitable for real-time deployment. Here, we present a photonic sensing platform that integrates carbon dots (CDs) as fluorophores within photonic bandgap–matched porous silicon photonic crystals (pSi-PhCs). The photonic structure enhances the fluorescence of embedded CDs through strong light–matter coupling, enabling ultrasensitive and selective detection of trace ammonia vapours. The sensor system employed a rhodamine b (RhB) derived carbon dots as selective fluorogenic agents which were embedded inside the pores of porous silicon photonic microcavities with matching photonic bandgap. The sensor demonstrated an ultra-wide working range spanning sub-ppb to hundreds of thousands of ppm levels under very high relative humidity conditions (RH 70-75 %), which is unprecedented. While the use of highly selective RhB-CDs ensured selective detection of ammonia. This approach offers a compact, low-cost, and high-performance optical sensing pathway toward deployable TIC monitoring technologies.

Associate Professor Tushar Kumeria, The University of New South Wales, Australia -Keynote Speaker

I am a Scientia Senior Lecturer at the School of Materials Science and Engineering, University of New South Wales (UNSW), Sydney, Australia. I received my Ph.D. in 2015 from the University of Adelaide with a Doctoral Thesis Medal and Dean's Commendation Letter. I spent the following two years at the University of California-San Diego (UCSD) as a postdoc, returning to Australia in 2017 to a prestigious Early Career Fellowship at the University of Queensland. I have co-authored over 132 peer-reviewed publications in top-tier journals in the field of nanomaterials, biomaterials, and drug delivery, and consequently have attracted more than 6850+ cites on Google Scholar with H-index of 51. I have successfully secured over $6 million (~$3.9M as lead CI) in competitive research grants, including an NHMRC early career fellowship, ARC Discovery Project, and Ramaciotti Health Investment Grant, US. Dept of Defense grant. I serve as the President of the Australian Chapter of the Controlled Release Society (AusCRS) and the Secretary for the Oral Delivery Focus Group of CRS. I have received over 20 prestigious awards/prizes/recognitions.

Presentation Abstracts & Speaker Profiles

Title: Metal Halide Perovskite Optoelectronics

In this talk I will outline our work on metal halide perovskite optoelectronics research at the University of Sydney. The first part will talk about the motivations of multi-junction tandem solar cells to overcome the efficiency limit of incumbent solar cell technology based on single-junctions and the role metal halide perovskites play in contributing to a plethora of literature on multijunction solar cells that were once monopolised by group III-V compound semiconductors. In the second part of the talk, I will talk about the more recently emerged two-dimensional (2D) perovskites with that offer a wider degree of versatility in terms of opto-electronic properties for a diverse range applications and research on these materials and their demonstrations for sensors and solar cells at the University of Sydney.

Professor Anita Ho-Baillie, The University of Sydney, Australia - Keynote Speaker

Professor Anita Ho-Baillie is the John Hooke Chair of Nanoscience at the University of Sydney, an Australian Research Council Future Fellow and an Adjunct Professor at University of New South Wales (UNSW). Her research interest is to integrate materials and devices at nanoscale for clean solar energy generation. She is a highly cited researcher from 2019 to 2024. She has been an Australian Museum Eureka Prize Finalist (2021 & 2024). In 2021, she was named the Top Australian Sustainable-Energy Researcher by The Australian Newspaper Annual-Research-Magazine. She won the Royal Society of NSW Warren Prize in 2022 for her pioneering work in the development of next generation solar cells. She won the Australian Space Awards Scientist of the Year in 2024 and Academic of the Year in 2025. In 2024, she won the Australian Academy of Science Nancy Millis Medal. She is a Fellow of the Australian Institute of Physics, the Royal Society of New South Wales and the Royal Society of Chemistry.

Presentation Abstracts & Speaker Profiles

Title: Engineering Nanoparticles for Catalytic Cancer Therapy

Nanoparticle-based catalysts have been developed for catalytic nanomedicine to generate therapeutic compounds locally towards safe and effective treatment of diseases. In this talk, I will present our recent work on development of bioresponsive nanoparticles for chemodynamic, photodynamic and sonodynamic therapy by leveraging the internal or external stimuli-triggered catalytic reactions. Our nanoparticle-based catalysts have demonstrated high catalytic activity to in-situ generate reactive oxygen species efficiently to induce apoptosis of tumor cells. The nanoparticles exhibited high selectivity to the tumor microenvironment. The hydroxyl radical generation-induced therapeutic effect was further enhanced cascade catalytic reactions triggered by photocatalysis.We have also shown that the nanoparticles generated oxygen bubbles and promoted the long-distance and directional movement, thus achieving target homing and deep penetration of thenanomedicine.

Associate Professor Sophia Gu, The University of New South Wales, Australia - Keynote Speaker

Zi (Sophia) Gu is an Associate Professor in the School of Chemical Engineering at the University of New South Wales (UNSW Sydney), where she leads the NanoBiotechnology Research Group. She is a Chief Investigator at the ARC Centre of Excellence for Carbon Science & Innovation, and a member of both the Australian Centre for NanoMedicine and the UNSW RNA Institute. After completing her PhD training at the University of Queensland and Cornell University, she was awarded an NHMRC Fellowship and joined UNSW in 2016. Her research focuses on the design of advanced nanomaterials and delivery strategies to tackle challenges in medicine and health. To date, she has published over 90 peer-reviewed papers in nanomaterials and nanomedicine. She currently serves as Editor-in-Chief of Cancer Nanotechnology and as Associate Editor for the Journal of Nanobiotechnology and Exploration.

Presentation Abstracts & Speaker Profiles

Title: Fabrication of Freestanding Single-Crystalline Perovskite Nanomembranes and Their Optical Properties

Perovskite oxides are emerging as stable alternatives to halide perovskites for optoelectronic applications. However, their integration with mainstream silicon platforms is restricted by the conventional need for high-temperature growth on lattice-matched substrates. This study aims to demonstrate a viable route to overcome these fabrication constraints by integrating transferrable, single-crystalline oxide perovskite nanomembranes with silicon. Ultrathin, single-crystalline strontium titanate ($SrTiO_3$) nanomembranes were synthesized using pulsed laser epitaxial deposition. Following growth, these freestanding membranes were transferred onto a silicon substrate and subsequently fabricated into a photodetector device. The synthesized $SrTiO_3$ membranes exhibited a thickness-dependent optical bandgap, tunable from 3.2 eV to 3.8 eV as the membrane thickness was reduced to as low as 6 nm. A photodetector fabricated from a 16 nm thick membrane showed excellent performance, achieving a high on/off ratio of 10^5 and a low dark current of 0.1 pA under 325 nm illumination. This work successfully demonstrates a method to overcome lattice-mismatch limitations, enabling the integration of high-quality single-crystal oxide perovskites onto silicon. This approach paves the way for the future development of on-chip optoelectronic devices based on oxide perovskites.

Dr. Yang Liu, The University of New South Wales, Australia - Invited Speaker

Dr. Yang Liu is a Postdoctoral Researcher at the University of New South Wales (UNSW). He earned his Ph.D. from the School of Materials Science and Engineering at UNSW in 2024. He specializes in the epitaxial growth of single-crystal materials using Laser Molecular Beam Epitaxy. His work, which focuses on perovskite oxide-based heterostructures and freestanding form structures, aims to accelerate the commercial application of perovskite technologies. This is achieved by establishing clear links between their fundamental properties and functional performance at the device level. This research targets advancements in water-splitting and nanoelectronics.

Presentation Abstracts & Speaker Profiles

Title: Stability and Conductivity of Ferroelectric Nanoscale Bubbles

Nanoscale ferroelectric topologies such as vortices, skyrmions, and bubble domains are stabilized in thin films through a delicate balance of mechanical and electrical boundary conditions. In particular, sub-10 nm ferroelectric bubbles promise intriguing functional properties for next-generation solid-state electronic devices. However, a systematic understanding of their phase stability and dynamic conductivity remains elusive.
Here, we address this gap using first-principle-based simulations and scanning probe microscopy on ultrathin epitaxial (001) $PbZr_{0.4}Ti_{0.6}O_3$ heterostructures. Simulations predict that labyrinthine domains transform into bubbles under reduced film thickness, increased mechanical pressure, and/or improved electrical screening. This transition is driven by a mechanism that conserves the residual depolarization field, pinned by an external or built-in electric bias. These predictions are experimentally verified using tomographic atomic force microscopy, demonstrating controlled manipulation of nanoscale bubble domains through concurrent effect of reducing film thickness and increased mechanical stimulus.
In addition, we investigate the conduction properties of as-grown bubbles in $PbZr_{0.2}Ti_{0.8}O_3$ heterostructures. At bubble sites, rectifying current-voltage characteristics with ultra-high current densities have been observed, attributed to tunneling. Conductivity is maintained or enhanced under an external electric field, provided the bubble configuration remains stable. Conversely, mechanical disruption of the dipolar configuration decreases conductivity by 50%. Simulations highlight the role of inhomogeneous depolarizing fields and screening conditions in dynamically tuning tunneling transport.
Our findings provide a comprehensive understanding of the phase stability and dynamic conductivity of ferroelectric bubbles, offering new opportunities for their application in future electronic and functional devices.

Dr. Peggy Zhang, CSIRO, Australia
- Invited Speaker

Dr Peggy Qi Zhang is a Research Scientist at Commonwealth Scientific and Industrial Research Organisation (CSIRO). She received her PhD degree in Materials Science and Engineering in 2015 from University of New South Wales (UNSW). Following her PhD, she worked as a research associate (2015-2021), and later a lecturer (2022-2023) at UNSW before joining CSIRO in 2023. In 2019, she was awarded Women-in-FLEET Fellowship by ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET). Her primary research interests include ferroelectric topological defects, application of scanning probe microscope, fabrication of ferroelectrics using chemical solution deposition, and development of low-energy nanoscale ferroelectric and quantum devices.

Presentation Abstracts & Speaker Profiles

Title: Aberration Corrected Electron Microscopy for Advanced Energy Materials

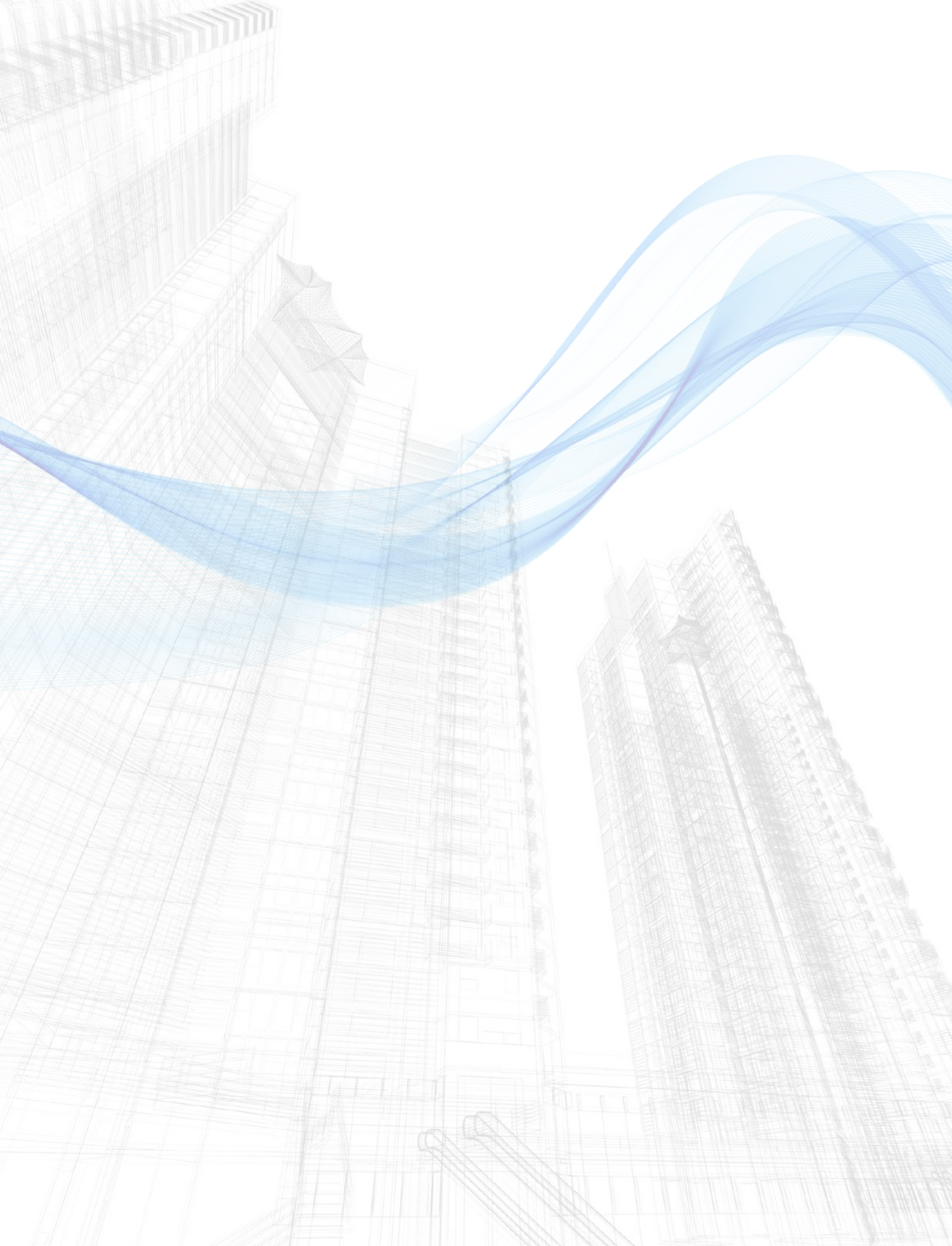
Aberration Corrected Scanning Transmission Electron Microscopy (AC-STEM) is an established technique to study the structure of materials at the atomic level [1]. With resolutions greater than 60 pm these instruments can identify individual atoms and measure small deviations in atomic positions using annular dark field STEM imaging (ADF-STEM). Modern AC-TEM can also collect scanning electron diffraction [2] (SED or 4D-STEM) datasets which reveal microscopic spatial variations in atomic structure and atomic scale electric fields. In addition, advanced spectroscopic techniques such as electron energy loss spectroscopy (EELS) can provide not only elemental but also chemical information and excited plasmon energies.

In this talk, I will present my recent research using the AC-STEM at UNSW, the JEOL GrandARM. I will explore the application of AC-STEM techniques including annular dark field STEM (ADF-STEM), 4D-STEM, and EELS to investigate catalytic [3] and ferroelectric materials [4,5]. The first part of the talk will focus on the characterisation of nanoparticles and single atom catalysts. I will demonstrate how using a combination of STEM techniques can lead to a deep understanding of the enhanced catalytic performance for salt-water splitting applications.

The second part of the talk will explore ferroelectric materials which are promising future candidates for high-density energy storage, nano-electronics and memory applications due to polarisation-driven effects caused by picometer displacements of atoms in the crystal lattice. Understanding how these atomic-scale distortions couple with electronic structure is vital for optimising their functional properties. Furthermore, the ability to directly visualise polar domains and local electric fields at the atomic level provides new ways to engineer ferroelectric behaviour for next-generation devices. This talk will highlight the power of aberration-corrected electron microscopy as a versatile tool for uncovering a wealth of structure–property relationships and guiding the design of next-generation energy materials.

Dr Richard F. Webster, The University of New South Wales, Australia
- Invited Speaker

Richard Webster holds a PhD from the University of Bristol in Physics and is employed as a research associate in the Electron Microscope Unit at UNSW, Sydney - a Node of Microscopy Australia. Richard has over 10 years experience using transmission electron microscopes and has over 50 peer-reviewed publications regarding TEM application to an extensive range of materials. Richard's role in the unit is to collaborate with researchers applying the latest microscopy techniques to enhance their research and answer their scientific questions and to teach researchers to use TEM. Richard is responsible for the two JEOL F200 microscopes and daily operation of the aberration corrected (S)TEM, the JEOL GrandARM300F2.



More Information at https://www.unsw.edu.au/research/mmfi/news-events/events/acs-nano-summit-2025