Australian Academy of Science

MATERIALS FOR THE 21ST CENTURY

FROM DESIGN TO APPLICATION

2015

THEO MURPHY

AUSTRALIAN FRONTIERS OF SCIENCE

PROGRAM

MELBOURNE, 9–11 DECEMBER

CONTENTS

To tweet about Frontiers of Science during the event, please use the hashtag #AusFoS15

FOREWORD

The Academy has hosted the Theo Murphy Australian Frontiers of Science symposium since 2003, bringing together the very best young Australian scientists to discuss emerging technologies, new opportunities and exciting cutting-edge advances in their fields.

This year, 70 outstanding early- and mid-career researchers (EMCRs) from the materials science field will identify ways to bring the ever-expanding 'tool-kit' of materials science to bear on the important materials-based problems of the 21st century.

Materials research heavily underpins the scientific, technological and industrial advancements that drive advanced economies and modern societies. As an endeavour, materials research is often highly collaborative, drawing upon skills from a wide variety of scientific disciplines to design and synthesise new materials, characterise their properties and develop new applications and technologies. Innovation in this domain is thus strongly reliant on healthy networks and strong partnerships towards ambitious common goals. This meeting will focus on building the collaborative networks that will ensure Australia's role as a materials innovation powerhouse in the coming decades.

The 2015 Theo Murphy Australian Frontiers of Science symposium is generously supported by the Theo Murphy (Australia) Fund courtesy of the Royal Society of London. The Academy is delighted to have this funding available to enable some of Australia's brightest young scientists to engage in fresh thinking about materials science and to develop networks that will enrich their careers.

Professor Andrew Holmes AM PresAA FRS FTSE
President, Australian Academy of Science

SYMPOSIUM ORGANISERS

ORGANISING COMMITTEE

Associate Professor Adam Micolich, Co-chair
Head of Nanoelectronics Group, School of Physics, UNSW Australia

Associate Professor Jodie Bradby, Co-chair
Senior Fellow, Department of Electronic Materials Engineering, Australian National University

Professor Julie Cairney
Professor, Materials Characterisation and Acting Director, Australian Centre for Microscopy and Microanalysis, University of Sydney

Dr Francesca Cavalieri
ARC Future Fellow, Department of Chemical and Biomolecular Engineering, University of Melbourne

Associate Professor Drew Evans
Research Leader,Advanced Manufacturing, University of South Australia

Associate Professor Lan Fu
Senior Fellow and ARC Future Fellow, Department of Electronic Materials Engineering, Australian National University

Associate Professor Matthew Hill
Principal Research Scientist and ARC Future Fellow, CSIRO and Monash University

Dr Sharath Sriram
Research Group Leader, Department of Electrical and Computer Engineering, RMIT University

Dr Chenghua Sun
ARC Future Fellow, School of Chemistry, Monash University

OVERSIGHT COMMITTEE

Professor Jim Williams, Chair
Emeritus Professor, Department of Electronic Materials Engineering, Australian National University

Professor Maria Forsyth
Associate Director, Institute for Frontier Materials and Chair of Corrosion and Electromaterials Science, Deakin University

Professor Max Lu
Provost and Senior Vice-President, University of Queensland

ACADEMY SECRETARIAT

Dr Sandra Gardam
Early- and Mid-Career Researcher Project Officer

Mr Mitchell Piercey
Events Manager

Mr Ray Kellett
Events Administrator

PROGRAM

DAY ONE—WEDNESDAY 9 DECEMBER

5.00 pm	**Registration and poster setup**
5.30 pm	**'The right words for the right people' workshop** Workshop facilitator: Tanya Ha
7.00 pm	**Official opening** Speaker: Dr Leonie Walsh, Lead Scientist of Victoria
7.30 pm	**Industry engagement session and cocktail reception**

DAY TWO—THURSDAY 10 DECEMBER

8.30 am	**Welcome** Professor Jim Williams, Chair of the oversight committee **General introduction** Associate Professor Adam Micolich, Co-chair of the organising committee
9.00 am	**Session 1: Materials for energy and the environment** **Chairs** Dr Matthew Hill and Dr Chenghua Sun
9.00 am	*Demystifying adsorption processes in ultramicroporous materials for CO_2 capture* Dr Josie Auckett, Australian Nuclear Science and Technology Organisation
9.20 am	*Battery: Evolution, future and challenges* Dr Da-Wei Wang, UNSW Australia
9.40 am	*Stimuli-responsive polymers: investigating structure–function relationships* Dr Lucy Weaver, CSIRO
10.00 am	**Group discussion with all participants**
10.30 am	MORNING TEA
11.00 am	**Session 2: Materials for electronic/ optoelectronic device applications** **Chairs** Associate Professor Lan Fu and Associate Professor Adam Micolich
11.00 am	*Frequency-based magneto-electronic nanoparticle detectors: towards fast nano-scale spintronic biosensors* Dr Peter Metaxas, University of Western Australia
11.20 am	*Photoconductivity of organic solar cells and photodetectors* Dr Almantas Pivrikas, Murdoch University
11.40 am	*Engineering nonlinear optics via metallo-semiconductor nanostructures* Dr Mohsen Rahmani, Australian National University
12.00 pm	**Group discussion with all participants**
12.30 pm	LUNCH
1.30 pm	**Session 3: Advanced manufacturing** **Chairs** Professor Julie Cairney and Associate Professor Jodie Bradby
1.30pm	*A novel energy absorbing metallic foam* Dr Thomas Fiedler, University of Newcastle
1.50 pm	*Amorphous alloys—next generation materials and future possibilities* Dr Kevin Laws, UNSW Australia
2.10 pm	*Materials science using atom probe tomography: 3D analysis of chemistry and nanostructure with near-atomic spatial resolution* Dr Ross Marceau, Deakin University
2.30 pm	**Group discussion with all participants**
3.00 pm	AFTERNOON TEA
3.30 pm	**Session 4: Application of thin-films, low dimensional materials and nanoparticles** **Chairs** Associate Professor Adam Micolich and Dr Drew Evans
3.30 pm	*Zinc oxide thin film stretchable electronics and sensors* Dr Madhu Bhaskaran, RMIT University
3.50 pm	*Surface plasmon coupling in assemblies of metal nanoparticles—towards functional superstructures* Dr Alison Funston, Monash University
4.10 pm	*Plasmonic effects in photocatalysis: nanostructures for light absorption* Dr Daniel Gomez, CSIRO
4.30 pm	**Group discussion with all participants**
5.00 pm	END OF DAY 2
5.45 pm	Coach departs hotel for dinner venue
6.30 pm	**Pre-dinner event and talk**
7.00 pm	**Dinner at Melbourne Zoo** Dinner speaker: Professor Veena Sahajwalla, Centre for Sustainable Materials Research and Technology, UNSW Australia
9.30 pm	Coach returns to hotel

DAY THREE—FRIDAY 11 DECEMBER

8.30 am	**Session 5: Gender equity in materials science and engineering—the issues, the challenges and the development of a path forward** **Chairs** Associate Professor Jodie Bradby and Dr Sharath Sriram
8.30 am	*Why science is sexist* Dr Nicola Gaston, Victoria University of Wellington
8.45 am	*Strategies to increase gender diversity in engineering at the University of Sydney* Professor Julie Cairney, University of Sydney
9.00 am	*Beyond the issues: two national initiatives that will transform the face of Australian science* Dr Marguerite Evans-Galea, Murdoch Childrens Research Institute
9.15 am	**Panel discussion and Q&A with all participants** **Panel** **Dr Nicola Gaston**, author of 'Why Science is Sexist' **Professor Julie Cairney**, Professor, Faculty of Engineering, University of Sydney **Dr Marguerite Evans-Galea**, steering committee member of Science in Australia Gender Equity (SAGE) and co-founder of Women in Science AUSTRALIA **Dr Sharath Sriram**, Chair, Early- and Mid-Career Researcher (EMCR) Forum
10.00 am	MORNING TEA
10.30 am	**Session 6: Soft matter and biomaterials** **Chairs** Dr Francesca Cavalieri and Dr Matthew Hill
10.30 am	*Bio-inspired materials: catalysts and functional interfaces* Dr Luke Connal, University of Melbourne
10.50 am	*Bioengineering extracellular matrix-based biomaterials for enhanced wound repair* Dr Megan Lord, UNSW Australia
11.10 am	*Atomic view of peptide nanotubes with a pH-responsive diameter: relevance to biology and nanobiomaterials* Dr Celine Valery, RMIT University
11.30 am	**Group discussion with all participants**
12.00 pm	LUNCH
12.45 pm	**Session 7: Computer-aided materials design** **Chairs** Dr Chenghua Sun and Associate Professor Lan Fu
12.45 pm	*Computational discovery and design: 2D materials for energy and electronic applications* Associate Professor Aijun Du, Queensland University of Technology
1.05 pm	*A multiscale approach to predicting the electronic properties of superatomic solids* Dr Nicola Gaston, Victoria University of Wellington
1.25 pm	*Terahertz metamaterial modulators with embedded large-area transparent thin film transistor arrays* Dr Fangfang Ren, Australian National University
1.45 pm	**Group discussion with all participants**
2.15 pm	**Session 8: Materials characterisation: surfaces, interfaces and properties** **Chairs** Dr Sharath Sriram and Professor Julie Cairney
2.15 pm	*Monolithic materials: fabrication, characterisation and applications* Dr Sinéad Currivan, University of Tasmania
2.35 pm	*Plasmonic perfect absorbers for photoelectrochemical systems* Dr Charlene Ng, CSIRO
2.55 pm	*New materials hidden inside old ones—the case of domain walls in multiferroic oxides* Dr Jan Seidel, UNSW Australia
3.15 pm	**Group discussion with all participants**
3.45 pm	**Closing remarks** Associate Professor Jodie Bradby, Co-chair of the organising committee
4.15 pm	Coach departs for airport

OPENING SPEAKER

DR LEONIE WALSH FTSE, **Lead Scientist of Victoria**

Leonie Walsh was appointed to the inaugural role of Victorian Lead Scientist in mid-2013. In this capacity Leonie represents Victoria on the Forum of Australian Chief Scientists, sits on the Australian Science Media Board, the Science and Engineering Advisory Committee for the Environmental Protection Authority, the Future Industries Ministerial Advisory Council and a newly formed STEM Advisory committee for the Department of Education and Training. She has held the honorary role of President of the Australasian Industrial Research Group (AIRG) since 2011 with the recent transition to Immediate Past President. In this role Leonie has 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.

Prior to taking on these positions Leonie had accumulated more than 25 years of technology leadership experience in a broad range of industrial applications both locally and globally in companies such as Dow Chemical, Henkel and Visy with a focus on the development and commercialisation of technology. She 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 Australian Academy of Technology and Engineering. Leonie received an Honorary Doctorate (HonDUniv) from Swinburne University of Technology for contributions to science and innovation.

WORKSHOP FACILITATOR

TANYA HA, **Associate at Science in Public and the Melbourne Sustainable Society Institute**

Tanya Ha is an award-winning Australian environmental campaigner, author, science journalist and sustainability researcher. She is an Associate at the communication agency Science in Public and the Melbourne Sustainable Society Institute at the University of Melbourne. She was an ambassador for National Science Week in 2009 and now, through Science in Public, is the national publicity manager for Science Week. Tanya has worked both in the media and on the 'Dark Side' of public relations (though she only uses her powers for good). Tanya was a science reporter for the ABC's flagship science show Catalyst, and was the host and main reporter for the WIN Tasmania show Warm TV, for which she won the UNAA Media Award for Environmental Reporting. Tanya has also had roles in public policy and stakeholder relations, including over six years on the board of Sustainability Victoria. She now consults on science and environmental engagement and communication for several organisations, companies and research institutions.

DINNER SPEAKER

PROFESSOR VEENA SAHAJWALLA, **Director, Centre for Sustainable Materials Research and Technology (SMaRT@UNSW); Associate Dean—Strategic Industry Relations, Faculty of Science, UNSW Australia**

Respected as an internationally award-winning scientist and engineer, Veena's research focuses on the sustainability of materials and processes with an emphasis on environmental and community benefits. One of her most celebrated achievements is the invention of a process of recycling plastics and rubber tyres in steelmaking, now known around the world as green steel.

Veena works collaboratively with companies and institutions in Australia and overseas and has established strong partnerships and a deep knowledge of industrial processes and problems.

As the Director of the SMaRT Centre, she provides leadership for research programs on sustainable materials, placing a strong emphasis on the skills and knowledge that are urgently needed to enhance sustainability.

Passionate about science and engineering and very active in communicating her ideas to industry, government, students and the wider community, Veena has presented widely on her research and experiences in Australia and overseas and has published in excess of 250 papers in leading scientific journals.

PRESENTATION ABSTRACTS

Each session will last 1.5 hours and include time for interactive discussion with all meeting participants.

SESSION 1: MATERIALS FOR ENERGY AND THE ENVIRONMENT

Chairs: Dr Matthew Hill and Dr Chenghua Sun

Demystifying adsorption processes in ultramicroporous materials for CO_2 capture

DR JOSIE AUCKETT

Australian Nuclear Science and Technology Organisation

The dependence of the industrialised world on fossil-fuel energy generation technologies and consequent increase in atmospheric CO_2 concentrations has been blamed for emerging adverse climate effects, including an increase in global mean temperatures. Until renewable, carbon-free energy sources can be efficiently harnessed to meet the world's energy needs, interim measures are sought to suppress the atmospheric release of CO_2 from traditional coal and natural gas combustion processes. Microporous materials such as zeolites and metal-organic frameworks (MOFs) are being investigated for the separation and capture of CO_2 at various stages of the combustion cycle.

MOFs represent one of the most promising classes of materials for this application, offering unrivalled tunability of structural and chemical characteristics via the substitution of metals and choice and functionalisation of ligands. In order for a MOF to be rationally tuned for improved performance, the nature of the interactions between host framework and guest molecules must be well understood at the atomic level. Our research targets this detailed understanding of MOFs using neutron scattering and computational methods. As we employ in situ diffraction to locate the preferred binding sites of guest molecules in the framework, inelastic neutron scattering to probe system dynamics, and density functional theory-based molecular dynamics simulations to validate and interpret our experimental results, we hope to gain new and detailed information about the mechanisms of gas uptake and diffusion in the most exciting MOF materials.

Battery: evolution, future and challenges

DR DA-WEI WANG

UNSW Australia

Battery is regarded as a viable solution to the emerging demand on energy storage. The first type of rechargeable battery was lead-acid battery invented by French physicist Gaston Planté in 1859. Lithium-ion batteries now dominate the market. Given the increasing dependence on cost-effective high-energy battery technology, many post-Li-ion batteries are under development, with a few well-known examples of Na-ion battery, Li-S battery and Li-Air battery. With the rapidly spreading uses of batteries, the recycling of those hazardous and expensive elements or materials will need to be addressed which is still in the infancy. This talk will share some ideas on how to deal with the future challenges towards greener and more sustainable battery technologies from the perspectives of materials and chemical engineering.

Stimuli-responsive polymers: investigating structure–function relationships

DR LUCY WEAVER

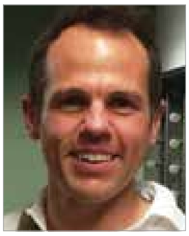
CSIRO

Stimuli-responsive polymers are important and versatile materials that possess the unique ability to transition between different structural states, reversibly, through the application of an external stimulus. For example, some temperature-responsive polymers undergo a coil to globule conformational change at a given transition temperature, which causes reversible loss in water solubility. This is one property that can be exploited in the development of new 'smart' materials, such as stimuli-responsive surface coatings or drug delivery vehicles. Whilst poly(N-isopropylacrylamide) (PNIPAM) systems are the most well-studied thermoresponsive polymers, other polymer systems are emerging as more flexible alternatives, as the transition temperature and other properties (e.g. biocompatibility, functionality) can be better tailored to suit the specific application.

In this study, a variety of different pH- and temperature-responsive polymer systems were investigated. Utilising a controlled polymer synthesis technique, the random or block copolymer structure of these polymers was studied to determine what effect structure plays on the stimuli-responsive properties of these polymers in solution. Through this study, important structure-function relationships have been elucidated, in order to help with future design of advanced stimuli-responsive materials.

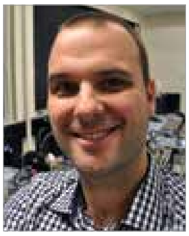
SESSION 2: MATERIALS FOR ELECTRONIC/ OPTOELECTRONIC DEVICE APPLICATIONS

Chairs: Associate Professor Lan Fu and Associate Professor Adam Micolich

Frequency-based magneto-electronic nanoparticle detectors: towards fast nano-scale spintronic biosensors

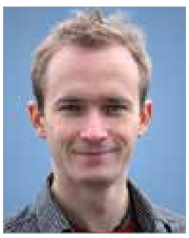
DR PETER METAXAS
School of Physics, University of Western Australia



Magnetic biosensors function by detecting magnetic particles that are bound to analytes of interest within a biological sample. Magnetic biosensing techniques are attractive for medical diagnostics, offering compatibility with magnetic separation as well as with a range of media (most biological fluids typically have nil magnetic background). This talk will present the basics of work being performed which is aimed at moving towards intrinsically frequency-based nanoparticle sensors (in contrast to voltage-level-based sensors such as conventional magnetoresistive devices). The frequency-based devices work by employing spin polarised currents in ferromagnetic nanostructures to drive and/or probe GHz frequency, precessional magnetisation dynamics. The critical aspect of these dynamics is that they are magnetic field dependent, enabling the detection of localised magnetic fields generated by magnetic nanoparticles. The routes for probing and exciting these dynamics in patterned magneto-electronic (spintronic) nano/micro-structures will be discussed and simulation work which uses local supercomputing and cloud-computing infrastructure will be explained.

Photoconductivity of organic solar cells and photodetectors

DR ALMANTAS PIVRIKAS
Murdoch University

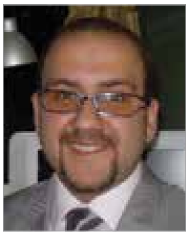


Optoelectronic devices made from non- or partially-crystalline semiconductors such as polymers, organic small molecules, dye-sensitised structures and nanoparticles as well as perovskites offer the potential for low cost and large area fabrication. All these systems lack long range electronic order and have a common feature—their electrical conduction is inferior compared to highly-crystalline inorganic semiconductors such as silicon because of orders of magnitude lower electron and hole mobilities. Low photocarrier mobility limits the performance of photovoltaic devices, light emitting diodes and transistors.

Classical photoconductivity and charge transport measurement techniques such as Time-of-Flight or Hall-effect are typically not applicable or are unreliable in the above-mentioned disordered systems. In this work a number of novel techniques developed for the purpose of unambiguous electron and hole mobility measurements in operational devices is presented. Drift-diffusion simulations were employed to predict the experimental conditions and outcomes. A critical conclusion arising from measured results demonstrates that, in contrast to the commonly accepted knowledge, the efficient solar cells do not need balanced charge carrier mobilities. Furthermore, the charge transport drift distance in light harvesting and photodetecting systems is redefined. It is shown that the classical approach in characterising the photocarrier drift distance by mobility/lifetime product is not applicable in organic solar cells and the novel approach using mobility/bimolecular recombination product is proposed.

Engineering nonlinear optics via metallo-semiconductor nanostructures

DR MOHSEN RAHMANI
Australian National University

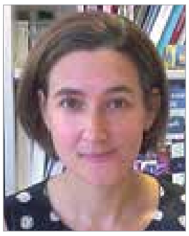


The unbeatable speed of light gives unmatched information capacity leaving no doubt that light is the ultimate means of conveying information. But in today's technology, optical and electric signals have to be converted between each other many times, which introduces delays and additional power consumption. Nonlinear optics holds a great potential to circumvent these current limitations by eliminating the need for electronics, whereby light is directly controlled by light. It is at the heart of modern photonic functionalities, including diversifying laser systems, light-material interactions and information technology. Currently, nonlinear optical interactions are generally based on large anisotropic transparent crystals, which are not compatible with the size requirements of photonic and optoelectronic systems. Recent studies have revealed the potential of nanophotonics to address this issue via the artificially induced nonlinear responses in certain nanostructures. This is possible because nanostructures are capable of squeezing light fields into volumes orders of magnitude smaller than the diffraction limit of light. Metallic nanoparticles can exhibit extremely high optical nonlinearity due to the strong local field enhancement and the intrinsically high non-linearity of the metals used. However, since metallic structures absorb light, they tend to have a relatively low heat resistance to high power lasers.

This disadvantage together with weak penetration of the exciting fields into the metal means conversion efficiency rates remain low, which could be key limiting factors to nonlinear optics at the nanoscale. In this talk, smart hybridisations of metals, dielectrics and semiconductors will be discussed to reveal the high potential of material engineering in this respect that can minimise energy losses and maximise conversion efficiency in novel nonlinear nanodevices on-chip, simultaneously.

SESSION 3: ADVANCED MANUFACTURING

Chairs: Professor Julie Cairney and Associate Professor Jodie Bradby



A novel energy absorbing metallic foam

DR THOMAS FIEDLER

University of Newcastle

Metallic foams are excellent energy absorbers intended for use in automotive impact protection, protective packaging and blast-proof barriers. However, conventional foams suffer from high cost and unreliable mechanical properties. The presentation introduces a novel type of metallic foam that addresses both constraints. The material, called perlite-metal syntactic foam, is created by combining volcanic perlite with a metallic matrix. The material is inexpensive due to the low cost of its constituents. Furthermore, porosity is introduced by expanded perlite particles that permit a close control of the geometry resulting in consistent mechanical properties. This presentation further showcases an application example: the usage of perlite-metal syntactic foam for the design of advanced roadside barrier systems.

Amorphous alloys—Next generation materials and future possibilities

DR KEVIN LAWS

UNSW Australia

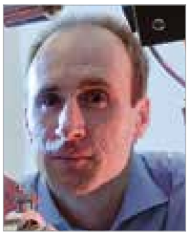
Amorphous alloys or metallic glasses have been earmarked as 'the most significant development in materials science since the discovery of plastics over 50 years ago' (Mike Ashby, 2011) and are gaining significant interest as 'next generation' materials. Like something straight from science fiction (think of the Liquid-Metal T1000 robot assassin in the Terminator films), these materials behave more like glass or plastic than metal. Most metals are crystalline when solid, with their atoms arranged in a highly organised and regular manner. Metallic glasses, however, have a highly disordered structure, with atoms arranged in a non-regular way. When compared to regular alloys, amorphous alloys possess superior strengths, elastic limits and corrosion resistance as a result of their amorphous structure and, unlike any other metal alloys, exhibit a glass transition temperature above which they become as malleable as chewing gum and can be easily moulded like glass/plastics into complex shapes.

There are many types of metallic glasses, with most based on zirconium, palladium, magnesium, titanium or copper. Until now, discovering alloy compositions that form glasses has required a lengthy process of trial and error in the laboratory. In a new study recently published in Nature Communications, Dr Laws and his colleagues describe a predictive model for metallic glasses which allows scientists to predict the metal combinations that will have high glass-forming ability. They have used their model to successfully predict more than 200 new metallic glass alloys based on magnesium, silver, copper, zinc and titanium in the past few years.

Materials science using atom probe tomography: 3D analysis of chemistry and nanostructure with near-atomic spatial resolution

DR ROSS MARCEAU

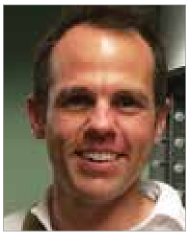
Deakin University



The challenge in characterising atomistic-level structures is that it pushes the limits of resolution and detection of most microscopy and characterisation techniques. Hence the drive for multi-technique, correlative approaches that also cover multiple length scales. Atom probe microscopy is a tomographic technique that fits into the atomic-scale end of this spectrum and provides a unique combination of highly resolved chemical and spatial information in three dimensions. So far, this technique is the closest to achieving the ultimate in microscopy, that is, to accurately locate and identify every atom in the specimen and provide capacity to reveal both composition and crystallographic structure at the atomic scale. In addition to technological advancements in instrument design, current and future research is applied to further develop new data analysis tools and methodologies. From a materials science perspective, atom probe tomography has enabled the characterisation of many important microstructural features occurring in physical metallurgy, providing new insights into structure–property relationships. Recent work on understanding the fundamental processes of carbon redistribution in modern steels will be highlighted in addition to the analysis of strengthening microstructures and corrosion initiation sites in aluminium alloys.

SESSION 4: APPLICATION OF THIN-FILMS, LOW DIMENSIONAL MATERIALS AND NANOPARTICLES

Chairs: Associate Professor Adam Micolich and Associate Professor Drew Evans




Zinc oxide thin film stretchable electronics and sensors

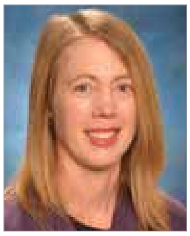
DR MADHU BHASKARAN
RMIT University

Fully transparent and flexible electronic substrates that incorporate functional materials are the precursors to realising next generation devices with sensing, self-powering and portable functionalities. Furthermore, flexible electronics offer a distinct advantage by organically conforming to irregular surfaces, enabling a new class of electronics that seamlessly integrates with the human body. Fully stretchable electronics pose a challenge for material science and micro fabrication to create devices with the ability to operate impeccably under various mechanically-stressed states.

This talk will introduce a distinctive micro-tectonic effect to enable oxygen-deficient, nano-patterned zinc oxide (ZnO) thin films on an elastomeric substrate to realise large area, stretchable, transparent and ultra-portable sensors. We harness the unique surface structure to create stretchable gas and ultra-violet light sensors, both of which outperform their rigid counterparts under room temperature conditions. The sensors show a high sensitivity to flammable and toxic gases as well as radiation in the UV-A and UV-B band. This work characterises the device performance in un-deformed and strained states using customised in situ techniques. It also demonstrates full functionality under strain as well as an increased sensitivity through micro-tectonic surfaces by comparison to their rigid counterparts. Additionally this work shows excellent control over dimensions by embedding nanometre ZnO features in an elastomeric matrix which function as tunable diffraction gratings, capable of sensing displacements with nanometre accuracy.

Surface plasmon coupling in assemblies of metal nanoparticles—towards functional superstructures

DR ALISON FUNSTON
Monash University

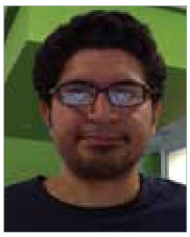


The spatial confinement of conduction electrons in sub-wavelength structures such as metal nanocrystals leads to localised surface plasmon resonances (LSPR). A consequence of the LSPR is an enhancement of the electromagnetic field close to the nanoparticle surface (near field). The near-fields of two nanoparticles located close to one another may interact to create localised areas of extremely high field enhancement. The interaction between nanoparticles is highly dependent on distance and geometry. Near-field coupling of particles spaced less than one diameter apart allows the transmission of light energy through an array.

Research in Alison's laboratory focuses on understanding the plasmon coupling in discrete one-, two- (and even 3-) dimensional nanoscale superstructures. This talk will describe the different methodologies used to assemble/fabricate the superstructures. These are combined with the optical analysis, and modeling, of the coupled plasmon resonance of the structures. The requirements for the assembly/fabrication in order to achieve a designed coupled plasmon resonance signature is highly important. Taken together, the geometry of the starting nanocrystals and the number and arrangement of each individual nanocrystal within the superstructure contribute to the landscape of coupling possibilities, and therefore possible optical responses and potential applications. These principles form the basis and road-map for the design and future realisation of functional superstructures.

Plasmonic effects in photocatalysis: nanostructures for light absorption

DR DANIEL GOMEZ
CSIRO



Photocatalytic processes offer the potential of utilising the energy of photons to drive various useful chemical reactions including water purification, solar production of chemical feedstocks and fuels. One approach to increase the efficiency of the photoconversion processes consists of integrating plasmonic metal nanostructures with semiconductor materials. Plasmonic nanostructures can improve photocatalytic processes via: (i) intrinsic charge separation mechanisms (built-in potentials) that occur at metal–semiconductor junctions (Schottky contacts), (ii) strong confinement of electromagnetic energy at the surface of the metal nanoparticles, which leads to enormous energy densities at the near-field regions of the metallic nanostructures and (iii) the emission of hot charge–carriers from the metal nanoparticles into the semiconductor material.

The transfer of hot charge–carriers from metal nanostructures into photocatalytically active materials has recently been shown to be an efficient photocatalytic mechanism. This process is secondary to the initial step of light absorption by the metal nanostructures. Light absorption in these structures can be controlled by designing complex geometries with tailored optical cross-sections. This talk will describe an approach to create plasmonic structures for optimum absorption of light and generation of hot charge carriers. In particular, it will illustrate how concepts such as diffraction coupling in nanowire gratings and nanorod dimer gratings have been employed for achieving enhanced absorption. Additionally how simple interference effects in multilayered structures have been employed for achieving near perfect absorption of light in the visible in photoelectrochemical systems will be briefly described.

SESSION 5: GENDER EQUITY IN MATERIALS SCIENCE AND ENGINEERING—THE ISSUES, THE CHALLENGES AND THE DEVELOPMENT OF A PATH FORWARD

Chairs: Associate Professor Jodie Bradby and Dr Sharath Sriram

Why science is sexist

DR NICOLA GASTON
MacDiarmid Institute for Advanced Materials and Nanotechnology, Victoria University of Wellington

It is hardly news to anyone working in science that the proportion of men and women in these careers is out of balance. Outreach targeted at encouraging young women into STEM careers has become rather fashionable, and discussion of both the numeric imbalances and suggested explanations for the gender disparity have become increasingly accessible. This talk will outline published literature on the data that demonstrates gender disparity, with a focus on behavioural studies that explain why gender disparity in the sciences is persistent, with the aim of increasing general understanding of a rather complex issue. It will present some ideas about why particular scientific disciplines, such as physics and engineering, appear so much worse than others in terms of gender equality, and conclude with a discussion of what needs to change in order for gender equality and diversity to improve across the sciences.

Strategies to increase gender diversity in engineering at the University of Sydney

PROFESSOR JULIE CAIRNEY
University of Sydney

Diversity matters: we know it intuitively, but statistics now back up this claim. A 2015 US report by McKinsey and Company shows that companies in the top quartile for gender diversity are 15 per cent more likely to have financial returns above their respective national industry medians (the figure is 35 per cent for racial and ethnic diversity—another important story!). It can be argued that the success of the American university system has at least in part been due to a much greater willingness to recruit the most able academic talent wherever it may be found.

Although we expect that making the best use of female talent will result in improved performance across the higher education sector, women constitute only 27 per cent of the professoriate at the University of Sydney, and only 12 per cent of continuing staff in the Faculty of Engineering. The reasons for this are complex, but it is necessary to identify the causes, if we are to address the issue.

The University of Sydney, and the Faculty of Engineering within it, has recently stepped up their efforts to develop better practices to encourage inclusion and diversity, especially at senior levels. This presentation will cover the business case for gender diversity in the higher education sector, and outline some of the strategies that the university is pursuing in order to make real progress towards achieving this important goal.

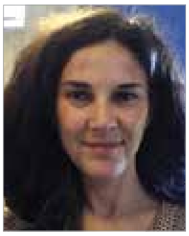
Beyond the issues: two national initiatives that will transform the face of Australian science

DR MARGUERITE EVANS-GALEA
Murdoch Childrens Research Institute

To secure Australia's health and economy into the future, the talents of women in science, technology, engineering and mathematics (STEM), including health and medicine, are vital. In biology, more than half of all Bachelor of Science and PhD graduates are women, yet there are between one and two women in every ten investigators at senior levels in our universities and research institutes. In contrast, physics, maths and engineering struggle to attract women to pursue careers in these disciplines. With most of Australia's higher profile scientists being men, students and young researchers engage with few senior women scientists. This lack of role models means successful women in science are not seen as part of 'the norm'. There has been a growing momentum to find solutions that will allow more women researchers to contribute to the decision-making processes, to diversify the ideas that will improve economic growth and innovation, and allow more women in science to lead and excel. In particular, two national initiatives—the Science in Australia Gender Equity (SAGE) program and Women in Science AUSTRALIA—have the potential to synergise and transform the face of Australian science. This talk will provide more information about these initiatives and how men and women can work together to create an environment that allows more women in science to lead and excel.

SESSION 6: SOFT MATTER AND BIOMATERIALS

Chairs: Dr Francesca Cavalieri and Dr Matthew Hill




Bio-inspired materials: catalysts and functional interfaces

DR LUKE CONNAL
University of Melbourne

Currently enzymes are being explored for a variety of applications. In fact, enzymes are already well established in common technologies, for example as active ingredients in detergents, food additives, and paper and pulp processing. Recently, enzymes have also been developed as useful catalysts in pharmaceutical and specialty chemical synthesis. Enzymes have also attracted attention for the renewable preparation of bioethanol and biodiesel. The downfall in the majority of these applications is the small operating range, limited stability, and the cost of enzymes. Enzyme mimics could address all of these issues and create new, high-value products for a range of industries. This presentation will describe the development of platform chemistries to mimic some of the complex mechanisms of enzymes. Specifically, this work will develop self-assembled macromolecular mimics of hydrolytic enzymes.

Bioengineering extracellular matrix-based biomaterials for enhanced wound repair

DR MEGAN LORD
UNSW Australia

The extracellular matrix (ECM) is a dynamic, highly organised three-dimensional scaffold that works in concert with cells to grow and repair tissues. Proteoglycans are functional components of the ECM. Perlecan is an abundant proteoglycan in the ECM that we have isolated previously and used to demonstrate its bioactivity in encouraging endothelialisation whilst inhibiting the activities of platelets and smooth muscle cells in an ovine vascular graft model. The bioactivity of perlecan is attributed to its C-terminal domain V (DV) with an integrin binding site as well as a glycosaminoglycan attachment site while the N-terminal domain I (DI) contains three glycosaminoglycan attachment sites. Perlecan can only be obtained in low abundance from natural sources, thus alternative sources are needed for biomaterials applications. The aim of this research was to bioengineer perlecan domains and to evaluate them for wound healing applications.

Both DI and DV were recombinantly expressed in mammalian cells as proteoglycans decorated with glycosaminoglycans including chondroitin sulphate or the growth factor binding, heparan sulphate, or both. The structure of the glycosaminoglycans decorating the proteoglycans could be altered by changing the bioreactor culture conditions. DV was effective in promoting endothelial, but not smooth muscle cell or platelet adhesion while DI did not support the adhesion of any cell type. In the absence of glycosaminoglycan chains DV supported the adhesion of all cell types. The DI heparan sulphate chains supported mitogenic growth factor binding. These data indicated that recombinantly expressed proteoglycans have potential roles in next-generation wound healing biomaterials as bioactives with tailored cell adhesion and growth factor delivery activities.

Atomic view of peptide nanotubes with a pH-responsive diameter: relevance to biology and nanobiomaterials

DR CELINE VALERY
RMIT University

External stimuli are powerful tools that naturally control protein assemblies and functions, whereas self-assembled nanomaterials hardly possess such responsive properties. In this context bio-inspired approaches could open the way toward tunable self-assembled architectures. Here we report a self-assembling pH-sensitive peptide that forms either highly ordered bundles of small nanotubes of 11nm diameter (pH<6.5) or large nanotubes of 50nm diameter (pH>7.5). Using a set of biophysical techniques (TEM, SAXS, IR, Raman, and crystallography), we were able to unravel the molecular mechanisms of the peptide conformational changes driving the transition between small and large nanotubes.

The sub-angstrom peptide crystal structure (basic pH) reveals a globular conformation stabilised through a strong histidine-serine H-bond and a tight histidine-aromatic packing. Lowering the pH affects histidine protonation, disrupts these interactions and triggers a large change to an extended beta-sheet based conformation. Re-visiting the available crystal structures (PDB) of proteins with pH-dependent functions reveals both histidine-containing aromatic pockets and histidine-serine proximity as key motifs. The mechanisms unraveled in this study may thus be generally used by pH-dependent proteins and opens new prospects in the field of responsive bio-nanomaterials.

SESSION 7: COMPUTER-AIDED MATERIALS DESIGN

Chairs: Dr Chenghua Sun and Associate Professor Lan Fu


Computational discovery and design: 2D materials for energy and electronic applications

ASSOCIATE PROFESSOR AIJUN DU
Queensland University of Technology

Graphene-based research has progressed quickly in ten years following its epoch-making discovery, but only a handful of realistic applications are available off the shelf due to its inability to act as a semiconductor. Now more attention has been focused on other two-dimensional (2D) atomic crystals such as mono- and few-layer crystals of hexagonal boron nitride, metal dichalcogenides and layered metal oxides. Recent research in Aijun's group mainly focuses on (i) predicting stability, electronic, mechanical and optical properties in experimentally less-explored 2D materials, e.g. BiI_3, NaSnP, TcS_2, SnSe, and PbI_2; (ii) exploring new structural phases and the phase transition in metal dichalcogenides; (iii) engineering 2D van der Waals type hetero-structures to achieve the combined electronic functionalities that are unavailable from the individual 2D material.

A multiscale approach to predicting the electronic properties of superatomic solids

DR NICOLA GASTON
MacDiarmid Institute for Advanced Materials and Nanotechnology, Victoria University of Wellington

The design of nanostructured materials depends on principles of assembly that must take into account the nature of the underlying building blocks. Small metal-based clusters, which can be synthesised with atomic precision, are candidates for the construction of materials based on a multiscale design approach. Individual clusters are described as 'superatoms' on account of their emergent electronic shell structure that mimics the orbitals of real atoms, but that can be tuned through doping and structural modification. This talk will discuss ways in which electronic shell structure can be shown to modify the stability and properties of individual metal clusters, and methods for describing these clusters within the superatomic model.

The electronic properties of doped thiolate protected gold clusters have been systematically calculated using density functional theory, and analyzed to understand their tunability. The effect of electron number—varied due to doping—is systematically evaluated and compared to the numbers obtained from Bader analysis of individual atomic charges. The superatomic model is shown to be highly applicable to these clusters, but significant perturbations of the model arise due to doping. In contrast to noble metal clusters, transition metal clusters have been excluded from discussions of the superatomic model due to the localised nature of the d-electrons. Extensions to the transition metals will be discussed, and models for the description of material properties based on the superatomic concept will be described.

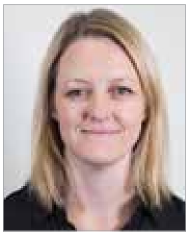
Terahertz metamaterial modulators with embedded large-area transparent thin film transistor arrays

DR FANGFANG REN
Australian National University

During the last few decades, terahertz (THz) technology has attracted much attention due to its great importance to medical, security and manufacturing sectors. To overcome the accessibility difficulties in THz gap, the electromagnetic metamaterials has emerged, in which the resonant unit cell can be controlled by external stimulus, enabling the modulation of THz radiation. So far, various ways to accomplish metamaterial modulators have been investigated by taking advantage of large doping density and high electron mobility in single crystalline semiconductors. However, they are unsuitable for large area fabrication, and actually pose more stringent requirements on sample fabrication processes. Here, we demonstrate a tunable metamaterial with monolithic integration of thin film transistors (TFTs) made of ionic amorphous oxide semiconductors. The properties of the active metamaterials are theoretically investigated via the CST Microwave Studio software, and the THz transmission measurements were performed with a THz-TDS system in a nitrogen-purged environment. At zero gate bias, the metamaterial shows a significant electric resonance around 0.75 THz. When sweeping the gate bias from 0 to 24 V, the capacitive split gap is gradually shortened due to the conductivity of oxide layer increases. At 24 V, a 4 dB relative intensity change of transmissivity with a cut-off frequency of ~1 kH can be observed. Such transparent TFT-based controllable metamaterials present a new platform for exploring stable, uniform and low-cost modulators in THz and other frequency ranges.

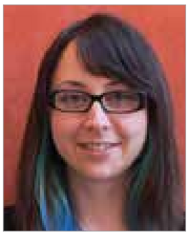
SESSION 8: MATERIALS CHARACTERISATION: SURFACES, INTERFACES AND PROPERTIES

Chairs: Dr Sharath Sriram and Professor Julie Cairney

Monolithic materials: fabrication, characterisation and applications

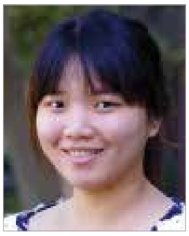
DR SINÉAD CURRIVAN
Australian Centre for Research on Separation Science, University of Tasmania



Novel materials are required if the progression of miniaturised analytical/diagnostic systems are to continue. Monolithic media provide porous materials of sufficient surface area, which can be easily modified for applications such as separations, sample extractions and sample clean up, with potential applications in sample collection. The advantages of monolithic media, particularly polymeric monoliths, lie in the range and flexibility of suitable housing materials, their stability (e.g. pH and temperature), the relative technical ease of modification, and the integration of such materials into novel technologies and microfluidics. The fabrication procedures involved in the preparation and modification of polymeric and inorganic monolithic materials will be introduced and discussed. A pathway from initial substrate formation, to characterisation and application will be described, with a predominant focus on polymeric monolithic materials for separations. The housings for these materials in separation sciences range from fused silica capillaries (< 5 µm to 500 µm internal diameters), metal tubes such as stainless steel and titanium (up to 1 mm), polymeric syringe barrels, and polymeric pipette tips, amongst others. With small scale polymeric monolithic materials, characterisation is often challenging, with some suitable methods including scanning electron microscopy and scanning capacitively coupled contactless conductivity detection, for example. These techniques have been demonstrated to provide characteristic information regarding morphology, column properties (e.g. homogeneity and capacity) and in the quality control of fabricated and modified materials.

Plasmonic perfect absorbers for photoelectrochemical systems

DR CHARLENE NG
CSIRO

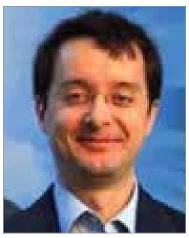


Metallic nanostructures exhibit localised surface plasmon resonances (LSPR), a phenomenon where the confined electrons of the metal collectively oscillate in response to the interaction of the nanostructure with light. These LSPRs result in highly intense and localised electromagnetic fields, which enable the top-down manipulation of energy flow at the nanoscale. Following the light excitation of LSPRs, the energy can flow out of the nanostructures radiatively though re-emitted photons or non-radiatively by generating highly energetic electrons, also known as hot electrons. When in contact with a semiconductor, plasmonic nanostructures can form a metal–semiconductor Schottky junction and could emit these hot electrons to the conduction band of the material where various photo-induced chemical reactions can occur or be induced. Most importantly, the generation of these hot electrons usually requires photon energies that are much lower than the band gap energy of the semiconductors, allowing visible or even near infra-red light to be harnessed.

One of the most interesting approaches to maximise hot electron generation from surface plasmon excitation is the utilisation of plasmonic broadband absorbers involving metal nanostructures to intensify the light energy. Typically, nanostructured metal-insulator-metal (MIM) absorber structures have been designed to achieve perfect broadband absorption, and various configurations such as metallic gratings and trapezoid arrays have shown promising results as broadband absorbers. By replacing the insulator with semiconductors, enhancement in the absorption of the materials and subsequent generation of hot electrons can be realised for photocatalytic reactions. In our work, we substitute the insulator layer with TiO_2 and the deposited Au nanoparticles are randomly sized and densely packed to achieve broadband perfect absorption. The efficiencies are then evaluated by investigating the light absorption, photocurrent generation and incident photon-to-electron conversion efficiency.

New materials hidden inside old ones—the case of domain walls in multiferroic oxides

DR JAN SEIDEL
UNSW Australia



Domain walls in complex oxides have recently received increased attention due to the fact that their properties, which are linked to the inherent order parameters of the material, its structure and symmetry, can be completely different from that of the parent bulk material. Here an overview of recent results regarding new intrinsic properties of multiferroic phase boundaries, domain walls, and other topological defects in multiferroic materials will be presented. The origin and nature of the observed confined nanoscale properties are probed using a combination of nanoscale transport measurements based on scanning probe methods, high resolution transmission electron microscopy and first-principles density functional computations. In addition an outlook on how these special properties can be found in other material systems will be given and possible future applications discussed.

POSTER ABSTRACTS

(listed by alphabetical order of author)

HIGH PERFORMANCE CELLULOSE NANOFIBRILS AND ITS POTENTIAL APPLICATIONS

Dr Nasim Amiralian

University of Queensland

Cellulose is the most abundant and renewable polymer on earth, and its nanoscale particles have rapidly gained prominence as a high-performance nanomaterials for many applications, due to their sustainability, renewability, tunable surface chemistry, superb mechanical properties, cost-effectiveness and many health and safety benefits. Nanocellulose has been explored as an efficient reinforcer for polymer nanocomposites, a potent rheological additive, and a renewable precursor for carbon fibres for potential uses in nonwoven applications, electronics, and biomedical applications such as wound dressings and tissue engineering scaffolds. This exploratory research identified unique features of Australian native arid grass spinifex and discovered a protocol for isolating very high grades of cellulose nanofibrils (CNF) cost-effectively. When benchmarked against other leading academic and commercially available materials, spinifex nanofibrils have the highest aspect ratio (length-to-diameter) of any cellulose nanofibrils to date. Normally, high grade nanocellulose requires aggressive chemical pre-treatments beyond typical delignification and bleaching steps, combined with high mechanical energy input. This results in unacceptably high infrastructure and manufacturing costs. For this reason, the commercial use of nanocellulose has been, until now, limited to niche applications. This discovery delivers very high quality cellulose nanofibres at very low cost. It is postulated that these unique properties are related to the evolution of spinifex to tolerate the extreme environmental conditions under which it grows. The presentation will be made on the processability of these unique nanofibrils and recent applications as nonwoven materials and nanofiller for making elastomeric composite.

INVESTIGATING GUEST-HOST INTERACTIONS IN POROUS METAL-ORGANIC FRAMEWORK MATERIALS (MOFS)

Dr Josie Auckett

Australian Nuclear Science and Technology Organisation

Metal-organic frameworks (MOFs) are porous solid materials consisting of metal ions or clusters connected by organic 'linker' molecules in a repeating network. The ability of many MOFs to host foreign molecules in the voids between the framework atoms renders them attractive materials for a wide range of applications, including gas separation and storage, catalysis, and drug delivery. Compared with other classes of porous solids, MOFs offer a high degree of structural and chemical tunability via the substitution of metals and choice and functionalisation of ligands.

In order for a MOF to be rationally tuned for improved performance, the nature of the interactions between host framework and guest molecules must be well understood at the atomic level. This research targets this detailed understanding of MOFs using neutron scattering and computational methods. As in situ diffraction is being employed to locate the preferred binding sites of guest molecules in the framework, inelastic neutron scattering to probe system dynamics, and density functional theory-based molecular dynamics simulations to validate and interpret the experimental results, it is hoped to reveal new and detailed information about the mechanisms of gas uptake and diffusion in the most exciting MOF materials.

FULLERENE-FULLERENE INTERACTIONS IN WATER: A MOLECULAR MODELLING STUDY

Dr Julia Baldauf

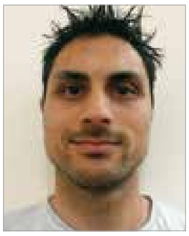
IBM Research

A comprehensive study of the pair-wise interaction of nested and hollow fullerenes, also known as carbon onions, in water was carried out. Molecular dynamic simulations employing the umbrella sampling technique gave insight in the distance dependent potential mean force between interacting particles. These results together with the size dependent water structuring around the nanoparticle surface gave insight into the self assembly behaviour of carbon onion structures and could potentially drive the design of novel structures employing fullerenes.

STRAIN MAPPING OF MANGANESE STEEL AROUND CARBIDE PARTICLES

Dr Vijay Bhatia

University of Sydney



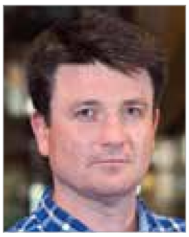
Manganese steel, more commonly referred to as Hadfield steel or Mangalloy, is an austenitic manganese steel that exhibits high toughness, strain hardening and wear resistance after work hardening. Due to these unique properties it is used extensively in the mining industry for hammer tips and rock crushers. A limitation of this use is when the wear rate is so high in comparison to the rate of work hardening that the alloy never reaches peak hardness. One proposed method to prevent this is to form carbides within the matrix of the steel. The benefit of this is potentially two fold. Firstly, hard carbides would typically increase the wear resistance of the alloy. Secondly, the thermally induced strain placed on the alloy matrix around the carbide has the potential to pre-work harden the steel.

The extent of plastic deformation of a Fe–12.1 wt.%Mn–1.2 wt.%C with 15 vol.% NbC is examined through the use of EBSD pole figure mapping, observing changes in the orientation of the lattice that is in contact with carbide. Samples are compared before and after cold rolling to observe any changes to the efficiency of plastic deformation. The extent of this plastic deformation is mapped out to determine if there is an increase in the percentage of plastic deformation within the matrix. Nano-indentation is performed to determine if the thermal stress is sufficient to harden the steel matrix around the carbides and if less cold working is required to achieve work hardening of the matrix.

MOLECULAR BEAM EPITAXY GROWTH CAPABILITY OF III-V COMPOUND SEMICONDUCTORS AT UNSW

Dr Stephen Bremner

UNSW Australia

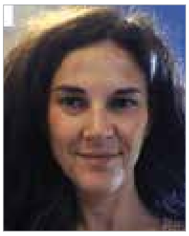


The newly commissioned Gen930 molecular beam epitaxy system at UNSW forms part of the Australian National Fabrication Facility suite of capabilities available to all researchers in Australia. The Gen930 system provides the ability to grow the highest quality III-V compound semiconductor structures with sub-atomic layer growth control allowing for precise interface formation between materials. This presentation will outline the current capabilities of the Gen930 system including materials systems available as well as future possible capability expansions. Some of the ongoing projects utilising this capability will also be outlined.

REDOX-SENSITIVE PEG-POLYPEPTIDE NANOPOROUS PARTICLES FOR SURVIVIN SILENCING IN PROSTATE CANCER CELLS

Dr Francesca Cavalieri

University of Melbourne



Creating micro-/nano-carriers that can deliver a highly potent therapeutic to a target tissue, while eliminating exposure to healthy cells, is regarded as the 'holy grail' in drug delivery. Bio-physicochemical interactions and barriers dictate the performance/behavior of micro-/nano-carrier in complex biological systems. This is a report on the engineering of intracellular redox-responsive nanoporous poly(ethylene glycol)-poly(L-lysine) particles (NPEG-PLLs). The obtained particles exhibit no toxicity while maintaining the capability to deliver a small interfering RNA sequence (siRNA) targeting the anti-apoptotic factor, survivin, in prostate cancer cells. The redox-mediated cleavage of the disulfide bonds stabilising the NPEG-PLL-siRNA complex results in the release of bioactive siRNA into the cytosol of prostate cancer PC-3 cells, which in turn leads to the effective silencing (~59 ± 8%) of the target gene. These findings indicate that NPEG-PLLs may protect the therapeutic nucleic acid in the extracellular and intracellular environment, thus preventing the occurrence of competitive interactions with serum and cytosolic proteins, as well as degradation by RNase. The intracellular trafficking and final fate of the NPEG-PLLs were investigated by a combination of deconvolution microscopy, fluorescence lifetime imaging microscopy and super-resolution structured illumination microscopy. A significant impairment of cell survival was observed in cells concomitantly exposed to paclitaxel and siRNA-loaded NPEG-PLLs. Overall, the findings indicate that NPEG-PLLs represent a highly loaded depot for the delivery of therapeutic nucleic acids to cancer cells.

POLYSULFIDES: VERSATILE MATERIALS FOR ENVIRONMENTAL REMEDIATION

Dr Justin Chalker

Flinders University

The synthesis of polymers from sustainable feedstocks is a pressing issue in chemistry and materials science. In this presentation, the synthesis and applications of a useful polymer, prepared entirely from sulfur and limonene, is described. Many thousands of tons of sulfur and limonene are produced each year as byproducts of the petroleum and citrus industries, respectively. The merger of these materials, without recourse to exogenous solvents or other reagents, provides a polysulfide that can be easily processed as a coating or moulded device. To illustrate the utility of this novel and inexpensive polymer, we show that it is efficient at removing toxic metals from water and soil. Additionally, the sulfur-limonene polysulfide changes colour on exposure to mercury salts. These properties motivate applications in sensing and environmental remediation.

MOLECULAR INSIGHTS INTO NEW ELECTROLYTE MATERIALS FOR Li AND Na ION BATTERIES

Dr Fangfang Chen

Deakin University

Sustainable energy future has urgent demands for a new generation of materials for energy storage, such as the low cost, high performance batteries used in various aspects of the community. In this project, new ionic conductive electrolyte materials were explored using molecular simulation techniques. The aim was to provide an atomic level of theoretical understanding of ion structure and transport mechanism in these materials for the optimal design of more novel electrolyte materials. In this presentation we summarised the recent progress of our modeling work, especially the alkali ions' transport in some promising solid and liquid electrolyte materials for developing Li and Na ion batteries.

MULTISTAGE DELIVERY NANOVECTORS FOR COMBINED CANCER THERAPIES

Dr Anna Cifuentes-Rius

University of South Australia

Cancer is causing increasing numbers of deaths in Australia and worldwide. Current treatments are of limited success due to the invasiveness of many of the tumours and their intrinsic resistance to chemotherapy drugs and radiation. There is an urgent need develop disruptive therapeutics for cancer treatment. A desirable treatment goal is to produce a synergistic tumoricidal effect that will overcome drug resistance while minimising side effects. This can be achieved by targeting tumours via their cell membrane receptors (active-targeting) using functionalised drug delivery vehicles loaded with therapeutics. Nanoparticle-based drug delivery systems are highly effective for the treatment of tumours as the particles accumulate in tissue by exploiting enhanced permeability and retention effects. However, current drug delivery vehicles are not easily coupled with multiple therapeutics, fail to release the payload exclusively to the tumour site, or are not biocompatible.

Porous silicon nanoparticles (pSiNP) have emerged as effective delivery carriers, due to their high surface area, tunable size and shape, biocompatibility and relatively simple surface functionalisation. Antibody-coated pSiNP, which actively targets tumour cells through binding to cell-surface receptors, were recently developed. The aim is to use the engineered pSiNP for combined delivery of a chemotherapy drug and gold nanoclusters (AuNC). This approach exploits the ability of AuNC to induce hyperthermia by an externally applied microwave field, increasing the cytotoxicity of the co-loaded drug. We call this system a multistage delivery nanovector, which takes advantage of dual therapeutic action in order to render cancer cells more susceptible to the treatment.

NANOSTRUCTURED BICONTINUOUS CUBIC LIPID SELF-ASSEMBLY MATERIALS AS MATRICES FOR PROTEIN ENCAPSULATION

Dr Charlotte Conn

RMIT University

The unique amphiphilic nature of bicontinuous cubic lipidic phases make them an ideal medium for the encapsulation of soluble, peripheral and integral membrane proteins. The lipid bilayer structure of these materials is particularly useful for the encapsulation of amphiphilic proteins and peptides as it mimics their native cell membrane environment. The lipidic cubic phase has been observed in nature, including in virally infected cells. As well as potentially retaining the protein in a functionally active form, the lipidic material can be biocompatible, and may protect the protein against degradation. However lipidic cubic phases formulated to date have been mainly based on a single lipid, or ternary systems comprising two lipids and water. Such materials may not be representative of the native cell membrane which can contain up to 100 different types of lipid. We have used high-throughput screening to investigate the phase behaviour of more complex lipidic cubic phases composed of three different lipids in excess water. The relationship between the lipidic material and the encapsulated protein has been investigated using multiple techniques including synchrotron small-angle X-ray scattering, synchrotron circular dichroism, optical microscopy and cryo-transmission electron microscopy. Results have been applied to a range of current and prospective applications for such hybrid protein-lipid materials including in meso crystallisation and drug delivery.

ADVANCED POLYMER DESIGN: ENABLING NEW MATERIALS

Dr Luke Connal

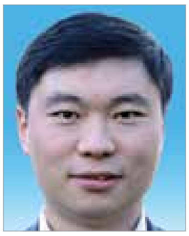
University of Melbourne

New methods in polymer design and self-assembly are enabling next generation materials development. The Connal group in the Chemical and Biomolecular Department at the University of Melbourne focuses on the design of new polymeric materials inspired by nature. The poster highlights shape changing polymeric nanoparticles, functional interfaces and new catalyst development. The materials could find applications in advanced drug design, intelligent camouflage, new cold water detergents and artificial trees.

NANOENGINEERED POLYMER THERAPEUTIC PARTICLES

Dr Jiwei Cui

University of Melbourne

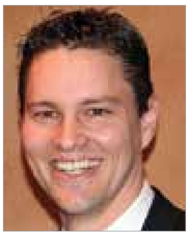


Polymer carriers with high loading capacity, stealth property and targeting ability have received great interest in therapeutic delivery systems for biomedical applications. Mesoporous silica (MS) particles are attractive candidates as templates for the preparation of such polymer carriers, due to their facile preparation method, high loading capacity and tunable template properties. A recently developed technique uses MS particles as templates to make polymer carriers with customised material properties, allowing for control over particle elasticity, types of therapeutics loaded, and different biological stimuli (e.g. enzyme, pH, reduction) capable of triggering release. The soft polymer particles with a Young's modulus from 0.2 to 25 kPa controlled by tailoring the polymer composition and/or the cross-linking density can be easily prepared by infiltrating polymers into MS particles, followed by cross-linking of the polymer chains, and subsequent removal of the templates. The deformability and stealth of the engineered particles (i.e. PEG particles) are favourable for increasing particle circulation time in vivo. For therapeutic delivery, both hydrophilic and hydrophobic anticancer drugs have been encapsulated in the MS-mediated polymer particles, which led to cytotoxicity in cancer cells. In addition, vaccine particles with effective dendritic cell stimulation could also be prepared using this general method, which highlights the potential of nanoengineered polymer particles for vaccine delivery. The reported technique is a facile and versatile method to prepare cargo-loaded soft polymer particles, which represents a novel paradigm for the delivery of drugs and vaccines.

CONDUCTING POLYMERS FOR ENERGY APPLICATIONS

Associate Professor Drew Evans

University of South Australia



Polymers are lightweight, flexible, solution-processible materials, which can possess insulating, semiconducting or metallic properties. Because of the high natural abundance of their constituting atoms, polymers are promising materials for low-cost printed electronics, mass produced and/or large-area applications. Conducting polymers offer several key advantages over their inorganic counterparts, such as mechanical flexibility, transparency, and material abundance, which can enable low-cost fabrication and novel applications such as printed and flexible electronics. The conducting polymer poly(3,4-ethylenedioxythiophene), PEDOT, is one material which displays (among others) high electrical conductivity, enhanced thermal conductivity and good electrocatalytic performance, as well as thermoelectric behaviour. Properties such as these lend themselves for use in electrochromic windows, electrical circuits, supercapacitors, metal-air batteries, microbial fuel cells and organic photovoltaics. The challenges faced include the scale-up of these materials in forms that allow their integration into new and novel devices.

PERLITE-METAL SYNTACTIC FOAM—PROPERTIES AND POTENTIAL APPLICATION

Dr Thomas Fiedler

University of Newcastle

Perlite-metal syntactic foam is a cost-efficient metallic foam that has recently been developed at the University of Newcastle. It overcomes the traditional limitations of metallic foams, that is, it is cost-efficient and exhibits consistent mechanical properties. Metallic foams combine a range of attractive properties such as controlled energy absorption, tailorable mechanical properties, low density, good damping ability and versatile thermal properties. Another important feature is the large surface area that enables their functional application as heat exchangers, catalysts or electrodes. The poster briefly summarises the main properties of perlite-metal syntactic foam and provides an overview on potential applications of this multi-functional material.

MATERIALS FOR ENHANCED BIOPROCESS ENGINEERING AND BIO-MOLECULE PRODUCTION

Associate Professor Gareth Forde

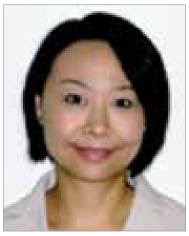
Queensland University of Technology

Complex biological feedstocks require novel and innovative materials for enhanced production and improved downstream purification. Examples include solid phase growth substrates to enhance the production and concentration of cellular biomass to improve the economics of biomolecule manufacture; affinity ligands to selectively purify therapeutics; chromatography polymers tailored to the physical and bio-chemical characteristics of the target molecule; and polymer-inorganic particles for controlled/multi-staged drug delivery.

SELECTIVE AREA METAL-ORGANIC VAPOR-PHASE EPITAXY GROWTH OF InP NANOWIRES FOR OPTOELECTRONIC DEVICE APPLICATIONS

Associate Professor Lan Fu

Australian National University

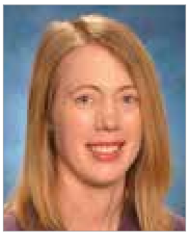


III-V compound semiconductor nanowires (NWs) have shown great promises for electronic, optoelectronic and photovoltaic device applications. Nanowires can be fabricated by a variety of crystal growth techniques, among which the selective area epitaxy (SAE) growth has the advantages of accurate control of the position, geometry, uniformity and doping of NWs to achieve excellent and reproducible device performances. This poster will demonstrate the growth of high quality, stacking-fault-free and taper-free wurtzite InP nanowires using selective-area metal-organic vapor-phase epitaxy (SA-MOVPE) for a series of optoelectronic and photovoltaic device applications.

CONCENTRATING AND DIRECTING LIGHT AT THE NANOSCALE

Dr Alison Funston

Monash University



The manipulation and use of light is a central feature in many current and potential applications. These include optical circuitry, various sensing methodologies and smart optical films. Manipulating light on the nanoscale is the key to unlocking new applications and regimes. Nanocrystals intrinsically manipulate light on the nanoscale. For example, the spatial confinement of conduction electrons in sub-wavelength structures such as metal nanocrystals leads to localised surface plasmon resonances (LSPR) and a concomitant enhancement of the electromagnetic field close to the nanoparticle surface (near field), ie on the nanoscale. The near-fields of two nanoparticles located close to one another are able to interact to create localised areas of extremely high field enhancement. These regions of extremely high electric field enhancement provide a means for increasing sensitivity within chemical and biological sensing applications. Furthermore, the designed arrangement of individual nanocrystals to form nanocrystal superstructures leads to the possibility of transferring the light energy throughout the structure in well-defined ways, leading to potential applications within optical circuitry, metamaterials and smart optical films.

MATERIALS FOR BIOELECTRONIC AND NEUROPROSTHETIC INTERFACES

Dr Vini Gautam

Australian National University

Interfacing electronic materials with electrically excitable cells and tissues provides a platform for accessing various physiological processes. Various materials are promising candidates for developing such bioelectronic interfaces, which have implications in neuroprosthetics and neural degenerative diseases. This poster will highlight the use of polymer semiconductors for interfacing with the visual system and their role as artificial receptors. In these studies, the optoelectronic properties of the semiconductor layer were utilised to stimulate and elicit neuronal activity in a blind retinal tissue. These studies demonstrated that optical stimulation of the interface between the organic semiconductor and retinal neurons result in a visual response in the otherwise blind retina, and have implications in developing novel retinal prosthetic devices. An overview of a current project focussing on growing primary neuronal cells from brain tissues on various kinds of materials will also be presented. The aim is to combine the topography and the optoelectronic properties of these materials to provide physical and electrostatic cues to the neuronal cells in vitro. Such neuronal guidance interfaces have implications in developing encoded neuronal circuits and novel platforms for nerve regeneration. The results from these studies will be utilised for developing technologies to build a prosthetic brain, which in turn can be used to develop interfaces and implants to treat neurological disorders.

PHOTOCATALYSTS FOR CLEAN ENERGY: DESIGNING MATERIALS FOR HIGH EFFICIENCY

Dr Judy Hart

UNSW Australia

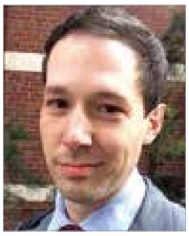
Photocatalytic materials have a wide range of applications, including degradation of pollutants in water (e.g. for treatment of industrial waste water), anti-bacterial coatings, and cancer treatment. They are also important for enabling increased use of renewable energy. Many renewable energy sources including solar energy are intermittent; for widespread use of these energy sources to be practical, an efficient means of storing the energy must be found. Photocatalytic materials can use energy from sunlight to directly produce hydrogen from water, thus allowing solar energy to be stored, while also providing a feedstock for a non-polluting transport fuel.

Many currently known photocatalytic materials have low efficiencies when used under sunlight, partly because they can only absorb ultraviolet light and not visible light. By using computational and experimental approaches in parallel, new materials can be designed to give improved performance. We have shown, based on density functional theory calculations, that both ZnO-AlN and ZnS-GaP solid solutions have the potential for high photocatalytic efficiency under sunlight. Preliminary experimental results indicate that, in agreement with our theoretical predictions, mixtures of ZnS and GaP have high photoactivity under visible light. Hence, these materials are very promising for highly-efficient, commercially-viable hydrogen production from sunlight.

ADVANCED BIOMATERIALS: FROM BLOOD COMPATIBILITY TO STEM CELL EXPANSION

Dr Daniel Heath

University of Melbourne



The field of biomaterials is in an exciting age where materials are being designed to interact in specific ways with the biological environment. These advances will result in improved performance of implantable devices along with the development of platforms for in vitro diagnostics and analysis. This poster discusses recent work on the design of advanced polymers for blood contacting applications, the development of a micro-patterned substrate for MSC analysis, and a platform for the improved expansion of MSCs.

SMALL MOLECULAR REPORTERS FOR PROTEIN MISFOLDING AND PROTEOSTASIS CAPACITY IN CELLS

Dr Yuning Hong

University of Melbourne

Maintaining proteostasis is an essential housekeeping function for cell survival. It involves chaperones and degradative pathways to ensure proteins fold correctly and to remove those that are misfolded, damaged or aggregated. Proteostasis is in principle affected in any disease that involves misfolded or mutant proteins that do not fold with normal efficiencies, and hence overdraw on the finite proteostasis resources of the cell. Tracking the proteostasis capacity of cells has the generic potential to track neurodegenerative diseases of diverse specific molecular origins. Building new approaches to identify the efficiency of proteostasis is thus highly desired in order to track the risk of cells succumbing to damage from protein misfolding and aggregation. Here the discovery of new fluorescent probes for detection of protein aggregates and quantitation of proteostasis capacity will be presented. Many recent studies suggest that the oligomeric form of protein aggregates instead of mature fibrils is the major contributor of neurotoxicity. Conventional fluorescent probe such as Thioflavin T, however, can detect mature protein fibrils only. A new fluorogen with aggregation induced emission (AIE) property to selectively detect certain early species during the formation of ordered protein aggregates is reported here. A novel approach to revealing the proteostasis states of cells under external stress or in disease conditions will also be introduced.

BUILDING A QUANTUM COMPUTER WITH PHOSPHORUS ATOMS IN SILICON

Dr Matthew House

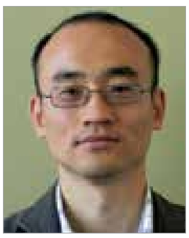
UNSW Australia

Quantum computing is a new concept for computation that calls for information to be stored and manipulated in coherent quantum states of a physical system. An excellent candidate for such a system is the spin state of phosphorus donor electron spins hosted in a silicon crystal, which have been shown to have very long coherence times, lasting milliseconds or more. In order to build a scalable quantum computer we need the ability to reliably place single phosphorus atoms into a silicon crystal, positioned relative to one another and to control electrodes with accuracy better than 1 nm. This we can achieve with scanning tunnelling microscope (STM) lithography, which uses an STM to selectively place phosphorus atoms in a silicon crystal. Control electrodes can also be made by patterning larger structures of phosphorus-doped regions. Using this technique our group has demonstrated transistors with active area of a single phosphorus atom, and conductive wires only 4 atoms wide. Recent work has focused on developing control and readout of electron spin states. We have demonstrated high-fidelity readout of the electron spins in single-atom and few-atom devices using a single-electron transistor charge sensor. We have used rf reflectometry to characterise the charge and spin states of electrons confined on small clusters of donors, and measure the strength of the tunnel couplings between them. The STM lithography fabrication technique, combined with measurement and control techniques currently under development, are building towards an architecture for a scalable, fault-tolerant quantum computer.

BORON FOR ENERGY STORAGE AND NANOMATERIALS

Dr Zhenguo Huang

University of Wollongong



Boron is an amazing element when it comes to energy storage and 2D materials. Recent research activities in the field of hydrogen storage have seen novel synthesis of known compounds, and brand new boron-containing compounds with highly interesting properties. For example, NaB_3H_8 releases high-purity H_2

during hydrolysis and forms highly soluble end-products, and it is therefore highly promising for liquid-phase hydrogen storage. Boron is also a key element of the electrolyte salt for the emerging Na-ion batteries and Mg batteries. For instance, sodium-difluoro(oxalato)borate (NaDFOB) outperforms the most used commercial salts for Na-ion batteries in terms of rate capability and cycling performance. Boron and nitrogen together form a layered compound, hexagonal boron nitride, which is isostructural to graphene. The recent findings have seen hydroxylated boron nitride dramatically improve the thermal response of temperature-sensitive hydrogels, which is being studied for drug delivery and bionic valves.

PHOTONICS—A MAGICAL TOOL FOR NANOMATERIALS ENGINEERING

Associate Professor Baohua Jia

Swinburne University of Technology

2D materials with exotic properties, inherent integration and miniaturisation advantages have championed themselves as a dream successor for silicon. However, the potential of this wonderful family of materials could not be fully explored due to lack of a capable fabrication tool. We endeavor to create a landmark atomic-fabrication tool based on the concept of laser controlled chemical reaction. By tailoring the strong-field laser pulses, the reaction channels of 2D materials can be steered at will, leading to the selective removal, rearrangement and production of desired bonds, thus the full fundamental manipulation of the atomic scale building blocks of 2D materials. As a result, new 'materials on demand' can be created by this powerful tool.

ION TRACKS IN SOLIDS: A MULTIDISCIPLINARY FIELD IN MATERIALS RESEARCH

Associate Professor Patrick Kluth

Australian National University

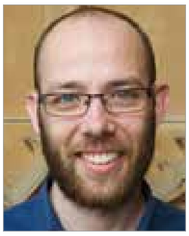
When penetrating a solid, ions with MeV to GeV energies interact predominately through inelastic interactions with the target electrons. The resulting intense electronic excitation can produce narrow trails of permanent damage along the ion paths, so called 'ion tracks'. Ion tracks are generally between 5–10 nm in diameter and can be tens of micrometers long.

Ion tracks have been observed in many materials and have numerous interdisciplinary applications across a variety of scientific areas such as materials science and engineering, nanotechnology, geology, archaeology, nuclear physics and interplanetary science. The presentation will show examples from our recent work in some of these areas, including the study of ion tracks in minerals, which are important for geo- and thermo-chronology, as well as the development of functional nano-pore membranes based on Si technology. The heart of the research evolves around the characterisation of ion tracks using synchrotron based small angle X-ray scattering. Our research in this area has led to significant advances in the understanding of ion track formation and stability under application specific conditions. A focus in the presentation will be placed on the unique capabilities that that have been developed for ion track characterisation at the Australian Synchrotron as well as the potential of the research to yield commercial outcomes.

RESPONSIVE PROBES: POWERFUL TOOLS TO ADDRESS BIOMEDICAL QUESTIONS

Dr Jacek Kolanowski

University of Sydney



The most pertinent questions in human health relate to an understanding of chemical processes and the dynamics of analyte concentration. This can be achieved by using small-molecule probes that report on their chemical environment by generating a detectable signal. Fluorescence spectroscopy and magnetic resonance imaging (MRI) are non-invasive complementary techniques, making them particularly attractive for the study of living organisms. While MRI has virtually no penetration limits and enables high resolution whole-body imaging, it suffers from low sensitivity and limited availability of responsive probes. In contrast, the rapid development of fluorescent switches has been fostered by the improvement of fluorescence detection instruments with increased sensitivity and spatio-temporal resolution. Nevertheless, most of these probes have never been reused beyond the proof-of-principle.

We aim to design, develop and demonstrate the versatility of new small-molecule responsive tools for fluorescence and MRI, which can be further used by a wide range of specialists. Our research focuses on creating probes and methodologies to monitor the real time dynamics of oxidative capacity and labile metal pools in biological systems in response to increasing evidence supporting their role in disease pathology and progression. This approach has been successfully complemented in collaborations with biomedical investigators, which has prompted us to expand our toolbox of fluorescent probes to organelle-localised sensors, to ultimately enable the precise spatio-temporal mapping of oxidative capacity and metal pools. Our continued involvement in cross-disciplinary collaborations, and further development of functional medical devices using our probes, is critical to transforming scientific inventions into meaningful technological outcomes.

AMORPHOUS ALLOYS—NEXT GENERATION MATERIALS AND FUTURE POSSIBILITIES

Dr Kevin Laws

UNSW Australia

Amorphous alloys or metallic glasses were described by Mike Ashby in 2011 as 'the most significant development in materials science since the discovery of plastics over 50 years ago' and are gaining significant interest as 'Next Generation' materials. Like something straight from science fiction, (think of the Liquid-Metal T1000 robot assassin in the Terminator films) these materials behave more like glass or plastic than metal. Most metals are crystalline when solid, with their atoms arranged in a highly organised and regular manner. Metallic glasses however, have a highly disordered structure, with atoms arranged in a non-regular way. When compared to regular alloys, amorphous alloys possess superior strengths, elastic limits and corrosion resistance as a result of their amorphous structure and, unlike any other metal alloys, exhibit a glass transition temperature above which they become as malleable as chewing gum and can be easily moulded like glass/plastics into complex shapes.

There are many types of metallic glasses, with most based on zirconium, palladium, magnesium, titanium or copper. Until now, discovering alloy compositions that form glasses has required a lengthy process of trial and error in the laboratory. In a new study recently published in Nature Communications, Dr Laws and his colleagues have describe a predictive model for metallic glasses which allows scientists to predict the metal combinations that will have high glass-forming ability. They have used their model to successfully predict more than 200 new metallic glass alloys based on magnesium, silver, copper, zinc and titanium in the past few years.

IMAGING 100% OF ATOMS IN 3D—THE NEW ATOM MICROSCOPE BY PROJECTION

Dr Peter Liddicoat

University of Sydney/Atomnaut

The capability to engineer materials at the atom scale exceeds the capability for atom-scale microscopy. The structures that imbue new materials with extraordinary properties—from superconductivity to super-strength—frequently remain unresolved. Such structures may be too small, too chemically diffuse, and/or too geometrically complex for conventional imaging. These poorly defined structure-to-property relationships impede the materials design process, limiting translation into real-world technologies. In this work, the field-ion microscope (FIM)—which provided man's first 2D projection image of atoms in 1955—has been further developed into a digital 3D atomic resolution instrument. For each atom the spatial position is determined using FIM imaging, followed by chemical element determination by field-evaporation (FEV) time-of-flight mass spectrometry (ToFMS). Conventionally configured, these spatial and chemical imaging techniques are not compatible—FIM utilises an imaging gas which FEV would ionise into irrecoverable TOFMS noise. Addition of a pulsed laser permits thermal, but not ionising, surface gas desorption, permitting a previously imaged surface atom to be FEV for TOFMS, noise-free. FIM geometrical super-resolution combined with projection corrected reconstruction permits overcoming FIM's 0.3 nm resolution limit. This new imaging configuration, referred to as an Atom Microscope by Projection (AMP), routinely achieves sub-angstrom xyz resolution. First results are presented using a modified atom probe tomography instrument. With customised hardware and software, it is anticipated the AMP will become an indispensable tool for resolving structure–property relationships and enabling atomic scale materials design.

COMBATING INFECTION WITH POLYMERS: THE ANTIMICROBIAL POLYMETHACRYLATES

Dr Katherine Locock

CSIRO Manufacturing Flagship

Antibiotic resistance has been hailed as the biggest current threat to our healthcare system. The World Health Organization has heralded this as a 'post antibiotic era' that we are entering, where once again infection could become the leading cause of death and could account for over 10 million deaths a year by 2050. We are in urgent need of new antimicrobial agents that allow us to tackle this problem in innovative ways.

We have designed series of antimicrobial polymethacrylates as mimics of naturally occurring antimicrobial peptides (AMPs). Polymers are superior leads in this area as they are typically cheaper and easier to produce, manipulate chemically and can have greater pharmacokinetic stability. Our optimal antimicrobial polymethacrylates candidates show very potent effects against both gram-positive (e.g. MIC of 4 µg/ml for S. aureus) and gram-negative bacteria (e.g. MIC of 8 µg/ml for E. coli) and pathogenic fungus (e.g. MIC of 8 µg/ml for C. albicans). These effects have also been found to be selective, with polymers displaying low human cell toxicity within these therapeutic ranges. Further, these polymers have shown high potency against a methicillin and vancomycin resistant strain of S. aureus (MIC = 10 µg/ml) and a low susceptibility to the development of resistance. This work has hence produced important new leads to combat the growing threat of antibiotic resistance and may form the basis of a new generation of biomaterials to tackle infection.

ENHANCED ELECTRONIC STABILITY OF A SUTURELESS POLYANILINE PATCH WITH DEMONSTRATED EFFECT ON CARDIAC ELECTROPHYSIOLOGY

Dr Damia Mawad

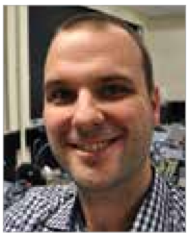
UNSW Australia

Electroactive biomaterials based on conjugated polymers (CPs) are being explored as platforms to improve the integration and coupling of electroresponsive cells for tissue repair. In cardiac regeneration and following myocardial infarction, they may enhance synchronous excitation of the remaining myocardium. We have developed a novel conductive patch designed to provide: i) an adhesive property offering a new dimension unmet by commonly employed patches that require the use of sutures, and ii) a conductive substrate shown to have an extended electronic stability in physiological conditions. We tested the sutureless application of the conductive patch in vivo and investigated its effect on the heart function after 2 weeks implantation. Ex-vivo experiments were conducted to assess the electrophysiological effects of applying a conductive material to an infarcted heart. Properties such as electrical wave propagation, action potential duration and conduction velocity were evaluated. By employing a new fabrication approach based on crosslinking the dopant in a conjugated polymeric matrix, the electronic stability of the system was prolonged in physiological conditions. This has an impact on the long term use of these intrinsically electroactive materials across a range of bioapplications.

BIO- AND GAS-SENSING WITH ELECTRICALLY PROBED MAGNETIC NANOSTRUCTURES

Dr Peter Metaxas

University of Western Australia

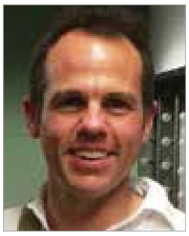


This poster will introduce projects being carried out at UWA, working towards developing novel bio- and gas-sensing techniques. The bio-sensing work is focused on developing sub-micron, frequency-based, high-speed electronic sensors for detecting magnetic nanoparticles. The latter can be used as bio-tags during magnetic biosensing; an attractive, matrix-insensitive technique for medical diagnostics. The gas sensing work is aimed at producing safe hydrogen gas sensors which do not require current flow in, or heating of, the sensing device. Instead, they exploit the fact that a Palladium layer capping a ferromagnetic film will modify the ferromagnetic resonance within that film and that this modification depends on the hydrogenation of the Palladium layer. We demonstrate how this dependence can be probed using electronic (non-contact) methods.

ADVANCED GATING STRATEGIES FOR SEMICONDUCTOR NANOWIRE TRANSISTORS

Associate Professor Adam Micolich

UNSW Australia

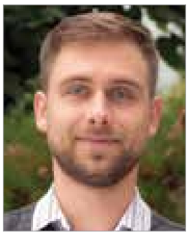


Our recent work has focused on methods for making multiple, independently controllable wrap-around gate structures for semiconductor nanowire transistors. This includes wrap-gates made using traditional metal/oxide formulations, as well as a new approach using polymer electrolytes that can be patterned using electron-beam lithography. The latter provides an interesting route to enacting external doping by freeze-out of ionic mobility at temperatures below 200 Kelvin.

CYLINDRICAL POLYMER BRUSHES: FROM TUNABLE MOLECULAR BUILDING BLOCKS TOWARD STRUCTURED NANOMATERIALS

Dr Markus Muellner

University of Sydney

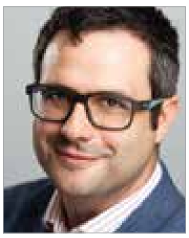


CPBs, or molecular brushes, are one-dimensional nanostructures consisting of polymer chains densely tethered onto a polymer backbone. The grafting density of polymer chains eventually becomes so high that the chains become crowded and stretched, leading to the typical cylindrical shape of CPBs. Due to the shape-persistent nature, the extraordinary spatial dimensions and the tunable architecture of CPBs, new opportunities of fabricating bottom-up nanomaterials have been created, providing access to nanostructures that are difficult to yield from linear polymers. Due to their cylindrical shape and multiple individually separated compartments, CPBs are able to be applied as delivery vehicles, and photonic or template materials. While CPBs have recently been used to produce anisotropic hybrid nanomaterials, their potential in nanomedicine is yet to be fully unravelled.

ADVANCED SOFT MATTER THERAPEUTIC NANOPARTICLES

Dr Xavier Mulet

CSIRO



Next generation drug delivery utilising nanoparticles will incorporate multifunctional systems and active targeting to specific sites. We have created Janus nanoparticles consisting of stable, coexisting ordered mesophases in discrete particles created by lipid self-assembly. Through Cryo-TEM images, we provided visual identification of the multicompartment Janus nanoparticles and, combined with SAXS data, confirmed the presence of mixed cubic phases and mixed cubic/hexagonal phases within individual nanoparticles. We further investigated computer visualisation models to interpret the potential interface between the interconnected coexisting nanostructured domains within a single nanoparticle.

Furthermore we have demonstrated combined active targeting with the inherent advantages of self-assembled lipid nanoparticles containing internal nano-structures. This was shown through the coupling of epidermal growth factor receptor (EGFR) to PEGylated lipid nanoparticles. The self-assembled lipid nanoparticles have internal lyotropic liquid crystalline nano-structures, verified by synchrotron small angle X-ray scattering and cryo-transmission electron microscopy, that offer the potential of high drug loading and enhanced cell penetration. Anti-EGFR Fab' fragments were conjugated to the surface of nanoparticles via a maleimide-thiol reaction at a high conjugation efficiency and retained specificity following conjugation to the nanoparticles. The conjugated nanoparticles were demonstrated to have high affinity for an EGFR target in a ligand binding assay.

NANOSTRUCTURED PHOTOELECTROCHEMICAL SYSTEMS FOR LIGHT ENERGY CONVERSION

Dr Yun Hau Ng

UNSW Australia

Hydrogen generation from photocatalytic and photoelectrochemical water splitting under visible light has been considered an effective way to make solar energy storable and transportable. As oxygen is the only by-product from splitting water, this reaction has great potential to simultaneously address the energy shortage and environmental issues by replacing fossil fuel. A great number of photoactive semiconductors (oxide, sulphide etc) have attracted extensive attention because they are low-cost, mostly non-toxic, usually highly stable, and possess considerable theoretical photocurrent density for H_2 generation. These characteristics meet favourably the requirements for water splitting. In contrast, the challenges in extending their capability in this application include the extension of the solar spectrum absorption, the charges transportation, and the photo-stability of the materials. For example, TiO_2 absorbs only UV wavelength, ZnO suffers from photocorrosion and many others experience significant charges recombination processes. Introduction of nanostructures or secondary components into the parental semiconductor is a potential way to tackle these issues. The main driving force for our research is to improve (if not overcome) the above shortfalls by using several different electrochemical and chemical synthetic approaches.

HIGH VOLUME THERMAL APPLICATIONS OF GRAPHENE AND OTHER 2D MATERIALS

Associate Professor Shannon Notley

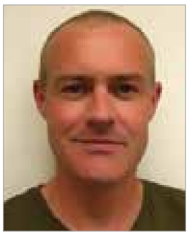
Australian National University

2D materials are of diverse interest due to their unique chemical, physical and material properties. Two of this class of materials, graphene and boron nitride, have ultra high thermal conductivity leading to the potential of modifying existing thermally insulating materials if the 2D particles can be adequately and controllably dispersed throughout the solid. Here, the thermal properties of some thermosetting plastics with dispersed graphene are discussed as well as the challenges to uptake and potential opportunities that may arise as inherently insulating materials are made conducting.

AN ELECTROCHEMICAL APPROACH TO MATERIALS SCIENCE

Associate Professor Anthony O'Mullane

Queensland University of Technology



The fabrication of nanostructured materials has recently received much attention due to their interesting optical, electronic, chemical and electrochemical properties. A popular method for creating such materials is using electrochemical approaches via either utilising an applied potential or manipulating the redox chemistry of the media employed. Advantages include the ease of fabrication, low cost, sample homogeneity and precise control over the size and shape of the required nanomaterial. The applicability of such materials created through electrochemical methods is quite extensive and includes electrocatalysts for fuel cells, electrolysers for water splitting, heterogeneous catalysts, electrochromism, superhydrophobic surfaces and as sensing layers for electroanalytical applications. In this poster an overview is given on how electrochemical methods can be used to both fabricate and characterise a variety of technologically important metal and metal oxide nanostructures as well as the new concept of liquid metal marbles and how they can be utilised in the aforementioned applications.

IONIC LIQUIDS FOR METAL AIR BATTERIES

Dr Cristina Pozo-Gonzalo

Deakin University

Energy storage devices that can store large amounts of energy (high energy density) and support fast delivery (high power) are required for critical applications including electronic vehicles. Metal air batteries have emerged as the next generation energy storage devices because of their high energy density values. The research in our group has been focused on the use of trihexyl(tetradecyl)phosphonium chloride, $[P_{6,6,6,14}]Cl$, as a promising candidate for magnesium air batteries due the ability to form a protective amorphous gel-like layer on the surface of the magnesium during discharge, enabling long term stability and performance. From the cathodic point of view, a detailed study of the cathode reaction mechanism has been undertaken, not only in neat $[P_{6,6,6,14}]Cl$, but in the presence of different protic additives (water, methanol and ethylene glycol).

PROBING BIOLOGICAL RESPONSE USING ENGINEERED POLYMER NANOPARTICLES

Dr Georgina Such

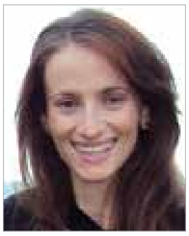
University of Melbourne

Polymeric carriers have generated significant interest for therapeutic delivery due to their potential to improve the side effects observed when therapeutics are delivered independently. Of particular interest are carriers that can respond intelligently to their environment, and thus offer precise control over the delivery of the therapeutic cargo. It is important that the design of such responsive materials is combined with fundamental understanding of the relationship between material properties and biological outcomes, in order to generate more efficient materials. In this poster, the synthesis of a new pHlexi nanoparticles will be presented. These responsive nanoparticles are attractive for use in therapeutic delivery as they are synthesised using a modular one-pot strategy and have rapid pH responsive in a physiologically relevant pH range. The cellular behavior of these nanoparticles was investigated to get an understanding of their endosomal escape behaviour. The use of a calcein assay demonstrated these particles had endosomal escape capabilities (30 per cent of cells), however, interestingly, the cell localisation studies showed strong colocalisation of the particles with the endosome/lysosome. These carriers provide new insights into the design of nanoengineered materials for application in drug and gene delivery.

PEPTIDE FUNCTIONALISED GOLD NANOPARTICLES FOR TARGETED BIOMEDICAL APPLICATIONS: DESIGN PRINCIPLES FROM IN SILICO AND IN VITRO STUDIES

Dr Nevena Todorova

RMIT University



Nanostructured gold materials exhibit a unique set of size-dependent physicochemical properties that are easily tailored through functionalisation with biologically relevant ligands. This has inspired the development of many innovative biosensors and drug-delivery agents, however our understandings of the fundamental interactions nano-gold has with biological media is lacking. Computer simulations present an avenue to assist in gaining such understanding through atomistic insights into the structure and dynamics of these bioconjugated nanoparticle systems.

Here, we present recent studies where we have employed classical molecular dynamics to provide theoretical insight into the functional interface of two distinct peptide-conjugated systems for (1) drug-delivery and (2) biosensing applications. We were able to (1) show how the local environment of the peptide-grafted nanoparticles affects properties essential for efficient cellular uptake, and (2) identify a peptide sequence and specific interactions that are important for improved antibody sensing. These works demonstrate that simulations offer a powerful complementary approach to assists in the design of novel therapeutic and diagnostic agents.

WEARABLE SENSORS BY ULTRA-POROUS NANOPARTICLE NETWORKS

Dr Antonio Tricoli

Australian National University

Nanomaterials have the potential to significantly enhance the performance of several devices as successfully demonstrated for dye-sensitised solar cells, chemical sensors and fuel cells. Recently, this has resulted in a gold rush toward novel applications ranging from flexible electronics to portable nanogenerators. However, integration of nanostructures in commercial devices is challenging and their assembly in suboptimal structures may drastically limit the final performance considerably below that of the individual nanocomponents. Here, we will present the fabrication of ultra-porous nanoparticle networks by scalable, low-cost flame synthesis. The feasibility of capturing unique metastable phases and nano-scale morphologies will be discussed along with the example of ZnO and Si:WO_3 nanoparticles. The main mechanisms dictating the self-assembly of these nanostructures will be shortly reviewed with respect to the feasibility of controlling the key film structural properties such as porosity and thickness. We will conclude by showcasing the integration of these tailored materials in highly performing devices for non-invasive medical diagnostics and wearable UV photodetectors.

STATE-OF-THE-ART BATTERY RESEARCH

Dr Da-Wei Wang

UNSW Australia

A summary of the current battery research at UNSW Chemical Engineering will be presented. Our research ranges from materials chemistry and synthesis to the next generation devices. The ultimate target is to develop batteries with higher energy density by using earth-abundant elements and catalytic processes.

THREE DIMENSIONAL ORGANIC CONDUCTORS WITH TUNABLE PROPERTIES FOR ENERGY STORAGE

Dr Caiyun Wang

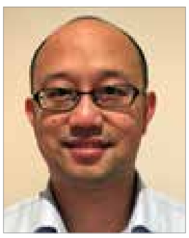
University of Wollongong

Organic conductors, including conducting polymers and carbon-based materials, are sustainable and renewable materials, and their practical application could assist in providing renewable energy. Organic conductors are environmentally benign and offer high charge storage, high conductivity and easy processability. Their properties can be tuned at the molecular level and fabricated into different forms for use, including as electrodes alone or as composites with different types of organic conductors, or even with conventional semiconducting metal oxides via different structural models. The synergistic effect between the components leads to enhanced electrochemical properties. These materials are ideal candidates for use in flexible/wearable energy storage devices. Some cytocompatible organic conductors (e.g. PPy, PEDOT, graphene) can be used for bio-batteries.

GATE-TUNED QUANTUM TRANSPORT IN TOPOLOGICAL INSULATORS $BiSbTeSE_2$ AND BETA-Ag_2Te

Dr Lan Wang

RMIT University



There are two parts in our report. First, we report tunable in-plane anisotropic magnetoresistance (AMR) in nanodevices based on topological insulator $BiSbTeSe_2$ (BSTS) nanoflakes. The AMR can be changed continuously from negative to positive when the Fermi level is manipulated to cross the Dirac point by an applied gate electric field. We propose that the electrically tunable AMR in BSTS devices originates from the in-plane magnetic field induced shift of the spin-momentum locked topological two surface states which are coupled through side surfaces and bulk weak antilocalisation (WAL).

Second, we report the strong experimental evidence of the existence of topological surface states with large electric field tunability and mobility in beta-Ag_2Te. Pronounced 2D Shubnikov-de Haas oscillations have been observed in beta-Ag_2Te nanoplates. A Berry phase is determined to be near p using the Landau level fan diagram for a relatively wide nanoplate while the largest electric field ambipolar effect in topological insulator so far (~ 2500%) is observed in a narrow nanoplate. The pi Berry phase and the evolution of quantum oscillations with gate voltage (Vg) in the nanoplates strongly indicate the presence of topological surface states in beta-Ag_2Te.

MULTI-FUNCTIONAL POLYMER NANOCOMPOSITES WITH ALIGNED CARBON NANOFILLERS

Dr Shuying Wu

RMIT University

The introduction of carbon nanomaterials such as carbon nanofibers (CNFs), and graphene nanoplatelets (GnPs) to polymers has been found to greatly improve their mechanical properties and thermal, electric conductivities. However, the property improvement is far below the theoretical calculation and further improvement has been reported when carbon nanofillers are aligned. This poster presents a comparative study on the efficacy of aligning carbon nanofillers by external fields (magnetic field and/or electric field) in enhancing properties of the nanocomposites.

By applying an electric field, CNFs and GnPs can be aligned along the field direction. The resulting nanocomposites exhibit significantly higher fracture toughness, thermal and electrical conductivity along the field direction than the composites with randomly-oriented nanofillers and the unmodified epoxy. In spite of these achievements, the application of electric field is restricted to below certain field strength to avoid possible dielectric breakdown of polymers. Therefore, the possibility of applying magnetic fields was also investigated. Fe_3O_4 nanoparticles were firstly coated onto CNFs or GnPs to increase the magnetic susceptibility. The obtained nanohybrids were found to be easily aligned by a low magnetic field (~0.05 T). The resulting nanocomposites show up to 2 orders of magnitude higher electrical conductivity in the alignment direction and up to 50% improvement in fracture toughness compared to the composites with randomly-oriented nanohybrids.

NOVEL HIGH SURFACE AREA MATERIALS FOR NATURAL GAS RELATED APPLICATIONS

Dr Yunxia Yang

CSIRO

New properties intrinsic to novel structures will enable breakthroughs in a multitude of technologically important areas. Of particular interest to materials scientists is the fact that nanostructures have higher surface areas than conventional materials. Such materials are of critical importance to many applications involving catalysis, separation and gas storage. This poster will present some examples of the novel materials fabricated by the frontier technology developed within our research group intended for a range of potential applications in natural gas processing.

One example includes synthetic high surface area catalyst, which has a unique capability of oxidising methane at a starting temperature of around 200 °C and prevails at a temperature of 400 °C, which is essentially lower than the existing methane oxidation temperatures of 600–1200 °C, thus reducing energy intensity. The material can improve the oxidation of methane to syngas (CO and H_2) at a much lower temperature, so that the following on Fischer–Tropsch synthesis to produce alternative fuels is more economically viable and profitable. This application can also be tailored to produce hydrogen with high selectivity key to many fuel cell applications. Other high surface area materials include adsorbents for treatment of raw natural gas to meet pipeline qualities. The material can be used to purify natural gas produced from well head, or biogas. The impurity components include hydrocarbons, CO_2, H_2S, water and so on.

NANOPARTICLE ADSORPTION AT LIQUID–VAPOUR INTERFACES: A MOLECULAR DYNAMICS STUDY

Dr George Yiapanis

IBM Research

Nanoparticles at liquid–vapour interfaces are important in many industrial, scientific and biological processes. In flotation, for example, mineral rich particulates are captured at the liquid–vapour interface of rising air bubbles and separated from the unwanted matter. However, the adsorption of nanoparticles at the liquid–vapour interface is a complex problem due to the fact that the particle's surface properties significantly deviate from those of macroscopic size. In this work, we investigate the adsorption of graphitic nanoparticles at a water–vapour interface using molecular dynamic simulations. The free energy associated with transferring a set of single-shelled and multi-shelled fullerene particles (C_{60}, C_{240}, C_{540}, C_{960}, C_{1500}, C_{2160} and C_{2940}) across the water–vapour interface is calculated. We examine these properties as a function of particle size and show that for a small nanoparticles (single and multi-shelled structures) the hydration free energy grows linearly with solute volume, while for larger fullerenes it grows linearly with surface area. Moreover, there appears to be a minimum contact angle and equivalent particle radius, below which single nanoparticles are unstable at the liquid–vapour interface and these particles are submerged into the bulk liquid phase. These results help explain the factors that dictate surface propensity and can be important for rational design of nanoparticle separation technologies.

NEXT GENERATION MEMORY TECHNOLOGY INSPIRED BY LEGO

Dr Adnan Younis

UNSW Australia

Over the past decades, the advances in semiconductor technologies have made electronic devices more powerful in processing speed and data storage capacities. In order to further increase the device performance, the chip dimensions are continuously scaled down to sub-100-nm range. At such low dimensions, it is really challenging to evade the local heat dissipation and power loss effects which usually originated from high operating device potentials. Therefore, it is extremely important to explore the utilisation of nanoscale structures for data storage and its efficient transportation.

In this research, we successfully fabricated sub-10 nm size nano-cubic shaped unique particle for the applications of next generation non-volatile memories. The new type of memories is named as Resistive Random Access Memories (RRAM), which utilises two bi-stable resistances of high resistance states (HRS) and low resistance states (LRS). In comparison with the existing memories, RRAM has unique advantages, such as a smaller bit cell size, much faster reading and writing speed, and lower operating voltages. Additionally, the resistive transition induced by electric pulses with opposite polarities can be achieved within tenths of nanoseconds at room temperature and the resultant resistance states can be retained for 10 years. Thus, RRAM is expected to be widely utilised as future nanoscale memory devices.

CONTROLLED-RELEASE NANOCAPSULES BASED ON BIO-INSPIRED NANOTECHNOLOGY

Dr Chun-Xia Zhao

University of Queensland

Silica nanocapsules have attracted significant interest in recent years due to their core-shell structure, with the core providing high-capacity loading of active components and the shell acting as a protective layer and diffusion barrier enabling the controlled release of actives. However, current approaches are mainly based on templating methods that most often associate with complex processes, including synthesis of core-shell particles using a core material as a template, template removal to make an empty core, and then drug loading after template removal. These methods often require elevated temperatures or extreme pH to remove the core template. A novel emulsion and biomimetic dual-templating platform technology for making oil-core silica nanocapsules under mild conditions, including room temperature, neutral pH and without use of any toxic chemicals was recently developed. The approach is to design bifunctional biomolecules (peptide or proteins) by modularizing a partial sequence encoding surface activity with a series of amino acids having biosilicification ability. Silica nanocapsules are produced by firstly forming nanoemulsions as a result of the surface activity of the bifunctional biomolecules, followed by adding TEOS to initiate biosilicification induced by the catalytic peptide sequence. The silica shell can be tuned by controlling the reaction conditions, and the size of capsules can be controlled by the emulsion droplet size. It has been demonstrated that the slow release of hydrophobic ingredients encapsulated in the oil phase can be controlled by adjusting the shell thickness of the silica nanocapsules. This technology opens a new facile and environmentally friendly strategy for fabricating capsules that are potentially applicable various fields.

PARTICIPANTS

DR NASIM AMIRALIAN

Postdoctoral Research Fellow
University of Queensland

- n.amiralian@uq.edu.au

Nasim Amiralian is Postdoctoral Research Fellow at the Australian Institute for Bioengineering and Nanotechnology, University of Queensland. Nasim's general research themes are processing and structure-property performance of novel materials, renewable-based polymers and nanocomposites. One of her key research aims is to shift the strong underlying science and engineering taking place in projects towards commercial applications. Her experience of investigation and characterisation of nanocomposites and knowledge of polymers has led to successful collaborations with both academics and industries.

During her PhD, Nasim discovered and patented a unique, very high aspect ratio cellulose nanofibre from 'Spinifex', an Australian native arid grass, through the use of simpler, more cost effective and more environmentally friendly methods. This work is at an early stage of commercialisation and validation process for several commercial opportunities such as nanocomposites, non-woven filtration media and renewable carbon fibre. She has experience in the areas of fabrication and characterisation of nanocellulose, electrospinning of polymers and nanocomposites.

DR JOSIE AUCKETT

Postdoctoral Research Fellow
Australian Nuclear Science and Technology Organisation

- josiea@ansto.gov.au

Josie Auckett joined ANSTO's Bragg Institute in 2015 as a postdoctoral researcher within the Energy Materials project. Her work currently focuses on the characterisation of metal-organic framework (MOF) materials for gas separation and storage applications using elastic and inelastic neutron scattering methods, especially in situ neutron diffraction, together with various computational approaches including DFT-based molecular dynamics simulations.

Josie completed her PhD at the University of Sydney in the area of solid-state chemistry. During her studies, she investigated the structural and physical properties of the brownmillerite oxides and gained experience in various methods of neutron and X-ray crystallography, magnetic property measurements, and inelastic neutron scattering. She also became a key user and avid promoter of the university's floating-zone crystal growth furnace, applying it successfully to the growth of large oxide crystals from the molten phase.

DR JULIA BALDAUF

Research Scientist
IBM Research

- jbaldauf@au1.ibm.com

Julia Baldauf is a physicist who received both her masters and PhD in the field of nanotechnology. Her research was focused on exploring the optical, mechanical and material properties of nano materials which were then employed in applications like LEDs, solar cells, lasers and bio labelling. She joined IBM Research in July 2013. Currently, Julia is working in the data analysis and modelling team at IBM Research Australia. One of her projects involves studying materials for more efficient energy storage and improving particle separation techniques like flotation by understanding the driving mechanism at a molecular scale.

DR MADHU BHASKARAN

Senior Lecturer
RMIT University

- madhu.bhaskaran@rmit.edu.au

Madhu Bhaskaran is an emerging research leader in the field of flexible micro- and nano-structures and novel functional materials. She is the co-leader of the Functional Materials and Microsystems research group at RMIT University. In addition to her research, she is passionate about communicating science to the public, enhancing support for women in research, and training of next generation researchers.

DR VIJAY BHATIA

Postdoctoral Researcher
University of Sydney

- vijay.bhatia@sydney.edu.au

Vijay Bhatia received his PhD in material science and nanotechnology from the University of Technology, Sydney. He is currently employed as a postdoctoral researcher at the University of Sydney, AMME. The main focus of this work is the development of wear resistant alloys for the mining industry and is a collaboration with Weir Mineral Australia. Using advanced casting and microscopy techniques Vijay is working at optimising the composition and microstructure of ferrous based metal matrix composites.

ASSOCIATE PROFESSOR JODIE BRADBY

Co-chair of the Organising Committee
Senior Fellow
Australian National University

- jodie.bradby@anu.edu.au

Jodie Bradby completed her undergraduate degree at RMIT before moving to ANU to commence a PhD on the mechanical properties of semiconductors. At the completion of her PhD she was awarded a Murdoch Education Fellowship that took her to Case Western Reserve University in Ohio. Jodie returned to Australia to take up an ARC postdoctoral fellowship at ANU and work closely with a startup company (Wriota) that was formed as a result of her PhD work. In 2009 Jodie was awarded a QEII fellowship by the ARC. She secured tenure at the ANU in 2012 and commenced an ARC Future Fellowship in 2014. She has an interest in the mechanical properties of materials, high-pressure phase transformations of semiconductors, and a growing interest in the mechanical properties of biomaterials including corals and plant cells.

DR STEPHEN BREMNER

Senior Lecturer
UNSW Australia

- spbremner@unsw.edu.au

After receiving his PhD in electrical engineering from UNSW Dr Bremner completed a postdoc at Cambridge looking at MBE re-growth for single photon sources. Following this he headed up the Advanced Photovoltaic Concepts group at the University of Delaware, overseeing the commissioning of a Gen3 MBE system and the growth programs for this research thrust. Since returning to UNSW in 2010 he has been the technical spearhead for the acquisition of a III-V MBE capability at UNSW as well as establishing funded research programs in III-V Si integration for advanced photovoltaics and novel low temperature processing of silicon solar cells. His main research interests lie in epitaxial nanostructures for solar energy conversion.

PROFESSOR JULIE CAIRNEY

Member of the Organising Committee
Professor, Materials Characterisation. Acting Director, Australian Centre for Microscopy and Microanalysis
University of Sydney

- julie.cairney@sydney.edu.au

Julie Cairney is a Professor of Materials Characterisation at the University of Sydney and the Acting Director of the Australian Centre for Microscopy and Microanalysis. She leads a research group that focuses on the relationship between microstructure and properties of materials, with particular emphasis on the application of advanced characterisation techniques for the development of new materials. Julie is currently investigating materials phenomena such as segregation and nanoscale precipitation in advanced materials systems using atom probe microscopy, a technique that provides atomic-scale 3-dimensional maps revealing the precise composition and structure of small volumes of material. She is currently investigating a wide range of materials such as advanced alloys for aerospace and mining, multilayers for fuel cells, and catalyst nanoparticles for biofuel production. She has a history of successful research with industry partners. Australian partners have included BlueScope Steel, Alcoa, Weir Minerals, Zeiss Australia and Sutton Tools. Her work has led to the publication of around 135 papers and she has been awarded approximately $7.5M in competitive grant funding.

DR FRANCESCA CAVALIERI

Member of the Organising Committee
Future Fellow
University of Melbourne

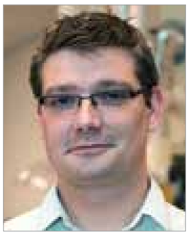
- francesca.cavalieri@unimelb.edu.au

Francesca Cavalieri is a Future Fellow in the Department of Chemical and Biomolecular Engineering, at the University of Melbourne. She received her Laurea degree, 'maxima cum laude,' in industrial chemistry in 1995 from the University of Rome La Sapienza. She completed her PhD in the School of Chemistry at the University of Melbourne in 2014. From 1998 to 2002, Francesca was employed as a scientist at ENEA (Italian Agency for New Technologies, Environment and Energy), Italy. She has been a tenured Assistant Professor and lecturer in Polymer Science in the Department of Chemistry, Physical Chemistry, at the University of Rome 'Tor Vergata' Italy since 2002. She has received a number of international research fellowships including a Victorian Research Fellowship, an ARC Linkage Fellowship, and the Australian Endeavour Fellowship. Francesca has produced 62 peer-reviewed publications in high quality journals (ACS Nano, Small, Chem Commun, Nanoscale, Biomacromolecules). She has coordinated two international research projects (IRSES Marie Curie), which involved researchers from Italy, Germany, the UK and Australia, funded by the EU FP7 and the Australian Academy of Science. Her research activity provides key contributions in a range of areas including polymeric biomaterials for drug/gene delivery, supramolecular assembly of biopolymers, and engineering and characterisation of nanostructured materials and interfaces.

DR JUSTIN CHALKER

Lecturer in Synthetic Chemistry and ARC DECRA Fellow
Flinders University

- justin.chalker@flinders.edu.au

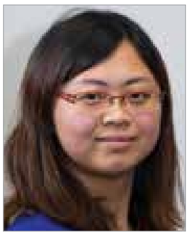


Justin Chalker earned a BS in chemistry and a BA in the history and philosophy of science at the University of Pittsburgh in 2006. At Pittsburgh, he contributed to the total synthesis of several natural products under the direction of Theodore Cohen. Supported by a Rhodes Scholarship and a National Science Foundation Graduate Research Fellowship, Justin then completed his DPhil at the University of Oxford under the supervision of Benjamin Davis, where he developed several tools for the site-selective modification of proteins. In 2012, Justin started his independent career as an assistant professor at the University of Tulsa where he established a diverse research program in organic chemistry, biochemistry and material science. In 2015, he moved to Flinders University where he is a Lecturer in synthetic chemistry and recipient of an ARC Discovery Early Career Researcher Award.

DR FANGFANG CHEN

Research Fellow
Deakin University

- chenf@deakin.edu.au



Fangfang Chen is a research fellow in the Institute for Frontier Materials at Deakin University. She obtained her PhD in computational chemistry in 2012 from the Center for Molecular Simulation, Swinburne University of Technology. She specialises in both molecular dynamics and quantum chemistry based molecular modeling methods. Her current work is focused on structures and diffusion mechanisms in energy storage materials, especially the electrolyte materials that are used for Li ion batteries, such as organic ionic plastic crystals, polymers and room temperature ionic liquids.

DR ANNA CIFUENTES-RIUS

Research Associate
University of South Australia

- anna.cifuentesrius@unisa.edu.au

Anna Cifuentes-Rius completed her PhD in bioengineering in the IQS School of Engineering at the Ramon Llull University (Barcelona, Spain) in December 2013, including a one-year internship at Massachusetts Institute of Technology (MIT) and at the Australian Institute for Bioengineering and Nanotechnology (AIBN, University of Queensland). Her thesis focused on the development of both functional bio- and nano-materials for targeted biomedical applications. During her time at MIT she exploited nanoparticle properties to control biological functions and monitor treatment response. Anna finished her PhD project at AIBN, where she used advanced bioimaging techniques to investigate the in-vivo biodistribution of two key nanomaterials with promising medical properties.

In May 2014, Anna took up a position as a full-time research associate at the Future Industries Institute (UniSA) to work with Professor Nico Voelcker as part of the ARC Centre of Excellence in Convergent Bio-Nano Science and Technology. Her interdisciplinary research is largely focused on the understanding of the biointerface of advanced bio- and nano-materials for the application in the emerging field of theranostics. Anna is working in the fabrication of three-dimensional nanoarchitectures of bioresponsive nanoparticles, containing drugs and bioactives for a range of therapeutic targets including cancer. She is seeking to grow as an independent researcher and to represent Australia at the forefront of nanomedicine, with significant prospects for linkages with international and national researchers, hospitals and companies.

DR CHARLOTTE CONN

Senior Research Fellow
RMIT University

- charlotte.conn@rmit.edu.au

Charlotte Conn is a Senior Research Fellow in the School of Applied Sciences, RMIT University. Charlotte completed her PhD in biophysical chemistry at Imperial College London in 2007. She was awarded an OCE Postdoctoral Fellowship from CSIRO in 2006, and worked as a Research Scientist at CSIRO from 2011 to 2014. Her research interests focus on the high-throughput design and structural characterisation of new lipidic materials, and the use of these materials in biomedical applications including membrane protein crystallisation, drug delivery and as MRI contrast agents. She is the current Chair of the SAXS Program Advisory Committee for the Australian Synchrotron, and an Associate Editor for the Australian Journal of Chemistry.

DR LUKE CONNAL

Senior Lecturer and veski Innovation Fellow
University of Melbourne

- luke.connal@unimelb.edu.au

Luke Connal received a Bachelor of chemical engineering in 2002 and a PhD in polymer chemistry in 2007 both from the University of Melbourne. From 2007 to 2009 he completed a post-doctoral position with Frank Caruso. In 2009 he was a Sir Keith Murdoch postdoctoral Fellow at University of California Santa Barbara with Professor Craig Hawker. In 2013 Luke returned to the University of Melbourne as a veski Innovation Fellow and Senior Lecturer in the Department of Chemical and Biomolecular Engineering. His research interests lie in the development of bioinspired materials using advanced polymer design, self-assembly and catalysis.

DR JIWEI CUI

Research Fellow
University of Melbourne

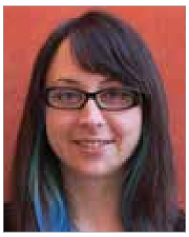
- jiweic@unimelb.edu.au

Jiwei Cui received his PhD in colloid and interface chemistry from Shandong University in 2010. Jiwei worked as an Australian Research Council Super Science Fellow from 2011 to 2014. He is currently a research fellow in the Department of Chemical and Biomolecular Engineering at the University of Melbourne and has published more than 50 articles in top ranking journals. His research interests include interface engineering, particle assembly and therapeutic delivery.

DR SINÉAD CURRIVAN

Postdoctoral Research Fellow
Australian Centre for Research on Separation Science, University of Tasmania

- sinead.currivan@utas.edu.au



Sinéad Currivan received her PhD in 2012 from Dublin City University, under the auspices of the Irish Separation Science Cluster, with the guidance of Professor Brett Paull and Dr Damian Connolly. Sinéad held a postdoctoral position in the University of Pardubice (with Professor Pavel Jandera), and the Lawrence Berkeley National Laboratory (visiting postdoctoral fellow with Dr František Švec). Most recently she received an Endeavour Research Fellowship from the Australian Department of Education. Her research themes have included the development of polymeric monolithic columns, stationary phase technologies and their application in separation sciences. Sinéad has recently begun working at the notable Australian Centre for Research on Separation Sciences (ACROSS) at the University of Tasmania.

ASSOCIATE PROFESSOR AIJUN DU

ARC QEII Fellow
Queensland University of Technology

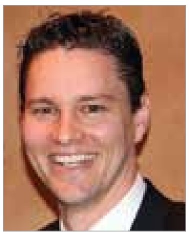
- aijun.du@qut.edu.au

Aijun Du received his PhD in 2002 from the Institute of Modern Physics at Fudan University. He is currently working at the Queensland University of Technology. He was awarded both an Australian Research Council Queen Elizabeth II Fellowship and a Future Fellowship. Since 2001, he has published over 100 refereed journal papers including Nano Letters, Nature Communications, Physical Review Letters and Journal of the American Chemical Society (around 3000 citations with H-index of 30). His research lies at the interface of chemistry, physics and engineering, focusing on the development of innovative nanomaterials for clean energy, environmental science and nanoelectronics applications via advanced theoretical modelling approaches.

ASSOCIATE PROFESSOR DREW EVANS

Member of the Organising Committee
Research Leader—Advanced Manufacturing
University of South Australia

- drew.evans@unisa.edu.au



Drew Evans is an Associate Professor and Research Leader of Energy and Advanced Manufacturing in the Future Industries Institute of UniSA. His work focuses on the engineering of thin film coatings, in particular nanoengineering of conducting polymer materials. Drew has worked at the interface between universities and industry for the past decade, both in the Australian private R&D industry and academia at both ANU and UniSA. To date he has over 40 scientific publications in leading materials science journals such as Nature Materials, has been listed as co-inventor on seven patents, secured more than $6 million in research funding, and co-invented commercial technology in the automotive and digital printing sectors. He is a current member of the SA Science Council by invitation from the SA Premier and SA Chief Scientist, and an affiliate of the Australian Institute of Company Directors.

DR MARGUERITE EVANS-GALEA

Team Leader
Murdoch Childrens Research Instituite

- marguerite.galea@mcri.edu.au

Marguerite Evans-Galea leads international collaborations that examine disease mechanism and develop novel therapies and biomarkers for repeat-associated neurodegenerative diseases at the Murdoch Childrens Research Institute. Her NHMRC-funded research is developing cell and gene therapies for Friedreich ataxia. Marguerite has received young investigator awards from the USA and Australia, and travel awards to present her research internationally. She currently serves on the American Society for Gene and Cell Therapy Immune Responses Committee, the Australasian Gene and Cell Therapy Society Executive and the Australian Science and Innovation Forum, a partner of the Australian Academy of Technology and Engineering. Committed to empowering early career researchers and women in science, Marguerite was founding chair of the Early- and Mid-Career Researchers Forum with the Australian Academy of Science, serves on the Science in Australia Gender Equity committee and is co-founder of Women in Science AUSTRALIA. A strong advocate for science, Marguerite has received an Australian Leadership Award and communicates regularly via social and mainstream media.

DR THOMAS FIEDLER

Senior Lecturer
University of Newcastle

- Thomas.Fiedler@newcastle.edu.au

Thomas Fiedler completed his Master studies in mechanical engineering at the University of Erlangen-Nuremberg in 2004. He continued his academic career at the University of Aveiro. After completing his PhD in December 2007, Thomas commenced working as a Postdoctoral Fellow at the University of Newcastle. In 2010 he was awarded an APD Fellowship by the ARC and since 2015 he is employed as a Senior Lecturer. His research addresses functional materials for structural, thermal and biomedical applications. To date he has attracted more than $1.7 million of competitive research funding and published 58 peer-reviewed journal papers.

ASSOCIATE PROFESSOR GARETH FORDE

Associate Professor (research and teaching)
Queensland University of Technology (QUT)

- g.forde@qut.edu.au

Gareth Forde has a background in process optimisation, engineering and business strategy for the biotech, food, oil and gas, mining, energy and manufacturing industries. At QUT, Gareth has a part time role researching in the areas of biotech and energy as well as teaching the final year design prize. He is a board member of the IChemE Energy Centre and Principal Engineer at All Energy Pty Ltd. Having received a BE(Chem, Hons I) from the University of Queensland, Gareth completed his PhD at Cambridge University in what is now the Department of Chemical Engineering and Biotechnology. From 2010 to 2015 he sat on the IChemE Australia Board as the Technical Policy Officer. He has previously sat on the Monash University Engineering Faculty Board. Gareth is a Chartered Engineer, a Chartered Scientist, and is a Registered Professional Engineer Queensland in both chemical and environmental engineering.

PROFESSOR MARIA FORSYTH

Member of the Oversight Committee
Associate Director Institute for Frontier Materials,
Chair of Corrosion and Electromaterials Science
Deakin University

- maria.forsyth@deakin.edu.au

Maria Forsyth FAA is an Australian Laureate Fellow, and an Alfred Deakin Professorial Fellow at Deakin University. She is the Associate Director in the ARC Centre of Excellence in Electromaterials Science (ACES) and Deputy Director of the Institute for Frontier Materials (IFM) at Deakin University in Australia, where she leads the research effort in energy storage and corrosion science. Specifically, her work has focused on understanding the phenomenon of charge transport at metal/electrolyte interfaces and within novel electrolyte materials. Such materials have included a range of novel ionic liquids, polymer electrolytes and plastic crystals. NMR techniques have featured strongly in Maria's research where she has applied pulsed field gradient NMR to measure diffusion of ionic species in electrolytes, variable temperature solid state wide line NMR and MAS to investigate structure and dynamics in solids and, most recently, NMR imaging of electrochemical processes. She leads collaborative projects in lithium and sodium battery technologies funded through recent ARC grants. Maria has co-authored more than 400 journal and conference publications that have attracted more then 11 000 citations. She has delivered more than 25 invited and plenary talks in the past five years.

PROFESSOR JADE FORWOOD

ARC Future Fellow
Charles Sturt University

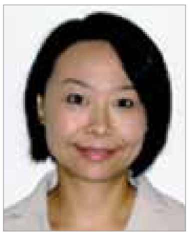
- jforwood@csu.edu.au

Jade Forwood has undertaken postgraduate and postdoctoral research in cell and molecular biology at the Australian National University, the University of Adelaide, Cambridge UK, and the University of Queensland. He established an independent laboratory in 2007 in protein crystallography.

ASSOCIATE PROFESSOR LAN FU

Member of the Organising Committee
Senior Fellow and ARC Future Fellow
Australian National University

- lan.fu@anu.edu.au



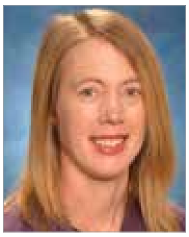
Lan Fu received her MSc from the University of Science and Technology of China in 1996 and her PhD from the Australia National University in 2001. She is currently an Associate Professor and Australian Research Council (ARC) Future Fellow at the Department of Electronic Materials Engineering, ANU. She has published over 130 peer-reviewed journal/conference papers and two book chapters, and held two US patents. She was the recipient of the prestigious IEEE Photonic Society Graduate Student Fellowship (2000), ARC Postdoctoral Fellowship (2002) and ARF/QEII Fellowship (2005). She is a senior member of IEEE, IEEE/Photonics and EDS Societies, and the Chapter Chair of IEEE Photonics/EDS Societies of IEEE ACT Section.

Lan's main research interests include design, fabrication and integration of optoelectronic devices (lasers and photodetectors) and high efficiency solar cells based on low dimensional III-V compound semiconductor structures including quantum wells, self-assembled quantum dots and nanowires grown by metalorganic chemical vapour deposition (MOCVD).

DR ALISON FUNSTON

ARC Future Fellow/Senior Lecturer
Monash University

- alison.funston@monash.edu



Alison Funston is a lecturer and Future Fellow in the School of Chemistry at Monash University. She received her PhD from the University of Melbourne in 2002. After working as a postdoctoral fellow at Brookhaven National Laboratory with Dr John Miller in the areas of electron transfer and radiation chemistry, she returned to the University of Melbourne where she worked with Professor Paul Mulvaney in the spectroscopy of nanoscale systems. She moved to Monash as a lecturer in 2010 and was awarded an ARC Future Fellowship in 2011. Her research focuses on the energy transport and optical properties of well-defined assemblies of nanoparticles, including metal nanocrystals and semiconductor nanocrystals, as well as charge and energy transfer within nanoparticle:organic systems.

DR NICOLA GASTON

Principal Investigator/Senior Lecturer
MacDiarmid Institute for Advanced Materials and Nanotechnology, Victoria University of Wellington

- nicola.gaston@vuw.ac.nz

Nicola Gaston has been a Principal Investigator in the MacDiarmid Institute for Advanced Materials and Nanotechnology, a New Zealand Centre of Research Excellence, since 2010, and is currently Deputy Director, Stakeholder Engagement. She is a Senior Lecturer in the School of Chemical and Physical Sciences at Victoria University of Wellington, where her research group studies the electronic properties of nanomaterials using ab initio quantum chemistry and condensed matter physics. She is particularly interested in the description of complex phenomena, such as phase transitions and the self-assembly of macro-scale structures, from first principles. Nicola has been the President of the NZ Association of Scientists since 2013. She also blogs about sexism in science at Why Science is Sexist, tweets about it (amongst other matters) as @nicgaston, and has written a short book on the same subject, called Why Science Is Sexist (published by Bridget Williams Books, Wellington).

DR VINI GAUTAM

Postdoctoral Researcher
Australian National University

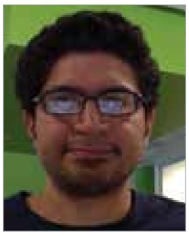
- vini.gautam@anu.edu.au

Vini Gautam is a postdoctoral fellow in the John Curtin School of Medical Research at the Australian National University. She received her PhD in materials science from the Jawaharlal Nehru Centre for Advanced Scientific Research (India) in 2014, during which she worked on integrating electronic materials and devices with biological systems. She has experience in experimental techniques in both materials science and neurophysiology and she collaborates with researchers across physics, chemistry, engineering and neuroscience. Her current research interests focus on biointerfacing of advanced materials for developing neuroprosthetic implants and exploring novel biomaterials for tissue engineering and drug delivery applications.

DR DANIEL GOMEZ

ARC Future Fellow
CSIRO

- daniel.gomez@csiro.au



Daniel Gomez completed a PhD in chemistry at the University of Melbourne, under the supervision of Laureate Professor Paul Mulvaney in 2007, where he studied the optical properties of individual semiconductor nanocrystals. This work was then awarded the Chancellor's Price for Excellence in the PhD thesis in 2008. After undertaking postdoctoral studies at CSIRO with Dr Timothy Davis, where he studied the surface plasmon resonance of interacting nanoparticles, he was awarded an ARC Fellowship. He is currently an ARC Future Fellow at CSIRO working on applications of plasmonics in photochemistry.

DR JUDY HART

Lecturer
School of Materials Science and Engineering, UNSW Australia

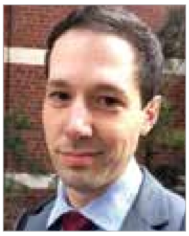
- j.hart@unsw.edu.au

Judy Hart is a lecturer in the School of Materials Science and Engineering at UNSW Australia. After completing her PhD at Monash University, she was a postdoctoral researcher and lecturer in the School of Chemistry, University of Bristol for five years. Her research is in the field of nanostructured semiconducting materials for energy and biomedical applications. She designs and develops new materials using computational and experimental approaches in parallel. She recently proposed from first-principles calculations a new semiconducting material as an efficient photocatalyst for hydrogen production using solar energy. Experimental work on this material is ongoing, but preliminary results suggest that a high efficiency can be achieved. She has studied novel synthesis methods for semiconducting nanorods and is applying these methods to develop nanostructures for high-efficiency photocatalysis. Another developing area of her research is photocatalytic materials for solar water splitting inspired by nature, particularly manganese oxides. Judy collaborates across a wide range of fields, providing computational analysis to support experimental studies. This includes collaboration with researchers in biomedical fields on the development of nanostructured materials for cancer treatment by photocatalysis.

DR DANIEL HEATH

Lecturer
University of Melbourne

- daniel.heath@unimelb.edu.au



Daniel Heath recently joined the teaching and research staff at the University of Melbourne as a lecturer. His work focuses on the development of better materials for use in biomedical applications. His current interests are blood compatibility of materials, designing materials to promote stem cell function, and creating 3D platforms for cell culture and/or analysis.

ASSOCIATE PROFESSOR MATTHEW HILL

Member of the Organising Committee
Principal Research Scientist and ARC Future Fellow
CSIRO, Monash University

- matthew.hill@csiro.au

Matthew Hill leads a team of researchers focused on the application of porous materials across a variety of areas. These include high efficiency separation membranes, triggered release storage matrices, and energy storage devices. Matthew is a 2014 winner of the Prime Minister's Prize for Science—Physical Scientist of the Year.

DR YUNING HONG

Research Fellow
University of Melbourne

- yuning.hong@unimelb.edu.au

Yuning Hong received her PhD from Hong Kong University of Science and Technology (HKUST) in 2011. She then worked as a Postdoctoral Research Associate in Dartmouth College in Biophysical Chemistry for one year before returning to HKUST as a Research Assistant Professor of Chemistry and Junior Fellow of the Institute for Advanced Study. She joined the School of Chemistry, the University of Melbourne in 2014 as a McKenzie Fellow. Yuning is the author and co-author of over 70 scientific papers and inventor of three US patents. Her current research interests focus on the development of novel luminescent materials and exploration of their biological applications, including recognition of important biological substances, monitoring of conformational change processes of biomolecules, and bio-imaging.

DR MATTHEW HOUSE

Research Fellow
UNSW Australia

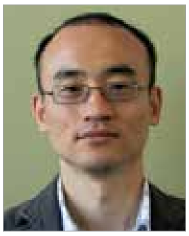
- matthew.house@unsw.edu.au

Matthew House is currently a postdoctoral research fellow in Michelle Simmons' group at the Centre for Quantum Computation and Communication Technology, UNSW Australia, where he studies the fabrication, operation and physics of silicon devices doped with phosphorus by scanning tunnelling microscope lithography. He received his PhD in 2012 from the University of California, where he studied electron spin physics for quantum computing applications in silicon MOSFET devices.

DR ZHENGUO HUANG

Research Fellow
University of Wollongong

- zhenguo@uow.edu.au



Zhenguo Huang received a PhD at the University of Wollongong in 2007. This was followed by a postdoctoral appointment at the Ohio State University. In 2011, he came back to the University of Wollongong as a Vice-Chancellor's Postdoctoral Research Fellow. In the same year, he won a Discovery Early Career Research Award, DECRA, from the Australian Research Council. His research is centred on boron chemistry. His contribution is known in the fields of hydrogen storage materials, electrolytes for Na-ion, Mg and Mg^{2+}/Li^{+} hybrid batteries and two-dimensional boron nitride nanosheets. As the (co-)corresponding author, he has journal articles in Advanced Materials, Energy & Environmental Science, Chemistry of Materials, Chemical Communications etc. He is the Chair of the hydrogen storage symposium at Pacifichem2015 and an editorial board member of Scientific Reports.

ASSOCIATE PROFESSOR BAOHUA JIA

Research Leader
Swinburne University of Technology

- bjia@swin.edu.au

Baohua Jia is a Research Leader at Swinburne University of Technology. She received her BSc (2000) and MSc (2003) degrees from Nankai University. She received her PhD (2007) from Swinburne University of Technology. She is now the Honorary Treasurer of the Australian Optical Society. Baohua's research focuses on ultrafast laser imaging, spectroscopy and nanofabrication of novel photonic nanostructures and employment of nanostructures and nanomaterials for clean energy related research. She has co-authored more than 200 scientific publications in highly ranked journals and prestigious international conferences including Nature Photonics, Advanced Materials and Nano Letters. She has delivered more than 30 invited talks at prestigious international conferences and serves on multiple professional committees. She has secured almost $2 million research grants as a key CI in the past seven years. She has received numerous prizes and awards including the 2013 Young Tall Poppy Science Award, L'Oréal Australia and New Zealand for Women in Science Fellowship (2012), Discovery Early Career Researcher Award (DECRA) from the Australian Research Council (2012), Vice-Chancellor's Industry Engagement Award (2011), Victoria Fellowship from the Victorian Government (2010), French Fellowship from the Australian French Association for Science and Technology (2010), Australia China Young Scientist Exchange Scheme grant from the Australian Academy of Technology and Engineering in 2009 and 2010, Australian Postdoctoral Fellowship (APD) from the Australian Research Council in 2009, Vice-Chancellor's Research Award (Early Career) for research excellence from Swinburne in 2009 and the Biotechnology Entrepreneur Young Achievement Australia Award in 2005.

ASSOCIATE PROFESSOR PATRICK KLUTH

Senior Fellow / ARC Future Fellow
Australian National University

- patrick.kluth@anu.edu.au

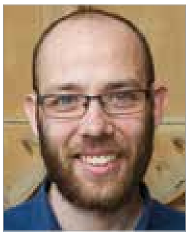
Patrick Kluth received his PhD from the Faculty of Physics at the RWTH University Aachen, Germany, in July 2002 with highest honours (summa cum laude). The work was carried out at the Research Center Jülich on the development and study of nano-structuring processes and design and fabrication of nanometric transistor devices. His work was acknowledged with the award of the 'Borchert-Medal' from the University Aachen in 2003. In January 2003 Patrick joined the Department of Electronic Materials Engineering at the Australian National University (ANU) as a Feodor-Lynen Research Fellow supported by the Humboldt Foundation in Germany. Subsequently he was awarded an Australian Research Council (ARC) Postdoctoral Fellowship from 2005 to 2008, an ARC Australian Research Fellowship from 2008 to 2013, and an ARC Future Fellowship that commenced in 2013. His current position is that of an Associate Professor.

Patrick has co-authored more than 100 publications and is frequently invited to national and international conferences. He is a member of the editorial board of the Elsevier Journal 'Nuclear Instruments and Methods in Physics Research Section B' and the International Scientific Committee of the 'Swift Heavy Ions in Matter' conference and has served on the Program Advisory Committee of the SAXS/WAXS beamline at the Australian Synchrotron. He is actively involved in undergraduate education at the ANU. Patrick's research focuses on materials science involving ion beams and characterisation methods using synchrotron-based analytical techniques.

DR JACEK KOLANOWSKI

Postdoctoral Research and Teaching Associate
University of Sydney

- jacek.kolanowski@sydney.edu.au



Jacek Kolanowski studied both biotechnology (BSc in 2007) and chemistry (MSc in 2009 with Professor Koroniak) at Adam Mickiewicz University in Poznan, Poland. He worked as a research assistant for Professor Roeschenthaler in Bremen, Germany on the development of new fluorination methods and a synthesis of fluorinated phosphonates with potential applications in biology. In 2010 he received the Ligue Nationale Contre le Cancer PhD Scholarship to work at ENS Lyon, France, with Professor Hasserodt on the development of a magnetogenic iron complexes for truly off-on activatable molecular probes for magnetic resonance imaging (MRI) and other sensing purposes.

After completing his PhD in 2013, Jacek received a Postdoctoral Outgoing Fellowship from the Fondation ARC pour la Recherche sur le Cancer to join the group of Dr New at the University of Sydney to work on the development of new fluorescent probes to study fluxes of oxidative stress in biological models and improve the diagnosis of prostate cancer. Currently, he holds a position of Postdoctoral Research and Teaching Associate in the same group, where he is involved in a range of projects on the design, development and biological applications of fluorescent and MRI tools to probe the spatio-temporal distribution of oxidising species and metal ions in complex samples in situ in real time. In recent years he has also been actively involved in forming and developing multidisciplinary scientific collaborations with scientists and clinicians from around the world.

DR KEVIN LAWS

Senior Research Fellow
UNSW Australia

- k.laws@unsw.edu.au

Kevin Laws has been employed at the School of Materials Science and Engineering, UNSW Australia since 2007: from 2008–2012 by the ARC Centre of Excellence in Light Metals Design as a Project Manager and Postdoctoral Research Fellow and from 2012–2015 as an ARC DECRA Senior Research Fellow. During this time he has worked for extended periods at the Swiss Federal Institute of Technology (ETH), Zurich and in Dayton, Ohio with the US Air Force Materials and Manufacturing Directorate, of which he is an adjunct member. His research interests are in the design, production and application of amorphous and high entropy alloys (physical metallurgy) with a focus on the fundamental topological and chemical aspects of their formation (metal physics) and deformation behaviour. Recent research investigations include the topological/structural modelling of short- and medium-range ordering in metallic glasses, the development of new, ductile magnesium- and aluminium-based bulk metallic glasses, shear band dynamics in metallic glasses, and the development of new high entropy brasses, bronzes and precious-metal alloys.

DR PETER LIDDICOAT

Research fellow / CEO
University of Sydney/Atomnaut

- peter.liddicoat@sydney.edu.au

As an ARC fellow, Peter Liddicoat was leading a small research group at the University of Sydney before leaving to launch Atomnaut, a materials engineering startup company. Atomnaut uses the world's highest resolution 3D microscope—the Atom Microscope by Projection—to unlock computer design of new materials. From developing new microscope techniques to winning Science magazine's Dance Your PhD competition, Peter is driven by curiosity, technical challenges, and transferring scientific discoveries to the world.

DR KATHERINE LOCOCK

Research Scientist
CSIRO Manufacturing Flagship

- katherine.locock@csiro.au

Katherine Locock received her PhD at the University of Sydney in 2010, where she focused on the development of conformationally restricted GABA analogues as potential treatments for Alzheimer's disease and mood disorders. She was later employed as an associate lecturer in the Pharmacology Department at the university. In 2012, Katherine took up a position as an OCE Postdoctoral Fellow in the Material Sciences and Engineering Division of CSIRO in Melbourne. Katherine focuses on the development of novel, biologically active polymers, based on CSIRO's patented RAFT technology. Her work has led to a number of publications, a book chapter and invitations to speak internationally, and she was awarded the CSIRO Staff Association Women in Science Scholarship in 2013. Katherine also currently holds a patent for the use of her antimicrobial polymers in treating established biofilms.

In 2015 she was appointed as a Research Scientist in the Manufacturing Flagship of CSIRO. She was recently invited to give a keynote presentation at the Australasian Polymer symposium and to speak at the Australian Academy of Science National Youth Forum in Canberra. In 2014 Katherine was selected by the UK Royal Society as one of 30 researchers to represent Australia at the Commonwealth Sciences Conference in India. Her current project involves mimicking antimicrobial peptides using RAFT polymers. These polymers are able to safely and effectively kill pathogenic bacteria and fungus and hence are new leads for the development of a generation of biomaterials to tackle antibiotic resistance.

DR MEGAN LORD

Senior Lecturer
UNSW Australia

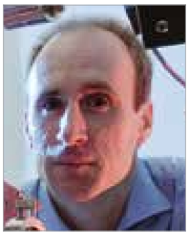
- m.lord@unsw.edu.au

Megan Lord is a Senior Lecturer in the Graduate School of Biomedical Engineering at UNSW Australia. She graduated with a Bachelor of engineering in chemical engineering (Hons I) and a Master of biomedical engineering in 2003 and obtained her PhD in 2006 in biomedical engineering from the same university. Megan's research aims to develop materials that replicate components of tissues called extracellular matrix for both the correct function of implantable medical devices that interface with tissues, and the controlled repair of tissues as a result of disease or injury. The extracellular matrix provides much of the tissue architecture and acts as a reservoir of chemical signals for tissue development and repair. By mimicking these natural structures with man-made engineered materials and bioengineered molecules her research team has been working towards repairing tissues including blood vessels, skin, bone and cartilage as well as extending the functional life of cochlear electrodes and platelet blood bags. This research has been disseminated in approximately 60 peer-reviewed publications. Megan has been awarded multiple competitive grants from Australian Government granting agencies and received recognition at the highest level locally and nationally by winning research and professional awards for outstanding achievement.

DR ROSS MARCEAU

Research Fellow
Deakin University

- r.marceau@deakin.edu.au



Ross Marceau is a research academic and technical manager of the LEAP 4000HR atom probe instrument within the Advanced Characterisation Facility at the Institute for Frontier Materials, Deakin University. He holds a Bachelor of engineering (materials) with First Class Honours obtained from UNSW Australia in 2004, together with a PhD from the University of Sydney. After completion of his PhD in 2008, Ross became a research associate of the ARC Centre of Excellence for Design in Light Metals within the Australian Centre for Microscopy and Microanalysis at the University of Sydney (2008–2011). Prior to starting at Deakin in July 2013, Ross was awarded an Alexander von Humboldt Postdoctoral Fellowship to conduct research at the Max-Planck-Institut für Eisenforschung (Max Planck Institute for Iron Research) in Düsseldorf (Germany) between 2011 and 2013.

DR DAMIA MAWAD

Lecturer
UNSW Australia

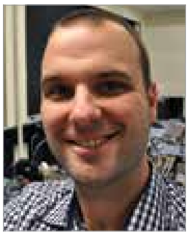
- damia.mawad@unsw.edu.au

Damia Mawad was appointed a lecturer at the School of Materials Science and Engineering, UNSW Australia in August 2015 after completing her Marie Curie International Incoming Fellowship in Imperial College London, UK. From 2008 to 2012, she was a Research Fellow at the Intelligent Polymer Research Institute (IPRI), University of Wollongong. Her research interests are in polymeric biomaterials applied in tissue engineering. One of her main investigations is development of electroactive and conductive scaffolds for biomedical applications. These include conductive porous hydrogels that induce cell attachment, proliferation and differentiation; conductive bioadhesives with micropatterned surfaces for cell alignment and photoadhesion to tissue; and conductive aligned meshes for improved cell integration and induced electrical stimulation.

DR PETER METAXAS

Research Fellow
School of Physics, University of Western Australia

- peter.metaxas@uwa.edu.au



Peter Metaxas received a joint-badged PhD in Physics in 2009 from the University of Western Australia and the Université Paris-Sud 11 in Orsay, France. His thesis focused on using magneto-optical microscopy to evidence universal regimes of magnetic domain wall motion in ultrathin, quasi-2D ferromagnetic films. He then spent another two years in the Paris region as a postdoc at the Unité Mixte de Physique CNRS/Thales working on the fabrication and measurement of nano-scale spintronic domain wall devices aimed at optimising magnetic domain wall motion in magnetic tunnel junctions and nanostrips. He returned to UWA in late 2012 after spending six months at Georgia Tech studying and fabricating graphene-based chemical and biological sensors, a research visit funded by an American Australian Association Fellowship. At UWA he holds an ARC DECRA as well as a grant from the US Air Force, which is funding the development of frequency-based spintronic detectors for magnetic nanoparticles with an aim to develop high speed biosensors. His current work involves measuring and simulating radiofrequency magnetisation dynamics in nanostructures which he probes experimentally using magnetoresistive methods and broadband ferromagnetic resonance spectroscopy.

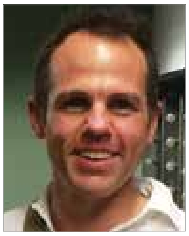
ASSOCIATE PROFESSOR ADAM MICOLICH

Co-chair of the Organising Committee

Associate Professor

UNSW Australia

- adam.micolich@gmail.com



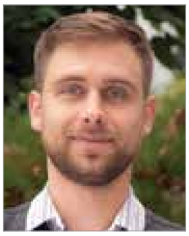
Adam Micolich is an Associate Professor in the School of Physics at UNSW Australia. His background is in nanoscale semiconductor devices and the role that quantum mechanics plays in their operation. His recent focus has been on advanced gating strategies for semiconductor nanowire transistors.

DR MARKUS MUELLNER

Lecturer

University of Sydney

- markus.muellner@sydney.edu.au



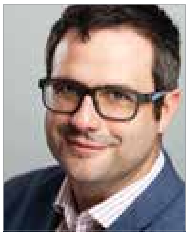
Markus Muellner studied polymer and colloid chemistry at the University of Bayreuth, Germany. He received his Doctorate in polymer chemistry under the supervision of Professor Axel H.E. Müller in 2012. He subsequently joined the University of Melbourne as a Postdoctoral Researcher, mentored by Professor Frank Caruso. In 2013, he was awarded a three-year McKenzie Postdoctoral Fellowship by the University of Melbourne and continued to work with the Department of Chemical and Biomolecular Engineering within the Nanostructured Interfaces and Materials Science group. In 2015, Markus became a lecturer in the School of Chemistry at the University of Sydney and joined the Key Centre for Polymers and Colloids. His research emphasis is on the design and study of macromolecules with a focus on elaborate polymeric architectures, such as cylindrical polymer brushes (CPBs), which can be subsequently used in template chemistry, sensing and biomedical applications.

DR XAVIER MULET

Research Scientist

CSIRO

- xavier.mulet@csiro.au



Xavier Mulet received his PhD in Chemical Biology from Imperial College in 2007. He is currently working as a Research Scientist at CSIRO. He has extensive experience in the field of soft matter and porous materials. His research spans two areas: biomedical and soft materials, and materials for energy and environment. Specifically, he focuses on how the structure of matter relates to their performance and therefore suitability for ultimate application. In the biomedical sphere, he is developing targeted, stimuli-responsive soft matter (lipid) nanoparticles for applications in RNA delivery and cancer therapy applications. He has also developed and patented novel porous materials composites that demonstrate class leading performance for gas storage and separations. These materials are particularly applicable to methane/hydrogen storage and carbon capture and will significantly impact the energy industry.

Working for CSIRO, a key focus is on the translation of novel, advanced technologies. Xavier is particularly interested in novel high-throughput and evolutionary approaches to new materials discovery in the biomedical fields and materials for energy and the environment, and works extensively with local and international industrial and commercial partners. This ensures that his material solutions are not only relevant for commercial application but can also translate to the market place. Xavier sees that fostering an entrepreneurial spirit is essential and therefore is particularly interested in novel approaches to translating research outcomes to real world impact.

DR CHARLENE NG

OCE Postdoctoral Fellow

CSIRO

- charlene.ng@csiro.au

Charlene Ng received her Bachelor of engineering (chemical and biomolecular) from Nanyang Technological University and completed her PhD in chemical engineering from UNSW Australia under the supervision of Professor Rose Amal, working on photocatalysis for solar energy conversion. She is currently an OCE Postdoctoral Fellow in CSIRO working on plasmonic photocatalysis. Her research focuses on developing materials for solar energy conversion.

DR YUN HAU NG

Lecturer

UNSW Australia

- yh.ng@unsw.edu.au

Yun Hau Ng is a lecturer at UNSW Australia. He received his doctorate from the Research Center for Solar Energy Chemistry, Osaka University in 2009 under the supervision of Professor Michio Matsumura. He spent a brief attachment at the Radiation Laboratory, University of Notre Dame led by Professor Prashant Kamat in 2008. Before his current position, he worked with Professor Rose Amal as an ARC Australia Postdoctoral Fellow (APD) in the School of Chemical Engineering at UNSW Australia. His research focuses on the integrated photoactive nanomaterial systems (particles and thin films) for solar fuels, photocatalysis, photoelectrocatalysis and catalysis. He has received numerous awards for early career researchers and was the recipient of the 2013 Honda-Fujishima Prize awarded by the Electrochemical Society of Japan.

ASSOCIATE PROFESSOR SHANNON NOTLEY

Associate Professor
Australian National University

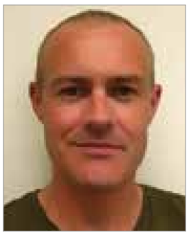
- shannon.notley@anu.edu.au

Shannon Notley is an Associate Professor of Surface Science in the Department of Applied Mathematics, Research School of Physics and Engineering at ANU. Prior to this he held an ARC Future Fellowship and research fellow roles at Swinburne University of Technology and ANU. Shannon's research interests include molecular self assembly, polymers at interfaces and the production and applications of 2D materials, including graphene. Most recently, Shannon has focused his attention on scaling production of graphene and other 2Ds at ANU where the manufacturing facility is now installed. Shannon and his research team are also developing applications using the materials generated through the unique high volume method with particular emphasis on enhancing thermal properties of various materials including thermosets and phase change materials.

ASSOCIATE PROFESSOR ANTHONY O'MULLANE

Associate Professor
Queensland University of Technology

- anthony.omullane@qut.edu.au

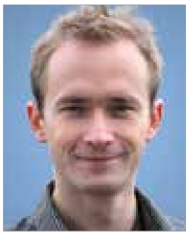


Anthony O'Mullane received his BSc degree in chemistry in 1997 and his PhD in electrochemistry in 2001 at University College Cork. This was followed by postdoctoral work at Technische Universitat Darmstadt, University of Warwick and Monash University. He was previously a Senior Lecturer at RMIT University and is currently an Associate Professor at Queensland University of Technology. He is Chair of the Electrochemistry Division of the Royal Australian Chemical Institute (RACI) and a Fellow of the RACI and Royal Society of Chemistry. His research interests are in the electrochemical fabrication, characterisation and application of a wide range of materials, including nanostructured metals, metal oxides, conducting polymers, organic semiconductors and liquid metals. He is particularly interested in applying electrochemical principles and techniques to the biological, chemical and physical sciences. He has published 1 book chapter and co-authored 109 journal articles and 14 conference proceedings.

DR ALMANTAS PIVRIKAS

Senior Lecturer
Murdoch University

- a.pivrikas@murdoch.edu.au



Almantas Pivrikas received his Bachelor degree at the faculty of physics, Vilnius University. He continued his studies at the Solid State Electronics and Condensed Matter Physics department headed by Professor Gytis Juska where he obtained his Master's degree. Here he actively participated in development and application of the novel charge extraction by linearly increasing voltage (CELIV) technique to study charge transport inorganic and organic semiconductors. For PhD studies he joined the group of Professor Ronald Osterbacka at Abo Akademi University where he continued the research of charge transport in various organic materials and devices. Here he discovered unexpected phenomena of reduced (non-Langevin recombination) photocarrier recombination in disordered organic materials.

After receiving his PhD, Almantas accepted a fix-term assistant professor contract in the group of Professor Niyazi Serdar Sariciftci, in Physical Chemistry Department and Linz Institute for Organic Solar Cells (LIOS) at Johannes Kepler University Linz. Here he further developed powerful transient techniques for charge transport studies and extended his expertise in other optoelectronic devices such as organic field effect transistors and light emitting diodes. To continue his career in academic research, he joined the group headed by Professor Paul Burn and Professor Paul Meredith at the School of Chemistry Molecular Biosciences, the University of Queensland. In 2012 he was awarded an ARC DECRA fellowship after which he received a senior lecturer position at Murdoch University.

DR CRISTINA POZO-GONZALO

Research Fellow
Deakin University

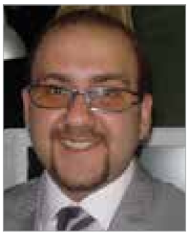
- cpg@deakin.edu.au

Cristina Pozo-Gonzalo attained her degree and honours in the University of Zaragoza. After graduating, she received her PhD degree in chemistry from the University of Manchester, working with Professor Peter J. Skabara on the electrochemical synthesis of conducting polymers. In 2004, she joined the Centre for Electrochemical Technologies in San Sebastian as the head of the electrooptical unit where she stayed for seven years, managing a total of 23 industry projects. After moving to Australia she worked with Professor Alan Bond at Monash University and in 2012 she joined Professor Maria Forsyth at Deakin University where she has been working in the reversible metal air battery team. During her research career, she has authored and co-authored more than 40 refereed journal publications and one book chapter, and holds three patents. Her research interest include ionic liquids, air cathode, conducting polymers and oxygen reduction.

DR MOHSEN RAHMANI

Postdoctoral Fellow
Australian National University

- mohsen.rahmani@anu.edu.au



Mohsen Rahmani graduated with his MSc in material sciences from the Kiev Polytechnic Institute (National Technical University of Ukraine) and his PhD in electrical engineering from the National University of Singapore. After spending two years at Imperial College London as a research associate, he recently joined the Australian National University to pursue his research activities in the Nonlinear Physics Centre. Mohsen's initial research direction was focused on the optical properties of wavelength scale plasmonics structures. At the fundamental level, he studied the concepts of surface plasmon polaritons, (localised) surface plasmon resonances, and various couplings and interactions at ultra-subdiffraction scales. He also actively contributed to design and development of several micro/nano devices for ultra-sensitive detection of molecular vibrational modes from visible to infrared frequencies via log-periodic multi frequency nanoantennas. His more recent interest is directed towards nonlinearity of nanostructures, which holds a great potential to control light by light. It is at the heart of modern photonic functionalities, including diversifying laser systems, light-material interactions and information technology. Mohsen has authored/co-authored more than 26 journal papers including a number in Nature Nanotechnology, Advanced Materials, Nano Letters and ACS Nano.

DR FANGFANG REN

ARC DECRA Fellow
Australian National University

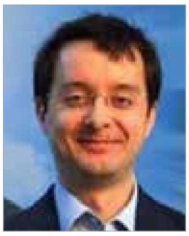
- fangfang.ren@anu.edu.au

Fangfang Ren is currently an ARC DECRA fellow working in the Department of Electronic Materials Engineering, the Australian National University. She has expertise in advanced simulations and device characteristics. Her research interest focuses on the implementation of metamaterials/plasmonics in optoelectronic devices, including (1) surface plasmons in Ge infrared photodetectors and GaN nano-LEDs; (2) photonic crystals in Si-based emission and photovoltaic applications; (3) meta-polarizers and THz metamaterials based on hybrid semiconducting devices; and (4) development of transparent conducting oxides for the applications in plasmonics and metamaterials. Fangfang has 44 journal papers published in Nano Lett., APL, PRB, OE, IEEE EDL/PTL, IEDM etc.

DR JAN SEIDEL

Associate Professor
UNSW Australia

- jan.seidel@unsw.edu.au



Jan Seidel is an Associate Professor and ARC Future Fellow at UNSW Australia. He received his doctorate in physics from the University of Technology Dresden in 2005. From 2006 to 2007, he was a Feodor Lynen Fellow (Alexander von Humboldt Foundation) at the University of California, Berkeley. From 2008 to 2011, he worked at Lawrence Berkeley National Laboratory before joining UNSW Australia. His main interests are in materials physics of complex oxides and nanomaterials characterisation by scanning probe techniques.

DR SHARATH SRIRAM

Member of the Organising Committee
Research Group Leader
RMIT University

- sharath.sriram@gmail.com

Sharath Sriram is the joint leader of the Functional Materials and Microsystems Research Group at RMIT University in Melbourne. He is also the Deputy Director of the university's Micro Nano Research Facility. Sharath's expertise includes the synthesis of functional thin films and micro/nanostructures and devices. His research focuses on the convergence of materials science, electronics, electromagnetics, physics and chemistry. Sharath is also the Chair of the Australian Academy of Science's Early- and Mid-Career Researcher Forum.

DR GEORGINA SUCH

Future Fellow/Senior Lecturer
University of Melbourne

- gsuch@unimelb.edu.au

Georgina Such completed her PhD in 2006 from UNSW Australia under the supervision of Adjunct Professor Richard Evans and Professor Tom Davis. After her PhD, Georgina commenced postdoctoral work in the Nanostructured Interfaces and Materials Science group headed by Professor Frank Caruso. Her research in this group focused on the use of customised polymeric building blocks to design intelligent layer-by-layer materials (LbL) for therapeutic delivery. In 2013, she commenced a Future Fellowship in the School of Chemistry, the University of Melbourne, enabling her to start her own research group in the area of functional materials. Georgina has authored 56 peer-reviewed publications and three book chapters. Her work has been recognised with the 2011 L'Oréal Women in Science Fellowship and a Tall Poppy award in 2012. Her research interests include customised polymer design, self-assembly and functional materials.

DR CHENGHUA SUN

Member of the Organising Committee
Future Fellow
Monash University

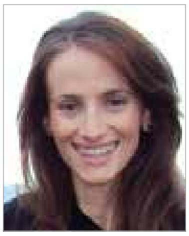
- chenghua.sun@monash.edu

Chenghua Sun obtained his PhD from the Chinese Academy of Sciences in 2007 and joined the University of Queensland (UQ) as a postdoctoral fellow with Professor Sean Smith and Professor Max Lu. As a research fellow, he worked in UQ from 2007 to 2013 and visited the Royal Institute of Technology (Sweden), Princeton University and Harvard University as a visiting postdoctoral fellow. Chenghua joined the School of Chemistry, Monash University as a lecturer in 2013 and has worked as an ARC Future Fellow from 2014. He is a computational chemist, working on computer-aided materials design, particularly the development of novel materials for clean energy and environment. Chenghua has published more than 100 peer-review papers, including Nature, J. Am. Chem. Soc., Angew Chem., Adv. Func. Mater., leading to 5400 citations.

DR NEVENA TODOROVA

Research Fellow
RMIT University

- Nevena.Todorova@rmit.edu.au



As an early-career researcher Nevana Todorova has made significant contributions to the field of computational biophysics and materials science through the development and application of innovative computer simulations to studying inorganic surfaces, biomolecules and the complex bio-nano interfaces at the atomic level. Nevena completed her PhD in 2009 at RMIT University, where she identified lead compounds and mutations for the development of amyloid fibril inhibitors for treatment of Alzheimer's and cardiovascular diseases. During her postdoctoral work she provided novel insights into the response of proteins to the presence of carbon and gold nanomaterials for design of safe and efficient materials and devices for the biomedical industry. Currently, she is a NHMRC Fellow in the Australian Centre of Research Excellence in Electromagnetic Bioeffects Research aiming to clarify the current uncertainty about health effects of telecommunication devices such as mobile phones, and provide fundamental guidelines for improved safety standards.

The outcomes of her work are of relevance to manufacturing and pharmaceutical industries and academic research. Nevena has published in leading journals in the field, including Nano Letters, Chemistry of Materials, PLoS Computational Biology. She has been awarded two international fellowships to visit the University of Cambridge, Imperial College London and University College Dublin, and four travel awards including the highly competitive CASS Foundation Travel Grant and VLSCI Travel Grant. Her work has been also recognised with six presentation awards by internationally and nationally renowned organisations such as the Materials Research Society, USA and the Royal Australian Chemical Institute.

DR ANTONIO TRICOLI

Senior Lecturer
Australian National University

- antonio.tricoli@anu.edu.au

Antonio Tricoli received his master in mechanical and process engineering from the Swiss Federal Institute of Technology (ETH Zurich) in 2004. Immediately after, he joined the Renewable Energy Laboratory of ETH where he worked on the production of hydrogen from solar energy. He continued his PhD studies in 2005 at the Particle Technology Laboratory (ETH Zurich) working on the nanofabrication of wearable sensor technology for non-invasive medical diagnostics. In 2010, he received his PhD in the field of nanotechnology. His thesis received numerous awards including the prestigious HILTI Prize of ETH Zurich. He continued his work as research fellow and lecturer at ETH Zurich working on the nanofabrication of nanoparticle and nanowire layers for renewable energy production and medical devices. In 2012, he joined the Australian National University under the Future Engineering Research Leadership Fellowship and founded the Nanotechnology Research Laboratory at the Research School of Engineering. His team currently includes five PhD students and numerous undergraduates. His research focuses on the scalable fabrication of ultra-porous nanostructures for portable devices and wearable with application including preventive medicine and healthcare.

DR CELINE VALERY

Lecturer in Pharmaceutical Sciences
RMIT University

- celine.valery@rmit.edu.au

Celine Valery obtained a PhD in Pharmacy in 2003 from the University of Paris XI after completing two Masters of Science in physicochemistry and chemical engineering at the University of Aix-Marseille. Her PhD thesis focused on the structural physicochemistry of peptide self-assemblies as biomaterials for drug delivery using a range of biophysical techniques. This work supported the registration and marketing of a novel type of peptide controlled release formulation in Europe and the US

(Somatuline Autogel) based on the drug intrinsic self-assembling properties into reversible nanotubes.

After postdoctoral work at the Collège de France, Paris, focused on gold nanoparticle synthesis and functionalisation (Chemistry of Supramolecular Interactions group, Prof JM Lehn), Celine joined the Ipsen research center (pharma company) in Barcelona in 2004. There she worked as a principal scientist on a range of peptide and protein formulations aiming at controlled release properties. In late 2010 she joined the Biomolecular Interaction Centre at the University of Canterbury in New Zealand for a postdoctoral fellowship on protein oligomerisation and model self-assembling peptide design under the guidance of Professor Juliet Gerrard. In February 2014, Celine joined the School of Medical Sciences at RMIT to take up a lectureship in pharmaceutical sciences. Her research focuses on the structural aspects of peptide self-assembly and protein oligomerisation using biophysical techniques (X-ray scattering, vibrational spectroscopy, electron microscopy mainly), with a special interest for functional and biomimetic nanoscale architectures (nanotubes, ribbons, tapes, rings, all biologically relevant).

DR DA-WEI WANG

Lecturer
UNSW Australia

- da-wei.wang@unsw.edu.au

Da-Wei Wang is a Lecturer at UNSW Australia. He received his PhD in materials science at the Institute of Metal Research, Chinese Academy of Sciences in 2009. His postdoctoral research was in collaboration with Professor Max Lu and Professor Ian Gentle at University of Queensland from 2009 to 2013. He is interested in electrochemical energy materials and engineering. He received a 2012 UQ Foundation Research Excellence Award and the 2013 Scopus Young Researcher Awards in Engineering for his research to develop advanced batteries. He has published around 60 peer-reviewed journal papers and several book chapters, with an h-index of 30 and total citations of over 6000 (Google Scholar).

DR CAIYUN WANG

Senior Research Fellow
University of Wollongong

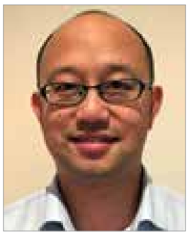
- caiyun@uow.edu.au

Caiyun Wang is currently a senior research fellow in the Intelligent Polymer Research Institute and ARC Centre of Excellence for Electromaterials Science at University of Wollongong. She has been involved in the field of organic conductors for energy storage application since she received her PhD in 2004. Her current research interests focus on the fabrication of flexible/stretchable electrodes and their applications in flexible/wearable batteries or implantable bioelectric batteries. She has acquired a solid understanding of the nature of organic conductors. The highlights of the work include publications in Advanced Materials, Advanced Energy Materials, and Chemistry of Materials. Her new research interest is the development of catalysts for CO_2 electrochemical reduction. She has published one book chapter, one US patent and 43 research papers, which have attracted more than 1000 citations with an h-index of 17.

DR LAN WANG

Associate Professor
RMIT University

- lan.wang@rmit.edu.au



Lan Wang was awarded a PhD degree in physics in 2003 at National University of Singapore and a PhD degree in materials sciences in 2006 at the University of Minnesota Twin Cities. After the defence of his PhD thesis in Jan 2006, Lan became an Assistant Professor at Nanyang Technological University. He was the Principle Investigator of the Magnetic Materials and Spintronics Lab for the whole period at Nanyang Technological University (from 2006 to 2014). Lan has published over 85 peer reviewed articles in prestigious journals, including Nature Communications, Physical Review Letters and Nano Letters. In November 2014, he joined RMIT University as an Associate Professor of Physics in the School of Applied Science. His research interests focus on various quantum materials, including topological insulators and 2D semiconductors. The aims are to understand the fundamental physics of these novel materials and to fabricate the next generation prototype electronic and spintronic devices.

DR LUCY WEAVER

OCE Postdoctoral Fellow
CSIRO

- lucy.weaver@csiro.au

Lucy Weaver is an organic chemist with broad experience working across numerous multi-disciplinary projects. Lucy completed her Bachelor of Science (Hons I) and PhD at the University of Queensland. During this time she delved into the world of carbohydrate chemistry for biomedical applications, synthesising and studying the ability of drug-sugar conjugates to improve drug bioavailability. She also investigated the potential of various dendritic and polymeric carbohydrate-based macromolecules as vaccine candidates against Staphylococcus aureus. Lucy is currently an OCE Postdoctoral Fellow at the CSIRO in Melbourne, where she is further developing her skills in polymer synthesis, through the development of new materials for separation applications.

PROFESSOR JIM WILLIAMS

Chair of the Oversight Committee
Emeritus Professor
Australian National University

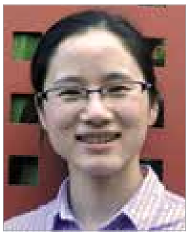
- Jim.Williams@anu.edu.au

Following his PhD (1973) from UNSW Australia, Jim Williams had a series of research appointments in Europe and North America, including a member of technical staff at Bell Telephone Laboratories, before taking up an academic post at RMIT in Melbourne in 1978. He was Director of the Microelectronics Technology Centre from 1982 to 1988, then moved to the ANU as Foundation Professor of the Department of Electronic Materials Engineering. He was Director of the Research School of Physics & Engineering at ANU from 2002 to 2012 and is now an Emeritus Professor. His research has been in semiconductors, nanotechnology and high pressure physics areas for over 45 years, publishing over 500 papers and five books, with over 10 000 citations and a h-index of 53. Jim was awarded the Boas Medal of the Australian Institute of Physics (1993) and the Thomas Rankin Lyle Medal of the Australian Academy of Science (2011). He is a Fellow of the Australian Academy of Science and the Australian Academy of Technology and Engineering, the MRS and the APS, and is President of Australian MRS, Chair of the National Committee for Materials Science and Engineering, and Meetings Commission Chair of the IUMRS. He has initiated two spin off companies. He is Chair of the Academy's Oversight Committee for this Australian Frontiers of Science Meeting.

DR SHUYING WU

Research Fellow
RMIT University

- shuying.wu@rmit.edu.au



Shuying Wu is a research follow at the School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University. Her current research is mainly concerned with developing multifunctional polymer nanocomposites and advanced composite materials based on carbon-based nanomaterials such as graphene and carbon nanofibers. By manipulating the orientation of carbon nanomaterials in polymer matrix, nanocomposites with greatly improved electrical, thermal conductivity and mechanical properties have been developed. This research has led to publications in journals such as Carbon, Polymer, and Composite Science and Technology. Prior to her current role as a research fellow at RMIT University, Shuying was a research assistant and PhD candidate at Deakin University. She was awarded the prestigious International Postgraduate Research Scholarships (IPRS) which is only awarded to outstanding international applicants who have a First Class Honours result or equivalent. The project she worked on involved the design and fabrication of nanostructured polymer composites through self-assembly of block copolymers. During this time, she has contributed to the area of functional nanostructured polymers, through the development of a new approach in toughening thermosetting polymers and establishing the correlation between nanostructures and mechanical properties. More importantly, her research has resulted in two inventions for a new technology to improve the toughness of thermoset resins.

DR YUNXIA YANG

Research Scientist
CSIRO

- yunxia.yang@csiro.au

Yunxia Yang received her PhD from the Department of Chemical Engineering at Monash University and is now working as a research scientist in CSIRO's Energy Flagship. She has extensive experience in material synthesis and catalyst development, characterisation, gas adsorption and separation. Yunxia has published 34 articles in the core journals of the field since her PhD. She is the author of a book chapter, and is also the author of two invited review articles in Catalysis Today and Journal of Materials Chemistry. She is a member of Materials Australia and was on the Local Organising Committee for the 2010 Pacific Rim International Conference on Advanced Materials and Processing in Cairns.

DR GEORGE YIAPANIS

Research Scientist
IBM Research

- gyiapanis@au1.ibm.com

George Yiapanis is a computational physicist at IBM Research Australia with a background in materials modeling and simulation, aiming to develop fundamental links between atomic structure and material properties. His interests are in molecular modeling, wetting phenomena and polymeric and nanostructured materials. George received his PhD in Physics from RMIT University. Past research projects have included the modeling of anti-fouling coatings, synthetic polymers used to extract valuable minerals, high-performance nano-composite materials and self-assembling polymers and lipids. Collaborative partners include BlueScope Steel, BHP Billiton, the University of Melbourne and National University of Singapore.

DR ADNAN YOUNIS

Postdoctoral Research Fellow
UNSW Australia

- a.younis@unsw.edu.au

Adnan Younis received his PhD in materials science and engineering from UNSW Australia in 2014. During his PhD, he studied novel bottom-up approaches to fabricate metal oxides based nano-architectures for the applications of nano-electronics. His work on novel transparent inks for printable nanoelectronic devices was recently highlighted in The Australian newspaper. Adnan is currently working in the same school as a research fellow with Professor Sean Li in the laboratory of advanced multifunctional and energy materials. His research interests involve development of hierarchical nano-microstructures for diverse applications ranging from nano-electronics to energy storage devices.

DR CHUN-XIA ZHAO

Future Fellow and Associate Group Leader
University of Queensland

- z.chunxia@uq.edu.au

Chun-Xia Zhao joined Australian Institute for Bioengineering and Nanotechnology (AIBN), the University of Queensland (UQ) as a Postdoctoral Fellow in early 2008 after she received her PhD from Zhejiang University. In 2011, Chun-Xia was awarded an ARC Discovery project along with the Australian Postdoctoral Fellow as the sole investigator. In 2014, she was awarded an Australian Research Council Future Fellow and appointed as the Associate Group Leader. Chun-Xia's research in bio-inspired nanotechnology and microfluidics has attracted more than $2 million in research funding since 2011, including three ARC projects as the lead investigator, two national prestigious fellowship and three UQ internal grants. She was invited to visit Harvard University as a Fellow of the School of Engineering and Applied Science in 2014. Chun-Xia has published more than 30 papers in leading journals, such as Angewandte Chemie International Edition, Chemical Communications, Journal of Materials Chemistry, AIChE Journal, Biotechnology and Bioengineering and Vaccine. She has been focusing on innovative research as evidenced by her four patents. She has been invited to submit book chapters, reviews and research papers in leading journals, such as Advanced Drug Delivery Reviews, Chemical Engineering Science Special Issue on Microfluidic Engineering, Industrial Engineering & Chemical Research and Vaccines. Chun-Xia is also an invited reviewer for more than 20 journals, including Advanced Materials, Chemical Communication, Lab on a Chip, Chemical Engineering Science, AIChE Journal and Langmuir.

NOTES

THE EMCR FORUM The Australian Early- and Mid-Career Researcher (EMCR) Forum is the national voice of Australia's emerging scientists, representing researchers who are up to 15 years post-PhD (or other research higher degree), irrespective of their professional appointment.

It examines critical issues including career structure, job security, funding, education, training and gender equity. The Forum engages with early- and mid-career researchers (EMCRs) from around Australia and advises the Australian Academy of Science on issues relevant to EMCRs, to help inform its policy recommendations to government and develop its EMCR activities. It also liaises with other national organisations to positively contribute to both Australia's scientific research and the future careers of emerging research experts. The Forum provides a vital connection between Australia's most eminent scientists and tomorrow's future scientific leaders.

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