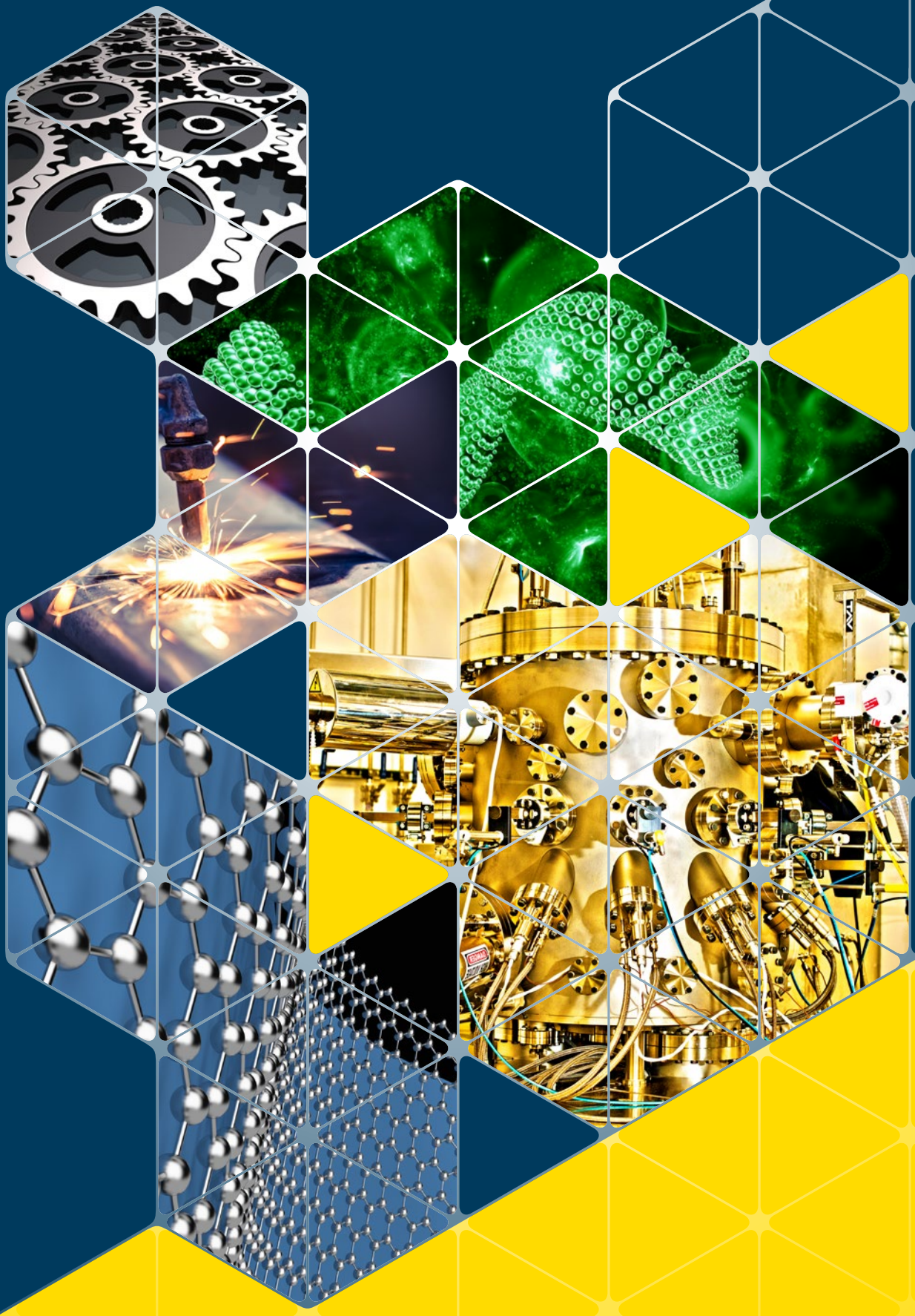
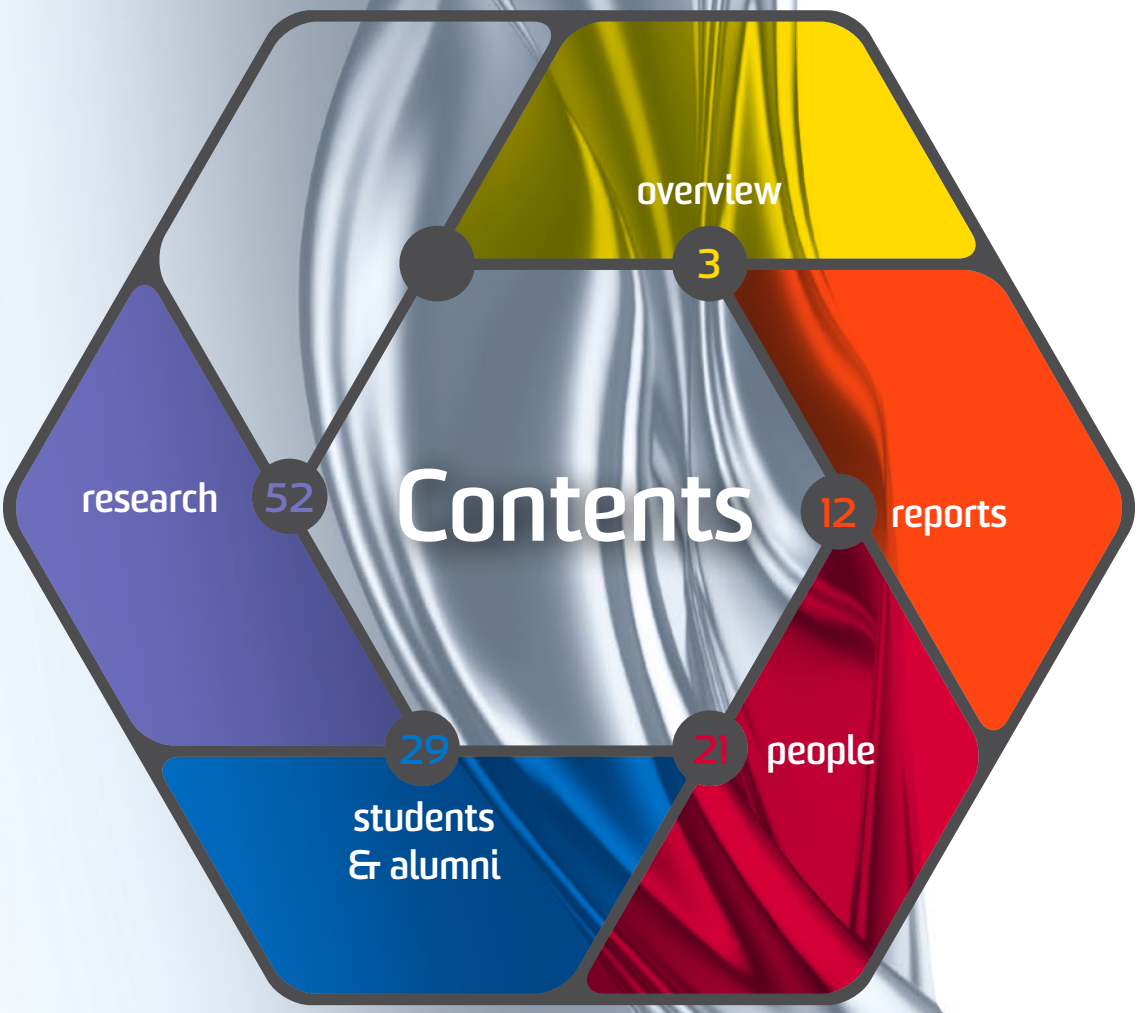


UNSW SYDNEY

School of Materials Science and Engineering

Annual Report 2016

Contents


overview
3
reports
12
people
21
students
& alumni
29
research
52

Who we are

The development of new materials drives innovation in a wide range of fields including transportation, information technology, health science and solutions for energy security.

The School of Materials Science and Engineering at UNSW Sydney is one of the leading schools in the world in the development of novel functional materials and in devising innovative solutions for their application. Beyond this, an emerging paradigm in materials development is sustainability, such that materials can be manufactured through energetically efficient processes and then readily recycled at the end of component lifetimes.

Our research covers a wide range of areas including:

- Functional materials for next generation electronic devices
- Sustainable recycling of e-waste
- Lightweight energy efficient materials for aerospace applications
- Advanced ceramic coatings for pollution control
- Graphene-based membranes for water purification
- Conducting polymers for tissue regeneration

The School of Materials Science and Engineering is located in a new purpose-built $143M building. The building contains a suite of state-of-the-art laboratories with cutting edge facilities for processing, analysis and testing of materials. The School is located adjacent to the Mark Wainwright Analytical Centre which features an extensive range of instruments for materials characterization.

Our goal is to provide first class teaching and research training in an intellectually stimulating and creative environment, equipping our graduates with technical and generic skills at a level that will lead them into attractive and productive employment. We continue to work in close partnership with local and international industry to develop innovative advancements in materials and solve real-world problems.

Welcome

Head of School
Professor Paul Munroe

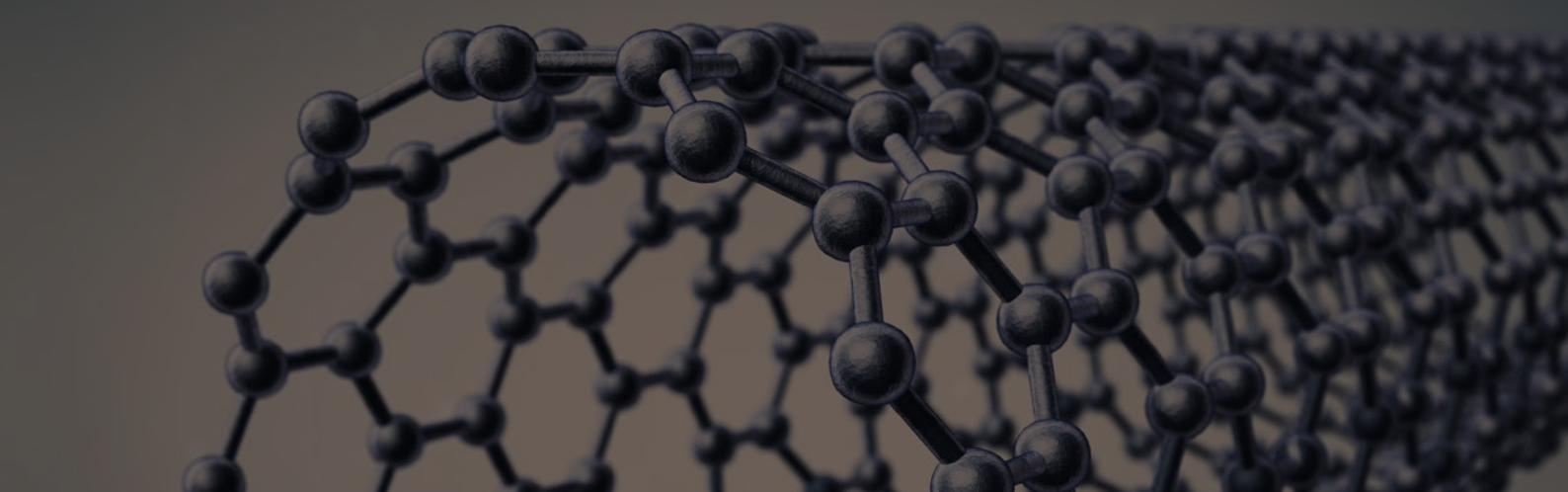
I am pleased to introduce the School of Materials Science and Engineering 2016 Annual Report.

Following a year of substantial disruption and change in 2015, the past 12 months have represented a phase of pleasing steady growth, consolidation of existing activities as well as expansion into a number of new, exciting enterprises.

The new building was renamed the Hilmer Building in honour of the outgoing Vice-Chancellor and formally opened by the, then, Premier, Mike Baird. Much of the operation of the building has now settled down following the relocation in 2015. However, in late 2017 building work will start (once again) to convert much of the building's 'cold shell lab space' into new laboratories to accommodate expansion in many of the School's research programs.

The School's undergraduate programs underwent formal accreditation by Engineers Australia mid-year. This is a formidable and onerous exercise where our programs and teaching are robustly evaluated and reviewed. I am pleased to report that our programs were given unreserved accreditation for the next 5 years. The review panel made a special point to commend the excellent engagement of our students. Later in the year these same programs underwent an internal review, under the auspices of the University Academic Board. Once again, our programs passed this review with flying colours.

A very exciting development across UNSW in 2016 was the establishment of the Torch program. This is a university-wide initiative to establish an innovation park at UNSW with emphasis on linkages with Chinese corporate business. Materials, though Sean Li, Dewei Chu and Danyang Wang, has very much led the charge across the University in this program and they have already garnered five very large research contracts principally in the development of functional materials. This activity is very much the first step and the contracts established already foreshadow a funding profile of 10's of millions of dollars in funding over the next few years. There is a high expectation that these activities will continue to expand.



In a second exciting research development, Nagy Valanoor and Jan Seidel were successful in their bid to establish an ARC-funded Centre of Excellence. The newly established Centre for Excellence in Future Low-Energy Electronics Technologies, led by colleagues at Monash University will provide over $3M of research funding to the School over the next five years.

Nagy and Jan will be working to develop next generation devices based on a deepened understanding of ferroelectric behaviour.

Beyond this, the School was highly successful in winning a large number of ARC grants and industry contracts. It is especially pleasing to see junior staff tasting success in different ARC programs and being highly engaged in securing industry-sponsored research contracts.

In 2016, the university began to implement its 2025 Strategic Plan. This plan includes a number of exciting and innovative initiatives that will reshape much of the direction and operation of the university over the next decade and beyond. The School has engaged strongly with the strategy, and through a number of different programs appointed several high performing academic staff, who will take up duty in late 2017.

Student numbers across all programs are strong and growing steadily. The Masters by Coursework program has been very successful attracting almost 100 students into the program in its first two years of operation. There has also been considerable growth in both local and overseas student numbers in the School's various undergraduate programs.

The quality of the teaching provided by the School is also excellent and highly regarded by the students. It is a pleasure to record that Judy Hart was awarded the Vice-Chancellor's Award for Teaching Excellence at the end of 2016. Judy is a highly committed and outstanding teacher. The School has active and vital student societies that do much to enrich our students' time at university. Credit must go to Gustad Irani and Akhila Mukkavilli, outgoing presidents of MATSOC and PGSOC respectively, for their energy and leadership. In collaboration with our student societies, the School launched an 'Equity Diversity and Inclusion' committee to prosecute an agenda of awareness and action, in conjunction with the Faculty and University-wide initiatives in this area.

In summary, the School is sailing exceedingly well. Research, teaching, leadership and engagement are excellent and contributing strongly to the University's mission.

Numbers at a Glance

25	Academic Staff
26	Research Staff
20	Professional and Technical Staff
1	ARC Laureate Fellow
4	Future Fellows
333	Undergraduate Students
82	Masters by Coursework
164	Higher Degree Students
297	Refereed research publications (2016)
$11.4m	Grant funding (2016)
$1.56m	Strategic UNSW Income (2016)

Academic Staff

ARC Future Fellow & Lecturer
Dr Claudio Cazorla

Claudio's research expertise is built on the study of bulk and low-dimensional condensed matter systems using advanced quantum simulation methods. The topics he investigates are relevant to a broad range of fundamentally and technologically important fields such as Nanotechnology, Materials Chemistry, Earth and Planetary Sciences and Atomic Physics. Claudio is particularly interested in the fundamental study of and technological applications involving multi-ferroic and fast-ion conductor materials.

Professor Alan Crosky

Alan's research focuses on the effect of structure (both micro and macro) on mechanical behavior. Specific areas of research include directed fibre placement in fibre reinforced plastic composites, failure of composites, natural fibre composites, wood plastic composites and engineering failure analysis.

Associate Professor
Sammy Lap Ip Chan

Sammy's research interests are in the areas of energy materials, hydrogen storage and metal matrix composites (MMCs).

Associate Professor
John Daniels

John's research focuses on the understanding of the structural origin of physical properties of materials. This research has, to date, been primarily directed in the field of electro-mechanical materials where a wide range of underlying structural processes at different length scales leads to the coupling of mechanical load and electrical charge.

ARC Future Fellow & Lecturer
Dr Dewei Chu

Dewei's research interests include ionic conductive oxide-based nanomaterials and their applications in nanodevices, including resistive random access memory, transparent thin film transistors, supercapacitors, electric double layer transistors, and artificial synapses, etc. He is also interested in functional ceramics for energy harvesting applications.

Professor Michael Ferry

Michael's research interests are concerned mainly with the mechanisms of microstructure and texture evolution during solidification, solid-state phase transformation and deformation & annealing with recent emphasis on the mechanical and physical properties of crystalline and amorphous light metals.

Lecturer **Dr Judy Hart**

Judy's research interests are in developing new semiconducting materials, particularly solid solutions and doped materials, for use in renewable energy applications such as photocatalysis and solar cells. The focus of this work is understanding relationships between composition and properties and finding effective ways of using computational and experimental techniques in parallel.

Senior Lecturer **Dr Kevin Laws**

Kevin's research interests are concerned with the design, development and fundamentals of new or advanced metal alloys; specifically amorphous alloys (bulk metallic glasses) and single-phase high entropy alloys. This is closely tied with the design and development of new alloy production technologies and applications for these materials.

Dean of Engineering **Professor Mark Hoffman**

Mark's research expertise is in the area of structural integrity of materials, specifically the design of materials for high reliability in complex environments through a combination of computational modelling and investigation using an extensive mechanical property research laboratory at UNSW. His research covers fracture mechanics, fatigue and wear and tribology from macro- to nano-scale.

Professor Sean Li

Sean's research interests mainly focus on advanced multifunctional materials including 2D electron gases of complex hetero-structured oxides, energy materials and other electrical and optical oxide based materials.

Lecturer **Dr Rakesh Joshi**

Rakesh is currently focusing on developing methods to prepare high value carbon materials such as graphene and fullerene from waste materials. He has developed experimental methods to prepare graphene and carbon nanotubes for various applications. His areas of interest include sustainable materials, 2D Materials-graphene and metal chalcogenides, nanomaterials and thin films. Dr Joshi is leading many industrial projects on the application of graphene and graphene supercomposites.

Lecturer **Dr Damia Mawad**

Damia's research interests are in tissue engineering/regenerative medicine. Her contributions in the field focus on development of advanced functional biomaterials with tailored properties. These include flexible bioelectronics with enhanced electronic stability, conjugated nanoparticles for photo-thermal therapy and on-demand drug delivery, and 3D printing of bioactive scaffolds.

Academic Staff

Head of School
Professor Paul Munroe

Paul's research is focused on the characterization of materials using electron microscopy and related methods. This includes publication of a significant body of work focused on ion beam technology. He is also active in a range of areas in characterization of materials such as functional thin films, intermetallic alloys and biochars.

ARC Laureate Fellow **Scientia**
Professor Veena Sahajwalla

Veena's research interests include sustainability of materials and processes with emphasis on environmental benefits. She has a deep knowledge of industrial processes. Veena invented an environmentally friendly process for recycling plastics and rubber into electric arc furnace steelmaking. As Director of SMaRT she provides leadership in research programs on sustainable materials.

Emeritus Professor
Oleg Ostrovski

Oleg's major contributions are in the field of pyrometallurgical technologies for minerals processing, iron-, steel- and ferroalloy-making. Areas of research include thermodynamics, kinetics and mechanisms of metallurgical reactions, properties of molten metals and slags, reduction, smelting and refining processes, and environmental issues in pyrometallurgy.

Associate Professor
Jan Seidel

Jan's research interests are in the area of advanced electronic, photonic and spintronic materials, including scanning probe microscopy, nanotechnology enhanced photovoltaics, electrochromism, nanoscale phase separation, nano-optics, spectroscopy, plasmonics, x-ray based synchrotron techniques and high-resolution transmission electron microscopy.

Lecturer **Dr Sophie Primig**

Sophie's research interests are in advanced property-structure relationships in structural metallic materials such as advanced steels, nickel-based alloys and refractory metals. She combines state-of-the-art experimental techniques such as electron microscopy, atom probe tomography and thermal analysis with mechanical testing and contemporary modeling approaches. Her research philosophy is to achieve a balance between fundamental discovery and industrial application.

Professor Chris Sorrell

The main focus of Chris' research has been the processing of ceramics, including fabricaiton, forming and densification of bulk materials, thick films and thin films. Main research areas include phase equilibria, crystal growth, high-temperature superconductivity, bioceramics, microwave heating of ceramics, gas sensors and fuel cells and photocatalytic titania.

Associate Professor Runyu Yang

Runyu is focussed in the field of particle/ powder science and technology. His primary research interests lie in particle technology, aiming to understand the behavior of particles through rigorous modelling and simulation at microscopic and macroscopic levels. This knowledge is then applied to solving problems in various industrial applications.

Deputy Head of School Senior Lecturer **Dr Owen Standard**

Owen's research is in the processing/ microstructure/ property relationship of advanced ceramics for functional applications including colloidal processing of electroceramics, compositional and microstructural modification of bioactive and bionert ceramics, sol-gel deposition of functional ceramic coatings, development of sol-gel coatings on textile fibres and ceramic coatings on biomedical alloys.

ARC QEII Fellow & Senior Lecturer **Dr Jiabao Yi**

Jiabao's most significant contributions are in the field of diluted magnetic semiconductors, based on oxide semiconductors, magnetic materials, nonstructural, oxide electronics and spintronics materials.

Professor Nagarajan Valanoor

Nagy's most significant contribution is in the field of thin film epitaxy functional property relationships for ferroelectrics, dielectrics and multiferroic nano-materials. Research includes thin-film oxide epitaxy, scanned probe microscopy of functional materials and Landau-Ginzberg modelling of phase transitions.

Emeritus Professor David Young

David's most significant contributions are in the field of high temperature alloy-gas interactions. Particular emphasis is placed on the diffusion and phase transformation processes which support these reactions. Current work includes fundamental studies of corrosion by CO_2, metal dusting reactions and water vapour effects on oxidation.

Lecturer **Dr Danyang Wang**

Danyang's most significant contribution is in the field of growth and characterization of functional oxide thin films for ferroelectric, piezoelectric, electro-optic and dielectric applications. Areas of research include thin film technology and physics, functional materials and devices, micro/nanofabrication techniques, structural analysis and x-ray physics.

Associate Professor Jianqiang Zhang

Jianqiang's research is focused in the field of gas-solid reactions at high temperature, including high temperature corrosion and processing metallurgy. Research emphasis is on reaction thermodynamics and kinetics, phase transformation and characterisation, reaction mechanism understanding, sustainable materials processing and new materials development.

More detailed information about our Academic Staff can be found on the School website: www.materials.unsw.edu.au

School Committees

School Advisory Committee

Paul Munroe *(Chair)*
Owen Standard
Dewei Chu
Pramod Koshy
Laura McNally
Lucy Zhang

Research Committee

Nagy Valanoor *(Chair)*
Paul Munroe
Veena Sahajwalla
Sean Li

Teaching and Learning Committee

Sammy Lap Ip Chan *(Chair)*
Alan Crosky
Owen Standard
Danyang Wang
Judy Hart
Paul Munroe

OHS Committee

Owen Standard *(Chair)*
Anthony Zhang
Paul Munroe
Rakesh Joshi
Rahmat Kartono
Anne Aylmer
Scott Gleason (Student Rep)

Equity and Diversity Committee

Paul Munroe *(Chair)*
Damia Mawad
Owen Standard
Joanne Hallis
Lucy Zhang
Gita Naidu *(UG Rep)*
Carina Ledermüeller *(PG Rep)*

Marketing and Recruitment Committee

(Operational)
Paul Munroe *(Chair)*
Juanita Vargas
Lucy Zhang
Joanne Hallis
(Strategic)
Chris Sorrell *(Chair)*
John Daniels
Juanita Vargas
Alan Crosky

Space Committee

Michael Ferry *(Chair)*
Lucy Zhang
Anthony Zhang

School Scholarship Committee

Veena Sahajwalla *(Chair)*
Owen Standard

School Co-op Scholarship Representative

Owen Standard

Postgraduate Coordinators

John Daniels

Sophie Primig

Undergraduate Program Coordinator

Owen Standard

Honours Projects Coordinator

Jianqiang Zhang

Master by Coursework Coordinator

Runyu Yang

Misconduct and Grievance Officer

Owen Standard

PGSOC Staff Representative

Jan Seidel

MATSOC Staff Representative

Jiabao Yi

Faculty Undergraduate Assessment

Owen Standard

Sammy Lap Ip Chan

Nanotechnology Degree Coordinator

Danyang Wang

Overseas Degree Programs / Asia Engagement

Danyang Wang

Women in MS&E

Judy Hart

Faculty Standing Committee

Jan Seidel

Seminars

Claudio Cazorla

John Daniels

School Staff

School Administration

Head of School	Paul Munroe
Deputy Head of School	Owen Standard
School Manager	Lucy Zhang
Projects Coordinator / Executive Assistant to Head of School	Joanne Hallis
Undergraduate and Postgraduate Student Advisor	Laura McNally
Outreach and Student Liaison Officer	Juanita Vargas
Administrative Officers	Anne Aylmer Alan Chow Qing Xia
Manager, Operations and Business Strategy, SMaRT	Uttra Benton
Research and Administrative Assistant, SMaRT	Nahid Sultana

Technical Staff

Technical Officer	Soo Woon Chong
Research Assistant	Vaibhav Gaikwad
ITC Support Officer	Jane Gao
Research Support Engineer	William (Bill) Joe
Technical Officer	Rahmat Kartono
ITC Support Officer	Danny Kim
Research Assistant	Irshad Mansuri
Technical Officer	David Miskovic
Research Assistant	John Sharp
Technical Officer	George Yang
Safety Officer	Anthony Zhang

Research Staff

Research Associate	Esmaeil Adabifiroozjaei
Postdoctoral Fellow	Joseph Arsecularatne
Research Associate	Wen Fan Chen
Research Associate	Rifat Farzana
Research Associate	Nicholas Hamilton
Senior Research Associate	Pramod Koshy
Research Associate	Nitish Kumar
Postdoctoral Fellow	Hamid Lashgari
Research Associate	Qianru Lin
Research Associate	Reza Mahjoub
Research Associate	Samane Maroufi
Research Associate	Suk Chun Moon
Postdoctoral Fellow	Ali Negahi Shirazi
Postdoctoral Fellow	Thuan Dinh Nguyen
Senior Research Associate	Farshid Pahlevani
Research Associate	Anh Pham
Research Associate	Ravindra Rajarao
Postdoctoral Fellow	Daniel Sando
Research Associate	Pankaj Sharma
Senior Research Scientist	Thiam Teck Tan
DECRA Fellow	Chunguang Tang
Postdoctoral Fellow	Xing Xing
Lecturer	Wanqiang (Martin) Xu
Postdoctoral Fellow	Jun Yang
Research Associate	Jiao Jiao Yi
Postdoctoral Fellow	Adnan Younis
Senior Research Fellow	Rong Zeng
Postdoctoral Fellow/Technical Officer	Qi (Peggy) Zhang

Industry Advisory Board

Name	Organisation
Mr Roger Leigh (Chair)	*Cochlear Limited*
Mr Adam Berkovich	*Pacific Aluminium*
Professor Lyndon Edwards	*ANSTO*
Dr Catherine Foley	*CSIRO*
Mr Michiel Freislich	*HATCH*
Mr Michael Gow	*PGH Bricks & Pavers*
Dr Edward Humphries	*Weir Minerals*
Mrs Cathy Inglis	*Brickworks*
UNSW Adjunct Professor Dr George Melhem	*Perfect Engineering Pty Ltd*
Dr David Nolan	*Bluescope Research*
Mr Andrew Petersen	*Sustainable Business Australia*
Professor Emma Johnston	*Dean of Science, UNSW Australia*
Professor Paul Munroe	*School of Materials Science and Engineering, UNSW Australia*
Dr Owen Standard	*School of Materials Science and Engineering, UNSW Australia*
Ms Lucy Zhang	*School of Materials Science and Engineering, UNSW Australia*

Staff Awards & Achievements

Vice-Chancellor's Award for Teaching Excellence

Dr Judy Hart was recognised for her outstanding teaching by being awarded the "Vice-Chancellor's Award for Teaching Excellence" in the "Contributions to Student Learning" category. This is an outstanding and much deserved award for Judy. She is an excellent and highly dedicated teacher.

The "Vice-Chancellor's Awards for Teaching Excellence" is regarded as the top award for teaching and learning in the university and rightly places Judy as one of the most outstanding teachers at UNSW. She joins a group of six other staff members (including multiple awardees) in the School who have received this award (including three in the past three years). This is clear evidence of the very high quality of teaching delivered by the School.

MSE family news

In July, **Dr Kevin Laws** and his wife, **Leah Koladin**, were delighted to welcome their first child, Riley Colin Laws.

We also welcomed our Marketing and Outreach Officer, **Juanita Vargas**, back to the fold after her time away on maternity leave with baby Ollie.

Dr Rakesh Joshi received the "JSPS invitation Fellowship for Research to Japan" for the purpose of conducting research with the Toyota Motor Corporation. The program enables Japanese researchers to invite their overseas colleagues to participate in cooperative research.

Dr Kevin Laws received the Australia-Korea Foundation Grant to perform collaborative research with Seoul National University. The Australia-Korea Foundation (AKF) was established by the Australian Government in 1992 to promote bilateral relations between Korea and Australia.

Professional Engineer of the Year

Professor Veena Sahajwalla received the Engineers Australia "Professional Engineer of the Year" award for her pioneering work in transforming e-waste and titania.

This is the highest individual award bestowed by Engineers Australia and gives appropriate and well deserved recognition to Veena's leadership and innovation in this area.

Nobel Laureate

Dr Adnan Younis was one of 380 young scientists (including 8 Australians) invited to attend the 66th Lindau Nobel Laureate meeting, held in Germany in June 2016. The 2016 meeting was based on the principle of dialogue, fostering the exchange of knowledge, ideas and experience between Nobel Laureates and young scientists – a truly extraordinary experience.

A/Prof. Sammy Chan and **A/Prof. John Daniels** were awarded funding through the "New Colombo Plan" to support travel by our undergraduates to Taiwan and China. John was also granted funding for undergraduates to travel to North Carolina State University.

Dr Yusef (Valentino) Kaneti was awarded the Japanese Society for the Promotion of Science (JSPS) Postdoctoral Fellowship and left the School in late 2016 to take up his position at the National Institute for Materials Science at Tsukuba, Japan.

Professor Sean Li was honoured with the Knowledge Commercialisation Australasia (KCA) Research Commercialisation Award for "Best Commercial Deal" for contracts generated with the Hangzhou Cable Company Limited (HCCL).

Sean also received the UNSW Innovation of the Year Award 2016 for his work in graphene enhanced high performance electric power grid transmission lines. The UNSW Innovation Awards celebrate the diversity and value of innovation originating from UNSW staff, alumni and students. It recognises ideas along every stage of the innovation path, from early stages to fully developed products with commercial applications.

Financial Report 2016

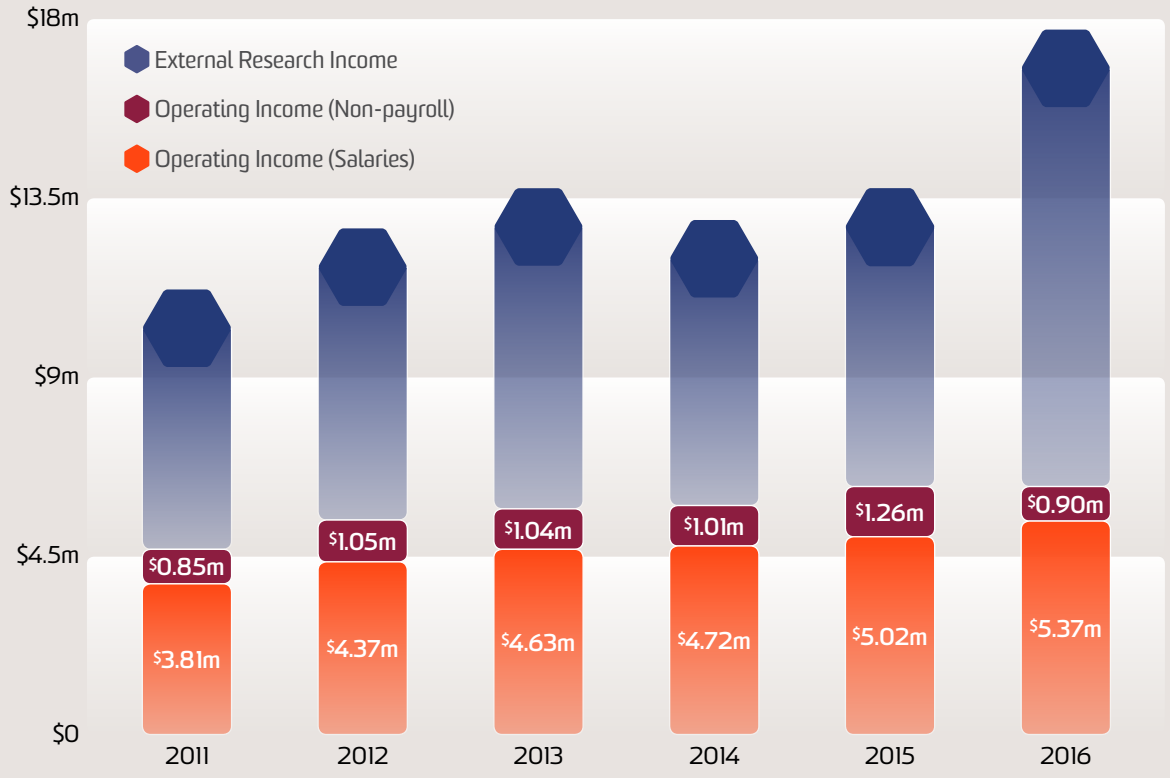
Unlike in previous years, UNSW Central and the Faculty of Science were unable to shield schools from financial pressure points, resulting in a 2% efficiency cut in the non-people budget allocation for 2016. However, our student numbers have increased, with a larger than ever postgraduate coursework student cohort. We had tremendous success in gaining prestigious ARC grants and secured significant overseas industry funding, led by Professor Sean Li - our school has become the leading Torch Innovation Precinct at UNSW. 2016 was a year that saw Materials Science and Engineering at UNSW continue to shine and consolidate.

Income

The School receives its income from three primary sources:

Operating income is allocations from the University, via the Faculty, to fund the day to day running of the School. For the 2016 financial year, budget allocations have been made using our current budget allocation principles. It is heavily based on student load from local and international undergraduates, postgraduate course work and higher degree research students.

Research income is derived from research grants obtained from bodies outside the university and Strategic allocations made by the University to the School for specific purposes. The graph below shows trends in the School's operating and research income.



Operating Income

Operating income is primarily allocated to salaries for teaching and research academics, technical and professional staff. Even though a number of the School's academic staff hold externally-funded research fellowships, there is invariably a shortfall in these fellowships which the School covers from its operating budget allocation, deriving a specific, though capped, allocation from the University for this purpose.

This income is also used to pay for casual teaching, administrative and technical staff. Other major expenditure items are support of teaching laboratories, administration, marketing and undergraduate recruitment scholarships, allocations to staff based upon research supervision and publications.

The table below shows the breakdown of School operating income. 2016 was a year of consolidation with great success. We secured seven ARC Discovery Projects, one Future Fellowship and partnered with other universities on several LIEF grants. We also saw many newer/junior academic staff starting to attract industry grants. Three of our staff were successful in securing Australian Coal Industry (ACARP) funding.

Income		
University:		
Teaching	$8,153,566	
Other	$13,910	$8,167,476
Allocation to School:		
Teaching and Research	$6,273,437	
Fellowship salary shortfalls	$91,741	
Capital equipment funding	$107,340	$6,380,777
Expenditure		
Salaries	$5,184,606	
Non-salary	$924,729	
Capital expenses	$194,095	$6,041,687

Apart from funding some essential replacement laboratory equipment, the School's Advisory Committee assessed applications for small equipment grants. The following bids were successful:

Equipment	Lead Applicants	Host Lab	Allocation
Precision diamond wire saw to support functional materials research - STX-202A	John Daniels Jan Seidel	310 Materials Preparation Lab	$10,000
Vacuum impregnation unit for cold mounting - CitoVac	Veena Sahajwalla Pramod Koshy Oleg Ostrovski Sammy Chan Irshad Mansuri	110 Metallography Lab	$5,000
Temperature stage for scanning probe laboratory	Jan Seidel Judy Hart Claudio Cazorla Pankaj Sharma Rakesh Joshi	B27 SPM Lab	$16,000
Hot Mounting Press - CitoPress-20	Sophie Primig Kevin Laws Alan Crosky Jianqiang Zhang George Yang	110 Metallography Lab	$16,000
Fully automatic sample cleaning unit - Lavamin	Alan Crosky Chris Sorrell Michael Ferry Owen Standard Sophie Primig	107 Metallography Lab	$5,000
Pumps for pulsed laser deposition system	Nagy Valanoor Daniel Sando	B23	$8,000
SA-9601 MP BET Surface area analyzer	Sean Li Dewei Chu Damia Mawad Chris Sorrell	Lab 308	$20,000

Financial Report 2016

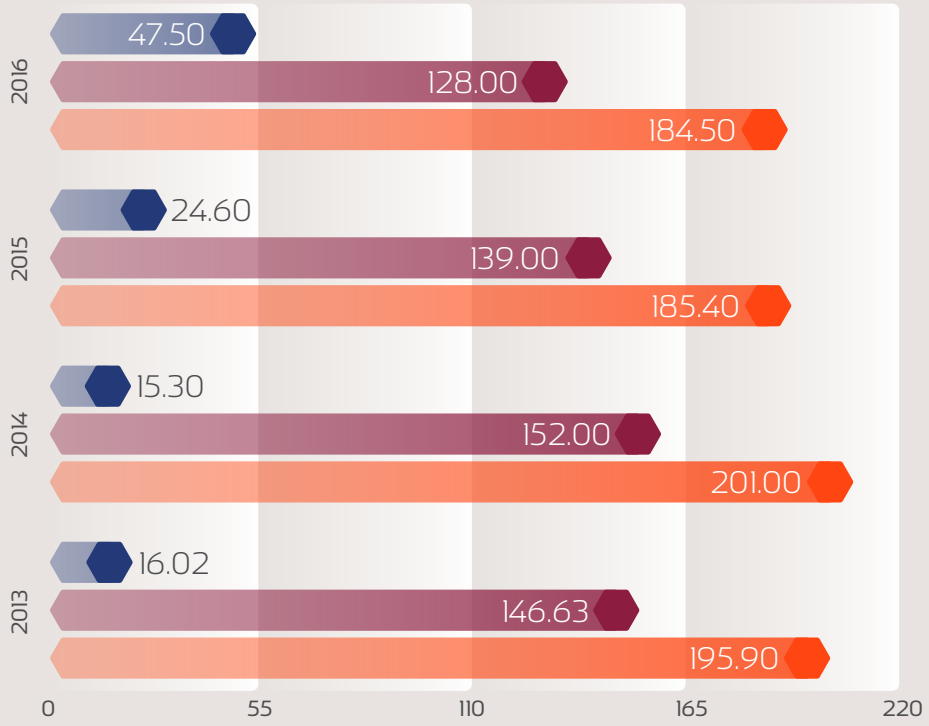
Operating Income *(continued)*

The primary driver for operating income at the School level is undergraduate and postgraduate teaching load.

The graph right shows the strong growth which the School has enjoyed in these areas in recent years especially the number of Undergraduate and Coursework Postgraduate students.

Key:

- Coursework Postgraduate
- Research Postgraduate
- Undergraduate



UNSW Strategic Funding

The University provides central funding for a range of strategic research purposes including infrastructure, support of national initiatives and projects for early career researchers. There are also strategic funds based on higher degree research student completions, quality authorships and grant income over the previous 3 years.

In 2016, these included:

Project Name	Project Manager	Amount ($)
Powder diffraction	John Daniels	13,074
Research support	Mark Hoffman	141,165
Research support	Sean Li	118,272
SPF03 strategic hire	Judy Hart	72,796
SPF3 strategic hire	Rakesh Joshi	151,082
Bridging support	Jiabao Yi	63,343
Early career research grant	Sophie Primig	10,238
Early career research grant	Adnan Younis	5,731
Early career research grant	Thuan Nguyen	5,731
Urban mining support	Veena Sahajwalla	50,000
Research support micro recycling	Veena Sahajwalla	52,000
Green manufacturing	Veena Sahajwalla	63,000
Laureate postdoc support	Veena Sahajwalla	66,000
Intelligent E-waste	Veena Sahajwalla	56,400
High temp E-waste investigations	Veena Sahajwalla	410,226
SPF02 Materials	Various	224,600
SPF04 Materials	Various	55,731
Total:		1,559,390

Major Research Equipment and Infrastructure Initiative (MREII) Grants

The University receives a Research Infrastructure Block Grant. With this funding, UNSW initiated the Major Research Equipment and Infrastructure scheme, designed to provide UNSW with a world-class research environment to attract and retain a critical mass of research excellence.

In 2016, the School was awarded the following major items:

Lead Chief Investigator	Project Title	Grant ($)
Sophie Primig	3D Confocal Scanning Microscope	120,000
Damia Mawad	Bioscaffolder-3D Printer	111,872
Rakesh Joshi	Surface Electronics Properties	71,927

Expenditure

The main component of School expenditure is staff salaries which comprised over 80% of total non-capital operating expenditure. This is in line with the majority of schools across the campus. Despite the efficiency cut, we were able to reduce the building maintenance budget now that we have settled into our new state-of-the-art facility. We are able to provide academic staff with continual support for student research and publications as in previous years. The table below shows the School's main expenditure items in 2016.

Item	Amount ($)
Faculty research grants	30,000
Student research allocations	125,000
Undergraduate scholarships	90,000
Publications allocation	100,000
Teaching laboratories	61,210
Safety	10,000
School Office	35,000
Staff start up	145,000
Marketing	35,000
Repair, maintenance & building utilities	80,000
International recruitment	5,000
Undergraduate association support	2,500
Postgraduate association support	7,000

Faculty Research Grants are funds for small research projects which are allocated from the School's operating budget. When allocating these grants, the School preferences junior staff who have not yet had the opportunity to build up significant external research funding.

In 2016, the recipients were:

Chief Investigator	Project Title	Grant ($)
Damia Mawad	Porous conductive cardiac patches with anisotropic properties and photo adhesion capabilities	10,000
Rakesh Joshi	Transforming biomass waste into grapheme oxide membranes	10,000
Judy Hart	Low-cost, highly-efficient materials for photo electrochemical hydrogen production through surface modification	10,000

External Research Income

The School's external research income comprises the largest fraction of the overall income of the School. We had a fantastic outcome in 2016, winning about 1% of the ARC grants nationally along with large amounts from overseas industries. The School experienced a very high performing research year. The income graph on page 16 shows a sharp increased trend in our external research income in 2016.

Marketing & Outreach Activities 2016

Once again our army of volunteer staff and students "oranged-up" to represent and promote our School during Open Day 2016. Our School tent, one of the liveliest and most interactive within Science, attracted a record number of high school visitors and their parents. From 589 survey respondents on the day, 349 (59%) were year 12 students - 137 (23%) of those opted in to join the School's mailing list to receive more information about upcoming scholarship opportunities and events.

Prospective students were able to see over ten demonstrations, try the liquid nitrogen ice cream and, for the first time, put on a Virtual Reality headset and immerse themselves in our 360 degree laboratory experience.

The nine VR videos showcase some of the School's world class laboratory and research spaces, including state-of-the-art instrumentation such as the Molecular Beam Epitaxy:

http://www.materials.unsw.edu.au/future-students/360-degree-lab-experience

The 360-degree Lab Experience videos were also featured during our end-of-year online recruitment campaign. The campaign was launched one month prior to the release of the ATAR results. It included paid Facebook posts, an email campaign and a launching page to generate interest and awareness among the target audience and increase traffic from the Facebook page to the School's website.

In May, the School hosted its first Industry Careers Night with the theme, what happens in the 'real' world? The event gave current students the opportunity to connect with a variety of recent alumni who have graduated within the last few years. The aim of the event was to showcase the variety of career options that are available to UNSW Materials Science and Engineering graduates and the pathways that alumni have taken to get to the position that they are in today. Over 70 students attended and the panellists faced some fantastic questions that made them think on their feet.

The School was successful in securing several grants to assist in student mobility experiences. The Australian Government's Endeavour Mobility Grants and New Colombo Plan programs allow our undergraduate students to experience short term research exchange with leading institutions and companies around the world. In addition to the experience gained, these students promote UNSW Materials to a global audience. In the past year, fifteen students have undertaking these mobility options, including seven in Taiwan, three at Tsinghua University, China, and five at North Carolina State University, USA. Read more about the students' experiences on page 38.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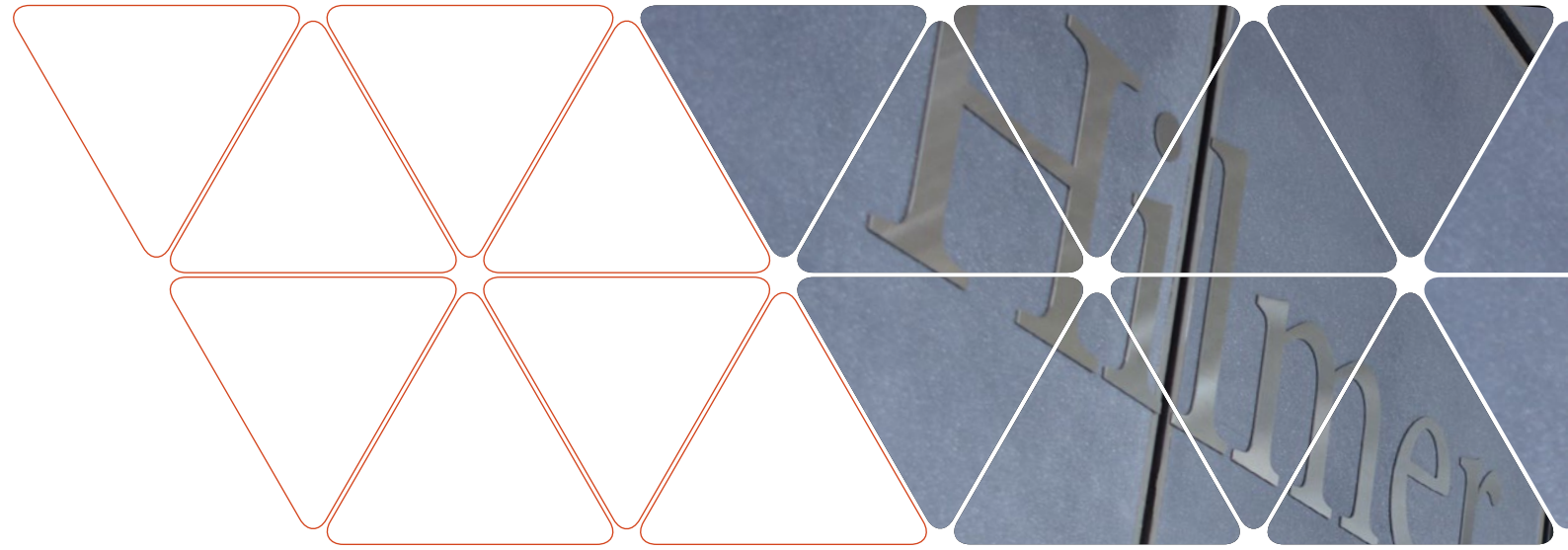


The Hilmer Building

On Wednesday 20 July 2016, the School's new state-of-the-art home was formally opened by then NSW Premier Mike Baird.

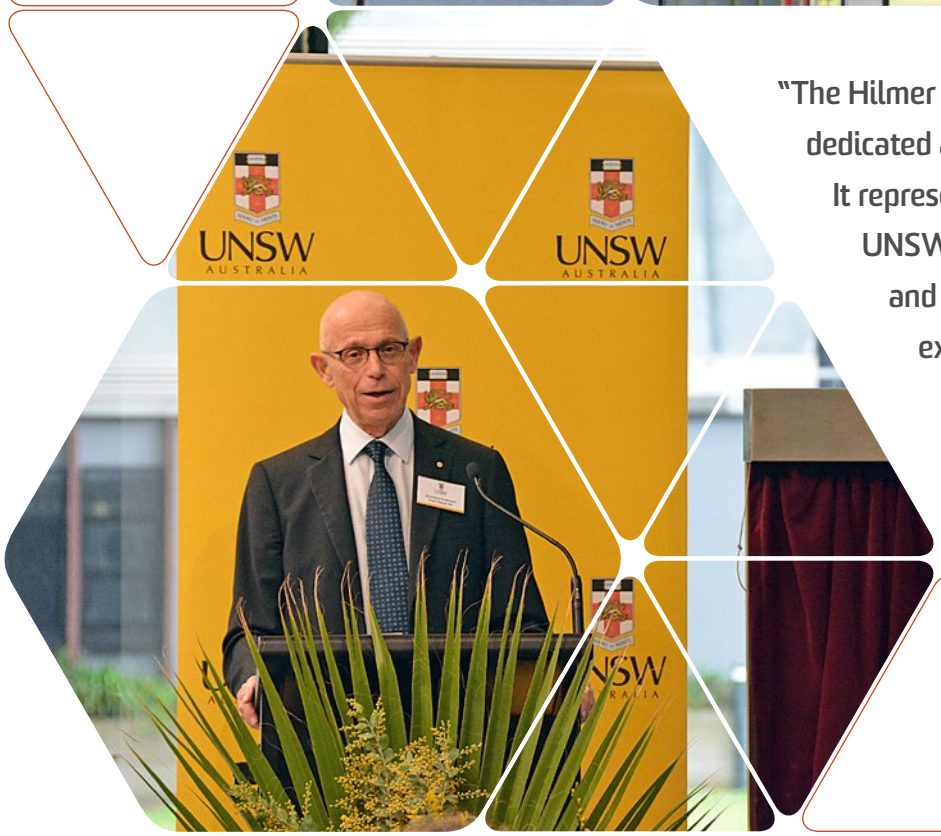
The new building will be known as the Hilmer Building in honour of former President and Vice Chancellor Professor Frederick Hilmer (2006-2015).

UNSW Chancellor David Gonski said: "Fred Hilmer was instrumental in the transformation of our campus and this naming honour recognises his outstanding service and dedication to UNSW. This world-class facility is a striking addition to UNSW and is already opening up new opportunities for staff and students. It is a fitting tribute to our esteemed former President and Vice-Chancellor."

Emeritus Professor Hilmer said: "While I am honoured to have my name on such a significant building, this event is really recognition of the efforts of a committed and effective team that restored and enhanced the performance and reputation of UNSW".

Along with Materials Science and Engineering, the Hilmer Building is now home to a range of world class research teams, including:

- The Centre for Sustainable Materials Research and Technology (SMaRT Centre), led by ARC Laureate Fellow, Scientia Professor Veena Sahajwalla
- The Mark Wainwright Analytical Centre occupies several custom-built laboratories allowing staff, students, industry partners and external researchers to collaborate on the study of the structure of chemical and physical materials
- A number of large, collaborative research projects with Chinese industry partners under the Torch program, led by Professor Sean Li and his team (see page 48 for more on the ground-breaking Torch program)
- The Michael Crouch Innovation Centre – a dynamic "makers and innovators space" bringing together students, staff and alumni along with industry partners and the wider community, to collaborate, innovate and create.



"The Hilmer building is ... truly a dream for our dedicated and ambitious researchers and students. It represents what we are trying to achieve at UNSW. It is bold, it encourages innovation and collaboration and it has a clear focus on excellence, creativity and the pursuit of new ideas."

Current President & Vice Chancellor
Ian Jacobs

Women in Materials

Dr Judy Hart,
Coordinator

In 2016, the activities of the "Women in Materials" group, which was established in 2014, continued.

In May, a group of students got together for a lively discussion about the issues that contribute to under-representation of women and a broader lack of diversity in science and engineering, based on a recent National Press Club address on "Women of Science".

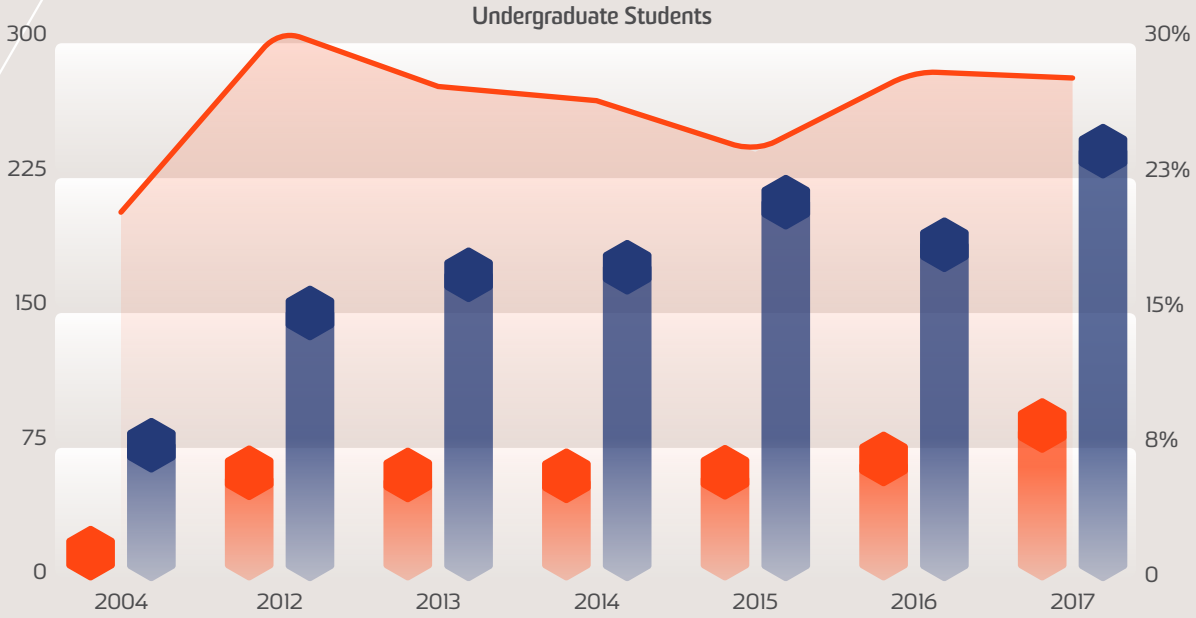
In a new venture in October, an event was held jointly with the UNSW Faculty of Engineering and Professionals Australia. Students participated in a Career Skills Workshop about the challenges and opportunities presented by the modern engineering workplace, particularly the unique challenges for women in STEM (science, technology, engineering and mathematics) industries. Students completed activities to develop important career skills such as resilience.

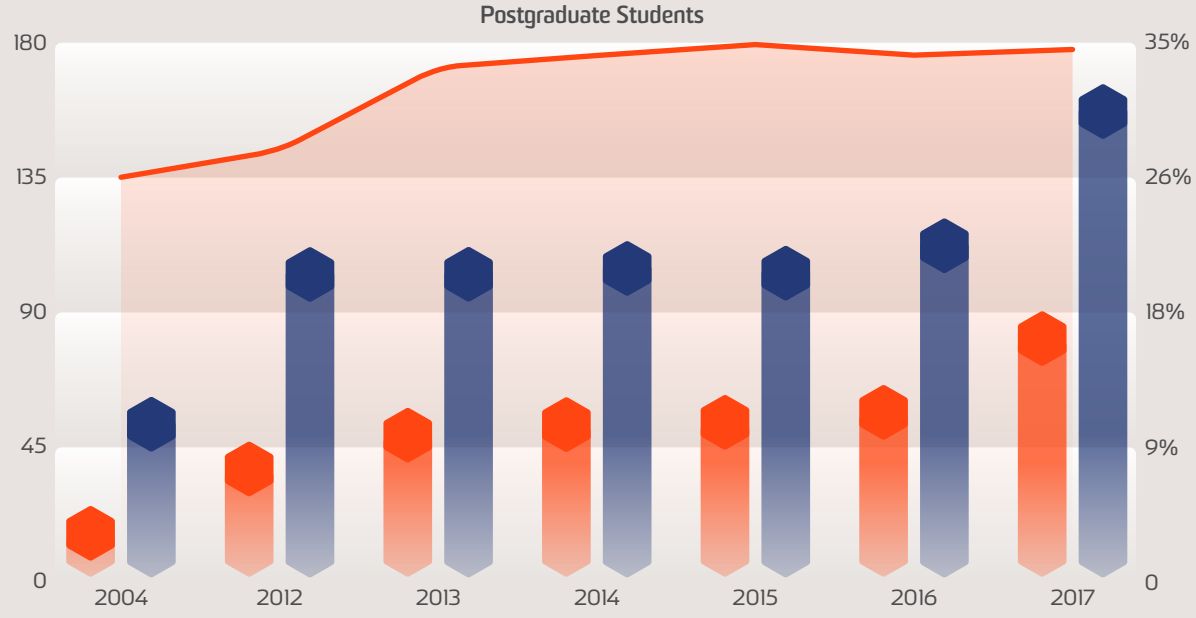
Both events were open to both male and female students, with a focus on discussing the role that everyone can play in increasing diversity in the science and engineering professions.

The proportion of female students in the School of Materials Science and Engineering has been maintained at around 30% for several years while the total student numbers have increased.

There is a slightly higher proportion of women at postgraduate than undergraduate level.


Simulations of Self-Assembly of Amphiphilic DNA Materials
UNSW
Mia Maric, Jessica Nash, Yaroslava G. Yingling
CHARPY
TOYOSEIKI


Undergraduate Students
300
225
150
75
0
30%
23%
15%
8%
0
2004
2012
2013
2014
2015
2016
2017
Key:
Women
Men
% Women


Postgraduate Students
180
135
90
45
0
35%
26%
18%
9%
0
2004
2012
2013
2014
2015
2016
2017

Work Health & Safety (WHS)

Dr Owen Standard
WHS Chairperson

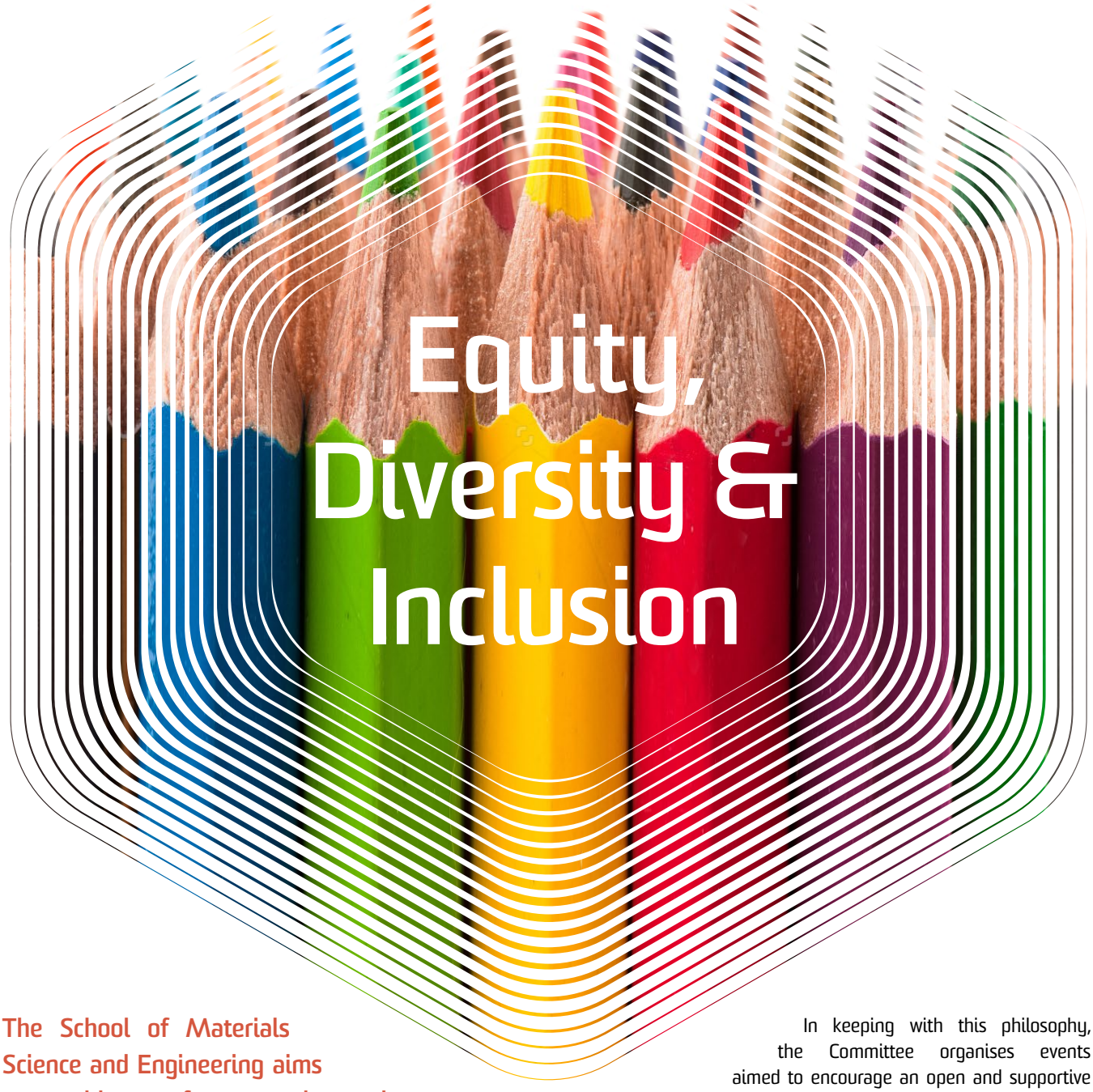
The School of Materials Science and Engineering is committed to providing a safe work environment for all staff, students and visitors in compliance with Work Health and Safety Act 2011 and as implemented through the UNSW Work Health and Safety Policy.

The members of the School WHS Committee in 2016 were Owen Standard (chairperson and academic representative), Anthony Zhang (School Safety Officer), Rahmat Kartono (technical staff representative), Shane Smith (administrative staff representative), Rakesh Joshi (academic staff representative), Scott Gleason (student representative) and Paul Munroe (management representative). Shane left the Committee and the School in October 2016 and the School gratefully acknowledges his contribution to the Committee. Shane was replaced on the Committee by Anne Aylmer. The Committee met quarterly to discuss, monitor and implement WHS policy and procedures, to investigate hazards and incidents and to consult with staff and students.

All staff and students in the School are thanked for their ongoing cooperation and compliance with WHS requirements and procedures.

WHS activities in the School during 2016 included:

- Completion of the university WHS self-audit tool for which the school received a compliance rating of 95%;
- Completion of laboratory safety inspections quarterly and completion of corrective actions;
- Formal university task force inspections of all school laboratories conducted by the faculty of science health and safety coordinator and WHS staff from other schools;
- Mandatory school WHS information sessions (held in both semesters) for all new research staff, new postgraduate students and honours students.
- Refresher staff safety training courses including first aid training, warden training, hazardous substance training and forklift training;
- Various laboratory training courses including hydrogen fluoride training, safesys training, gas and cryogenics handling and safety (by Supagas Australia) and spill response training (by Argyle Commercial);
- Implementation in all laboratories of the new globally harmonized system (GHS) of classification and labelling of chemicals and samples;
- Electrical tagging and testing of all single-phase equipment and appliances in the school;
- Implementation of new UNSW engagement and documentation process for engagement of external contractors;
- Attendance by laboratory managers of the Sydney safety in action 2016;
- Purchase of new manual handling equipment for laboratories;
- Completion of annual emergency evacuation drill for the entire building; and
- Participation of school staff in the Global Corporate Challenge, a workplace health and engagement program designed to improve the health and performance of employees.



Equity, Diversity & Inclusion

The School of Materials Science and Engineering aims to provide a safe, supportive and welcoming environment for all students regardless of their race, sex, age, religion, disability, sexual orientation or gender identification.

As such, the School strongly supports ***UNSW's Equity and Diversity Policy*** in regard to these matters.

The School has established an Equity and Diversity Committee to oversee these issues and to ensure that we provide a comfortable and safe educational environment for all. The Committee consists of 5 staff members along with representatives from our postgrad and undergrad societies.

In keeping with this philosophy, the Committee organises events aimed to encourage an open and supportive environment for all our staff and students. In 2016 we began with "R U Ok?" day, which was attended by over 150 staff and students, both undergrad and postgrad. Two members of Headspace Bondi gave a presentation about the importance of asking the questions that could save a life. We then met Aaron, an inspiring young man who talked from the heart about anxiety and depression and his own ongoing journey. It was pleasing to see staff and students mingling afterwards and talking about what they had learned. Several students emailed the Head of School to thank him, some mentioning that it had touched a chord and given them the courage to start a conversation with someone they felt was at risk or, in some cases, seek help themselves.

Early in 2017 we held a very successful Harmony Day lunch and plans are underway for our next event.

www.gs.unsw.edu.au/policy/documents/equitystatement.pdf

Student Awards & Achievements

In our Graduating Class of 2016, the following prizes were awarded:

- The prestigious Hugh Muir Prize for the student, who, in the opinion of the Head of School, has contributed most to the corporate life of the School of Materials Science and Engineering was awarded to Gustad Irani. Gustad also earned the Perfect Engineering prize for the best final year project in Process Metallurgy
- The three other Perfect Engineering prizes for the best final year project went to Scarlet Kong (Ceramics), Adam Coorey (Physical Metallurgy) and Lin Jiang (Materials Engineering).

- The Wallarah Minerals Prize for best performance in an honours thesis in the BE Ceramic Engineering program was awarded to Sarah Pearn.
- The Max Hatherly Prize for the best performance in MATS4001 Secondary Processing of Metals was awarded to Richard Chen.

- Jonathan Hopkins (5) had a stellar year. He was awarded the Cochlear Prize for the highest overall WAM at the end of Year 3, the Pacific Aluminium prize for the best performance in MATS3007 Materials Industry Management and the Sir Rupert Myers Prize for the best performance in MATS3001 Micromechanisms of Mechanical Behaviors of Metals.
- The Australasian Corrosion Association Prize for the best performance in MATS4007 Engineered Surfaces to Resist Corrosion and Wear was awarded to Oscar Dunn.
- And finally, Catherine Isaac (6) was awarded the University Medal for her studies in Materials Science and Engineering (Ceramic Engineering). The University Medal is the most distinguished award that UNSW bestows on an undergraduate student.

Congratulations to these students and to the entire graduating class of 2016.

We wish them all great success in the future.

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4

Other Student Achievements

In addition to these prizes, throughout 2016 several of our undergraduate and postgraduate students were recognised for their achievements:

Postgraduate student, **Amanda Wang (4)**, who is supervised by Professor Paul Munroe, was awarded Best Student Presentation at the 2016 International Thermal Spray Conference in Shanghai for her work on 3D reconstructions of thermally sprayed Ni coatings. Then, during the trip to America which resulted from her Shanghai prize, Amanda won the Oerlikon Metco Young Professionals Award for her presentation "Three Dimensional Reconstruction of Plasma Sprayed Ni-20Cr on Alumina".

Ralph Bulanadi (2), who is currently studying a Bachelor of MSE / Master of Biomedical Engineering, was part of the winning team at the 2016 BIOMOD championships held at Harvard University, taking first prize in all three categories – website, video and presentation. "Team Tiny Trap" pioneered a novel method for reliably capturing DNA origami vessels with unbound cargo. See page 36 for more about this fascinating concept.

(3) Siddharth Doshi, a fifth year MATS/BioMed student, was named in the Australian Financial Review Top 100 Future Leaders. Sid was also granted an internship with the Harvard Stem Cell Institute Internship Program, commencing in June 2016.

Fred Marlton, a postgraduate student supervised by A/Prof. John Daniels, was elected to the President's Council of Student Advisors for the American Ceramic Society. PCSA delegates represent their universities as student leaders in the ACerS ceramic and glass community.

Postgraduate student **Patrick Tung (1)**, also supervised by A/Prof. John Daniels, won the Faculty of Science 1-Minute Thesis Competition, with his compelling presentation about efforts to understand the imperfect atom structures of lead-free piezoelectrics. He then went on to represent the Faculty at the UNSW 3-Minute Thesis Competition and again took out first prize. With the variety of topical subject matter on offer, it is a rare feat for a materials science and engineering student to beat out the competition. He went on to represent the University at the national competition held at the University of Queensland.

The Hult Prize

In December 2016, **Andrew Ham** (in his final year of a B MSE / M BioMed), along with 5th year medical student Andrew Fong and 4th year BioMed/ChemEng student Benjamin Dalby, took out 3rd Prize in the Hult Prize Competition at UNSW for their innovative design of a smaller epinephrine autoinjector called the "MiniEpi".

The Hult Prize is the largest and most prestigious social entrepreneurship competition in the world, launched through the Bill Clinton Foundation and the Hult International Business School in Boston. The Hult Prize in 2016/17 invited student teams to develop sustainable, scalable social enterprises which restore the rights and dignity of refugees around the world – the team competed with almost 100 students from UNSW in this challenge.

After undergoing an incubation program and further applications, the team was honoured to be selected from a record breaking pool of over 50,000+ applications, received from over 100 countries, to pitch their solution at the Hult Prize regional finals in Dubai in March 2017. While unsuccessful in obtaining one of the top three prizes, they were commended by the judges as one of the better teams among some very stiff competition.

MATSOC 2016 Report

In 2016 the executive team of MATSOC had a goal to hold a broader range of events and dramatically raise our attendance rates.

We had a strong start to the year with MATSOC's first Liquid Nitrogen Ice Cream Day at O-Week. We collaborated with Shane Smith, the School's Outreach & Recruitment Officer, to define a new tradition; introducing first year students to Materials Science through the deliciousness of ice cream.

Several BBQ's and one incredible first year camp later it came time for MATSOC to collaborate with CEUS to recreate our annual Cruise. With an enormous effort from our executive team we sold more than three times as many tickets as the previous records, with over 300 tickets sold. The Cruiser was massive, the food was delicious and everyone, especially our MATSOC members, loved the mid semester break. Our Cruise proved to be a turning point in MATSOC and CEUS history, setting a new standard for future events.

In 2016 our brilliant executive team co-organised the first ever MATSOC/PGSOC Trivia Night. The night was full of laughs and odd challenges, with Materials Science postgrads and staff joining in our antics. Our other successes include a record attendance for CEUS/MATSOC Ball, an adventure filled Board Games Night, and our first Industry Night held in conjunction with the School.

Personally, the proudest moment I had in 2016 was hearing that our Head of School recognised our successes and wanted to increase the School's annual financial contribution for MATSOC.

This contribution and the dedicated MATSOC executives who are now in the 2017 team will play a huge role in redefining MATSOC in future years and ultimately allow Mat Sci students to enjoy their time at UNSW while developing as industry ready professionals. Thank you Paul for investing in MATSOC and thank you to the talented students who volunteered their time to be part of MATSOC's executive team in 2016.

Gustad Irani
2016 MATSOC President


MATSOC


MATSOC

PGSOC Report

In 2016, the Materials Science and Engineering Postgraduate Society (MSE PGSOC) continued to provide support to our large postgraduate cohort through social, networking and academic events.

Peer mentoring

The peer mentoring scheme continued in 2016 as our PGSOC team helped the new set of postgraduates settle into life at UNSW. On top of this, once again the student guides and free USBs were handed out during the official welcome by the Head of School.

Little Social Events: Welcome Back BBQ & Movie Nights

Our BBQ in February on the Alumni Lawn was an excellent way to bring in the new academic year, with everyone heading back to the office with full bellies, (and some having sweated a little during our staff/student soccer match). We also held two movies nights, one in July and one in November. The screenings were very popular, and included free pizza, soft drinks and an awful lot of popcorn!

Baking competition

The annual baking competition was a roaring success, with money raised in aid of the Black Dog Institute. This year's theme was "Around the World" and the competition was very tight, with 18 participants.

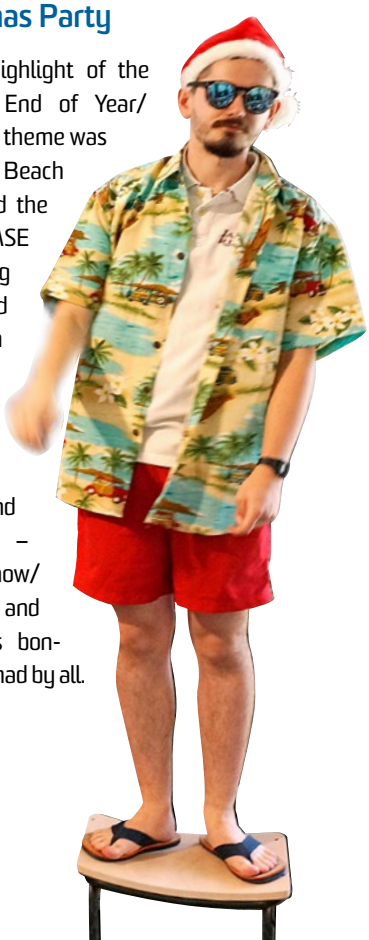
Big congratulations to our winner, Khushalini Ulman (Indian Short Bread buiscuits pictured right), and thank you to everyone for taking part and baking some delicious treats!

Joint trivia night w/ MATSOC

In September, we teamed up with the school staff and our undergraduate friends in MATSOC to host a trivia night in the nearby Doncaster Hotel. With mic in hand, our friendly Quizmaster Kev threw question after question at our combined teams of staff, postgrads and undergrads. The night involved a great helping of food, beers and bonus games, but was not without controversial questions and answers! Overall, a lot of fun was had by all the teams, and we hope to make this an annual event in order to strengthen the ties between ourselves and the undergraduate students in the school.

End of Year/Christmas Party

In December came the highlight of the PGSOC calendar – our End of Year/Christmas party. This year's theme was Winter Wonderland Vs. Beach Party, and we transformed the level 1 breakout space in MSE appropriately. The incoming PGSOC executives thanked the outgoing team with small gifts during the banquet. Alongside the mountains of food and drink, we brought back our giant garden games and invented one of our own – Where's Santa?! With our snow/sand mash up photo booth and traditional giant Christmas bon-bon circle, a merry time was had by all.



Poster competition

Poster night is always one of PGSOCs biggest events of the year (and the most academic!). 2016 was no exception, with a record number of high quality entrants. This year, Masters and Honours students also had the chance to show off their work.

The winners on the night were Solmaz Jahangir, Bernd Schulz, Zhao Kevin Liu and Peng Jiang. A special thanks to our judges: Dr Damia Mawad (pictured above), Dr Michael Drew and Associate Professor Clemens Ulrich. It was an enjoyable night of food, drinks and learning.

Friday socials

A staple of the postgraduate diet at MSE, Friday socials continues to provide a regular time and place to get together once a week and unwind with your colleagues and staff, with many themes, games and mini sporting events being held throughout the year.

New PGSOC Committee

Our Annual General Meeting (AGM) was held in October, and our new committee for 2017 was voted in; Stuart Burns (President), Carina Ledermueller (Vice President), Felix Theska (Treasurer), Richard Winkler (Secretary), Scott Gleason (Arc Delegate).

The team is very thankful for the work done by the outgoing executives and the continued support from both the school and the postgrads themselves. Here's to a very successful 2017!

Undergraduate Industrial Training

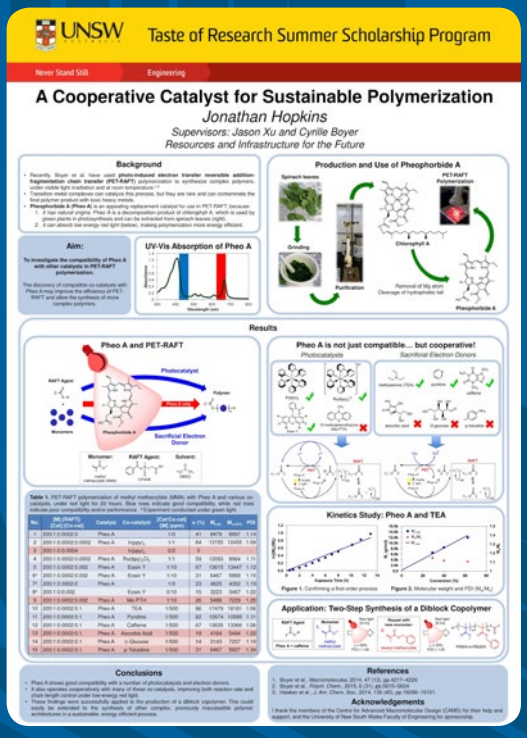
In March, the School held its annual Industrial Training Placement Evening.

Each of our bachelor degree programs contains a requirement for students to complete a minimum of 60 hours industrial training, aimed at preparing them for future employment in their chosen engineering discipline. Industrial training enhances the academic material studied and allows students to practice what they have learned, while developing key professional attributes.

Around 38 undergraduate students presented posters and a brief oral summary outlining their experiences during their industrial training. The quality of the presentations was extremely high and clearly many students found their IT placements to be a very valuable learning experience. We were very pleased to welcome George Melhem and Elie Nakhel from Perfect Engineering as our judges for the evening.

3rd Prize
Nathan Doran

2nd Prize
Jonathan Hopkins



Poster Competition

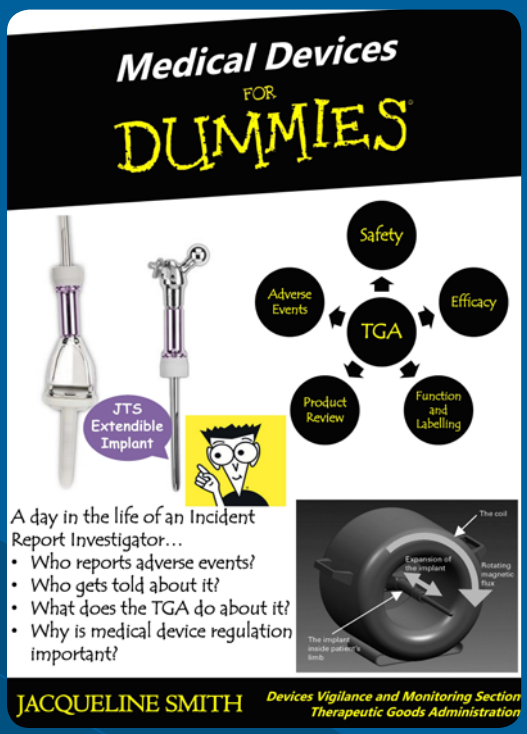
The 2016 winners for the best presentations were:

1st Prize - Jacqueline Smith *Medical Devices for Dummies*

2nd Prize - Jonathan Hopkins *A Cooperative Catalyst for Sustainable Polymerization*

3rd Prize - Nathan Doran *Modelling Knee Instability and Injury Mechanisms in C57BL/6 Mice*

We congratulate Jacqueline, Jonathan and Nathan for their outstanding and, importantly, highly reflective presentations.



Jacqueline shared her thoughts on the industrial training experience:

This summer I worked for the Incident Reporting and Investigation Scheme of the Therapeutic Goods Administration (TGA) in Canberra. This team investigates when something goes wrong with a medical device. This might be a single adverse event, or a big-picture review of a family of similar medical devices.

One prevalent issue discussed in our team was the idea of usability. In my presentation I spoke about an implantable bone replacement, for children who had had a tumor removed from their bone, and offers an alternative to an amputation.

To keep up with the child's growth, the implant has a gear that allows it to extend - the child's leg is placed in a large electromagnetic coil which slowly and painlessly extends the implant to catch up with the child's leg length.

At TGA, we received a report of an implant which had been placed in the coil pointing in the wrong direction, so the extension hadn't worked. Even with "head" and "foot" labels, the incident re-occurred! So we began to think about how the design of a medical device affects its usability.

Since many medical devices (asthma puffers, glucose monitors, epipens to name a few), are used by people who are not professional or trained, they need to be easy and intuitive to use. And you can't just blame the user. So as engineers, our challenge is to incorporate usability into our designs right from the start, and of course this doesn't just apply to medical devices.

My time at TGA was extremely gratifying. I gained valuable insights into the medical devices industry, both from an engineering and a regulatory standpoint. I also had the rewarding experience of working in a public office, with a dedicated and passionate team.

Team Tiny Trap

A clean sweep for UNSW students at BIOMOD 2016

The annual international biomolecular design competition, BIOMOD, was held at Harvard University in September 2016.

Team Tiny Trap took first place in all three categories of the competition with their extraordinary concept, *"Use of spring-loaded DNA origami to capture unbound molecular cargo"*.

- Best project website
- Best YouTube video
- Best presentation

Team Tiny Trap

The team is made up of five UNSW undergraduate students: **Abi Prakash** is studying chemical engineering, **Jackson Nexhip** is studying Chemistry, **Sabrina Rispin** is studying bioinformatics Engineering and Biomedical Engineering, **Wendy Chen** is studying Telecommunications Engineering and Biotechnology, and our own **Ralph Bulanadi** is studying Materials Science and Engineering and Biomedical Engineering.

Use of spring-loaded DNA origami to capture unbound molecular cargo

- Abstract:

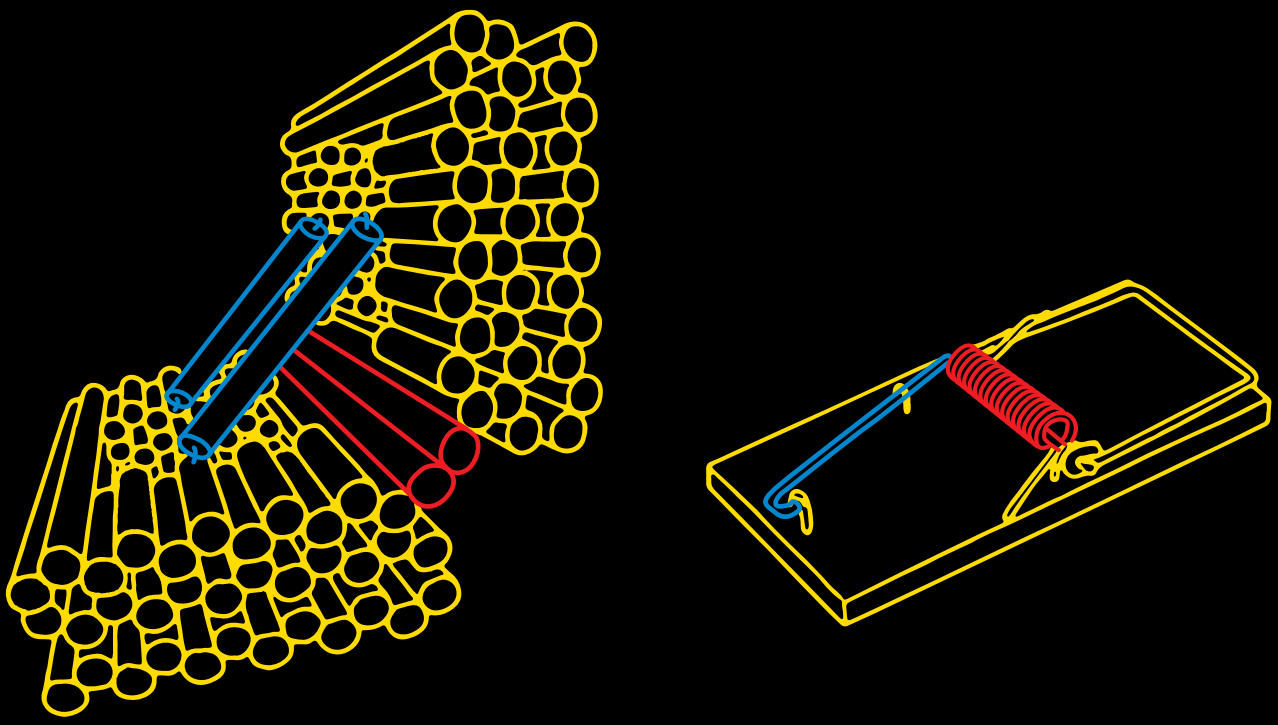
The programmable self-assembly of DNA into arbitrary 3D shapes provides an exciting new avenue for the targeted delivery of molecular cargo. However, efficient capture of freely diffusing molecules into DNA cages is a primary challenge that remains unsolved.

We have developed a spring-loaded DNA origami box consisting of two symmetrical lids joined by a hinge under torsional stress. The hinge forces the two lids to form a closed box, which can be opened with a dsDNA brace containing a specific endonuclease cut site sequence. This allows the box to be selectively triggered to close and capture an endonuclease-containing payload.

We use transmission electron microscopy and small angle x-ray scattering to characterise our structure, and Förster resonance energy transfer to monitor the closing mechanism.

The work provides a new potential method for reliably loading molecular cargo into a confined space, solving a fundamental problem in the development of molecular delivery vessels.

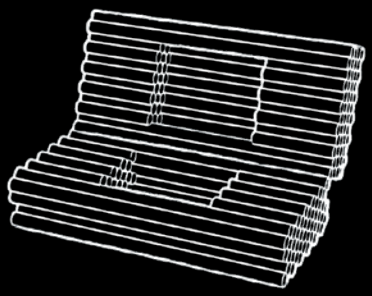
Get the full story at Team Tiny Trap's award-winning website:
www.biomod2016.gitlab.io/teamtinytrap/



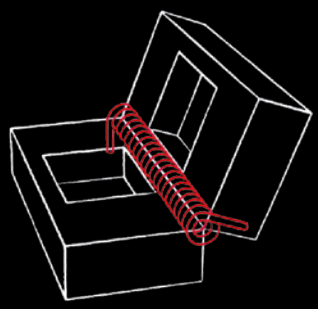
Our Solution

Our vessel consists of two hollow DNA origami lids joined by a spring-loaded hinge. The lids are braced open against the torsional strain of the hinge, and the brace contains a cut-site for a specific endonuclease.

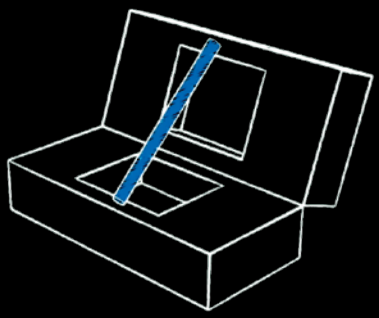
The endonuclease lands on the box, it cuts the brace, and then the lids slam shut and capture it. The endonuclease can also be engineered to carry other molecules such as proteins with it while it cuts.



1. DNA Origami Box

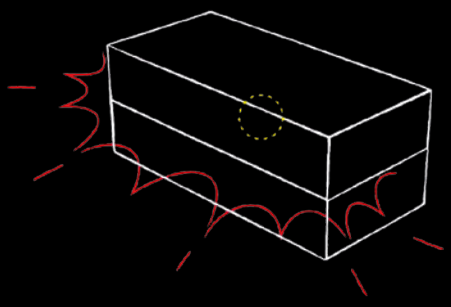


2. Adjustable spring- loaded hinge



3. DNA brace

4. Brace-cutting payload



5. Captured molecular cargo

Practicum Exchange Program

Rewarding.

Eye-opening.

Fun.

Different.

These are just some of the words a small group of material science students would use to describe the three months they spent at North Carolina State University (NCSU) and Tsinghua University.

Whilst Sydney was sweltering, these students spent their summer vacation in university laboratories getting first hand experiences in research in an entirely different cultural context. For them, this was a chance to witness science on a global scale and explore the many areas that material science can take them. Projects that they were involved in spanned from piezoelectric ceramics to dielectric polymers, cryogenics, 2D materials, computer simulations and thin films.

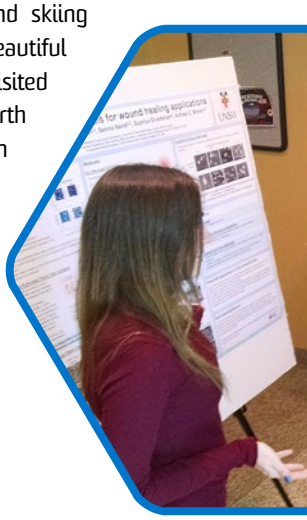
Of course, it wasn't 'all work and no play'. Having the opportunity to spend three months in another country was the perfect excuse to do some exploring. For the group at NCSU, Chicago, New York, Miami and Los Angeles were just some of the locations on their itineraries. In China, the three students who called themselves the 'Tsinghua Trio', visited sites like the Forbidden City and the Great Wall and found themselves taking a high-speed train for a five-hour hike on one of China's most dangerous mountains.

The students share their remarkable experiences below.

North Carolina State University Exchange

As five materials engineers packed their belongings and boarded a 15-hour flight to America, excitement filled the air. Landing in the USA with a sense of awe and wonder, we soaked in the culture, scenery and foods that this beautiful country has to offer, as we made our way to Raleigh - the small quiet capital of North Carolina that we would come to call our second home. We were immediately immersed in a variety of research topics - things that some of us had never even heard of, such as computational simulations of DNA materials, doping of monolayer molybdenum disulphide and studies on the mechanisms behind piezoelectrics. With each of these projects, we were all able to develop important skills that would equip us for our future careers. Some of us greatly improved our computer skills through running numerous computer simulations, one became a cryo-SEM-imaging dynamo while others learned how to use various pieces of laboratory equipment, such as vacuum chambers, sputtering devices and X-Ray diffractometers.

Although most weekdays were spent in the lab learning the intricacies of research, on weekends we explored North Carolina. We visited our host Jacob Jones' lake house where we spent the days kayaking and the nights by the campfire, roasting s'mores and poorly singing classic rock songs (to much laughter). The ski trip, organised by some PhD students from Jacob's research group was definitely a highlight. We spent the weekend skiing down the slopes taking in the beautiful mountain scenery. We also visited Charlotte, the largest city in North Carolina, where we indulged in amazing food and some of us even caught an NBA basketball game! We were rooting for the Charlotte Hornets and luckily they won!



Another highlight was visiting New York City - the city of dreams - during the Christmas break. We spent hours exploring the streets, taking in the rich culture and scenery and visiting well-known landmarks such as the Statue of Liberty, Brooklyn Bridge and Central Park. Our group dinners at different restaurants within the city were very memorable. On the way back to NCSU, we each visited different places within the US, including Boston, Washington, Michigan and Miami.

We returned to Raleigh refreshed and ready to continue researching. We also spent many hours at the university gym burning off the copious amount of junk food consumed. There are so many unforgettable memories: the Krispy Kreme Challenge - where you run 5 miles and eat 12 Krispy Kreme donuts in less than an hour, college sport games, the friendships we built with each other and with those from NCSU, copious amounts of shopping and enjoying the beauty of the snow.

At the end of February, the five materials engineers reluctantly boarded the flight back to Sydney, their luggage filled to capacity and journals filled with incredible recollections of the best three months of their lives, where each of them in their own way learnt to spread their wings and fly. We have all been missing our new friends but are excited to be reunited with the incoming NTSU research exchange students and to have the chance to show them around our own beautiful city.

Tsinghua Research Exchange

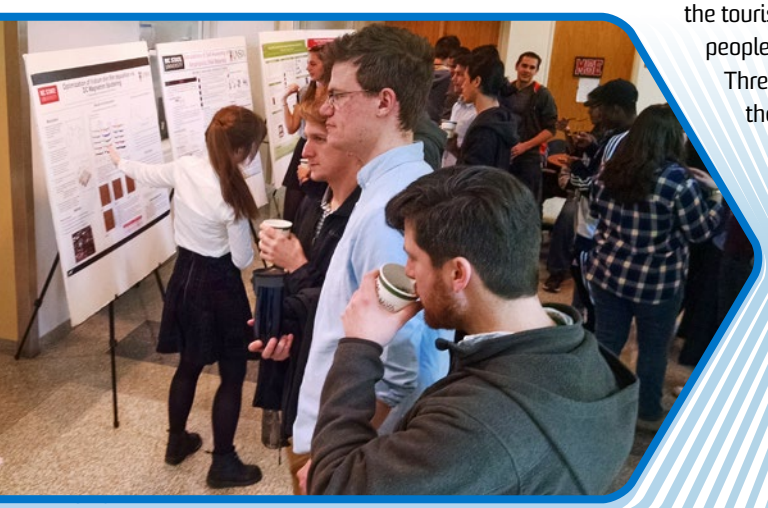
An average day at Tsinghua started off with breakfast in our student apartments before heading off on our bicycles to the laboratories. There we would undertake practical work, including sample preparation and recording measurements with equipment that, more often than not, was completely new to us. Processing data from our samples saw our software skills put into practice (and certain content covered in earlier year coursework proved to be highly relevant at times!). Alongside the laboratory work, reading research papers helped us to better understand the topic - one article lead to another and then another and often we found ourselves on some completely obscure article wondering how we ended up there. We were even asked to help read over and edit papers that the group intended to publish – a few of us got our names on a paper too!

Initially arriving in a completely different setting, we were anxious about expectations the research groups might have for us (and for one of us, that included the language barrier), but equally importantly, we worried about how to get food at dining halls and how to build rapport with our respective research groups. However, we soon found ourselves eating both lunch and dinner with our shi xiong and shi jie (translated as our seniors) almost every day. There were days we found ourselves stealing glances at the group as lunchtime rolled round, anticipating that remark that signalled mealtimes. We marvelled at the diverse range of Chinese dishes available and some of us found new favourites we won't be able to find in Sydney.

The university itself was a great place to explore and we couldn't possibly miss out on the tourist sites of Beijing. But as with any trip, it is also about the company – the people we met and the friendships we built made the trip especially memorable. Three months may seem short but it was enough to have us reluctant to leave the group that taught us so much and welcomed us into their research family.

Immersion into the culture and professional environment of the research group at Tsinghua University truly gave us an experience of what academic research entails.

This learning experience, cultural experience, this experience of a lifetime, we will never forget.



Undergraduate Studies

Dr Owen Standard Undergraduate Program Coordinator

Undergraduate Programs Offered

The School offers two undergraduate degree programs covering a broad spectrum of materials science and engineering. These are the Bachelor of Engineering Honours (BE) in Materials Science and Engineering and the Bachelor of Science (BSc) majoring in Materials Science. The BE degree consists of four years of full-time study and requires students to complete at least 60 days of approved industrial training (in materials engineering or a related field) and is fully accredited with Engineers Australia. The BSc (Materials) consists of three years of full time study and Honours can be obtained by a further year of full-time study. The BSc can also be combined with degree programs in other Faculties, including Bachelor of Law, Bachelor of Engineering, Bachelor of Arts, etc.

In the BE program students complete a common engineering first year, a common second year of fundamental materials engineering courses and mathematics courses, followed by more discipline-specific materials courses in Years 3 and 4, as well as an Honours research project in Year 4. Students major in either Materials Engineering, Ceramic Engineering, Physical Metallurgy or Process Metallurgy by the selection of appropriate professional electives in Years 3 and 4 and an appropriate Honours research project in Year 4. It is noteworthy that the School is the only one in Australia that provides engineering majors in Process Metallurgy and Ceramic Engineering.

In addition to the standard BE program, the School offers three combined degree programs: Bachelor of Engineering Honours and Bachelor of Engineering Science in Chemical Engineering (BE/BSc); Bachelor of Engineering/Master of Biomedical Engineering (BE/MBiomedE); and Bachelor of Engineering Honours and Bachelor of Commerce (BE/BCom). These combined degree programs qualify students for two degrees after completing additional courses in either Chemical Engineering Science, Biomedical Engineering, or Commerce.

The primary aim of the School's undergraduate programs is to deliver graduates possessing the fundamental knowledge, skills, and capabilities needed to succeed in the discipline of Materials Science and Engineering, as well as having the graduate engineering competencies prescribed by Engineers Australia and, more generally, the generic graduate attributes expected in a university graduate. The School's undergraduate programs are designed to have strong relevancy to today's material's industry and research whilst being adaptable to future trends and growth in the discipline.

Implementation of Revised Undergraduate Programs

The School's undergraduate programs were revised in 2015 to ensure ongoing compliance with the University's policies and procedures in terms of student academic progression and the awarding of Honours, as well as to ensure compliance with the Australian Government's Australian Quality Framework (AQF) requirements for Bachelor Honours degrees. The revised programs were implemented in 2016 with the newly enrolling first year cohort entering these programs.

Accreditation and Reviews of School Undergraduate Programs

In 2016 the School's BE program and BE-combined programs were reviewed by Engineers Australia as part of its accreditation of UNSW BE programs (done every 5 years). In addition, the School's BE, BE-combined, and BSc programs were reviewed by the University as part of its formal quality assurance processes for undergraduate programs. The EA accreditation and UNSW reviews were comprehensive and examined important aspects such as: quality assurance of program structures and individual courses; mapping of learning outcomes, assessment tasks, and graduate attributes; quality assurance of teaching delivery and assessment methods; delivery of graduate attributes; evaluation of student, graduate, and employer satisfaction; and evaluation of staffing requirements, resources and facilities. The Engineers Australia Review was extremely positive and the School was granted unreserved accreditation for the next 5 years.

New Enrolments

Admission to the School's BE programs is through the Universities Admissions Centre (UAC) for local students. International students with appropriate qualifications apply through UAC International or directly through UNSW Apply Online. Enrolments into the School's BE programs have been healthy over the past ~5 years. Similar to previous years, the quality of the new local students was high as indicated by ATAR entry scores of 85.0 for the BE program, 91.0 for the BE/BSci program, 91.0 for the BE/MBiomedE program, and 97.0 for the BE/BCom program. International students comprised just over one third of the 2016 student intake. In addition to these programs, in recent years a small, but growing, number of students have enrolled in the BSc(Materials Sci.) program, but it is difficult to get reliable entry numbers because most students do not declare their major until late in their program. The School continues to have the largest undergraduate program in the discipline nationwide by a considerable margin.

Overall Program Enrolment

Table 1 lists the numbers of students in each program and year of the particular program. The number in each year of study is dependent on the number of students who entered that cohort initially (i.e., in Year 1) as well as the number of students who transferred into or out of the cohort in subsequent years. Furthermore, the number of students in a particular year of study includes students who are deemed by the University's enrolment system to have not yet completed that year of study (owing to failed courses and/or courses not yet undertaken). In addition to the School's undergraduate cohort, a significant number of undergraduate students from other schools enrol in the School's courses, the majority being Engineering students who enrol in a first year introductory materials subject.

Table 1: 2016 Program Enrolment

Program	Year 1	Year 2	Year 3	Year 4	Total
3131/3135 BE(Materials Sci. & Eng.)	74	24	26	16	140
3132/3137 BE(Materials Sci. & Eng.)/BE(ChemEng)	5	8	7	13	33
3133/3138 BE(Materials Sci. & Eng.)/MBiomedE	23	10	19	25	77
3134/3136 BE(Materials Sci. & Eng.)/BCom	4	5	1	4	14
Total:	106	47	53	58	264

Graduating Class

The BE degree is awarded at Honours First Class (H1); Second Class Division 1 (H2/1), Second Class Division 2 (H2/2), or Pass classifications as determined by a weighted average mark calculated based on the year of study and the relative weighting of each course in the curriculum for that year. In addition, an exceptionally high level of attainment for H1 may be recognised by the awarding of the University medal. A total of 34 students graduated in 2016 (nb. programs are those prior to revision) with classifications as listed in Table 2.

Table 2: 2016 Graduating Class

Program	H1+Medal	H1	H2/1	H2/2	Pass	Total
3135 BE (Materials Sci. & Eng.)	–	9	3	3	9	24
3136 BE (Materials Sci. & Eng.)/BCom	–	–	–	–	–	0
3137 BE (Materials Sci. & Eng.)/BE(ChemEng)	–	4	–	–	–	4
3138 BE (Materials Sci. & Eng.)/ MBiomedE	1	2	1	2	–	6
Total:	1	15	4	5	9	34

Co-op Scholarship Program

Owen Standard Academic Coordinator Co-op Program in Materials Science and Engineering www.coop.unsw.edu.au

The Co-op Scholarship Program provides industry-funded scholarships to UNSW undergraduate students across various Faculties and degree programs. These scholarships provide students with a significant stipend (~$20,000 per annum for 4 years) and substantial opportunity for industrial training with the partner companies. For the School of Materials Science and Engineering, Co-op scholarships are an effective means to attract high-quality students into our discipline and to provide them with beneficial industrial training in the engineering sector.

Co-op scholarships in Materials Science and Engineering commenced in 1989 and since then there have been a total of 127 scholarships from 30 different industrial sponsors. Currently, the Co-op Program requires prospective students to have an ATAR of at least 96 and, for successful students, the ATAR typically is greater than 99. Co-op scholars are selected not only on the basis of their academic ability, but also their communication skills, motivation, teamwork skills, and leadership potential as well as passion and understanding for the materials science and engineering discipline. Scholars also need to demonstrate responsibility, commitment and resilience.

A total of 2 scholarships (Table 1) were provided in 2016 by two industrial sponsors – Pacific Aluminium (Rio Tinto) and Weir Minerals. This represents an investment by industry of ~$~40,000 for the year. The attraction of new scholarships remains a challenge owing to business pressures on traditional Australian manufacturing industries, but effort is being made to find opportunities in new and emerging areas.

During the duration of their scholarship, Co-op Scholars complete 68 weeks of structured and highly relevant industrial training with up to 4 sponsor companies – 10 weeks at the end of year 1, 10 weeks at the end of year 2, and two 24 week placements at the end of Year 3. Students take 5 years to complete their degree but this is offset by the scholarship and, more significantly, by the immensely valuable graduate skills, networking, and workplace experience obtained from the industrial training placements. The industrial sponsors are provided with highly motivated, capable students to complete important and valuable industrial work. It also provides sponsors the opportunity to have direct involvement in the education and development of our School's students and from whom they can potentially recruit their future managers and leaders.

Each IT placement is reviewed by the Academic Coordinator in the form of an interview with the scholar and sponsor representative(s). The scholar and sponsor also provide written appraisals of the placement. Each scholar is required to give a short presentation to industry sponsors and fellow Co-op students summarising their IT work and, importantly, the technical and professional benefit they obtained from the placement. Industry sponsors quantify the quality and value of work completed by the scholars during their placements to give the students meaningful feedback on the value (and importance) of their work to the business.

In addition to the industrial training placements, the Co-op Program provides students with an ongoing professional development program to help them develop strong graduate attributes that differentiate them from other students and to make a smooth transition to the workplace. The Co-op Program provides scholars with access to a range of support networks, an academic mentor is assigned to each program cohort to offer specific program advice and guidance and all first years have an opportunity to connect with a Co-op alumnus to help them prepare for placements. Workshops and training activities are offered throughout the duration of the scholarship and these provide an interactive environment for scholars to learn about professional expectations and ethics, reflect on their own work experiences individually and with peer support and gain advice from industry representatives. Co-op graduates are highly sought by industry and many of those who have entered the materials industry have risen to senior leadership and management positions.

The School takes this opportunity to again thanks its Co-op sponsors for the efforts they put into organising the placements as well as their training, guidance, and support of scholars during the placements, and for their continued generous support of the Co-op Program.

Any company interested in learning more about the Co-op Scholarship Program or offering a Co-op Scholarship in Material Science and Engineering can contact Dr Standard (o.standard@unsw.edu.au) or the Coop Program Office (cooprog@unsw.edu.au).

Table 1: Statistics of Co-op Program in Materials Science and Engineering – (2012 to 2016)

Intake Year	2012	2013	2014	2015	2016	Total
Current Year of Degree	4	3 (IT)	3	2	1	
Number of Scholars: Ceramic Eng.	–	–	–	–	–	0
Number of Scholars: Materials Eng.	–	–	–	1	–	1
Number of Scholars: Physical Met.	–	1	–	–	–	1
Number of Scholars: Process Met.	–	–	–	–	–	0
Total:	–	1	–	1	–	2

Postgraduate Degree Programs

The School of Materials Science and Engineering has one of the largest and most active programs in postgraduate research in Australia.

The School's staff normally lead UNSW in research grant success, journal publication rates, and postgraduate supervision/graduation rates.

Master of Materials Technology (Coursework)

The Master of Materials Technology program consists of 2 years of full-time or equivalent study comprising coursework in materials processing, materials design, materials technology and materials industry management. It is designed for graduates wishing to acquire expertise in the design, selection, use and performance of modern materials. It also includes a component of experimental and/or design project work, and an original research project is also undertaken in a chosen area.

Materials Science and Engineering – Master of Philosophy (Research)

The M.Phil degree involves minimum of 1.5 years full time study during which students undertake supervised research leading to the production of a thesis. The program is designed to provide an alternative to the honours program for students who have previously completed a BSc and wish to proceed to a research degree.

There is the opportunity for graduates of the Master of Philosophy program to progress to PhD study.

Materials Science and Engineering – Master of Science (Research) / Master of Engineering (Research)

A Master by Research degree requires completion of an original piece of research, more limited in scope and nature than that required for a PhD. Candidates develop mastery of appropriate methodology and they present their findings in the wider context of their discipline.

There is the opportunity for graduates of either the Master of Science or Master of Engineering program to progress to PhD study.

Materials Science and Engineering – PhD

A PhD degree requires completion of a piece of research that demands a significant and original contribution to knowledge in the field of study. Candidates acquire advanced specialist research training and produce a thesis that summarises the research and provides evidence of independent thought and critical analysis, effective communication and expert knowledge of the discipline in the international context.

Program	Mode	UNSW Program Code	Length of Study	Minimum Units of Credit
Materials Technology - Masters Degree (Coursework)	Campus, Directed Research, Independent Research	8717	2 years full-time	96
Materials Science Engineering - Master of Philosophy (Research)	Directed Research, Independent Research	2475	1.5 years full-time	72
Materials Science Engineering - Master of Science (Research)	Directed Research, Independent Research	2055	2 years full-time	96
Materials Science Engineering - Master of Engineering (Research)	Directed Research, Independent Research	2175	2 years full-time	96
Materials Science and Engineering - PhD	Directed Research, Independent Research	1045	3 years full-time	144

Vale Lowin Chung

31 March 1986 – April 2016

(L-R):
Aparna Nair,
David Almeida,
Dr Pramod Koshy,
Nathan Doran,
Lowin Chung,
Yuan Kai Yeo and
Prof Chris Sorrell.

Sadly, in early 2016 we lost one of our most recent graduates. Lowin Chung was a shining star among the student cohort. Her honours supervisor, Dr Pramod Koshy, shared the following:

Lowin Chung was an exceptionally bright person with incredible mental toughness which enabled her to deal with any difficulties or issues that she encountered both personally and academically.

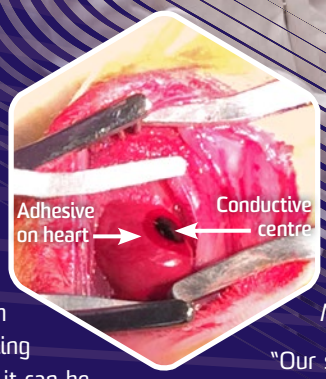
She started off her time at the School by receiving an industry scholarship and concluded her degree with outstanding work leading to a distinction for her Honours thesis.

She always showed a cheerful personality and had an optimistic outlook on life that enabled her to connect and form friendships easily. Her quirky nature always left a strong impression in the minds of everyone who knew her, and this makes her unforgettable.

She was a bright spark and her presence will be greatly missed by all her friends and colleagues at the School.

Mending a broken heart

Researchers have made a significant advance in heart attack research, with the development of a polymer patch which improves the conduction of electrical impulses across damaged heart tissue.



The flexible patch, which has been shown to work in animal models, is long lasting and has the significant advantage that it can be stuck onto the heart without the need for stitches.

The research, by an Australian and British team led by Dr Damia Mawad at UNSW in Sydney and Professor Molly Stevens at Imperial College London, is published in the journal Science Advances.

"Heart attacks create a scar which slows and disrupts the conduction of electrical impulses across the heart," says study team member Professor Sian Harding of Imperial's National Heart and Lung Institute.

"This leads to potentially fatal disturbances of the heart rhythm. Our electrically conducting polymer patch is designed to address this serious problem."

The patch is made from three components: a film of chitosan, a polysaccharide found in crab shells that is often used as a food additive; polyaniline, a conducting polymer that is grown on top; and phytic acid, a substance found in plants which is added to the polyaniline to switch it to its conducting state.

"Conducting polymers work when they are dry, but most become non-conducting in a very short time when placed in bodily fluids," says study first author Dr Mawad, of UNSW 's School of Materials Science and Engineering.

"Our suture-less patch represents a big advance. We have shown it is stable and retains it conductivity in physiological conditions for more than two weeks, compared with the usual one day of other designs.

"No stitches are required to attach it, so it is minimally invasive and less damaging to the heart, and it moves more closely with the heart's motion."

The patch is made to adhere to the heart tissue by shining a green laser on it, in a patented technique developed at UNSW by Dr Antonio Lauto of Western Sydney University.

Team members at the British Heart Foundation's Imperial Cardiovascular Regenerative Medicine Centre, led Professor Harding and Professor Cesare Terracciano, tested the patch by implanting it into rats. They found it improved the conduction of electrical impulses across the heart scar tissue.

"We envisage heart attack patients eventually having patches attached as a bridge between the healthy and the scar tissue, to help prevent cardiac arrhythmia. However, our patch is at the very early stages of this research. This technology can now be used for basic research to gain insights into the interface between the material and tissue," says Dr Mawad.

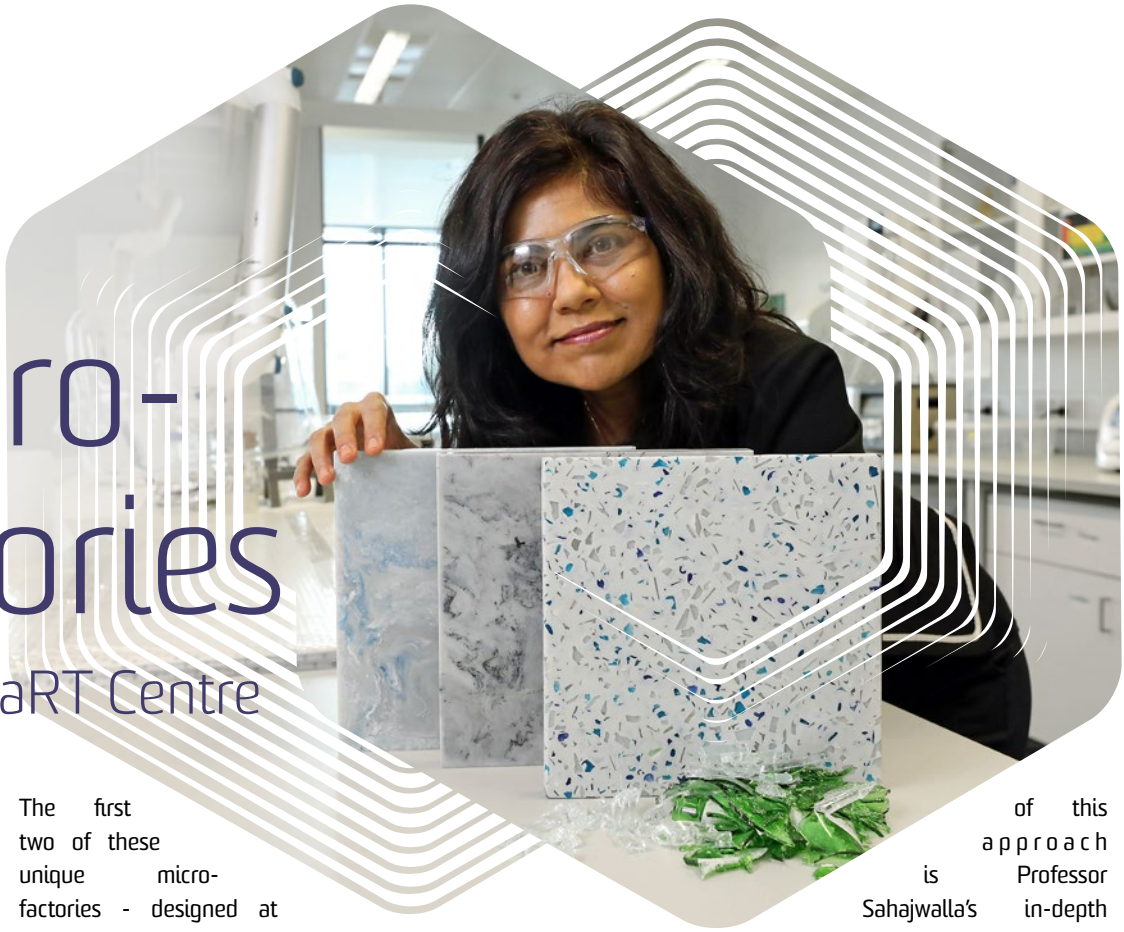
"The patch can help us better understand how conductive materials interact with heart tissue and influence the electrical conduction in the heart, as well as better understand the physiological changes associated with heart attacks."

Dr Mawad carried out much of the experimental research on the patch while on a Marie Curie Scholarship in Professor Molly Stevens' group in Imperial College.

The full research article, *"A conducting polymer with enhanced electronic stability applied in cardiac models"* by D. Mawad, C. Mansfield, A. Lauto, F. Perbellini, G.W. Nelson, J. Tonkin, et al., can be found at:
http://advances.sciencemag.org/content/2/11/e1601007 (Credit: UNSW Science media officer Deborah Smith)

Micro-factories

at the SMaRT Centre



The future of recycling lies in cost-effective micro-factories that can transform waste into new green products, materials and resources, anywhere waste is stockpiled.

The first two of these unique micro-factories - designed at UNSW's Centre for Sustainable Material Research and Technology (SMaRT) -- will be unveiled at UNSW in 2017. Unlike conventional industrial scale recycling plants that require the costly and, often technically challenging, separation of waste into single material streams, the SMaRT Centre's new micro-factories can handle complex waste currently destined for landfill. This means serious and even toxic global waste challenges – like electronic waste (e-waste), automotive waste, mixed glass, construction waste and even food industry by-products – can be safely processed locally, with no residue left behind. The UNSW micro-factories will demonstrate the technology, licenced through UNSW Innovations, as well as providing invaluable opportunities for education, training and engagement.

The micro-factories, pioneered by SMaRT Centre Founding Director, ARC Laureate Professor Veena Sahajwalla, employ the unparalleled portfolio of new science developed over years at the Centre, with valuable contributions from industry partners. Just under half of Australia's waste is recycled, and in the US it's just 34%. Yet the world's landfills are packed with useful elements and materials like carbon, hydrogen, silica, titania and various oxides, that industries otherwise source from finite virgin resources. Much of this vast wealth of resources embedded in waste cannot be easily recovered using conventional recycling methods. By using precisely controlled reactions, the SMaRT Centre's new processes are selectively breaking the bonds in complex waste to transform its molecular structures and produce new value-added green materials and products. One key to the success of this approach is Professor Sahajwalla's in-depth understanding of high temperature reactions, which has enabled her, and her team, to avoid the generation of toxic emissions. This creates an unprecedented new opportunity to 'mine' the world's landfill for cost-effective sustainable resources. As the micro-factory model brings the solution to the problem for the first time, any community or business, virtually anywhere in the world, can transform waste onsite. In doing so, the micro-factories can meet local needs for a wide range of products, from building materials to metal alloys and advanced nano-materials.

UNSW's two micro-factories will focus on e-waste and green materials. The e-waste micro-factory uses a pre-programmed automated drone to identify items, such as circuit boards, from piles of granulated e-waste. Workers, supported by robotic arms, sort the waste into carefully calculated mixtures that are processed in small furnaces using selective temperatures to extract valuable resources, such as copper alloys. The glass and plastic from e-waste can also be combined in a high-temperature smelter to produce silicon carbide nanoparticles, with multiple industrial uses. E-waste plastics, too, can be safely processed into filament for 3D printers. The green materials can be configured to handle a high volume of mixed and complex wastes like broken, laminated and tempered glass, waste plastics, wood, textiles and food industry processing waste to produce high quality building products such as bench tops, flooring and building panels and boards, at a fraction of the cost of conventional products. UNSW has also designed a portable version of the micro-factories that fits within a 12m high side-folding container that can be delivered to any site.

Overview of how e-waste can be turned into value added outputs

Waste inputs	Sources of waste	Value added outputs	
Plasma LCD Smart Phone Screens Organic Light Emitting Diodes (OLEDs) Flat Panel Displays Computer, laptop and Smart Phone Circuit Board Printed circuit boards E-waste plastics	Waste electrical and electronic equipment (WEEE)	▪ Next generation polymeric charge briquettes	Metals manufacturing
		▪ In_2O_3/SiO_2 and Eu_2O_3/SiO_2 composites	Environment and gas sensing applications
		▪ High strength-low carbon 3D printing filaments ▪ High strength composites	Construction and built environment & Automotive industry

'The future depends on what we do in the present.'

Mahatma Gandi

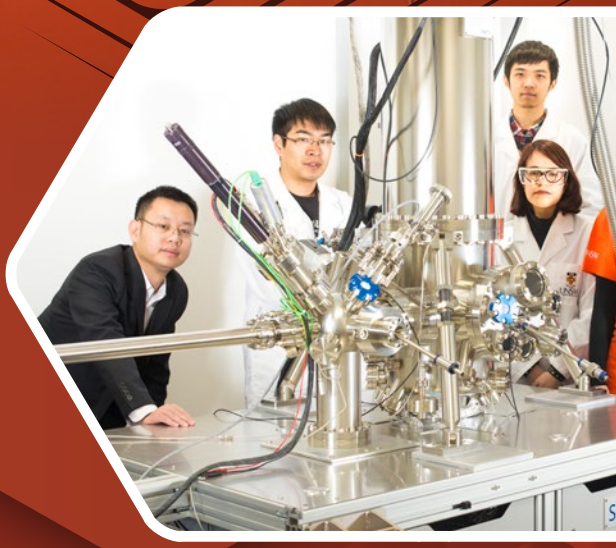
Green manufacturing micro-lab 3D projection

The green microfactory will transform waste wood, plastic, glass and textiles from a variety of sources, into various value added sustainable products. The green manufacturing micro-factory will only process non-toxic waste including those listed above. Waste inputs, sources and value added outputs are described in the following table.

Waste inputs	Sources of waste	Value added outputs	
Wood Plastics (PP, PE, PVC, PET, ABS, SAN, PC etc.) Glass Textile fibres (PET, PVC, PP, PE, Nylon, Latex etc.)	Construction and demolition	▪ SMaRT stone glass panels ▪ 'Green particleboards using waste plastic and textiles as binders' ▪ Flooring ▪ Composites	Built environment
	Packaging	▪ Grenew carbon pellets- zero coke content ▪ Ferro-silicon and Silico-manganese alloy ▪ Sources of solid and volatile carbon	Metal manufacturing
	Office furniture Electronics Textiles	▪ Activated carbon and carbon based nano-materials ▪ Silica based nano- materials (SiC and Si_3N_4) ▪ High porosity insulators ▪ Copper-tin alloy ▪ Nano-structured gold and silver ▪ Platinum alloys	Electronics applications and Environment sensing
		▪ Carpets ▪ Car mats	Domestic applications

Torch

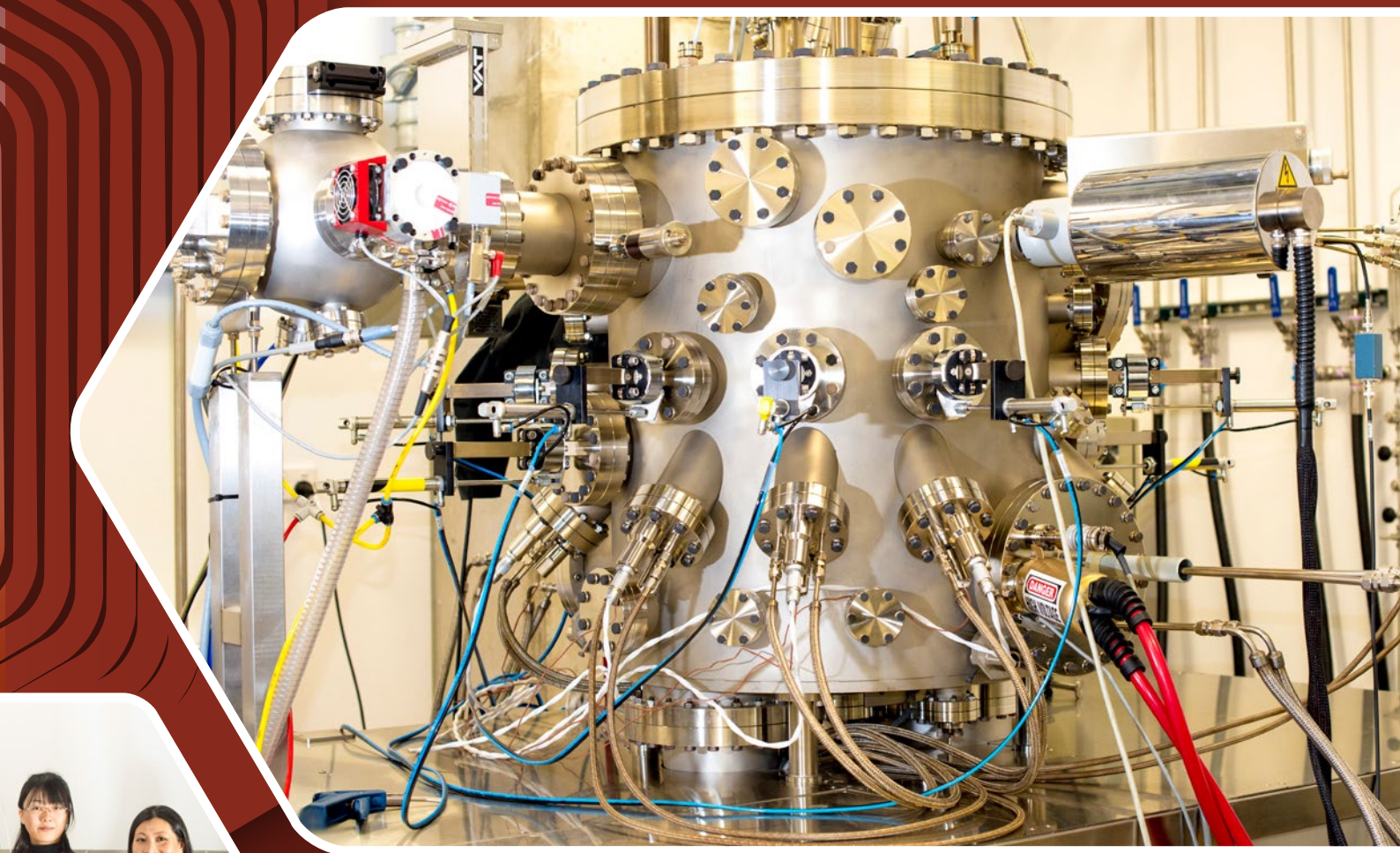
As part of the 2025 Strategy, UNSW is launching an ambitious, government-backed initiative to bring the successful Chinese innovation ecosystem – the 'Torch' model of science and technology parks - to Australia.



A Torch Technology Business Incubator has been established on the main campus and plans are underway for the development of a new 20,000 m^2 innovation precinct in Sydney's eastern suburbs, with a view to bringing together industry, SMEs, entrepreneurs, investors and policy makes, from Australia, China and beyond.

The School of Materials Science and Engineering has already established itself as a major contributor to the Torch initiative, with several of our academic staff developing joint projects with business partners in China.

Professor Sean Li, in collaboration with Dr Dewei Chu and Dr Danyang Wang, is currently researching higher-efficiency graphene-enhanced cables, which could help overcome persistent electricity leakages in conventional power grids. This has already seen the establishment of the UNSW-HCCL (Hangzhou Cable Company Limited) joint laboratory. It is estimated that the commercialization and application of these cables could save some 275 terawatt hours of power a year across China alone – more than Australia's entire annual energy consumption.



Next generation touch screen technology

Dr Danyang Wang's Torch project aims at development of a highly sensitive and accurate touch screen using low-cost, readily available technologies. Success of the project will provide a promising replacement to the existing resistive and capacitive-type touch screens, which suffer from the issues of aging, low resolution and inaccuracy. This project is in collaboration with VTouch Technology Co Ltd, China. The total funding for this project is $1.1m over 2 years.

Technology for the next generation of electric motors

An estimated 720 million electric vehicles will be on the world's roads by 2030. There is therefore a pressing need to develop energy efficient magnetic core materials for the next generation of electric motors, which can save more electricity. The Torch project, run by Dr Dewei Chu in colloboration with Suzhou Londerful Nanotechnology Co. Ltd, aims to develop new magnetic core materials which have much lower energy loss compared with conventional silicon steels, through theoretical prediction of optimized materials composition and inducing a new annealing process which is called stress-relax annealing technique. The company has invested $500k to UNSW for 2 years.

Sean, Dewei and Danyang have also developed partnerships with ShenZhen Smart Power Co. Ltd to develop climate responsive transmission lines and Fuzhou Danlaw Xicheng Electronic Technology Co. Ltd to develop transparent conductive ceramic thin films – specifically, de-fogging technology for automotive application.

Current Research Grants

Name	Details
ANSTO	Ionescu, M., Klose, F., **Li, S.**, *Isotope Engineering and Nuclear Characterisation of Novel Nanoscale Thin Film Functional Materials*, $217,530
ANSTO PG Scholarship	**Zhang, J., Li, S.,** *Isotope engineering and nuclear characterisation of novel nanoscale thin film functional materials - scholarship for Ji Zhang*, $103,950
ARC Centre of Excellence - Monash / UNSW	**Seidel, N., Valanoor, N.**, *ARC Centre of Excellence in Future Low-Energy Electronics Technologies FLEET*, $3,590,096
ARC DECRA	**Hinterstein, J.M.**, *On the origin of high strain in lead-free piezoelectric materials*, $315,000
ARC DECRA	**Tang, C.**, *Materials Design for Self-toughening Bulk Metallic Glasses*, $368,000
ARC Discovery Project	Birbilis, N., **Laws, K.J., Ferry, M.**, *Ultra-lightweight alloys with unique multi-dimensional property profiles*, $355,100
ARC Discovery Project	Dai, J., Tan, X., **Wang, D.**, Lead-free oxide perovskites for highly efficient solar cells, $300,000
ARC Discovery Project	**Ferry, M.**, *A new crystallographic approach to deformation and annealing of metals*, $425,500
ARC Discovery Project	**Koshy, P., Sorrell, C.C.**, *X-Ray Activation of Photocatalytic Titania-Coated Biomedical Implants in Situ*, $365,000
ARC Discovery Project	Koumoto, K., **Li, S.**, *Beyond Phononic Crystals - Building New Concepts to Enhance Thermoelectricity*, $384,700
ARC Discovery Project	Koumoto, K., **Li, S.**, *High Performance Complex Oxide Heterostructures for Nanoelectronic Devices*, $373,500
ARC Discovery Project	Manske, D., Rubhausen, M., Ulrich, C., **Seidel, J.**, *Topological spin systems as basis for novel multifunctional materials*, $355,000
ARC Discovery Project	Morozovska, A., **Munroe, P.R.**, Weyland, M., *'Designer defects' - a new approach to functional oxide interfaces*, $473,900
ARC Discovery Project	Morozovska, A., **Valanoor, N.**, *Engineered control of polarization rotation in ferroelectric bilayers*, $400,500
ARC Discovery Project	Ng, Y.H., **Hart, J.**, Scott, J., Iwase, A., *Advanced anodisation methods and materials for solar water splitting*, $315,000
ARC Discovery Project	**Seidel, J.**, *Electronic charge separation at polar topological defects - photovoltaics beyond the conventional p-n junction*, $380,000
ARC Discovery Project	**Sorrell, C.C., Hart, J., Koshy, P.**, *Engineering Quantum-Size Bioceramics: Photocatalytic / Sonocatalytic Ceria*, $301,500
ARC Discovery Project	**Sorrell, C.C., Koshy, P.**, *X-Ray Activation of Photocatalytic Titania-Coated Biomedical Implants in Situ*, $365,000
ARC Discovery Project	**Munroe, P.R.**, Xie, Z., Xu, J., *Design of Tough, Durable and Corrosion-resistant Coatings*, $325,500
ARC Discovery Project	**Young, D.J., Zhang, J.-Q.**, *Controlling nickel-base alloy high temperature corrosion in CO_2-rich gases*, $399,500

Name	Details
ARC Future Fellowship	**Cazorla Silva, C.**, *Rational Design of Novel Multiferroic Materials for Energy Harvesting and Energy Efficiency*, $778,874
ARC Future Fellowship	**Chu, Dewei**, *Building Novel Solid State Electric Double Layer Transistors with Interface Engineering of Ionic Conductive Oxide Superlattices*, $735,144
ARC Future Fellowship	**Yi, J.**, *Enhance ferromagnetic ordering by exchange coupling and defect engineering*, $776,000
ARC Industrial Transformation Research Hub	Dippenaar, R.j., Littlejohn, R., Lloyd, S., **Ostrovski, O.**, Prusty, G., Rasmussen, K.J., Simpson, S., Singh, R., Tooze, I., **Sahajwalla, V.H.**, *Transforming Waste Directly in Cost-effective Green Manufacturing*, $4,021,756
ARC Laureate Fellowship / Georgina Sweet Award	**Sahajwalla, V.**, *Fundamental high temperature e-waste investigations for high-value products*, $3,465,119
ARC LIEF Grant	Arnold, M., Ball, G., Bossomaier, T.R., Cheung, K.W., De Marco, O., Dlugogorski, B.Z., **Ferry, M.**, Ford, M., Georges, A., Gondro, C., Greer, P., Henskens, F., Johnson, M., King, G., Lewis, G., Muller, D., Poulton, C., Radom, L., Rahmani, A., Reimers, J.R., Sajeev, A., Stampfl, C.M., Susilo, W., Wilkins, M., Yang, R., Yu, A.B., Yu, H., Zhao, M., Hawkes, E., *Renewing intersect's share of the National Computational Infrastructure's peak facility*, $1,970,000
ARC LIEF Grant	**Ferry, M., Sahajwalla, V.H., Li, S.**, *High Temperature Atomic Structure and Physical Property Analysis Facility*, $1,430,500
ARC LIEF Grant	Tilley, R., **Munroe, P., Li, S.**, Zhang, L., Hao, X., Cairney, J., Liao, X., Zheng, R., Pereloma, E., Tieu, K., Saunders, M., Ma, Q., Bradby, J., Piazolo, S., Sun, B., *Plasma-focused ion beam for nanoscale characterisation of materials*, $1,100,000
ARC LIEF Grant - Monash / UNSW	**Munroe, P.R.**, **Valanoor, N.,** *Next generation, ultrahigh resolution TEM for the characterisation of matter in space and time*, $1,800,000
ARC Linkage Project	Aminorroaya-Yamini, S., Doy, S.X., Li, W., Zhang, C., **Li, S.**, *New generation high efficiency thermoelectric materials and modules for waste heat recovery in steelworks*, $226,896
ARC Linkage Project	Bhushan, B., Freislich, M.C., **Khanna, R., Sahajwalla, V.H.**, *Lower temperature ironmaking:macro and atomic-level understanding of accelerated carburisation of reduced iron*, $450,000
ARC Linkage Project	Byrnes, R.P., Craig, P., **Crosky, A.**, Hagan, P.C., Hebblewhite, B., Johnson, R., McCowan, B., Sheffield, P., Timms, W.A., Saydam, S., *Avoiding catastrophic failure of cable bolts in underground mines*, $210,000
ARC Linkage Project	Hockings, K., Zhang, G., Zulli, P., **Ostrovski, O.**, *Coke integrity in blast furnace ironmaking: Understanding and technology development*, $665,000
ARC Linkage Project	**Koshy, P.**, Pandolfelli, V., da Luz, A.P., **Sorrell, C.C.**, *New Paradigm for Materials Technology for AZS Glassmaking Refractories*, $580,000
ARC Linkage Project	**Laws, K.J.**, Lin, P., **Ferry, M.**, *Reducing the environmental impact of passenger vehicles by the design of lightweight alloy components*, $727,000
ARC Linkage Project	Lenagh, M., Williams, R., **Zou, R.** Yu, A.B., *Fundamental studies of multiphase flow and separation performance of natural medium cyclones for recovering waste coal*, $905,000

Current Research Grants

Name	Details
ARC Linkage Project	**Sahajwalla, V.**, *Recycling lignocellulosic agricultural waste as an iron oxide reductant in ferrous processing*, $360,000
ARC Linkage Project	**Yang, R.**, Shen, Y., *Preparation and use of lignite-iron ore composite briquettes for ironmaking*, $694,000
ARC Linkage Project	**Zhang, J.**, *Understanding the role of nanoparticles in water-based lubrication*, $45,000
ARC Research Hub	**Yang, R.**, *ARC Research Hub for Computational Particle Technology*, $125,000
Australia-Korea Foundation Grant	Park, E.S., **Laws, K.J.**, *The Australia-Korea Advanced Metal Alloys/Metal Technology Project*, $61,980
BaoSteel-Australia Joint Research and Development Grant	Fang, Y., Wang, X., **Xu, W.**, Yu, Y., **Ferry, M.**, *An integrated metallurgical and process control strategy for generating new high-strength strip-cast steel grades free of detrimental casting defects*, $200,000
BaoSteel-Australia Joint Research and Development Grant	**Ostrovski, O.**, Zhang, C., **Zhang, J.**, *Investigation of CaO-Al_2O_3-based flux for high Al steel continuous casting of high-Al steel*, $300,000
CRC for Low Carbon Living	Amin, S., Bartesaghi Koc, C.A.A., Bruce, A., Craft, W.J., Diaz Sandoval, C.A., Fiorito, F., Heriyanto, Hodge, T., Irger, M., Karim, S.M., Macgill, I., Marzban, S., Osmond, P.W., Peters, A., Prasad, D.K., Roberts, M.B., **Sahajwalla, V.H.**, Sanchez Gomez, A., Sproul, A.B., Thompson, S.M., Timchenko, V., Williams, P., Yang, S., Ding, L., *Node of Excellence in High Performance Architecture*, $100,000
CRC for Low Carbon Living	Else, D., Hatrz-Karp, J., Hill, R., Maher, K., Newton, P., Pearson, C., **Sahajwalla, V.H.**, Sproul, A.B., Taylor, M., Thompson, S.M., White, S., Prasad, D.K., *The CRC for Low Carbon Living*, $150,000
CSIRO PG Scholarship	**Ly, T.C.L.**, Miljak, D., **Daniels, J.E.**, *CSIRO Mineral Resources Top-Up Scholarship for Thai Ly*, $51,000
Industry	Bailey, T., **Sahajwalla, V.H., Joshi, R.K.**, *Generation of Gases from End-of life Tyres and Purification Using Novel Graphene Molecular Sieve*, $75,000
Industry	Chavara, D., Drew, M., **Gupta, S.K., Sorrell, C.C., Toppler, K., Koshy, P.**, *In-Situ High Temperature Strength of Low CSR Cokes*, $104,000
Industry	**Cholake, S.T., Haque, E., Pahlevani, F.**, *Textile waste: a cost effective component for building materials*, $99,966
Industry	Jonsson, C., Yao, Y., **Chan, S.L.I.**, *A Study on the Microstructure and Wear Properties of Ferrous Alloys Reinforced with In-Situ Formed (V, W)C*, $12,997
Industry	Mahoney, M., Monaghan, B.J., **Ostrovski, O.**, Rogers, H., **Sharp, J.**, Zhang, G., Zulli, P., **Xing, X.**, *Characterising the degradation of cokes made from Australian coals and subjected to simulated blast furnace operating conditions*, $167,640
Industry	**Mawad, D.**, *Development of injectable conductive hydrogel*, $26,677
Industry	Oberwinkler, B., **Theska, F., Primig, S.**, *High resolution analysis of strengthening effects in Ni-based alloys. Student Project Agreement for Felix Theska*, $236,046
Industry	**Pahlevani, F.**, *Vinyl commercial flooring - recycling and reprocessing trials with partners in the supply chain*, $57,600

Name	Details
Industry	Richardson, M., **Sahajwalla, V.H., Pahlevani, F.,** *Advertising banner reprocessing and design project,* $30,000
Industry	**Sahajwalla, V.H., Joshi, R.K.**, *Application oriented characterisation of carbon from end-of-life tyres*, $33,000
Industry	**Sahajwalla, V.H., Joshi, R.K.**, *Developing Graphene Integrated Super-Composite Materials using End-of-Life Tyres - PhD Scholarship Yi You*, $75,000
Industry	**Sahajwalla, V.H., Joshi, R.K.**, *Graphene oxide project*, $205,000
Industry	**Seidel, J.**, *PFM measurements on GaN samples,* $13,000
Industry	**Sharp, J., Xing, X.**, Zulli, P., **Ostrovski, O.**, *Degradation studies of additional BHP Billiton's pilot oven cokes,* $26,500
Industry	**Sorrell, C.C., Koshy, P.**, *Mullite Fibre Template Fabrication & Mullite Fibre Formation from Topaz*, $50,189
Industry	**Young, D.J.,** *High temperature CO_2 corrosion in gas-cooled reactor environment*, $79,123
SJTU-UNSW Collaboration	Escobedo-Diaz, J.P., Kong, L., **Laws, K.J.**, Li, J., Shen, Y., Tang, S., Xu, W., Yi, J.J., Zhou, Y., **Ferry, M.,** *Metallurgical design of toughened amorphous metals,* $132,000
Torch Project	**Wang, D., Chu, D., Li, S.**, *Pressure Sensors*, $1,084,640
Torch Project	**Chu, D., Li, S., Lashgari, H.R.,** *High performance Fe-based nanocrystalline alloys*,$501,401
Torch Project	**Li, S., Chu, D., Wang, D.,** *Climate responsive transmission lines*, $998,400
Torch Project	**Li, S., Chu, D., Wang, D.,** *Graphene enhanced performance of transmission power cables and High performance power grid scaled graphene supercapacitors*, $2,575,000
Torch Project	**Li, S., Chu, D., Wang, D.,** *Transparent conductive ceramic thin films,* $577,187
UNSW Research Infrastructure Scheme	**Chu, D., Ferry, M., Sorrell, C.C., Standard, O.**, Uddin, A., Walsh, W.R., **Li, S.**, Faculty Infrastructure Project: Specialized Glove Box Workstation for Synthesis of Atmosphere-Sensitive Materials for 3D and Thin Film Printing, $100,000
UNSW Research Infrastructure Scheme	Hamilton, A., **Joshi, R.K., Sharma, N.**, Ulrich, C., **Seidel, J.**, *Faculty Infrastructure Project: Flexible modular multilayer sputtering system*, $77,760
UNSW Research Infrastructure Scheme	**Joshi, R.K., Pahlevani, F., Prasad, D.K., Rajarao, R., Sahajwalla, V.H.**, *Faculty Infrastructure Project: Hyphenated Thermal Analyzer*, $54,960
UNSW Research Infrastructure Scheme	Kruzic, J.J., Chun, W., **Ferry, M., Laws, K.J., Primig, S.**, Walsh, B., Tilley, R., *Mechanical Testing Stage for use in an environmental scanning electron microscope*, $37,875
UNSW Research Infrastructure Scheme	Kruzic, J.J., **Laws, K.J., Primig, S., Ferry, M.**, *Network Lab: Technical Support Engineer*, $180,008
UNSW Research Infrastructure Scheme	**Li, S., Sahajwalla, V., Munroe, P., Ferry, M., Zhang, J.**, Lennon, A., Green, M., Hao, X., Thomas, T., Tilley, R., *Low energy argon milling system for TEM preparation*, $273,000
UNSW Research Infrastructure Scheme	**Sorrell, C.C.**, Ulrich, C., **Wang, D., Yang, R., Daniels, J.E.**, *Faculty Infrastructure Project: Particle Size Analyser with wet and dry dispersion units*, $150,902

2016 Publications

Journal Papers

1. Wahyudi H, Chu K, Yu A, *3D particle-scale modeling of gas-solids flow and heat transfer in fluidized beds with an immersed tube*, International Journal of Heat and Mass Transfer, Vol. 97, pp 521-537, 2016
2. Rajarao R, Sahajwalla V, *A cleaner, sustainable approach for synthesising high purity silicon carbide and silicon nitride nanopowders using macadamia shell waste*, Journal of Cleaner Production, Vol. 133, pp 1277-1282, 2016
3. Ye J, Zhang R, Nielsen S, Joseph SD, Huang D, Thomas T, *A combination of biochar-mineral complexes and compost improves soil bacterial processes, soil quality, and plant properties*, Frontiers in Microbiology, Vol. 7, No. 372, 2016
4. Mawad D, Mansfield C, Lauto A, Perbellini F, Nelson GW, Tonkin J, Bello SO, Carrad DJ, Micolich AP, Mahat MM, Furman J, Payne DJ, Lyon AR, Gooding JJ, Harding SE, Terracciano CM, Stevens MM, *A conducting polymer with enhanced electronic stability applied in cardiac models*, Science Advances, Vol. 2, No. 1601007, 2016
5. Zhao FA, Xiao HY, Liu ZJ, Li S, Zu XT, *A DFT study of mechanical properties, thermal conductivity and electronic structures of Th-doped $Gd_2Zr_2O_7$*, Acta Materialia, Vol. 121, pp 299-309, 2016
6. Sando D, Xu B, Bellaiche L, Nagarajan V, *A multiferroic on the brink: Uncovering the nuances of strain-induced transitions in $BiFeO_3$*, Applied Physics Reviews, Vol. 3, No. 11106, 2016
7. Neuefeind J, Skov AL, Daniels JE, Honkimäki V, Jakobsen B, Oddershede J, Poulsen HF, *A multiple length scale description of the mechanism of elastomer stretching*, RSC Advances, Vol. 6, pp 95910-95919, 2016
8. Hossain MJ, Wang L, Wang Z, Khansur NH, Hinterstein M, Kimpton JA, Daniels JE, *A sample cell for in situ electric-field-dependent structural characterization and macroscopic strain measurements*, Journal of Synchrotron Radiation, Vol. 23, pp 694-699, 2016
9. Rajagopal RR, Aravinda LS, Rajarao R, Bhat BR, Sahajwalla V, *Activated carbon derived from non-metallic printed circuit board waste for supercapacitor application*, Electrochimica Acta, Vol. 211, pp 488-498, 2016
10. Laws KJ, Granata D, Loeffler JF, *Alloy design strategies for sustained ductility in Mg-based amorphous alloys - Tackling structural relaxation*, Acta Materialia, Vol. 103, pp 735-745, 2016
11. Mahjoub R, Laws KJ, Hamilton NE, Granata D, Ferry M, *An atomic-scale insight into the effects of hydrogen microalloying on the glass-forming ability and ductility of Zr-based bulk metallic glasses*, Computational Materials Science, Vol. 125, pp 197-205, 2016
12. Zhang J, Zhang G, Ostrovski O, *An experimental investigation of the gasification of graphite by carbon dioxide*, Canadian Metallurgical Quarterly, Vol. 55, pp 104-111, 2016
13. Arsecularatne JA, Chung NR, Hoffman M, *An in vitro study of the wear behaviour of dental composites*, Biosurface and Biotribology, Vol. 2, pp 102-113, 2016
14. Lee BH, Kim SI, Kim SM, Oh DH, Gupta S, Jeon CH, *Ash deposition characteristics of Moolarben coal and its blends during coal combustion*, Korean Journal of Chemical Engineering, Vol. 33, pp 147-153, 2016
15. Liu L, Knapp M, Ehrenberg H, Fang L, Fan H, Schmitt LA, Fuess H, Hoelzel M, Dammak H, Thi MP, Hinterstein M, *Average vs. local structure and composition-property phase diagram of $K_{0.5}Na_{0.5}NbO_3$-$Bi_{1/2}Na_{1/2}TiO_3$ system*, Journal of the European Ceramic Society, Vol. 37, pp 1387-1399, 2016
16. Kim YC, Jeon NJ, Noh JH, Yang WS, Seo J, Yun JS, Ho-Baillie A, Huang S, Green MA, Seidel J, Ahn TK, Seok SI, *Beneficial Effects of PbI_2 Incorporated in Organo-Lead Halide Perovskite Solar Cells*, Advanced Energy Materials, Vol. 6, No. 1502104, 2016
17. Liu X, Zheng J, Zhang D, Cheng K, Zhou H, Zhang A, Li L, Joseph S, Smith P, Crowley D, Kuzyakov Y, Pan G, *Biochar has no effect on soil respiration across Chinese agricultural soils*, Science of the Total Environment, Vol. 554-555, pp 259-265, 2016
18. Zhang D, Pan G, Wu G, Kibue GW, Li L, Zhang X, Zheng J, Zheng J, Cheng K, Joseph S, Liu X, *Biochar helps enhance maize productivity and reduce greenhouse gas emissions under balanced fertilization in a rainfed low fertility inceptisol*, Chemosphere, Vol. 142, pp 106-113, 2016
19. Nair AK, Thazhe Veettil V, Kalarikkal N, Thomas S, Kala MS, Sahajwalla V, Joshi RK, Alwarappan S, *Boron doped graphene wrapped silver nanowires as an efficient electrocatalyst for molecular oxygen reduction*, Scientific Reports, Vol. 6, No. 37731, 2016
20. Maroufi S, Ciezki G, Jahanshahi S, Ostrovski O, *Carbothermal reduction of iron and silicon oxides in ironstone ore*, Transactions of the Institutions of Mining and Metallurgy, Section C: Mineral Processing and Extractive Metallurgy, Vol. 125, pp 86-94, 2016
21. Khanna R, Ikram-Ul-Haq M, Seetharaman S, Sahajwalla V, *Carbothermic Reduction of Alumina at 1823 K: On the Role of Molten Iron and Reaction Mechanisms*, ISIJ International, Vol. 56, pp 1300-1302, 2016
22. Tong Z, Zhong W, Yu A, Chan HK, Yang R, *CFD-DEM investigation of the effect of agglomerate-agglomerate collision on dry powder aerosolisation*, Journal of Aerosol Science, Vol. 92, pp 109-121, 2016
23. Tong ZB, Yang RY, Yu AB, *CFD-DEM study of the aerosolisation mechanism of carrier-based formulations with high drug loadings*, Powder Technology, Vol. 314, pp 620-626, 2016
24. Zhou T, Li L, Zhang X, Zheng J, Zheng J, Joseph S, Pan G, *Changes in organic carbon and nitrogen in soil with metal pollution by Cd, Cu, Pb and Zn: A meta-analysis*, European Journal of Soil Science, Vol. 67, pp 237-246, 2016
25. Xing X, Rogers H, Zhang G, Hockings K, Zulli P, Ostrovski O, *Changes in Pore Structure of Metallurgical Cokes under Blast Furnace Conditions*, Energy and Fuels, Vol. 30, pp 161-170, 2016
26. Maroufi S, Ciezki G, Jahanshahi S, Ostrovski O, *Characterisation and reduction of ironstone ore by CO gas*, Transactions of the Institutions of Mining and Metallurgy, Section C: Mineral Processing and Extractive Metallurgy, Vol. 125, pp 95-102, 2016
27. Farzana R, Rajarao R, Sahajwalla V, *Characteristics of waste automotive glasses as silica resource in ferrosilicon synthesis*, Waste Management and Research, Vol. 34, pp 113-121, 2016
28. Taherymoosavi S, Joseph S, Munroe P, *Characterization of organic compounds in a mixed feedstock biochar generated from Australian agricultural residues*, Journal of Analytical and Applied Pyrolysis, Vol. 120, pp 441-449, 2016
29. Rahman MM, Jiang Z-T, Munroe P, Chuah LS, Zhou Z-F, Xie Z, Yin CY, Ibrahim K, Amri A, Kabir H, Haque MM, Mondinos N, Altarawneh M, Dlugogorski BZ, *Chemical bonding states and solar selective characteristics of unbalanced magnetron sputtered $Ti_xM_{1-x-y}N_y$ films*, RSC Advances, Vol. 6, pp 36373-36383, 2016
30. Zhang Q, Sando D, Nagarajan V, *Chemical route derived bismuth ferrite thin films and nanomaterials*, Journal of Materials Chemistry C, Vol. 4, pp 4092-4124, 2016

31. Ievlev AV, Maksymovych P, Trassin M, Seidel J, Ramesh R, Kalinin SV, Ovchinnikova OS, *Chemical State Evolution in Ferroelectric Films during Tip-Induced Polarization and Electroresistive Switching*, ACS Applied Materials and Interfaces, Vol. 8, pp 29588-29593, 2016

32. Xing X, Rogers H, Zhang G, Hockings K, Zulli P, Ostrovski O, *Coke degradation under simulated blast furnace conditions*, ISIJ International, Vol. 56, pp 786-793, 2016

33. Du H, Lin X, Zheng H, Qu B, Huang Y, Chu D, *Colossal permittivity in percolative ceramic/metal dielectric composites*, Journal of Alloys and Compounds, Vol. 663, pp 848-861, 2016

34. Sharma N, Bahri OKA, Han MH, Gonzalo E, Pramudita JC, Rojo T, *Comparison of the structural evolution of the O_3 and P_2 phases of $Na_{2/3}Fe_{2/3}Mn_{1/3}O_2$ during electrochemical cycling*, Electrochimica Acta, Vol. 203, pp 189-197, 2016

35. Gain AK, Zhang L, Quadir MZ, *Composites matching the properties of human cortical bones: the design of porous titanium-zirconia (Ti-ZrO_2) nanocomposites using polymethyl methacrylate powders*, Materials Science & Engineering A, Vol. 662, pp 258-267, 2016

36. Khansur NH, Benton R, Dinh TH, Lee J-S, Jones JL, Daniels JE, *Composition dependence of electric-field-induced structure of $Bi_{1/2}(Na_{1-x}K_x)_{1/2}TiO_3$ lead-free piezoelectric ceramics*, Journal of Applied Physics, Vol. 119, No. 234101, 2016

37. Zhou Y, Lin Q, Liu W, Wang D, *Compositional dependence of electrocaloric effect in lead-free (1 - x)$Ba(Zr_{0.2}Ti_{0.8})O_3$-x$(Ba_{0.7}Ca_{0.3})TiO_3$ ceramics*, RSC Advances, Vol. 6, pp 14084-14089, 2016

38. Ghodrat M, Qi Z, Kuang SB, Ji L, Yu AB, *Computational investigation of the effect of particle density on the multiphase flows and performance of hydrocyclone*, Minerals Engineering, Vol. 90, pp 55-69, 2016

39. Cayumil R, Khanna R, Rajarao R, Mukherjee PS, Sahajwalla V, *Concentration of precious metals during their recovery from electronic waste*, Waste Management, Vol. 57, pp 121-130, 2016

40. Hu W, Xu J, Lu X, Hu D, Tao H, Munroe P, Xie Z-H, *Corrosion and wear behaviours of a reactive-sputter-deposited Ta_2O_5 nanoceramic coating*, Applied Surface Science, Vol. 368, pp 177-190, 2016

41. Xu J, Huang HJ, Li Z, Xu S, Tao H, Munroe P, Xie ZH, *Corrosion behavior of a ZrCN coated Ti alloy with potential application as a bipolar plate for proton exchange membrane fuel cell*, Journal of Alloys and Compounds, Vol. 663, pp 718-730, 2016

42. Kumar A, Khanna R, Ikram-Ul-Haq M, Spink J, Sahajwalla V, *Corrosion Behavior of Al_2O_3-C Refractories with Casting Mould Meniscus Slags at 1550°C*, Steel Research International, Vol. 87, pp 46-56, 2016

43. Yun JS, Seidel J, Kim J, Soufiani AM, Huang S, Lau J, Jeon NJ, Seok SI, Green MA, Ho-Baillie A, *Critical Role of Grain Boundaries for Ion Migration in Formamidinium and Methylammonium Lead Halide Perovskite Solar Cells*, Advanced Energy Materials, Vol. 6, No. 1600330, 2016

44. Yang J, Zhang J, Sasaki Y, Ostrovski O, Zhang C, Cai D, Kashiwaya Y, *Crystallization Behavior and Heat Transfer of Fluorine-Free Mold Fluxes with Different Na_2O Concentration*, Metallurgical and Materials Transactions B: Process Metallurgy and Materials Processing Science, Vol. 47, pp 2447-2458, 2016

45. Beuerlein MA, Kumar N, Usher T-M, Brown-Shaklee HJ, Raengthon N, Reaney IM, Cann DP, Jones JL, Brennecka GL, *Current Understanding of Structure–Processing–Property Relationships in $BaTiO_3$–Bi(M)O_3 Dielectrics*, Journal of the American Ceramic Society, Vol. 99, pp 2849-2870, 2016

46. Lim KL, Liu Y, Zhang QA, Lin KS, Chan SLI, *Cycle stability improvement of La-Mg-Ni based alloys via composite method*, Journal of Alloys and Compounds, Vol. 661, pp 274-281, 2016

47. Kurnia F, Ng YH, Amal R, Valanoor N, Hart JN, *Defect engineering of ZnS thin films for photoelectrochemical water-splitting under visible light*, Solar Energy Materials and Solar Cells, Vol. 153, pp 179-185, 2016

48. Xie Q, Chen Z, Hou Q, Yu AB, Yang R, *DEM investigation of heat transfer in a drum mixer with lifters*, Powder Technology, Vol. 314, pp 175-181, 2016

49. Wang L, Quadir MZ, Aguey-Zinsou KF, *Direct and reversible hydrogen storage of lithium hydride (LiH) nanoconfined in high surface area graphite*, International Journal of Hydrogen Energy, Vol. 41, pp 18088-18094, 2016

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51. Hou Q, Dianyu E, Yu A, *Discrete particle modeling of lateral jets into a packed bed and micromechanical analysis of the stability of raceways*, AIChE Journal, Vol. 62, pp 4240-4250, 2016

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53. Walker J, Simons H, Alikin DO, Turygin AP, Shur VY, Kholkin AL, Ursic H, Bencan A, Malic B, Nagarajan V, Rojac T, *Dual strain mechanisms in a lead-free morphotropic phase boundary ferroelectric*, Scientific Reports, Vol. 6, No. 19630, 2016

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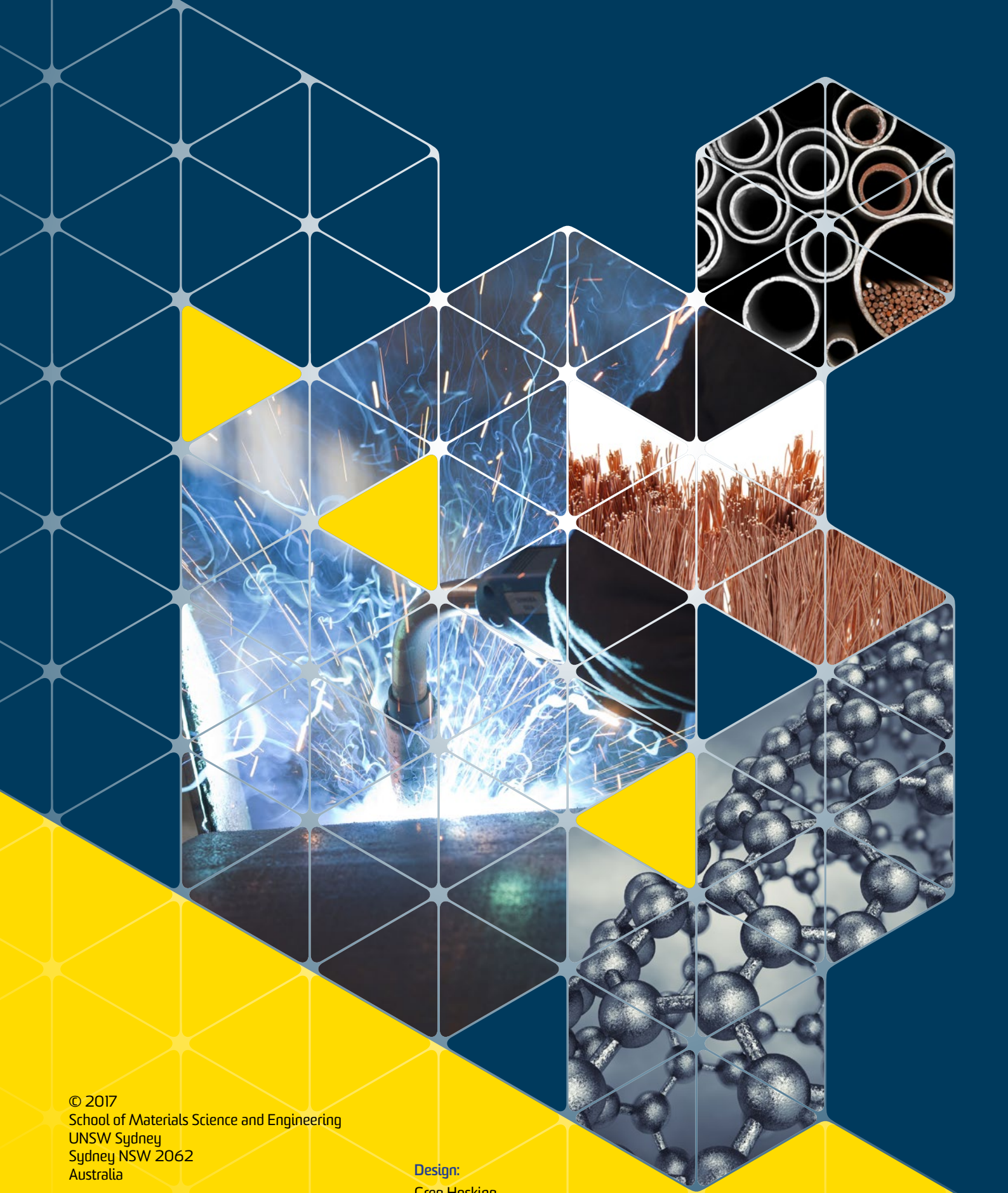

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