UNSW SYDNEY | Australia's Global University

SCHOOL OF MATERIALS SCIENCE & ENGINEERING

ANNUAL REPORT 2021

HoS welcome

PROFESSOR MICHAEL FERRY
HEAD OF SCHOOL

I am delighted to introduce the School of Materials Science and Engineering 2021 Annual Report.

I wish to express my sincere thanks to all students, staff and colleagues for their incredible support as the School navigated through another difficult year of COVID-19.

The year was punctuated by several local and widespread lockdowns, resulting in the complete lockdown of the Greater Sydney area from late-June to October, including some particularly severe restrictions for many of our staff and students living in various local government areas.

Throughout the year, the School's laboratories remained open, but on a very restricted basis. This required the highest standards of workplace safety and continued implementation of our myriad safety initiatives developed for minimising infections throughout the School. A special thanks goes out to the School's WHS Committee and our students and staff for ensuring safety at all times.

To accommodate a hybrid delivery mode for all School courses, we are formulating an optimal balance of on-campus and remote learning activities, supported by a suite of new educational technology equipment and software packages. Such an approach appears to be well-received by our students, judging by School's excellent myExperience Teaching scores and feedback. I thank all teaching and support staff for their ongoing effort in creating such a stimulating and interactive experience for our students during a period of major change.

While COVID-19 continues to pose an ongoing risk, the successful vaccination rollout throughout the year has enabled us to move gradually beyond lockdowns and the strict social distancing measures of the past few years.

The University is cautiously optimistic that next year will be a major turning point, and it will be great to see the campus come back to life via a balance of face-to-face and online learning and on-campus social activities. However, our thoughts go out to our international students who currently remain overseas. We hope they can make it to UNSW in the very near future.

The School continued to perform strongly across UNSW's three pillars of Educational and Research Excellence, and Social Impact, Engagement & Leadership. The various achievements of our students and staff are highlighted throughout this report.

The School is exceptionally proud of our students' myriad achievements. This report highlights several of their recent achievements and awards, including our undergraduate prize winners, Industry Training poster presentation evening winners and award winners in the Materials Australia annual student thesis competition.

The School thanks our 2021 undergraduate (MATSOC) and postgraduate (PGSOC) society presidents, Scott Jones and Yue Jiang, together with members of their Executive Committees for their incredible effort throughout the year in keeping our students actively engaged via a range of exciting online and in-person social activities and events. We warmly welcome the incoming 2022 Executive Committees led by Scott for the second year and Hien Nguyen who will continue the momentum of the past few years.

Highlights of our student society events are provided in this report, including MATSOC's collaborative camp and cruise, online Trivia Night and Games Nights, Industry Panel Night, Industrial Site Visits, MATSOC/PGSOC Movie Night, and PGSOC's Confidence Workshop, Alumni Career Workshop, Mid-Year society Lunch, Term 3 Welcome BBQ, and the Online Student Support Platform. A particular highlight to end the year was our on-campus undergraduate and postgraduate Christmas celebrations attended by both students and staff.

Our staff continue to cement their internationally leading reputations for scientific and engineering research excellence. Professor Tom Wu once again made the prestigious list of Clarivate Highly Cited Researchers. Staff were also very successful with research funding from myriad sources spanning fundamental to translational research. In the esteemed ARC scheme, staff received three Discovery grants, three Linkage grants, two LIEF grants and several staff are chief investigators on two newly-funded ARC Research Hubs and an ARC Training Centre. This is a wonderful achievement for our modest-sized School. A research update from each of our four societal theme leaders, through to a complete summary of staff and student research funding and publications, are contained herein.

The School celebrated several more academic staff promotions in 2021. We congratulate Peggy Zhang for her promotion to Lecturer and to Rakesh Joshi and Farshid Pahlevani for their promotions to Associate Professor! These achievements are based on very strong performances in teaching, research and service, engagement &

leadership. We also welcome two new academic staff members - Drs Samane Maroufi (Sustainable Materials & Processes) and Jack Yang (Computational Materials Science) - to the School!

A major highlight to end the year was the wonderful news that Scientia Professor Veena Sahajwalla was named the 2022 NSW Australian of the Year! The School is very proud of Veena's myriad achievements, with this most recent accolade further highlighting her ongoing leadership as a remarkable Australian Scientist and Engineer!

In summary, despite the challenges faced, the School remains in a strong position and is delivering excellent outcomes on all fronts.

I close by thanking Nicole Cooney and various other staff and students for producing this annual report. I hope you enjoy reading about our various achievements in 2021.

PROFESSOR MICHAEL FERRY

HEAD OF SCHOOL

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95 MASTERS BY COURSEWORK

123 HIGHER DEGREES STUDENTS

30 ACADEMIC STAFF

$1,755,999 STRATEGIC
UNSW INCOME 2021

$8,482,812
RESEARCH FUNDING

1 ARC LAUREATE
FELLOW

3 SCIENTIA
FELLOWS

124 UNDERGRADUATES

20 PROFESSIONAL
& TECHNICAL STAFF

20 RESEARCH
STAFF

academic staff

HONORARY PROFESSOR SAMMY CHAN

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

ASSOCIATE DIRECTOR OF EMU ASSOCIATE PROFESSOR SHERY CHANG

Shery Chang joined UNSW in 2020 as an Associate Professor and Associate Director of the Electron Microscope Unit, Mark Wainwright Analytical Centre. Her research uses state-of-the-art transmission electron microscopy and spectroscopy to study structure-property relationships in a range of advanced functional materials, including nano-photonics materials, wide bandgap materials and nano catalysts. In addition, she is developing new strategies to enable an understanding of material properties over multiple length and energy scales, including machine learning of big data sets, as well as correlative, multi-modal strategies.

EMERITUS PROFESSOR ALAN CROSKY

Alan's research focuses on the effect of structure (both micro and macro) on mechanical behaviour. 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.

PROFESSOR DEWEI CHU

Dewei's research interests include design, fabrication and printing of metal oxides and suflides based nanoionic materials for nanoelectronics (including sensors, memories and transistors), as well as energy storage and conversion materials (including supercapacitor electrodes, solid-state electrolytes, and electro-catalysts). His group targets to develop solution processed, printable and flexible nanoionic materials for cost-effective and energy-efficient wearable electronics.

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.

Lecturer **Dr Caitlin Healy**

Caitlin's research interests are the design, development and characterisation of new metallic alloys. With a focus on single phase high entropy alloys and using the compositionally complex designs to enhance binary intermetallics.

Head of School **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.

Senior Lecturer **Dr Rakesh Joshi**

Dr Rakesh Joshi FRSC AFIChemE is a Senior Lecturer at the School of Materials Science and Engineering and leading a Graphene Research Group. He is the Fellow of the Royal Society of Chemistry (FRSC), A/Fellow of the Institution of Chemical Engineers (AFIChemE) and among a select group of researchers who have been awarded each of the world's most prestigious relevant International Research Fellowships; the JSPS Invitation Fellowship; the Humboldt Fellowship and the Marie Curie International Fellowship. He is currently leading various industry funded research projects on application. His research interest includes experiment design for application of graphene and 2D materials, membranes, separation and purification, diffusion mechanism.

Senior 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.

ARC Future Fellow & Scientia Fellow **Associate Professor Dr Kris Kilian**

Kris's research group explores how natural and synthetic materials influence the signalling that controls cell fate and function. Combining both 'soft' and 'hard' materials chemistry with nano- and micro-fabrication techniques, they specialise in designing and developing synthetic tissue models to more accurately explore cell signalling and tissue assembly across numerous physiological and pathological conditions including development and cancer.

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.

academic STAFF

SENIOR LECTURER
DR DAMIA MAWAD

Damia's research interests are in conductive polymers as active materials in flexible organic bioelectronic devices. She leads a multidisciplinary research team that brings expertise in chemistry, physics and material science aimed at developing chemical strategies and electronic circuitry towards the realisation of flexible bioelectronics with advanced functionalities.

NHMRC EARLY CAREER FELLOW
SCIENTIA SENIOR LECTURER
TUSHAR KUMERIA

Tushar is a Scientia Senior Lecturer and an Australian National Health and Medical Research Council (NHMRC) Early Career Fellow with the School. He has co-authored over 84 journal publications in top-tier journals in the field of nanomaterials, biomaterials, drug delivery, and sensing. Tushar has been successful in securing over $3.6 million in competitive research grants including an NHMRC fellowship, 2 ARC Discovery projects, a US. Dept of Defence grant, and several others. Tushar's group focuses on: 1. Porous materials-based drug delivery systems for efficient and targeted delivery. 2. Porous materials/Polymer composite scaffolds and implants for tissue engineering. 3. Porous photonic crystals-based point-of-care sensors for diagnostics and environmental applications.

DR. SAMANE MAROUFI

Dr. Samane Maroufi is Lecturer at School of Materials Science and Engineering, UNSW where she teaches and conducts research. Her research spaces across the fields of high temperature pyrometallurgical processing, sustainability of materials process (waste recycling and materials transformation) and synthesizing nano-structure materials from waste for energy storage devices. As an expert on innovative green solutions for waste challenges, she has considerable experience of working closely with industries, leading industrial projects in SMaRT Centre, and incorporating research into the manufacturing industry. Since 2018, Samane has made a significant contribution to education through teaching, fully designing, developing, and delivering courses related to waste recycling and sustainability. Reflecting on her teaching pedagogy and practice earned her recognition against global standards as a Fellow of the Higher Education Academy (FHEA), awarded by Advance HE in 2021 and she was also the recipient of 2022 UNSW Vice-Chancellor award for outstanding contributions to student learning (early career).

DIRECTOR OF MATERIALS AND MANUFACTURING FUTURES INSTITUTE
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.

Deputy Dean - Research
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.

Lecturer Benjamin Pace

Dr Ben Pace joins us as an Education Focused Lecturer, with a teaching focus primarily in foundational materials science and sustainable materials. He also maintains a number of research interests spanning the range of thin film deposition technologies, particularly for highly tailored mechanical, biomedical and electrical/energy applications such as photovoltaics. More broadly, Ben maintains a strong interest and publishes in the: 1. Characterisation of coating morphology and behaviours, and; 2. Exploration of micro and nanoscale interactions that occur at interfaces between organic and metallic or mineral phases in composite products, biochars, soils and plant matter.

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.

ARC DECRA Fellow & Scientia Fellow Associate Professor Sophie Primig

Sophie's current research contributions are in processing-structure-property relationships of structural metallic materials for high-performance applications such as aerospace. Currently, these materials include Ni-based superalloys and advanced steels processed by industrial forging or metal 3D printing. She combines state-of-the-art microscopy techniques with mechanical testing and contemporary modelling approaches. Her research philosophy is to achieve a balance between fundamental discovery and industrial application.

Director - SMART Centre, ARC Laureate Fellow Scientia Professor Veena Sahajwalla

As a leading expert in the field of recycling science, and founding Director of the Centre for Sustainable Materials Research & Technology at UNSW, Professor Veena Sahajwalla is producing a new generation of green materials, products and resources made entirely, or primarily, from waste. Veena also heads the ARC Industrial Transformation Research Hub for 'green manufacturing' – a leading national research centre that works in collaboration with industry to ensure new science is translated into real world environmental and economic benefits. Veena has been extensively recognised for the innovation and significance of her work, including via election to be a Fellow of the esteemed Australian Academy of Science.

academic staff

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.

PROFESSOR CHRIS SORRELL

The main focus of Chris's research has been the processing of ceramics, including fabrication, forming, and densification of bulk materials, thick films, and thin films. While his overarching approach is the use of phase equilibria to inform his strategies, his emphasis on publications is the elucidation of phenomenological mechanisms underpinning the data. His current research is focussed on chemocatalytic, biocatalytic, and photocatalytic nanomaterials for energy, environmental, and biomedical applications.

DEPUTY HEAD OF SCHOOL, SENIOR LECTURER DR OWEN STANDARD

Owen's research is in the processing/microstructure/property relationship ofadvanced 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.

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. Nagy is also our postgraduate coordinator.

ASSOCIATE PROFESSOR DANYANG WANG

Danyang's most significant contribution is in the field of growth and characterization of functional oxide thin films and heterostructures for nanoelectronic and energy applications. Areas of research include thin film technology, functional materials and devices, micro/nanofabrication techniques, heterointerface effects.

PROFESSOR TOM WU

Tom's research focuses on the vapour- and solution-based synthesis of transition-metal oxides and hybrid halide perovskites, in the forms of thin films, nanomaterials and mixed-dimensional nanocomposites. His team is interested in exploring composition-structure-property correlations in emerging materials, targeting at diverse disruptive electronic, data storage and energy conversion technologies.

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 behaviour of particles through rigorous modelling and simulation at microscopic and macroscopic levels. This knowledge is then applied to solving problems in various industrial applications.

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 CO2, metal dusting reactions and water vapour effects on oxidation.

LECTURER JIANLIANG (JACK) YANG

Jack is Lecturer in Material Studies with Artificial Intelligence at the School of Material Science and Engineering and Materials and Manufacturing Futures Institute, UNSW. He is also a member of the Research technology Service Team under the office of the Pro-Vice-Chancellor (Research Infrastructure) at UNSW, to provide support for computational research on HPC across the University. Jack obtained his BSc(Nanotech) in 2008 and PhD in 2011 from UNSW. Before returning to UNSW in 2017, Jack had been Postdoctoral Research Fellow in Westfälische Wilhelms-Universität Münster, Germany and University of Southampton, UK where he worked on developing new structure prediction and machine-learning methods for discovering new functional organic materials. Currently, Jack is leading his own group in AI-driven material studies in UNSW with major research interests on the electron and phonon dynamics in perovskites for electronic, photovoltaics, energy storage and catalytic applications.

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.

SCHOOL STAFF

RESEARCH STAFF

Postdoctoral Fellow	Ghazaleh Bahman Rokh
Research Associate	Vivasha Govinden
Postdoctoral Fellow	Nima Haghdadi
Research Associate	Rasoul Khayyam Nekouei
Research Assistant	Ganesh Kokil
Senior Research Fellow	Pramod Koshy
Research Associate	Mengyao Li
Postdoctoral Fellow	Chun-Ho Lin
Postdoctoral Fellow	Tiziana Musso
Associate Professor	Farshid Pahlevani
Industry Engagement Executive	Bo Qu
Senior Research Associate	Daniel Sando
Research Associate	Sajjad Seifi Mofarah
Postdoctoral Fellow	Peggy Schoenherr
Postdoctoral Fellow	Chuhan Sha
Research Associate	Pankaj Sharma
Research Fellow	Sara Taherymoosavi
Postdoctoral Fellow	Felix Theska
Postdoctoral Fellow	Tao Wan
Research Fellow	Martin Xu
Postdoctoral Fellow	Dawei Zhang
Postdoctoral Fellow	Ji Zhang
Research Associate	Qi (Peggy) Zhang

TECHNICAL STAFF

Technical Officer	Soo Woon Chong
ITC Support Officer	Jane Gao
Technical Officer	Anirban Ghose
Technical Officer	William (Bill) Joe
Technical Officer	Xi Lin
Laboratory Manager	Irshad Mansuri
Technical Officer	David Miskovic
Research Officer	Thuan Nguyen
Senior Research Scientist	Thiam Teck (Tt) Tan
Technical Officer	George Yang
Safety Officer	Anthony Zhang
Technical Officer	Qi (Peggy) Zhang

ADMINISTRATIVE STAFF

Administrative Officer	Alan Chow
Projects Officer/ Executive Assistant To HOS	Nicole Cooney
Executive Assistant To Prof Sean Li	Kim Foster
Student Advisor	Michael Lai
Research & Administration Assistant, Smart	Peggy Leung
Community & Engagement Officer	Marcus Wong
Research Support Officer	Qing Xia
School Manager	Lucy Zhang

INDUSTRY ADVISORY BOARD

UNIVERSITY REPRESENTATIVES:

ANSTO	Lyndon Edwards
BG&E	Sean Windred
Bluescope	Jason Hodges
Brickworks Ltd	Cathy Inglis – Chair
Cochlear	Steven Kennedy
Emescent	Holstein Wong
HATCH	Michiel Freislich
Perfect Engineering	George Melhem
PGH Bricks and Pavers	Michael Gow
Rio Tinto	Adam Berkovich
Sustainable Business Aust.	Andrew Petersen
WEIR	Edward Humphries

UNIVERSITY REPRESENTATIVES:

Dean of Science, UNSW	Emma Johnston
HOS, MSE, UNSW	Michael Ferry
Deputy HOS, MSE, UNSW	Owen Standard
School Manager, MSE, UNSW	Lucy Zhang

SCHOOL COMMITTEES

SCHOOL BOARD

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Academic Staff
Professional Staff (Technical)
Professional Staff (Administrative)

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Owen Standard
John Daniels
Peggy Zhang
David Miskovic
Lucy Zhang

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Michael Ferry
Judy Hart
Caitlin Healy
Damia Mawad
Nagarajan Valanoor
Runyu Yang

RESEARCH COMMITTEE

Jan Seidal (Chair)
Michael Ferry
Dewei Chu
Rakesh Joshi
Kris Killian
Sean Li
Sophie Primig
Veena Sahajwalla

HIGHER DEGREE RESEARCH COMMITTEE

Nagarajan Valanoor (Chair)
John Daniels
Michael Ferry
Kris Killian
Damia Mawad
Danyang Wang
Runyu Yang
Jianqiang Zhang

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Owen Standard
Lucy Zhang

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Michael Ferry
Rakesh Joshi
Teresa Kahwati (Faculty Sci.)
Florence Lui (HDR)
David Miskovic
Owen Standard
Anthony Zhang (School Safety Officer)

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Michael Ferry
Ben Pace
Owen Standard
Lucy Zhang

SPACE COMMITTEE

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Lucy Zhang
Anthony Zhang

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Michael Ferry
Owen Standard
Lucy Zhang
Nicole Cooney
Scarlet Kong
Postgraduate Student (Tasmia Zaman)
Undergraduate Student (Naman Bansai)

WOMEN IN MATERIALS COMMITTEE

Judy Hart (Chair)
Caitlin Healy
Kris Kilian
Samane Maroufi

SCHOOL INFORMATION TECHNOLOGY COMMITTEE

Michael Ferry (Chair)
Paul Eccleston (UNSW IT)
Jan Gao (UNSW IT)
Kathleen Gray (FSci. IT Business Partner)
Owen Standard
Lucy Zhang

POSTGRADUATE COORDINATORS

Nagarajan Valanoor
Danyang Wang

UNDERGRADUATE PROGRAM COORDINATOR

Owen Standard

HONOURS PROJECTS COORDINATOR

Kevin Laws

MASTER BY COURSEWORK COORDINATOR

Runyu Yang

MISCONDUCT & GRIEVANCE OFFICER

Owen Standard

FACULTY UNDERGRADUATE ASSESSMENT

Owen Standard
Sammy Lap Ip Chan

OVERSEAS DEGREE PROGRAMS/ ASIA ENGAGEMENT

Sammy Lap Ip Chan

FACULTY ENTERPRISE COMMITTEE

Dewei Chu

OUR FINANCIAL PERFORMANCE IN 2021

OUR FINANCIAL PERFORMANCE

Second year into the pandemic, the Faculty received a 6% decrease on the last year's operating budget. This is comprised of the savings that are required for the reorganisation of the University and the resetting the of Science budget. School's 2021 budget includes a minimum people cost savings target of $200k to be achieved through a reduction in workforce. From the 2021 financial year, there is also change to transitional funding rules for external fellowships. We have been made aware that the rules around transitional funding are expected to change such that an academic employed on a continuing basis at the commencement of an external fellowship will no longer be eligible for transitional funding at the end of the fellowship. They will instead require to be fully funded from the School's operating budget immediately following the end of the external fellowship unless an alternative source of funding is secured. For us, the impact in 2021 is $160, 241.

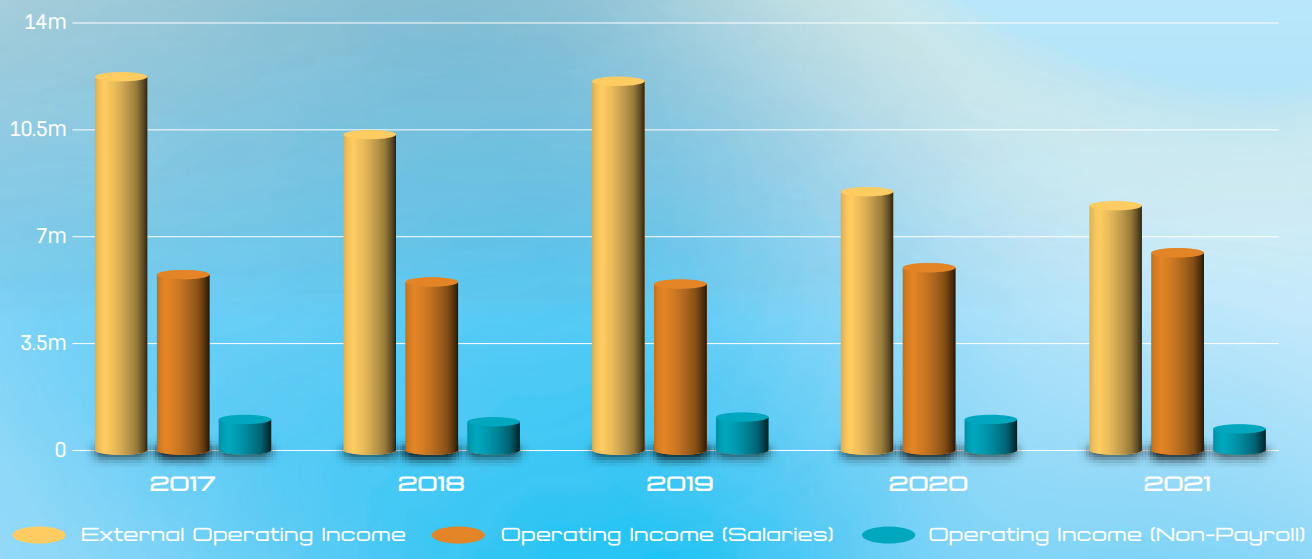
INCOME

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 2021 financial year, budget allocations have been made using our current budget allocation principles. It is still based on enrolment plan student load from local and international undergraduates, postgraduate course work and higher degree research students.

Research income is from research grants obtained from bodies outside the university. Past and current research performance, and future research potential, are incentivised and supported by the University through ***Strategic Funds***. Due to the pandemic border closure and geopolitical factors, our research income also experienced a slight downward dip.

INCOME



OPERATING INCOME

Operating income budgets have been derived from teaching revenue, research revenue from Commonwealth Government, indirect cost recoveries on contract research and other revenues projected from historical levels, adjusted for price and volume. Our allocated operating budget primarily is used for 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. Transitional fellow fund has been introduced to expect School to cover the gas over a three-year period.

This budget is also used to pay for casual teaching staff. Other major expenditure items are support of teaching laboratories, daily operational expenses, marketing and undergraduate recruitment, undergraduate scholarships, allocations to teaching staff based upon research supervision and various research outputs including publications and provide start-up funds for newly started staff. We have Dr Tushar Kumeria joined us in BioMaterials and Dr Ben Pace joined us as teaching focussed academic.

The table right shows the breakdown of School operating income. Due to Covid budget cut, we did not receive capex as allocation but we received allowed expenses to purchase a suite of teaching and research equipment and software in 2021, which benefited School tremendously in the next three to five years.

INCOME

University:		
Teaching	$11,359,215	
Other	$13,166	**$11,372,381**
Allocation to School:		
Operating Costs	$6,268,311	
Ring-fenced Scientia	$334,874	
Efficiency saving	-$200,000	
Confederated ShaRP	$431,815	
		$7,235,000

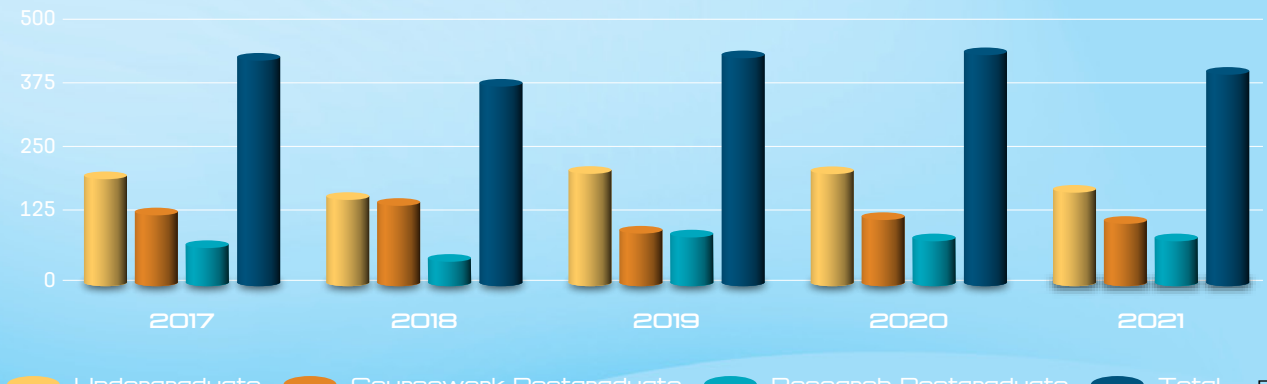
EXPENDITURE

Salaries	$6,451,962	
Non-salary	$879,026	
Capital expenses	$213,303	**$7,544,021**
Variance		$11,063,360

The primary driver for operating income at the School level is undergraduate and postgraduate teaching load. The graph below shows slight drop in our student numbers compared with pre Covid years. It is a universal phenomenon across the campus and in Australia.

Let us hope we will go through these difficult challenging years.

EQUIVALENT FULLTIME TEACHING UNITS (EFTSL)



OUR FINANCIAL PERFORMANCE IN 2021

UNSW STRATEGIC FUNDING

UNSW aspires to be Australia's global university, improving and transforming lives through excellence in research, outstanding education and a commitment to advancing a just society. Some of our staff are key players in the UNSW Materials and Manufacturing Futures Institute. As projects are approved, they are enabled financially through strategic allocation.

In 2021, these included:

Project Name	Project Manager	($)
SHARP hire	Tom Wu	431,815
Scientia Fellow Support	Tushar Kumeria	50,127
Scientia Fellow Support	Kristopher Kilian	20,901
Scientia Fellow Support Salary	Sophie Primig	219,526
Scientia Fellow Support	Sophie Primig	44,320
MMFI Special Fund	Danyang Wang	22,000
MMFI Special Fund	Jianliang Yang	14,000
MMFI Institute Special Fund	Charles Sorrell	10,000
DGSF	Danyang Wang	20,000
DGSF	Dewei Chu	40,000
DGSF	Sammy Chan	60,000
Fellow Transitional Fund	Dewei Chu	42,528
Fellow Transitional Fund	Claudio Cazorla	101,169
Strategic Research Support	Sean Li	245,710
Strategic Award Stephen Joseph	Paul Munroe	57,017
Strategic post Laureate	Veena Sahajwalla	309,492
SPF02 Materials	Various	101,750
SPF02 Covid Support	Nima Haghdadi	2,130
SPF02 Covid Support	Peggy Schoenherr	2,250
SPF02 Covid Support	Farshid Pahlevani	3,000
SPF02 Covid Support	Pankaj Sharma	4,000
SPF04 Materials	Various	112,450
Total:		**1,755,999**

RESEARCH INFRASTRUCTURE SCHEME

The University receives a Research Infrastructure Block Grant. Through competitive internal grant process, UNSW can provide a world-class research environment to attract and retain a critical mass of research excellence.

In 2021, the School was awarded the following major items:

Lead Chief Investigator	Project Title	Grant ($)
Danyang Wang	High-precision dicing saw	110,000
Rakesh Joshi	AEkiA for Surface Analysis	90,000
Jan Seidel	Scanning Thermal Microscope	70,000

ADDITIONAL CAPEX SUPPORT FROM THE FACULTY:

Software/Education Technology

ANSYS GRANTA EduPack materials selection software licenses for our undergraduate and post graduate teaching programs. (250 licenses) (Benjamin Pace)
Thermo-Calc software licenses for both undergraduates and postgraduates. (99 licenses)
Reindeer Graphics A QIA-64 Mac/PC Hybrid MSRP licenses for our computer teaching lab. (30 licenses) (Owen Standard)

Laboratory Equipment	Lab Manager
Secotom cutting machine for physical. metallurgy lab	George Yang
Tilt pour furnace for first year undergraduate experience lab	David Miskovic
Freezer dryer for general metallography lab.	David Yang
Tristar II Plus 3030 Surface area and pore size analyser	George Yang
Instron Mini Flexure Fixture	Bill Joe

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 many schools across the campus.

The table right shows the School's main expenditure items in 2021 after meeting the minimum people cost savings target.

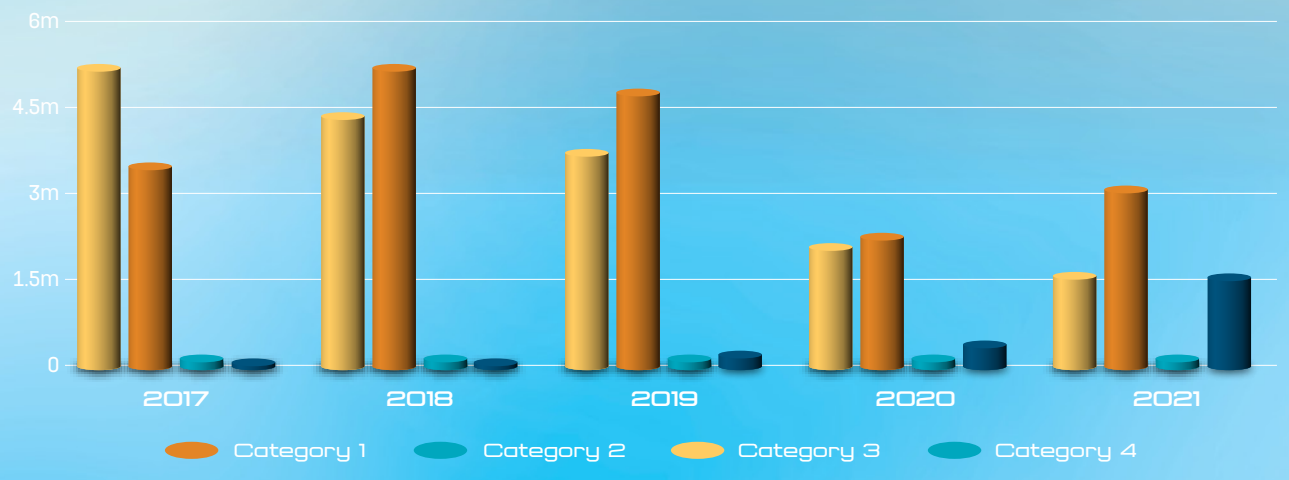
Item	*Amount ($)*
Student research allocations	100,000
Undergraduate scholarships	30,000
Publications allocation	100,000
Teaching laboratories	50,000
Safety	12,000
Staff start up	103,000
Education focused staff support	15,000
Early career research grant	22,000
School office	35,000
Marketing	15,000
Repair, maintenance & building utilities	25,000
Undergraduates association support	5,000
Postgraduates association support	5,000

RESEARCH INCOME

The School's research income comprises the largest fraction of the overall income of the School. Though our overall experienced slight drop possible due to the stalling geopolitical climate.

We had a successful outcome winning six new ARC Discovery Grants.

LUCY ZHANG *SCHOOL MANAGER*



UNDERGRADUATE STUDIES

UNDERGRADUATE PROGRAMS OFFERED

The main undergraduate degree program offered by the School is a Bachelor of Engineering Honours (BEHons) in Materials Science and Engineering. The program 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. In addition, the BEHons program is offered as formal structured combination with the following programs: Bachelor of Engineering Science in Chemical Engineering (BEHons/BSc); Bachelor of Commerce (BEHons/BCom); and a Master of Biomedical Engineering (BEHons/MBiomedE).

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, Functional Materials, Physical Metallurgy, or Process Metallurgy by selection of appropriate professional electives in Years 3 and 4 and an appropriate Honours research project in Year 4.

The School also offers a major in Materials Science in the Bachelor of Science (BSc) coordinated by the Faculty of Science. 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 Engineering, Bachelor of Arts, Bachelor of Law, etc. The major in Materials Science is also offered in the 4-year Bachelor of Advanced Science Honours (BAdvScHons) coordinated by the Faculty of Science.

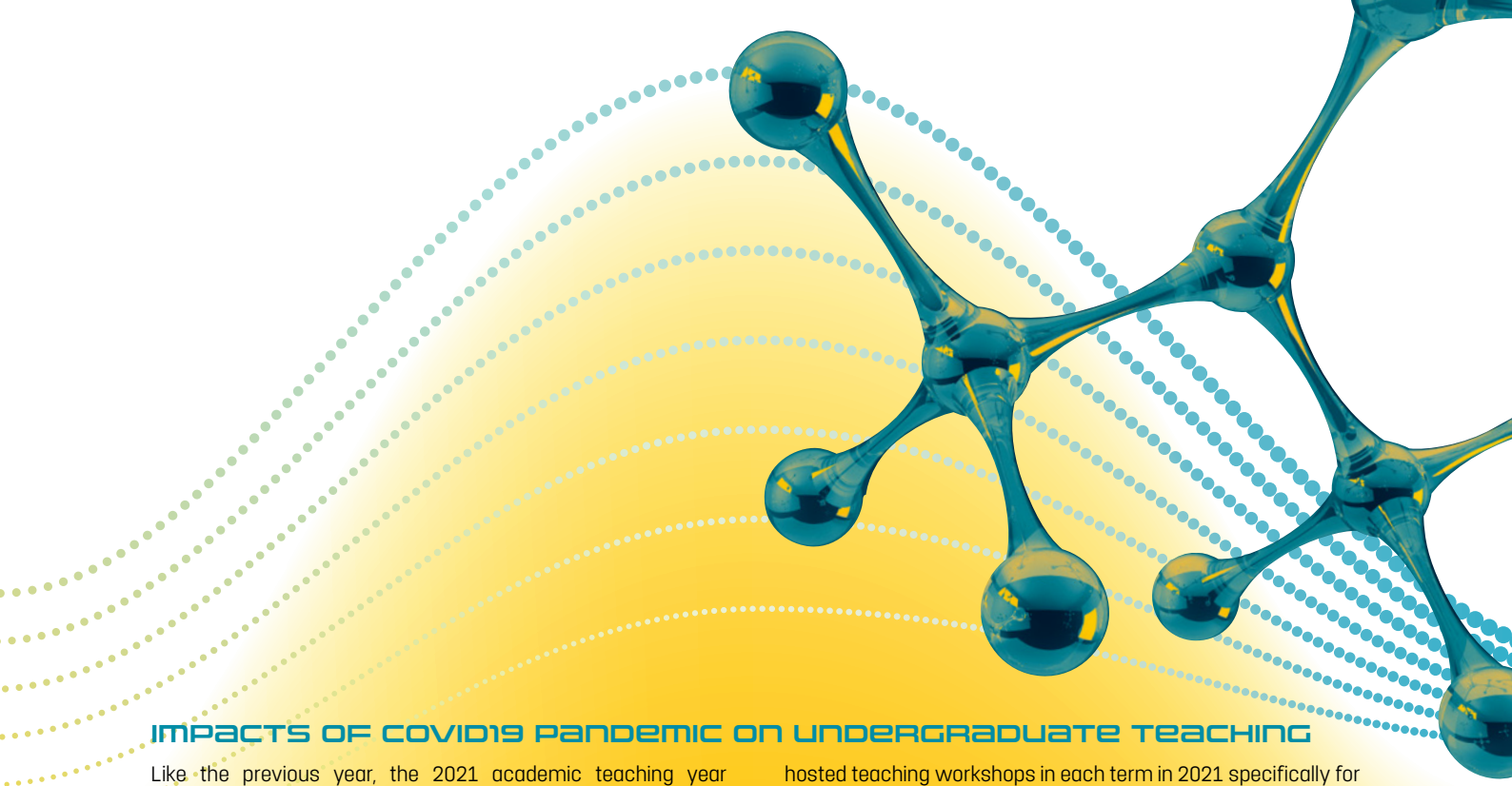
The primary aim of the School's undergraduate programs is to deliver graduates possessing the fundamental knowledge, skills, and capabilities needed to succeed in the discipline of Materials Science and Engineering, as well as having the generic graduate attributes expected in a university graduate and, in the case of the BEHons program, having the Stage 1 graduate engineering competencies prescribed by Engineers Australia. 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.

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 and are summarised in Table 1. After the significant decrease in 2019 (this was attributed to, in part, to the new trimester structure and a change to centralised management of program marketing), the first year intake has showed recovery in 2020 which continued in 2021. The School continues to have the largest undergraduate program in the discipline nationwide by a considerable margin and the total number of undergraduate students enrolled remains stable as shown in Figure 1. Similar to previous years, the quality of the new local students was high as indicated by ATAR entry scores of >87 for the School's undergraduate programs with approximately 30% being female.

TABLE 1: FIRST YEAR INTAKE (2011–2021)

Program	2017	2018	2019	2020	2021
3131 BE(Materials Sci. & Eng.)	98	95	35	52	33
3132 BE(Materials Sci. & Eng.)/BEngSci.	2	6	1	6	11
3133 BE(Materials Sci. & Eng.)/MBiomedE	20	33	19	11	29
3134 BE(Materials Sci. & Eng.)/BCom	6	1	0	0	1
Total:	126	135	55	69	73



IMPACTS OF COVID19 PANDEMIC ON UNDERGRADUATE TEACHING

Like the previous year, the 2021 academic teaching year saw most classes delivered online, the main exception being laboratory classes (when permitted during the pandemic). This was supported by funding from the Faculty of Science to purchase a suite of computer equipment for online teaching including high-quality web cameras, high-quality microphones, document cameras, face-tracking cameras, digital tablets, Atem Mini Streaming kit, and advanced digital collaboration tools (including a Surface Hub 2s digital whiteboard). The School hosted teaching workshops in each term in 2021 specifically for academics to share teaching online practices and experiences. An emerging trend in the development of the educational technology for the School was in "hybrid delivery" specifically for the purpose of delivering synchronous content simultaneously in face-to-face and online modes. The School gratefully thanks the Science Education Team (SET) of the Faculty of Science for its extensive advice and support in the School's implementation of shift to online learning.

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 summary of the graduating class is given in Table 2.

TABLE 2: 2021 GRADUATING CLASS

Note that in 2016 the following program code changes occurred: 3135-3136-3137-3138 changed to 3131-3134-3132-3133 respectively, hence had some students graduating from both sets in 2021.

Program	H1 + Medal	H1	H2/1	H2/2	Pass	Total
3131 BE(Materials Sci & Eng)	1	3	3	11	12	30
3132 BE(Materials Sci & Eng)/BEngSc		1			1	2
3133 BE(Materials Sci & Eng)/MBiomedE	1	1		1	3	6
3136 BE(Materials Sci & Eng)/BCom						0
3135 BE(Materials Sci & Eng)				1	1	2
3137 BE(Materials Sci & Eng)/BE(ChemEng)					1	1
3138 BE(Materials Sci & Eng)/MBiomedE					1	1
3972 BAdvSci(Materials Sci)						0
3970 BSc (Materials Sci)					13	13
Total:						55

BE PROGRAM ACCREDITATION

The School's BE program is accredited with Engineers Australia (EA). EA accreditation assesses the suitability of the engineering education program to prepare graduates to enter professional practice in engineering. Accreditation is done on a 5-year cycle and an accreditation evaluation of all the University's BE programs was done in 2021 (previous one was in 2016). This involved EA visiting the School to inspect facilities and to interview staff, students, and alumni (all done online owing to the COVID19 pandemic) as well to complete an evidence-based evaluation against the following accreditation criteria:

UNDERGRADUATE STUDIES (CONTINUED)

Academic Program: (including program structure, curriculum design, learning outcomes, assessment, and engagement with professional practice); Operating Environment (including organisational structure, staffing, academic leadership, funding, educational facilities, student management; and Quality Systems (including continuous improvement of the educational program, engagement with students. engagement with external stakeholders, and dissemination of educational expectations, and benchmarking with similar programs in Australia and overseas).

As a result of the accreditation visit, all of the engineering the University's undergraduate engineering programs were required by EA to improve in specific areas of systemic quality assurance which, after these were addressed, full accreditation was awarded (this happened in 2022). In addition, it was recommended for the School's BE program that the academic streams be reviewed to ensure they are sufficiently differentiated and cater to the required needs in the industry, and that the program be reviewed for coverage of ethics and safety embedded throughout the curriculum (both recommendations will be addressed in the revision of our BE program in 2022).

BE PROGRAM REVISION

As part of The School's strategic vision based on societal themes of transport and infrastructure, energy and environment, biomedicine and health, and electronics and communications, a revision of the School's undergraduate BE program commenced in 2020. However, owing to the major task of the BE program accreditation, as well as continued disruption to School operations caused by the COVID19 pandemic, the program revision was delayed. Work is in progress to remove the existing academic streams of Materials Engineering, Ceramic Engineering, Physical Metallurgy, Process Metallurgy, and Functional Materials (the need for these was questioned in the EA accreditation evaluation of the program) and to redesign the program to have an overall thematic structure containing new design-directed themes of Transport & Infrastructure, Health & Wellbeing, Electronics & Communications, and Energy & Environment. This will involve the introduction of a new suite of Professional Electives based on the 4 themes, incorporation of explicit materials selection and design in each Professional Elective, review and revision the content and arrangement of core courses in Years 2 and 3 of the program (especially to address any overlap or deficiencies), explicit integration of computational methods in selected courses throughout all years of the BE program, and design of courses/program to optimise online, face-to-face, and blended modes of course delivery and assessment

DR OWEN STANDARD

Undergraduate Program Coordinator

BERNADETTE PUDADERA
STUDENT STORY

Bernadette Pudadera graduated in 2021, with exemplary grades and a stellar list of brilliant achievements she had earned over her University Career. She enrolled in the BE Materials Science and Engineering and Master of Biomedical Engineering program and has become a shining example of a student who grasped the opportunities available to her and accomplished many fantastic feats through her hard work and determination. Her active involvement in extracurricular activities in both academic and social aspects is a testament to her outgoing nature to experience the unknown with confidence.

Prior her enrolment into university, she had already applied for the Sir Rupert Myers Scholarship; a scholarship for upcoming UNSW Materials Science and Engineering students to obtain during their first year. Sir Rupert Myers Scholars are assessed on their academic merit and personal qualities that demonstrate leadership skills. She would continue to receive this scholarship until 2020, for recognition of her continued excellence.

During the start of 2017, Ms Pudadera was elected to lead her cohort as the First Year Representative for the student society of Materials Science and Engineering (MATSOC). A society that she continued to be involved in, helping foster a warm community for undergraduates. Ms Pudadera went further to achieve her place in the Engineering Dean's Honours List by attaining a Weighted Average Mark (WAM) within the High Distinction Grade (over 85). However, this would not be the only time she would achieve that prestigious award; Ms Pudadera would continue to be named on the Dean's List in 2018, 2019, 2020, and her graduating year of 2021. With an already brilliant start to her university career, Ms Pudadera successfully applied to a summer research exchange program in North Carolina State University at the end of 2017, researching the topic "In Silico Characterisation of Polymers Through the Simulation of Dynamic Mechanical Analysis Testing".

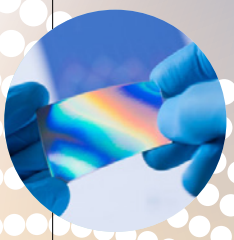
During her second year, Ms Pudadera was elected as the Intersociety Representative for MATSOC, and joined the ENGSOC committee. She also mentored the new First Year students as part of the Materials Science and Engineering Peer Mentoring Program. Concurrently, she also joined the NEMCAT Research Group, supervised by Dr Pramod Koshy, investigating "Fabrication Methods of Zn02-Ti02 and W02-Ti02 Photocatalysts"; a topic she would continue in 2019. Her third year started strong, being elected as the Arc Delegate for MATSOC and starting her internship at Brickwork's R&D and Technological Innovation Centre, where she continued to work there up until 2021. Ms Pudadera also seized the opportunity to partake in a semester exchange program to the Swiss Federal Institute of Technology in Zurich, also known as ETH Zurich. She would come back to accept her Cochlear Prize for maintaining the highest overall WAM at the end of her third year, along with the Rio Tinto Aluminium Prize.

As the pandemic rolled through 2020, Ms Pudadera persevered against the COVID-19 lockdowns as the Vice President of MATSOC. She achieved first place in her Honour's thesis with Cochlear under the supervision of Dr Pramod Koshy, investigating "Platinum Electrode Dissolution Behaviour in Dulbecco's Phosphate Buffered Saline", earning her the Wallarah Minerals Prize for best Honour's thesis in Bachelor of Engineering in Ceramic Engineering. Her academic achievements were further reflected in MATS4007, a course on Engineered Surfaces to Resist Corrosion and Wear, awarding her the Australian Corrosion Association Prize for best performance in the course.

Finally, in her fifth year, Ms Pudadera interned for Marine and Civil Maintenance and achieved a spot on the Science Dean's List to accompany her success on the Engineering Dean's List. Her outstandingly hard work aptly caught the recognition of the University, granting her the distinguished University Medal.

Currently, Ms Pudadera is working at the biomedical company, RESMED, as a Graduate Engineer. It is without doubt that Bernadette Pudadera strived towards her excellence and has received well deserved awards in doing so. Her brilliance sets an example of maximising the vast opportunities that studying Materials Science and Engineering at UNSW provides, along with the focus and determination to score exemplary grades throughout her university career.

CO-OP SCHOLARSHIP PROGRAM




CO-OP SCHOLARSHIP PROGRAM

The Co-op Scholarship Program provides industry-funded scholarships to UNSW undergraduate students in 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 sponsoring 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 were introduced in 1989 and since then there have been a total of 132 scholarships from 30 different industrial sponsors. Co-op scholars are selected on the basis of their academic ability (successful students have ATARs typically 99+) as well as their communication skills, commitment and motivation, perseverance and resilience, teamwork skills, and leadership potential as well as passion and understanding for the materials science and engineering discipline.

Two new scholarships commenced in 2021 to give a total of 5 scholarships concurrently provided by three industrial sponsors – Rio Tinto, Weir Minerals, and Bluescope Steel (see Table 1). The companies have been involved in the Co-op program for many years and their contribution to it and their role in the development of the Co-op scholars they have supported is highly valued.

TABLE 1: STATISTICS OF CO-OP PROGRAM IN MATERIALS SCIENCE AND ENGINEERING (2017–2021)

Intake Year	2017	2018	2019	2020	2021
Current Year of Degree	4	3 (IT)	3	2	1
Number of Scholars	–	2	–	1	2

Co-op Scholars complete at least 68 weeks of structured and highly relevant industrial training with the sponsor companies which, from 2019, consists of 4 weeks at the end of year 1 (optional), 20 weeks during Term 3 of Year 2, and two 24 week placements in Year 3.

Students are paid a scholarship stipend for the first 4 years of their Co-op program with an Honours scholarship possible for those students who elect to undertake their Honours research project with a sponsor company.

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. Each IT placement is reviewed by the Academic Coordinator in the form of an interview with the scholar and sponsor representative(s) and by written appraisals of the placement by the scholar and sponsor. 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 and to make a smooth transition to the workplace. The Co-op Program provides scholars with access to a range of support networks and academic mentor is assigned to each program cohort to offer specific program advice and guidance.

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.

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. 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.

OWEN STANDARD

Academic Coordinator

Co-op Program in Materials Science and Engineering

www.coop.unsw.edu.au

RESEARCH THEMES

STRUCTURE & GROUPS OVERVIEW

The field of materials science and engineering offers unlimited possibilities for innovation and development. Australia is a country rich in minerals and materials science is a priority area for research and development. Advanced materials and improvements in sustainability can give manufacturing companies, in virtually any industry, the edge over their competitors.

Beyond our basic scientific curiosity and the thrill of discovery, we consciously design materials and sustainable processes that impart a substantial benefit to society through the way they positively impact the environment, improve human health, increase our standard of living, increase productivity of our vital resources, enhance national security, or by simply promoting economic prosperity. Taking this fact into account, we have restructured our research to create four new interconnected society centred research themes (right).

Underpinning this new thematic structure is our enabling platform, which is the necessary suite of skills and expertise that materials scientists and engineers need to possess to be able to create the materials of use to society. It consists of a deep understanding of fundamental phenomena, multi-scale computational methods, correlative structural analysis techniques, and the behaviour and properties of materials. The cornerstone of the platform is advanced manufacturing, which is the critical path for creating all those wonderful materials of significant benefit to a contemporary society.

Our four Theme Leaders are responsible for coordinating the various research groups within their theme and encouraging communication and collaboration between groups through to cross disciplinary collaboration between Themes and other Schools, and Research Centres, Hubs and Institutes both within UNSW and externally.

The close relationship between our four interconnected research themes and our enabling platform is illustrated in the diagram Figure 1 (opposite page).

TRANSPORT & INFRASTRUCTURE: THEME LEADER SOPHIE PRIMIG

Primarily structural materials used expressly for creating the means of transportation, to large-scale structures and infrastructure that dominate our daily lives, including land, sea and aerospace vehicles to buildings, superstructures, machines and any other fixed or moving infrastructure.

ENERGY & ENVIRONMENT: THEME LEADER RAKESH JOSHI

Materials that play a critical role in the production, storage and conversion of energy, through to eco-materials, created by sustainable processes using either raw constituents or recycled waste, that impart an overall positive impact on the environment. These are integral materials in next generation fuel cells, solar devices, gas-powered generators, electric vehicles, water purification systems, recycled products.

ELECTRONICS & COMMUNICATIONS: THEME LEADER DEWEI CHU

Primarily functional materials with structural requirements used in electrical, electronics and microelectronics applications, including components and devices that comprise integrated circuits, circuit boards and visual displays, to cables, wires and optical fibres for transferring power and information.

BIOMEDICAL & HEALTH: THEME LEADER KRISTOPHER KILIAN

Structural materials exhibiting specific functionality to largely functional materials that are designed to interact with biological systems for therapeutic and diagnostic medical purposes. These materials are used in dental devices, orthopaedic implants, artificial organs, implantable devices, artificial skin, drug delivery.

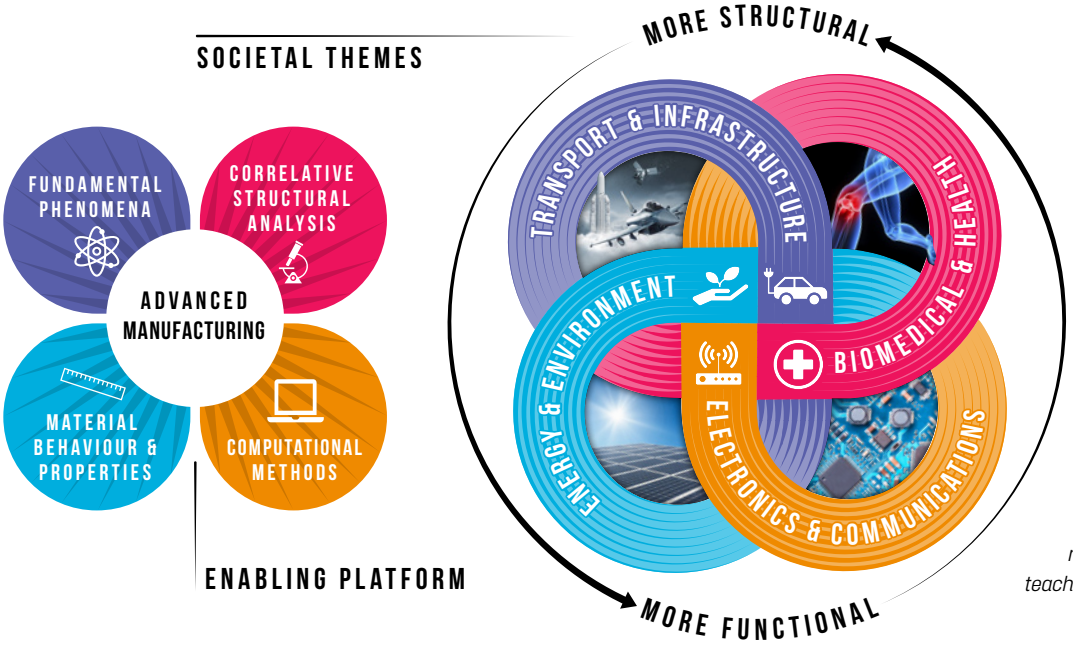


Figure 1: The School's new structure for teaching and research.

TRANSPORT & INFRASTRUCTURE

Future engineering innovations in transport and infrastructure fundamentally depend on the design and discovery of next generation of structural materials enabling better performance under severe conditions. Next generation structural materials often combine several advanced properties including superior strength, ductility, and corrosion resistance, while also being lighter, safer, more cost efficient, and more recyclable than currently available materials.

Combinations of properties that are traditionally often in conflict with each other are unlocked via advancements in materials synthesis and processing. These efforts are further underpinned by the application of state-of-the-art techniques in characterisation, modeling and testing, all across multiple length scales. The academics, researchers and students in this theme are leaders in advanced structural materials, with interests in fundamental and applied research, often carried out in collaboration with manufacturers, defence and government agencies.

In 2021, significant investments were made to extend the previously somewhat limited capabilities for ThermoCalc and Dictra – software packages for thermodynamic and phase diagram calculations for multi-component systems. Network licenses were updated to accommodate up to 100 users, and several new databases were added, e.g. for high entropy alloys, Titanium alloys, oxides, and more. In some projects, this is combined with through-process modelling of the microstructural evolution and properties of advanced alloys using the thermo-kinetic modelling tool MatCalc. These investments are not only significant as complementary computational tools to support our experimental research but are now increasingly applied in teaching and final year projects where some students remain overseas based due to pandemic related challenges.

The academics in this theme have also been successful in attracting significant new funding in 2021. Prof Jianqiang Zhang and Emeritus Prof David Young have been awarded a new ARC Discovery grant on 'High temperature corrosion of heat resisting alloys in steam/hydrogen-rich environments related to hydrogen production and utilisation' worth $450k. Dr Kevin Laws has been awarded an ARC Linkage grant on 'Lead-Free Brass Solutions for Drinking Water Applications' worth $444k from the ARC. Both projects will start in 2022. Finally, after rigorous online reviews in front of a panel of US-based and Australian engineers and defence scientists, AProf Sophie Primig's AUSMURI project on 'The role of interfaces during metal additive manufacturing' has been extended for two years, with additional $2M funding to be shared between The University of Sydney and UNSW.

The handpicked 2021 research example below showcases microstructures and images of machining and machine swarf from bright

AProf Sophie Primig	Engineering Microstructures (Theme Group Leader)
Prof Michael Ferry	Frontier Alloys & Processes
Dr Kevin Laws	Metal Physics & Advanced Alloy Research Team
Prof Paul Munroe	Structure-Property Optimisation Group
Prof David Young	High Temperature Materials Group
Prof Jianqiang Zhang	Advanced Corrosion Resistant Materials

TRANSPORT & INFRASTRUCTURE (CONTINUED)

brasses and bronzes developed by Dr Kevin Laws and team, with increased strength, machinability and reduced cost compared to traditional brasses and bronzes.

Top: Light optical micrograph of Cu-based quaternary Cu-Mn-Ni-Zn base alloy and machinability test of new Cu-Mn-Ni-Zn-Al alloy

Bottom: Swarf size of free-cutting Cu-Mn-Ni-Zn-Al alloy at 1 ½"/min (~38mm/min) and scanning electron micrograph of cuttings.

BIOMEDICAL & HEALTH

The Biomedical & Health theme was established to bring together the diverse biomedical and health-based research conducted in the school, in order to establish a centralised structure that would provide regular interactions among members, disseminate opportunities to the theme through emails, and connect materials science students and staff to biomedical colleagues across all faculties. 2021 was a challenging year, but adversity can also lead to reflection and new opportunities. All together the research groups in the B&H theme made some outstanding advances.

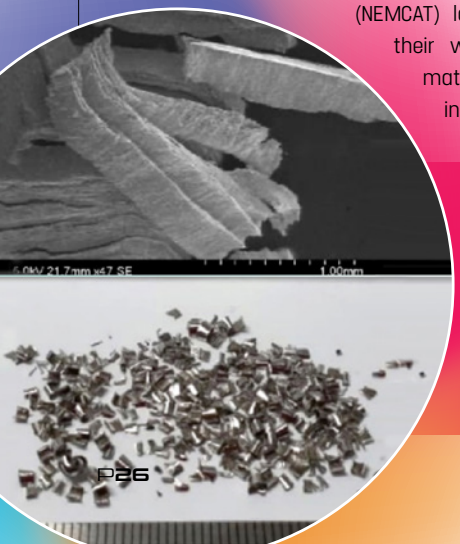
Dr. Tushar Kumeria, head of the Laboratory for Advanced Porous Nano-Biomaterials, received several defence-related grants from Australia and the USA for his nanomaterials research. He was also recipient of several awards and honour including his chairing of the Australian Controlled Release society conference, Drug Delivery Australia.

A/Prof Damia Mawad, head of the Polymer Research in Therapeutics (PRinT), continued her exciting research in bioelectronics including new research as part of a successful team to receive an ARC Research Hub for Connected Sensors for Health. Prof Charles Sorrell and A/Prof Pramod Koshy, co-leads the Novel Engineered Materials for Conventional and Advanced Technologies (NEMCAT) laboratory, and have continued their work to develop new ceramic materials, including several new industry funded projects in 2021.

A/Prof Kris Kilian, head of the Laboratory for Advanced Biomaterials & Matrix Engineering (LAB&ME), initiated a new program in using materials to model cancer which is funded by the National Cancer Institutes of the National Institutes of Health in the USA. A/Prof Runyu Yang continued his exciting research in studying powder dispersions with several industry partners and has begun investigating new avenues for translating these approaches to aerosols in biosystems. A/Prof Shery Chang initiated new research in the area of combining machine learning with advanced imaging, towards novel means for nanomaterial design and development. She was also a co-investigator on the ARC Training Centre for Next-Gen Technologies in Biomedical Analysis, an international venture fostering bridges between academic science and industry.

Together, the B&H theme brought in multiple grants to support biomaterials-based research and published >80 journal manuscripts in 2021. Late in the year, the group leaders assembled a committee of student and postdoc representatives to begin planning B&H activities. Their first task involves the establishment of an annual symposium to highlight research in the theme, which will be launched in 2022.

Several theme members began discussions with clinical scientists towards new collaborative opportunities to improve translation of biomaterials innovations to clinical settings. Moving forward, the theme is excited about new activities engaging with colleagues in medicine at UNSW and beyond.



Polymer Research in Therapeutics (PRinT) group – led by Dr. Damia Mawad

Laboratory for Advanced Biomaterials & Matrix Engineering (LAB&ME) – led by A/Prof. Kris Kilian

Novel Engineered Materials for Conventional and Advanced Technologies (NEMCAT) group – led by Prof. Charles Sorrell

Laboratory for Advanced Porous Nano-Biomaterials – led by Dr. Tushar Kumeria

Electron Imaging for Advanced materials (EIAM) group – led by A/Prof. Shery Chang

Computational Granular materials (CGM) group – led by A/Prof. Runyu yang

ENERGY & ENVIRONMENT

The Energy and Environment (EE) theme is ideally aligned with UNSW's 2025 vision. The research groups in the EE theme collaborate very actively via joint research student supervision, writing research projects together and co-author publications. Research group leaders of the EE theme are in constant exchange of ideas, engaging in formal and informal meetings to strengthen their research collaboration and maximising the vast potential of their combined expertise.

In the last year, EE theme researchers have achieved significant success in the development of highly innovative, internationally competitive research, evidenced by high impact journals, securing ARC linkage grant, and active collaboration with local and international partners.

Dr Judy Hart's team has graduated two HDR students and published 14 articles in high impact journals including Small and ACS Applied Entergy Materials.

Prof. Dewei Chu's team has filed three patent applications, and more than 40 articles published in high impact journal including Nano Energy; in addition, one HDR student was selected for a Dean's award for outstanding PhD thesis. A/Prof.

Sammy Chan's group recently innovated the laboratory with advanced equipment for more effective study of solid-state hydrogen storage. Within last year, the group demonstrated the outstanding research on the possibility of lowering the dehydrogenation of magnesium alloys, and the feasibility of effective hydrogen storage at room temperature. The group has graduated 2 PhD students.

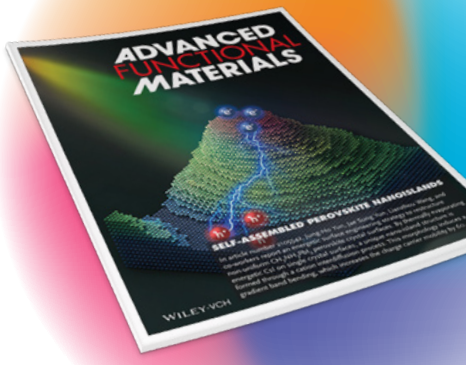
A/Prof. Rakesh Joshi's group has received the extended fundings from multiple industrial collaborators: Sydney Water (Australia), Vesi Water (Australia), and Baxter International (U.S.A). The completed projects are under the process of patent application. Team has published many articles at high impact journals including Materials Today Nano Energy, ACS Nano, and Nano Letters.

SMaRT centre lead by Prof Veena Sahajwalla has been constantly working with a broad research partners and government across Australia, on the development of innovative environmental solutions for the world's biggest waste challenges. A/Prof. Danyang Wang's group has published 19 articles in international journals including Nature, Science, and Small.

ELECTRONIC & COMMUNICATION

2021 was a fruitful year for the EC team with large external grants, high impact publications and intensive collaborations. One of the biggest fund is the ARC Research Hub (in total $10M) for Connected Sensors for Health, where Dewei and Tom lead the energy and information management theme with 2 local industry partners over the next 5 years. This Hub aims to develop, manufacture and deploy high-tech, cyber-secure, medically-certified IoT sensors to global health markets by integrating disparate Australian capabilities into a productive end-to-end value chain. This Hub expects to position Australia at the forefront of connected health by integrating sensor science with cyber-secure data analytics, regulatory approval and certified manufacturing capabilities.

Electronic materials have attracted more and more attention owing to potential applications in the area of energy storage and conversion, optoelectronic and nanoelectronic devices. For example, organometal perovskite single crystals have been recognized as a promising platform for high-performance optoelectronic devices, featuring high crystallinity and stability. However, a high trap density and structural nonuniformity at the surface have been major barriers to the progress of single crystal-based optoelectronic devices. Jan et al developed an unique engineering approach through the single crystal surface to provide a pathway towards developing high-quality perovskite single-crystal surface for optoelectronic applications.



The team organized a series of online seminars for electronic materials and invited leading researchers in optical, nanoelectronic and energy conversion devices to deliver talks to academic staff and student. The team is co-organizing the Symposium on Advanced Materials & Sustainable Technology 2022 later this year.

2021 SMaRT REPORT

The UNSW Centre for Sustainable Materials Research and Technology (SMaRT) at the University of New South Wales works with industry, national and international research partners, industry and governments across Australia, on the development of innovative environmental solutions for the world's biggest waste challenges, with a strong focus on end users, to help UNSW achieve its strategic goals of creating social impact, innovation and engagement, and academic excellence.

The SMaRT Centre has state-of-the-art furnaces and laboratories, and sophisticated analytical and processing equipment. Combining the distinctive research capabilities of UNSW's academics, the SMaRT Centre has a track record of delivering research and multiple technologies suitable for implementation, the latest being various MICROfactorie™ technologies for which extensive future research and development initiatives are planned, as well as its next generation research for its patented Green Steel® Polymer Injection Technology®.

The core aims of the SMaRT Centre are to develop novel research for sustainable materials and manufacturing processes, build industry partnerships to activate research for real world, end user impact, and to disseminate and commercialise green materials and manufacturing technologies that benefit industries, local communities, and enhance sustainable economic growth while delivering important environmental and social benefits.

SMaRT's pioneering of "microrecycling science" has resulted in the development of many novel processes, technologies and outcomes but extending this and creating new innovations with commercial and end-user benefits are our future goals, along with helping to chart a new 'materials circulatory' for the critical elements, resources and materials required for the future electrification of our society. Many of the natural resources and materials needed for batteries and other renewable energy technologies are becoming scarce and more costly (economically and environmentally) and recovering these materials from end of life products will be crucial to future global efforts around sustainability. We are turning our attention to this challenge.

SMaRT is advancing its work to create real world impact via multiple collaborations involving industry, the community organisations and government agencies.

new TRAILBLAZER

Through the end period of 2021, SMaRT Centre led the recycling stream for the successful major Federal Government grant application for the UNSW/University of Newcastle-led Australian Trailblazer Universities Program. Headed by UNSW in partnership with the University of Newcastle, the new Australian Trailblazer Recycling and Clean Energy (ATRaCE) initiative will lead research commercialisation initiatives that will help Australia and the world transition to sustainable recycling and clean energy solutions and systems.

UNSW Vice-Chancellor and President, Professor Attila Brungs, said that UNSW was proud and honoured to be leading Australia's efforts in research commercialisation to support the nation's manufacturing priorities. He said: "The Recycling and Clean Energy Trailblazer will create a step change in Australian environmental sustainability transition. UNSW has a proud track record of commercialising research such as solar panels, energy storage, Green Steel® and various MICROfactorie™ technologies led by 2022 NSW Australian of the Year, ARC Laureate Professor, Veena Sahajwalla. We look forward to working with our partners on the Trailblazer program to deliver further change in the recycling and clean energy innovation landscape."

new NESP HUB

The National Environmental Science Program Sustainable Communities and Waste (SCaW) Hub involves five research nodes working on developing policy, planning and design for more sustainable communities. Hazardous chemicals and pollution affecting the environment are another key focus area, while improving air quality is another. The fourth impact area is reducing the effects of plastic waste and other common waste streams (with SMaRT leading this specific project stream). The SCaW Hub predominantly focusses on applied science and capability for recommendations to government and end users, to help create more sustainable communities, and is engaging with local communities, councils in many rural, regional and metro locations.

UNSW President and Vice Chancellor Attila Brungs and Veena greet Indian Trade and Commerce Minister Goyal and former Trade Minister Tehan.

The Hub is a consortium comprising five world-class research institutions: UNSW Sydney, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Monash University (MU), Curtin University (CU), and the University of Tasmania (UTas), and various industry, government and community partners.

GLOBAL OUTREACH

SMaRT has been engaging bilaterally for a number of years, across various continents, and in particular as part of formal Australian and UNSW initiatives with India. SMaRT for UNSW was instrumental in former Prime Minister Malcolm Turnbull providing a special gift to President Modi made in one of our MICROfactories™, while more recently Veena was involved in talks at UNSW with the Indian and (now former) Australian trade ministers, Piyush Goyal and Dan Tehan MP, about our UNSW SMaRT Centre's Green® Steel Polymer Injection Technology and various MICROfactorie™ technologies.

SMART TECHNOLOGIES AND MICROFACTORIES (INNOVATION)

Australia faces a growing waste crisis with vast amounts of waste materials, such as glass, electronic waste (e-waste) and plastics stockpiled or landfilled across the country.

Australia generated an estimated 74.1 million tonnes (Mt) of waste in 2019, equating to 2.94 Mt of waste per capita, one of the highest globally. Australia has traditionally shipped most of its recyclable waste to China (with smaller amounts shipped to Indonesia, Vietnam, India, Malaysia, and Thailand), in shipping containers that would otherwise return empty to their country of origin. The 2019 National Waste Policy introduced new bans on the export of waste materials, including tyres, glass, paper, and plastic.

2021 SMaRT REPORT

This promises to be an opportunity for the SMaRT Centre to develop new science, commercialise technologies, and take advantage of favourable economic and social conditions.

MICROfactories™ promise to transform waste into new and reusable materials that can be used to manufacture high value products. MICROfactories™ can reshape waste where it is stockpiled and created, enabling local businesses and communities to tackle local waste problems and develop a commercial opportunity from the valuable materials that are created.

In 2021, the SMaRT Centre helped launched the first commercially operated Green Ceramics MICROfactorie™. This MICROfactorie™ has been supported by the NSW Government's Physical Sciences Fund via the NSW Office of Chief Scientist and Engineer, and is in partnership with local businesses.

GREEN STEEL®

The SMaRT Centre is now carrying out brand new research into using waste bio-resources like coffee grounds, and rubbers and their application in steel making under its SMaRT@UNSW Green Steel® next generation "Polymer Injection Technology" work.

This includes not just using more wastes with the aim of one day replacing the need for coke and coal in electric arc furnace (EAF) steel making but using waste resources as a source of the vital steel making ingredient of hydrogen for an overall more efficient process.

COLLABORATION & COMMUNICATIONS (ENGAGEMENT)

SMaRT is implementing a comprehensive stakeholder engagement/ collaboration effort to enhance outcomes of its future research strategy. This is activated via knowledge and impact transfer and concerted communications initiatives to support SMaRT's operational objectives to deliver optimised impact and outcomes in relation to attracting funding, partners and industry, via knowledge transfer, research impact and proactive communications.

Some highlights are:

- Helping achieve UN Sustainable Development Goals
- SMaRT@UNSW Green Steel recognition
- Coffee grounds and hydrogen from waste Green Steel breakthroughs
- Sustainable solutions for ghost net waste
- SMaRT backs new national battery recycling initiative
- SMaRT joins Australian technology initiative
- Minister and NESP behind new MICROfactorie™
- SMaRT's green steel technology wins grant
- SMaRT and Mirvac project wins award
- ABC Australian Story
- Op ed: smart waste to electrify the world
- BBC on SMaRT's wealth from waste tech

MMFI

UNSW Materials & Manufacturing Futures Institute

The UNSW Materials & Manufacturing Futures Institute (MMFI) continues building as a world-leading and revenue-generating hub for interdisciplinary research and advanced manufacturing, underpinned and guided by a robust media and engagement strategy that will take MMFI through to 2025.

In 2021, MMFI continued to push ahead and deliver on our commitments, demonstrating effective and excellent research, innovation and organisational capabilities and practices.

Having successfully established a solid research foundation and network, building relationships with diverse industry groups and innovators and successfully communicated the message about the world-class facilities we have here at our home at the University.

These engagements provided MMFI with ongoing opportunities to articulate the vision and goal of the Institute: to produce tangible solutions and real-world social impact, backed by lasting collaboration and solid science.

The Institute's profile grew through 2021 with our efforts to promote MMFI and our world-class facilities, notably with short videos distributed via our media platform.

For the full version of MMFI's 2020 Annual Report, please visit:

https://issuu.com/unswmmfi/docs/mmfi_annual_report_2021_-_revised

2021 STAFF AWARDS & ACHIEVEMENTS

GRANTS SUCCESS

Tushar Kumeria was successful with his application for a **Ramaciotti Health Investment Grant**! Tushar's grant is focused on developing advanced composite microdevices for transdermal cannabinoids delivery for pain management in patients with chronic illnesses. Each university is only allowed lodge in two applications and only nine in total were funded this year. The total grant is $245k over 2 years and is built from his UNSW-Industry Network Seed Funding project in 2020-21.

Sophie Primig's AUSMURI project on metal additive manufacturing in collaboration with researchers from the University of Sydney and the United States has been extended! The USYD and UNSW teams will share a further $2M in funding over the next two years.

UNSW SCIENCE DEAN'S AWARDS FOR EXCELLENCE

"Stand Out" Award Winner:	**Owen Standard**
Research Excellence Awards:	**Dewei Chu & Kris Kilian**
Operational Excellence Award:	**Anthony Zhang**
Collaboration & Partnership Award:	**Sophie Primig**
Equity, Diversity & Inclusion Excellence Award:	**Damia Mawad**

WELCOME ADDITIONS

Dr Samane Maroufi (SMaRT-funded EF Lecturer in Sustainable Materials Processing)

Dr Jacky Yang (DVCRE-funded Lecturer in Computational Materials & Artificial Intelligence)

ACADEMIC PROMOTIONS

Peggy Zhang	Promoted to Lecturer
Rakesh Joshi	Promoted to Associate Professor
Farshid Pahlevani	Promoted to Associate Professor

STAFF SUCCESS

Professor Tom Wu has once again has made the prestigious list of Clarivate Highly Cited Researchers. This annual list identifies researchers throughout the entire world who are in the top one per cent by citations in their respective field/s of expertise!

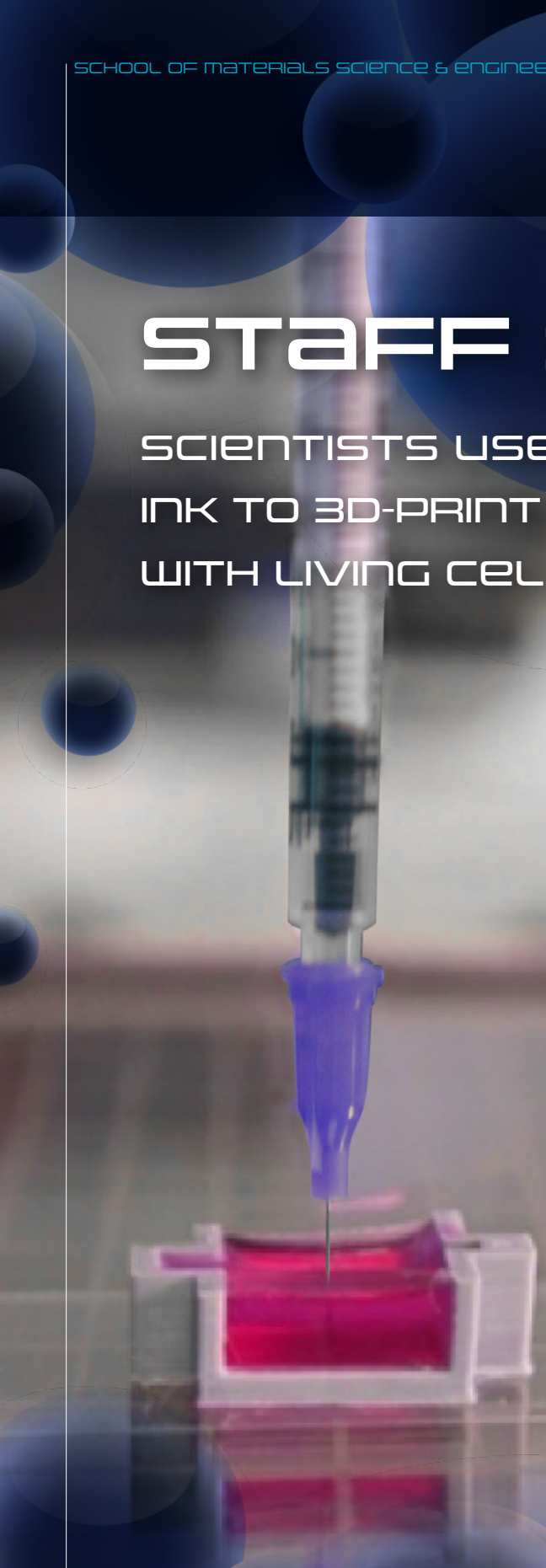
Dewei Chu, **Damia Mawad** and **Tom Wu** were Chief Investigators on a successful **ARC Research Hub for Connected Sensors for Health** announced today by Minister for Education and Youth Alan Tudge! The new ARC Hub, administered by UNSW's School of Mechanical & Manufacturing Engineering, will receive $5M in ARC funding over 5 years, with further matching funding from various health industry partners. Dewei, Damia and Tom will receive $800k of this funding, and Dewei has been named as the Theme leader (in total 5 themes) for Energy and Data Management Solutions.

Congratulations to **Dr Sukriti Mantri** and **Associate Professor John Daniels** for receiving a Best Paper award from the Journal of the American Ceramic Society for their recently published work on Domain Walls in Ferroelectrics.

In addition to being a successful researcher, Dr Mantri is also an experienced novelist with a range of murder mysteries and an award-winning children's book in her collections!! You can find out more about her research and her novels at: https://sukritimantri.com/research/research-projects/

STAFF STORY

SCIENTISTS USE NOVEL INK TO 3D-PRINT 'BONE' WITH LIVING CELLS



3D printers may one day become a permanent fixture of the operating theatre after UNSW scientists showed they could print bone-like structures containing living cells.

Scientists from UNSW Sydney have developed a ceramic-based ink that may allow surgeons in the future to 3D-print bone parts complete with living cells that could be used to repair damaged bone tissue.

Using a 3D-printer that deploys a special ink made up of calcium phosphate, the scientists developed a new technique, known as ceramic omnidirectional bioprinting in cell-suspensions (COBICS), enabling them to print bone-like structures that harden in a matter of minutes when placed in water.

While the idea of 3D-printing bone-mimicking structures is not new, this is the first time such material can be created at room temperature – complete with living cells – and without harsh chemicals or radiation, says Dr Iman Roohani from UNSW's School of Chemistry.

"This is a unique technology that can produce structures that closely mimic bone tissue," he says.

"It could be used in clinical applications where there is a large demand for in situ repair of bone defects such as those caused by trauma, cancer, or where a big chunk of tissue is resected."

Associate Professor Kristopher Kilian who co-developed the breakthrough technology with Dr Roohani says the fact that living cells can be part of the 3D-printed structure, together with its portability, make it a big advance on current state-of-the-art technology.

Up until now, he says, making a piece of bone-like material to repair bone tissue of a patient involves first going into a laboratory to fabricate the structures using high-temperature furnaces and toxic chemicals.

"This produces a dry material that is then brought into a clinical setting or in a laboratory, where they wash it profusely and then add living cells to it," Professor Kilian says.

"The cool thing about our technique is you can just extrude it directly into a place where there are cells, like a cavity in a patient's bone. We can go directly into the bone where there are cells, blood vessels and fat, and print a bone-like structure that already contains living cells, right in that area."

"There are currently no technologies

that can do that directly."

In a research paper published recently in Advanced Functional Materials, the authors describe how they developed the special ink in a microgel matrix with living cells.

"The ink takes advantage of a setting mechanism through the local nanocrystallisation of its components in aqueous environments, converting the inorganic ink to mechanically interlocked bone apatite nanocrystals," Dr Roohani says.

"In other words, it forms a structure that is chemically similar to bone-building blocks. The ink is formulated in such a way that the conversion is quick, non-toxic in a biological environment and it only initiates when ink is exposed to the body fluids, providing an ample working time for the end-user, for example, surgeons."

He says when the ink is combined with a collagenous substance containing living cells, it enables in-situ fabrication of bone-like tissues which may be suitable for bone tissue engineering applications, disease modelling, drug screening, and in-situ reconstruction of bone and osteochondral defects.

Already there has been keen interest from surgeons and medical technology manufacturers. A/Prof. Kilian thinks while it's early days, this new bone-printing process could open up a whole new way of treating and repairing bone tissue.

"This advance really paves the way for numerous opportunities that we believe could prove transformational – from using the ink to create bone in the lab for disease modelling, as a bioactive material for dental restoration, to direct bone reconstruction in a patient," says A/Prof. Kilian.

"I imagine a day where a patient needing a bone graft can walk into a clinic where the anatomical structure of their bone is imaged, translated to a 3D printer, and directly printed into the cavity with their own cells.

"This has the potential to radically change current practice, reducing patient suffering and ultimately saving lives."

Next up the duo will be performing in vivo tests in animal models to see if the living cells in the bone-like constructs continue to grow after being implanted in existing bone tissue.

Dr Sara Romanazzo prepares to 3D-print a piece of bone using the COBICS technique. Photo: UNSW

2021 STUDENT AWARDS & ACHIEVEMENTS

SCHOOL AWARDS

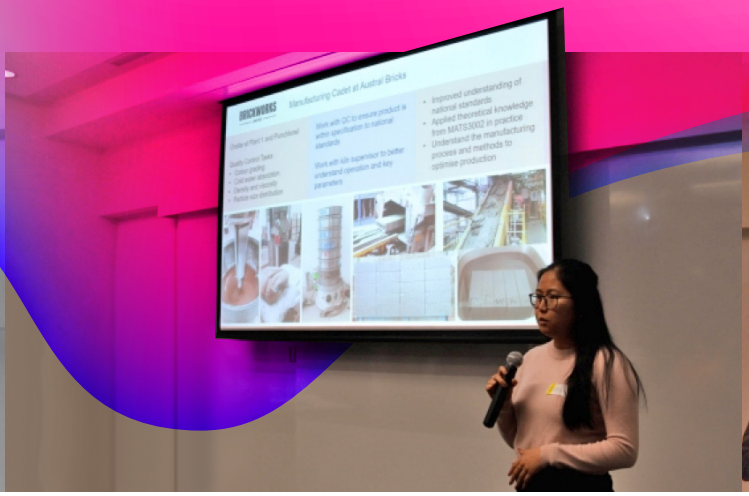
It has been amazing to see students back on campus this year, and we were also able to hold an in-person prize and graduation ceremony this year!!

Congratulations to our undergraduate and postgraduate students for accomplishing a major achievement of completing their degrees during the pandemic.

Several of our undergraduate students also received awards for achieving outstanding results during the 2020 academic year.

- 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 **Anthony Zhang**.
- **Bernadette Pudadera** had a terrific year, winning both the Wallarah Minerals Prize for the best Honours thesis in Bachelor of Engineering in Ceramic Engineering, and the Australasian Corrosion Association Prize for the best performance in MATS4007 Engineered Surfaces to Resist Corrosion and Wear course.
- **Marcus Miljak** received the Max Hatherly Prize for achieving the highest overall Weighted Average Mark (WAM) at the end of second year.
- **Jiachen Jiang** received the Cochlear Prize for achieving the highest overall Weighted Average Mark (WAM) at the end of third year.
- **Edward Whitelock** was awarded the Perfect Engineering Prize achieving the highest overall Weighted Average Mark (WAM) at the end of fourth year.
- **Alexander Danon** took home both the Sir Rupert Myers Prize for the best performance in MATS3001 Micromechanisms of Mechanical Behaviour of Metals course.
- **Jacqualine Huynh** was awarded the Rio Tinto Aluminium Prize for the best performance in MATS3007 Materials Industry Management course.
- **Brenda Leung** received the Perfect Engineering Prize for the best final year project in Process Metallurgy.
- **Aurpa Bhuiyan** received the Perfect Engineering Prize for the best Honours thesis in Bachelor of Engineering in Materials Engineering.
- **Young Park** received the Perfect Engineering Prize for the best Honours thesis in Bachelor of Engineering in Physical Metallurgy.

And special thanks to William Ward (The Australian Corrosion Association), Allen Ho (Perfect Engineering), Michael Ferry (HoS and on behalf of Rio Tinto) and Chris Sorrell (on behalf of Wallarah Minerals) for presenting these prizes to our students.



MATERIALS AUSTRALIA ANNUAL STUDENT THESIS PRESENTATION COMPETITION

Nine students from universities across NSW were handpicked to present their thesis projects in front of an expert panel. Three students were selected to represent our School:

- **Vienna Wong**: 2D-3D Metal Oxide Nanostructures for Air and Water Purification (Supervised by Pramod Koshy)
- **Max Arkley-Smith**: Production of Highly Porous Chars from the Pyrolysis of Waste Polycarbonate (Supervised by Veena Sahajwalla)
- **Edward Whitelock**: Designing a Wasteform from Cs Loaded IONSIV Material (Supervised by Pramod Koshy)

Each of our students presented exceedingly well, with Edward and Vienna taking out 2nd and 4th place, respectively! Each of the winners received a certificate, cash award and complementary Materials Australia membership.

INDUSTRIAL TRAINING POSTER PRESENTATION EVENING 2021

The School and MATSOC hosted its annual Industrial Training poster night last month on the 19th May. Throughout the evening, in a series of short presentations, our undergraduate students showcased their experience and what they learnt during their industrial training period at various organisations both in Australia and around the world. The event is a major component of our undergraduate curriculum for our students, where they gain some real-on-the-job experience and graduate as professional engineer with accreditation given by Engineers Australia.

The winners who gave outstanding and highly reflective presentations were:

- 1st place: **Nelson Moo** - Industrial Training at Pallion and 3M
- 2nd place: **Sarah Yakob** - Materials Research & Development at Weir Minerals
- 3rd place: **Shannon Lee** - Manufacturing Cadet at Austral Bricks

Congratulations to our winners and to all the participating students for sharing your experience with us.

Special thanks to the UNSW Industrial Training team and our industry guest judges, Steven Kennedy (Cochlear), Michael Thien (Infrabuild Steel, alumni) and Michelle Yeoh (CSR, alumni).

MATSOC 2021

The year of 2021 has provided many challenges with the ongoing COVID-19 crisis. I am very proud to say that the MATSOC executive committee has managed these challenges professionally as we have continually strived to build a strong Materials Science and Engineering (MSE) community and offered students insight into a diverse range of industry opportunities.

At the start of the year, MATSOC was fortunate to hold 10 in-person events, allowing our students to catch-up after their extended break last year. Two standout events were our annual collaborative camp and cruise held alongside CEUS and FSA. For the first time, we offered 2nd year students the opportunity to attend the camp after theirs was cancelled last year. This resulted in a truly impressive turnout of over 100 students, providing an excellent opportunity for inter-year and intersociety bonding. We also collaborated with PGSOC in a Movie Night, allowing for undergraduate and postgraduate students to mingle while they watched Shrek 2 with some snacks and drinks.

I am truly grateful for the grit and flexibility demonstrated by the MATSOC committee as Sydney was plunged into another lockdown from June of this year. With their effort, we were able to pivot and replace organised in-person events with an online Trivia Night and a Games Night. We later provided another Games Night and a collaborative Murder in the Dark event with BESS. We recognised that the conditions of the lockdown are difficult for many students and it was incredibly important for us to provide a means for people to interact.

Through the year, the MATSOC team sought out several opportunities to bring industry to students. We began the year with a new hybrid Industry Panel Night which hosted 6 different industrial representatives from sectors including research, engineering consulting and infrastructure. This allowed students to listen to and engage with the representatives in-person and from afar, benefitting our international students oversees. Several students also attended ANSTO and InfraBuild Steel site visits, gaining a very rewarding insight into the career prospects available post university. We are very thankful for InfraBuild Steel and ANSTO for hosting these events and providing these unique experiences.

In summary, I am incredibly optimistic about the prospects of the future MATSOC team and their commitment to the MSE students. I want to personally thank our sponsor, Cochlear and the School of Materials Science and Engineering for their support. Collectively, we are able to provide the best possible experience for MSE students at UNSW and create a platform to transform them into world-class professionals.

Scott Jones

2021 MATSOC President


Beat the nerves &
have the confidence
in public speaking

PGSOC 2021

Passing 2021 has been a challengeable but vigorous year on PGSOC. Due to the pandemic, we were unable to hold most of our signature events such as the poster competition. In response, PGSOC has set up anonymous online platforms for students to seek support during these difficult times. Online chatroom server was also set up to make communications easier. Social media activity was also paramount in these difficult times. Community news were shared via Instagram and Facebook more so than before.

Confidence Workshop

Confidence workshop was held just before the pandemic hit. The workshop was a great way to enhance the public speaking and confidence for students

Career Workshop

Career workshop was held to build a good connection between our postgrads and alumni. It is useful to know about the industry and broaden future career path.

Mid-Year Society Lunch

The Mid-year society lunch was held to celebrate the return to campus after the first lockdown. During the lunch, the communication was promoted and encourage us to move on with the support of peers.

Weekly Friday Social (Online & Live)

PGSOC persisted with Online Friday Socials to connect students during difficult times. Ice breaking games and various board games were played with group voice chat to elevate stress and unwind as well as to stay connected with fellow peers during lockdown.

On the latter half of the year, in-person Friday socials were re-instated with precautions in accordance with public health orders. Themed Socials such as Halloween and Eid Special Socials remains one of our best ways to promote engagement and inclusiveness.

Peer Mentoring-Welcome BBQ

Welcome BBQ was held at Maroubra beach at the beginning of Term 3 as restrictions eased. This was done in collaboration with the Peer Mentoring program. The first big party of the year, it's a great way to bring the new students into the fold through ice-breaking games and delicious BBQ.

It has been without a doubt year full of challenge, but it also proves the teamwork is the best approach to overcome the difficulties. The PGSOC will always stand with all of postgraduates and the school and be active in student engagement.

The PGSOC team is very grateful for the continued support from the School of Material Science and the students during these difficult times. We couldn't have done it without you!

Yue Jiang
(2021 PGSOC President)

EQUITY, DIVERSITY & INCLUSION

The EDI committee is made up of Damia Mawad (Chair), Michael Ferry, Owen Standard, Lucy Zhang, Nicole Cooney, Scarlet Kong, Tasmia Zaman (Postgraduate Student Rep.), and Naman Bansai (Undergraduate Student Rep.).

With COVID still around we didn't get many events off the ground but were able to successfully run a hybrid event during National Reconciliation week.

During the National Reconciliation Week, our school along with the Faculty of Science hosted a lunch time panel, led by Rebecca Harcourt from Deadly Science and UNSW Business School .

Through the hour-long session, we heard from Biripi woman Leanne Howard and Kamilaroi man Matt Taylor, both UNSW alumni, about their journey, the challenges they've faced, their successes and how we can all engage in reconciliation to honour Aboriginal & Torres Strait Islander history and voices.

Leanne and Matt both spoke about how important it is for them to feel a sense of belonging and connection with their Indigenous heritage but also sharing their story with the community. Matt particularly touched on the support provided by UNSW, through Nura Gili's various education programs such as the Winter School and Indigenous Pre-programs that inspired and showed him and other students that going to university is achievable for young Aboriginal & Torres Strait Islanders.

On the topic of Western vs Non-western Sciences, they both said that we should look into how the Aboriginal & Torres Strait Islander people interacted with the environment, their sustainable practices and perspectives. As after all, they have lived on this land longer than we have.

And the best way to help the Indigenous community is to get involved, either by participating in programs led by or supporting Indigenous Australians. Both Leanne and Matt have given back to the community that has supported them by helping, volunteering, and educating whenever the opportunity arises.

Special thanks to Rebecca Harcourt and Dr. Damia Mawad for organising this enlightening event.

WORK HEALTH & SAFETY

WHS COMMITTEE MEMBERS:

The members of the School WHS Committee in 2021 were **Jianqiang Zhang** (Chairperson), **Michael Ferry** (HOS, management representative), **Owen Standard** (Deputy HOS), **Anthony Zhang** (School Safety Officer), **David Miskovic** (technical and administrative staff representative), **Rakesh Joshi** (Academic representative), and **Florence Lui / Tasmia Zaman** (postgraduate student representative).

COVID-19 CHALLENGES

- Mandatory face mask wearing to all our labs, F2F teaching, meeting rooms and open plan office areas
- Covid high risk activities assessment/ case by case assessment
- QR checking/ coding to all areas (University buildings & labs)
- UNSW Covid contact tracing/ notification and implementation of NSW Health Advice

BUILDING

- Updating Hilmer building Emergency Control Organisation and First aid officers
- Installed a brand-new key watcher for our Dangerous goods lift, new bi-lock key and process
- Building management System (BMS) access for technical staff to monitor our building remotely
- Integrating new route for dangerous goods transport through basement of Hilmer and SEB building
- Completing annual checks for RCD, life safety system, and fume cupboards
- Continuation of good neighbors meeting with staff in Hilmer, SEB and F10

INSPECTIONS

- Building visit by all the WHS School reps in the Faculty
- Completion of electrical test and tagging for the year
- Completing Technical staff training to do 3 Phase test and tag
- Quarterly workplace/laboratory safety inspections and completion of corrective actions
- End of year WHS committee lab inspection and corresponding corrective actions

COMPLIANCE

- Introducing WHS monitoring program to the School, a new auditing and checklist platform
- Introducing our new Schedule 14 health monitoring program to the School
- Updating the biological samples/work checklist for the School
- Resuming and implementing afterhours access policy in the School
- Checking and updating all high-risk safe work procedures (SWPs) in the School
- Auditing/Updating MSE Chemicals in JAGGAER
- Reviewing Lasers in our School under UNSW RECS

TRAINING

- External company SUPAGAS training for gas and cryogenics for both staff and students
- Implementing WHS monitor to the School for our inspections and incident reporting
- Updating warden training
- Completing Refresher WHS Awareness and Ergonomics and Sexual Harassment online by all staff
- Completing University "Supervisor Training" course by all academic and research staff
- Mandatory School WHS info sessions (~11 per year) for all new staff, postgrad and Honours students
- UNSW Laser Course (UNSW ADFA)
- Completing contractor engagement training by lab staff

School WHS committee would like to thank all staff and students in the School for all their understanding, cooperation and compliance with WHS requirements and procedures.

MARKETING OUTREACH

ANNUAL REPORT

We had a great start to 2021 with some plans to get students back on campus and running in person outreach activities again. But the Delta outbreak and lockdown put a pause on everything! Thankfully, our experience with COVID the previous year had us capable of rapidly switching face to face events. Nevertheless, our focus was to plan for a face to face whilst simultaneously using our online foundations to prepare for any last-minute changes to online events. Here are some of our highlights of the year.

EXPERIENCE UNSW DAY

Experience UNSW Day was a massive success! After the major lockdowns at the end of 2020 and beginning of 2021, this event was able to host 30 year 12 students in person at the Colombo rooms in a COVID safe environment. The students disassembled discarded hard drives, to find the plethora of materials in e-waste and with it the opportunities and challenges in forging a circular economy. Thank you to Anirban Ghose, Irshad Mansuri, Wei Wang, Lucas Way, Salim Al Khadhoori and the SMART Centre UNSW for putting on such an engaging workshop!

RECONCILIATION DAY

During the National Reconciliation Week, our school along with the Faculty of Science hosted a lunch time panel, led by Rebecca Harcourt from Deadly Science. Through the session, we heard from Biripi woman Leanne Howard and Kamilaroi man Matt Taylor, both UNSW alumni, about their journey, the challenges they've faced, their successes and how we can all engage in reconciliation to honour Aboriginal & Torres Strait Islander history and voices.

ONLINE MSE WORKSHOP FOR HIGH SCHOOL STUDENTS

In August and September, during in lockdown in NSW, high school Engineering Studies students from Sydney Secondary College in Blackwattle Bay, Waverly College, South Sydney High School, Meriden School, and Norwest Christian College in Riverstone, were able to learn more about Materials Science and Engineering, virtually with Scarlet. She took these students on a journey into the world of Materials Science and Engineering, talking about how important and relevant the research we do at UNSW is to society, the wide range of career paths you can take as a materials graduate and her own experiences as a student transition from high school into university and studying in our very own school.

HSC REVISION SESSION

With learning from home due to lockdown and the delay in HSC exams this year, we were able to support high school engineering studies students by running an HSC Revision Session on covering the materials science and engineering topics in their stage 6 syllabus.

Over 90 students and teachers tuned in on the afternoon of the 18th of October and many more watched the recording on YouTube.

OPEN DAY

The University held its second fully online Open Day on Saturday. While the School could not star on-campus with our amazing Open Day tent and display, our staff and students ensured that the online day was just as inspiring to our future students!

Open Day is always extremely important for the School as it is the biggest event in the domestic undergraduate recruitment calendar and often a major factor in a student's decision to study materials science & engineering.

We had our academics and student representatives on standby to answer any questions about degrees, student community and experiences, and Scott Jones and Dr Judy Hart also helped pre-record a sim-u-live Q&A video on Materials Science and Engineering on what it's like to study with us.

OUTREACH VIDEO PROJECT

An initiative to further integrate digital learning with our marketing resources was the Outreach Video Project. Scarlet Kong, Scott Jones, Rumaysa Goolam and Wenceslao Ocampo sought out alumni of MSE to recount their experiences and reflect on how they used their degree to throughout their journeys in their careers.

Online workshops were also migrated into the digital platform, multiple demonstrations were filmed and uploaded onto the website to give a chance for students in lockdown an opportunity to glimpse at what materials science is without facing COVID risks.

new merch

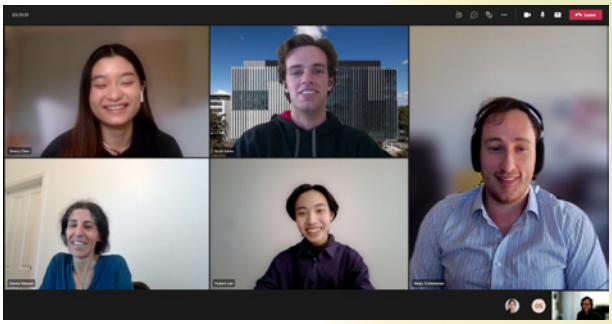
A lot of new and exciting merchandise were purchased during 2021. Focusing on practicality and function, our merchandise line now has a variety of tote bags, bamboo themed wireless chargers and phone holders, business card sized multitools, A5 and A4 notebooks, and vacuum sealed drink bottles. The merchandise will be handed out as awards for exceptional work in hackathons and trivia events, gifts for guest speakers, and participation in assisting the school.

engineering teachers network seminar

Dr Ben Pace and Dr Felix Theska gave a seminar to Engineering studies teachers from the Engineering Teachers Network (Thursday 21st October 3:30pm) on semiconductors and mechanical properties of materials (session was recorded by ETN). Feedback from both events was that teachers and students were very happy with the content taught and found it very beneficial.

social media

Like always with our social media platforms, our primary objective is to showcase the brilliant achievements of our undergraduates, postgraduates, and staff. Our marketing strategy on these platforms enforce our online presence and advertise our research, outreach, and industry opportunities. This year, we had 12 separate posts both on Facebook and Instagram, with many viewers engaging with us through comments, messages, and emails.



2021 RESEARCH GRANTS

Amount in brackets is apportioned amount for 2021

AINSE

Escobedo-Diaz, JP; Bhattacharyya, D; Gunturi, C, *Effect of irradiation temperature on microstructure and properties of ODS steel MA957 - Honours Scholarship for Chaitanya Gunturi* ($2,500)

Koshy, P, *Pyrochlore Glass-Ceramic Wasteforms for Immobilising Nuclear Waste – Student Joel Abraham* ($4,125)

Valanoor, N; Paull, OH, *Interfacial magnetism effects and multiferroic thin films for device applications - PGRA for Oliver Paull* ($3,292)

ANSTO – COMMONWEALTH GOVERNMENT CONTRACT

Valanoor, N, *FLEET scholarship awarded to PhD student Michael Lord* ($16,000)

Koshy, P, *30 Day Internship Placement for Calvin Dinh Tuan Hoang* ($500)

Koshy, P, Fission product incorporation and γ-Irradiation of Cementitious Nuclear Wasteforms - Internship for Katherine Anne Firth ($1,800)

Koshy, P; Gregg, D, *Cementitious wasteforms for high sulphate wastes - for Honours student Clayton Feng* ($1,200)

Koshy, P; Gregg, D, *Corrosion of hot-isostatically pressed nuclear waste glass - Student Agreement for Jialuo (Carol) Ke* ($1,020)

Laws, KJ, *Atomistic-Simulations-Assisted Development of Novel Materials for Extreme Environments - for Kaili Xue* ($6,000)

Munroe, PR, *Probing the Disorder and Defect in the Carbon-fibre Reinforced Carbon Matrix Composite: a Multiscale Characterisation for Honours Student Shannon Lee* ($6,000)

ARC CENTRES OF EXCELLENCE

Hamilton, A; Fuhrer, MS; Ostrovskaya, E; Helmerson, K; Wang, X; Kalantar Zadeh, K; Kalantar Zadeh, K; Bao, Q; Culcer, DM; Davis, J; Davis, M; Klochan, O; Medhekar, N; Parish, M; Seidel, J; Schiffrin, A; Sushkov, OP; Valanoor, N; Vale, C; Wang, L; Cole, J (with Monash University) *ARC Centre of Excellence in Future Low-Energy Electronics Technologies FLEET* ($423,729)

ARC DISCOVERY PROJECT

Chu, D; Furlong, TM; Wu, L; Cazorla Silva, C; PENG, S, *Bioinspired Flexible Haptic Memory Materials for Artificial Sensory Nerves* ($54,819)

Ferry, M; Primig, S; Birbilis, N; Nakashima, P, *Unlocking the diverse property profile of ultra-lightweight Mg alloys* ($164,776)

Kilian, KA; Kruzic, JJ, *Force-mediated dynamic chemistry in hydrogels* ($69,106)

Kumeria, T, *Cell Membrane Coated Photonic Crystal to study Receptor-Ligand Interactions* ($138,000)

Li, S, Thin Combinatorial Films for Heat Management in Microelectronics ($135,000)

Mawad, D; Officer, D; Lauto, A, Bioelectronics: addressing the biointerface challenge ($122,352)

Munroe, PR; Xie, Z, Designed to last: Novel gradient coatings for extreme environments ($200,000)

Scott, JA; Amal, R; Hart, J; Valanoor, N, Designing a photo-electro-catalysis system for selective organic oxidation ($80,126)

Seidel, J, Multiferroic Skyrmion Materials for Next Generation Nanoelectronics ($110,000)

Seidel, J; Cazorla Silva, C, Topotactic Control of Magnetism in Multiferroic and Skyrmion Materials ($144,000)

Wu, T; Hu, B; Hu, B, Light-Responsive Spin Transport and Spintronics with Stable Perovskites ($160,000)

Munroe, PR; Berndt, C; Ang, A (shared with Swinburne University of Technology) DP210103318 - Design of Non-Equilibrium Architectures: Leveraging High Entropy Materials ($37,609)

ARC LINKAGE PROJECT

Chu, D; Cazorla Silva, C; Wang, D; Sharma, N, Engineering Nanoionic Interfaces towards High Performance Cathode Coatings ($68,306)

Chu, D; Cazorla Silva, C; Wu, T; Howard, M; Chesman, A, High performance metal oxide inks for printable memory arrays ($104,866)

Primig, S, Advancing the Australian specialty alloy processing capability ($109,724)

Primig, S; Ringer, SP, Structure-property relationships of next generation aero-engine materials ($142,500)

Saydam, S; Lamei Ramandi, H; Kumar, N; Crosky, A; Manefield, M; Canbulat, I, Microbiologically Induced Stress Corrosion Cracking in Underground Mines ($29,759)

Sorrell, CC; Hart, J; Koshy, P; Swain, MV, New Ceramic: Fully Stabilised Monoclinic Zr02 by Al203 + Si02 Additions ($131,500)

Primig, S; Ringer, SP; Czettl, C (Ceratizit Shared Partner Contribution with University of Sydney) Advanced hard metals: microstructure-property-processing relationships ($12,533)

Primig, S; Ringer, SP; Czettl, C (shared with University of Sydney) Advanced hard metals: microstructure-property-processing relationships ($72,133)

Yang, R; Chan, H; Kourmatzis, A (shared with University of Sydney) High-load powder dispersion and aerosol delivery: an integrated approach ($88,355)

ARC FUTURE FELLOWSHIP

Kilian, KA, Synthetic extracellular matrices for control of cellular reprogramming ($214,922)

Wang, D, Oxide-Semiconductor Epitaxy: Towards Next Generation Nanoelectronics ($212,030)

ARC INDUSTRY PARTNER CONTRIBUTION

Amal, R; Aguey-Zinsou, K; Macgill, I; Zhao, C; Scott, JA; Daiyan, R; Cazorla Silva, C; Lovell, EC; Lu, X; Shen, Y; Kara, S, (funded by H2Potential) ARC Training Centre for The Global Hydrogen Economy ($5,000)

Chu, D; Cazorla Silva, C; Wang, D; Sharma, N, (funded by AOTOL Pty Ltd) Engineering Nanoionic Interfaces towards High Performance Cathode Coatings ($16,640)

Chu, D; Cazorla Silva, C; Wu, T; Howard, M, (funded by Australian Advanced Materials Pty Ltd) High performance metal oxide inks for printable memory arrays ($44,443)

Sahajwalla, VH, (funded by Commonwealth Steel Company) ARC Research Hub for Microrecycling of battery and consumer wastes ($275,000)

Sahajwalla, VH (funded by Mattress Recycle Australia) ARC Research Hub for Microrecycling of battery and consumer wastes ($25,000)

Sahajwalla, VH; Wang, H; O'Mullane, A; Pahlevani, F; Joshi, RK; Boehme, T; Pozo-Gonzalo, C; Prashant, S; Giurco, D; Bhattacharya, S; Tricoli, A; Sharma, N; Maroufi, S; Kerr, R; Perez, P; Malik, A; Florin, NH; Tricoli, A (funded by Nespresso Australia) ARC Research Hub for Microrecycling of battery and consumer wastes ($160,000)

Amal, R; Aguey-Zinsou, K; Macgill, I; Zhao, C; Scott, JA; Daiyan, R; Cazorla Silva, C; Lovell, EC; Lu, X; Shen, Y; Kara, S (funded by Origin Energy Limited) ARC Training Centre for The Global Hydrogen Economy ($3,750)

Sahajwalla, VH (funded by Planet Ark Environmental Foundation) ARC Research Hub for Microrecycling of battery and consumer wastes ($50,000)

Chu, D; Cazorla Silva, C; Sharma, N; Wang, D (funded by Qidong QiAo New Materials Technology Co Ltd) Engineering Nanoionic Interfaces towards High Performance Cathode Coatings ($3,164)

Amal, R; Aguey-Zinsou, K; Macgill, I; Zhao, C; Scott, JA; Daiyan, R; Cazorla Silva, C; Lovell, EC; Lu, X; Shen, Y; Kara, S (funded by Shenzhen Evolution Technology Co. Ltd) ARC Training Centre for The Global Hydrogen Economy ($750)

Sahajwalla, VH (funded by Sydney Water Corporation) ARC Research Hub for Microrecycling of battery and consumer wastes ($20,000)

2021 RESEARCH GRANTS

Sahajwalla, VH (funded by TES-AMM Australia Pty Ltd) ARC Research Hub for Microrecycling of battery and consumer wastes ($100,000)

Sorrell, CC (funded by Vecor Australia) New Ceramic: Fully Stabilised Monoclinic Zr02 by Al203 + Si02 Additions ($100,000)

Primig, S; Ringer, SP, (funded by voestalpine BOHLER Edelstahl GmbH & Co KG) Structure-property relationships of next generation aero-engine materials ($55,000)

Primig, S (funded by Western Australian Specialty Alloys Pty Ltd) Advancing the Australian specialty alloy processing capability ($58,887)

ARC INDUSTRIAL TRANSFORMATION RESEARCH HUBS

Sahajwalla, VH; Wang, H; O'Mullane, A; Pahlevani, F; Joshi, RK; Boehme, T; Pozo-Gonzalo, C; Prashant, S; Giurco, D; Bhattacharya, S; Tricoli, A; Sharma, N; Maroufi, S; Kerr, R; Perez, P; Malik, A; Florin, NH; Tricoli, A, ARC Research Hub for Microrecycling of battery and consumer wastes ($630,000)

Wang, C; Lovell, N; Gooding, J; Delbaere, K; Chu, D; Celler, BG; Wu, T; PENG, S; Zhang, J; Do, T; Bllston, L; Stevens, M; Liu, G; Mao, G; Argha, A; Han, Z; Brodie, AM; Mawad, D; Lord, SR; Yeoh, GH; Parameswaran, S; Hill, DJ; Li, B; Neff, R; Bhaskaran, M; Cheng, W; Gu, Y; Xi, J; Minichiello, MA; Wu, S; Sriram, S; Kou, L; Wright, RF; Egglestone, P; Raad, R; Carroll, N; Ooi, S, ARC Research Hub for Connected Sensors for Health ($125,000)

Gao, W; Setunge, S; Mendis, P; Wang, H; Horne, R; Fernando, N; Choudhury, NR; Shah, K; Giustozzi, F; Law, D; Pathirana, PN; Pahlevani, F; Li, W; Tam, V; Polonsky, M; Halgamuge, S; Zhang, G; Smith, S; Lokuge, W; Gravina, R; Iyer-Raniga, U; Madapusi, S; Daver, F; Nguyen, T; Sofi, M; Sabri, Y; Wijayasundara, M; Costa, S (shared with RMIT) ARC Research Hub for Transformation of Reclaimed Waste Resources to Engineered Materials and Solutions for a Circular Economy ($15,000)

ARC INDUSTRIAL TRANSFORMATION TRAINING CENTRES

Amal, R; Aguey-Zinsou, K; Macgill, I; Zhao, C; Scott, JA; Daiyan, R; Cazorla Silva, C; Lovell, EC; Lu, X; Shen, Y; Kara, S, ARC Training Centre for The Global Hydrogen Economy ($57,256)

NATIONAL HEALTH & MEDICAL RESEARCH COUNCIL FELLOWSHIPS

Kumeria, T (Early Career Fellowship) Bioresponsive Porous Silicon for Site Specific Oral Delivery of Antibodies for the Treatment of Inflammatory Bowel Disease ($84,042)

AUSMURI PROGRAM

Primig, S; Ringer, SP; Liao, X (DIIS - Dept of Defence US-Australia International Multidisciplinary University Research Initiative shared with University of Sydney) Microstructure Control in Metal Additive Manufacturing ($432,100)

ARENA RESEARCH AND DEVELOPMENT (R&D) PROGRAM

Green, M; Ekins-Daukes, N; Bilbao, J; Keevers, MJ; Jiang, Y; Zhou, Z; Timchenko, V; de Silva, C; Tkachenko, SA; Pillai, S; Chu, D; Egan, RJ; Chang, NL, UNSW – R&D Project – Advanced Silicon - Reduced Solar Module Temperature R&D Project ($40,794)

ACARP

Koshy, P; Gupta, SK; Ostrovski, O; Sorrell, CC; Xing, X, Effect of Coke Properties on High-Temperature Strength and Hot Metal Reactivity Under Blast Furnace Conditions ($189,000)

AMSI – ADVANCED ALLOY HOLDINGS – APR INTERN PROGRAM

Laws, KJ; McKenzie, W, Development & optimisation of Metal-Alloy Compositions ($5,500)

CSIRO

Koshy, P (Commonwealth Government Contract) Characterisation of surfaces and advanced thin film materials for devices - Part 2 (17,820)

Sahajwalla, VH (Dept of Industry, Science, Energy and Resources – Australia-India Strategic Research Fund (AISRF) - COVID-19 Collaborative Research Project Subcontract) India - Australia Industry and Research Collaboration for Reducing Plastic Waste coordinated by the CSIRO ($175,000)

COMMONWEALTH GOVERNMENT CONTRACT

Sahajwalla, VH; Ghose, A (with Reserve Bank of Australia) SMaRT@UNSW product development for 65MP ($120,209)

STATE GOVERNMENT CONTRACT

Joshi, RK (with Sydney Water Corporation) Development of methodology for scale up of Graphene Oxide Coating for technology commercialisation ($95,000)

NSW GOVERNMENT GRANTS

NSW CIRCULAR ECONOMY INNOVATION NETWORK

McLean, L; Sahajwalla, VH, NSW Circular Economy Innovation Network ($650,000)

NSW DEPARTMENT OF PLANNING AND ENVIRONMENT / RAAP - ARC INDUSTRIAL TRANSFORMATION RESEARCH PROGRAM

Sahajwalla, VH; Joshi, RK; Boehme, T; Sharma, N; Maroufi, S; Wang, H; Forsyth, M; Perez, P; Pahlevani, F; Giurco, D; Bhattacharya, S; O'Mullane, A; Kerr, R; Tricoli, A; Malik, A; Florin, NH; Tricoli, A, ARC Research Hub for Microrecycling of battery and consumer wastes ($16,000)

NSW DPI/ CRC FOR HIGH PERFORMANCE SOILS LTD SUBCONTRACT

Munroe, PR, Amelioration of subsoil constraints using innovative products and precision placement of soil amendments - PJA3.3.002 ($15,000)

NSW ENVIRONMENT PROTECTION AUTHORITY (EPA) / PRODUCT IMPROVEMENT PROGRAM

Sahajwalla, VH; Maroufi, S, Transforming complicated waste into value-added products ($15,000)

NSW TREASURY / BOOSTING BUSINESS INNOVATION PROGRAM

Gibson, IR; Koshy, P; Stevens, M; Van der Meyden, R; Lim, ET; Hao, X; Szymanska, JM; Gross, M; Oliver, S; Bridge, W; Pettit, CJ; Laws, KJ; Davies, JE; Anderson, DJ; Miller, BM; Cassis, G; Lucien, F; Shen, X; Yao, L, UNSW SME Global Innovation Connections Program ($3,750)

DEFENCE INNOVATION NETWORK SEED PROJECT LEVERAGE SCHEME INDUSTRY PARTNER CONTRIBUTION

Daniels, JE (funded by Critus) Development of novel crystal growth furnace allowing high-volume production of relaxor ferroelectrics for sonar applications ($20,533)

2021 RESEARCH GRANTS

DEPARTMENT OF AGRICULTURE, WATER & THE ENVIRONMENT / NATIONAL ENVIRONMENT SCIENCE PROGRAM (NESP 2)

Sahajwalla, VH; Green, D; Wiedmann, T, Sustainable Communities and Waste Hub ($390,500)

DFAT

Seidel, J (Australia-Korea Foundation Grants Program) Next generation quantum technology and electronic materials workshop ($20,000)

DEFENCE SCIENCE & TECHNOLOGY GROUP (DSTG) - HAZARDOUS AGENT CHALLENGE SHARED GRANT

Kumeria, T; Voelcker, N; Prashant, S (with Monash University) Porous Photonic Microcavities Enhanced In-field Toxic Chemical Sensors ($ 126,594)

DARPA - TOPOLOGICAL EXCITATIONS IN ELECTRONICS SUBAWARD

Valanoor, N; Sando, D; Bellaiche, L, Topological functionalization of ferroelectrics and multiferroics ($3,307)

DISER AUSTRALIA-INDIA STRATEGIC RESEARCH FUND SHARED GRANT

Kumeria, T; Shiddiky, M; Nguyen, N; Santos, A; Voelcker, N (shared with University of Adelaide) Photonic Viropsy: Harnessing light on chip for precise SARS-CoV-2 diagnosis ($95,645)

DEFENCE INNOVATION NETWORK SEED PROJECT LEVERAGE SCHEME SHARED GRANT

Daniels, JE (shared with UTS Sydney) Development of novel crystal growth furnace allowing high-volume production of relaxor ferroelectrics for sonar applications ($50,000)

NORWEGIAN RESEARCH COUNCIL SHARED GRANT

Munroe, PR; Joseph, (with Standard Bio) Catch&Kill - Sustainable low-cost materials for air and water disinfection ($102,559)

PARKS AUSTRALIA SUBCONTRACT

Sahajwalla, VH; Pahlevani, F (with TierraMar Ltd) Northern Australia ghost nets removal needs analysis and feasibility study ($15,000)

NATIONAL INSTITUTES OF HEALTH (NIH) / CANCER TISSUE ENGINEERING COLLABORATIVE: ENABLING BIOMIMETIC TISSUE-ENGINEERED TECHNOLOGIES FOR CANCER RESEARCH

Kilian, KA; Copland, J, Engineered microtumor arrays for development of combination therapies ($319,409)

CONTRACT RESEARCH

Chan, SL; Yang, G (with Weir Minerals Australia) Self-Propagating High Temperature Synthesis (SHS) of Titanium Carbide in White Cast Irons ($15,388)

Chu, D, (with Australian Advanced Materials Pty Ltd) Development of a hybrid self-charging battery technology ($205,722)

Chu, D; Cazorla Silva, C; Jiang, Y (with YCGC Pty Ltd) Enhancing the performance of photovoltaic panels by phase change inhibited materials ($21,333)

Daniels, JE; Cain, T; Kurusingal, V; Dean, C; Doisy, M; PHAM THI, M, (with DMTC Limited) Exploring electro-mechanical response of textured ceramics for underwater acoustics applications - PhD student Scarlet Kong ($3,193)

Joshi, RK (with Vesi Water Pty Ltd) Graphene Oxide Desiccant Project ($136,539)

Koshy, P, (with Brickworks Building Products Pty Ltd) Characterisation of Building Products ($23,422)

Koshy, P, (with Map to Mine Pty Ltd) Assessment of Mineral Resource Quality for Industries ($53,420)

Koshy, P; Sorrell, CC, (with Hy-Tec Industries Pty Ltd) Assessment of Quality of Sand and Clay Products ($6,957)

Koshy, P; Sorrell, CC; Chen, W (with Vecor Australia) Development of Fly Ash-Based Composite Ceramics insert ($10,031)

Munroe, PR; Joseph, SD (with Standard Bio) Analysis of Biochars ($22,000)

Pahlevani, F (with Woolworths Format Development Limited) Coil leakage analysis in refrigerators ($17,500)

Primig, S (with OneSteel Manufacturing Pty Ltd) Advancing Australian steelmaking for next generation construction applications ($20,000)

Sorrell, CC; Koshy, P, (with Allegra Orthopaedics Limited), Optimisation of Processing Parameters for Superior Biomedical Product Characteristics - Part 1 ($36,450)

INTERNATIONAL CONTRACT RESEARCH

Joshi, RK, (with Baxter Healthcare Corporation (USA)) Graphene based membranes for the removal of chlorine and hardness from water ($193,349)

Koshy, P; Gupta, SK, (with POSCO) Survey of coal study trend and property database for developing high temperature coke property analysis methods ($67,280)

Primig, S; Stanojevic, A (with voestalpine BÖHLER Aerospace GmbH & Co KG) Direct ageing plus: process design through high resolution characterisation of Alloy 718 ($108,916)

Primig, S; Plesiutschnig, E; Turk, C; Kapp, M; Leitner, T; Kleber, S (with voestalpine BÖHLER Aerospace GmbH & Co KG) Processing-structure-property relationships of forged Ni-based superalloys. ($81,077)

Young, DJ; Xie, Y, (with ExxonMobil) Cyclic steam-air oxidation ($49,253)

2021 RESEARCH PUBLICATIONS

JOURNAL

Abbas, M., Smith, G. M., & Munroe, P. R. (2021). Microstructural study of HVOF sprayed Ni particles on a grit-blasted stainless-steel substrate. *Surface and Coatings Technology*, 409. doi:10.1016/j.surfcoat.2021.126832

Abul Hashem, M., Sahen, M. S., Hasan, M., Payel, S., & Nur-A-Tomal, M. S. (2021). Tannery liming sludge in compost production: sustainable waste management. *Biomass Conversion and Biorefinery*, 10 pages. doi:10.1007/s13399-021-01759-5

Akbarpour, S., Khoshandam, B., & Maroufi, S. (2021). Effect of V additive on the crystallization of zircon via SCS method: Synthesis, characterization and reaction mechanism. *Chemical Physics Letters*, 762. doi:10.1016/j.cplett.2020.138119

Akhter, R., Zhou, Z., Xie, Z., & Munroe, P. (2021). Enhancing the adhesion strength and wear resistance of nanostructured NiCrN coatings. *Applied Surface Science*, 541. doi:10.1016/j.apsusc.2020.148533

Akhter, R., Zhou, Z., Xie, Z., & Munroe, P. (2021). Harmonizing mechanical responses of nanostructured CrN coatings via Ni additions. *Applied Surface Science*, 538. doi:10.1016/j.apsusc.2020.147987

Akhter, R., Zhou, Z., Xie, Z., & Munroe, P. (2021). Influence of substrate bias on the scratch, wear and indentation response of TiSiN nanocomposite coatings. *Surface and Coatings Technology*, 425. doi:10.1016/j.surfcoat.2021.127687

Akhter, R., Zhou, Z., Xie, Z., & Munroe, P. (2021). TiN versus TiSiN coatings in indentation, scratch and wear setting. *Applied Surface Science,* 563. doi:10.1016/j.apsusc.2021.150356

Akurati, S., Jansson, A., Jones, J. L., & Ghosh, D. (2021). Deformation mechanisms in ice-templated alumina–epoxy composites for the different directions of uniaxial compressive loading. *Materialia*, 16. doi:10.1016/j.mtla.2021.101054

Al-Alharbi, L., Alrooqi, A., Ibrahim, M. M., El-Mehasseb, I. M., Kumeria, T., Gobouri, A., . . . El-Sheshtawy, H. S. (2021). In situ H202generation for tuning reactivity of V407nanoflakes and V205nanorods for oxidase enzyme mimic activity and removal of organic pollutants. *Journal of Environmental Chemical Engineering,* 9(2). doi:10.1016/j.jece.2021.105044

Alcala, R., Richter, C., Materano, M., Lomenzo, P. D., Zhou, C., Jones, J. L.,Mikolajick, T., Schroeder, U. (2021). Influence of oxygen source on the ferroelectric properties of ALD grown Hf1-xZrx02films. *Journal of Physics D: Applied Physics*, 54(3). doi:10.1088/1361-6463/abbc98

Alder, R., Hong, J., Chow, E., Fang, J., Isa, F., Ashford, B., Comte, C., Bendavid, A., Xiao, L., Ostrikov, K., Fu, S., Murphy, A. B. (2021). Application of plasma-printed paper-based SERS substrate for cocaine detection. *Sensors (Switzerland),* 21(3), 1-13. doi:10.3390/s21030810

Alipal, J., Lee, T. C., Koshy, P., Abdullah, H. Z., & Idris, M. I. (2021). Evolution of anodised titanium for implant applications. *Heliyon*, 7(7). doi:10.1016/j.heliyon.2021.e07408

Alipal, J., Lee, T. C., Koshy, P., Abdullah, H. Z., & Idris, M. I. (2021). Influence of altered Ca-P based electrolytes on the anodised titanium bioactivity. *Surface and Coatings Technology*, 412. doi:10.1016/j.surfcoat.2021.127041

Allan, N. L., Conejeros, S., Hart, J. N., & Mohn, C. E. (2021). Energy landscapes of perfect and defective solids: from structure prediction to ion conduction. *Theoretical Chemistry Accounts*, 140(11). doi:10.1007/s00214-021-02834-w

Almessiere, M. A., Güner, S., Gungunes, H., Sertkol, M., Slimani, Y., Badar, R., Akhtar, S., Shirsath, SA., Baykal, A. (2021). Structural, Magnetic, and Mossbauer Parameters' Evaluation of Sonochemically Synthesized Rare Earth Er3+ and Y3+ Ions-Substituted Manganese–Zinc Nanospinel Ferrites. *ACS Omega*, 6(34), 22429-22438. doi:10.1021/acsomega.1c03416

Almessiere, M. A., Güner, S., Sertkol, M., Demir Korkmaz, A., Baykal, A., Auwal, I. A., Shirsath, S.E., Slimani, Y., Hassan, M. (2021). Comparative study of sonochemically and hydrothermally synthesized Mn0.5Zn0.5SmxEuxFe2-2x04 nanoparticles: Structural, optical and magnetic properties. *Nano-Structures and Nano-Objects*, 28. doi:10.1016/j.nanoso.2021.100792

Almessiere, M. A., Slimani, Y., Auwal, I. A., Shirsath, S. E., Gondal, M. A., Sertkol, M., & Baykal, A. (2021). Biosynthesis effect of Moringa oleifera leaf extract on structural and magnetic properties of Zn doped Ca-Mg nano-spinel ferrites. *ARABIAN JOURNAL OF CHEMISTRY*, 14(8), 16 pages. doi:10.1016/j.arabjc.2021.103261

Almessiere, M. A., Unal, B., Demir Korkmaz, A., Shirsath, S. E., Baykal, A., Slimani, Y., Gondal, M.A., Baig, U., Trukhanov, A. V. (2021). Electrical and dielectric properties of rare earth substituted hard-soft ferrite (Co0.5Ni0.5Ga0.01Gd0.01Fe1.9804)x/(ZnFe204)y nanocomposites. *Journal of Materials Research and Technology*, 15, 969-983. doi:10.1016/j.jmrt.2021.08.049

Alosaimi, G., Shin, S. J., Chin, R. L., Kim, J. H., Yun, J. S., & Seidel, J. (2021). Probing Charge Carrier Properties and Ion Migration Dynamics of Indoor Halide Perovskite PV Devices Using Top- and Bottom-Illumination SPM Studies. *Advanced Energy Materials*, 11(37). doi:10.1002/aenm.202101739

Alsawat, M., El-Sheshtawy, H. S., Altalhi, T., Mezni, A., Kumeria, T., Al-Juaid, S. S., & Ibrahim, M. M. (2021). Spectral and Structural Characterization of Metformin with Different Counter Anions: Comparative Analysis and DFT Calculations. *Asian Journal of Chemistry*, 33(11), 2817-2825. doi:10.14233/ajchem.2021.23422

Altalhi, T. A., Ibrahim, M. M., Mersal, G. A. M., Alsawat, M., Mahmoud, M. H. H., Kumeria, T., Shahat, A.,El-Bindary, M. A. (2021). Mesopores silica nanotubes-based sensors for the highly selective and rapid detection of Fe2+ ions in wastewater, boiler system units and biological samples. *Analytica Chimica Acta*, 1180. doi:10.1016/j.aca.2021.338860

Altalhi, T., El-Moemen, A. A., Ibrahim, M. M., Mezni, A., Alsohaimi, I. H., Mahmoud, M. H. H., Kumeria, T., Mersal, G.A.M., Mostafa, N. Y. (2021). Integrated approach in treatment of solid olive residue and olive wastewater. *Materials Research Express*, 8(11). doi:10.1088/2053-1591/ac34b9

Ameri, A., Wang, H., Li, Z., Quadir, Z., Rickard, W. D. A., Gonzalez, M., Hazell, P.J., Escobedo-Diaz, J. P. (2021). Ferrite phase transformation in dual-phase steel under shock loading. *Materials Science and Engineering A*, 802. doi:10.1016/j.msea.2020.140690

Amin, M. L., Mawad, D., Dokos, S., Koshy, P., Martens, P. J., & Sorrell, C. C. (2021). Fucoidan- and carrageenan-based biosynthetic poly(vinyl alcohol) hydrogels for controlled permeation. *Materials Science and Engineering C,* 121. doi:10.1016/j.msec.2020.111821

An, X. Z., Dong, K. J., Yang, R. Y., Zou, R. P., & Yu, A. B. (2021). On the relationships between structural properties and packing density of uniform spheres. *Powder Technology*, 388, 139-148. doi:10.1016/j.powtec.2021.04.079

Anupam, A., Ang, A. S. M., Guruvidyathri, K., Abbas, M., Sivaprahasam, D., Munroe, P., Berndt, C.C., Murty, B.S., Kottada, R. S. (2021). Evaluating the influence of microstructural attributes: Fraction, composition, size and spatial distribution of phases on the oxidation behaviour of high-entropy alloys. *Corrosion Science*, 184. doi:10.1016/j.corsci.2021.109381

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2021 INDUSTRY PARTNERS

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UNSW Sydney - Sydney NSW 2052 Australia

Enquiries:

Phone: +61 (0)2 9385 7298

Fax: +61 (0)2 9385 6565

Email: enquiries.materials@unsw.edu.au

Web: materials.unsw.edu.au

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Project Coordinator & Editor: Nicole Cooney

Design: Greg Hosking, Monotron Creative - greg@monotron.com