

ARC Centre of Excellence for Electromaterials Science

Annual Report 2021



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Welcome

The year 2021 marked the final official year of ACES. It was a year marked by the appearance of an end but more suitably seen as the beginning of new journeys for the ACES collaboration members.

The remarkable achievements by the team members of ACES are staggering and this report details not only the achievements for 2021 but also the impact ACES has made on the fundamental science, community and translation to industry. ACES also leaves a sizable legacy that has positioned the people and knowledge bank ready for the next chapters. Many of the fundamental science discoveries have made the journey through to the cusp of translation and positioned well to move through the technology readiness levels.

The team, at ACES, has continued to produce substantial outputs and outcomes throughout the year. All members of ACES are now poised for the "bigger and better" adventures in 2022 and the years beyond.

Publications continue to be plentiful with over 240 publications cited more than 590 times in 2021 and over 1,600 journal articles with more than 47,500 citations since the start of 2014.

The ACES Partners

We have established a global network of partners integral to our success in research, training, commercialisation and engagement. ACES, led by the University of Wollongong, incorporated eight Australian collaborating organisations and five international partner institutions known for their expertise in materials and device fabrication.

The collaborating organisations currently are Deakin University, Monash University, University of Tasmania, The Australian National University, The University of Melbourne, Swinburne University of Technology and La Trobe University.

The international partner institutions are Dublin City University, Ireland; University of Warwick, UK; Friedrich Alexander University of Erlangen, Germany; Hanyang University, Korea and Yokohama National University, Japan.

Each node comprises of individuals with key research strengths that, when combined, placed ACES in a powerful position to design, discover and develop new electromaterials.

Our Funding

The Australian Research Council (ARC) invested \$25 million in ACES over 2014-2021 to translate our materials science

knowledge into practical, game-changing devices that will have a significant impact in the areas of diagnostics, energy, health and soft robotics.

The NSW Government invested \$500,000 through its Research Attraction and Acceleration Program (RAAP) to help us facilitate the commercialisation of our research. In addition, to assist in developing innovative approaches that encourage entrepreneurship and commercialisation.

Our core funded activities provided a fundamental research program, facilities and expenditure that has enabled new opportunities through MedTech and Pharma Growth Centre connect (MTPConnect) funded projects, Australian Renewable Energy Agency (ARENA), CRC funded projects, ARC linkage (project and training hubs), NHMRC and ARC discovery projects.



STEVE KLOOS
CEO, AQUAHYDREX, AND PARTNER,
TRUE NORTH VENTURE PARTNERS

"ACES is an example of a research organisation tackling commercially relevant problems at fundamental and applied levels. The talent of the team, coupled with the equipment and facilities to translate lab ideas to prototypes, is truly world-class."



A Word from the Director

We are proud of the achievements of ACES and the contributions we have made to providing new technologies that have impacted across the energy and health sectors. Both of these sectors are critical to the wellbeing of Australians and indeed the Global community. While we will continue to build on this amazing platform of knowledge to realise translational opportunities in 2022, please indulge me as I pause and reflect on the impact and the legacy ACES has created.

New Knowledge: Much of this is encapsulated in the publications produced by ACES, and summarised in the annual reports produced each year. ACES has produced more than 1,600 journal articles since 2014, with over 47,500 citations.

In particular, ACES has pioneered advances in graphene, ionic liquids, biomaterials and 3D printing – and ACES has used these to enable advances in energy conversion and storage, biomedical technologies and novel diagnostic systems.

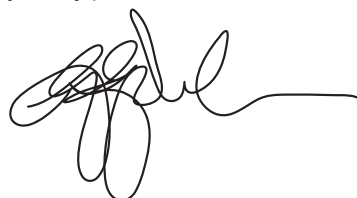
A Translational Ecosystem: The ACES team has established unique facilities targeting translation – the BatTRI-Hub at Deakin University and the Translational Research Initiative for Cell Engineering and Printing (TRICEP) in Wollongong. ACES was instrumental in the formation of Biofab3D at St Vincent's Hospital, a forerunner to the exciting initiative the Aikenhead Centre for Medical Development (ACMD). ACES has pioneered a holistic approach to research endeavours involving non-technical aspects including regulatory, policy and ethical considerations from the beginning of a project.

Global Networks: The ACES team has established a network encompassing collaborations in 56 different countries. All of these have delivered high impact publications and have created a global network for technology deployment.

World Class Training: An exceptional workforce, bringing together interdisciplinary researchers trained for translation and with end-user connections created. These individuals are well prepared to embark on the ideas to industries journey and to play their part in the human chain that makes such journeys possible. ACES graduates are steeped in a multidisciplinary, multi-institutional and internationally collaborative environment throughout their training, and are presented with the opportunity and challenge to refine their research in response to real-time advances in the foundational science, in government regulation, societal concerns and global translation opportunities.

I, of course, must thank the Australian Research Council (ARC) for its ongoing support, particularly given the difficulties of the last couple of years due to the pandemic. A special thank you also to our International Advisory Committee chaired by Dame Bridget Ogilvie for your advice, support and mentorship. Lastly, I would like to thank each and every one who engaged with the Centre over its many years. We could not have achieved what have without you.

I look forward to the future that our legacy and impact has helped shape going forward. Should you like to join us on that journey please do not hesitate to contact me.



Prof Gordon Wallace
Executive Director of ACES





IAC Report

This is the final report from the International Advisory Committee (IAC) on the activities of ACES.

Over the years, the outstanding leadership and exceptional congeniality of ACES members have always impressed the IAC. Considering its multiple sites in universities, institutes and international involvement, these characteristics are remarkable and underlie its success.

Likewise, the IAC has watched with admiration as the early focus on high quality fundamental discovery research of ACES progressed into translation and spinouts. ACES has also been outstanding for its commitment to the training of students, early career researchers and fellows. This legacy is essential for the future of electromaterials science, already obvious as former trainees have continued their activities elsewhere. Examples include ACES graduates moving on to positions in industry as well as those in research and academia.

Two new spin out companies, Jupiter Ionics and Hysata began in 2021. They join the existing list of successful spin outs from ACES including AquaHydrex. The establishment of the Translational Research Initiative for Cellular Engineering and Printing (TRICEP) has supported new commercial ventures

including iFix, Inventia and Axcelda, while the BatTRI-Hub facility has enabled partnerships with companies including Sensorplex, Calix and Boron Molecular. It is likely that further translation of the fundamental research, which has continued throughout the existence of ACES, will occur in the near future, Edge Functionalised Graphene (EFG), CO₂ removal strategies and additional medical products are among the areas poised to attract commercial investment.

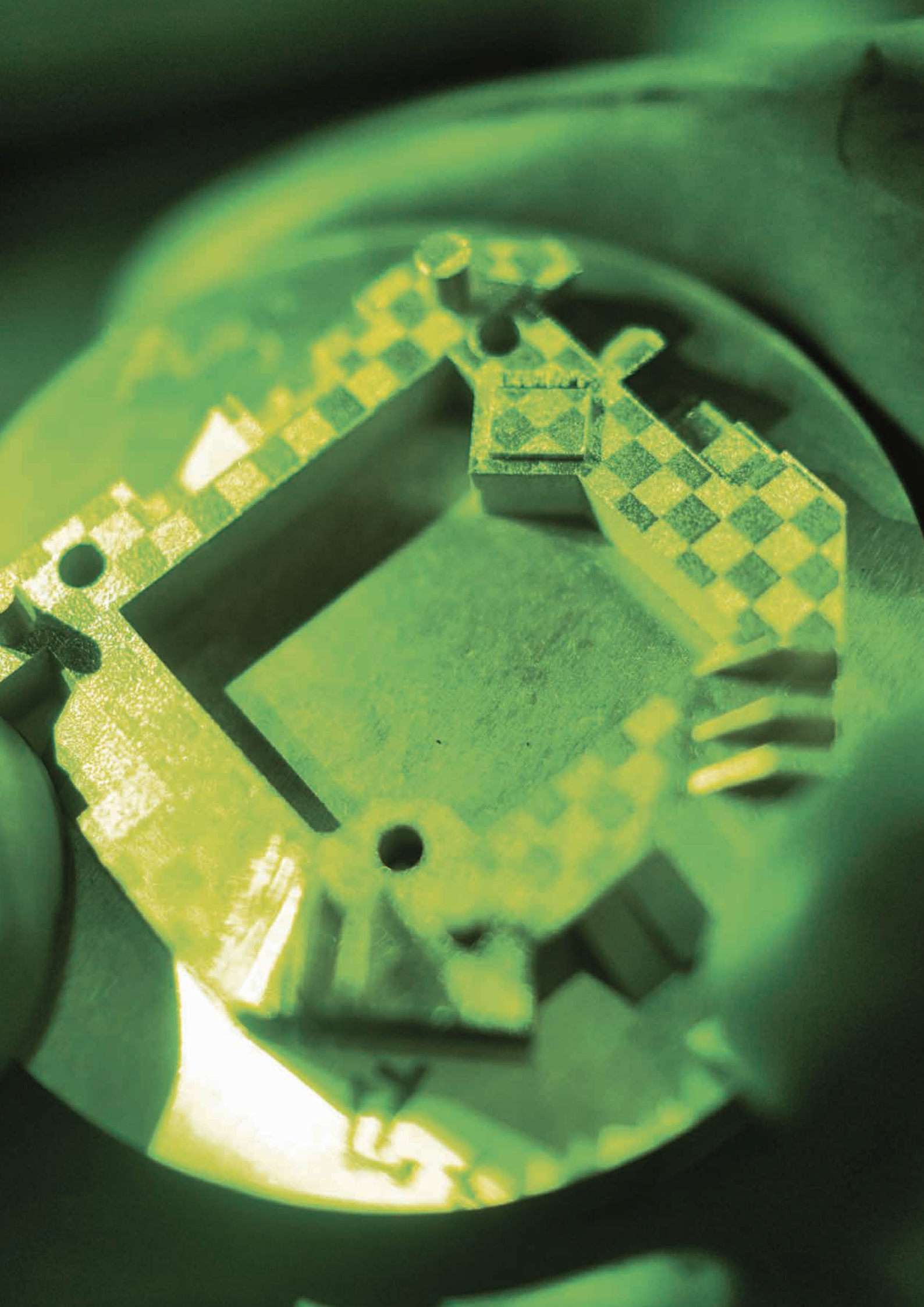
The IAC is confident that Australia will continue to benefit from the work of ACES in future. Its large social and economic impact resulting from the funds it has won in competition from national bodies over many years is an excellent example of the importance of discovery scientific research to the growth of new businesses.



Dr (Dame) Bridget Ogilvie (AC, DBE, FAA, FRS, FMedSci)
Chair of the ACES International Advisory Committee



ACES Symposium, February 2020



| Impact

“Research is the key to unlocking intellectual capital, as well as bolstering its competitiveness, productivity and innovative capacity.”

- Prof Mary O’Kane NSW Chief Scientist

ACES has had a profound impact on the frontiers of electromaterials science and technology, generating products, technologies and services that assist Australia and the world. ACES has benefited from two rounds of ARC funding. The first from 2005-2013 and the second from 2014-2021. The Centre has engaged broadly with national and international collaborations, community and education partners, along with industry allies.

The Centre’s impact has penetrated into the scientific and general communities, as well as guiding Government decision-making to drive a global understanding of the value of electromaterials to human life. As such, ACES has forged a foundation for addressing some of humanity’s most challenging global problems as outlined by the UN Sustainable Development Goals (UN-SDGs) in Good Health and Wellbeing (UN-SDG 3), Quality Education (UN-SDG 4), Affordable and Clean Energy (UN-SDG 7), Industry Innovation and Infrastructure (UN-SDG 9), Responsible Consumption and Production (UN-SDG 12), and Partnerships for the Goals (UN-SDG 17) - all areas of direct national benefit to Australia.

ACES has produced groundbreaking research evidenced by more than 2422 publications, with 53% involving international collaborators, and gaining over 114,000 citations. Commercially, 56 patents have been filed, many of which have been used to build new commercial opportunities. ACES has successfully translated this research into innovative, commercially viable technologies and products for “real-world” applications. Relevant to SDG Goal 17, Partnerships for the (SDG) Goals, industry partners have engaged early with ACES’ research and have adopted new technology to match their individual company needs. Some examples include the Translational Research Initiative for Cellular Engineering and Printing (TRICEP), BatTRI-Hub, BatriAquaHydrex, and IMAGINE.

UN-SDG (3): Good Health and Wellbeing

ACES has demonstrated the innovative use of electromaterials to control biological cell function in both 2D and 3D which has global significance. ACES has used electromaterials to make devices that integrate into the human body and restore function in failing tissue and systems. The following provides an overview of some of the most significant contributions:

Brain on a bench (BoB): *Bioinks and fabrication tools to make award-winning 3D printed brain-like tissues from human stem cells to enable new insights into brain function and tissue building.* This research is impacting biomedical research and translation by enabling transition away from animal testing to human tissue modelling for pharmaceuticals discovery and laboratory-based medical device testing, as well as providing clinically relevant tissues for regenerative medicine. The BoB approach has evolved from ACES’ award winning work on “electric neural tissue engineering”. This work was recognised by Research Australia through its inaugural 2019 Health and Medical Frontiers Research Award, which “recognises transformative research that extends existing knowledge and understandings within health and medical research that will enable Australia’s health system to position itself as a global leader”. The proprietary technology enables the development of advanced and customised tissues for ethical and more cost-effective biomedical research and prospective therapeutics.

Neurally driven prosthetics: *A monolithic soft hand prototype and cell-based electrode interface have impacted the area of prosthetic limb applications, providing significant improvement in quality of life for people with missing limbs.* In the course of this pursuit, 3D printed prosthetic hands with enhanced functionality driven by wearable electrodes have been developed. In collaboration with patient advocacy groups and studies into desirable characteristics in a prosthetic hand, are ongoing patient trials in collaboration with Prince of Wales Hospital.

Axcelda Pen: *Development of a hand-held 3D fabrication tool to deliver stem cell therapies in degenerative disorders such as arthritis.* This device will impact on the treatment options available to patients suffering from cartilage damage resulting from sports injury through to old age. Axcelda Pen provides a new way in which regenerative medicine will impact people’s quality of life and in turn reduce the cost burden associated with current surgical interventions to repair cartilage damage.

3D Printed Ears: *The development of customised printers capable of producing hybrid structures that maintain shape while facilitating cartilage regeneration.* In particular, ACES and surgeons have developed a customised multi-materials bioprinting solution to assist in the regeneration of cartilage for use in reconstructive ear surgery to treat microtia, a congenital deformity where the external ear is underdeveloped. In the course of this journey, a parallel project involving the development of a customised device to realise 3D printed prosthetic ears has emerged. Working

closely with prosthetists in Australia and India, as well as Andhra Pradesh MedTech Zone (AMTZ), this project has been rapidly progressed. The complete package involves the use of mobile phones to scan the existing ear on a patient, providing data to enable printing of the prosthetic ear.

3D PICT: *Development of a customized 3D bioprinter for the delivery of islet cells to treat diabetes.* The transplantation of donor islets is emerging as a potential cell therapy for Type 1 diabetes. ACES has developed a 3D Pancreatic Islet Cell Transplant System comprising a customized 3D PICT bioprinter and bioinks to deliver insulin-producing islet cells to revolutionise treatment for people with Type 1 diabetes. Prototype printers have been supplied to the Royal Adelaide Hospital and Asan Medical Center Medical in Korea.

Additionally, the ACES Synthetic Biosystems theme has been an integral component in the establishment of new facilities, including the the BioFab3D@ACMD facility, a hospital-based robotics and biomedical engineering centre at St Vincent's Hospital Melbourne. This centre embeds both scientific research into the clinical setting and clinical needs into the research environment; consequently increasing and accelerating solutions for long-standing human health issues. The centre facilitates and expedites problem solving through involvement of experts in the field, tailoring solutions to their patients' real world problems and needs. This multi-institution facility (ACES partners UOW, RMIT, University of Melbourne, Swinburne University and St Vincent's Hospital) has established vibrant collaborative research initiatives leading towards accelerated translation resulting in improved health impact. This facility also forms part of the Aikenhead Centre for Medical Discovery (ACMD), a AUD\$210million multi-institutional facility, that will fuse medicine, engineering, science and industry to yield significant economic, patient and healthcare impact, unlike anywhere else in Australia.

UN-SDG 4: Quality Education

At ACES, technical research training was at the core of the impact delivered and the graduates were able to contribute to interdisciplinary teams, communicate at all levels in society, adapt and re-skill to face new challenges and emerging opportunities. ACES has provided students and ECRs with additional training in topics including:

- Communication, to engage across disciplines and explain their research to the wider community;
- Entrepreneurship and Innovation via intensive short courses;
- Ethics and Public Engagement, which built awareness of ethical and policy issues that will arise from their research.

The leadership team has taken a non-traditional approach to supervision and mentoring next-generation leaders. As a result of the multidisciplinary nature of the research carried out, researchers were encouraged to work together in teams, and across traditional boundaries, and provided

with access to collaborators' laboratories across the globe. Innovative programs were implemented which facilitated researchers to acquire skills in technology transfer and the commercial development of research. Beyond dedicated mentoring workshops or webinars, ACES exemplified a culture of innovation, translation and building the confidence and resilience required to "just have a go". The educational scaffold provided by ACES allowed our domestic and international student cohort to excel in their careers be it in industry, academia or their own entrepreneurial journey.

UN-SDG (7): Affordable and Clean Energy

ACES has developed new approaches to the use of renewables to drive water reduction to hydrogen, CO₂ reduction of carbon based fuels and the reduction of nitrogen to ammonia. In particular, an Australian-based platform of expertise and equipment in electrocatalysis relevant to chemical energy storage of ammonia or hydrogen has been established with strong international links. This concentration of expertise and equipment has led to the establishment of the Ammonia Energy Association Australian Chapter by the Monash node of ACES, which has further resulted in frequent state and federal government briefings to shape and form future-orientated renewable policies.

The ACES concentration of expertise and equipment as a Centre of Excellence has led to significant further funding from various sources. Selected examples include industry-funded projects with Woodside Ltd and Applied Nanotechnologies P/L; as well as major research projects funded by the Australian Renewable Energy Agency (ARENA). "Ammonia Production from Renewables at Ambient Temperature and Pressure - Developing a process for reduction of nitrogen to ammonia", was an ARENA project awarded to ACES researchers aimed at the extension of ACES IP in the ammonia generation area to higher levels of Technology Readiness. A second ARENA-funded project, "Low-cost, Robust, High-activity Water Splitting Electrodes" was funded to further develop the substantial catalyst IP within ACES, in the field of water splitting to hydrogen, focused on inexpensive/affordable energy materials and high through-put manufacturing.

The world-leading ACES expertise, that has emerged in the ammonia field, has led to new projects more broadly in sustainable nitrogen chemistry. One such project has been funded as an Australian Research Council Discovery Project: "Sustainable Nitrogen Chemistry" (2020-2023).

The ACES research led by CIs Prof Pringle and Prof MacFarlane has also developed into a collaboration with local start-up company Energy Storage P/L in the thermal energy storage area. Thermal energy storage is increasingly seen as an emerging solution to low cost renewables storage. The venture included licensing of technology and new ARC

Linkage Project funding 2020-2023 to further develop the materials technology.

The Battery Technology Research and Innovation Hub (BatTRI Hub): Prof Maria Forsyth was both ACES Deputy Director and the BatTRI Hub director. The hub draws on Deakin's critical mass of battery-related expertise, CSIRO's polymer research strengths and scale-up facilities, and ACES' electromaterials expertise. BatTRIhub has facilitated co-operative research centre based projects which involved engagement with industry including Calix and Boron Molecular and the Future Battery Industries CRC. It also engaged with a number of companies and local industry through the ARC Training Centre in Future Energy Storage Technologies, StorEnergy. Without the fundamental science in ACES and BatTRIhub, these innovative collaborations would not have been possible.

Affordable and Clean Energy – Assuring Ethical Impact: ACES cross-node collaborations in energy-related research contributed to both SDG 7 and Responsible Consumption and Production (UN-SDG 12), which reflected the ARC's support for multidisciplinary research that linked STEM scientific research with ethics, policy and community engagement. This included research and publications on ethical renewables supply chains in university laboratory research; the relationships between disasters and resilient renewable energy systems; ethical battery supply chain research (Bolivia and India); circular economy in solar and battery research; ethical and international relations implications of international supply chains in renewable (solar) hydrogen exports to Asia; and policy implications of solar versus brown coal-generated hydrogen exports to Japan and South Korea. Policy impact included research focused on disaster-resilient renewable energy systems and policies in India, as well as Australia-Germany comparisons of the policy and community impact of citizen-led low-carbon energy transitions. CI involvement as a Board Director on the first Australian community wind farm (Hep Wind) has contributed to hybrid energy operations and negotiating current policy risks/barriers/opportunities for community-scale renewable energy.

UN-SDG (9) Industry Innovation and Infrastructure

Sustainable consumption and production is defined by doing more and better with less. It also includes circular economy and ethical supply chains, decoupling economic growth from environmental degradation, increasing resource efficiency and promoting sustainable lifestyles.

ACES was focused on the development and characterisation of new electromaterials and the creation of structures and devices that contained them. This led to the development of new fabrication tools widely applicable outside the field of electromaterials. These new fabrication strategies enabled

the integration of the discovered materials into the developed structures and devices which enabled their translation to industry. Selected examples that have commenced navigation of the translational pipeline are illustrated below.

Graphene: A new form of graphene was discovered by ACES researchers. The unique discovery of a multilayer edge functionalised structure has revolutionised graphene applications. The discovered structure was unique in that it combined features of high conductivity and high dispersability in water and organic solvents. This enabled a variety of processing options to be utilised to create unique structures. This included processing a range of composites with host polymers including polyurethane, latex rubber and biomaterials such as chitosan and alginate.

Australian National Fabrication Facility (ANFF): Strong links to the ANFF Materials Node paid significant dividends for the industry take-up of ACES research. Industries, attracted by the ANFF materials processing and fabrication capabilities have subsequently engaged in longer term research (e.g. Enware, Romar Engineering and Venus Shell Systems). Emerging industries have used the ANFF capability to attract investment in new commercial entities based on ACES discoveries (e.g. AquaHydrex).

Fundamental research requirements emerging from ACES continually highlight the need for customised fabrication tools. UOW has established TRICEP – a facility for printing printers.

Contactless characterisation tools: Additive fabrication of 3D structures and devices demanded the development of contactless characterisation tools to monitor the physical and biological properties of materials during assembly. ACES researchers developed unique tools based on microwave and ultrasound interpretation that enabled the deduction of the electrical and mechanical properties.

Fabrication tools: New fabrication tools included a range of customised 3D printers that were developed by ACES researchers. It involved a multidisciplinary team of scientists and clinicians at ACES who developed the handheld Axcelda 'Biopen' which enabled biofabrication in a surgical environment. Further fabrication tools tailored to the surgical environment included the iFix system to treat wounds in the eye and 3D PICT, a customised printer which created constructs to facilitate islet cell transplantation to treat diabetes.

Development of these new fabrication tools required the coordination of five interdependent streams of research available through the ACES network: (i) device development, (ii) materials development, in combination with (iii) biological development, through to (iv) surgical implementation and (v) ethics and regulation of a novel medical device.

Other fabrication techniques to create 3D structures included fibre spinning, knitting and braiding. These tools have been used to fabricate a range of wearable sensing and energy storage technologies.



Legacy

“An account of the things that mattered most, the lessons learnt and the values left so you are making a contribution to future generations...”

- Prof David Officer, ACES Chief Investigator

This section summarises the legacy of ACES over two instalments of funding from 2005-2021 (2005-2013 and then again from 2014-2021) based on the following legacy areas:

The Overarching Legacy

ACES was established in 2005 to stimulate advances in energy and health systems through the creation of new electromaterials; develop the science at both the nano and macro-dimensions; and introduce new expertise in electromaterials into the Australian workforce. Sixteen years later, the team has addressed the technical and societal requirements of some of the most challenging 21st century global problems in clean energy, sustainable manufacturing and health. This is thanks to a closely integrated research program of materials and electromaterials design, modelling, synthesis, additive manufacturing, ethics and public policy considerations, and the ACES network of over 300 national and international researchers, commercial partners and partner investigators.

Knowledge advancement has been communicated through more than 1,600 journal articles and translated into a wide range of entities including three spinouts, over 100 grants awarded, six research hubs and training centres, six Cooperative Research Centres and projects, as well as into state and federal government policy.

Over 50 postdoctoral and 75 PhD students have been trained in ACES. Through innovative training and mentoring, along with programs in entrepreneurship and science communication, ACES has produced emerging research leaders well equipped on the global stage to engage in high impact frontier translational and commercial opportunities. ACES researchers also currently lead start-up companies, academic, government and industry research groups, and consultancies.

The diversity and scope of the ACES network demonstrates the benefit of large research networks in addressing the most challenging research problems, exactly as envisioned in the Centres of Excellence funding scheme. The multidisciplinary nature of the network has delivered societal benefits in the fields of health, energy and advanced manufacturing. For example, the creation of biofabrication facility, the Translational Research Initiative for Cellular Engineering

and Printing (TRICEP) at the University of Wollongong, could not have been achieved without the extensive ACES national and international clinical network that continues to radically impact on future health outcomes.

Hand in hand with ACES cutting edge research has been the development of outstanding ACES node facilities and instrumentation, both for doing better research and also translating it into the public and commercial domains. Facilities such as TRICEP and BatTRIHub, the Deakin Battery Technology Research and Information Hub, along with a number of others, will foster ACES research for many years into the future.

From its inception, the engagement of experts from ethics, policy and industry to guide the design of new technologies has been a fundamental part of ACES, addressing not only the technological requirements, but also their social acceptance and likely uptake and commercial success. This has resulted in not only better trained and ethically aware researchers but also better technology.

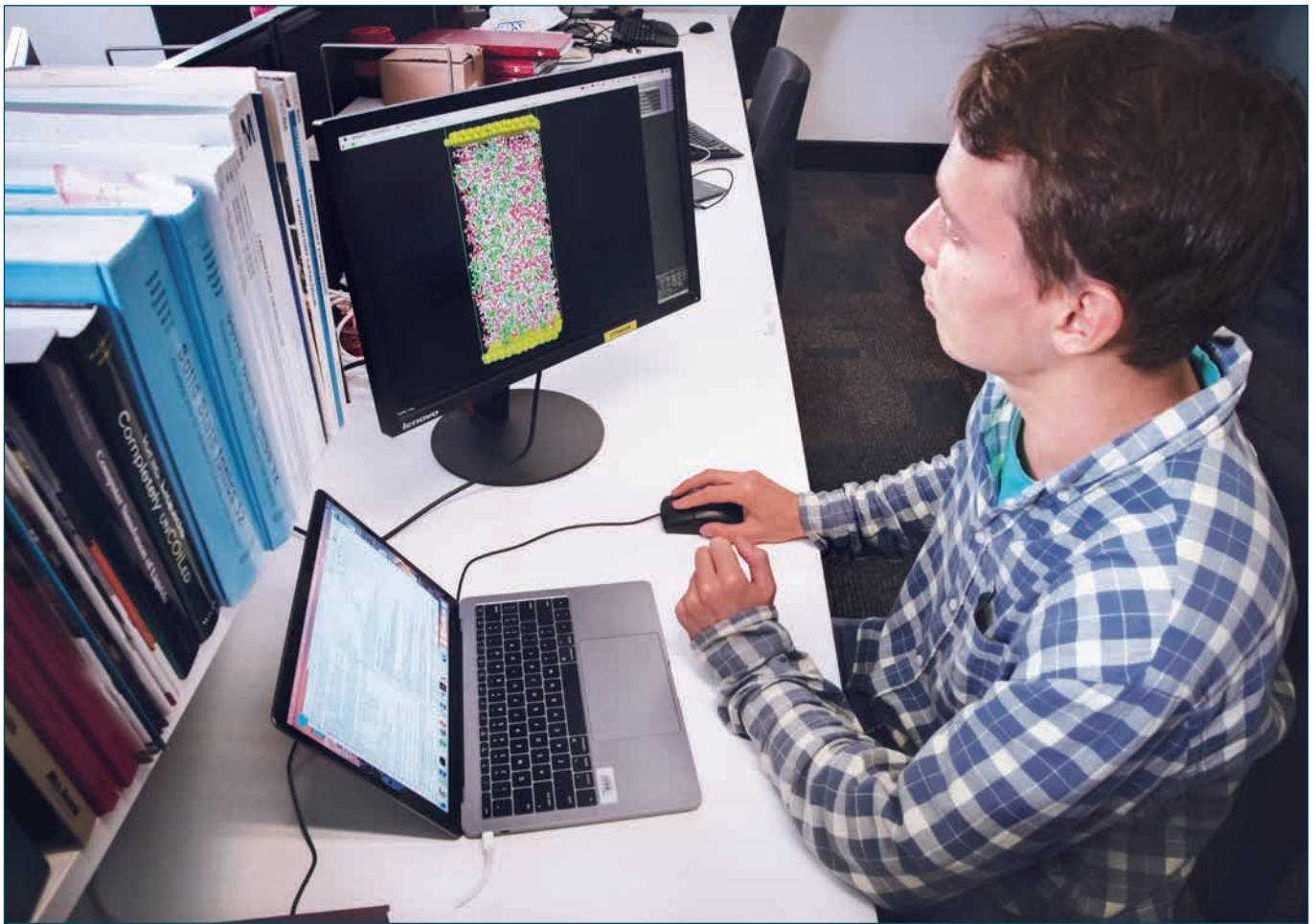
ACES has not only changed the way electromaterials research is done but demonstrated how to do it better.

Knowledge Generation

ACES has created a new approach to knowledge accrual that ensures end-user engagement from project initiation. Our mantra on translation – “Don't wait till the end to get started” – will bode well for future research activities. The ACES approach involves consideration of all technical and non-technical issues (regulatory, ethical, social) in the prioritisation, design and execution of a project or program.

Some of the ACES discoveries that have laid the foundation for significant further research include:

- Graphene, whose synthesis and fabrication into devices has had a major influence on international research and commercial output;
- Ionic electrolytes that have been used to enhance the performance of next generation batteries, solar cells, and the synthesis of solar fuels;
- Bioinks that, along with new 3D printing fabrication techniques and technology (biopens), have changed the way clinicians will treat a wide variety of medical conditions in the future;
- The 'Brain on a Bench', a 3D printed nerve cell construct that resulted from ACES 3D bioprinting capability and is providing new insights into brain physiology and diseases;



- Bioinspired soft actuators that can be used in a wide variety of robotic applications including grippers, locomotion robots, and artificial muscles, and that led to the development of a soft prosthetic hand with myoelectric control systems, which control and power the prosthetic through the detection of the electric signals generated naturally by muscles.

A Translational Eco-System

One of the key ACES legacies is the ability to successfully manage the commercialisation of ACES research in marketplace with industry partners, which has benefited Australian and global communities. ACES has shown its strength in demonstrating a unique platform for transferring ACES research to industry technology, through which industry partners can engage with ACES research through different models/options, such as IP Licensing (IMAGINE), VC investment (AquaHydrex), and industry partner entity (TRICEP). ACES is also able to conduct "knowledge translation" to respective target communities, the clinician community and local social communities, in order to promote clinical applications and policy integration. ACES researchers will continue to explore and discuss ACES research with relevant end-users, translating ACES research into the marketplace with multidisciplinary partners.

The approaches developed to facilitate translation include early end-user engagement and consideration of non-technical matters. Also critical to future translation are the training system, networks and facilities that are part of the ACES legacy.

Training

ACES has pioneered an entire platform of non-traditional training programs, arming the Centre's researchers with the practical skills for their productive engagement with scientists, businesses, community groups and government.

Ranging from short webinars to postgraduate courses, from online learning to face-to-face mentoring and group learning, ACES training programs are relevant and fitting to the career path of every member of the ACES family. The three most significant outcomes in innovative research training are:

- Two freely available online courses (via Futurelearn) in Biofabrication and Clean Energy generation, accessed by well over 5000 students to date;
- A Certificate in Innovation and Entrepreneurship course tailored to complement the busy candidature of over 100 PhD students associated with the Centre; and

- Cross-institutional Master courses in Biofabrication and Electromaterials, leading to enhanced research collaboration and outputs.

The benefits of these training activities outlive the current funding cycle of the Centre through the high-quality graduates and researchers, the innovative teaching platforms and course materials readily transferable to other major research centres, and ultimately, the better translation of research findings into business ideas, community knowledge and research policy.

Networks

The ACES network has grown to a global, multidisciplinary network across 50 countries, sharing a common vision to use fundamental electromaterials research for end-user benefit. The establishment of a clinical network to tackle significant medical challenges is enabling the development of treatments for specific diseases (e.g. diabetes, cartilage repair, eye injuries, brain and nerve disorders). The multidisciplinary network of ACES is accelerating the development of a customisable soft robotic prosthetic hand with sensory feedback features, which is lightweight, energy efficient, and inexpensive. A growing ACES network of energy researchers across academia and industry is tackling challenges in energy conversion and storage. Without a strong and interconnected partnership with all stakeholders, such innovations would take a significantly longer time to reach the end beneficiaries.

Facilities

The coming together of knowledge from fundamental research and collaborations with ACES multidisciplinary themes and industry identified the demand for multiple customer focused innovative technology facilities to meet the needs of research institutions and industry.

All of the ACES partners have invested in creating multidisciplinary state-of-the-art research facilities with each of the nodes. In addition, ACES has led the world in creating unique translational facilities. TRICEP, for example, evolved due to a rapidly growing demand for a central, end-to-end solution, in a fully integrated facility, to translate biomaterials to printers to hardware for real world clinical problems. Examples of this work include biopens such as the iFix medical pen for corneal repair, 3D Alek to produce 3D printed ears and to treat microtia, and the Axcelda pen for cartilage regeneration. Secondly, the Deakin Battery Technology Research and Information Hub (BatTRIHub) facilitates advanced battery prototyping and commercialisation of energy storage technologies and is part of the fabric of fundamental research today and in the future.

These facilities will continue to expand and operate beyond ACES, and the knowledge and skills gained by students and staff working in these evolving research structures will add value to a diverse range of professions, influencing the future of technologies and their public benefit.





| 2022 and Beyond

The future of ACES will be different. Better yet, it will be very bright – thanks to ACES enduring legacy.

The work over the years has delivered a platform for the future that will leverage the significant intellectual capital developed. The extraordinary fundamental research achievements and training initiatives leaving a legacy that will live beyond the centre. ACES has also demonstrated the ability to build resources, infrastructure and processes that enabled translation of the fundamental advancements achieved. These advancements have resulted in;

- Outcomes that have real world impacts;
- New companies being launched;
- Product and process improvement for existing companies;
- New policies within organisations and government.

In the health and medical realm, translational and commercial development activities of ACES will continue with iFix and Axcelda pens moving to clinical trials in 2022. Other research developments like the PANC for treatment of pancreatic cancer, 3D REDI bioprinter for education and UltraImage for *in situ* analysis all under development for translation in the near future. Biomedical innovations, including brain research and that alike will also continue.

Electrofluidics will move to the next opportunities by integrating with biological systems for *in situ* delivery and monitoring, rapid diagnostics, and controlled transport via functionalised membranes.

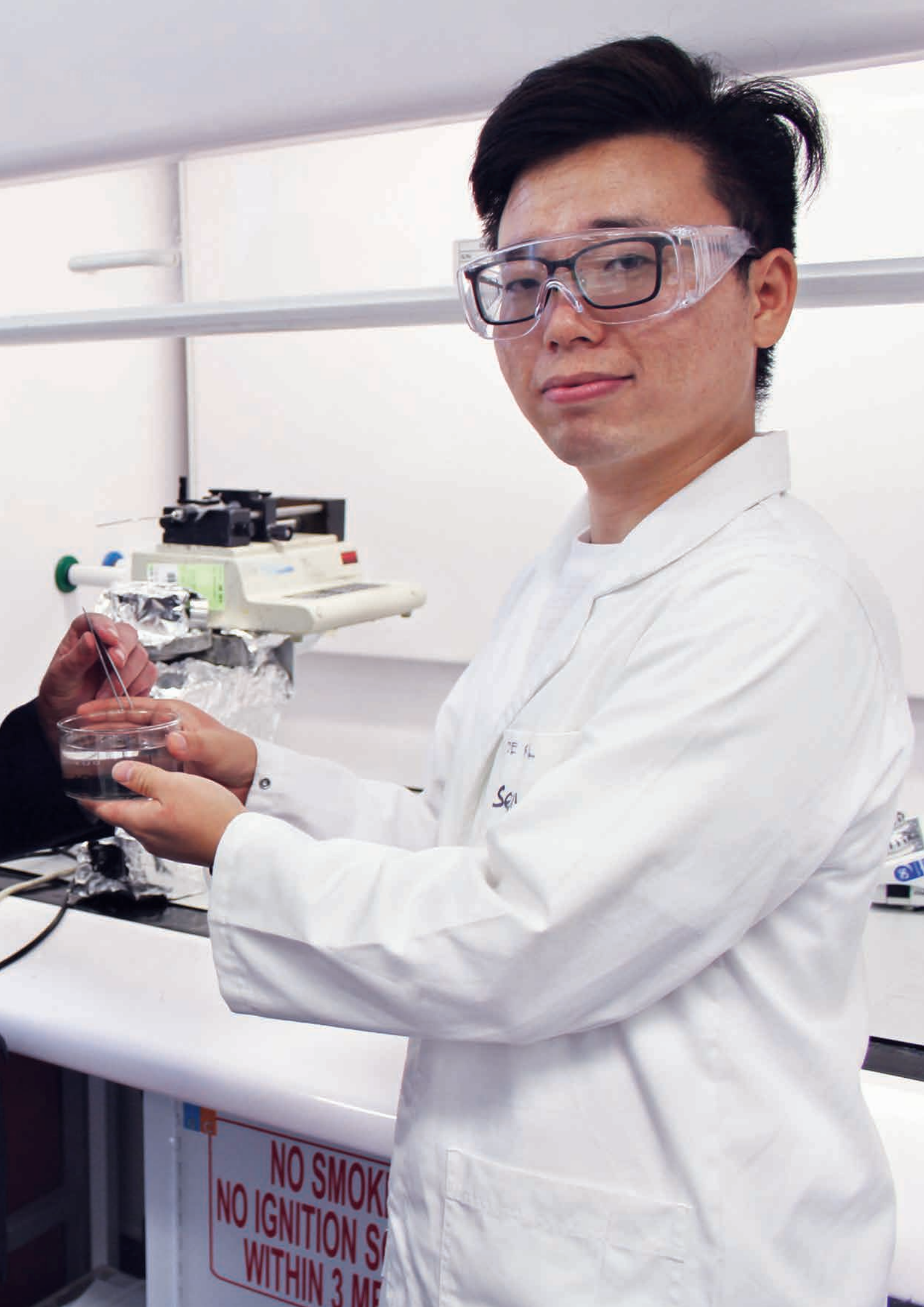
In the clean energy areas, technologies are showing promising developments that will continue through innovative work on the developing ammonia economy, highly efficient energy storage solutions and CO₂ reduction strategies.

The outcomes of the soft robotics team have had real impact in the prosthetics domain and will continue to develop cost effective and lightweight solutions addressing the human machine interface. The work developed by the team will move beyond prostheses to assistive devices including; co-bots, wheelchairs, and drones in and around the home.

Plans are in motion for continuing research in the following areas: EFG – Functional Composites; Efficient Electrolysers; H₂ Generation; Fuels from CO₂; Thermal Energy Harvesting; Customised 3D Printing Protocols; 3D Bioprinting electrocuetical based research including Electrode Materials, Wireless stimulation (via RF, Implantable batteries, Ultrasound, Magneto-piezo); Brain on a bench and Targeted diseases; and more.

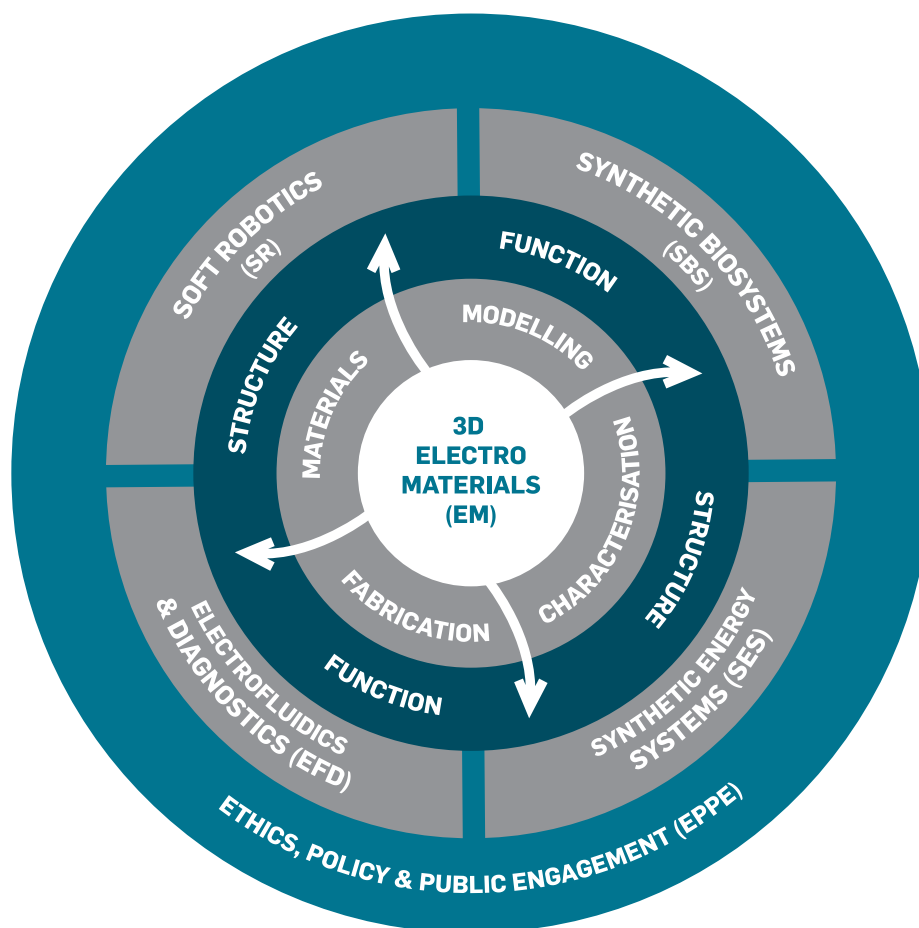
The future is very bright indeed.





NO SMOKING
NO IGNITION SOURCE
WITHIN 3 METERS

Research



Schematic 1: ACES Core 3D Electromaterials research theme and associated application themes

2021 saw the culmination of several of the outstanding ACES research efforts into translational outcomes, efforts achieved over the previous 6 years in the Electromaterials (EM), Electrofluidics and Diagnostics (EFD), Soft Robotics (SR), Synthetic Energy Systems (SES), and Synthetic Biosystems (SBS) themes. In addition, the collaborative engagements from the Ethics, Policy and Public Engagement (EPPE) theme and others continued to deliver national and international impact. This was achieved despite the challenges of carrying out research in highly restrictive environments because of COVID-19, and is a testament to the exceptional capabilities and resilience of ACES researchers. There was an extraordinary output of fundamental and applied research from all the themes, described in over 240 publications, the highest number produced in any ACES year. Evident from the following ACES research outcomes relevant to our 2021 Activity plan and Year 7 milestones (see Table 1), ACES research will have significant impacts well beyond this final ARC-funded year.

Electromaterials (EM)

Electromaterials research involves developing high performance electromaterials and fabrication protocols to enable integration into devices for applications in energy, robotics, bionics and diagnostics.

As indicated in the Milestones (Table 1), the materials supply by researchers in the Electromaterials Theme (EM20) has continued across all the theme projects. Here the material development is described, while the application of many of the materials is included in the other theme reports.

Materials

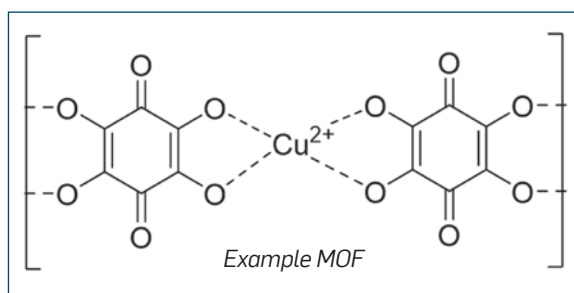
Porphyryns (Milestone EM20)

Synthesis of porphyryns continued for fundamental studies within the EM Theme. For example, amphiphilic zinc porphyrin single-

walled carbon nanotube hybrids were developed and studied in collaboration with Dirk Guldi, PI FAU (*Small*, 2021, 17, 2005648).

Metal Organic Frameworks MOFs (Milestone EM20)

ACES researchers have demonstrated for the first time that reactive inkjet printing can be used to rapidly produce patterned electroactive MOF films by covalent attachment of redox-responsive ferrocenyl groups to the MOF (*Chem. Commun.* 2021, 57, 4706). MOFs were also developed to improve the water vapour transport of PVDF membranes (*J. Clean. Prod.* 2021, 293, 126157)



Graphene and Nanocarbons (Milestone EM20)

Exploration of new methods of graphene production continued, with electrochemical methods proving to be particularly effective (*J. Mater. Sci.* 56, 3612–3622; *ChemElectroChem* 2021, 8(16), 3168–3173).

Work has continued apace in the development of applications for Edge Functionalized Graphene (EFG) and Edge Functionalized Expanded Graphene (EFxG). EFG:PDMS polymer composites were developed for neural cuff applications. The previously developed EFG:Latex polymer composites have attracted the attention of a new Wollongong-based startup company, Imagine Resources Technology (IRT), who are interested in developing sensing solutions for the mining industry and a collaborative research program in this area was established.

The translation of EFG research into the marketplace was propelled through the establishment of a collaborative research program with NSW start-up Sicona Battery Technologies Ltd. (Sicona) as detailed below. Significant enhancement of Sicona silicon battery anodes using EFG and that of coolant performance using EFG dispersions were achieved.

Graphene commercialization

The business case for EFG/EFxG was completed in January 2021, by consultant Dr Roger Buckeridge. Following this, negotiations were undertaken between the University of Wollongong (UOW) and Sicona to purchase the rights to EFG and fund national patent costs. A terms sheet to this effect was signed in early April, with EFG national patent applications submitted in a number of international jurisdictions on April 8. An IP transfer and commercialization agreement was completed

Table 1: ACES 2014-2021 Research Milestones – Year 7

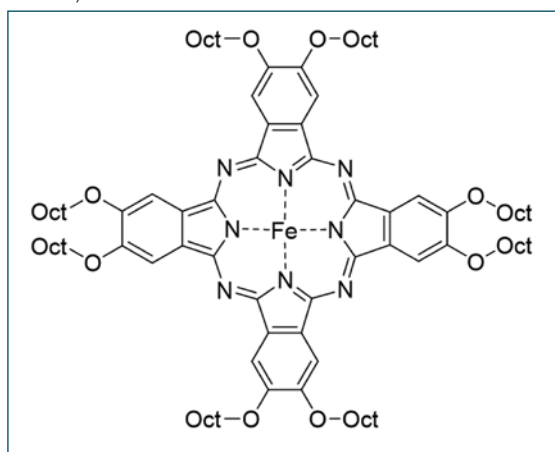
Milestone	Year	Description
Theme 1: Electromaterials (EM) - (Leader: Prof D Officer)		
EM20	7	Provided optimised materials to the application theme projects.
EM21	7	Designed optimal electrolytes for Na-air battery applications and other applications as required.
EM22	7	Used an electric field to grow a sequence controlled polymer on a surface.
EM23	7	Designed improved visible light initiators for 3D printing applications.
Theme 2: Electrofluidics and Diagnostics (EFD) - (Leader: Prof B Paull)		
EFD8	7	Extended the application of cell culture, stimulation and analysis platform into study of other neural conditions, e.g. Parkinson's Disease.
Theme 3: Synthetic Energy Systems (SES) - (Leader: Prof D MacFarlane)		
SES7	7	Demonstrated optimised devices.
The above milestones relate to a (i) solar driven CO ₂ or N ₂ reduction cell, (ii) sodium-air battery and (iii) thermoelectrochemical cell.		
Theme 4: Synthetic Biosystems (SB) - (Leader: Prof M Cook)		
SBS7	7	Applied Integrated Modelling Platforms to <i>in vitro</i> Functional Modelling Studies.
Theme 5: Soft Robotics for Prosthetic Devices (SR) - (Leader: Prof G Alici)		
SR6	7	Test and refine neural interface.
Theme 6: Ethics, Policy and Public Engagement (EPPE) - (Leader: Prof S Dodds)		
EPE5	7	Identified the policy and supply chain aspects of renewables to assess their impact on equity, access, conflict and resilience.
EPE6	7	Identified implications of new medical diagnostic systems for access to health care and international aid policy.

in November, including a two year research agreement in which Sicona and ACES/IPRI researchers will investigate the scale up of EFG and its use in Sicona batteries and coolants.

Catalysts (Milestone EM20)

A wide variety of new catalysts such as mixed metal antimony oxide nanocomposites (*J. Mater. Chem. A*, 2021,9, 27468-27484) and ϵ -Fe₃N single-phase nanoparticles (*Adv. Mater. Interfaces* 2021, 8, 2100070) continued to be developed, typically for oxidation and reduction processes for synthetic fuels. Supply of small molecule phthalocyanine and metal organic framework catalysts have also continued to SES researchers.

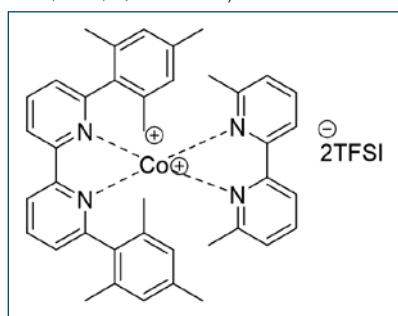
New methods of catalyst production such as the use of mechanochemistry were also explored (*Nano Energy*, 2021, 80, 105535).



Phthalocyanine catalyst for CO₂ reduction

Electrolytes (Milestones EM20 and EM21)

A wide range of copper and cobalt pyridyl complexes have been prepared and studied by EM researchers for a variety of electrochemical and photoelectrochemical processes (*J. Am. Chem. Soc.* 2021, 143, 1, 488–495).



Example of cobalt pyridyl complex electrolyte

EM researchers have also been developing a new concept of zwitterionic plastic crystals. This builds on the substantial prior work in ACES on organic ionic plastic crystals (OIPCs), in which a range of new OIPCs have been developed and successfully used to form solid and liquid electrolytes for lithium and sodium batteries. Feeding into the SES theme, the most promising zwitterion has been used to demonstrate

potential application as electrolytes using three different approaches – (1) as a neat matrix for solid electrolytes, (2) with functionalised polymer particles for increased target ion transport and (3) finally for formation of a high salt content non-volatile liquid electrolyte (*Nat. Mater.* 2022, 21, 228–236). These electrolytes were shown to facilitate selective ion transport and stable lithium metal cycling. This work is the subject of a patent application, recently filed as PCT International Patent Application (*PCT/AU2021/050450 - Electrolytes for target ion transport*).

Biopolymers (Milestone EM20)

ACES researchers have reviewed the synthesis, properties, and biomedical applications of alginate methacrylate (ALMA)-based hydrogels (*Appl. Mater. Today*, 2021, 24, 101150) as well as hybrid gelatin hydrogels (*ACS Appl. Bio Mater.* 2021, 4, 2886–2906). Novel tuneable hybrid hydrogels have been prepared via complementary self-assembly of a bioactive peptide with a robust polysaccharide (*ACS Biomater. Sci. Eng.* 2021, 7, 3340–3350). The gelatin methacrylate hydrogel (GelMA) has become a key component of bioinks. It was shown that addition of graphene oxide to GelMA enhances its electroactivity, mechanical properties and printability (*ACS Biomater. Sci. Eng.* 2021, 7, 2279–2295).

Fabrication

Bioprinter hardware development

3D REDI - Work has continued in bringing the research and training biofabrication platform, 3D REDI, (Research, EDucation, Innovation) to scaled commercial production. The integrated bioprinting platform and control software offer printing functionality that economically surpasses the capabilities of current market leaders. The innovative system enables the development of new hybrid structures with target biomaterials and has been envisaged through previously reported hardware developments guided through clinical end-user engagement and consultation. The deployment of 3D REDI systems to global collaborators has begun. There was a target for a total of 50 individual systems to be produced and dispatched by the end of 2021, however the COVID-19 pandemic and the pivot to remote learning impacted on initial deliveries. Systems have been delivered and remotely installed with collaborators in UOW, India, Finland, Dubai and Japan. The system was integrated into 3rd year practical sessions in UOW's Degree in Biomedical Engineering via pre-recorded lab demonstrations and will be further integrated through face-to-face teaching in 2022.

3D ALEK – A multi-material pneumatic extrusion platform for the development of ear scaffolds has been deployed to RPA Sydney.

3D GENII – A low cost printing platform developed for the production of prosthetic scaffolds using silicone. Prototype systems deployed to collaborators in India and RPA Sydney for evaluation and use by prosthetic specialists.

Animal trial evaluations of Axcelda, BioPen, and iFix Medical iFixPen and associated materials have been undertaken. The results of both trials have shown promise and are guiding future hardware and materials development prior to moving towards clinical trial studies.

Commercial Activities

The commercial research activities facilitated through TRICEP continue to grow with the development of bespoke solutions for commercial partners towards the commercialisation of a suite of Class 1 medical devices for Australian and International markets.

Characterisation

The study that paves the way for the application of ultrasound imaging into complex and dynamic biological constructs, such as the 3D imaging of neocartilage formation in bioscaffolds (*Ultrasound in Medicine & Biology*, 2021). This protocol is now being used in several applications of interest in translational medicine. This includes cartilage tissue regeneration, cardiac cell organoids, porcine skin burn injuries, and electro compacted collagen films. A presentation of our ultrasound research program resulted in the best presentation award at an event of the Australasian Society for Tissue Engineering (ASBTE). A manuscript on the ultrasound imaging of neocartilage development in collaboration with researchers from the Aikenhead Centre for Medical Discovery has been submitted to a peer-reviewed journal. A summary of our work in this area is illustrated below. As a result of these developments, the commercialisation of the proprietary ultrasound software is being explored.

The study of thermoelectrochemical cells was significantly advanced with the development of *in situ* or operando magnetic

resonance imaging approach that could provide quantitative spatial maps of the electrolyte temperature and redox ion concentrations in functioning thermoelectrochemical cells (*Nat. Commun.* 2021, 12, 6438). This is the first time that the experimental observation of the various inter-related and spatially-dependent phenomena occurring in a working thermocell has been achieved.

Modelling

Structure of electrolytes (Milestone EM 21)

ACES modelers at Deakin are undertaking computational investigations of an ether-aided salt-concentrated ionic liquid (IL) electrolytes at metal electrode interfaces to understand the early formation of solid electrolyte interphase (SEI) and the impact on cycling performance. The modelling work reveals how dimethyl ether (DME) and applied voltage affects the composition of the innermost electrolyte layer compared to the system without DME, and how DME-assisted fast Li diffusion at interface could contribute to a more homogeneous interface morphology. (*Energy Environ. Sci.* 2022, accepted). In collaboration with Artem Baskin and John W. Lawson at NASA Ames Research Center, USA, Deakin researchers further extended this investigation and reported different preconditioning steps for salt concentrated ILs with and without DME co-solvent to achieving the better electrochemical performance (*Chem. Mater.* 2022, 34, 165).

Combining NMR techniques with Molecular Dynamic (MD) simulations, Deakin ACES researchers showed how a novel protonated anion affects ion interaction and dynamics in ILs, which helps to design new IL electrolytes compositions in the future (*J. Phys. Chem. C* 2021, 125 (27), 14818; *J. Mol. Liq.*

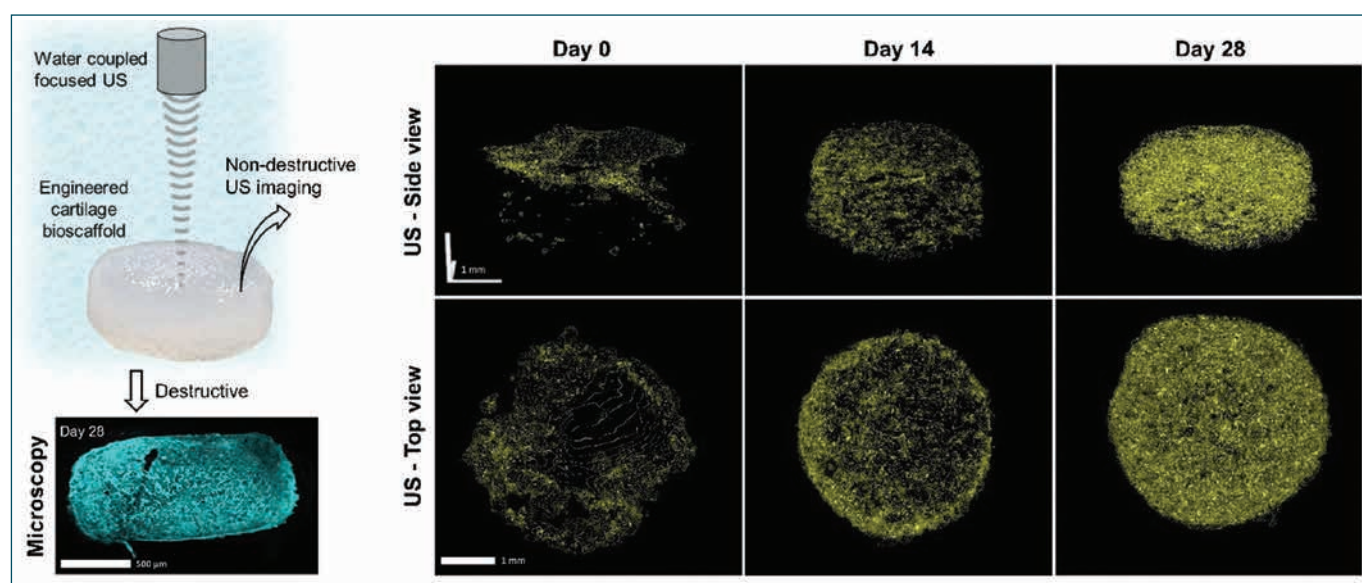


Illustration of the capabilities of ultrasound imaging in translational medicine applications, featuring its contactless character and ability to detect biological changes occurring in bioengineered bioscaffolds without damage. In the image, the developed Standardized Quantitative Ultrasound Imaging (SQUI) procedure enables the monitoring of cartilage growth in bioscaffolds over time. In contrast, the conventional imaging of neocartilage formation in bioscaffolds requires the use of destructive approaches such as histology.

2021, 327, 114879). In addition, they also used simulation to predict gas absorption capability in organic ionic plastic crystals by free energy models (*RSC Adv.* 2021, 11, 19623).

Computational design of novel polymer electrolytes for high energy density has continued. ACES modelers predicted a 'polymeric ionic liquid-in-salt' system with great potential in solid-state sodium and potassium battery applications. The fast metal ion transport mechanism and impact factor from the chemical environment has been reported. The work point to a new platform for the development of solid state electrochemical devices. The manuscript is currently under review. (DOI: 10.21203/rs.3.rs-532893/v1).

In collaboration with Simone Ciampi (Curtin) and Katya Pas (Monash), ANU ACES researchers have shown that ionic liquids develop ordered structures at electrodes that generate their own electric fields, detectable by open circuit potentiometry. Depending on the system, the structures and their associated electric fields can persist for up to a day after the external potential is removed (*J. Am. Chem. Soc.*, 2021, 143, 17431). It has been previously shown that by modelling these internal fields, they could be harnessed for electrostatic catalysis of chemical reactions; they may also be useful in the emerging field of redox-enhanced electrochemical capacitors.

Electric fields (Milestone EM22)

Work by ANU ACES researchers on harnessing electric fields to catalyse chemical reactions has continued, most recently with the design of proline derivatives bearing charged functional groups that deliver enhanced enantioselectivity (*J. Org. Chem.* 2021, 86, 9076) and switchable NHC catalysts for decarboxylation reactions (*Phys. Chem. Chem. Phys.* 2021, 23, 24627). A new textbook on using electric fields to catalyse chemical reactions was published (*Effects of Electric Fields on Structure and Reactivity: New Horizons in Chemistry*, Royal Society of Chemistry, 2021), to which EM researchers contributed two chapters.

Light initiators (Milestone EM23)

Our previous theoretical work showing that charged functional groups and coordinated metal ions could electrostatically red-shift popular photoinitiators such as Irgacure 2959 into the visible region was experimentally validated by our collaborator Adam Trevitt (UOW), and the work selected for the cover (*J. Am. Chem. Soc.* 2021 143, 2331). This validates our strategy for electrostatically manipulating photochemical processes, and can facilitate 3D-printing without damaging UV light.



Synthetic Energy Systems (SES)

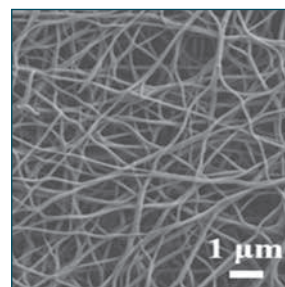
Research directions in this theme during 2021 were focused on developing new materials with outstanding performance and demonstrating these in prototype devices. Current project areas include:

- Metal batteries including metal based flow batteries
- Solar fuels electrocatalytic N_2 , H_2O and CO_2 reduction coupled with H_2O oxidation as a store of renewable energy
- Thermoelectrochemical cells

Metal Batteries and Flow Batteries (Milestone SES7)

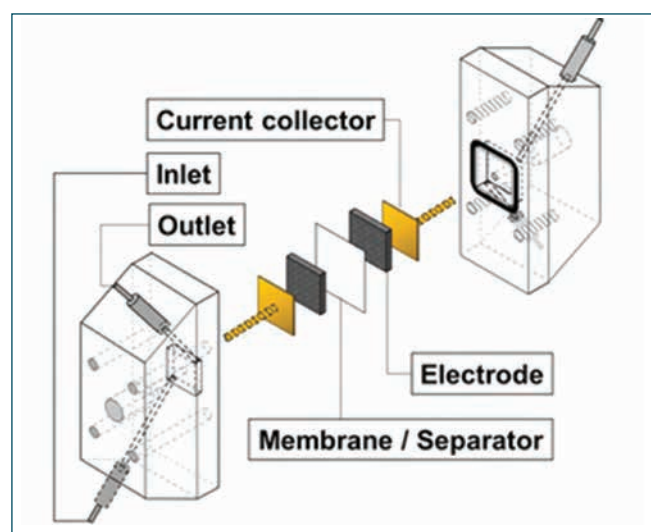
The Deakin team has approved lodging of a provisional patent on plastic crystal electrode materials as solid-state electrolytes for both the Li and Na solid-state battery devices that the team is developing and testing.

Freestanding Polyacrylonitrile:poly(diallyldimethylammonium):bis(fluorosulfonyl)imide (PAN: poly(DADMA):FSI) electrospun carbon nanofibre electrodes prepared for Na- O_2 batteries challenge the world's-best performance for this type of battery (157 cycles, 0.1 mA/cm^2 , 0.25 mA/cm^2) using an ionic liquid/diglyme blend electrolyte.



Electrospun carbon nanofibre electrodes for batteries

The flow battery systems reached an important milestone with the iron-based, non-aqueous flow battery prototype subjected to full cycle testing with cyclic efficiencies > 95% and discharge voltage around 2.2 V.



Prototype non-aqueous flow battery cell

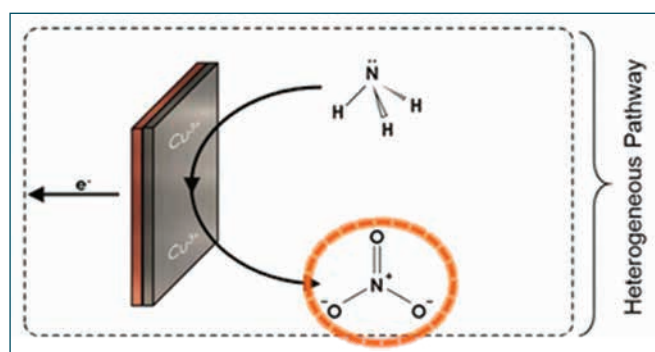
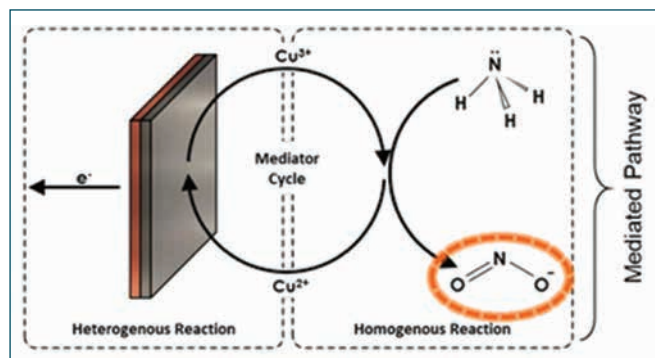
Solar Fuels and Chemicals (Milestone SES7)

The N_2 reduction to ammonia project that is funded by ACES with additional support from ARENA has made rapid progress in 2021. The work that was carried out in late 2020, and patented in 2020, was accepted for publication in *Science* (*Science*, 2021, 372, 1187). The work has achieved a breakthrough in N_2 reduction performance metrics, achieving faradaic efficiencies at high as 90% and yield rates around 50 nmol/s/cm².

A spin-out company Jupiter Ionics P/L was formed by Monash in April 2021 with funding from Monash and several Melbourne based high net-worth families. The company's first major goal is to scale up the current lab-scale prototype.

A project investigating ammonia oxidation for fuel cell and/or nitrate fertiliser production has demonstrated the selective electrooxidation of NH_3 to either NH_4NO_2 or NH_4NO_3 . Through scrutinising the reaction mechanism and detailed screening of a broad range of catalytic materials, we learned to selectively guide ammonia electrooxidation towards either nitrite or nitrate by switching the mode of catalysis.

Coupled with the nitrogen reduction process described above, this provides a sustainable route to many N-based compounds.



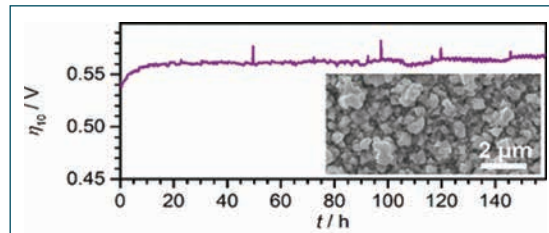
Alternate, catalyst-controlled mechanisms of ammonia oxidation to nitrate and nitrite.

As a demonstration, we were able to show what we believe to be a world first in application of a renewables-based fertiliser to growing plants in December 2021.



The ammonia team delivering their first batch of renewable energy generated fertiliser in December 2021.

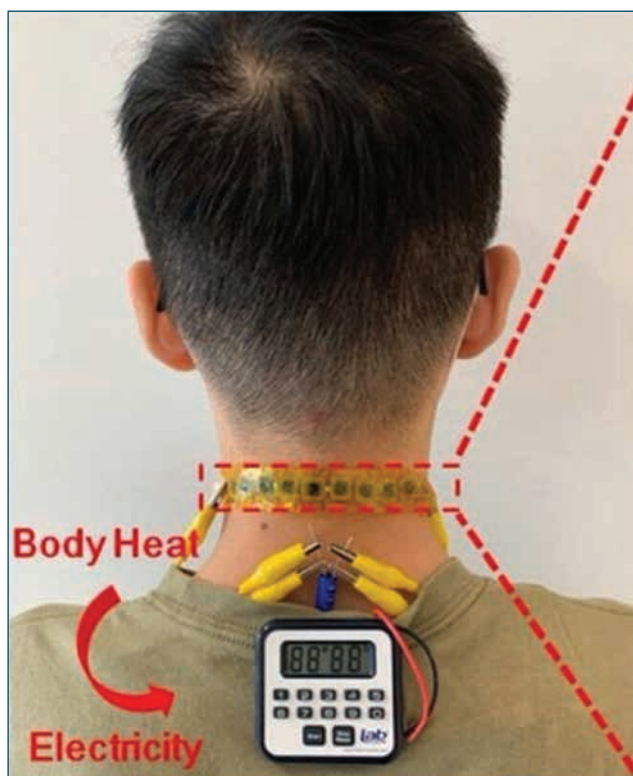
In the water oxidation project, a new "catalyst-in-matrix" family of remarkably robust catalysts for acidic water electro-oxidation have been developed and are under investigation in prototype water splitting devices. Encapsulation of the "catalyst" (Co, Mn, Ag, Ru) in a stable oxide "matrix" (Pb, Bi, Sb) enables outstanding stability at temperatures up to 80°C, pH down to 0, and current density up to 1 Acm⁻² – a performance unachievable even for some of the best iridium-based commercial catalysts.



Steady water oxidation to oxygen observed over a weeklong test at 80°C.

Thermoelectrochemical cells (Milestone SES7)

All-polymer wearable thermoelectrochemical cells that harvest body heat have been developed (*iScience*, 2021, 24, 103466). A flexible, cost-effective, and 3D porous all-polymer electrode was fabricated on an electrical conductive polymer substrate via a simple 3D printing method. Owing to the high degree of electrolyte penetration into the 3D porous electrode materials for redox reactions, the all-polymer based porous 3D electrodes delivered an increased power output of more than twice that of the film electrodes under the same mass loading using either n-type or p-type gel electrolytes. To create a wearable thermocell, 18 pairs of n-p devices were fabricated through a series connection of single devices. The strap shaped thermocell arrangement was used to charge a commercial supercapacitor to 0.27 V using the body heat of the person upon which it was being worn. This could then be used to power a typical commercial lab timer.



Wearable thermoelectrochemical cells harvesting body heat.

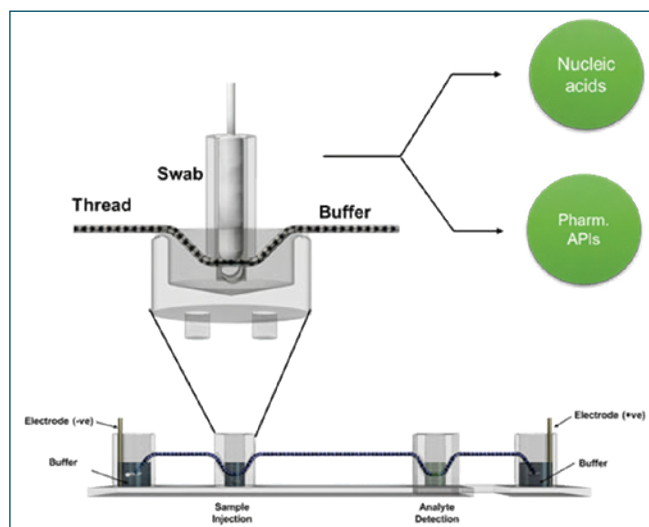
SES researchers also reviewed the mechanism, materials, and strategies to applications of wearable thermo-electrochemical cells for body heat harvesting (*Adv. Sci.* 2021,8, 2100669) as well as 3D-Printed wearable electrochemical energy devices (*Adv. Func. Mater.* 2022, 32, 2103092).

Electrofluidics and Diagnostics (EFD)

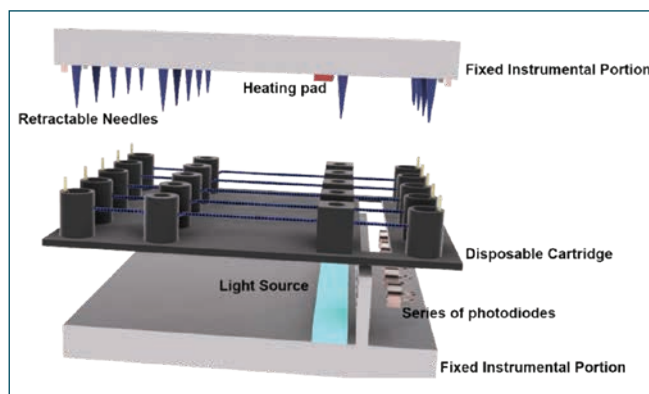
In the EFD Theme, a number of emergent and collaborative projects developed that utilised the application of modified and/or functional fibres and threads in microfluidic, electrofluidic and diagnostic applications.

Integrated electrofluidic platforms (Continuation of Yr 5/6 milestones)

The EFD theme has continued to focus on the development and application of modified fibres as substrates for electrofluidic platforms. The EFD researchers worked on the development of a multiplexed fibre-based platform for rapid extraction, selective enrichment and detection of biomolecules (including RNA and DNA) from biological samples (*Lab Chip*, 2021, 21, 2565; *Anal. Chim. Acta*, 2022, 1193, 338810). This work, progressed to a filing of a provisional patent (*Provisional Application Number 2021901294*) on the 30th April, entitled 'uTAD and swab based analysis'. Details of the provisional patent filed for direct swab-based analysis and multi-well configuration on a thread based analytical system are shown as shown in the following illustrations.

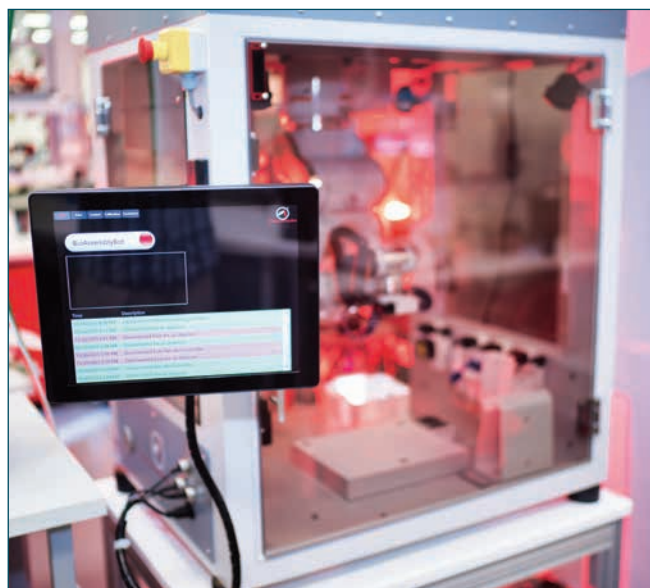


Direct transfer of analytes from swabs onto thread-based analytical systems.

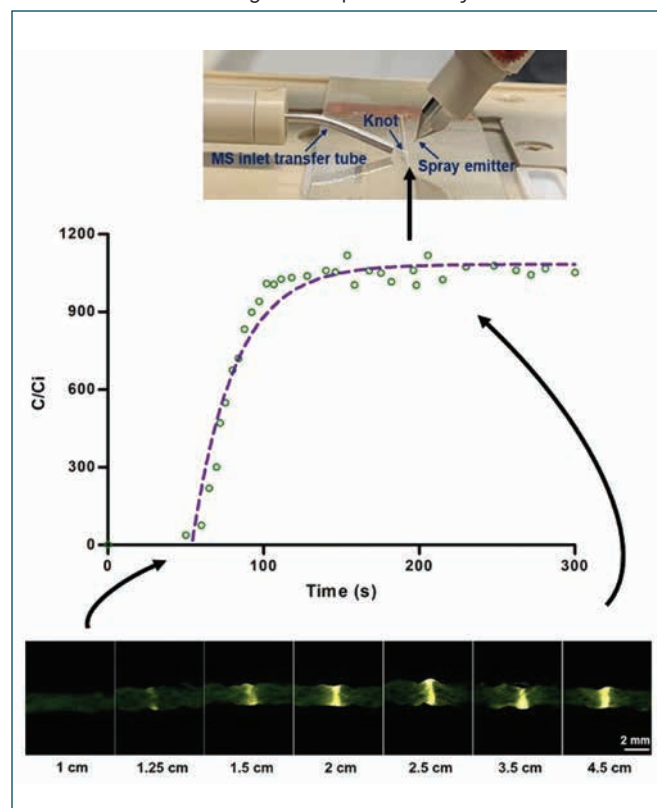


Multiplexed analysis using thread-based analytical systems.

Wireless bipolar electrode-based textile-electrofluidics was also developed as an approach to point of care testing using micro-total-analysis systems (μ TAS) for healthcare devices (*Lab Chip*, 2021, 21, 3979).



In an extension of the fibre-based electrofluidic project, a project linking fibre-based solute separation and concentration with direct analysis using ambient mass spectrometry (DESI) was completed in 2021. The project, illustrated below, allowed isolation of solutes and target metabolites directly from biological samples and their on-fibre identification using mass spectrometry.



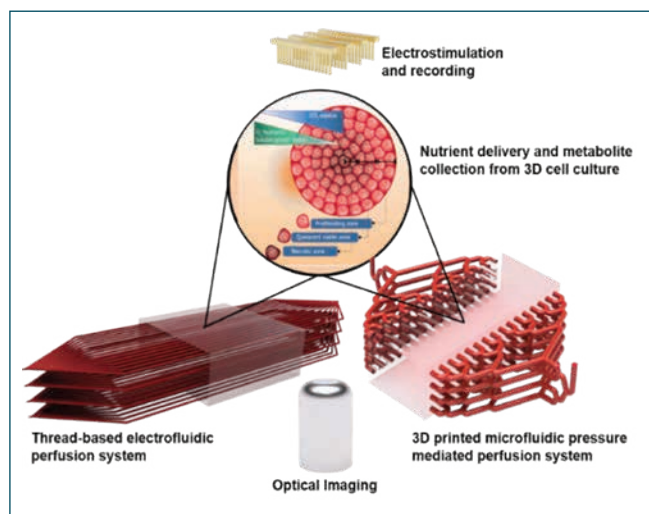
Fibre-based solute separation and concentration with direct analysis using ambient mass spectrometry (DESI)

EFD researchers also reviewed the applications of nanomaterials in ambient ionization mass spectrometry (*Trends in Analytical Chemistry*, 2021, 136, 116202).

Application of cell culture, stimulation and analysis platform (Milestone EFD8)

EFD researchers continued the development of antifouling lubricin coatings, in a study, on the cellular interactions with lubricin and hyaluronic acid-lubricin composite coatings on gold electrodes in passive and electrically stimulated environments (*ACS Biomater. Sci. Eng.* 2021, 7, 3696). Antifouling strategies for electrochemical biosensing for point of care based diagnostic applications were also investigated (*ACS sensors*, 2021, 1-26). The use of lubricin as a tool for controlling adhesion was reviewed (*Biointerphases*, 2021, 16, 020802).

The development of better representative synthetic biosystems through uniform perfusion and electro-stimulation of 3D stem cell and tissue cultures is illustrated in the following.



Renders of the 3D printed solid-phase extractors required for the evaluation of three online solid-phase extractors based on different fluid distributors.

Soft Robotics (SR)

The aim of the SR team was to use the mechanical actuation and sensing properties of selected electromaterials to develop new robotic systems. Examples include a multi-digit, fluid and highly dexterous 3D robotic hand with a control system; programmable mechanical compliance; integrated sensors and a neural interface system; and delivering new benchmarks in performance for applications in industrial, personal and prosthetic robotic systems.

Multi-digit 3D robotic prosthetic hand (Continuation of Yr 5 milestone)

A 3D printed soft robotic hand (called the ACES-V2) with embedded soft sensors, intended for prosthetic applications, has been developed to efficiently operate with pattern recognition based myoelectric control systems. Pneumatic chambers were designed to be embedded within the fingers and thumb, working as flexure hinges for the joints and soft position sensors simultaneously. The whole hand can be 3D printed monolithically and requires minimal post-processing for the addition of its embedded sensors. These characteristics are of significant benefit for a bionic device that is required to be lightweight and anthropomorphic. The mechanical structure of the hand was fabricated by using a low-cost and open-source 3D printer. With the addition of position sensors, self-collision can be avoided and therefore the neutral fully open position can be eliminated when switching between different gestures. This makes the transition between hand gestures much faster, more efficient, and more intuitive as well. Initial contact detection of each finger/thumb is enabled to achieve pre-shaping of multi-finger grasps (i.e., tripod grip and power grasp). This considerably alleviates the issue of grasp instability due to a grip force imbalance, which is the result of the fingers of the hand reaching towards the palm at different times. The inclusion of pre-shaping allows the hand to achieve form closure of a grasped object readily, which greatly improves the stability and quality of the hand grasps. Moreover,



the free transition between gestures allows the hand to perform multi-stage grasps by combining different grasp types sequentially so that the hand is not limited to carrying or holding one object at one time. This improves the hand's dexterity and grasping diversity, rendering this soft robotic hand one-step closer to its biological counterpart. This work has been both presented (*IEEE/ASME (AIM) International Conference on Advanced Intelligent Mechatronics*, Delft, The Netherlands, 12-16 July 2021) and published (*IEEE/ASME Transactions on Mechatronics*, April 2021 876-887).

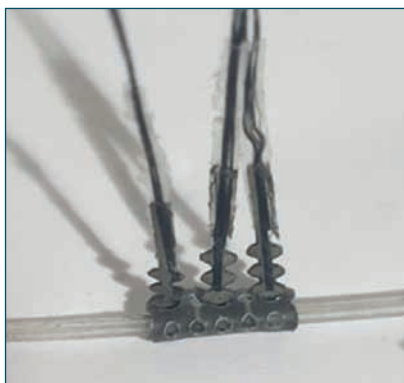
Interactions with the Prince of Wales Hospital, prosthetic hand manufacturers and distributors, and prosthetic hand end-users have been consolidated. This collaborative network has been used to explore collaborative research opportunities, including amputee recruitment for patient trials, commercial translation of the soft robotic hand and the pattern recognition based user-hand interface.

Adaptive Neural Interface to control Prosthetic Devices: Design, Fabrication and performance evaluation (Continuation of Yr 6 milestone/SR6)

Neural cuffs based on the use of PDMS integrated with graphene (EFG) were developed. We have proven that our EFG:PDMS neural cuffs can compete with more traditional structures in terms of electrochemical properties and offer a number of advantages including flexibility and stretchability and provide a locking mechanism that does not require additional sutures. The cuffs were sent to our research partners in the US (Prof Mario Romero) for *in vivo* testing.



Two different types of neural cuffs



Example of the application of a neural cuff

Identifying and Translating Intention of Prosthetic Hand Users into Control Signals using Machine Learning Techniques (Milestone SR6)

The major challenge in the development of the prosthetic hand control interface is in trying to couple the muscle movements of a prosthetic user to control their prosthetic hand. It is critical to determine when muscle activity occurs as well as rapid response, within 1 or 2 seconds, such that the hand movement appears natural. It is necessary to discriminate between hand gestures but to have enough time to see the difference in the gestures. If the muscle firing rate is identified early, then the prosthetic hand can be controlled in real time. Therefore, the aim of this modelling work was use machine learning to determine when muscles fired.

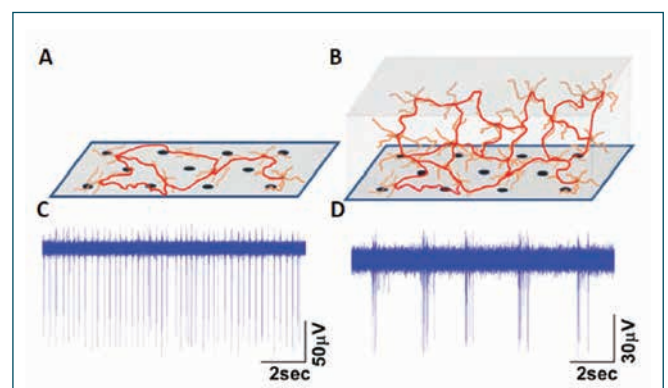
During 2021, two significant advances were made. Firstly, a novel feature was calculated from the approximation of muscle firing rate that improved resemblance to real gesture movement. Secondly, machine learning was used to exhaustively evaluate previously developed methods for muscle activity detection and to estimate the muscle force. Machine learning requires access to high quality and large amounts of data with a high reliability. Insufficient amount of high quality data has always been a constant challenge in this type of research. Previous literature has shown that even a small shift of a few millimetres in electrode placing position can lead to significant degradation in gesture recognition and identification. These advances will significantly enhance the future development of the prosthetic hand control interface.

Synthetic Biosystems (SBS)

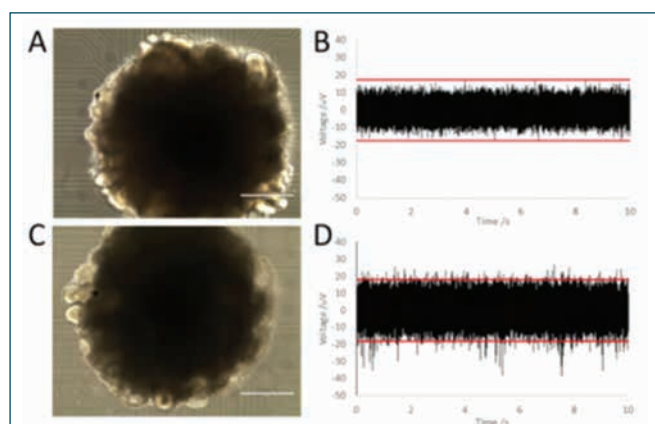
Applied Integrated Modelling Platforms to *in vitro* Functional Modelling Studies (SBS7)

3D Neural Network Models of CNS Tissue

Neuronal networks *in vivo* develop in a true 3D environment, and we have shown that network connectivity in true 3D cultures produce higher-order connectivity than 2D cultures with the same neurons, resulting in longer bursting periods and a network functionality that better mimics the bursting activity of *in vivo* networks



Neural network formation in 2D (A) and 3D (B) dimensions, typical single electrode readings from 2D (C) and 3D (D) cultures with comparable time-scales



Typical MEA data from isogenic (A&B) & CDKL5 deficient (C&D) cortical organoids at 14 days differentiation. CDKL5 deficient organoids show increased spiking and hyperexcitability at early stages of organoid differentiation.

3D Organoid Model of Epileptiform CNS

Cyclin-Dependent Kinase-like 5 (CDKL5) protein is a critical neuronal kinase, and loss of CDKL5 function causes defects in neuronal outgrowth and impairment of synaptic connectivity, resulting in generation of epileptiform neural activity. With collaborators at Royal Children's Hospital Melbourne/Murdoch Institute, we have made neural organoids derived from skin-derived induced pluripotent stem cells from children with CDKL5 gene mutations who have epileptic syndromes. Our collaborators have also made organoids from these children's iPSCs in which the mutation causing the epileptiform neural activity has been removed, thereby rendering them non-epileptiform. Electrophysiological recordings from these neural organoids respectively showed that the original (CDKL5 mutant) structures yielded neuronal firing that was much higher frequency than did

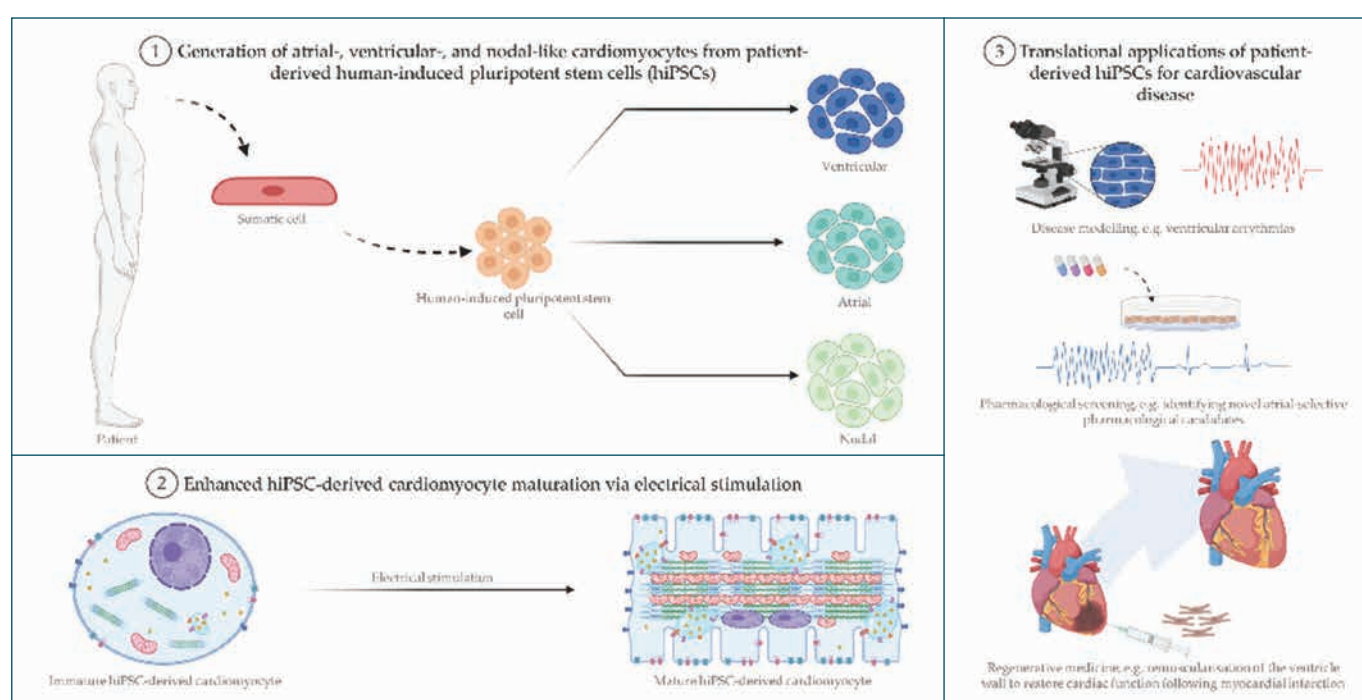
the isogenic non-epileptiform (non CDKL5 mutation) organoids. This provides the basis of a 3D epileptiform neural modelling system that can be used to establish anti-epilepsy drug efficacy and to study epileptiform neural activity *in vitro*.

Bioprinting and electro stimulation of human induced pluripotent stem cells for schizophrenia patient tissue modelling (Continuation of Yr6 milestone and Milestone SBS7)

SBS researchers have utilised previously reported and published methods developed for bio printing and electro stimulation for building and modelling functional 3D human schizophrenia neural tissue systems to develop and apply biologically valid and reproducible 3D neural tissue models of schizophrenia for advanced clinically-specific disease modelling and therapeutics (*Brain Research Bulletin*, 2021, 175, 48). Healthy- and patient-donor iPSC lines have been used to build 3D human neural tissues for *in situ* cellular and molecular characterisation. By doing so, identified disease pathology and innovative treatment approaches relating to electro-ceuticals and augmented pharmacotherapeutics (*APL Bioengineering* 2021, 5, 020901).

Biofabrication of cardiac tissues using integrated piezoelectric materials for wireless electrostimulation and functional modelling (Continuation of Yr6 milestone and Milestone SBS7)

In this project, SBS researchers utilised previously reported and provisionally patented (*PCT/AU2021/051216*) methods. Procedures for wireless ultrasound-mediated piezoelectric stimulation of human cells for tissue engineering and electroceuticals to develop and apply biologically valid and reproducible 3D cardiac tissue models for advanced clinically-specific disease modelling and therapeutics; the latter



including tissue replacement therapy and electroceuticals for treating heart failure (*Int. J. Mol. Sci.* 2021, 22(6), 3005). Patentable IP has been developed from this and an earlier project relating to novel wireless neural tissue engineering and a patent application is being explored.

3D electrical and optically active platforms for neural stimulation (Continuation of Yr6 milestone)

Research focused on further development of novel platforms. The addition of small amounts of graphene oxide to gelatin methacryloyl hydrogels, a key component of bioinks, was found to significantly enhance the electroactivity, mechanical properties and printability as well as subsequent use for cell growth (*ACS Biomater. Sci. Eng.* 2021, 7, 2279). Analysis of metabolic activity and differentiation of PC12 cells imbedded in these hydrogel scaffolds is ongoing. Preliminary data was obtained on the ability of these scaffolds to contain and release nerve growth factors (NGFs).

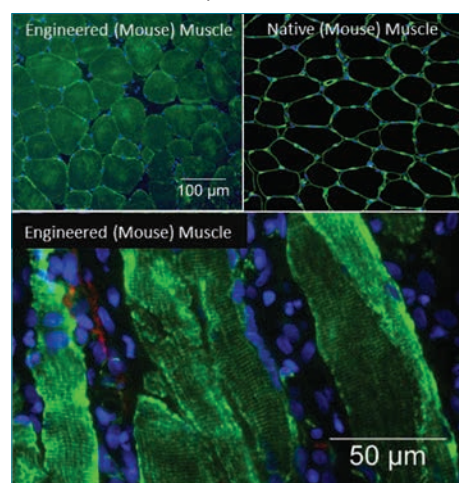
A synthetically simple, low cost cell culture substrate functionalized with gold nanorods was developed to support cell proliferation and detachment through photothermal means (*Acta Biomater.* 2021, 129, 110).

To develop electrically and optically active 3D materials for neural stimulation, the synthesis of amine coated gold nanorods (NH-GNR) was undertaken. These will be functionalised with LCGO and edge functionalised graphene (EFG) and incorporated into the common bioink hydrogel, GelMA.

Other work relevant to the development of active platforms for neural stimulation includes the formation of alginate microspheres prepared by optimized microfluidic parameters for efficient encapsulation and controlled delivery of bioactive molecules (*J. Colloid Interface Sci.* 2021, 587, 240) and microencapsulation of growth factors by microfluidic system (*MethodsX*, 2021, 8, 101324).

Engineering of muscle tissue constructs (Continuation of Yr6 milestone)

Fully innervated and vascularised synthetic mouse muscle was grown in a modified arterioventricular loop (AV Loop) within the peritoneum of a nude rat as the motor component model of an *in vivo* brain-machine interface for mechatronic prosthetic limbs (*Gels.* 2021, 7, 171). The construct was shown to transmit evoked potentials from sciatic nerve to a recorder embedded in the muscle within the AV loop, demonstrating proof of concept that it could be used as a motor brain-machine interface. This work is being continued to the building of a sensory version that will be able to send proprioceptive signals from a mechatronic prosthesis back to the brain.



Mouse muscle engineered within an AV loop (top left panel) after just 2 weeks was morphologically similar to native mature mouse muscle (top right panel). In addition, the mouse muscle was innervated by the recipient rat's nervous system (red in bottom panel) and fully vascularised by the rat's vasculature (not shown). This forms the basis of a synthetic motor brain-machine interface and a model for neuromuscular disorders



Ethics, Public Policy and Engagement (EPPE)

The Ethics, Policy and Public Engagement (EPPE) theme has continued work towards the EPE milestones relating to regulation and supply chain for renewable energy and to the use of biomedical technologies in enhancing global health, as well as collaboration across themes as part of the increased focus on research translation. Throughout COVID-19 restrictions, EPPE members have retained contact with the theme and researchers globally through a range of on-line seminars, conferences and meetings.

Policy and supply chain aspects of renewables (Milestone EPE5)

EPPE researchers have worked on ethical supply chains in renewable energy. They have sought to identify supply chain solutions to adhere to responsible minerals challenges and opportunities, for example, recycling rare earths and critical minerals. Their aim is to transform renewable energy supply chains through deliberate ethical materials choices at every stage from research and development, through production, use and decommissioning.

A project to identify and develop an analytical framework for disaster policy and energy system design informed through the lens of vulnerability and has extended that work to combine disaster response with COVID-19 response in disaster prone countries like India.

Significant advances on policy barriers for community based renewable energy to hasten the transition to renewables and democratise control of distributed energy systems (*Energies* 2021, 14(23), 8103; *J. Clean. Prod.*, 2022). A major report on justice in energy transitions was also prepared for Melbourne University's Climate Futures, Building prosperous, just and resilient zero-carbon regions (*Wiseman, Wollersheim* 2021), learning from recent Australian and international experience.

Implications of new medical technology and diagnostic systems (Milestone EPE6)

EPPE researchers working on bioethical and regulatory aspects of emerging health technologies have continued to assist researchers, regulators and policy makers. Enabling them to anticipate and assess likely risks of inequity and, in some cases, to set in place mechanisms to avoid these risks and inequities being realised (*Bioethics Forum*, 2021, 12, 15; *AI and Society*, 2021, 36, 685; *AJOB Neuroscience*, 2021 DOI: 10.1080/21507740.2021.1949404).

They have explored how regulatory approval, commercialisation and product design affect equity and access to technologies (*Philosophy and Technology*, 2021, 34, 1545; *Hastings Center Report*, 2021, 51, 28).

The team has explored the ethical significance of treating all neural data as medical data, the risk that this could lead to

both medical regulatory "over-reach", and therefore distract from more prevalent ethical concerns (*Neuroethics*, 2022).

An indication of the impact of ACES EPPE research is a recent issue of *The New Yorker* magazine, which included an article by Cristine Kenneally "Do Brain Implants Change Your Identity". That article focussed on the impact of the NeuroVista epilepsy prediction implant (Australian trials for the device involved SBS CI Mark Cook) and AI Frederic Gilbert undertook to understand the experience of clinical trials on neural implants from the perspective of patients (see [newyorker.com/magazine/2021/04/26/do-brain-implants-change-your-identity](https://www.newyorker.com/magazine/2021/04/26/do-brain-implants-change-your-identity)). Research on how neural implants affect patients' sense of self and agency also continued to be conducted (*Bioethics*, 2022, 36, 25-41; *Neuroethics*, 2021, in press).





Research Training

ACES Research Theme and Training Workshops

The ACES research training changed focus in 2021 in-line with the approach of the end of the centre. The research training group made a concerted effort to prepare all researchers for life beyond ACES.

- Careers in Research Panel, 5 February.
- Research Integrity Webinar delivered by Justin Withers from the ARC, 18 March.
- Analytical Capabilities Workshop, 12 April.
- Preparing for your Future Career Workshop, 28 April.
- Careers Beyond Academia Panel, 19 May.
- Identifying and Commercialising an Idea Workshop, 24 & 31 May.

Along with these activities ACES has maintained its traditional training through:

- Monthly ACES Webinar Series.
- 15th Annual ACES Electromaterials Science Symposium, 3-5 February.
- ACES Full Centre Meeting, 7-8 June - the majority of attendees were ECRs and students.
- A fortnightly 'ACES All' virtual meeting (March to December). This meeting allowed members, particularly ECRs and students, to talk all things ACES from introduction of new members, facility reports and updates, theme highlights and governance matters. Within these meetings, ECRs and students were encouraged via active participation; this enables training of the next generation in governance, administration and research.
- Research theme meetings were conducted as required to progress and co-ordinate the research activities, and to address the milestones.
- A number of virtual targeted ACES research theme workshops. 2021 workshops included LKM public address, ACES Symposium Translational Showcase 2021, Mario Ortega neuro-interfacing and bioelectronics medicines, 3D printing workshops with Royal Prince Alfred Hospital Sydney and Andhra Pradesh Medtech Zone (AMTZ) in India.
- ACES Legacy Symposium, celebrated with Alumni presentations, 2-3 December

Webinars

ACES continued with a program of webinars featuring external researchers delivering informative presentations followed by Q&A. The webinars were delivered throughout the year, with a total of 560 participants; see appendix 4 for individual webinar details.

BioFabrication Courses

Graduate Certificate Biofabrication

An online course designed for professionals currently working in the fields of science, health, engineering and technology, as well as those who want to pursue a career in biofabrication. UOW re-formatted the course content to be available as micro-credential course in 2021. Each course is worth 2 credit points and runs for 1-2 weeks.

The Graduate Certificate in Biofabrication also provides an entry pathway into the Masters of Philosophy (BioFabrication) or a Doctor of Philosophy, both of which involve undertaking of a research project in one of the ACES laboratories.

Masters of Philosophy (BioFabrication)

Master of Philosophy (Biofabrication) offered as coursework and thesis project (two years) at UOW. The course has been running successfully for 4-5 years.

This degree is accessible to students anywhere in the world. The coursework component is fully available online and students can elect to undertake the research component of the masters at a collaborative university. Eleven Memorandum of Understanding (MOU) with various universities, allow students to undertake the research component of the master course at an institution suitable to them.



Masters in Materials Science for Energy

ACES, through Deakin University, are involved formally in a European Masters course, 'Materials for Energy Storage and Conversion' (MESC), supported by Erasmus Mundus funding, until 2024. MESC is a two-year education program in materials science and electrochemistry.

Partners in the program include five universities in four European countries (France, Poland, Slovenia and Spain), universities in USA (Drexil) and Australia (Deakin), a European research institute (ALISTORE), the French Network on Energy Storage (RS2E), the Slovenian National Institute of Chemistry (NIC) and a leading research centre in Spain (CIC Energigune). These Institutions host world renowned, leading research laboratories in the field of energy related materials.

In 2021, a student was co-supervised by ACES CI Prof Jenny Pringle hosted in France (Bordeaux) due to travel restrictions. ACES provided a scholarship to student Luis Guerrero and we look forward to welcoming him to Deakin for his internship in 2022.

Certificate in Entrepreneurship

The Certificate in Innovation and Entrepreneurship from the Sydney Business School has been running since 2016 and will continue beyond 2022. There has been 111 students trained over the duration of the course with 17 students in the 2021 cohort. The ACES Innovation and Entrepreneurship Pitch Session was delivered to an international audience at the ACES Legacy meeting on 3 December.

Participants receive six credit points towards the UOW Graduate Certificate in Entrepreneurship and Innovation if they wish to continue further studies in this area. The success of this course has led to the development of plans to continue this course at UOW in the future. The overwhelming response from course recipients has demonstrated a change in perception, communication and attitude towards commercialisation, leaving them better prepared to navigate the changing landscapes.

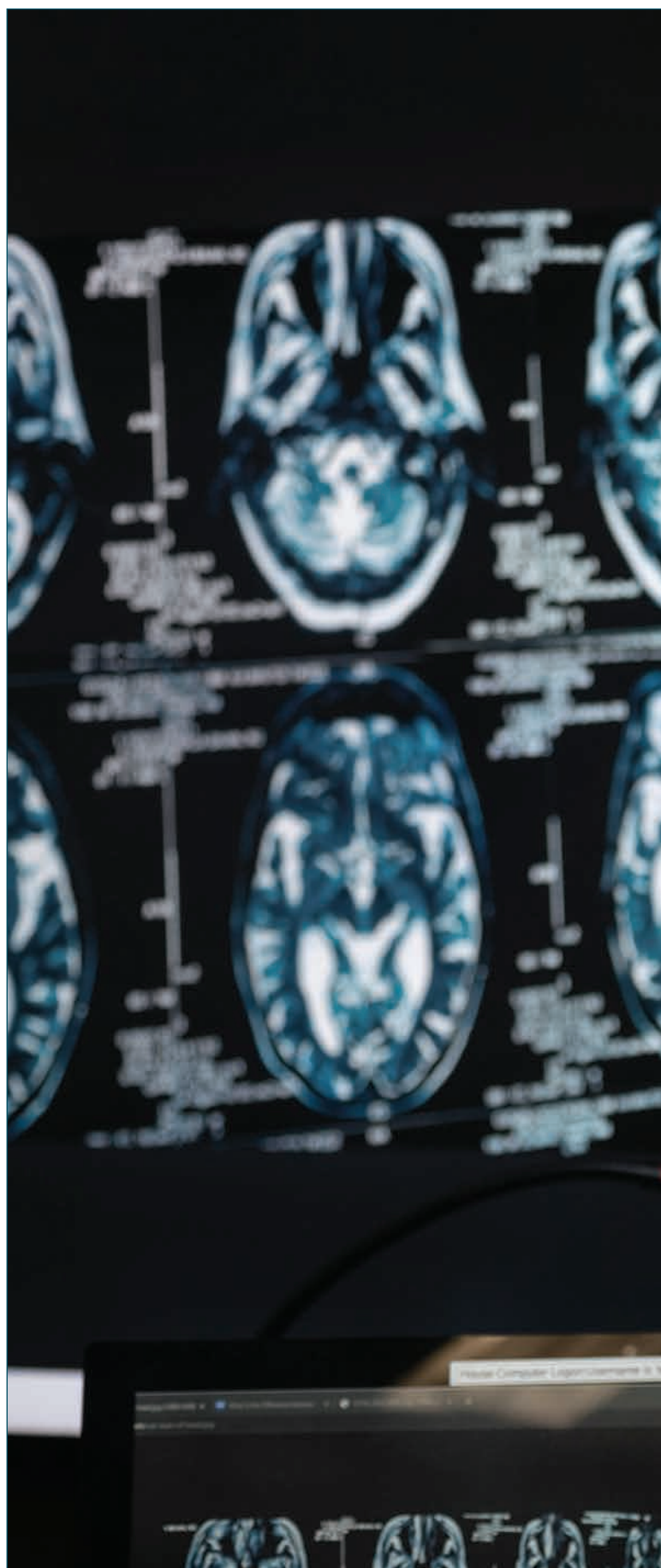
Undergraduate Opportunities

Summer Scholarships

ACES hosted two summer scholarships students at Deakin during summer 2020-2021 working on new electrolyte materials-based research.

International Conference Bursaries

ACES sponsored 17 undergraduate students from across Australia to attend the international Biofab2021 conference. Bursaries, covering the costs of attendance, were offered on a competitive basis for undergraduates looking to pursue a career based in biofabrication.







| Translation and Engagement

Translation

As ACES moved towards the end of official funding, the ACES team strategically focussed upon translation of research through existing paths and new initiatives. ACES continued its strong forward momentum to bring to life new opportunities.

Treatments for corneal injuries and disease

MRFF translational funding has been secured for work on novel bioink printing through to bioengineered partial or full thickness corneas. Rapid developments in biomaterials, advanced fabrication, imaging and cell biology have converged to make our goal possible – the bioengineered cornea. In collaboration with Sydney University and NSW Eye Bank Ophthalmic Surgeon Prof Gerard Sutton, the ACES team will be accelerating product development and rapidly decreasing time to market.

Green Ammonia

Ammonia is one of the most widely produced chemicals worldwide, mainly used in agriculture as fertiliser, and has transformed global food production in order to meet the needs of our growing world population. The ACES solar fuels team identified in 2014 that nitrogen reduction to ammonia could play a key role in developing a sustainable method to produce ammonia and support the renewable energy industry. The ACES team's research success continued to grow, buoyed by recent interest from researchers, industry and government to develop the cleanest, most efficient processes to generate ammonia from the nitrogen in the air and water around us. Their breakthroughs and other progress in the scale-up effort proved the process was practical for commercialisation, and a new spin-out company Jupiter Ionics was formed this year.

Better batteries

Through established local and international industry collaborations, ACES research is quickly moving towards exciting new energy technologies that can address major challenges at the heart of this new world of energy provision and storage requirements. BatTRI-Hub is fast becoming a centre for all kinds of industry engagement, ranging from chemical companies through to battery manufacturers and energy providers. A number of businesses and research groups have come on board to partner with the world class researchers on offer at the BatTRI-Hub, including Toyota, AusNet Services, Boron Molecular, Calix and Sensorplex, Sicona Battery Technology, Solvionic, Targray, AnteoTech.

Seaweed for bioinks

The collaboration between ACES researchers and Venus Shell systems is moving towards translation, with Ulvan based wound treatments; aiming on improving the health outcomes for patients with wounds. Ulvan is a green seaweed derived product that plays a key role in wound healing with its structure resembling the biomolecules found in humans.

ACES Edge Functionalised Graphene (EFG) to be commercialised.

The University of Wollongong (UOW) has sold the rights to ACES-developed Edge Functionalised Graphene (EFG) to lithium battery anode developers Sicona Battery Technologies Ltd (Sicona), a NSW start-up. Sicona has funded EFG patent applications in several global jurisdictions and will work with ACES and the Australian National Fabrication Facility (ANFF) researchers to develop the use of EFG in their silicon-based battery anodes and in coolants for a range of applications. ACES will continue to develop other applications of EFG with its academic and commercial research partners.

Functional fibres

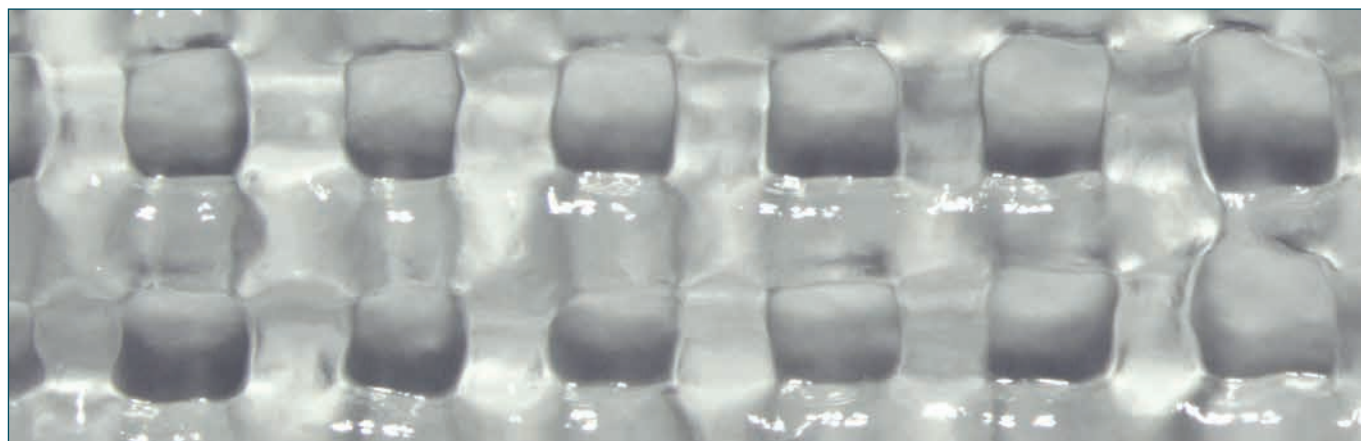
The fabrication of functional fibres such as the Sutrode continues to be a major activity in the Centre. The Sutrode combines the electrical properties of an electrode with the mechanical properties of a suture, for the localised targeting of electrical stimulation to the neural circuits. Commercial opportunities are being developed with our international partners surrounding the Sutrode platform. Here there is an emphasis on scaling up the production of these fibre based electrodes in accordance with industry standards and working towards ISO13485.

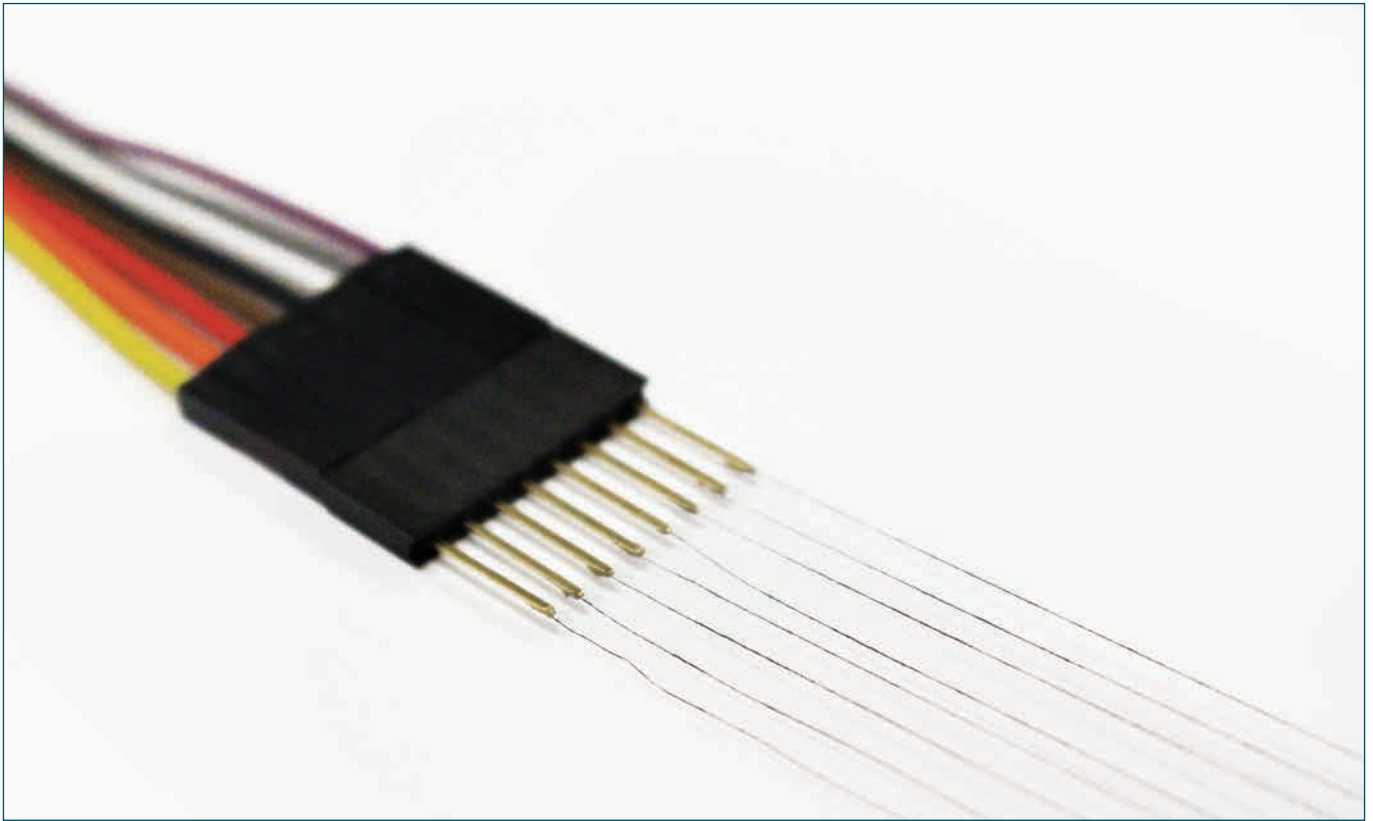
Soft robotic prosthetics

Through the soft robotics team, the development of soft and smart 3D printable prosthetic fingers and hands with sensing for upper limb amputees, have taken great leaps forward to commercial solutions during the year. The team have kept interactions with hospital, clinic, and prosthetic hand manufacturers to explore collaborative research opportunities, including amputee recruitment for testing systems, commercial translation in prosthetics, orthotics and rehabilitation industries. The team will maintain the interaction with prosthetic hand end-users, especially those who reside in Illawarra area, to keep them actively involved in our prosthetic hand project and ensure end-user satisfaction.

Table 2: Funding Awarded in 2021 Leveraged from ACES Research Activities

Funding leveraged from ACES research activities	Team and project Description	Years
Australian Research Council (ARC) Discovery Project: \$675,000	ACES CI Jun Chen, RF Si-Xuan Guo, and Marco Sacchi, "Ambient Electrochemical C-N Coupling via Co-electrolysis of N ₂ and CO ₂ "	2022-2025
Australian Research Council (ARC) Discovery Project: \$503,862	ACES CIs Brett Paull, Jeremy Crook, RF Dr Eva Tomaskovic-Crook, and Estrella Sanz Rodriguez, "Micro-electrofluidic platforms for monitoring 3D human biological models"	2022-2025
Australian Research Council (ARC) Discovery Project: \$481,000	ACES CI Jie Zhang, Paul Webley, and Ian McPherson, "Medium temperature electrolysis for low-cost carbon dioxide utilization"	2022-2025
Australian Research Council (ARC) Discovery Project: \$630,000	ACES CI Robert Sparrow, Christopher Degeling, and Christopher Mayes, "Artificial Intelligence, Robots, and Agriculture: Social and ethical issues"	2022-2025
Cooperative Research Centre (CRC): \$59,000,000	ACES Director Gordon Wallace and UOW team, in conjunction with a consortium of 68 Australian and international partners, led by Wei Zhang from Flinders University in the Marine Bioproducts Cooperative Research Centre (MB-CRC)	2022-2032
Medical Research Future Fund (MRFF): \$999,224	ACES Director Gordon Wallace and UOW team, ACES AI Gerard Sutton, and teams from USyd, QUT and UMelb, "Australian Corneal Bioengineering: Novel Therapies to Fight Blindness"	2021-2022
New Frontiers in Research Fund – Transformation \$19,200,000	ACES Director Gordon Wallace, Ian Madden (UBC), and collaborators, "Mend the Gap: A Transformative Biomaterials Platform for Spinal Cord Repair"	2021-2027
Cancer Institute NSW Translational Program Grant: \$3,750,000	Jonathan Clark, Ruta Gupta, Jenny Lee, Bruce Ashford, Marie Ranson, Michael Boyer, Helen Rizos, Jean Yang, Gregg Suaning, and ACES Director Gordon Wallace, "Reducing the Morbidity of Head and Neck Cancer Treatment"	2021-2026
NSW Health Medical Devices Fund: \$3,600,000	Inventia Life Sciences, Fiona Wood and ACES Director Gordon Wallace, "3D Bioprinting System for Intraoperative Skin Regeneration"	2021-2022
Victorian Government: \$34,900,000	ACES Associate Director Maria Forsyth and CI Patrick Howlett, "Battery Technology Research and Innovation Hub 2.0 (BatTRI-Hub 2.0)"	2021





Additional Commercial Activities

External commercial relationships with a focus on biomedical therapeutics continue to grow with iFix Medical, Axcelada, and GenesisCare.

The ACES research behind 3D bioprinting has reached commercial viability. The 3D REDI, launched at the end of 2020, provides intuitive bioprinting platform, and performs as both a research and education tool. The system also comes complete with interactive printing and characterisation tutorials to allow educators and students to familiarise themselves with the capabilities of multi-material bioprinting. Users also receive example cases they can utilise to get started on their own research. The 3D Genii also hit the global stage in 2021, a printer built specifically to deliver high precision silicon rubber prints in complex shapes. The 3D Genii designed to print implantable, flexible, customised prosthetic ears that match the anatomy of patients suffering from microtia.

Engagement Strategies

Facilities

Translational Research Initiative for Cellular Engineering and Printing (TRICEP)

Work on meeting current and future clinical needs has enabled TRICEP to bring about real advances to tackle significant medical challenges. TRICEP initiatives include; seaweed bioinks, 3D Alek, Ed3D, the Biopen (Axcelada), iFix and 3D PICT.

Quality Management System at TRICEP is being implemented to be aligned with ISO13485, the international standard for medical device manufacturers.

The Battery Technology Research and Innovation Hub (BatTRI-Hub):

The BatTRI-Hub facilities enable academic and industrial researchers to address the increasing consumer demands for safer, lighter, longer lasting batteries. The team have been engaging more extensively with industry and CSIRO. Recently, they were successful in having a \$1.66M project approved by the FBICRC which involves 10 companies across the resources and materials sectors. There is a current submission to expand the operations of BatTRI-Hub to be able to make larger format cells and batteries and further enhance the interaction with industry and a potential start-up company is being explored.

International Engagement highlights

AMTZ, India

The ACES-AMTZ partnership continues to develop business opportunities involving 3D printing capabilities.

AMTZ is an enterprise under the Government of Andhra Pradesh, a 270 acre zone, dedicated for Medical Device Manufacturing. The objective behind this 'One-Stop- Solution' is not only to reduce the cost of manufacturing up to 40% or to just simplify the end-to-end operations but also to reduce the import dependency, which is presently around

75%. AMTZ envisions to put India on the global map of high-end medical equipment production and make health care products affordable and accessible not only for India but for world at large.

University Texas Houston, US

Our partnership with Professor Mario Romero-Ortega's group in the area of new electromaterials for electroceuticals continues to flourish. Research continues to progress the possibilities of the Sutrode, going from strength to strength in conjunction with RBI Medical.

ASAN Medical, Korea

ACES has been engaged with the Asan Medical Center (AMC) which is Korea's leading hospital for surgery. ACES and AMC are working together on clinical testing the 3D printing of islet cells developed previously. This collaboration is to ensure the development of robust the translation protocols for *in vivo* studies.

Engagement Events

- A 3D printer event was held virtually in conjunction with RPA in January.
- NSW Chief Scientist Prof Hugh Durrant-Whyte visited ACES UOW in January.
- A Genii 3D printing event was held in virtually with colleagues in India in January.
- ACES Translational Showcase was held virtually in February.

Table 3: End-User Engagement Events

Event	Date	Venue
Royal Prince Alfred Hospital 3D Printer Event	18 January	Hybrid Wollongong and Virtual
3D Genii Printer India-Australia Workshop	25 January	Virtual
ACES Translational Showcase 2021	5 February	Virtual
ACES/TRICEP 3D Printing and Characterisation Capabilities Workshop	22 June	Virtual
Graphene Forum	16 November	Virtual
3D Bioprinting 2030 Forum	23 November	Virtual

Commercial Development Plans

Plans have been developed to commercially progress the research that has been cultivated within ACES in areas with sufficient maturity. This includes contracting external consultants to investigate the opportunities. The current plans are:

- Edge Functionalised Graphene with Roger Buckeridge
- 3D Printed Prosthetics with Jackie O'Connor
- TRICEP Phase 2 with Andrew Batty



Table 4: ACES Patent Filings 2014-2021

	Patent Description		Lead for Submission	Year filed
1.	Thermo-Electrochemical Cell and Method of Use	PCT/AU2015/901513	Deakin and Monash Universities	2015
2.	Functionalised Photo-Electrocatalyst and Method for Chemical Conversion	PCT/AU2015/000248	Monash University	2015
3.	Electrochemical Cell	PCT/AU2016/050389 WO/2016/183638	Deakin University	2015
4.	Nanostructured electrode for CO ₂ reduction	2016/903555	Monash University	2016
5.	High-efficiency electrochemical conversion of nitrogen into ammonia	2016/900354	Monash University	2016
6.	High-efficiency electrochemical conversion of nitrogen into ammonia	2016/900613	Monash University	2016
7.	Sodium-ion Electrolyte Composition	PCT/AU2016/051172 WO/2017/091854	Deakin and Monash Universities	2016
8.	Appartus and method for handheld free-form Biofabrication	PCT/AU2016/050886	St Vincents Hospital Melbourne	2016
9.	Method and Cell for Conversion of Dinitrogen into Ammonia	PCT/AU2017/000036, WO/2017/132721	Monash University	2017
10.	Method and Cell for Conversion of Dinitrogen into Ammonia	AU 2018900370	Monash University	2018
11.	Method and Cell for Conversion of Dinitrogen into Ammonia	AU 2017902960	Monash University	2018
12.	Method and Cell for Conversion of Dinitrogen into Ammonia	PCT/AU2018/000122	Monash University	2018
13.	An Implantable Device and a Method for Implanting said Device in a Subject	PCT/AU2019/051017, WO/2020/056467	University of Wollongong	2020
14.	Edge Functionalised Graphene	AU 2018903793	University of Wollongong	2018
15.	A device and a method for using a device to receive and/or deliver a substance <i>in vivo</i>	PCT/AU2018/051033, WO/2019/068136	University of Wollongong	2019
16.	A device for immobilising a robotic capsule within a body lumen	PCT/AU2018/051034, WO/2019/068137	University of Wollongong	2019
17.	Tissue Scaffolds and Constructs	AU 2020903779	University of Wollongong	2020
18.	Self-Regulating Electro-Synthetic or Electro-Energy Cell	AU 2020903369	University of Wollongong	2020
19.	An Implantable Device	AU 2020901409	University of Wollongong	2020
20.	Dispersible edge functionalised graphene platelets	WO-2020073081-A1	University of Wollongong	2020
21.	Chemical gradients	US20200268934	University of Texas/Wollongong	2020
22.	Methods of making and bioelectronic applications of metalized graphene fibers	PCT/US2019/062663, WO/2020/106986	University of Texas/Wollongong	2020
23.	Electrolytes for target ion transport	PCT/AU2021/050450, AU 2020901539	Deakin and Monash Universities	2021
24.	Cell harvest method	PCT/AU2021/050511, WO/2021/237295	St Vincents Hospital Melbourne	2021
25.	Electrochemical capture of carbon dioxide and production of carbonate mineral	AU-2021901253-A0	University of Wollongong	2021
26.	uTAD and swab based analysis	AU-2021901294	University of Tasmania	2021



Communications

ACES has had a committed focus on communicating research findings to a broad and diverse audience. We have strived for a highly successful communications strategy and have created effective platforms to showcase the work of our researchers – as well as promote engagement whilst targeting a variety of stakeholders in areas that include commercial sectors, healthcare, government and the community.

2021 saw a further increase in the use of social media including the continued utilisation of Facebook, Twitter, LinkedIn, YouTube and Instagram. These platforms maintained consistency, with regular posts each week throughout the year.

In addition, initiatives including The ACES Podcast and ACES Webinar Series returned for another year in an effort to disseminate our work to a wider audience, especially given the continued difficulties of the COVID-19 pandemic.

Our outreach efforts involve six key stakeholder audiences:

- **Global research community:** To provide insight into our state-of-the-art electromaterials science and integrated device fabrication knowledge and facilities, that are readily accessible for scientists, engineers, clinicians, regulators and policy makers;
- **Prospective students:** To provide an inclusive and supportive global research training opportunity, by giving access to the most innovative and dynamic research training programs and laboratories in Australia, also facilitated by global connections;
- **Investors:** To facilitate the development of technologies to create new disruptive business opportunities and to enhance existing businesses;
- **Government and Regulators:** To provide information on the effectiveness of funding programs (for research training) and issues affecting policy and regulation in Energy and Health;
- **Community:** To provide access to the exciting world of science, the wonder of discovery, and what can be achieved through open engagement for the community, using multidisciplinary research to address real community needs so that science can positively influence people's daily lives;
- **Internal:** To unite with a common purpose to build a sense of community for the communication of research progress.

Media

Table 5

Public Communication	2021 KPI Target	Actual
Podcast (external from our podcast)	0	2
Print	20	12
Radio	10	14
Television	5	6
Web Stories	100	106

During 2021, ACES members and their research activities were highlighted in 12 print and 106 electronic articles, 14 radio appearances, 2 external podcasts and 6 television stories in Australian and international media (see above table).

Media Highlights

Made in Wollongong: UOW's 3D-Printed Prosthetic Ears Go Global

In articles covered by the Illawarra Mercury, Canberra Times and Examiner, news of the 3D REDI and 3D Genii printing systems hit the global stage and was delivered internationally in a strategic partnership developed between ACES researchers from UOW and the Andhra Pradesh Medtech Zone (AMTZ) in India.

New Electrolyser Company Hysata Puts \$2/Kg Green Hydrogen Within Reach

Based on breakthrough Australian technology developed by ACES researchers at UOW, spin out company Hysata was commercialised to develop a new hydrogen electrolyser with potential to significantly shift the economics of green hydrogen production. The launch of the company, with \$5 million in funding led by IP Group and support from the Clean Energy Finance Corporation (CEFC), was captured by local and national media, including the Illawarra Mercury, Cosmos Magazine and ABC.

3D Printers now Producing Body Parts

ACES Director Prof Gordon Wallace joined ABC Radio National's The Science Show for an interview and walkthrough tour at ACES headquarters with host Robyn Williams to chat about the work being done in 3D printing and more.

Table 6: A Summary of ACES Outreach Activities and Involvement with Community and Professional Bodies in 2021

Outreach Activity	Date	Venue
Leon Kane Maguire Public Address: Celebrating the life of Leon Kane-Maguire, one of Australia's great scientific minds, the Address featured a panel of special guests for a presentation on the pros and cons of collaborative research. The panel included ACES CIs Geoff Spinks and David Officer as well as UOW Biomechanics Research Lab's Prof Julie Steele and Dr Toni Campbell. The Leon Kane-Maguire student prize, donated by the Kane-Maguire family, was awarded to Aelon Rahmani for being the highest achieving School of Chemistry and Molecular Bioscience Honours degree student.	4 February	Hybrid event Wollongong-virtual with a limited number of people in-person
Public Lecture: Robert Forster, AI DCU/UOW, "What Happens When you Flush the Loo! Electrocuting Pollutants" to Celbridge Community School, Celbridge, Co Kildare.	8 February	Virtual
RACI Australasian Polymer Summer School: Michelle Coote, CI ANU, presented a lecture, "The art of scientific writing".	18 February	Virtual
Bill Wheeler Symposium: Hosted during Science Week, the community annual event to celebrate and recognise an outstanding University of Wollongong (UOW) bionics student. Dating back to 2009, the Symposium and Award was created in honour of Bill Wheeler, who was a very active member of the Illawarra community and took a keen interest in new bionics research at UOW. Head and neck surgeon A/Prof Bruce Ashford, academic at UOW and is the Clinical Director of the Illawarra Health and Medical Research Institute (IHMRI), gave symposium feature presentation. A/Prof Ashford also leads the Covid-19 Task Group for the local health district. Last year's winner, Grishmi Rajbhandari, gave an update on her past year since being awarded and how she has used the funds as well as what winning meant to her. ACES Affiliate and UOW Biofabrication PhD student Jeremy Di Noro was awarded this year's Bill Wheeler Award for his research on patient-specific implants through 3D printing. Presented by Kiama Rotary Club President Trevor Phillis, the award recognised Jeremy for best communicating the social impact of his research and how the prize would benefit his work.	17 August	Virtual

Deakin University to Create World-Leading Clean Energy Products

The Victorian State Government announced a \$34.9 million plan for a new battery facility and hydrogen hub at Deakin University with a focus on clean and green energy. This initiative received significant coverage in local, state and national media.

Breakthrough Brings Green Ammonia Production Closer to Reality

ACES researchers at Monash University, including Chief Investigator Prof Douglas MacFarlane and Research Fellow Dr Alexandr Simonov, devised a method of producing green ammonia that has the potential to make Haber-Bosch plants obsolete. These findings were captured by local and national media, with the Monash team's ammonia research gaining funded from the Australian Renewable Energy Agency (ARENA).

Groundbreaking Electroceutical Research on Spleen Function

An international team of researchers, led by University of Houston's Prof Mario Romero-Ortegain collaboration with ACES and Director Prof Gordon Wallace, progressed

electroceutical research for treatment of diseases including rheumatoid arthritis, colitis and sepsis. This research builds on the collaboration and development of the Sutrode, created using the fabrication technique known as fiber wet spinning.

Communications Platforms

The ACES Website

The ACES website (electromaterials.edu.au) serves as our main online communications platform as well as being utilised for many other functions. We want to share what we do at the Centre and use our website to do so, whilst also promoting our content via our integrated social media channels, including Twitter, Facebook, LinkedIn, YouTube and Instagram.

Our ACES research makes headlines in news and attracts international headlines. However, not all ACES stories can be covered in the media – and this is where our website comes in.

The website provides a platform to showcase our work and to distribute it to a wider audience online. We use the website to publish news stories, interviews, events, podcasts, case studies, videos and interesting research achievements described in plain English.



Due to the COVID-19 pandemic, our online presence became even more important and we aimed to further utilise the website. The ACES Communications Team ran a number of initiatives in place of those that would have otherwise taken place face-to-face through workshops, public events and media interviews. These initiatives included interviews and podcasts with ACES researchers and students, guest blogs, online webinars, feature articles, case studies and more.

Facebook

Facebook continued to be an effective platform to promote the work of ACES, linking back to both our website and external media content. Our Facebook page (facebook.com/electromaterials) currently has over 1,400 likes (people who support our page), compared to 1,399 in 2020.

Twitter

Our Twitter account (twitter.com/ARC_ACES) has over 2,190 followers compared to 1,743 in 2019. In addition to the ACES Twitter account, our team, including many of our Chief Investigators, are active on Twitter and frequently retweet posts. ACES Director Prof Gordon Wallace has 3,702 followers, compared to 3,199 in 2020.

YouTube

Videos are a powerful communication tool reaching a broad and diverse audience. The ACES YouTube channel has over 1,170 subscribers, and our videos have gained thousands of views.

ACES added 32 videos to the ACES channel in 2021. Our video content on YouTube increased as a result of the Centre adapting to the socially-distanced reality of COVID-19. The majority of our Webinar Series were recorded and videos then made available for later viewing (with the presenter's permission).

Instagram

After introducing ACES on Instagram in 2019, we continued to maintain the Centre's presence on the platform. In 2021, the ACES Instagram account had 102 new followers, bringing the Centre's followers to 337 in total.

LinkedIn

In 2019, ACES renewed its presence on LinkedIn after not being utilised for some time, and in 2021 the page grew to have 1,620 followers, compared to 1,103 in 2020.

Initiatives

The ACES Podcast

The ACES Podcast returned for a second season and 10 additional episodes in 2021 after being launched the year prior. The podcast features interviews with former ACES students, current researchers, and ACES collaborators making a difference in their field.

The podcast continued to provide a fresh way to reach a broad audience and introduce them to ACES research.

Episodes from 2021 included conversations with ACES Director Prof Gordon Wallace, Reconstructive Microsurgeon and Cancer Researcher A/Prof Bruce Ashford, Supply Chain Management Academic Dr Tillmann Böhme, ACES Affiliate Dr Vipul Gupta and more.

Since its launch in April 2020, The ACES Podcast has received 2,237 plays across the eight different platforms that it is available on, such as Apple Podcasts, Spotify and Google Podcasts.

ACES Webinar Series and Online Events

Launched in 2020 due to the pandemic and not being able to conduct in person workshops or training, the ACES Webinar Series returned in 2021 for the variety of monthly talks, from latest advances in research to preparing for a future career, to identifying and commercialising an idea.

The webinars were advertised both internally within ACES and externally via social media, making the initiative (and the latest in electromaterials science research) accessible to the research community, end-users, industry and the community simultaneously.

As well as the series, we also ran a number of other online events that were advertised to the general public and were freely available. The team worked to provide a variety of events that would interest ACES' different stakeholders, including the annual Leon Kane MaGuire Address (LKM) and Bill Wheeler Symposium. These events were well attended, with people registering to attend these sessions from a broad cross-section of the community.

Outreach

While COVID-19 continued to somewhat limit our team in being able to share their knowledge and expertise in person, a number of our researchers took on the opportunity to educate, inspire and engage the broader community through a number of outreach events.

ACES 2021 Communications Snapshot



@ARC_aces



2,190 followers



447 new followers



1,417 retweets



@electromaterials



1,400 followers



816 page visits



6,868 reach



@ACESElectromaterials



1,173 subscribers



USA, Top Viewing Country



39.7K views



@ARC_aces



920 total posts



337 followers



102 new followers

ARC Centre of Excellence
for Electromaterials Science

1,620 followers



Sydney, top following city



517 new followers



electromaterials.edu.au



15.9K users



39.8K page views



Most Views



Awards

ACES members have been recognised for their outstanding contribution to science and research through a number of honours, prizes and awards.

2021 RACI Leighton Memorial Medal

ACES CI Prof Michelle Coote was awarded the 2021 RACI Leighton Memorial Medal. Prof Coote earned the award in recognition of eminent services to chemistry in Australia, commemorating the distinguished career of A E Leighton. The RACI National Awards are held each year by the Royal Australian Chemical Institute (RACI) to recognise and promote the contributions and achievements of their members.



Australian Academy of Humanities Fellow

ACES CI Prof Susan Dodds was named as an Australian Academy of Humanities Fellow. The fellowship is the highest honour for achievement and contribution to the humanities and arts in Australia, with 40 new members elected this year. Prof Dodds is a philosopher and is the ACES Ethics, Policy and Public Engagement Theme Leader.

Advances in Cleaner Production Network (ACPN) Award - Senior Researcher for 2021

ACES CI Linda Hancock was awarded the Senior Researcher for 2021 Award by the Advances in Cleaner Production Network (ACPN). This prize is given to individuals who, in the judgment of the members of the Award Committee, have made outstanding contributions to the Advances in Cleaner Production. As a senior professional devoted to assist the public and private sectors to achieve their goals towards environmental compliance and for her contributions to cleaner energy production.

2021 RH Stokes Medal

ACES Associate Director Prof Maria Forsyth was awarded the 2021 RH Stokes Medal. The Royal Australian Chemical Institute (RACI) awards the Medal to distinguished researchers in the field of electrochemistry. Prof Forsyth has worked at the forefront of energy materials, making breakthrough discoveries in areas that include polymer electrolytes, ionic liquids and organic plastic crystals.





Falling Walls Science Summit Science Breakthrough of the Year 2021

ACES CI Prof Geoffrey Spinks was announced as one of ten global winners in the Engineering and Technology category for Science Breakthrough of the Year 2021 at the Falling Walls Science Summit, Berlin, for his world-leading artificial muscle material research. The award is acknowledgement of the research, by Prof Spinks and his team, in the development of artificial muscles in miniature devices that for application in medicine and robotics.

2021 Clarivate Highly Cited Researchers

ACES CI Prof Douglas MacFarlane and Prof Jun Chen were named on the 2021 Clarivate Highly Cited researchers list. The list identifies scientists for their significant contributions to global research, demonstrated through publications and multiple highly cited papers over the previous decade that rank in the top one per cent for their field.

UOW Vice-Chancellor's Researcher of the Year

Awarded for an outstanding contribution to UOW research outputs and reputation, ACES CI Prof Jun Chen received the honour of Researcher of the Year at the Vice-Chancellor's Awards. The impact of Prof Chen's research in areas including 3D printing, biomaterials, conducting polymers, electrochemistry and renewable and sustainable energy.

Additional awards and accolades

Dr Andres Ruland, UOW Research Fellow, received the Best Postdoc/ECR presentation award at the Australasian

Society for Biofabrication and Tissue Engineering (ASBTE) research showcase. The award was for his presentation titled "Ultramimage: a versatile platform for the non-invasive evaluation of biomaterials and cell containing structures".

UOW Researchers Dr Holly Warren and Dr Hao Zhou were successful in receiving research fellows as part of UOW's Prioritising Emerging Research Leaders (PERL) Fellowship Scheme in the Faculty of Science, Medicine, and Health.

Jeremy Dinoro, UOW PhD student, was awarded the Bill Wheeler Award for Bionics research 2021, for "3D Printing Bone".

Dr Saimon Silva, Swinburne Associate Investigator, received the SET ECR Excellence Award (Highly Commended) from Swinburne University of Technology.

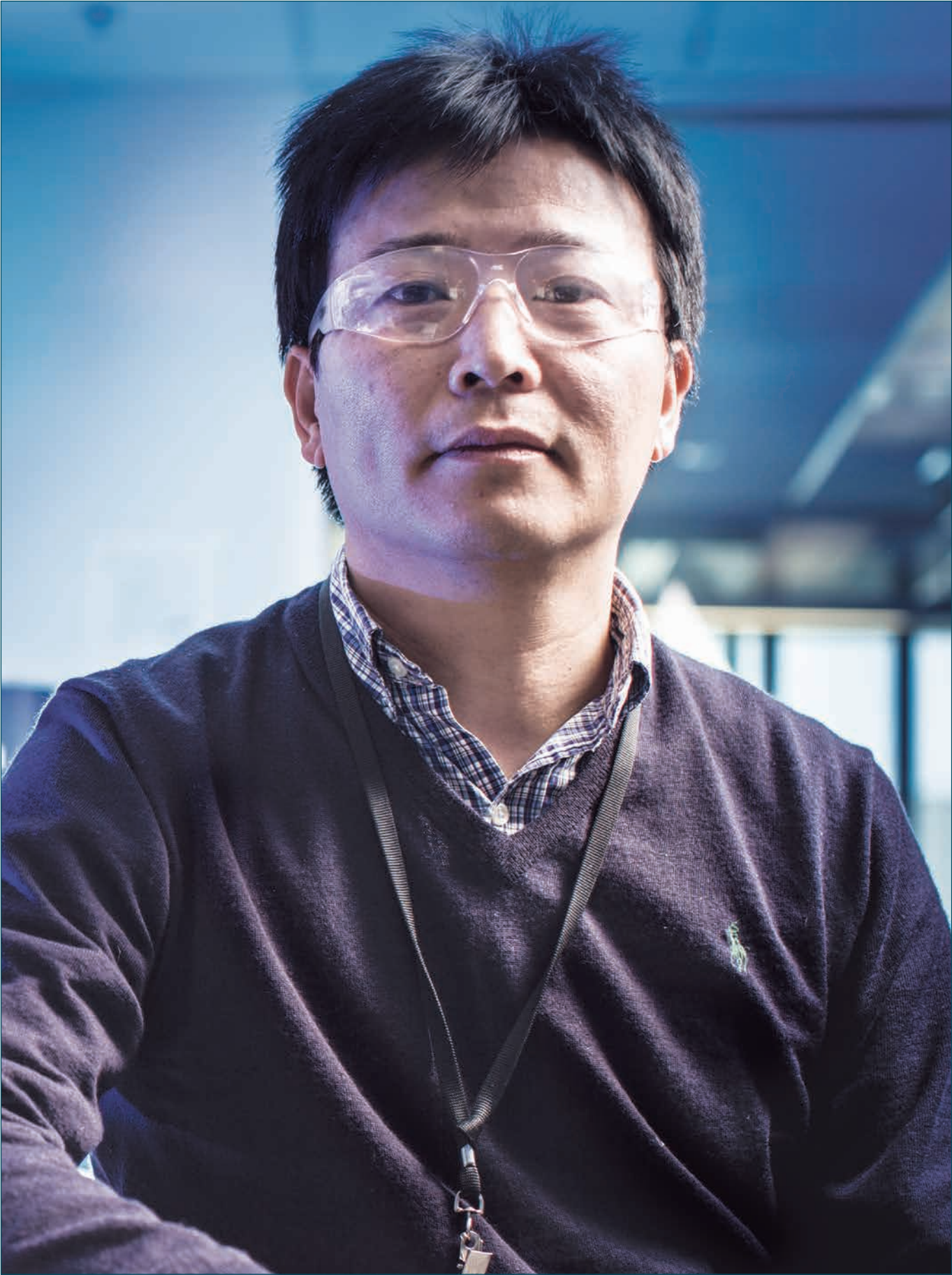
ACES and Deakin University's Dr Kalani Periyapperuma, Nanditha Sirigiri, Sneha Malunavar and Mojtaba Eftekharnia, came together to form the company Smart Eco Energy Labs (SEE Labs). The SEE Labs team came first out of 14 teams who pitched at the South East Asia Climatelaunchpad Regional competition, and went on to compete at the Global Finals. Their start up idea is based on using AI techniques to optimise repurposing of used batteries.

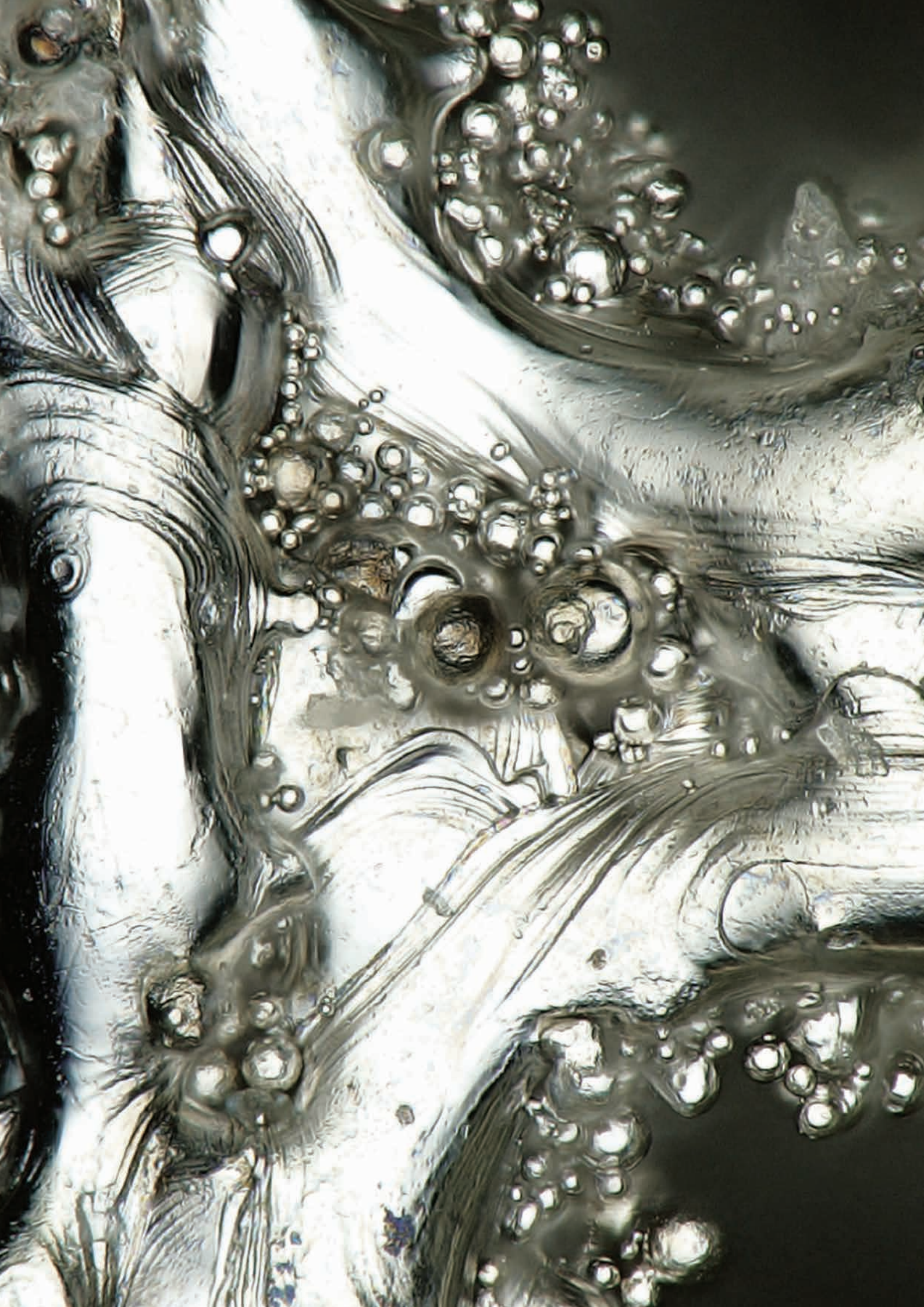
Luciana Yumiko Daikuara, UOW PhD student, received the IHMRI 2021 Publication of the Year Award.

Daniela Duc, Swinburne PhD student, was nominated (by the thesis examiners) for The Iain Wallace Research Medal 2020 at Swinburne University of Technology.

Carly Baker, UOW PhD student, was awarded the Prize for Engagement at the PolyNSW symposium, 15-16 November.

ACES UOW Associate Investigators Benjamin Filippi and Dr Sepidar Sayyar both received a 2020 Frater Award, presented to Australian National Fabrication Facility (ANFF) staff members to enable them to progress their professional careers.





KPIs and Publications

Table 7: Performance Indicators

Key Performance Indicators (KPI)	Target 2021	Actual 2021	Target 2020	Actual 2020
Number of research outputs				
Journal publications	140	236	140	217
Book chapters	3	10	3	20
Conference publications/abstracts	90	69 • 3 refereed papers • 66 abstracts non-ACES conferences	90	93 • 9 refereed papers • 84 abstracts non-ACES conferences
Patents (filed)	2	3	2	5
Quality of research outputs				
Quality of research outputs	50% with impact factor >3.2	69% (161 publications)	50% with impact factor >3.2	70% (153 publications)
Cumulative Citation data Average cumulative citation per publication	22 Av cumulative citation per publication	29.7 (1453 cited publications from 1603 captured in database 2014-2021)	22 Av cumulative citation per publication	24.3 (1225 cited publications from 1382 captured in database 2014-2020)
Overall publication and citation activity of ACES publications	Overall Field weighted citation impact: 1.7 Outputs in top 10% most cited: 25% Views in top 10% world % views: 30%	2.00 29.1% 27.8%	Overall Field weighted citation impact: 1.7 Outputs in top 10% most cited: 25% Views in top 10% world % views: 30%	2.02 35.3% 48.2%
Number of invited talks/papers/keynote lectures given at major international meetings	40	40 13 plenary/keynote 27 invited talks	40	50 15 plenary/keynote 35 invited talks
Student prizes and awards	2	5	2	9
Training and Professional Education				
Number of training courses held/offered by the Centre Annually	Total = 17 Thematic workshops: 5 Summer scholarships: 2 Researcher exchanges: 10	Total = 17 Thematic workshops: 14 Summer scholarships: 2 Researcher exchanges: 1 • 0 international students hosted by ACES (>5 days) • 1 ACES national X-nodal student or ECR exchanges (>3 days)	Total = 17 Thematic workshops: 5 Summer scholarships: 2 Researcher exchanges: 10	Total = 24 Thematic workshops: 14 Summer scholarships: 5 Researcher exchanges: 5 • 0 international students hosted by ACES (>5 days) • 5 ACES national X-nodal student or ECR exchanges (>3 days)

Key Performance Indicators (KPI)	Target 2021	Actual 2021	Target 2020	Actual 2020
Number of workshops/conference held/offered by the Centre	Total = 7 Full Centre Meeting: 1 International Symposium/Event : 1 International or National Joint workshops: 2 End-User sessions: 3	Total = 27 Full Centre Meeting: 1 International Symposium/Event: 6 International or National Joint workshops: 9 End-User sessions: 11	Total = 7 Full Centre Meeting: 1 International Symposium/Event : 1 International or National Joint workshops: 2 End-User sessions: 3	Total = 23 Full Centre Meeting: 1 International Symposium/Event : 2 International or National Joint workshops: 9 End-User sessions: 11
Number of additional researchers working on Centre research • Postdoctoral researchers • Honours students • PhD students • Masters by research students • Masters by coursework students • Associate Investigators	Associate Postdoctoral researchers: 15 Affiliate PhD students: 20 Masters by research students: 5 Associate Investigators: 15	Associate Postdoc researchers: 22 Affiliate PhD students: 29 Associate Investigators: 25	Associate Postdoctoral researchers: 15 Affiliate PhD students: 20 Masters by research students: 5 Associate Investigators: 15	Associate Postdoctoral researchers: 17 Affiliate PhD students: 32 Masters by research students: 7 Associate Investigators: 25
Number of postgraduate completions	12	25 • 18 PhD • 7 Masters	12	16 • 11 PhD • 5 Masters
Number of mentoring programs offered by the Centre	Total = 6 Webinars: 2 Additional skill training activities: 3 Enduser mentoring program: 1	Total = 16 Webinars: 10 Additional skill training activities: 6 Enduser mentoring program: 0 (not possible due to COVID-19 restrictions)	Total = 6 Webinars: 2 Additional skill training activities: 3 Enduser mentoring program: 1	Total = 47 Webinars: 40 Additional skill training activities: 6 Enduser mentoring program: 2 APR internships
International, national and regional links and networks				
Number of presentations/briefings To the public To government (parliamentarians and departments/agencies at both State and Federal level) To industry/business/end-users To non-government organisations To professional organisations and bodies Other (please specify)	To the public: • 100 web • 20 print • 10 radio • 5 television To government (parliamentarians and departments/agencies at both State and Federal level): 6 To industry/business/end-users: 40 To professional organisations and bodies: 10 Other (STEM education activities): 1	To the public: • 106 web • 12 print • 14 radio • 6 television • 10 podcasts To government: 18 To industry/business/end-users: 86 To professional organisations and bodies: 19 Other (STEM education activities): 6	To the public: • 100 web • 20 print • 10 radio • 5 television To government (parliamentarians and departments/agencies at both State and Federal level): 6 To industry/business/end-users: 40 To professional organisations and bodies: 10 Other (STEM education activities): 1	To the public: • 109 web • 9 print • 7 radio • 1 television • 4 podcasts To government: 10 To industry/business/end-users: 59 To professional organisations and bodies: 17 Other (STEM education activities): 11

Key Performance Indicators (KPI)	Target 2021	Actual 2021	Target 2020	Actual 2020
Number of new organisations collaborating with, or involved in, the Centre since 2014	1	4 <ul style="list-style-type: none"> • Chris O'Brien Lifehouse • Imagine Resources Technology • National Yang Ming Chiao Tung University • Eye Hospital, Wenzhou Medical University 	1	5 <ul style="list-style-type: none"> • UWA • Inventia Life Science • Åbo Akademi University • CALHN • IFix Medical Pty Ltd
Centre-specific Key Performance Indicators				
Commercial translation of Centre research	Ongoing through life of Centre	See main body of report	Ongoing through life of Centre	See main body of report
Attraction of new funding from endusers and stakeholders in government, NGOs, industry and the private sector	Ongoing through life of Centre	See main body of report	Ongoing through life of Centre	See main body of report
Specific training courses in entrepreneurial skills for Centre staff and students	Run a Certificate in Innovation and Entrepreneurship each year	1	Run a Certificate in Innovation and Entrepreneurship each year	1
Initiatives on gender equity and diversity for Centre staff and students	Organise one training activity on equity or diversity each year	1	Organise one training activity on equity or diversity each year	1 Webinar held
	ACES Code of Conduct ACES Conference Code of Conduct	Code conduct and conference policy are now available on the ACES website.	ACES Code of Conduct ACES Conference Code of Conduct	Code of conduct and conference policy on the ACES website.

Table 8: Equity and Diversity Metric

Gender Equity and Diversity (census date 31 December 2021)	Gender Equity	Diversity - Indigenous	Diversity - Disability	Total personnel
	Number of individuals identifying as female	Number of indigenous personnel	Number of personnel with a disability	
Chief Investigators	5	0	0	24
Partner Investigators	0	0	0	5
IAC	4	0	0	16
RFs and ECRs	16	0	0	32
Students (core)	10	0	0	24
Professional and Administrative staff	10	0	0	19

Publications

Book Chapters

1. Ralph N., "An Introduction to Social Enterprise for Practitioners in Preventing and Countering Violent Extremism". In Barton G., Vergani M., Wahid Y. (eds) Countering Violent and Hateful Extremism in Indonesia. New Security Challenges. **2021** pp. 255-275 (Palgrave Macmillan, Singapore) ISBN 9789811620317.
2. Ferguson P., Wollersheim L., Lowe M., "Approaches to Climate Resilience". In Brears, R.C. (ed) The Palgrave Handbook of Climate Resilient Societies. **2021** pp. 1-25 (Palgrave Macmillan, Cham) ISBN 9783030328115.
3. Harris A. R., Gilbert F., "Military Medicine Research: Incorporation of High Risk of Irreversible Harms into a Stratified Risk Framework for Clinical Trials". In Messelken D., Winkler D. (eds) Health Care in Contexts of Risk, Uncertainty, and Hybridity. Military and Humanitarian Health Ethics. **In Press** pp. 253-273 (Springer, Cham) ISBN 9783030804428.
4. Sparrow R., "How robots have politics". In Carissa Véliz (ed.) The Oxford Handbook of Digital Ethics. **2021** (Oxford University Press, Oxford) ISBN: 9780198857815.
5. Ciampi S., Diez-Perez I., Coote M. L., Darwish N., "Experimentally Harnessing Electric Fields in Chemical Transformations". In Shaik S., Stuyver T. (eds) Effects of Electric Fields on Structure and Reactivity: New Horizons in Chemistry. **2021** pp. 71-118 (Royal Society of Chemistry) ISBN: 9781839161698.
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Refereed Articles

As captured by SCOPUS database with ACES in the address line (31.01.2022). This list contains the articles used to calculate the statistics in Table 7.

1. Luke, S., Chatti, M., Yadav, A., Kerr, B.V., Kangsabanik, J., Williams, T., Cherepanov, P.V., Johannessen, B., Tanksale, A., MacFarlane, D.R., Hocking, R.K., Alam, A., Yella, A., Simonov, A.N., *Mixed metal-antimony oxide nanocomposites: low pH water oxidation electrocatalysts with outstanding durability at ambient and elevated temperatures*, 2021, Journal of Materials Chemistry A, **9**, 48, 27468-27484.
2. Zhang, S., Zhou, Y., Liu, Y., Wallace, G.G., Beirne, S., Chen, J., *All-polymer wearable thermoelectrochemical cells harvesting body heat*, 2021, iScience, **24**, 12, 103466.
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15. Menon, A., Münich, P.W., Wagner, P., Officer, D.L., Guldi, D.M., *Amphiphilic Zinc Porphyrin Single-Walled Carbon Nanotube Hybrids: Efficient Formation and Excited State Charge Transfer Studies*, 2021, *Small*, **17**, 48, 2005648.
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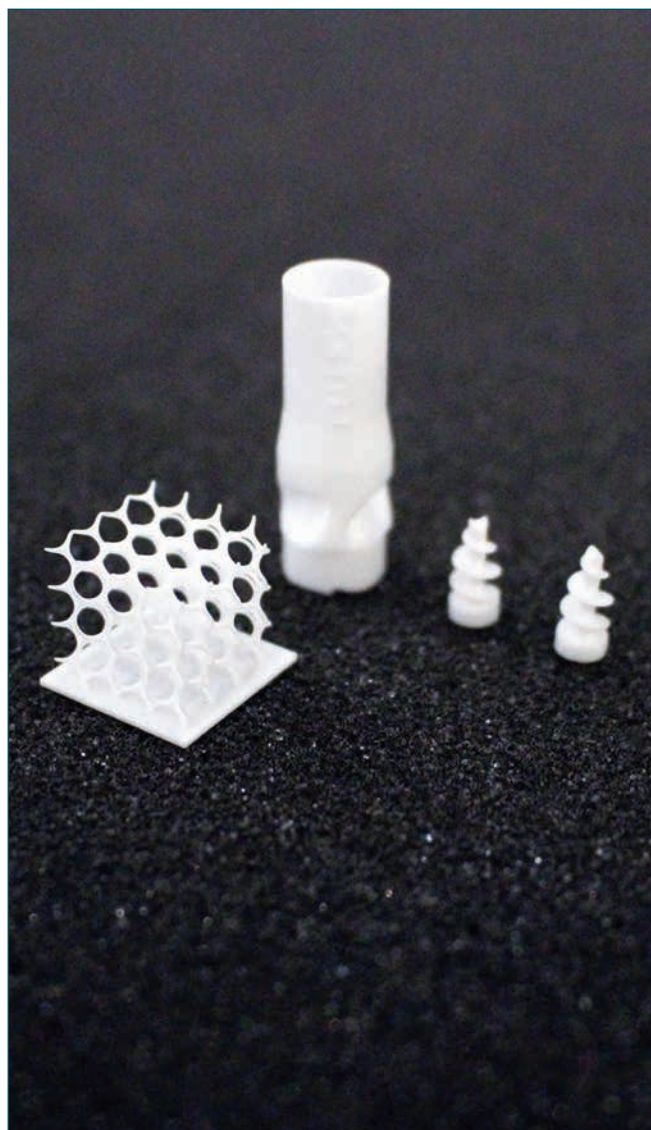
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Other Developments

ACES members are involved in other research initiatives. In some cases the ACES entity (facilities, personnel and market presence) has enabled the development of these research initiatives that could not be funded by the Centre of Excellence core funding. A list of some of the other research initiatives is shown in Table 9.

Table 9: Examples of Other Fundamental Research Initiatives Where ACES Members are Involved

ACES Research Area	Project	Researcher	Funding Body
Biomaterials	2021-2023: A wireless electric nerve-guide for peripheral nerve repair.	A/Prof Jeremy Crook	NHMRC Ideas Grant 2002761
Biology	2021-2023: Autologous constructs for muscle engineering and repair.	Prof Robert Kapsa	NHMRC Ideas Grant 2002723
Fluidics	2021-2023: 3D printed microchemical devices and systems.	Prof Michael Breadmore; Dr Vipul Gupta (ACES)	ARC Discovery Grant DP210102928
Bionics	2021-2023: Non-invasive and safe human-machine interface (HMI) systems.	Prof Gursel Alici	ARC Discovery Grant DP210102911
Materials/Energy	2021-2023: Designing disorder into ionic materials for clean energy applications.	Prof Jennifer Pringle (ACES); Prof Douglas MacFarlane (ACES); Dr Mega Kar	ARC Discovery Grant DP210101269
Energy	2021-2023: Parameterisation of voltammetry in a machine learning environment.	A/Prof Jie Zhang (ACES); Prof Alan Bond (ACES); Prof David Gavaghan; Dr Alison Parkin	ARC Discovery Grant DP210100606
Energy	2021-2023: Sustainable high energy sodium batteries with enhanced safety and cycle life.	Prof Maria Forsyth (ACES); Dr Luke O'Dell; Prof Patrick Howlett (ACES); Dr Fangfang Chen (ACES); Prof Agilio Padua; Prof Michel Armand	ARC Discovery Grant DP210101172
Materials	2021-2023: Switchable and stereocontrolled photoredox catalysis.	Dr Alexander Bissember; Prof Michelle Coote (ACES); Prof Jianwei Sun	ARC Discovery Grant DP210100025
Materials/Energy	2021-2023: Flexible flame aerosol synthesis technology.	Prof Antonio Tricoli; Prof Douglas MacFarlane (ACES); Prof Huanting Wang; Prof Lan Fu; Prof David Nisbet; A/Prof Jason Scott; Dr Alexandr Simonov (ACES); Dr Zongyou Yin; Dr Enrico Della Gaspera; Dr Samuel Ippolito; Dr Emma Lovell; Dr Alexey Glushenkov	ARC LIEF LE210100084
Materials/Energy	2021-2025: New dimensions of electrocatalyst design for sustainable energy future.	Dr Alexandr Simonov	Future Fellowship FT200100317

OTHER DEVELOPMENTS

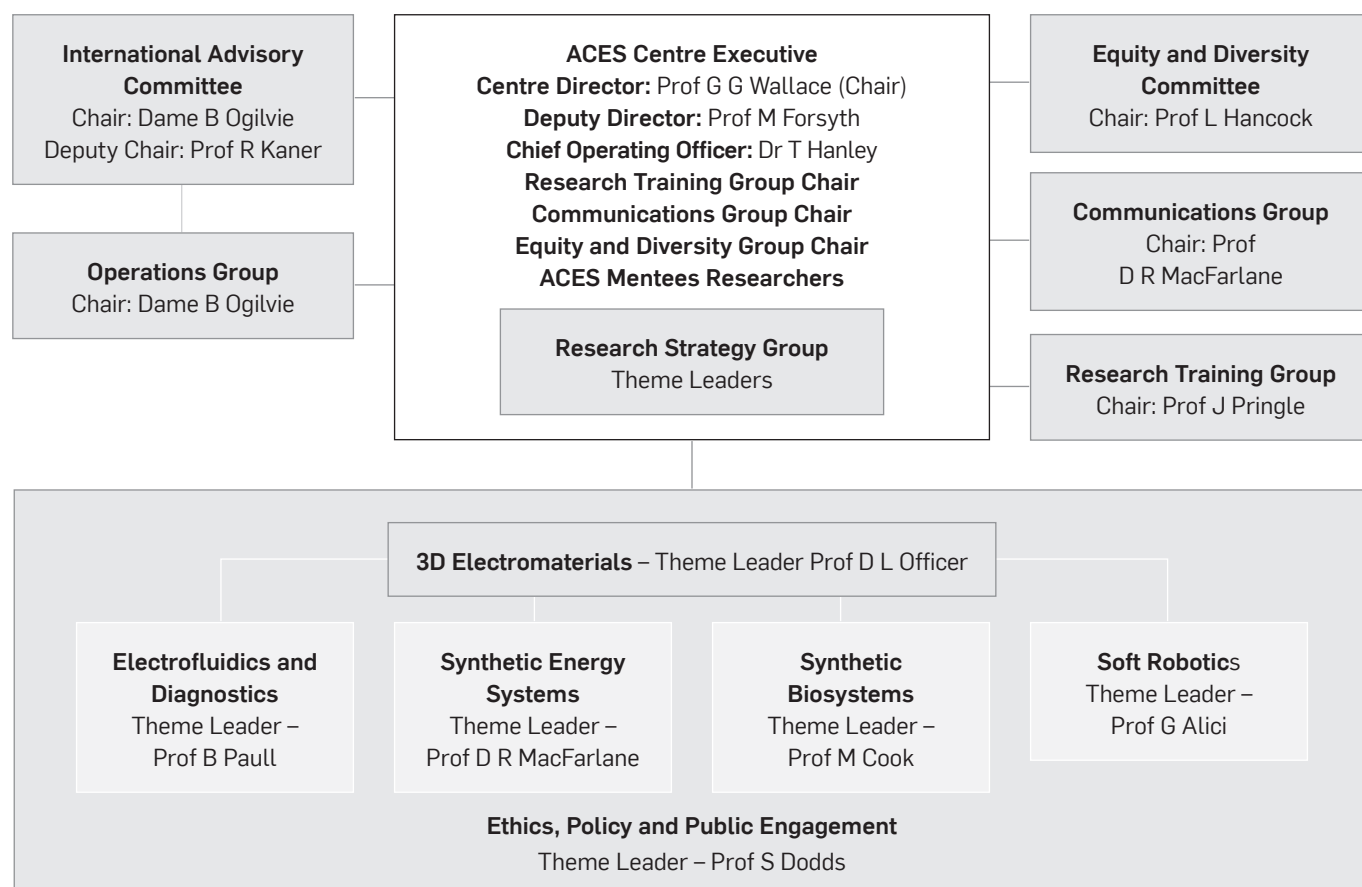
ACES Research Area	Project	Researcher	Funding Body
Materials/Energy	2021-2024: Ammonia production from renewables at ambient temperature and pressure.	Prof Douglas MacFarlane, Dr Alexandr Simonov, Prof Gordon Wallace, and Prof Gerry Sweigers	Australian Renewable Energy Agency (ARENA) Project
Biology	2021: Autologous cell therapy for fascio scapulo humeral muscular dystrophy.	Prof Robert Kapsa and Dr Anita Quigley	FSHD Global Foundation translational grant
Biology	2021: Next generation tissue building and regenerative medicine for neural repair.	A/Prof Jeremy Crook	MedTech Actuator Menzies Fellowship
Materials/Fluidics	2020-2023: 3D printing of multi-level porosity glass.	Dr Vipul Gupta	DECRA DE200101733
Energy	2020-2023: Developing sustainable liquid fuels from carbon dioxide conversion.	Dr Fengwang Li	DECRA DE200100477
Energy	2020-2023: Sustainable nitrogen chemistry.	Prof Douglas MacFarlane; Dr Alexandr Simonov	ARC Discovery Grant DP200101491
Bionics	2020-2023: Protein structural-dynamics at solid surfaces.	Prof Michael Higgins	Future Fellowship FT190100451
Energy	2020-2022: Change materials for wind and solar energy storage.	Prof Jennifer Pringle, Prof Douglas MacFarlane	ARC Linkage Project
Biosystems	2020-2022: Changes in brain resilience underlie seizure susceptibility in epilepsy.	Prof Mark Cook	NHMRC Ideas Grant
Materials	2020-2022: Rapid Molecular (Bio)material Imaging by Infrared and Raman Microscopies.	Prof Peter Lay; Prof Ewan Blanch; Prof Michael Kassiou; A/Prof Elizabeth New; Prof Ewa Goldys; Prof John Gooding; Prof Emma Johnston; Prof Gordon Wallace (ACES); Dr Thomas Rodemann; Dr Tamim Darwish; Dr Julio Ribeiro; Prof Georges Grau	ARC LIEF grant LE200100043
Energy	2019-2021: Next-generation solid-state batteries to drive an automotive revolution.	Prof Patrick Howlett, Prof Maria Forsyth and Dr Robert Kerr	ARC Linkage Project
Energy	2019-2021: Faster interfacial electron transfer: the effect of molecule shape and size.	A/Prof Attila Mozer (ACES); Dr Pawel Wagner (ACES); Dr Andrew Nattestad (ACES AI); A/Prof Shogo Mori; Prof Keith Gordon	ARC Discovery grant DP190100687
Bionics	2019-2021: Bioelectronics: addressing the biointerface challenge.	Dr Damia Mawad; Prof David Officer (ACES); Dr Antonio Lauto; Prof George Malliaras	ARC Discovery grant DP190102560

ACES Research Area	Project	Researcher	Funding Body
Ethics	2018-2021: Navigating an uncertain antimicrobial future: A sociological study.	Prof A Broom, Prof E Kirby, A/ Prof M Davis, Prof S Dodds (ACES)	ARC Linkage Project LP170100300
Chemistry	2017-2021: Controlling chemical reactions via pH-switchable electrostatic catalysis.	Prof Michelle Coote	ARC Laureate Fellowship FL170100041





Governance



Schematic: ACES Governance Structure

The Centre's governance structure aimed to ensure the efficient operation of the Centre across multiple locations, and was focused on achievement of Centre objectives through specialist committees and advisory groups informing the Centre Executive. The Governance arrangements provided an appropriate mix of strategic planning and day to day management and ensure proper engagement with key stakeholders.

Highly effective engagement at many levels has underpinned the success of ACES in tackling the big multidisciplinary research challenges. None of this has been possible without the commitment of individuals within the ACES research, administration, communication, and governance teams.

ACES

Director Prof Gordon Wallace, supported by Prof Maria Forsyth, as Associate Director, provided a strong research leadership team. Both are passionately committed to fundamental research that can be translated into real outcomes for our community.

Senior CIs in their role as research theme leaders on the ACES research strategy group, mentored other CIs as deputy theme leaders who lead many of the activities within the ACES themes.

RF Dr Crisitina Pozo-Gonzales, CI A/Prof Patrick Howlett and SRF Dr Caiyun Wang co-ordinate the SES theme meetings, research group discussions and specialised workshops.

Prof Robert Kapsa and A/Prof Jeremy Crook drive the SBS research activities. A/Prof Crook also co-heads the Equity and Diversity Committee.

Prof Jennifer Pringle assists in the co-ordination of the EM theme activities.

The transition of ACES into strategic applications required the relevant theme leaders (and deputies) to assume greater responsibility for communication of findings and dissemination of knowledge accumulated.

Table 10: Associate Theme Leaders 2021

Associate Theme Leader	Theme	Node
Dr Shaikh Faisal	Electromaterials	University of Wollongong
Dr Eva Tomaskovic-Crook	Synthetic Biosystems	University of Wollongong
Dr Hao Zhou	Soft Robotics	University of Wollongong
Dr Vipul Gupta	Electrofluidics & Diagnostics	University of Tasmania
Dr Si-Xuan Guo	Synthetic Energy Systems	Monash University
Linda Wollershiem	Ethics, Policy & Public Engagement (EPPE)	Deakin University

The six ACES Themes across all Nodes continued to meet virtually throughout the year as whole groups or sub themes. These meetings addressed the strategic direction of the themes and focused on current projects.

Centre Executive Committee

The Centre's governance structure aimed to ensure the efficient operation of the Centre across multiple locations and focused on achievement of Centre objectives through specialist committees and advisory groups informing the Centre Executive. The Governance arrangements provided the appropriate mix of strategic planning and day-to-day management and ensured proper engagement with key stakeholders.

The Centre Executive Committee was responsible for reporting outcomes to the ARC and stakeholders, for setting strategic directions, and broad budget allocations.

The membership included representatives from Chief Investigators, Early Career Researchers and Communications from across the Nodes.

The Executive met four times in 2021 (Feb, May, Aug, Nov) where it reviewed and endorsed the activities of sub-committees including Research Training Group, Research Strategy/Procurement Group, Communications and Equity and Diversity Group.

International Advisory Committee

The International Advisory Committee (IAC) reviewed the Centre's research performance annually against key performance indicators, provided strategic advice on research and training opportunities, and facilitated connections with national and international research programs in industry, academia and non-academic research groups.

The IAC met twice virtually in 2021 once after the International Electromaterials Science Symposium in February and again virtually in June.

Operations Group

The Operations Group comprised of DVC (Research) or their appointed proxy from each of the collaborating organisations. The annual meeting was chaired by Dame Bridget Ogilvie (IAC Chair) and addressed cross-institutional matters. The Operations group met on 12th March 2021 to address cross-institutional matters and ensure proper alignment of the Centre's activities with the strategic directions of the participating Universities, as well as addressing any impediments to progress and to explore the most effective ways to provide support.

Research Strategy Group

The Research Strategy group in its refocussed form Resource Procurement Group with a focus on future planning beyond the end of ACES in 2021, chaired by Centre Director Prof Gordon Wallace and comprised of invited Chief Investigators, Associate Investigators, Senior Researchers, ACES Professional/Administrative staff including Chief Operating Officer and Communications Officer.

The mission of the ACES planning group was to identify opportunities for research endeavours that build on the ACES Platform and extend beyond the lifetime of the centre; identify skills portfolio needed to pursue these activities, present to the International Advisory Committee for endorsement and to present Impact Statement, Legacy Statement and Opportunity Plan.

The group also contained three subcommittees chaired by Chief Investigators. The subcommittees included Impact & Engagement (research impact pathway), Legacy (knowledge base, facilities, training, network and industry alliances/partnerships and the Opportunity Group.

Research Training Group

The Research Training Group (RTG) was responsible for designing, establishing and implementing an innovative research training and career development program, including various industry and web-based programs designed to meet the Centre key performance indicators relating to training and career development for ACES staff and students. The training in 2021 continued through virtual delivery with a focus on preparing for life beyond ACES.

The two Masters courses in Biofabrication and Electromaterials continued in 2021 along with the Certificate in Entrepreneurship and Innovation targeting PhD students.

The RTG met four times in February, April, July and October in 2021 with representation from across the Nodes.

Communications Group

The Communications Group worked with Chief Investigators to ensure effective and efficient communication of research progress to all levels of the community including media, industry, government departments and the public.

The Communications Group met in Feb, May, July, and October in 2021, its membership included representation from all nodes including academic, student and administrative members. The group finished with 10 committee members with a split of four males and six females.

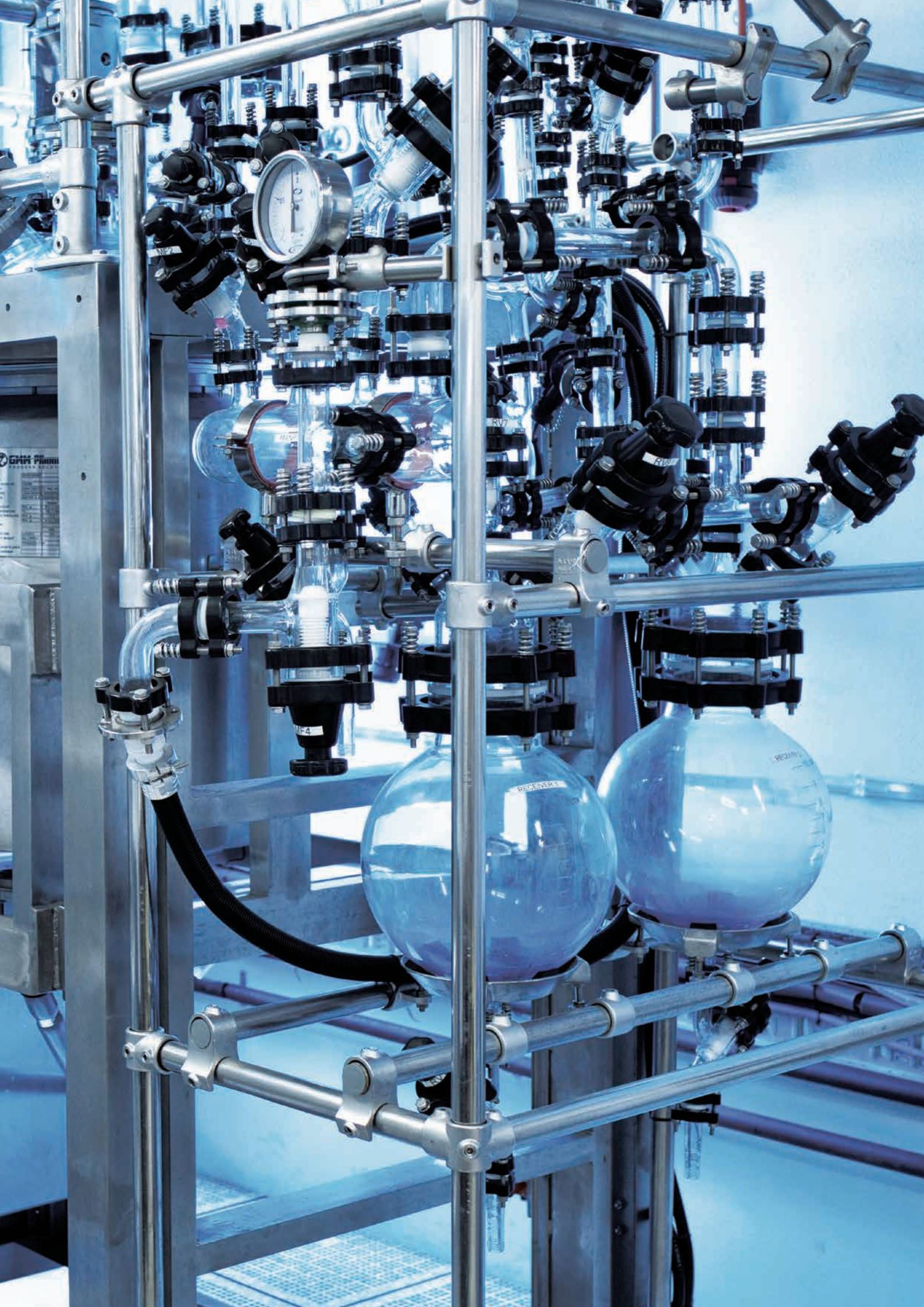
Equity and Diversity Committee

The Equity and Diversity Committee was responsible for ACES initiatives including a review of ACES Gender Equity Plan and ACES policies including a Code of Conduct, that embrace gender equity and diversity. The Committee initiated training activities on equity or diversity, collected gender and diversity related metrics, and monitored progress on KPIs on an annual basis; reporting to ACES Executive on progress against targets.

The Committee met four times in 2021 (Jan, May, Jul, Oct) and successfully implemented the ACES Code of Conduct Policy and the ACES Conference Policy which sits on the ACES website for public access.

The Committee actively promoted International Women's Day week through social media and stories on the website.





Financial Statement

Statement of Operating Income and Expenditure for year ended 31 December 2021.

INCOME	\$ BALANCE B/F	\$ 2021
ARC Grant CE140100012	2,054,836	0
University Cash Contributions	1,115,864	1,820,980
Partner Cash Contributions	0	0
Other Income	0	0
TOTAL INCOME	3,170,700	1,820,980

IN-KIND	\$ 2021
University In-Kind Contributions	2,309,733
Partner In-Kind Contributions	115,597
TOTAL IN-KIND	2,425,330

EXPENSES	\$ 2021
Personnel (Salaries & Stipends)	4,202,860
Equipment	75,583
Travel	23,047
Research maintenance & consumables	562,380
Other (3rd party expert services, administration, dissemination)	127,810
TOTAL EXPENSES	4,991,680



Membership

Table 11: List of ACES Chief Investigators and Partner Investigators 2021

Name	Node	EM	SES	SBS	SR	EFD	EPPE
Chief Investigators							
Wallace, Gordon	University of Wollongong	•	•	•	•	•	
Officer, David	University of Wollongong	•	•				
Alici, Gursel	University of Wollongong	•			•		
Chen, Jun	University of Wollongong	•	•				
Crook, Jeremy	University of Wollongong	•		•			
Higgins, Michael	University of Wollongong	•		•			
in het Panhuis, Marc	University of Wollongong	•		•	•		
Innis, Peter	University of Wollongong	•				•	
Kapsa, Robert	University of Wollongong	•		•			
Mozer, Attila	University of Wollongong	•	•				
Spinks, Geoffrey	University of Wollongong	•	•		•		
MacFarlane, Douglas	Monash University	•	•				
Zhang, Jie	Monash University	•	•				
Sparrow, Robert	Monash University						•
Forsyth, Maria	Deakin University	•	•	•			
Howlett, Patrick	Deakin University	•	•		•		
Pringle, Jennifer	Deakin University	•	•				
Wang, Xungai	Deakin University	•					
Hancock, Linda	Deakin University						•
Paull, Brett	University of Tasmania	•				•	
Dodds, Susan	La Trobe University						•
Cook, Mark	University of Melbourne	•		•			
Coote, Michelle	Australian National University	•	•	•			
Moulton, Simon	Swinburne University of Technology	•		•		•	
Partner Investigators							
Kim, Seon Jeong	Hanyang University, Korea	•			•		
Guldi, Dirk	Friedrich Alexander University, Germany	•					
Watanabe, Masa	Yokohama University, Japan	•	•				
Diamond, Dermot	Dublin City University, Ireland	•				•	
Unwin, Patrick	Warwick University, UK	•	•				

MEMBERSHIP

Table 12: List of ACES Research Fellows, Early Career Researchers, Engineers and Technicians 2021

Name	Node	EM	SES	SBS	SR	EFD	EPPE
Research Fellows							
Hunt, Holly	University of Wollongong	•		•	•		
Lee, Chong Yong	University of Wollongong		•				
Nattestad, Andrew	University of Wollongong	•	•				
Ruland, Andres	University of Wollongong	•					
Tomaskovic-Crook , Eva	University of Wollongong	•		•			
Wagner, Klaudia	University of Wollongong	•	•				
Wang, Caiyun	University of Wollongong	•	•				
Yue, Zhilian	University of Wollongong	•		•			
Guo, Si-Xuan	Monash University	•	•				
Howard, Mark	Monash University						•
Simonova, Irina (0.8FTE)	Monash University	•	•				
Balkis, Ali	Deakin University	•	•				
Chen, FangFang	Deakin University	•	•				
Melag, Leena (Aug-Dec)	Deakin University	•	•				
Pozo-Gonzalo, Cristina	Deakin University	•	•				
Tang, Bin (0.5FTE) (Jan-Feb)	Deakin University	•	•				
Wang, Jinfeng (0.6 FTE) (Jan-Sep)	Deakin University	•					
Yao, Ya (casual 0.6FTE) (Mar-May)	Deakin University	•					
Harris, Alex	University of Melbourne	•		•			
Goddard, Eliza (Jan-Feb)	La Trobe University						•
Patridge, Bradley (Oct-Dec)	La Trobe University						•

Name	Node	EM	SES	SBS	SR	EFD	EPPE
Early Career Researchers							
Zhou, Hao	University of Wollongong				•		
Bakker, Jacinta	Monash University		•				
Hatherley, Joshua (casual)	Monash University		•				
Ha, The An (0.5FTE)	Deakin University	•	•				
Liang, Yan	Deakin University	•	•				
Makhlooghiyazad, Faezeh	Deakin University		•				
Wollersheim, Linda (casual 0.5FTE)	Deakin University						•

Name	Node	EM	SES	SBS	SR	EFD	EPPE
Ghiasvand, Alireza	University of Tasmania					•	
Manchanda, Arushi	University of Tasmania					•	
Wu, Liang	University of Tasmania	•				•	
Murphy, Rhys (0.5 FTE)	Australian National University	•					

Name	Node	EM	SES	SBS	SR	EFD	EPPE
Professional Services Staff							
Canales, Ros (0.6FTE Feb-Dec)	Research Assistant University of Wollongong			•			
Talebian, Sepehr (Jan-June)	Fabrication Technician University of Wollongong	•		•			
Newman, Peter 0.15FTE (casual)	Monash and Deakin Universities		•				
Taylor, John 0.05FTE (casual)	Monash University		•				
Xiao, Changlong (casual)	Monash University						
Datta, Robi (casual)	Monash University						
Newbegin, Timothy (casual 0.5FTE)	Research Assistant Deakin University		•				
Lebanov, Leo (casual)	University of Tasmania					•	
Hemida, Mohamed (casual)	University of Tasmania					•	

Table 13: A List of Aces Non-Academic Positions 2021

Professional Services Staff		
Name	Node	Position
Cairns, Christine (0.6 FTE)	University of Wollongong	Administration
Clark, Renae (0.6FTE)	University of Wollongong	Administration
Findlay, Samuel	University of Wollongong	Communications & Media Officer
Hanley, Tracey	University of Wollongong	Chief Operations Officer
Hood, Lauren Jan-July	University of Wollongong	Communications & Media Coordinator
O'Brien, Vanessa (0.6 FTE Jan-June, 0.4 July-Dec)	University of Wollongong	Operations Officer
Wales, Jacqueline (casual) Aug - Dec	University of Wollongong	Communications & Media Casual
Georgiadis, Sofia (0.5 FTE)	Deakin University	Administration Support
Gustowski, Lisa (0.4 FTE)	La Trobe University	Administration Support
Martin, Amanda (0.1 FTE)	La Trobe University	Administration Support

Table 14: List of ACES Postgraduate Students Working on Core Centre Research and Supervised by Centre Staff in 2021

Name (Start Year)	Funding Source	Project Description	Node	Country of Birth	Program Theme
Core Funded PhD					
Abeywardena, Sujani (2019)	ACES	Threads in Gels	University of Wollongong	Sri Lanka	EFD
Gayani, Buddhika (2019)	ACES	Cell-Cell Adhesion on Materials for Biomedical Applications	University of Wollongong	Sri Lanka	EM/SBS
James, Emma (2019)	ACES	Direct piezoelectricity for 3D human neural tissue engineering and remodelling	University of Wollongong	Australia	SBS
Kim, Kyuman (2019)	ACES	Redox Mediated "Wireless" Connections for Solar assisted CO ₂ or N ₂ Reduction	University of Wollongong	Korea	EM/SES
Le, Hong Quan (2019)	ACES	Control system for robotic hand	University of Wollongong	Vietnam	SR
Marks, Sulokshana	ACES	3D Fabrication of Remotely Activated, Contactless Electrode for Biomedical Applications	University of Wollongong	Sri Lanka	EM/SBS
Montoya Gurrola, Gerardo (2018)	ACES	Integration of sensing technology into soft robotic hand	University of Wollongong	Mexico	SR
Naseri, Aida (2017)	ACES	3D electrical stimulation in hydrogel	University of Wollongong	Iran	SBS
Shekibi, Bijan (2017)	ACES	Design of an integrated multi-well cell culture system for functional tissue constructs	University of Wollongong St Vincent's Hospital Melbourne	Australia	SBS
Warren, Danielle (2019)	ACES	Electro stimulation of 3D bioprinted neural tissues	University of Wollongong	Germany	SBS
Zhang, Shuai (2018)	ACES	Flexible thermoelectrochemical cells	University of Wollongong	China	SES
Blesch, Thomas (2018)	ACES	Non aqueous flow batteries	Monash University	Germany	SES
Johnston, Sam (2019)	APA- ACES topup	Electrochemical oxidation of ammonia for the sustainable production of nitrates	Monash University	Australia	SES
Li, Linbo (2019)	ACES	2D Catalysts for high performance electrochemical CO ₂ reduction	Monash University		SES
Long Du, Hoang (2017)	ACES	Nanostructured catalysts for electrochemical ammonia synthesis	Monash University	Malaysia	EM/SES
Nguyen, Cuong Ky (2018)	ACES	Photoelectrocatalytic production of ammonia	Monash University	Vietnam	SES
Biernacka, Karolina (2019)	ACES	An Investigation of Novel Solid State membranes for Sodium Batteries	Deakin University	Poland	SES
Cherian, Mathew (2015- from 2018 part time)	ACES	Global development, community development and energy	Deakin University	India	EPPE

Name (Start Year)	Funding Source	Project Description	Node	Country of Birth	Program Theme
Panhwar, Ghulam Murtaza (2019)	ACES	Development of new thermal energy harvesting devices	Deakin University	Pakistan	SES
Rakov, Dmitrii (2018)	ACES	Characterisation and modelling electrolytes and interface for Na-Oxygen batteries	Deakin University	Russia	SES
Blum, Anna (2016)	ACES	Ethical challenges for electromaterials and neuroscience: the benchtop brain	University of NSW	USA	EPPE
Mendes, Alexandre Xavier (2019)	ACES	Functional hydrogels for 3D Neural Systems	Swinburne University of Technology	Brazil	SBS
Nascimento, Adriana Teixeira Do (2020)	ACES	The development of electrical and optical 3D materials for neuronal stimulation.	Swinburne University	Brazil	EM
Simpson, Catherine (2016- Part time from 2017)	ACES	Nitroxides for energy	Australian National University	Australia	EM/SES
Affiliated PhD					
Baker, Carly (2020)	AGRTP Scholarship	The Development of conducting polymers for bioelectronics interfaces	University of Wollongong	Australia	EM
Daikuara, Luciana Yumiko (2016)	University Of Wollongong-IPRI-IHMRI matching	Fabricating delivery system for wound healing- thread based electrofluidics	University of Wollongong	Brazil	EM/SBS
Dhanushka, nuwan hegoda arachchi (2018)	University of Wollongong	Plasma Protein Adsorption on Blood Contacting Device Coatings	University of Wollongong		EM
Fan, Yuchao (2017)	University Of Wollongong-IPRI matching	Hybrid bioprinted cartilage scaffold based on cellulose nanocrystals reinforced GelMA/ HAMA hydrogel	University of Wollongong	China	SBS
Hai, Abdul Moqheet (2018)	HEC scholarship with ACES topup	Fabrication of silk-based structures for corneal application	University of Wollongong	Iraq	SBS
Higginbottom, Sarah (2020)	Aust Govt RT scholarship	Investigating the therapeutic effects of electrical stimulation (e-stim) on a 3D human cerebral-organoid glioblastoma (GB) model	University of Wollongong	Australia	SBS
Jay, Sky (2021)	AGRTP Scholarship	Electrifying 3D human neural tissues for enhanced pharmacotherapy.	University of Wollongong	Australia	SBS
Kavungathodi, Munavvar Fairaos Mele (2019)	IPTA & UPA University of Wollongong	Inventive approaches to fabricate highly efficient sensitized solar cell: Change the way to dye-sensitise and to regenerate	University of Wollongong	India	EM
Khan, Jawairia (2017)	Pakistan HEC & IPTA	Fibre electrofluidics for ambient ionisation mass spectrometry	University of Wollongong	Pakistan	EFD
Kulaga, Anna (2019)	AGRTP Scholarship	Development of methods to improve vascularization with islet-laden constructs with 3D bioprinting	University of Wollongong		SBS

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Name (Start Year)	Funding Source	Project Description	Node	Country of Birth	Program Theme
Kuppanacharry, Praneshwar Sethupathy (2017)	UPA	Developing new architectures for redox-based energy processes	University of Wollongong	India	EM
Lisha, Jia (2019)	ARC DP – affiliated PhD	Fabrication of nanoporous metallic alloys/graphene as high-performance electrocatalysts	University of Wollongong	China	EM/SES
Maher, Malachy (2018)	University of Wollongong-CSIRO scholarship	Development and evaluation of new biologically based materials for bioprinting cells	University of Wollongong	Australia	SBS
Posniak, Stephen (2018)	Australian Govt Research Training Program (AGRTP)	Development of 3D printed hybrid structures for cartilage reconstruction	University of Wollongong	Australia	SBS
Potts, Michael (2020)	University Of Wollongong	Printing and modification of metal-organic framework films	University of Wollongong	Australia	EM/E&D
Qin, Chunyan (2017)	University Of Wollongong-IPRI-IHMRI matching	Injectable electrodes - bipolar electrochemical chips for wireless cell stimulation driven by electric field	University of Wollongong	China	EM/SBS
Rajbhandari, Grishmi (2018)	BIOFAB Training Hub affiliate	Antennas and coils for cochlear devices	University of Wollongong	Nepal	EM
St Clair-Glover, Mitchell (2020)	RTP & Rotary Club School	3D printing of innervated skin tissue for burn treatment	University of Wollongong	Australia	SB
Vijayakumar, Amruthalakshmi (2016)	IPTA	N-doped graphene for electrocatalytic reduction of CO ₂	University of Wollongong	India	EM/SES
Wang , Kezhong (2018)	University Of Wollongong-IPRI matching	Graphene-based soft electrodes	University of Wollongong	China	EM
Wallace, Eileen (2021)	AGRTP Scholarship	Development of a 3D Bioprinting System to Fabricate Full-thickness Skin-equivalents with Improved Sensory Function	University of Wollongong	Australia	SBS
Zhou, Yuetong (2018)	ARC DP affiliate PhD	The Design and Development of Flexible Redox-Gel Integrated Electrode	University of Wollongong	China	EM/SES
Castillo, Yady Garcia (2019)	IFM Deakin	Probing interface regions in novel composite energy materials using advanced magnetic resonance techniques	Deakin University		EM
Desroches, Pauline (2018)	ARC DP affiliate	Ultra-low fouling active surface for bionic implants	Deakin University	France	EM

Name (Start Year)	Funding Source	Project Description	Node	Country of Birth	Program Theme
Hasanpoor, Meisam (Sam) – 01.FTE (2018)	UPA affiliate	Investigation of degradation mechanisms in advanced lithium metal batteries	Deakin University	Iran	SES
Malunavar, Sneha Subhas (2018)	Deakin Scholarship	Ionic liquid based solid electrolyte for sodium batteries	Deakin University		SES EM
Sirigiri, Nanditha (2019)	Deakin international scholarship	Computational investigation of organic ionic plastic crystals	Deakin University		EM
Mladenovska, Tajanka (2016, part-time)	UOM	Innovation, commercialisation and regulation of 3D-BioPrinted surgically implantable orthopaedic medical devices	University of Melbourne	Macedonia	SBS/EPE
Chen, Liang (2018)	ARC LP affiliate	Fibre based electrofluidics with ambient mass spectrometry based detection.	University of Tasmania	China	EFD

Table 15: ACES Work Submitted for Examination 2021

Name	Project Description	Node	Country of Origin	Program Theme
Chao, Yunfeng ACES Core PhD	CSC Fabrication of graphene-based composites for energy storage application	University of Wollongong	China	EM
Cho, Inseong Affiliate PhD	Developing new asymmetric redox mediators with large difference in forward/backward electron transfer rates	University of Wollongong	Korea	EM/SES
Zou, Jinshuo Affiliate PhD	Electrocatalytic nitrogen reduction at ambient temperature and pressure	University of Wollongong	China	SES
Hodgetts, Rebecca ACES Core PhD	Understanding the mechanism of electrocatalytic nitrogen reduction	Monash University	Australia	SES
Ha, The An Affiliate PhD	Carbon based air cathodes for sodium oxygen batteries using ionic liquid electrolytes	Deakin University	Vietnam	SES
Quintana, Laura Garcia ACES Core PhD	Designing ionic liquid-based electrolytes for controlling sodium superoxide deposition	Deakin University	Spain	SES
Dong, Shuo Affiliate PhD	Redox couples for flow batteries	Deakin University	China	SES
Mudiyanselage, Isuru Eranda Gunathilaka Adikari Affiliate PhD	Studying novel redox systems for electrochemical devices by magnetic resonance spectroscopy and imaging	Deakin University	Sri Lanka	SES
Wollersheim, Linda ACES Core PhD	Assessing policy and supply chain aspects of renewable energy	Deakin University	Germany	EPPE

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Name	Project Description	Node	Country of Origin	Program Theme
Brooks, Joshua Affiliate PhD	Development of high aspect ratio ordered thermoplastic nano-materials as print media for 3D additive fabrication	University of Wollongong	Australia	EFD/EM/SR
Gietman, Shaun ACES Core PhD	Synthesis of optically active drug delivery systems	Swinburne University of Technology	Australia	EFD/SBS
Duc, Daniela ACES Core PhD	Materials design and fabrication of effective optical and electrical co-stimulation of cells	Swinburne University of Technology	Mauritius	SBS
Masters Students				
Gray, Diego Castaneda	MPhil Biofabrication - 3D printed degradable stents with controlled drug delivery capabilities	Utrecht University/ University of Wollongong	Mexico	SBS
Gruska, Anne	EU-Biofab project MPhil Biofabrication- Parameter optimisation of co-axial melt extrusion writing.	Wurzburg University/University of Wollongong	Germany	SBS
Gutierrez, Borja Sanz	EU-Biofab project MPhil Biofabrication- Evaluation of marine collagen for 3D bioprinting	Utrecht University/ University of Wollongong		SBS
Haag, Hannah	EU-Biofab project. MPhil Biofabrication-3D printed structures for cartilage growth in predestined shape with high resolution.	Wurzburg University/University of Wollongong	Germany	SBS
Sanchez, Ane Albillos	EU-Biofab project MPhil Biofabrication-Nerve/muscle cell simulation	Utrecht University/ University of Wollongong	Spain	Spain

Table 16: Successful Completions ACES 2014-2021

Name	Degree	Project Description	Node	Program Theme	What was next?
Completed 2015					
Grierson, Keira	Honours International Bachelor of Science		University of Wollongong	SBS	
Completed 2016					
Lee, Richmond	Affiliate PhD	Studying reactive oxygen chemistry and its role in oxidative degradation in materials and biology	ANU	EM	Research Singapore Employed overseas
Noble, Benjamin	Affiliate PhD	Study stereoregulation in radical polymerization	ANU	EM	ECR ACES
Completed 2017					
Gately, Reece	Affiliate PhD	3D printed robotic hand	University of Wollongong	SR	UOW lab technician

Name	Degree	Project Description	Node	Program Theme	What was next?
Gu, Qi	Affiliate PhD *awarded 2017 outstanding self financed student abroad.	3D Bioprinting for neural tissue engineering	University of Wollongong	EM/SBS	Head, Intelligent Biomaterials and Biomedical Engineering lab, Chinese Academy of Sciences
Jia, Xiaoteng	Affiliate PhD *awarded 2017 outstanding self financed student abroad.	Biodegradable electrodes for energy storage applications in medical bionics	University of Wollongong	EM/SES	Department of Chemical & Biomolecular Engineering, University of California, Irvine
Maksour, Simon	Awarded First Class Honours	Establishing a novel human neural stem cell model for DISC1 loss-of-function: a valuable tool in molecular studies of neurogenesis and psychiatric disorders	University of Wollongong	SBS	
Sangian, Danial	Affiliate PhD	Developing a new type of McKibben artificial muscles	University of Wollongong	SR	Alexander von Humboldt Postdoctoral Fellow, Technical University of Berlin, Germany
Bonke, Shannon	Affiliate PhD	APA- Co-, Mn- and Ni-oxides from various preparation methods will be examined electrochemically for conversion of solar energy to drive the synthesis of solar fuels	Monash University	SES	Post doctoral Hermholtz Zentrum Berlin
Chun, Ken	Core PhD	Develop novel nanoporous metals for electrochemical applications	Monash University	SES	
Al-Masri, Danah	Core PhD	New redox couples and ionic liquid electrolytes for thermal energy harvesting	Deakin University	SES	ECR Deakin University
Completed 2018					
Aziz, Shazed Md	Affiliate PhD	Polymer fibre artificial muscle	University of Wollongong	EM/SR	
Carter, Sarah-Sophia	MPhil Biofabrication masters	Development of bioprinting platforms for bioartificial pancreas constructs	Utrecht University/ University of Wollongong	SBS	Uppsala University, Sweden
Farajikhah, Syamak	Core PhD	Sensor systems for fluidics	University of Wollongong	EM/EFD	ECR University of Sydney
Ge, Yu	UPA –ACES Core funded project PhD	Graphene and its inorganic analogues based materials for energy storage device	University of Wollongong	EM SES	Postdoctoral China
Hamilton, Charles	ACES Masters Cored funded	Printable tough, thermally-active hydrogel actuators	University of Wollongong	SR	Doing medical degree US
Lu, Zan	CSC Scholarship – Affiliate PhD	Carbon nanotube fiber and its application in garment and wearable sensors	University of Wollongong	EM SES	

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Name	Degree	Project Description	Node	Program Theme	What was next?
Liu, Yuqing	Affiliate PhD	Flexible 3D electrodes via extrusion-printing for flexible and wearable device	University of Wollongong	EM	ECR ACES University of Wollongong
Rathbone, Sam	Honours Bachelor of Science	The stimulating application of nanoparticles in neural stem cells	University of Wollongong	SBS	Further studies
Van Kogelenberg, Sylvia	MPhil Biofabrication masters	Fabrication of ulvan based structures for cell culture in wound healing	Utretch University/ University of Wollongong	SBS	ING Netherlands, Amsterdam
Zheng, Tian	University of Wollongong matching scholarship -Affiliate PhD	Development of magnetoelectric polymer composites	University of Wollongong	EM SBS	ECR Melbourne University
Zong, Yan	Self funded -Affiliate PhD	Development of biocompatible and biodegradable magnetoelectric electrodes for remote and contactless electrical stimulation of neural tissue	University of Wollongong	EM SBS	Lecturer at College of Chemistry and Chemical Engineering, Shaanxi University of Science and Technology, China
Cabral, Diogo	Core PhD	Novel redox couples for redox flow batteries	Monash University	SES	Employed overseas
Halima, Ahmed	Monash Scholarship – Affiliate PhD	Novel Si-based photocathode assemblies.	Monash University	SES	
Hoogeveen, Dijon	Core PhD	Dye-Sensitized photocathodes catalysing light driven reduction	Monash University	EM SES	Research Fellow Monash
Li, Fengwang	Core PhD *Mollie Holman award best thesis	Photoelectrocatalytic and electrocatalytic reduction of CO ₂ using novel 2D materials	Monash University	SES	Post Doc University of Toronto, Canada
Li, Haitao	Affiliate PhD	Develop several different kinds of photocatalysts with excellent properties to convert the CO ₂ into fuel or other useful chemicals.	Monash University	SES	
Rao, Jun (Rossie)	Core PhD	3D nanostructured electrolytes	Deakin University	EM	
Russo, Mathew	ACES MPhil Electromaterials	Development of quasi-solid state electrolytes for thermal energy harvesting	Deakin University	SES	
Gupta, Vipul	Affiliate PhD	New composite and micro/ nanostructured materials for chemical analysis	University of Tasmania	EFD	ECR ACES
Li, Feng	Affiliate PhD	Microfluidic devices with integrated nanochannels for sample-in/answer-out analysis of pharmaceuticals from body fluids.	University of Tasmania	EFD	

Name	Degree	Project Description	Node	Program Theme	What was next?
Completed 2019					
Al-Graiti, Wed	Iraqi Govt Affiliate PhD	Development of functionalised nanoporous carbon fibre electrodes for probe-sensing technology	University of Wollongong	EM	Employed overseas
Barsby, Tom	ACES core PhD	Electrical stimulation 3D structures – stem cell effects	University of Wollongong St Vincent's Hospital Melbourne	SBS	Postdoctoral research position University of Helsinki Finland
Berthel, Marius	MPhil Biofabrication	Dual drug-eluting collagen matrix for epilepsy treatment	Wurzburg University/ University of Wollongong	SBS	Employed overseas
Blanco Peña, Laura	MPhil Biofabrication	3D printing flexible electrodes	Utrecht University/ University of Wollongong	EM/SBS	Business Analyst at McKinsey & Company
Chen, Zhi	ACES core PhD	Bio inks for stem cells	University of Wollongong	EM/SBS	ECR ACES University of Wollongong
Choi, Jaecheol	ACES core PhD	Electrocatalytic reduction of CO ₂	University of Wollongong	EM SES	ECR Monash University
James, Daniel Reynolds	Grad Cert Biofabrication		University of Wollongong	SBS	
Javadi, Seyed Mohammad	Affiliate PhD	Developing graphene oxide based composite materials capable of acting as a temperature sensor	University of Wollongong	EM	Aussie Bee
Kade, Julianne	EU- MPhil Biofabrication	3D hybrid printed structures for auricular cartilage regeneration	Wurzburg University/ University of Wollongong	SBS	Functional Materials in Medicine & Dentistry University Hospital, Wurzburg
Li, Jianfeng	ACES core PhD	Electrical stimulation cell effects-molecular markers.	University of Wollongong	SBS	Post Doc Max Plank Institute Germany
Maher, Declan	Grad Cert Biofabrication		University of Wollongong	SBS	Employed overseas
Mehropouya, Fahimeh	ACES core PhD	Polymeric nanodispersion and growth factors	University of Wollongong	EM SBS	Postdoctoral Research Associate, School of Physics, University of Sydney
Puckert, Christina	ACES core PhD	Cell-material interactions using Bio-AFM	University of Wollongong	EM SBS	Employed overseas
Robinson, Thomas	MPhil Biofabrication	Corneal tissue engineering with methacrylated gellan gum	University of Wollongong	EM/SBS	Employed by other Institution
Shahangi, Farzad	MPhil Biofabrication	3D printing polycaprolactone structures and modelling and finite element analysis of the internal structure to predict properties of auricular structures	University of Wollongong	EM	Bucher Municipal, Sydney

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Name	Degree	Project Description	Node	Program Theme	What was next?
Siti Naquia, Abdul Rahim	PhD Malaysian Gov't - ACES extension	Studying schizophrenia using induced pluripotent stem cells and conductive biomaterials	University of Wollongong	SBS	Lab Technician at Macquarie Stem Cells
Tawk, Charbelh	ACES core PhD	3D printed pneumatic soft actuators and sensors: their modeling, performance quantification, control and applications in soft robotic systems	University of Wollongong	SR	Soft Robotics Engineer, Employed by University of Wollongong
Weisgrab, Gregor	EU- MPhil Biofabrication	Novel fabrication methods for collagen-based implantables for the cornea	Utrecht University/ University of Wollongong	EM SBS	Vienna University of Technology, Vienna
Williams, Joanne	MPhil Biofabrication	3D printing controlled drug delivery systems	University of Wollongong	EM SBS	Systems Manager Peoplecare Health Fund
Wright, Cody	ACES core PhD	Electro-printing	University of Wollongong	EM	Compliance Specialist Waters Corporation
Xiao, Yang	Affiliate PhD	The synthesis and characterisation of photoactive materials and their use in the chemopropulsion-based fluidic transport systems.	University of Wollongong	EM	
Yu, Changchun	PhD CSC with an ACES extension	Functional batteries for cellular communications	University of Wollongong	SBS	Postdoctoral research position Wenzhou Medical University China
Zhang, Long	ACES affiliate PhD – matching University of Wollongong scholarship	Electrostatic control over radical reactions at solid/liquid interfaces	University of Wollongong	EM	Employed by other University
Zhao, Yong	ACES affiliate PhD – CSC with ACES extension	CO ₂ reduction on Copper Metal or Copper Oxide electrodes	University of Wollongong	EM SES	Postdoctoral research at UNSW, Sydney
Kang, Colin	Affiliate PhD	Fluorinated Ionic Liquid-Based Electrolytes with High Nitrogen Gas Solubility for Electrochemical Ammonia Synthesis	Monash University	SES	Assoc. Research Fellow Deakin
Muataz, Ali	PhD	Photo and Photo-electrochemical reduction reaction on black silicon membrane	Monash	SES	High School Teacher
Xiao, Changlong	ACES core PhD	3D structural control of ionic conduction	Monash University	EM SES	PostDoc researcher UQ
Zhang, Ying (Sherry)	ACES core PhD	Utilisation of CO ₂ as C1 building block for electroorganic synthesis in ionic liquids	Monash University	SES	Associate Professor Jiangnan University, China

Name	Degree	Project Description	Node	Program Theme	What was next?
Begic, Srdjan	ACES core PhD	Characterisation and modelling of 3D electrolytes & active metal interphases	Deakin University	EM SES	Entrepreneur
Biernacka, Karolina	European Masters (MESC)	Materials for Energy Storage and Conversion	Deakin University	SES	PhD ACES
Erangi Periyapperuma Achchige, Mary Kalani	ACES core PhD	Energy storage for soft robotics	Deakin University	SES SR	Associate research fellow, Deakin
Grzelak, Aleksandra	European Masters (MESC)	Materials for Energy Storage and Conversion Masters	Deakin University	SES	PhD Universite de Liège Belgium
Taheri, Abuzar	ACES core PhD	Integrating 3D materials in thermoelectrics-new solid and liquid electrolytes and 3D electrocatalysts for thermal energy harvesting	Deakin University	SES	Research and Development Chemist, Palla Pharma Melbourne
Caballero Aguilar, Lilith	ACES core PhD	3D printing of drug delivery structures	Swinburne University of Technology	SBS	Univeristy of Melbourne at St Vincent's Hospital Melbourne
Ngan, Catherine	ACES affiliate PhD	3D muscle constructs for ablated muscle injury and robotics tissue-electrode interfaces	University of Melbourne	SBS	Medical Dr, St Vincent's Hospital Melbourne
Viana, John	ACES affiliate PhD	Ethical issues involved in recruiting people with dementia for clinical trials	University of Tasmania	EPPE	PostDoc Research ANU
Waheed, Sidra	ACES Core PhD	3D fabricated micro-fluidic manifolds – design and characterisation	University of Tasmania	EFD	Postdoctoral Researcher Beijing University
Hill, Nicholas	Affiliate PhD	Modelling 3D spatial effects on radical orbital switching and associated properties, and indeed electric field effects on chemical reactions in general	Australian National University	EM/SES	Postdoctoral Researcher ANU
Castillo, Gabriel Comeron	MESC – 6 month project	Harvesting waste heat using thermoelectrochemical cells	Deakin University	SES	
Completed 2020					
Chan, Kuan Phang	Masters	HDPE Bone Graft Fabrication: Establishing Proprietary HDPE Fabrication Protocol by Selective Laser Sintering	University of Wollongong	EM SBS	Employed by Health/Medical Industry - Lyka Smith
Feng, Lei	PhD	Direct Visualization of Single Molecule Amyloid Beta Peptides in Action by High-Speed Atomic Force Microscopy	University of Wollongong	EM SBS	
Hamzawy, Sameh	PhD	Intermediate Band Solar Cells	University of Wollongong	SES	

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Name	Degree	Project Description	Node	Program Theme	What was next?
Marks, Sulokshana	Masters	3D printing of chitosan-based scaffolds for wound healing	University of Wollongong	EM SBS	PhD at University of Wollongong
Mokhtari, Fatemeh	PhD	Self-Powered smart fabrics for wearable technologies	University of Wollongong		Academic Assistant employed by University of Wollongong
Nagle, Alex	ACES Core PhD	Nanofabrication of polymer nanoarray architectures for tissue engineering	University of Wollongong	EM	Employed by Industry
Salahuddin, Bidita Binte	Affiliate PhD	Hydrogel Based Braided Artificial Muscle	University of Wollongong	SR	Postdoctoral Researcher, University of Queensland
Shahshahan, Sayadmohsen	Masters	Development of 2D Metal Organic Frame (MOF) for Photocatalytic CO ₂ reduction	University of Wollongong	SES	Employed by Industry
Stephens-Fripp, Benajmin	Affiliate PhD	Providing Non-Invasive Sensory Feedback for Transradial Prosthetic Hand Users	University of Wollongong	SR	Mechatronic Engineer, Facebook Reality Labs
Talebian, Sepehr	PhD	Development of novel fiber for smart drug delivery application	University of Wollongong	EM SES	Post-Doctoral Researcher University of Wollongong
Van Tienderen, Gilles	MPhil Biofabrication	Towards an innervated <i>in vitro</i> 3D corneal tissue model	Utrecht University/ University of Wollongong	SBS	
Yang, Dan	PhD	Development of Nanomaterial based Antimicrobial Coatings	University of Wollongong		R & D position at GPS Pharmaceuticals in Sydney
Yungfeng, Chao,	ACES Core PhD	Fabrication of Graphene Structures for Energy Storage using Roll-to-Roll Printing	University of Wollongong	SES	Employed by University of Wollongong
Zarghami, Sara	Affiliate PhD	Chemopropulsion	University of Wollongong	EM	Nature's Care Manufacture Pty Ltd
Chatti, Manjunath	ACES Core PhD	Photo-processes- MoS ₂ nanosheets integrated into graphene matrix for enhanced hydrogen evolution	Monash University	EM SES	Research Fellow School of Chemistry Monash
Buttar, Karmjeet Kaur	MPhil Electromaterials	Organic Ionic Plastic Crystal/ Carbon Composites for Solid-State Battery Electrodes and supercapacitors	University of Wollongong	SES	Further study
Mehmood, Irfan	MPhil Electromaterials	Photocatalytic water splitting using novel electromaterials	University of Wollongong	EM/SES	

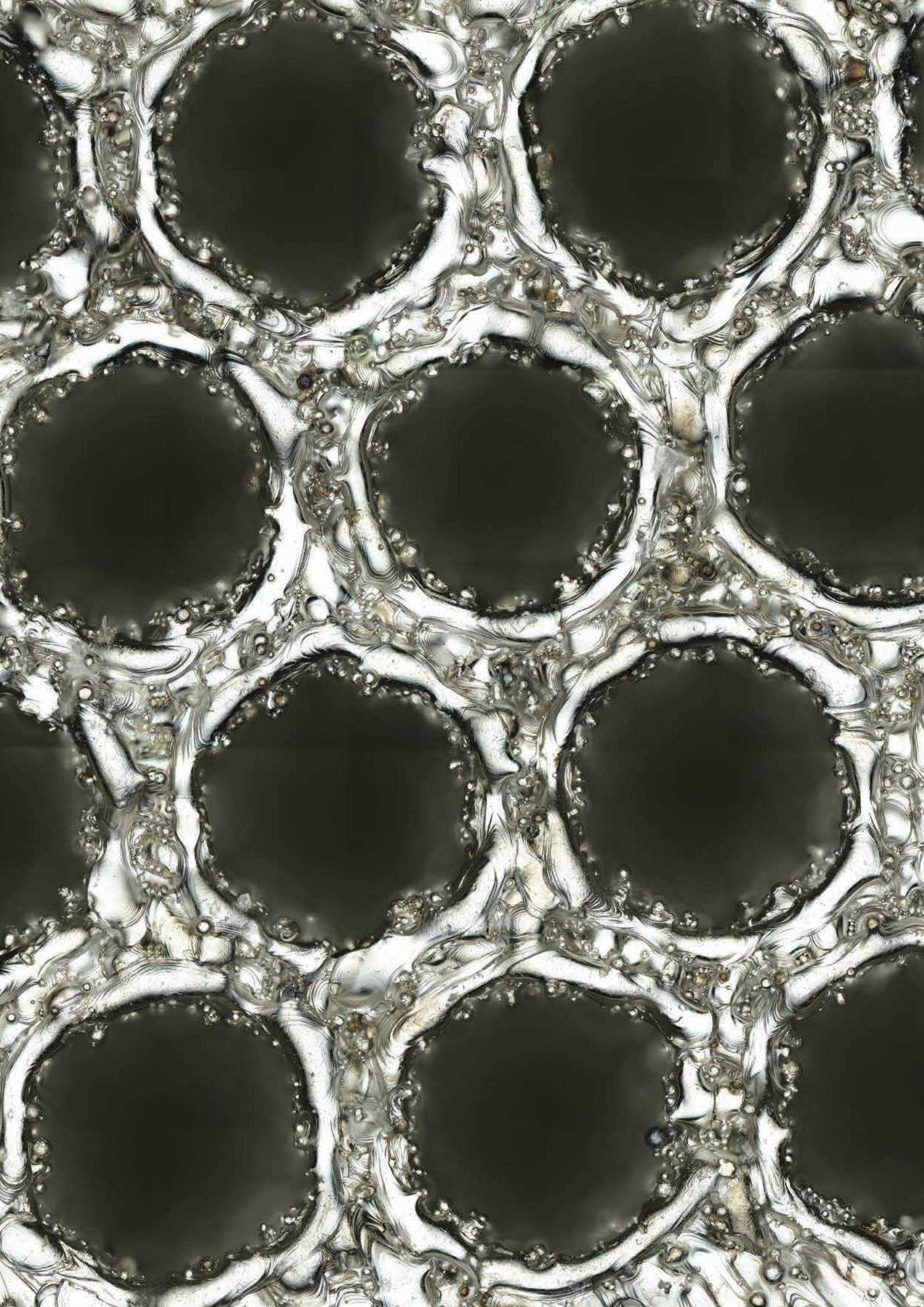
Name	Degree	Project Description	Node	Program Theme	What was next?
Asua, Ane Urigoitia	MPhil Biofabrication	Collagen Printing	Utrecht University/ University of Wollongong	SBS	
Bani, Jacopo	MPhil Biofabrication	3D Co-axial Bioprinting for Cartilage Repair and Regeneration	Utrecht University/ University of Wollongong	SBS	
Ebert, Markus	MPhil Biofabrication	3D printed graphene-flexible electrodes	Wurzburg University/ University of Wollongong	EM/SBS	
Gantumur, Narangerel	MPhil Biofabrication	Encapsulation of VEGF for islet transplantation	University of Wollongong	SBS	Canada
Completed 2021					
Chen, Xifang	Affiliate PhD	Ulvan fabrication for wound healing	University of Wollongong	SBS	Intern, scientific editor Baishideng Publishing Group
Adesanya, Olumayowa	Affiliate PhD	The legal and ethical aspects of bioprinting	University of Tasmania	EPPE	
Kang, Lingzhi	Affiliate PhD	Biofabricated platforms (based on collagen) for skin repair and regeneration	University of Wollongong	SBS	Parental leave
Wu, Liang	Core PhD	Detection systems for diagnostics - 3D printing microfluidics materials	University of Wollongong	EFD	Researcher UTAS
Khakbaz, Hadis	Core PhD	Development of high nanofilled (aspect ratio ordered) bio-thermoplastics as print media for 3D additive fabrication.	University of Wollongong	EM, EFD	
Al-Ghazzawi, Fatimah	Affiliate PhD	New metal-organic interfaces- new photo-active interfaces for catalytical chemistry and/or energy harvesting/conversion applications	University of Wollongong	EM	
Brodmerkel, Maxim	MPhil Biofabrication	3D printed degradable stents with controlled drug delivery capabilities	Wurzburg University/ University of Wollongong	SBS	
Renes, Max	MPhil Biofabrication	Towards the fabrication of pancreatic islet tissue constructs through co-axial bio-printing	Utrecht University/ University of Wollongong	SBS	

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Table 17: Associate Investigators 2021 with ACES Acknowledgement or Deeds in Place

Name	ACES Node	AI affiliation	Program Theme	AI RF or AI
Beirne, Stephen	University of Wollongong	University of Wollongong, Australia	EM- fabrication	AI RF
Chung, Johnson	University of Wollongong	University of Wollongong, Australia	EM/SBS	AI RF
Dittori, Mirella	University of Wollongong	University of Wollongong, Australia	SBS	AI
Esrafilzadeh, Dorna	University of Wollongong	RMIT, Australia	EM/SBS	AI RF
Faisal, Shaikh	University of Wollongong	University of Wollongong, Australia	EM	AI
Forster, Robert	University of Wollongong	Dublin City University, Ireland	EM/SBS	AI
Gambhir, Sanjeev	University of Wollongong	University of Wollongong, Australia	EM	AI RF
Huang, Xu-Feng	University of Wollongong	University of Wollongong, Australia	SBS	AI
Jalili, Rouhollah (Ali)	University of Wollongong	UNSW, Australia	EM	AI RF
Liu, Xiao	University of Wollongong	University of Wollongong, Australia	EM/SBS	AI RF
McCaul, Margaret	University of Wollongong	Dublin City University, Ireland	EM/SBS	AI RF
Morin, Aoife	University of Wollongong	Dublin City University, Ireland	EM/SBS/EFD	AI
Mutlu, Rahim	University of Wollongong	University of Wollongong, Australia	SR	AI RF
Oetomo, Denny	University of Wollongong	University of Melbourne, Australia	SR	AI
Richardson, Chris	University of Wollongong	University of Wollongong, Australia	EM/SES	AI
Sayyar, Sepidar	University of Wollongong	University of Wollongong, Australia	EM	AI RF
Sencadas, Vitor	University of Wollongong	University of Wollongong, Australia	SR	AI RF
Sutton, Gerard	University of Wollongong	University of Sydney, Australia	EM/SBS	AI
Wagner, Pawel	University of Wollongong	University of Sydney, Australia	EM	AI RF
Zhang , Binbin	University of Wollongong	Yokohama National University, Japan	EM/SBS	AI RF
Bond, Alan	Monash University	Monash, Australia	SES	AI
Choi, Jaecheol	Monash University	Monash, Australia	SES	AI
Hatherley, Joshua Aug-Dec 2021	Monash University	Monash, Australia	EPPE	AI
Fukuda, Junji	Monash University	Yokohama National University, Japan	SES	AI
Hutchison, Katrina	Monash University	Adjunct Monash & Macquarie University, Australia	EPPE	AI

Ali, Saleem	Centre for Energy and Environmental Policy, Deakin	Newark, USA	EPPE	AI
Greene, Wren (George)	Deakin University	Deakin, Australia	SBS/EFD	AI
Kerr, Robert	Deakin University	Deakin, Australia	SES	AI RF
Khoo, Timothy	Deakin University	Deakin, Australia	EM/SES	AI
Mecerreyes, David	Deakin University	Polymat-University of the Basque Country, Spain	EM/SES	AI
O'Dell, Luke	Deakin University	Deakin, Australia	EM	AI RF
Ralph, Natalie	Deakin University	Deakin, Australia	EPPE	AI RF
Porcarelli, Luca	Honorary Fellow at Deakin University	Deakin, Australia	SES	AI RF
Zhu, Haijin	Deakin University	Deakin, Australia	EM	AI
Goddard, Eliza	University of La Trobe	University of La Trobe	EPPE	AI RF
Choong, Peter	University of Melbourne	University of Melbourne, Australia	SBS	AI
DiBella, Claudia	University of Melbourne	University of Melbourne, Australia	SBS	AI
Duchi, Serena	University of Melbourne	University of Melbourne, Australia	SBS	AI
Li, Dan	University of Melbourne	University of Melbourne, Australia	SBS	AI
O'Connell, Cathal	University of Melbourne	University of Melbourne, Australia	SBS	AI RF
Onofrillo, Carmine	University of Melbourne	St Vincent's Hospital, Melbourne, Australia	SBS	AI RF
Quigley, Anita	University of Melbourne	RMIT University	SBS	AI
Adesanya, Olumayowa	University of Tasmania	UTAS, Australia	EPPE	AI
Breadmore, Michael	University of Tasmania	UTAS, Australia	EFD	AI
Gilbert, Frederic	University of Tasmania	UTAS, Australia	EPPE	AI RF
Gupta, Vipul	University of Tasmania	UTAS, Australia	EFD	AI RF
Lewis, Trevor	University of Tasmania	UTAS, Australia	EFD	AI
McArthur, Sally	Swinburne University of Technology	Swinburne University of Technology, Australia	EM/SBS	AI
Silva, Saimon Moraes	Swinburne University of Technology	Swinburne University of Technology, Australia	EM/SBS	AI
Stoddart, Paul	Swinburne University of Technology	Swinburne University of Technology, Australia	EM/SBS	AI



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Appendix 1: ACES Stakeholder Engagement Activities of the Ethics, Policy and Public Engagement Team (EPPE)

Description of Engagement Activities ACES EPPE Group 2021

1. Linda Hancock, CI Deakin, attended 'Democratic accountability, transparency & integrity at the Commission, Parliament and Council of the EU' Green Growth Knowledge Platform (GGKP). 19 January
2. Linda Hancock, CI Deakin, attended Green Growth Knowledge Partnership (GGKP). 'What progress has been made on the UNEA-4 resolution on mineral resource governance? What do we need to know before UNEA-5? 19 January
3. Linda Hancock, CI Deakin, attended Davos Energy Week, on-line Davos, Switzerland. 19-21 January
4. Linda Hancock, CI Deakin, attended Webinar on 'Nanomaterials: Assessing the dispersion stability and dissolution (rate) of nanomaterials in the environment' Organisation for Economic Co-operation and Development (OECD) Paris. 25 January
5. Anna Blum, AI UNSW, attended IEEE virtual panel discussion 'Choose your own device: DIY neuromodulation'. 27 January
6. Linda Hancock, CI Deakin, attended a virtual presentation 'Global Governance for Transformation'. 27 January
7. Linda Wollersheim, PhD Deakin, Coalition for Community Energy (C4CE) Research Committee meeting. 10 February
8. Linda Hancock, CI Deakin, attended the Australian Energy Market Operator (AEMO) Q4 2020 Quarterly Energy Dynamics report virtual meeting, AEMO, Canberra and Melbourne Energy Institute. 10 February
9. Linda Wollersheim, PhD Deakin, Participated in German Transmission Network Service Providers (TNSP) webinar, 'First Draft Scenario Framework for the 2035 Network Development Plan' (translated from German). 12 February
10. Linda Hancock, CI Deakin, attended 'Why should public participation and engagement precede decision-making in science and technology?' webinar, ECPR Environmental Politics Online Seminar Series, Presented by Jesse L. Reynolds, Eric B. Kennedy & Jonathan Symons. 18 February
11. Linda Hancock, CI Deakin, attended Beyond the Burning, Environment Victoria. 23 February
12. Anna Blum, AI UNSW, attended IEEE neuroethics webinar: 'Scientific Oppression, Biological Reductionism, and the Future of Neurotechnology'. 25 February
13. Linda Wollersheim, PhD Deakin, attended '5th International Community Wind Symposium', World Wind Energy Association. 3 March
14. Anna Blum, AI UNSW, attended BCI Society workshop (portion): 'On the need of good practices and standards for benchmarking Brain-Machine Interfaces'. 4 March
15. Susan Dodds, CI La Trobe, attended National Press Club Speech with Professor Deborah Terry on Commercialisation and Translation of Research. 10 March
16. Linda Wollersheim, PhD Deakin, attended Coalition for Community Energy (C4CE) Research Committee meeting. 10 March
17. Linda Hancock, CI Deakin, attended 'Grassroots and Community Innovation' webinar, Sussex University. 11 March
18. Linda Wollersheim, PhD Deakin, attended 'Grassroots and Community Innovation' webinar, Sussex University. 11 March
19. Linda Wollersheim, PhD Deakin, attended 'Berlin Energy Transition Dialogue' virtual conference. 16 – 17 March
20. Mark Howard, RF Monash, presented in a webinar with Monash Data Futures Institute on the embedded ethicist in technology assessment. 18 March
21. Linda Wollersheim, PhD Deakin, attended 'Social license for Control of DER' webinar, Energy Consumers Australia. 23 March
22. Linda Wollersheim, PhD Deakin, attended 'Big Batteries – Strengthening our Grid' webinar, Smart Energy Council. 30 March
23. Anna Blum, AI UNSW, attended INS webinar: 'Culturally-aware global neuroethics'. 31 March
24. Linda Wollersheim, PhD Deakin, attended Coalition for Community Energy (C4CE) Research Committee meeting. 7 April

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25.	Linda Wollersheim, PhD Deakin, attended 'Decarbonising our Regional Cities - A Ballarat Case Study' webinar, Beyond Zero Emissions. 20 April
26.	Linda Wollersheim, PhD Deakin, attended 'Yallourn Closure Briefing' webinar, Environment Victoria. 22 April
27.	Linda Wollersheim, PhD Deakin, attended 'Citizen Energy Communities' virtual conference, organised by REScoop (European federation of citizen energy cooperatives). 22 – 23 April
28.	Linda Wollersheim, PhD Deakin, attended 'AEMC Post-2025 Market Design' webinar, Australian Energy Market Commission. 4 May
29.	Linda Wollersheim, PhD Deakin, attended Coalition for Community Energy (C4CE) Research Committee meeting. 5 May
30.	Linda Wollersheim, PhD Deakin, attended 'Including Gender: Policy Choices Towards A Just Transition' webinar, International Energy Agency (IEA) Gender Task Group. 12 May
31.	Linda Wollersheim, PhD Deakin, attended 'Green and Sustainable Chemistry: From Objectives to Action' webinar, Green Growth Knowledge Partnership (GGKP). 17 May
32.	Linda Wollersheim, PhD Deakin, attended 'Integrating DER into the grid', Australian Energy Market Commission. 20 May
33.	Linda Wollersheim, PhD Deakin, attended 'Litigation for mitigation: constitutional dimensions of renewable energy and climate change' webinar, World Wind Energy Agency. 2 June
34.	Linda Wollersheim, PhD Deakin, attended Coalition for Community Energy (C4CE) Research Committee meeting. 2 June
35.	Linda Wollersheim, PhD Deakin, attended 'Power to the People: Goulburn Community Energy Cooperative Dispatchable Solar Farm' webinar, Renew Australia. 9 June
36.	Linda Wollersheim, PhD Deakin, industry interaction: Co-organised and attended Coalition for Community Energy (C4CE) Virtual Member Mixer Event. 9 June
37.	Linda Wollersheim, PhD Deakin, attended 'Power Shift: The Global Political Economy of Energy Transitions', webinar, Independent Social Research Foundation. 17 June
38.	Linda Wollersheim, PhD Deakin, attended Coalition for Community Energy (C4CE) Research Committee meeting. 7 July, 4 August and 10 August
39.	Linda Wollersheim, PhD Deakin, attended 'DER Lab Launch' webinar, ANU. 13 July
40.	Linda Wollersheim, PhD Deakin, attended 'System Resilience' webinar, Energy Consumers Australia. 12 August
41.	Linda Wollersheim, PhD Deakin, participated in Visualise Your Thesis (VYT) competition. 19 August
42.	Linda Wollersheim, PhD Deakin, attended Environment and Energy Committee public hearing as part of the Parliamentary Inquiry into Australian Local Power Agency Bill proposed by independent Indi MP Helen Haines. 27 August
43.	Linda Wollersheim, PhD Deakin, attended 'From responsive regulation to ecological compliance' webinar, Melbourne Law School. 27 August
44.	Linda Wollersheim, PhD Deakin, attended 'Large-scale batteries showcase', Smart Energy Council. 8 September
45.	Linda Wollersheim, PhD Deakin, attended 'Climate Change and International Trade: The EU Carbon Border Mechanism' webinar, ANU Climate and Energy. 16 September
46.	Linda Wollersheim, PhD Deakin, attended 'The Age of Climate Structural Adjustment Programs' webinar, UOM Climate and Energy College. 12 October
47.	Linda Wollersheim, PhD, Deakin, attended 'Maximising Consumer Demand' webinar, ANU Energy Conversations. 14 October
48.	Linda Wollersheim, PhD Deakin, Participated in Coalition for Community Energy (C4CE) Writing Group, C4CE. 19 October
49.	Linda Wollersheim, PhD Deakin, attended 'Global Race to Zero Summit' (online). 20-21 October
50.	Linda Wollersheim, PhD Deakin, attended 'Human well-being within planetary boundaries: Integrating climate policies with the UN 2030 Agenda' webinar, UOM Climate and Energy College. 26 October
51.	Linda Wollersheim, PhD Deakin, attended 'Time for a Paradigm Shift? Reflections on the Post-2020 Biodiversity Framework' webinar, Melbourne Sustainable Society Institute. 27 October
52.	Linda Wollersheim, PhD Deakin, attended 'Regulating peer-to-peer energy trading and community self-consumption models' webinar, International Energy Agency UsersTCP Academy. 10 November

53.	Linda Wollersheim, PhD Deakin, attended 'Wie kann der Ausbau von Photovoltaik und Windenergie beschleunigt werden?' webinar (German), acatech (Deutsche Akademie der Technikwissenschaften), 15 November
54.	Linda Wollersheim, PhD Deakin, participated in Coalition for Community Energy (C4CE) Writing Group, C4CE. 18 November
55.	Linda Wollersheim, PhD Deakin, attended virtual SCORE Final Conference 'Supporting Consumer Ownership in Renewable Energy: Challenges to be met'. 17-18 November
56.	Linda Wollersheim, PhD, Deakin, attended 'Post COP26: What happened, and where to from here?' webinar, British High Commission to Australia/Australian National University Institute for Climate, Energy & Disaster Solutions. 18 November
57.	Linda Wollersheim, PhD Deakin, attended 'Victorian Battery Manufacturing Roundtable', StorEnergy Symposium. 25 November
58.	Linda Wollersheim, PhD Deakin, attended '7th Annual Conference on the Economic Assessment of European Climate Policies' (Zoom), EUI FSR Climate. 29-30 November

Appendix 2: ACES Research Training and Mentoring Events

The ACES program targets the professional development of research staff and postgraduate students, as well as key areas of continuing technical and scientific education. The workshops in 2021 were undertaken in the form of events, podcasts, and webinars.

Research Training and Mentoring Events/Meetings 2021		Date	Venue	Attendees Registered
Events				
1.	15th Annual International Electromaterials Science Symposium The annual International Electromaterials Science Symposium brings together leaders in electromaterials science research across a broad range of disciplines in electromaterials science research across a broad range of disciplines.	3-5 Feb	Virtual	138
2.	ACES Special Panel on Careers in Research A panel of experts gave an overview of their careers in research and then responded to questions from the audience covering all aspects of research careers. Prof Susan Dodds, CI La Trobe, Prof Debbie Silvester, (Curtin) Prof John Madden, UBC, and Prof Jennifer Pringle (panel convenor), CI Deakin.	5 Feb	Virtual	54
3.	Webinars A new series of webinars from a wide range of academic experts were offered.	March - December	Virtual	See appendix 4
4.	ARC Research Integrity Policy – Reporting and Expectations Justin Withers presented Australia's framework for the responsible conduct of research. Key components of ARC's involvement and expectations regarding research integrity. Australian Code for the Responsible Conduct of Research Guides supporting the Code. What is a breach of the Code and model process for investigations?	18 Mar	Virtual	90
5.	Podcasts New ACES podcasts were added to the collection, with new episodes recorded over the year.	April-December	Virtual	See appendix 3
6.	Identifying and Commercialising an Idea Workshop An interactive session on the steps involved in identifying and commercialising an idea, hosted by Prof Gerry Swiegers (held twice, once in person, once virtual)	7 April 24 and 31 May	iC, Wollongong and Virtual	17 45

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7.	Analytical Capabilities Workshop Introductory workshop, covering the main analytical capabilities available to researchers specifically aimed at techniques relevant to ACES research. Presented by Dr Luke O'Dell, Dr Alexandr Simonov, Prof Michael Higgins, and Prof Peter Innis.	12 April	Online	43
8.	Preparing for your Future Career Workshop: A career options workshop presented by Jovana Sobat from CS Executive, a consultancy firm specializing in scientific recruitment. Exploring all non-academic career choices.	28 April	Virtual	68
9.	Careers Beyond Academia An ACES Panel The ACES Research Training Group hosted an insightful panel discussion on considering your career options beyond academia. The panel included Dr Brianna Knowles, Science and Commercialisation Policy Division, Department of Industry, Science, Energy and Resources; Dr Tristan Simons, Materials Chemistry Specialist, Defence Science and Technology Group; Dr Marianne Repacholi, Associate Patent Attorney, Melbourne Chemistry Team, FB Rice.	19 May	Virtual	46
10.	PhD Opportunities in Intelligent Materials Director Prof Gordon Wallace presented on PhD opportunities currently available in areas including 3D printing and 3D bioprinting, chemical fuels, thermal energy harvesting, and electrical stimulation of cells, and meet potential supervisors.	4 June	Virtual	26
11.	ANFF TRICEP Capabilities Workshop The workshop featured presentations from specialists on the capabilities available within ANFF and TRICEP, followed by breakout Q&A sessions with each of the presenters to address specific enquiries about how you can utilise these facilities.	22 June	Virtual	45
12.	Research Performance Metrics Webinar An overview and history of the use of research performance metrics in Australia as well as strategies to employ useful metrics to advance research, presented by Dr Tim Cahill, Managing Director Research Strategies Australia.	28 July	Virtual	66
13.	Innovation and Entrepreneurship Certificate Provided students with the opportunity to apply a commercial lens to their research and identify business opportunities within a wider research environment. The course is highly interactive and participants exposed to multidisciplinary expertise in the classroom to provide perspective on ACES research.	9 Aug – 6 Sep	Sydney Business School Virtual	17
14.	Bill Wheeler Symposium 2021 The Symposium and Award in honour of Bill Wheeler, who was a very active member of the Illawarra community and took a keen interest in new bionics research at UOW. Feature presentation was given by head and neck surgeon A/Prof Bruce Ashford and last year's winner Grishmi Rajbhandari.	17 Aug	Virtual	123
15.	ACES Symposium: The Legacy Celebrating the legacy of ACES, the symposium featured presentations from ACES alumni and recent graduates as well as a session on innovation and entrepreneurship, special panel discussion and more.	2-3 Dec	Virtual	159

16.	Innovation and Entrepreneurship Pitch Session Students undertake a group project where they develop an investment pitch. Pitches include the commercialization strategy including target market, competitive advantage, IP strategy, project planning for commercialisation, financial plan and “the ask” from potential investors.	3 Dec	Virtual	153
17.	Picture A Scientist Film Screening The ACES Equity and Diversity Committee organised the film screening and invited participants reflections after watching the film.	9-11 Dec	Virtual	22
18.	ACES Impact Symposium: The symposium will feature presentations from ACES chief investigators, theme leaders and more. This will be our final opportunity to get together to celebrate ACES.	17 February 2022	Virtual	95

Appendix 3: ACES Podcast Series

The number of plays recorded as of 2.2.2022. The podcast series was first introduced in 2020 with 20 episodes; an additional 10 episodes were added in 2021. The total number of plays for all episodes is 2,231.

Podcasts 2021		Date	Speaker Affiliation	Number of Plays
1.	Ep. 21 - Karolina Biernacka Chats about her passion for science, living and studying in Europe and now Australia, her PhD and success in last year's ClimateLaunchpad, which led to her co-founding ElevenStore, and much more.	1 Apr	Deakin	38
2.	Ep. 22 - Ben Filippi Fabrication Technician and Mechatronics Engineer, Benjamin talks about his background in mechatronics and engineering, 3D printing, working at TRICEP, his passion for motor vehicles and much more.	30 Apr	TRICEP/ANFF	40
3.	Ep. 23 - Dr Frederic Gilbert Conversation with ACES Associate Investigator and Senior Lecturer in Ethics at the University of Tasmania (UTAS), Dr Frederic Gilbert.	14 May	UTas	45
4.	Ep. 24 - Shaun Gietman Conversation with Shaun Gietman about his PhD experience, the Brain on the Bench project, his new exciting job, life outside of work and more.	28 May	Swinburne	16
5.	Ep. 25 - Laura Garcia-Quintana Conversation about her interest in science, her PhD journey and finishing up, new research, what's next and much more.	18 Jun	Deakin	27
6.	Ep. 26 - Dr Sepidar Sayyar Talks about his background, moving to Australia for his PhD, his current work and collaborations including 3D GENII and Alchemical Worlds, his passion for philosophy and much more.	9 Jul	UOW	28
7.	Ep. 27 - Associate Prof Bruce Ashford A specialist in Head and Neck Surgery as well as being a reconstructive Microsurgeon and Cancer Researcher.	22 Jul	UOW/IHMRI/NSW Health	37
8.	Ep. 28 - Dr Tillmann Boehme Conversation about his experience in logistics and supply chain management, his work exploring an additive manufacturing cluster in Australia, running the Certificate of Innovation and Entrepreneurship and much more.	27 Aug	UOW	24

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9.	Ep. 29 - Dr Vipul Gupta Conversation about his career in science, completing a PhD with ACES, Co-founding 3D MADe and much more.	19 Oct	UTas	22
10.	Ep. 30 - ACES Director Gordon Wallace Conversation about how and why his career began, moving from Belfast to Australia, the ACES journey and much more. Plus, an outro song by Gordon himself.	17 Dec	UOW	31
11.	Episode 1-30 – Total Number of Plays The total number of plays for every podcast episode	2 Feb 2022	Various	2231

Appendix 4: ACES Webinar Series

Webinars 2021		Date	Registered participants
1.	ACES Seminar Dr Aaron Elbourne RMIT: Bio-Interfacial Interactions and Antimicrobial Nanomaterials	4 Mar	26
2.	Research Integrity: Justin Withers – ARC (Joint RTG Training Webinar)	18 Mar	90
3.	Prof Attila Mozer UOW: Faster, cheaper, better! – Enhancing electron transfer rates between molecules by exploiting intermolecular interactions and some new tricks	30 Mar	48
4.	A/Prof Matthew Hill CSIRO: Recent progress in high capacity, stable, lithium-sulphur batteries	27 Apr	35
5.	A/Prof Kathryn Mumford UOM: Electrochemical regeneration of granular activated carbon <i>in situ</i> of reactive permeable barriers	25 May	39
6.	Prof Mario Romero-Ortega University of Houston: Electrochemical research and its future	1 Jun	90
7.	Dr Amelia Liu: Characterising Disordered Materials with Scanning/Transmission Electron Microscopy	27 Jul	45
8.	Dr Tim Cahill: Research Performance Metrics Webinar	28 Jul	66
9.	Prof Keith Martin UOM: From bench to bedside in ophthalmology: academic and commercialisation voyages of discovery	21 Sep	45
10.	Prof Lee Astheimer (former DVCR Deakin): Reflections on Grant Writing	26 Nov	77

Appendix 5: ACES Cross Nodal Interactions

Cross-nodal visits/interactions are reported (this year including virtual) when members travel between ACES nodes to undertake multidisciplinary research, which includes brainstorming, project meetings, or access to laboratories to undertake research tasks. These visits are additional to ACES support provided to attend targeted workshops or ACES events/conferences. Due to COVID-19 restrictions, the usual face-to-face interactions could not occur and meetings were moved to smaller, informal online interactions.

ACES Cross Nodal Interactions 2021	
1.	Si-Xuan Guo, RF Monash, held discussions with Jun Chen, CI UOW on electrochemical synthesis of N-fertilizers. 11 January - 24 December.
2.	CIs Dodds, Sparrow, Hancock, RFs Goddard and Howard, PhDs Blum, Wollersheim, Adesanya, Als Gilbert, Hutchison, Walker participated in a virtual Ethics, Policy and Public Engagement EPPE cross-nodal meeting. 3 February
3.	Robert Forster, AI DCU, Virtual Seminar, '3D Electrodes for Electrochemiluminescence and Electrocatalysis' IPRI. 4 February.
4.	Susan Dodds, CI La Trobe, Alex Harris, Mary Walker, Frederic Gilbert virtual cross-nodal and cross theme meeting and discussions. 8 February

5.	Susan Dodds, CI La Trobe, Jeremy Crook, CI, UOW, Eva Tomaskovic-Crook, RF, UOW, Eliza Goddard, RF, La Trobe, participated in a virtual meeting to discuss work in progress on collaborative activity for joint manuscript relating to ethics of brain organoids. 10 February
6.	Susan Dodds, CI La Trobe, Mark Howard, RF Monash participated in a virtual meeting to discuss research collaborations. 23 February
7.	Steven Posniak, PhD UOW, met with A/Prof Kathryn Stok, UOM, to undertake six months of research investigating the ECM of cartilage (primarily focusing on elastin) and printing GelMA/HAMA scaffolds with elastin to produce a natively similar environment for chondrocyte regeneration. February - August
8.	Simon Moulton, CI Swinburne, Eva Tomaskovic-Crook RF UOW and Jeremy Crook CI UOW discussions and supervision of ACES Affiliate PhD student Sky Jay. February – December.
9.	Susan Dodds, CI La Trobe, Maria Forsyth, CI, Deakin participated in a cross nodal virtual meeting to discuss future collaborations. 2 March
10.	David Officer, CI UOW met with Alici Gursel, CI UOW to discuss EFG involvement and dry electrodes with Soft Robotics. 3 March
11.	Laura Garcia-Quintana met with Prof Alan Bond, AI, to discuss simulation results for the reviewed manuscript to send to Electrochemistry Communications. 2, 5, 10 March
12.	Susan Dodds, CI La Trobe and Gordon Wallace, CI UOW, participated in a cross nodal phone call to discuss future developments. 12 March
13.	Si-Xuan Guo, RF Monash, met with Dr Sebastian Thomas and Thang Vu Dinh, Materials Science and Engineering, Monash to discuss the collaborative CO ₂ reduction project, sample preparation, characterization, electrolysis results, and directions for future work. 8, 9 & 17 March
14.	Jinfeng Wang, Deakin, worked with Greg Ryder, UOW, to discuss the potential of applying graphene for sensing. 17 March
15.	Linda Wollersheim, PhD Deakin met with Cristina Pozo-Gonzalo, RF Deakin to discuss social aspects of energy storage. 18 March
16.	Jinfeng Wang, Deakin, worked with Jenny Sun, Deakin to discuss the performance of carbonized fabrics as electrode. 25 March
17.	Hao Zhou, RF, UOW, worked with the research team Patrick Howlett and his co-workers Deakin to develop customised batteries for the hand prototype(s). March
18.	Andres Ruland, RF, UOW, is collaboration with Jeremy Crook, Eva T-Crook and Emma James, SBS Theme, UOW with preliminary tests on the feasibility of monitoring the actuation of cardiac cells with ultrasound, which resulted in very encouraging results. Emma to prepare samples for performing full study during April.
19.	Laura Garcia Quintana, Deakin went to Monash to work with Prof Alan Bond to discuss oxygen reduction reaction electrochemistry in the P based electrolytes. 15 April
20.	Faezeh Makhlooghiazad, ECR Deakin, met with Prof John Andres, Royal Melbourne Institute of Technology, to visit their proton fellow battery labs. 22 April
21.	Monash and Deakin nodes transferred materials related to plastic crystal and zwitterion, along with multiple meetings ongoing throughout the year.
22.	Virtual EPPE cross-nodal meeting CIs Dodds, Sparrow, Hancock, RFs Goddard and Howard, PhDs Blum, Wollersheim, Adesanya, Als Gilbert, Hutchison, Walker. 8 September Virtual EPPE cross-nodal meeting CIs Dodds, Sparrow, Hancock, RFs Goddard and Howard, PhDs Blum, Wollersheim, Adesanya, Als Gilbert, Hutchison, Walker. 8 June

Appendix 6: ACES End-User Visits to ACES

End-User and Industry Visits to ACES in 2021

1.	Laurie Koster, Managing Director Global Defence, met with Gordon Wallace, CI UOW, to discuss projects. 12 January
2.	Dr Tamra Enbom, Orthotist Clinician, The Australian Orthotic Prosthetic Association, met with Gordon Wallace, CI UOW, and visited TRICEP. 14 January
3.	Dr Payal Mukherjee, Ear Nose and Throat Specialist, San Clinic Tulloch Ear Nose Throat Care, met with Gordon Wallace, CI UOW, via video conference. 19 January

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4.	Paul Barrett, Head of Physical Sciences, IP Group Australia met with Gordon Wallace and David Officer, CIs UOW, to discuss Ultrimage and 3D REDI where David Officer presented on Edge Functionalised Graphene (EFG), and visited TRICEP. 19 January
5.	Cameron Ferris, Chief Operating Officer, Inventia Life Science, met with Gordon Wallace, CI UOW, regarding bioinks and 3D REDI and a visit to Tricep. 27 January
6.	Neil Wilson, Romar, met with Gordon Wallace, CI UOW, regarding 3D Printing. 1 February
7.	Jaishankar Raman (medical practitioner) met with Andres Ruland, RF UOW, on possibilities for collaboration: need of multifunctional probes for the local assessment of tissues. 23 February
8.	Brad Neilson, Hyperflow Technologies, met with Gordon Wallace, CI UOW, regarding 3D Printing technologies. 4 March
9.	Arthur Brandwood, Director and Principal Consultant, Brandwood CKC, met with Gordon Wallace, CI UOW for a tour of the TRICEP facility. 5 March
10.	Vincent Garvey, Engineering Director, Ellen Medical Devices Pty Ltd, met with Gordon Wallace, CI UOW for a tour of the TRICEP facility. 5 March
11.	Nicole Kane-Maguire visited with Johnson Chung, AI UOW, for to tour the AIM and TRICEP Facilities, as part of the LKM Award activities. 19 March
12.	Pia Winberg (Venus Shells) and Dr. Helen Fitton, Marinova's Chief Scientist visited with Johnson Chung, AI UOW. 22 March
13.	Dr. John Lam and Priya Vasudevan of Trajan scientific and Medical, visited Brett Paull, CI UTas, at UTas analytical research laboratories to demonstrate and discuss collaboration in developing new analytical platforms for remote and in-site analysis. 23-24 March
14.	David Dome, Shaun Gill and Leigh Stewart, Wellington Phoenix, visited ACES UOW to discuss opportunities with Gordon Wallace, CI UOW. 29 March
15.	Dr. Jie Ding and Mr. Tim Bussell from Defence Science and Technology Group, visited Gordon Wallace, CI UOW and Caiyun Wang, RF UOW, to discuss the research progress on the current project and the future collaboration. 1 April
16.	John Grew, BioAdvisory Group, visited Gordon Wallace, CI UOW to discuss potential opportunities. 7 April
17.	Marisa Phelan, Head of Market & Technology Intelligence, Henkel Loctite, met with Robert Forster, AI DCU, for discussions on collaborative projects focused on inks for screen printed electrodes and wearable sensors. 9 April
18.	Harvey Hua, Director, Fushion Biobased Materials, met with Xungai Wang, CI Deakin, to discuss biodegradable fibre and polymer materials. 16 April
19.	Monira Hoque, NSW Tissue Bank, met with Sepidar Sayyer, AI UOW, for analysis techniques. 5 May
20.	Stijn Gillissen, Global Head Printed Electronics, Henkel Loctite, met with Robert Forster, AI DCU, for discussions on collaborative projects focused on printed sensors for wearable electronic devices. 11 May
21.	Maria Forsyth, CI Deakin, met with Oliver Hutt from Boron Molecular meeting about Deakin capabilities and NDA with Deakin on 18 May
22.	Jenny Pringle, CI Deakin, Peter Airey and colleague visited Deakin labs, Microanalysis and Nanotechnologies Product Specialists, AXT PTY LTD, to discuss various analytical techniques 19 May
23.	Roger Buckeridge, Theo Renard, and Duro Fricek met with David Officer, CI UOW, Greg Ryder, RF UOW and Gordon Wallace, CI UOW, to discuss EFG composites. 20 May
24.	David Batson from SRBEC met with Gordon Wallace, CI UOW, for a tour of facilities and potential future business opportunities. 21 May
25.	Michael Sharpe, AMGC National Director, met with Gordon Wallace, CI UOW, for technology demonstrations. 4 June
26.	Tim Parsons, Smartsat CRC, met with Gordon Wallace CI UOW, to tour the facilities and discuss space related opportunities. 18 June
27.	Liam O'Neill, CTO, TheraDep, met with Robert Forster, AI DCU, to discuss collaborative project on low temperature plasma deposition of proteins for cell growth and wireless electrical stimulation. September
28.	Karolina Biernacka, PhD Deakin, undertook a part time internship (as Business Development Intern) at Sodium-ion Batteries. Multiple dates

Appendix 7: ACES Government and Non-Government Organisation Interactions

Government and Non-Government Organisation Interactions 2021

1. Linda Hancock, CI Deakin, was an Expert Reviewer for the Second Order Draft of the Working Group III contribution to the Sixth Assessment Report on Climate Change Mitigation (AR6). 18 January - 14 March
2. Susan Dodds, CI La Trobe, Foreign Interference Taskforce (UFIT) Critical Technology Working Group discussions. 19 January
3. Gordon Wallace, CI UOW, met with Hugh Durrant-Whyte, NSW Chief Scientist, Office of the NSW Chief Scientist & Engineer, regarding 3D Biofabrication opportunities and a visit to TRICEP. 19 January
4. Mary Walker, AI La Trobe, discussion on prosthetics and international development with George Goddard, Engineers without Borders. 21 January
5. Gordon Wallace, CI UOW, met with Bruce Thomson, Tamara Ogilvie, Andrew Hodge, CSIRO SME Connect, to discuss innovation connections programme. 22 January.
6. Maria Forsyth, CI Deakin attended the Working Group Sectional Committee review process, as member of the Australian Academy of Science. 3 February
7. Maria Forsyth, CI Deakin, attended the Association of Asian Studies (AAS) Roundtable and Australian Council of Learned Academies (ACOLA) Australian Energy Transition Research Plan. 17 February
8. Susan Dodds, CI La Trobe, Foreign Arrangements Scheme workshop (online). 18 February
9. Gordon Wallace, CI UOW, met with Anthony Body, Director Illawarra Shoalhaven, Department of Regional NSW, for a tour of the TRICEP facility. 18 February
10. Susan Dodds, CI La Trobe, Appointed to the Governance Committee of ORCID. March
11. Robert Forster, AI DCU, met with Environmental Protection Agency of Ireland, discussion of emerging technologies for treating recalcitrant micropollutants. 2 March
12. Susan Dodds, CI La Trobe, attended veski STEMsidebyside closing ceremony, British High Commission, Melbourne. 15 March
13. Peter Masterton, Jenny Aiken, Valouri Nazarian and Usman Iftikhar, Department of Industry Science Energy and Resources, met with Gordon Wallace, CI UOW, to discuss commercialisation. 16 March
14. Susan Dodds, CI La Trobe, Foreign Interference Taskforce (UFIT) Working Group meetings throughout 2021.
15. Gordon Wallace, CI UOW, met with Paul Scully MP for discussion and a tour of the facilities, 7 April
16. Maria Forsyth, CI Deakin, invited to the Breakthrough Victoria - Clean Economy Roundtable on 4 June
17. Maria Forsyth, CI Deakin, participated in ARC Exciton Mid-term Review meeting. 1-2 July
18. Maria Forsyth, and Patrick Howlett CIs Deakin, attended to the VIC Major Government Announcement. BatTRI-Hub 2.0 was announced as a part of Victorian Major government VHESIF, at Deakin University, Burwood Campus. 15 July
19. Maria Forsyth, Patrick Howlett CIs, and Christina Pozo-Gonzalo, RF Deakin, attended Australian Battery Recycling Initiative - Victorian Govt funding for Deakin battery project meeting with Katharine Holeon from Australian battery recycling. 14 July
20. Maria Forsyth, and Patrick Howlett CIs Deakin, had a meeting the Deakin Vice-Chancellor as well as Victorian Minister D'Ambrosio, about Deakin Energy projects. 12 August
21. Susan Dodds, CI La Trobe, appointed to the Board of Intersect, Pty. September
22. Jenny Pringle, CI Deakin, hosted Geoff White (Defence Scientist, Soldier Autonomy) Defence Science and Technology Group (DSTG) to discuss possible Thermocell collaboration.
23. Maria Forsyth, CI Deakin, chaired the Victorian Battery Manufacturing Feasibility VIC workshop. 25 November

Appendix 8: ACES Out and About With Stakeholders

ACES Out and About Interacting with Stakeholders in 2021

1. David Officer, CI UOW, and Shaikh Faisal, AI UOW, had a virtual meeting with New Zealand company Carbonscape to discuss developing graphene from their carbon material. 18 January
2. David Officer, CI UOW, had a virtual meeting with Dr Dennis Antihos, Imagine Resources Technologies to discuss future collaboration using Edge Functionalised Graphene (EFG) in rubber composites for coalmine conveyor belts. 19 January

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3.	Andres Ruland, RF UOW, met with Dr. Robert Utama, Lead Product Manager at Inventia Life Science. 27 January
4.	David Officer, CI UOW, and Greg Ryder had a virtual meeting with Mark Winfield (CEO) and researcher, Baozhi Yu, of Boron Nitride Nanotubes (BNNT) Technology Limited to discuss EFG use in LiS batteries. 2 February
5.	Maria Forsyth, CI Deakin, as member of the Australian Academy of Science, was invited to attend to the The Working Group Sectional Committee review process. 3 February
6.	Jeremy Crooke, CI UOW met with Buzz Palmer, CEO MedTech Actuator, MedTech Actuator Menzies Fellowship mentor meeting, online. 4 February and face to face 18 March
7.	Jie Zhang, CI Monash, met virtually with Weiguang Lan and his teams at Sinomem and Xiamen University to discuss collaboration on energy applications of the catalysts developed in his group. 6, 9 & 11 February
8.	Maria Forsyth, CI Deakin, National battery facility discussion with ANSTO. 9 February
9.	Andres Ruland, RF UOW, liaised with James Yoo, National Institute of Health (NIH), regarding collaboration opportunities. 12 February
10.	Maria Forsyth, CI Deakin, ACOLA Australian Energy Transition Research Plan, meeting David Downie. 16 February
11.	Maria Forsyth, CI Deakin, attended the Australian Academy of Science Roundtable and ACOLA Australian Energy Transition Research Plan. 17 February
12.	Maria Forsyth, CI Deakin, as a member of the FBICRC (Future Battery Industries- Cooperative Research Centre) RIAC (Research Implementation Advisory Committee) attended FBICRC RIAC committee meeting. 18 February
13.	Maria Forsyth, CI Deakin, met with Peter Hansford (Manager Business Development, DELWP, VIC) on Battery Manufacture opportunity. 19 February
14.	Grishmi Rajbhandari, PhD UOW, met with Patrick Sorsby, Senior Manager, Process Technology, Cochlear Limited, Sydney, to characterize printed coil antennas. 26-28 February
15.	Susan Dodds, CI La Trobe, appointed to the Governance Committee of ORCID March 2021
16.	Zhi Chen, AI UOW, met with the Inventia Life Science team regarding 3D printing of PEG-based bioink and human corneal fibroblasts. 2 March
17.	Linda Hancock, CI Deakin, made a submission to VCAT 1209/2020 Cliff Top at Hepburn: Presentation to VCAT 25-26 February 2021 and 1-2 March
18.	Maria Forsyth, CI Deakin, met with Aurn P Murali (Strategy Consultant, Accenture) on batteries research project. 1 March
19.	Maria Forsyth, CI Deakin, met with ANSTO group Sandy Haig (Senior Manager, Industry and Stakeholder Engagement), Michael James (Senior Principal Research Scientist) on Battery Facility. 3 March
20.	David Officer and Gordon Wallace, CIs UOW, had a virtual meeting with Professor Liming Dai (UNSW) to discuss collaboration. 3 March
21.	Robert Sparrow, CI Monash, was an invited participant at the World Economic Forum, Quantum Computing Ethics online workshop. 10 March
22.	Maria Forsyth, CI Deakin, met with Kristin Vaughan, Director of Innovation Fund at Clean Energy Finance Corporation CEFC, funding for Sicon. 12 March
23.	Hao Zhou, RF, UOW, and Gursel Alici CI UOW met with Mathew Jury and Jamie Cairns from TASKA Prosthetics (New Zealand), regarding collaboration on the soft robotic hands. 19 March
24.	Susan Dodds, CI La Trobe, Research Australia Roundtable on Clinician Researchers. 25 March
25.	Maria Forsyth, CI Deakin, attended the ITRP21 Selection Advisory Committee meeting – ARC. 23 March, 14 April
26.	Geoff Spinks, CI UOW, participated as a judge in the SPIE Electroactive Polymer Actuators and Devices Symposium, EAP In Action Demonstrations. 24 March
27.	Peter Innis, CI UOW, attend the bi-annual ANFF Managers meeting, 16 March and quarterly meeting. April
28.	Jeremy Crook, CI UOW, met with Dr Vishaal Kishore, Chief Strategy Officer MedTech Actuator, MedTech Actuator Menzies Fellowship mentor meeting, online. 1 April, 6 May, 3 June
29.	Andres Ruland, RF UOW, Presented UltralImage commercialisation opportunities to Dr Ian Griffiths, Chief Executive Officer of the Australian National Fabrication Facility. 7 April

30.	Maria Forsyth, CI Deakin, met with Ali Clunies-Ross (Sicona) re. StorEnergy. 7 April
31.	E Tomaskovic-Crook, RF UOW, met with Carmine Gentile and David Ortega, from University of Technology Sydney, discuss opportunities for collaboration. 9 April
32.	Si-Xuan Guo, RF Monash, Cameron Bentley and Alan Bond, Monash, had a virtual meeting with Prof. Pat Unwin, Univ. of Warwick, UK and Dr. Minkyung Kang, Deakin, to discuss the structure of the invited review article on CO ₂ reduction. 13 April
33.	Jenny Pringle, CI Deakin, visited DSTG to discuss thermocell research and future collaborations. 14 April
34.	Maria Forsyth, CI Deakin, attended the Official Opening of the Renewable Energy Microgrid and met with Alan Finkel Australian Chief Scientist. 20 April
35.	Jun Chen, CI UOW, met with Dr Andrew Minett, Sicona Technologies Pty Ltd, to discuss potential industry-collaborative project on Active Carbon materials. April 2021
36.	Maria Forsyth, CI Deakin, met Steffen Jeschke, Research Fellow at RMIT. 22 April
37.	Jeremy Crook, CI UOW attended the MetTech Actuator Origin Gala, online. 22 April
38.	Maria Forsyth, CI Deakin met Sam Riggall, Managing Director and CEO, Sunrise Energy Materials, Clean TeQ. 23 April
39.	Maria Forsyth, CI Deakin, met Kevin Nitschke, Business Development at Lockheed Martin - Advanced Energy Solutions. 27 April
40.	Mitchell St Clair-Glover, PhD UOW, met with StemCell Technologies account manager, Trish Murphy, to discuss methods and applications of skin cell culture products. 27 April
41.	Hao Zhou, RF UOW, met with Greg Bowring, Melissa Leong and two prosthetic hand users at the Prince of Wales Hospital, to conduct human trials with the pattern recognition systems. 28 April, 13 May
42.	Andres Ruland, RF UOW, met with Jaishankar Raman from St. Vincent's Melbourne to explore ultrasound on detection of tissue injuries in <i>ex vivo</i> cardiac tissue. 30 April
43.	Caiyun Wang, Gordon Wallace, Pawel Wagner, Attila Mozer, CIs UOW, met with Prof. Yusuke Yamauchi from University of Queensland, to discuss the potential collaboration in the nanoporous/mesoporous materials for energy applications. 31 April
44.	Mitchell St Clair-Glover, PhD UOW virtually met with Ewa Czuba-Wojnilowicz UOM to establish collaboration – using neural progenitors to trial drug delivery methods. 6 May
45.	Yady Castillo, PhD Deakin, started an international collaboration with Vera Bocharova, Department of Chemistry University of Tennessee to study OIPC/Poly-TFSI-Li composite interphases. May 2021
46.	Jeremy Crook, CI UOW, participated in the Elsevier Journals Editors Meeting online. 11 May
47.	Johnson Chung, RF UOW, virtual meeting with Pradeep Tanwar from University of Newcastle for request to 3D print their samples. 11 May
48.	Johnson Chung, RF UOW visited Fiona Stapleton at UNSW for research collaboration. 13 May
49.	Maria Forsyth, CI Deakin met Jo Staines UOM for FBICRC. 17 May
50.	Maria Forsyth, CI Deakin, Patrick Howlett and Rob Kerr have a regular project meeting with the Calix Global Pty Ltd re. CRC-P (Advanced Hybrid Batteries, Cooperative Research Centre). They met Mark G Sceats on 5 May and Mark G Sceats and Matt Boot-Hansford. 20 May
51.	Maria Forsyth, CI Deakin, Patrick Howlett and Rob Kerr held regular meetings with FBICRC on Future Electrolyte Systems. 28 April, 10 May, 19 May, and 31 May
52.	Mitchell St Clair-Glover, PhD UOW, met with UNSW/Cochlear Ltd. – establishing collaborative project. June 2021
53.	Andres Ruland, RF UOW, regular meetings with Mark Fear, Burn Injury Research Unit, UWA and Jai Raman, UOM. June 2021
54.	Maria Forsyth, CI Deakin, held discussions with Riggall and Narelle Glanfield, Sunrise energy metals, and Peter Voigt, Cleanteq Water. 1 June
55.	Maria Forsyth, CI Deakin, met with Phil Hodgson Calix CEO, Mark G Sceats, Matt Boot Handford. 2 June
56.	Maria Forsyth, CI Deakin, had a meeting with Leigh Kennedy from Nera Org. 8 June
57.	Maria Forsyth, CI Deakin, met with Joshua Newton on CSCL & Deakin Collaborative Research Opportunities on 9 June
58.	Maria Forsyth, CI Deakin, met with Warren King from Cap- XX. 9 June
59.	Maria Forsyth, CI Deakin, met with Christiaan Jordaan and Andrew Minett, Sicona. 11 June

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60.	Jeremy Crook, CI UOW attended the Sydney Catalyst Research Showcase, face-to-face. 16 June
61.	Xungai Wang, CI Deakin, virtual meeting with IITG polymer research group to discuss research collaboration. 22 June
62.	Maria Forsyth, CI Deakin, met with Richard Trett, Managing Director, AXT PTY LTD. 29 June
63.	Praneshwar Sethupathy, PhD UOW, visited Dr. M. Jeyanthinath, MKU School of Chemistry, India regarding possible collaborations. 5 July
64.	Jeremy Crook, CI UOW met with Silvio Tiziani, CEO, Centre for Commercialisation Regenerative Medicine Australia. 6 July
65.	Si-Xuan Guo, RF Monash, attended the 'Newcastle University (UK) - Monash University Collaboration Workshop'. July 28 – 30
66.	Faezeh Makhlooghiazad, PhD Deakin, attended ClimateLunchpad accelerator Workshop. 28 July, and 8-9 Sept
67.	Robert Forster, AI DCU, Henkel Loctite, Dr. Stijn Gillissen, Global Head Printed Electronics, discussion on collaborative projects. 1 August
68.	Robert Forster, AI DCU, i-Sens, Korea, Dr. Hakhyun Nam, CEO, i-SENS, Inc. discussion on screen printed inks for implantable CGMS systems. 2 August
69.	Maria Forsyth, CI Deakin, attended the John Booker Medal Award Committee meeting confirmation. 4 August
70.	Maria Forsyth, CI Deakin and Dr. Pozo-Gonzalo attended to the Circular economy and waste plastics use in batteries meeting with Dr. Yvonne Mah (BASF Australia Ltd). 13 August
71.	Maria Forsyth, CI Deakin, attended meetings with industries in regard to the FBICRC project in Perth such as Fortescue Future Industries, Twiggy, Curtin University and about 10 more companies from 30-31 August
72.	Maria Forsyth, CI Deakin, attended the Li and energy virtual conference in Perth. 1-2 September
73.	Jeremy Crook, CI UOW, participated in the Medtech Actuator 2021 Sprint Courses. 4-5, 26-31 August and 1 September
74.	Maria Forsyth, CI Deakin, Patrick Howlett met with Peter Hansford from The Battery Manufacturing Roundtable with (DELWP). 6 September
75.	Xungai Wang, CI Deakin, met with representatives from Hanes Australia and CSIRO on materials testing and sustainability, including discussion on energy related work.
76.	Maria Forsyth, CIs Deakin, Howlett, Pringle met with Dr Steffen Jeschke from RMIT University for collaborative work. 7 September
77.	Maria Forsyth, CI Deakin, attended the PhysSci Victoria Prize and Fellowships Selection Panel Meeting. 9 & 13 September
78.	Robert Forster, AI DCU, Alertgy, Dr. Marc Rippen, wireless CGMS systems. 14 September
79.	Robert Forster, AI DCU, Glucovation, Dr Jeff Suri, commercialisation of screen printed sensor. 15 September
80.	Andres Ruland, RF UOW and Gordon Wallace met with CELLINK. Meeting with Dr. Itedale Namro Redwan, Cecilia Edebo, Christian Silva. 13 August and 17 September
81.	Andres Ruland, RF UOW, met with Mark Fear, Burns Research Unit UWA. 17 September
82.	Maria Forsyth, CI Deakin, attended Centre of New Energy Technology, C4NET Board Meeting. 8 October and 8 December
83.	Hao Zhou, RF UOW, and Gursel Alici, CI UOW held monthly virtual meetings with Greg Bowring, Clare Griffin, Melissa Leong from Prince of Wales Hospital, Randwick, to discuss the prosthetic hand project and amputee recruitment for further clinical testing. Multiple dates
84.	Fangfang Chen, RF Deakin, is collaborating with the Computational Materials Modelling group at NASA, working on 'ionic liquid at electrode interface through ab initio based computational methods' meeting 3 times in the year.
85.	Andres Ruland, RF UOW, met with Santosh Balivada from AMTZ, India, regarding Ultralmage system. 16 November
86.	Andres Ruland, RF UOW, met with Cellink to discuss Ultralmage. 25 November

Appendix 9: ACES End-User Events

A list of events where in 2021 members raised awareness of the facilities and research activities amongst end-users.

End-User Event Description 2021		Date	Venue
1.	15th Annual International Electromaterials Science Symposium The annual International Electromaterials Science Symposium brings together leaders in electromaterials science research across a broad range of disciplines in electromaterials science research across a broad range of disciplines.	3-5 February	Virtual
2.	ACES Symposium Showcase 2021 An opportunity for each research themes to be highlighted, including Electromaterials, Electrofluidics and Diagnostics, Soft Robotics, Synthetic Energy Systems, Synthetic Bio Systems and Ethics Policy Public Engagement.	5 Feb	Virtual
3.	Podcasts A variety of podcasts were recorded over the year and covered among other topics research progression and variety of career paths (Appendix 3).	April-December	Virtual
4.	Webinars There were a significant number and variety of webinars this year (Appendix 4).	April - December	Virtual
5.	ACES Full Centre Meeting ACES is internationally recognised as a leader in electromaterials research, focused on turning our fundamental knowledge of cutting-edge materials into the next generation of 'smart devices' for the benefit of the community. Our Full Centre Meeting is a fantastic opportunity to gain insights into developments in electromaterials research, how our work has real world applications to build new innovations and industries, and opportunities for engagement between researchers, industry and end-users. Hear the latest on electrofluidics and diagnostics, synthetic energy systems, synthetic biosystems, soft robotics, and 3D electromaterials, as well as ethics, policy and public engagement considerations associated with these new technologies.	7-8 June	Hybrid in person and virtual
6.	ANFF TRICEP Capabilities Workshop The workshop featured presentations from specialists on the capabilities available within ANFF and TRICEP, followed by breakout Q&A sessions with each of the presenters to address specific enquiries about how you can utilise these facilities.	22 June	Virtual
7.	Biofabrication and translation symposium An ACES event focused on exploring translational opportunities in biofabrication, featuring talks and demonstrations of current technologies including 3DREDI and Ultralimage.	30 Sep- 1 Oct	Virtual
8.	ACES/ANFF Materials Graphene Forum ACES researchers have made a number of seminal contributions and continue to do so with the recent discovery of Edge Functionalised Graphene (EFG). The forum reviewed translation and commercial advances involving graphene, and look forward at the emerging opportunities for Graphene.	16 Nov	Virtual
9.	3D Bioprinting 2030 Forum The convergence of advances in biomaterials, stem cell biology and 3D fabrication has enabled us to tackle challenges in health, food production and remote manufacturing that may have seemed insurmountable just a few years ago. A panel of experts discuss what the next few years might bring.	23 Nov	Virtual
10.	ACES Legacy Symposium Celebrating the legacy of ACES, the symposium featured presentations from ACES alumni and recent graduates as well as a session on innovation and entrepreneurship, special panel discussion and more.	2-3 December	Virtual
11.	ACES Impact Symposium The symposium will feature presentations from ACES chief investigators, theme leaders and more. This will be our final opportunity to get together to celebrate ACES.	17 February 2022	Virtual

Appendix 10: Plenary and Keynote Addresses

Plenary and Keynote Addresses given by ACES members in 2021

1. G Sutton, AI UOW, Invited Keynote Lecture (Virtual) Corneal Bioengineering Royal Society of Medicine. January 2021
2. Michelle Coote, CI ANU, Invited Keynote: "Electricity as a Sustainable Catalyst of Chemical Reactions" MacDiarmid Institute Annual Symposium, Rotorua & Virtual. 12 February
3. Xungai Wang, CI Deakin, Invited Keynote: "Waste Textiles and Colour Recycling for Fashion Sustainability", 6th International Conference on Value-addition and Innovation in Textiles Virtual Conference. 2 March
4. Maria Forsyth, CI Deakin, Discussion Panel at the 'f100 – a festival for 100 women' International Women's day event. 8 March
5. Mark Cook, CI UOM, Invited Keynote: "Seizure Detection Devices: New Insights Into Epilepsy" Malaysian Epilepsy Congress, Virtual. 18-21 March
6. Maria Forsyth, CI Deakin, Plenary Speaker: "Electrochemical Energy Storage for a Sustainable Future", at the Virtual Global Renewable Energy Researchers meeting. 7-8 May
7. Maria Forsyth, CI Deakin, Plenary Speaker: "The role of women in state-of-the-art Post-Li energy storage research", POLiS. 27-28 July
8. Stephen Beirne, AI UOW, Keynote Speaker: "3DREDI – A multi-modal biofabrication research and training platform" International Conference on Biofabrication 2021. 25-27 September
9. Gordon Wallace, CI UOW, Keynote Speaker: "Taking 3D Bioprinting into the clinic. Jumping hurdles in a three legged race!" International Conference on Biofabrication. 27-29 September
10. Gordon Wallace, CI UOW, Panellist: "Diversity in Biofabrication" International Conference on Biofabrication 27-29 September
11. Zhilian Yue, RF UOW, Keynote Speaker: "Hybrid Printing Chondral Constructs" International Conference on Biofabrication. 27-29 September
12. Maria Forsyth, CI Deakin, Plenary Speaker at 4th International Conference on Emerging Advanced Nanomaterials ICEAN 2021. 18-22 October
13. Linda Wollersheim, PhD Deakin, Invited Keynote: "Mapping the main discourses in approaches to climate resilience and sustainable development" 10th International Workshop Advances in Cleaner Production. 11 November

Appendix 11: Invited Talks

Invited Talks or Panels by ACES Members in 2021

1. Michelle Coote, CI ANU, "The art of scientific writing", RACI 21st Australasian Polymer Summer School. 18 February.
2. Brett Paull, CI UTas, "Accelerating Instrumental Development in the Analytical Lab with Rapid Prototyping via 3D Printing" Pittcon (Virtual) Conference and Exposition 2021. 8-12 March
3. Mark Cook, CI UOM, "Efficacy of direct delivery of AED to the brain", Melbourne Epilepsy Meeting. 24-25 March
4. Robert Sparrow, RF Monash, "Why machines cannot be moral" University of Vienna, Department of Philosophy. 26 March
5. Saimon M. Silva, RF Monash, "Properties and applications of multifunctional lubricin coatings" Pacific International (Korea-Australia Joint) Online Workshop, "Engineered Materials in Medicine". 8-9 April
6. Michelle Coote, CI ANU, "Coming full circle: Adapting controlled radical polymerization for organic synthesis", American Chemical Society Spring 2021. 6 April
7. Chong-Yong Lee, RF UOW, "Electrolyte effects on the electrochemical reduction of CO₂" Virtual 2021 MRS Spring Meeting and Exhibit. 18-23 April
8. M Forsyth, CI, Deakin, Panelist at the Victorian Cleantech Expo. Victorian Cleantech Cluster partnered with Global Victoria to host the first Victorian Cleantech Expo. 21 April
9. Gerard Sutton, AI UOW, Invited Lecture Asia Pacific Academy of Ophthalmology. July
10. Gordon Wallace, CI UOW, "Innovation Translation: Non-technical skills", for the RPA Institute of Academic Surgery. 12 July 2021
11. Maria Forsyth, CI Deakin, International Conference on Solid State Ionics in Boston. 17-20 July
12. Gerard Sutton, AI UOW, Invited Lecture: Asia Society of Cataract & Refractive Surgeons. August

13.	Maria Forsyth, CI Deakin, IUPAC World Chemistry Congress 2021, Montreal, Canada, Chemistry for Energy theme, Symposium Electrochemical Energy Storage and Conversion. 13-20 August
14.	Luke O'Dell, AI Deakin, "Operando MRI for quantitative mapping of temperature and redox species concentrations in thermo-electrochemical cells", International Society of Magnetic Resonance (ISMAR) and Asia-Pacific Nuclear Magnetic Resonance (APNMR). 22-27 August
15.	Crook, Jeremy, CI UOW, "Building the tissue electric" 3rd Australian Bioprinting Workshop for Tissue Engineering and Regenerative Medicine. 4-5 October
16.	Robert Forster, AI DCU, "3D Electrodes for Enhanced Detection of Bacteria and Biofilms", 2021 Fall Meeting of the European Materials Research Society (E-MRS). 20-23 September
17.	Cristina Pozo-Gonzalo, RF Deakin, "Sustainable Neodymium Recovery Using an Electrochemical Approach" 240th Electrochemical Society ECS Meeting 10-14 October
18.	Cristina Pozo-Gonzalo, RF Deakin, "Insight on quality" at all-energy Australian 202, PV magazine virtual. 12 October
19.	Jeremy Crook, CI UOW, "Electrostimulation for synthetic biosystems" 3D Prosthetic & Advanced Reconstructive Translational Surgery (PARTS) Meeting. 27 September
20.	Attila Mozer, CI UOW, "Plasmon Excitation and Outcoupling in Quantum Mechanical Tunnel Junctions" APC 2021 11th Asian Photochemistry Conference. 1 November
21.	Susan Dodds, CI La Trobe, "Machine Learning in Medicine - questions of reliability and responsibility" Frontiers 2021: The Art, Science and Future of Otolaryngology Head and Neck Surgery. 3-6 November
22.	Maria Forsyth, CI Deakin, Invited Talk at the International workshop on Sodium-Ion Battery in Spain. 24 November
23.	Maria Forsyth, CI Deakin, Renewable Energy- batteries lecture (Syllabus and HPCD in Materials Design). 25 November
24.	Maria Forsyth, CI Deakin, 3rd POLYSTORAGE Workshop on Polymer-in-salt electrolytes based on polymerisable ionic liquids (PILs) with enhanced ion dynamics. 1 December
25.	Maria Forsyth, CI Deakin, "Enhanced Stability and Rate Performance of Sodium Batteries by Tuning SEI Formation Through Ionic Liquid Chemistry and Controlled Formation Cycles" 2021 MRS Fall Meeting, EN12, Advanced Materials and Chemistries for Low-Cost and Sustainable Batteries. 7 December
26.	Gordon Wallace, CI UOW, "3D Bioprinting—What Cells Find Attractive in a Gel", at Materials Research Society Fall Meeting Symposium - From Hydrogel Fundamentals to Novel Applications via Additive Manufacturing. 7 Dec
27.	Maria Forsyth, CI Deakin, "The potential for battery manufacturing in Victoria" State of Energy Research Conference (SoERC2021)/ERICA. 8 Dec

Appendix 12: Conference Presentations

A list of ACES conference presentations not listed in appendices above. Please note that the lists included in these appendices do not contain presentations by ACES members at ACES run events.

Conference Presentations by ACES Members in 2021

1.	L Wollersheim, PhD Deakin, "A Challenge to Big Grid? The impact of policy barriers on mid-scale projects owned by Renewable Energy Communities" APPN conference. 5 February
2.	Nuwan Hegoda Arachchi, PhD UOW, "Single Molecule Fibrinogen Adsorption and Dynamics on Functionalized Silica Nanoparticle Coatings Revealed by High-Speed Atomic Force Microscopy" 10th Australian Colloid and Interface Symposium. 8-11 February
3.	Thomas Blesch, PhD Monash, "Iron-based, symmetric, non-aqueous redox flow battery" virtual Royal Society of Chemistry (RSC) Poster Twitter conference. 2 March
4.	Hao Zhou, ECR UOW, "A 3D Printed Soft Prosthetic Hand with Embedded Actuation and Soft Sensing Capabilities for Directly and Seamlessly Switching Between Various Hand Gestures" AIM2021 Conference. May 2021
5.	Saimon Silva, AI Swinburne "Lubricin: a versatile protein for electroactive surfaces" RACI Chem2021, Showcasing Achievements of Victorian EMCRs. 12-13 July

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6.	Thomas Blesch, PhD Monash, "Iron-based, Symmetric, Non-aqueous Redox Flow Battery" 5th annual meeting UK redox flow battery network. 1-2 July
7.	Saimon Silva, AI Swinburne, "Lubricin (PRG4): A versatile protein for electrochemical sensing" 31st Anniversary World Congress on Biosensors. 26-29 July
8.	Jenny Pringle, CI Deakin, gave a contributed talk at the 15th International conference on materials chemistry (MC15). 13 July
9.	Alexander Harris, RF UOW, "Understanding Charge Transfer on the Clinically Used Conical Utah Electrode Array: Charge Storage Capacity, Electrochemical Impedance Spectroscopy and Effective Electrode Area" Aikenhead Centre for Medical Discovery Research Week. 2-6 August
10.	Chunyan Qin, PhD UOW, "Bipolar Electroactive Conducting Polymers for Wireless Cell Stimulation", 72nd Annual Meeting of the International Society of Electrochemistry. 30 August
11.	Saimon Silva, AI Swinburne, "Low-cost sensors for on-spot detection of PFAS" 72nd Annual Meeting of the International Society of Electrochemistry, Jeju, Korea. 1 September
12.	Danielle Warren, UOW PhD, participated in the Plymouth Electrophysiology and Imaging workshop. 1-17-September
13.	Malachy Maher, PhD UOW, "Comparison of collagen hydrogels for bioprinting and orthopaedic tissue engineering" International Conference on Biofabrication 2021. 25-27 September
14.	Jeremy Dinoro, PhD UOW, "Novel fabrication of High-Density Polyethylene via Selective Laser Sintering" International Conference on Biofabrication 2021. 25-27 September
15.	Sepidar Sayyar, AI UOW, Development of a 3D Printer for Printing Prosthetic Ear, International Conference on Biofabrication 2021. 25-27 September
16.	Andres Ruland, ECR UOW, "Standardized contact-less three-dimensional quantitative ultrasound imaging approach for cartilage regeneration analysis" International Conference on Biofabrication 2021. 25-27 September
17.	Kalani Ruberu, AI UOW, "Coupling Machine Learning With 3D Bioprinting to Fast Track Optimisation of Extrusion Printing" International Conference on Biofabrication 2021. 25-27 September
18.	Anna Kulaga, PhD UOW, "Development of models to improve vascularisation within islet-laden constructs with 3D bioprinting" International Conference on Biofabrication 2021. 25-27 September
19.	Grishmi Rajbhandari, PhD UOW, "Printing Flexible Antennas for Cochlear Implants" International Conference on Biofabrication 2021. 25-27 September
20.	Cathal O'Connell, AI RMIT, "3D MEW: Melt-electrowriting upon sacrificial collectors to create complex, human scale, three-dimensional scaffolds for tissue engineering" International Conference on Biofabrication. 27-29 September
21.	Johnson Chung, AI UOW, "A bioprinting approach to regenerate cartilage for microtia" International Conference on Biofabrication. 27-29 September
22.	Alexander Harris, RF UOW, "A framework for assessing the emergence of novel behaviours in complex systems - demonstrated in neural tissue" International Conference on Biofabrication. 27-29 September
23.	Cristina Pozo-Gonzalo, RF Deakin, "Sustainable Neodymium Recovery Using an Electrochemical Approach" 240th the electrochemical Society ECS Meeting. 10-14 October
24.	Cristina Pozo-Gonzalo, RF Deakin, "Insight on quality" at all-energy Australian 2021, PV magazine. Virtual 12 October
25.	Carly Baker, PhD UOW, PolyNSW symposium: Functionalisation of polythiophene derivatives with cholesterol for biointerface applications, 15-16 November
26.	Jenny Pringle, CI Deakin, "Development of New Ionic Electrolytes by Tailoring the Cation, Anion and Molecular Structure" Materials Research Society Fall Meeting, 6-8 December

Appendix 13: Invited Seminars/Collaborative Research Visits

ACES Invited Seminars/Collaborative Visits Showcasing Research Activities in 2021

1. Robert Forster, AI DCU, Presented Virtual Seminar, "Early Detection of Disease to Improve Health", with Our Lady Of Mercy College, Beaumont, Dublin. 19 January
2. Robert Forster, AI DCU, Presented Virtual Seminar, "What Happens When you Flush the Loo! Electrocuting Pollutants" to Celbridge Community School, Moortown, Maynooth Road, Celbridge, Co Kildare. 8 February
3. Faezeh Makhlooghiazad, PhD Deakin, spoke at Institute for Frontier Materials (IFM) staff meeting on "Zwitterion-based electrolytes as a novel electrolyte for battery applications". 11 February
4. Mitchell St Clair-Glover, PhD UOW, attended West Wollongong Rotary Club to present as an Australian Rotary Health scholarship recipient, speaking to club members about research and IPRI/ACES. 24 February
5. Robert Forster, AI DCU, Invited Virtual Seminar: "Disease Diagnosis: Retrospect and Prospects" Royal College of Surgeons in Ireland, FutureNeuro Centre. 26 February
6. Michelle Coote, CI ANU, visited (in person) Flinders University for meetings and to present a seminar, "Electrochemical and Electrostatic Catalysis of Chemical Reactions". 4-5 March
7. Michelle Coote, CI ANU, presented an invited seminar (virtually) at Queensland University of Technology, "Electrochemical and Electrostatic Catalysis of Chemical Reactions". 10 March
8. Robert Forster, AI DCU, Virtual Seminar, "Future Medicine: From Finger Prick to Wearable Sensors", Ard Scoil Ris, Dublin. 29 April
9. Alici Gursel, CI UOW, speaker, BioMedTech - Discover Your Edge (Networking Event) organized by UoW-ICRU. 5-May
10. Maria Forsyth, CI Deakin, gave an invited talk at the FBICRC 2021 Participant Research Forum. 19 May
11. Mitchell St Clair-Glover, PhD UOW, presentation for neurodevelopment and neurodegeneration lab group at IHMRI. 25 May
12. Johnson Chung, RF UOW virtual presentation for Jonathan Clark's group at Chris O'Brien Lifehouse for research collaboration. 21 June
13. Sujani Abeywardena, PhD UOW, attended the virtual Micro-engineering Winter School 2021 Organized by ANFF - South Australia. 13-16 July
14. Si-Xuan Guo, RF Monash, presented "Strategies for Enhancing the Activity of Bismuth for Electrochemical Reduction of Carbon Dioxide", and "Fourier transformed large amplitude ac voltammetry, and its applications in the mechanistic studies of CO₂ reduction", at the Monash-Newcastle University (UK) collaboration workshop. July 2021
15. Mitchell St Clair-Glover, PhD UOW, started new collaboration with UWA (Peripheral neuropathies and fibrosis), continuing collaborations with UOM (Friedrich's Ataxia therapeutic delivery) and with UNSW/Cochlear Ltd. (*In vitro* modelling of Cochlear implants and pathologies). 11 August
16. Mitchell St Clair-Glover, PhD UOW, participated in a webinar held with local high school students (Illawarra region) to discuss the 'World of Stem Cells' during National Science Week, including an overview of my research at ACES, IPRI, and IHMRI. 17 August
17. Mitchell St Clair-Glover, PhD UOW, held a webinar with high school students (Illawarra region) to discuss the careers in STEM. 3 September
18. Caiyun Wang, RF UOW, attended the UOW-ANSTO Joint Workshop. 9 September
19. Danielle Warren, UOW PhD, attended the ISSCR International Symposium. 13-15 September
20. Maria Forsyth CICECO research institution in materials science in Portugal. 29 September
21. Jeremy Crook, CI UOW, Invited Talk, School of Biomedical Engineering, The University of Sydney, "Advanced Tissue Engineering for Biomedical Innovation". 8 October
22. Jeremy Crook, CI UOW, Invited talk Polymer Electronics Research Centre & MacDiarmid Institute for Advanced Materials and Nanotechnology, University of Auckland "Electrostimulation for synthetic biosystems". 11 October
23. Mitchell St Clair-Glover, PhD UOW, conducted a speech delivered to West Wollongong Rotary Club and Australian Rotary Health (PhD Scholarship funding partners) – 'What the rotary scholarship means to me'. 20 October
24. Linda Wollersheim, PhD Deakin, presented research findings at Discussion Paper Launch Event and participated as a Panel Discussant, Building prosperous, just and resilient zero-carbon regions webinar event, Melbourne Climate Futures, UOM. 21 October
25. Danielle Warren, UOW PhD, attended the 2021 EMBL Australia PhD Course. 22-26 November

Appendix 14: ACES International Events

2021 Global Engagement Event Description	Date	Venue
1. 15th Annual International Electromaterials Science Symposium The annual International Electromaterials Science Symposium brings together leaders in electromaterials science research across a broad range of disciplines in electromaterials science research across a broad range of disciplines.	3-5 Feb	Virtual
2. International Society for Biofabrication 2021 Conference Biofabrication 2021 had over 400 people registered for the conference and 17 different countries represented by attendees. This was the first time the conference was held entirely online. The conference featured experts in the field of bioprinting, biofabrication, medicine, and engineering.	27-29 September	Virtual
3. ACES Full Centre Meeting ACES is internationally recognised as a leader in electromaterials research, focused on turning our fundamental knowledge of cutting-edge materials into the next generation of 'smart devices' for the benefit of the community. Our Full Centre Meeting is a fantastic opportunity to gain insights into developments in electromaterials research, how our work has real world applications to build new innovations and industries, and opportunities for engagement between researchers, industry and end-users. Hear the latest on electrofluidics and diagnostics, synthetic energy systems, synthetic biosystems, soft robotics, and 3D electromaterials, as well as ethics, policy and public engagement considerations associated with these new technologies.	7-8 June	Hybrid in person and virtual
4. Forging New Frontiers in 3D Printing for Medicine Andhra Pradesh MedTech Zone (AMTZ), India in collaboration with ACES UOW is hosting a collaborative forum and panel discussion on 3D Bioprinting for Precision Medicine and Therapeutics. The forum hosted speakers from clinical, scientific, academic backgrounds for an insightful discussion, featuring: Prof Gordon Wallace CI UOW Dr Payal Mukherjee and Dr Sophie Fleming: 3D Printed Ears Prof Toby Coates: Islet Cell Transplantation Prof Jaishankar Raman: Fabrication of Heart Valves Prof Gerard Sutton: The Bioengineered Cornea Prof Jonathan Clark: 3D Printing for Bone Regeneration	12 Dec	Virtual
5. ACES Legacy Symposium Celebrating the legacy of ACES, the symposium featured presentations from ACES alumni and recent graduates as well as a session on innovation and entrepreneurship, special panel discussion and more.	2-3 December	Virtual
6. ACES Impact Symposium The symposium will feature presentations from ACES chief investigators, theme leaders and more. This will be our final opportunity to get together to celebrate ACES.	17 February 2022	Virtual

Appendix 15: International Academic Visitors

The list below does not include visitors to ACES as part of events or conferences that ACES organized throughout 2021. The list also contains virtual visits in-line with COVID-19 travel restrictions.

ACES International Academic Visitors 2021

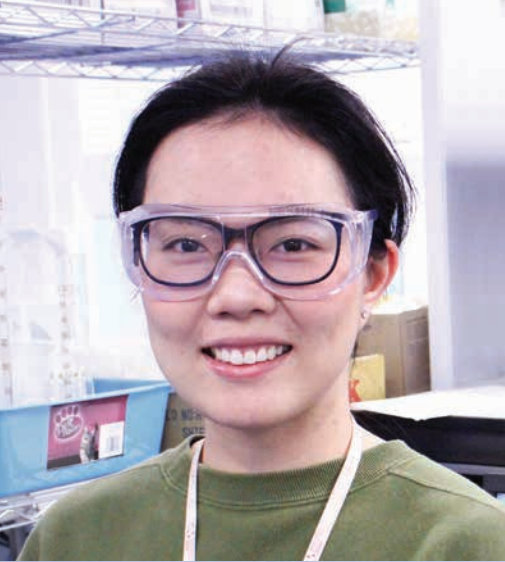
1. Dr Preston Sutton, SNF Postdoc. Mobility Fellow with Deakin University for 2 year period from February 2020 – 2022.
2. Jeremy Crook, CI UOW met with Prof Glyn Stacey, International Stem Cell Banking Initiative and Chinese Academy of Sciences, meeting re: collaborative activity for joint manuscript relating to Human Pluripotent Stem Cells in Research and Cell Therapy Products. 11 March
3. Prof Tadaharu Ueda, Kochi University, Japan, had a virtual meeting with Si-Xuan Guo, RF Monash, Jie Zhang and Alan Bond, Monash, to discuss results on our collaborative project on the study of electrode kinetics of vanadium-containing polyoxometalates using FTacV. 29 April
4. Fangfang Chen, RF Deakin, had a meeting with Prof. Daniel Brandell and Dr. Jonas Mindemark (Uppsala University, Sweden), Dr. Jelena Popović-Neuber (Max Planck Institute for Solid State Research), Prof Yoichi Tominaga (Tokyo University of Agriculture and Technology), Naomi Nishimura (Tokyo University of Agriculture and Technology) to discuss about a collaboration to write a review paper "Polymer-in-salt electrolytes". 11 May and 22 June
5. Dr Cristina Pozo-Gonzalo was visited by Prof. David Mecerreyes for Ionogels for sodium-air batteries. 6 October
6. Dr Cristina Pozo-Gonzalo was visited by Dr. Nagore Ortiz-Vitoriano for Hybrid electrolytes for sodium-air batteries. 7 October
7. Dr Francesco Mazzali is visiting from Faradion in the UK for cell testing for at least 6 weeks visiting Rob Kerr and Patrick Howlett CI Deakin. 1-31 May
8. Yady Castillo, PhD Deakin, started an international collaboration with Vera Bocharova, from the Department of Chemistry at the University of Tennessee to study OIPC/Poly-TFSI-LI composite interphases, 30 March

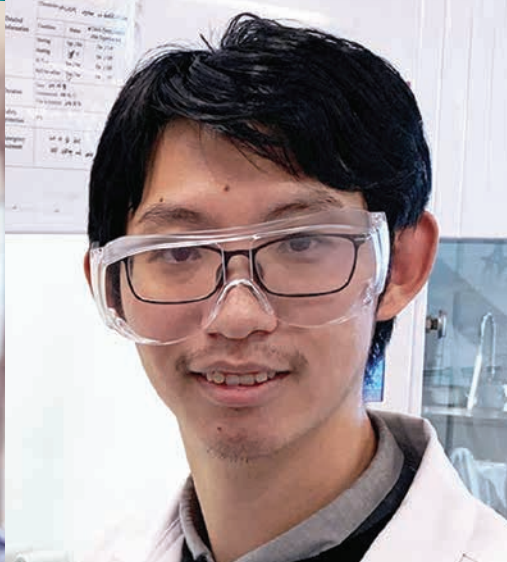
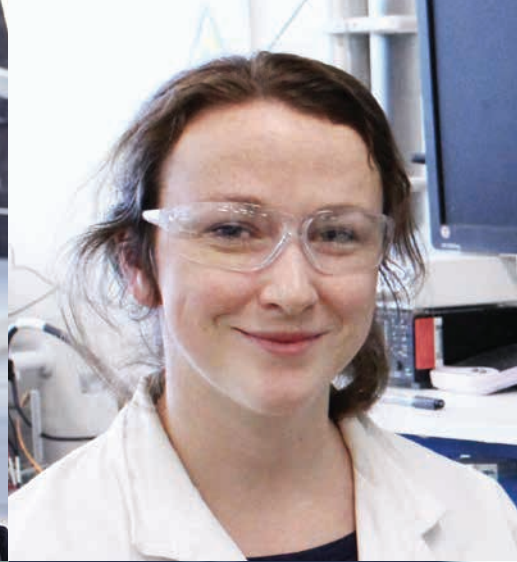
Appendix 16: National Academic Visitors

The list below does not include visitors to ACES as part of events or conferences that ACES organised throughout 2021.

ACES National Academic Visitors 2021

1. LKM Address: Celebrating the life of Leon Kane-Maguire, one of Australia's great scientific minds, the Address featured a panel of special guests for a presentation on the pros and cons of collaborative research. The panel included ACES Chief Investigators Prof Geoff Spinks and Prof David Officer as well as UOW Biomechanics Research Laboratory's Prof Julie Steele and former ACES Chief Operating Officer Dr Toni Campbell. 9 February
2. Patrick Conaghan and Alison Campbell met with Attila Mozer, CI UOW, to discuss collaborations in time resolved spectroscopy. 19 February
3. Professor Liming Dai (UNSW) visited ACES UOW to present his research and tour the facilities. Professor David Officer, CI UOW, presented on EFG. 26 February
4. Seminar: Bio-Interfacial Interactions and Antimicrobial Nanomaterials, presented by Dr Aaron Elbourne (RMIT) virtual. 4 March
5. Dale Duncan, Monash University, visited Dr. Faezeh Makhlooghi Azad, RF Monash to use laboratory and equipment for their experiments. 3 and 22 March
6. Harriet Wiley, Flinders University, visited Michael Higgins, CI UOW, to discuss collaboration projects. 17 March
7. Clayton Manasa, Swinburne University, visited Wren Greene, AI Deakin, to use laboratory and equipment. 21-22 March
8. Muhammad Fairuz, University of Newcastle, visited Johnson Chung RF UOW, to work together. 21 May
9. Nick Duncan visited Prof Patrick Howlett. 25 May
10. Mark Howard, CI Monash, met with Prof Patrick Kwan from Monash/Alfred Neuroscience department to discuss collaboration on health technology assessment of prototype microfluidic point-of-care COVID-19 diagnostic. 3 and 31 May
11. Johnson Chung, RF, UOW met with Arnab Ghosh Uni of Newcastle. 18 June







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ARC Centre of Excellence for Electromaterials Science
University of Wollongong, Innovation Campus
North Wollongong NSW 2500 Australia
+61 2 4221 3127
www.electromaterials.edu.au

University of Wollongong
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Hanyang University
University of Warwick
Yokohama National University