ARC Centre of Excellence for Electromaterials Science

ANNUAL REPORT 2016

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Welcome

Our vision is to be the pre-eminent world centre for research in the field of electromaterials science and integrated device assembly.

This report shows how we have addressed our mission:

- To use our research into advanced materials to deliver innovative device solutions for clean energy and medical bionics.
- To deliver research programs that produce world-class graduates with not only exceptional technical skills, but skills in science communication, research management, commercialisation, and an awareness of the impact of their research.
- To realise commercial opportunities for our research through delivery of step-change technologies that positively impact on quality-of-life issues for the global community.
- To educate, inspire and engage stakeholders and the broader community, by effectively communicating our research messages.

THE ACES PARTNERS

We have established a global network of partners that will be integral to our success in research, training, commercialisation and engagement. ACES welcomed a new Australian node in 2016–Swinburne University of Technology. ACES, led by the University of Wollongong, now incorporates seven Australian collaborating organisations and five international partner institutions known for their expertise in materials and device fabrication.

The collaborating organisations are Deakin University, Monash University, University of Tasmania, The Australian National University, The University of Melbourne and Swinburne University of Technology. Approval has been sought for the University of NSW to join ACES.

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 possesses key research strengths that when combined, place ACES in a powerful position to design, discover and develop new electromaterials.

OUR FUNDING

The Australian Research Council invested $25 million in ACES over 2014-2020 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 also invested $500,000 through its Research Attraction and Acceleration Program (RAAP) to help us facilitate the commercialisation of our research.

This is to assist in developing innovative approaches that encourage entrepreneurship and commercialisation.

As we work towards our goals, we embrace the challenge of training the next generation of multidisciplinary research leaders, and providing new manufacturing and industrial opportunities for Australia.

The challenges are numerous, but the opportunities are even greater. The ACES team is committed to building a knowledge base in an environment that ensures effective training which will be used to deliver economic returns for Australia.

VALE PROFESSOR LEONE SPICCIA

One of our longest standing ACES Chief Investigators Professor Leone Spiccia passed away during 2016.

Leone had been fighting cancer for several years.

Professor Leone Spiccia commenced his university studies at the University of Western Australia in 1975 and graduated with BSc Honours (1978) and PhD (1984) degrees in physical and inorganic chemistry, with the latter being completed under the supervision of Professor Don Watts and Dr Jack Harrowfield.

Following postdoctoral positions with Professors Tom Swaddle (Calgary, 1983-84), Werner Marty (Neuchâtel, 1984-86) and Alan Sargeson (ANU, 1986-87), he took up an appointment as Lecturer in Chemistry at Monash University (1987). He was promoted to Reader in 1999 and Professor of Chemistry in 2006.

Leone held various major administrative positions including Deputy Head of the School of Chemistry (2002-06), and Deputy Dean and Associate Dean Research of the Faculty of Science (2006-08).

He was a member of the ARC College of Experts (2008-10) and Chair of the Physics, Chemistry and Earth Sciences panel in 2010. He was member of the international advisory boards of several leading journals, including NanoEnergy and Inorganic Chemistry, and the International Organising Committee of the International Conference on Photochemical Conversion and Storage of Solar Energy.

Leone received several prestigious awards in recognition of his research contributions in inorganic and materials chemistry. He was also honoured through a Forschungszentrum Dresden-Rossendorf Fellowship (2007), a Specially Appointed Professorship in the Catalysis Research Centre at Hokkaido University (2012) and a von Humboldt Senior Fellowship (2010).

In 2013 Leone was awarded the RACI Inorganic Division Burrows Award for contributions to research in inorganic chemistry. The Award commemorates George Joseph Burrows (1888-1950), who made important contributions to coordination chemistry over twenty one years.

In accepting the award Leone noted "*It most importantly is testimony to the world-class research that the students and postdoctoral fellows working in my group have carried out over my whole career. It would also not have been possible without their inspiration, dedication and commitment to hard work. It also recognises the tremendous contributions made to our research by our collaborators from many parts of the world, including many members of ACES*".

During his career Leone supervised more than 55 students and more than 50 postdoctoral fellows. In recognition of his supervisory excellence, he received the 2005 Vice Chancellor's Award for Postgraduate Supervision from Monash University. He and his team authored more than 300 refereed publications and four patents.

Professor Doug MacFarlane, ACES Node Leader at Monash said "*Leone was a tremendous member of the ACES team from the origins of the Centre and we will miss him greatly. He combined a terrific sense of good humour with a clear vision of how to do excellent science. He was an inspiration to us all*".

"*Leone's great work within ACES will continue with his team, and his important contributions to the big picture goals that we all seek to achieve will always be remembered,*" said Director Gordon Wallace.

Director's Report

"I still leap out of bed each morning excited by the prospect of what the day will bring—excited by the unknown."

I am privileged to work alongside some of the most talented and committed researchers in Australia, many drawn from across the globe. I am constantly in awe of their ingenuity and their determination to find a way through the multi-dimensional scientific maze we often find ourselves in.

ACES researchers are committed to building a body of knowledge that enables us to harness the inherent properties of newly discovered electromaterials by creating 3D structures wherein appropriate mechanical properties and active components are distributed. We have already demonstrated the impact this can have in the:

- Soft Robotics (SR) theme, where the ability to distribute mechanical properties in three dimensions (3D) has helped us realise a soft prosthetic hand prototype.
- Synthetic Energy Systems (SES) theme, where the ability to distribute catalytic reactive centres throughout 3D electrodes is helping us build systems that can be used to convert carbon dioxide into useful fuels such as ethanol. The creation of 3D structures using the most advanced electromaterials with distributed active centres has also enabled us to deliver better energy storage devices and thermal energy conversion devices.
- Synthetic Biosystems (SBS) theme, where the ability to distribute other active centres—living cells—throughout appropriate softer structural materials is bringing us closer to clinical applications as well as enabling us to engage in unprecedented fundamental studies. The positioning of stem cells throughout a 3D structure and studying the effect on the environment we have created is providing extraordinary fundamental insights.
- Electrofluidics and Diagnostics (EFD) theme, where the ability to create 3D structures means that we can build systems wherein we have precise control over fluid movement and indeed movement of specific molecules contained in these fluids. Such control is enabling advances in new flow battery technology, as well as diagnostic systems to interrogate our three dimensional structures containing living cells. This is an important aspect of our 'brain on the bench' project—established to obtain insights into the development of diseases such as epilepsy and schizophrenia.

These advances place us at forefront of these areas of research nationally and internationally. Being at the forefront we must also engage as a research community on issues that arise in our Ethics, Policy and Public Engagement (EPPE) theme.

We would not have contemplated embarking on these challenging programs had we not been confident we could rely on our national and international collaborators. We need to be innovative in how we establish and maintain such collaborations. We understand we need to invest in identifying and building collaborations so they are strong and productive—we know this does not happen by accident—it requires substantial time and resources.

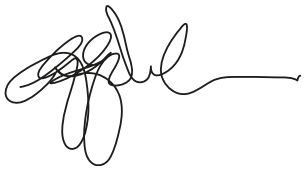
ACES is committed to being at the forefront of research training initiatives. We understand technical research training is at the core of what we do—but today's researcher needs more than that. Skills in communication are essential; in how to engage across disciplines as well as at many levels in our community. For students to have an awareness of ethical and policy issues that will arise from our research is important. It is critical they are trained to have the ability to bring our communities along with us on the research journey.

Our online engagement program (Massive Open Online Courses [MOOC] on 3D Bioprinting) has already provided over 20,000 people with an awareness of our research activities across the globe. Through our training programs we are putting the ability to create back in the hands of the creative. The next generation of researchers is poised to achieve much more than we have achieved.

Engagement with end-users is to ACES a natural part of our knowledge building pipeline. Multiple outlets from this pipeline ensure we are engaged at many levels with idea flows to existing industries, to emerging industries, and to new commercial ventures. ACES researchers are committed to engagement.

It is highly effective engagement at many levels that has enabled our success in research to date. This engagement enables us to tackle big challenges together. These are challenges critical to society in developing new energy systems and providing new insights into the development and treatment of debilitating diseases such as epilepsy and schizophrenia.

Of course none of this is possible without the commitment of highly talented individuals across our ACES research, administration, communication and governance teams. These teams of individuals together bring a special type of resilience—an underrated quality so essential to success in research. I thank all of my colleagues and our collaborators for being an important part of this exciting journey!



PROF GORDON WALLACE
Executive Director of ACES

International Advisory Committee Report

The IAC acknowledged the tragic loss of ACES Chief Investigator Prof Leone Spiccia late in 2016. His contributions to ACES since its inception in 2005 were enormous. Leone remained an active contributor to ACES throughout 2016 despite his struggle with illness—a testimony to his commitment to the ACES shared vision. ACES personnel will continue to progress his vision in honour of his memory.

RESEARCH REPUTATION

ACES members were recipients of a number of prestigious honours in 2016 and early 2017. Special mention and congratulations to the ACES Director and Deputy Director, ARC Laureates Gordon Wallace and Maria Forsyth, for their five awards which resulted from contributions to brilliant and innovative research outcomes, toward the understanding and improvement of materials, as well as commitment and passion for research collaboration, leadership and innovation.

These awards are testimony to the ability of ACES to undertake highly innovative and potentially transformational research leading to a significant increase in capabilities and knowledge.

As Gordon stated in acceptance of the Eureka prize "*these awards acknowledge the ability of ACES and its partners to take fundamental discovery to real applications. It takes an integrated, cohesive and committed team to achieve this*".

It has been realised through ACES and their achievements that an effective research team, appropriately governed, bring about much, much more than the sum of their parts. Building collaborations is essential to progress multidisciplinary scientific research that tackles big global challenges.

Key performance indicators were exceeded during 2016. This adds to the ACES reputation to serve as a point of interaction among higher education institutions (directly partnered with seven national universities and five international universities), publishing with researchers from 124 institutions in 35 countries in 2016.

The aim to add to its global engagement activity by establishing a small number of strategic alliances with other international Centres in 2017 will only strengthen this global research reputation.

RESEARCH TRAINING

ACES graduates are trained to be flexible, creative and innovative in approaches to problem solving. The ACES research environment provides the opportunity to be immersed in interdisciplinary training that spans the continuum from ideas to industry.

ACES graduates have opportunities to translate their cutting edge research into the understanding of materials science and fabrication into next generation health and energy devices—developing new materials for bionics, energy harvesting and storage, soft robotics and microfluidics. Increasingly, they are seeing that new discoveries and new PhD projects are occurring in the convergence of chemistry, materials science, nanotechnology, biology and mechatronics.

ACES also provides training in science communications, ethics and public engagement, entrepreneurship and business management. Much of the additional training is in the form of short courses.

What a fantastic success story that has been!

The 3D bioprinting MOOC has provided an effective and efficient conduit for the introduction of this rapidly emerging topic. More than 20,000 people have engaged with the MOOC to date demonstrating the relevance of 3D bioprinting today.

This MOOC ties in with the formal qualification courses of the 'Masters in Philosophy (Biofabrication)', run by the University of Wollongong, with a Department of Education and Training Grant and ACES support, and the Doctor of Philosophy scholarships starting in 2017 through the ARC Training Centre in Additive Biomanufacturing. Having this pipeline of educating the next generation of graduates in 'Biofabrication' and 'Additive Biomanufacturing' is set to transform the foundations of manufacturing and medicine. The job descriptions are not well defined as yet because it is an emerging field but it is sure to open up a myriad of opportunities for these new graduates.

TRANSLATION

ACES is very well placed to advance applications—the underlying knowledge and available fabrication, prototyping, characterisation tools that have high level impact in the application domains places ACES in a great position. ACES, in partnership with ANFF, provide state-of-the-art facilities and highly skilled personnel in materials research and its application in the energy and health arenas.

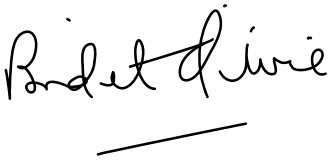
As expected the ACES end-user network has grown substantially in 2016. Events with clinicians, industry and government entities facilitated such developments.

ACES staff are active and thoughtful in their efforts to translate the generated knowledge in materials science—CRCs, ARC linkage hubs, ARC linkage projects, NHMRCs and direct links with industry.

"To me, the key translational outcome for scientists who are based in a university is to produce well trained people for the benefit of society. ACES and its many partners are exceptionally committed to and successful in this activity.

The unusually strong collegiate and collaborative atmosphere this group has created is fundamental to its success in this and all its work. IAC members were universally impressed by this and what it has achieved and is likely to continue to achieve and think.

It is a pleasure and privilege to be associated with ACES."



DR (DAME) BRIDGET OGILVIE (AC, DBE, FAA, FRS, FMEDSCI)
Chair International Advisory Board for ACES

ACES Research

ACES STRATEGIC PLAN GOAL 1: RESEARCH

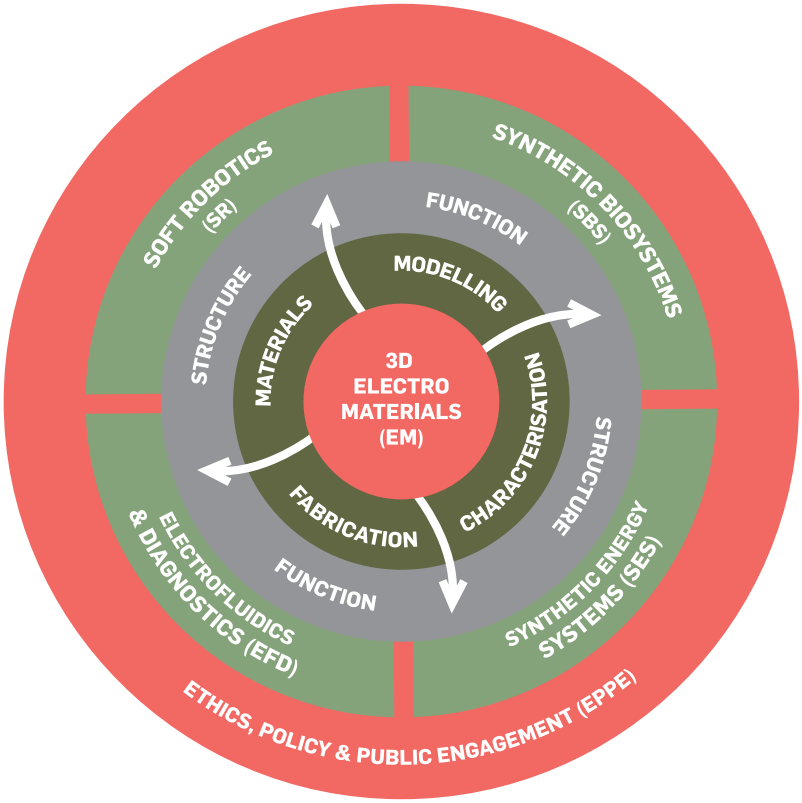
Our goal is to deliver integrated nanoassembly and fabrication technologies with the capacity to build electrochemical systems by drawing on advances in materials, 3D printing and fibre spinning, characterisation and modelling.

TOWARDS OUR GOAL

Our focus to date has been to identify and develop materials amenable to 3D fabrication, and with inherent properties that result in structure-function performance of relevance to one or more of the strategic application themes. Progress has been enabled by simultaneous development of new characterisation and fabrication tools as well as modelling approaches to support the experimental program.

After 2.5 years of ACES research, there have been outstanding advancements in the development of Generation 1 materials (as listed in the 2015 annual report) and excellent progress towards Generation 2 materials (Table 1) that are amenable to 3D assembly using customised fabrication approaches.

Since the common requirement across all themes is to construct 3D structures in which the spatial distribution of the required functional elements can be controlled, the effect of 3D structure on the common functions of charge transfer, reaction centre reactivity and structural support has been a primary focus through structure-function studies.



Schematic: ACES core 3D Electromaterials theme and associated application themes

These have been undertaken within each of the technical theme areas, leading in some cases to the development of devices. Some of those developments, along with more fundamental material and structure-function studies, are described in 'Research in Action case studies' placed throughout this report.

3D ELECTRO-MATERIALS

The common requirement across all the ACES research themes is to construct complex 3D structures in which the spatial distribution of the required functional elements can be controlled. Therefore, assembly and fabrication of suitable electromaterials that have been developed through appropriate characterisation and modelling are the key components of the 3D Electromaterials theme. ACES is one of the few research centres worldwide that integrates material development and fabrication in this way.

Several studies to elucidate the electrochemical and catalytic (reactive) properties of individual materials, structures and systems have been carried out using both modelling and experimental techniques.

Table 1: Generation 2 materials

Composition	Structural	Electromaterial	Reaction Centre	Fabrication
Layered transition metal dichalcogenides including MoS_2	✓	✓	✓	Film formation or 3D printable
2D nanocarbon such as carbon nanodots	✓	✓	✓ after functionalisation	Film formation
Graphene composites	✓	✓	✓	Film formation or 3D printable
Metal-graphenic composites	✓	✓	✓ after functionalisation	3D metal printing
New metal powders such as Cu/Ni	✓	✓	x	3D metal printing
Metal organic frameworks (MOFs)	✓	✓	✓	Self assembled films or printed
Gallium alloys	x	✓	x	3D printable
Co/Ni/Fe complex redox mediators	x	✓	x	Printable as liquids or gels
Modified NIPAM hydrogels	✓	x	x	Printable or film formation
Phosphonium ionic liquids	x	✓	x	Printable or film formation
Nanocellulose	✓	x	✓ wound healing	3D printable
Methacrylated hyaluronic acid (HAMA)	✓	x	x	Printable ink
Methacrylated chitosan (ChiMA)	✓	x	x	Printable ink
Methacrylated ulvan (UlvMA)	✓	x	x	Printable ink
Methacrylated gellan gum (Gellan Gum MA)	✓	x	x	Printable ink
Gellan gum RGD	✓	x	x	Printable ink

ASSEMBLY AND FABRICATION

While it is critical that electromaterials are designed with their fabrication in mind, it is of equal importance that novel methods of assembly of materials are developed to ensure that the properties encountered in the nanodomain are maintained in structures with dimensions that are practically useful. Over the last year, ACES researchers have developed a number of new approaches to electromaterial assembly and fabrication in areas such as electrode fabrication and bioprinting.

This is beautifully illustrated by ACES graphene research in which a number of different graphene-based materials have been produced to suit either the fabrication method or the theme application. Liquid crystalline dispersions of large graphene oxide (LCGO) platelets are stable and viscous enough to utilise in a number of differing assembly or fabrication methodologies, and the resulting non-conducting graphene oxide (GO) structures can then be converted to conducting graphene based structures. Thus, freeze dried aqueous LCGO dispersions were used to form graphene based aerogels with enormous surface area that ensured high charge storage capacity for SES applications such as batteries or supercapacitors.

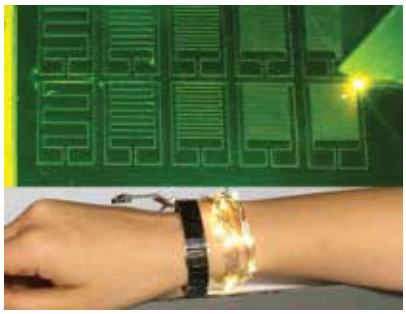
Research in action: Thermocells

Challenge: Providing alternative means of generating energy from a thermal source.

Solution: Thermocells promise clean, continuous energy. In a nutshell, this device generates clean energy from waste heat. A thermocell is similar to a battery in that it consists of two electrodes in contact with an electrolyte. The advantage of the thermocell is that the device never needs to be recharged—energy conversion is instant and continuous as long as one electrode is heated and the other is kept cold. Unfortunately, progress in this field to date has been limited and the fundamental science behind the temperature response of different electrolytes is poorly understood. Thermocell development is a core-funded research activity in ACES that recognises the urgent need for the sustainable generation of energy. ACES research tries to understand the science behind the chemical reactions occurring in the thermocell and the effect of safer, alternative electrolytes such as ionic liquids that can access readily available sources of heat energy. ACES published a paper (Faraday Discussions, 2016), that examined the effect that the unique chemical structure of selected ionic liquids had on the performance of the thermocell. As a result of these studies, we achieved the highest Seebeck coefficient (a measure of voltage produced per degree temperature difference) published so far for ionic liquid-based electrolytes.

Engagement: This work involves collaboration with ACES IAC member Prof Ray Baughman from the University of Dallas Texas.

Impact: The research has allowed us to draw conclusions that will help future choices of ionic liquids for this application. There are presently hundreds of ionic liquids and new ones being synthesised on a regular basis. Being able to choose the best one as a result of a deeper understanding of the chemical structure and electrolyte function would be a big step forward in this field.



Flexible supercapacitors from graphene that can drive LEDs.

Modification of this aerogel approach to include a second 2D material such as molybdenum disulphide (MoS_2) has provided exciting new composite electrode materials for batteries. A highly porous MoS_2/reduced graphene oxide (rGO) hydrogel can be formed by mixing an ACES developed aqueous MoS_2 dispersion with the LCGO dispersion. Freeze drying the resulting hydrogel retains the porous structure to give a high surface area battery electrode.

Using wet spinning, graphene fibre microelectrodes can also be produced from LCGO. These are proving to be highly effective for MRI imaging and neural recording in international collaborations as part of our Synthetic Biosystems (SBS) theme.

Aqueous and organic dispersions of small chemically converted graphene (CCG) platelets require combination with host structural materials to facilitate fabrication. A number of biopolymers including chitosan and methacrylated gelatin (GelMA) have proven to be excellent host materials. Conducting polymers such as PEDOT have also proven to be excellent hosts enabling subsequent fabrication. A notable example of this approach in 2016 was the drop-casting of a graphene-PEDOT/PSS composite film onto a conductive substrate and the subsequent laser-etching of an appropriate pattern into the composite film. In this way, flexible micro-supercapacitors with high energy density have been constructed.

The micron size graphene sheets have also proven to be an excellent platform on which to immobilise nanodimensional catalysts. SES researchers have assembled the 2D material MoS_2 onto the graphene in a polymer graphene composite and shown that the resulting assembled structure is a highly efficient and selective electrocatalyst for the reduction of carbon dioxide (CO_2) to carbon monoxide (CO) in water.

CCG dispersions have been used to coat preprinted structures. A highly porous graphene based 3D scaffold for tissue engineering has been created in this way by 3D printing a porous polymer (PDMS) structure and then coating it with micron size graphene nanoplatelets from an aqueous CCG dispersion. This structure has proven to be an excellent substrate for cell growth, adhesion and differentiation.

Traditional materials have been utilised to fabricate exciting new 3D structures. 3D metal printing has been used to create a range of novel electrode configurations based on titanium (Ti), stainless steel (SS), copper (Cu) and nickel (Ni) as well as Ti/graphene. Our ability to further modify these 3D printed electrodes with reaction centres or electromaterials creates enormous potential for these structures in electrochemical devices. The same chemistry that was used to functionalise graphene is being explored for the functionalisation of the Ti/graphene electrodes.

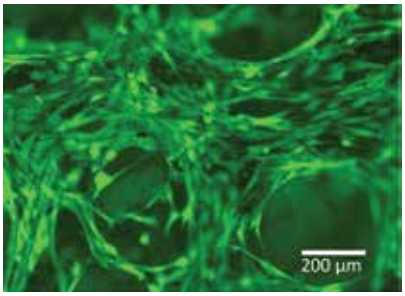
An intriguing example of the value of this capability to 3D print metal electrodes was explored in a study on the potential controlled or electrotactic movement of ionic liquid droplets, a project with PI Diamond. Four electrodes were 3D printed and embedded in a polymer channel cross in order to demonstrate droplet movement between the electrodes by varying the electrode polarities.

3D metal printing is also proving valuable to create new analytical chemistry devices in the EFD theme with the 3D printing of titanium microbore columns containing polymer monoliths for reversed phase liquid chromatography.

Another goal was to assemble systems that allow us to study the interaction of electromaterials with reactive centres in 3D systems; particularly challenging when the reactive materials are living cells. This has required the development of bioinks that allow the printing of structures that contain living cells or at least will support the subsequent introduction of living cell-containing formulations. The development of bioinks based on either methacrylated gelatine (GelMA), Gellan Gum or CMC agarose have enabled us to succeed on both fronts. As a result adipose stem cells have been printed in a GelMA bioink, primary neuronal cells in a Gellan Gum based bioink and neural stem cells and iPS cells in a CMC agarose bioink.

The challenges encountered in printing living cells have caused us to continue to refine printing protocols and build new machinery. Thus, the Biopen, a handheld device for surgical printing of adipose stem cells at a wound site, has been modified to provide onboard irradiation capabilities that allows for the crosslinking of the GelMA bioink containing the live cells.

The production of fibres has been a key technique for the 3D fabrication of electromaterials in ACES, as has been described above for graphene fibres. Carbon fibres have been used to fabricate supercapacitor devices, including microporous carbon functionalised carbon fabric based flexible devices and fibre like devices made of carbon fibre electrode twisting. Biocompatible fibres have also been fabricated for drug delivery.



New methods of fibre spinning have been developed to create different types of fibres such as core shell electromaterial fibres. Biopolymeric continuous core sheath fibres, with an inner core of chitosan and alginate as the sheath or an inner core of graphene and chitosan as the sheath had previously been wet spun. This has now been extended to triaxial fibres with conductive polymer inner and outer layers sandwiching a biopolymer layer. These two electrode fibres showed good electrochemical and mechanical properties, as well as cytocompatiblity, which make them useful for potential applications as biosensors, electrodes, tissue scaffolds or biobatteries.

A new printing approach developed by ACES allows distribution of preformed fibres throughout a 3D printed structure as the core of a coaxial print.
A combination of wet spinning and in line electrospinning has enabled a continuous process wherein micron diameter conducting fibres based on PEDOT are coated with a nanoweb of cytocompatible polymers.

The quest to build a multiple delivery print system for both fundamental and translational studies has resulted in the development of a multihead system that incorporates coaxial print options.

A nanofabrication platform using a Near Field Electrospinning (NFE) technique on a three axis linear stage system has been built. The platform has the capability of printing programmed patterns with fibre diameters ranging from a few hundred nanometers up to a few micrometres, with a printing precision of about 20 micrometres. Such a fabrication system is ideal for printing nano- and micro-scale structural reactive centres and electromaterials.

The nanoprinting of several polymer systems, including polyethylene oxide (PEO), polycaprolactone (PCL) and poly(lactic-co-glycolic acid) (PLGA) has been examined using this tool. This nanoprinting platform is being used for

Research in action: Renewable fuels from thin air

Challenge: Energy efficient production of renewable fuels.

Solution: ACES made a significant advance in the potential to produce renewable fuels from excess atmospheric carbon dioxide (CO_2), with the discovery of a cheap and efficient catalyst with which to carry out this process (Energy and Environmental Science 2015, Angewandte Chemie 2017). Previous attempts to electrochemically reduce CO_2 into useful materials and fuels have relied on expensive catalyst materials such as gold or palladium or have been inefficient in terms of energy use. ACES research found that a combination of cheap materials—molybdenum sulphide catalytic nanoparticles with a conductive layer of graphene and a well-known polymer called polyethylenimine—acted together to create this energy efficient catalyst. Each component in the catalyst played a specific role in the reaction and it was only when the three were combined that the energy efficiency of the process was realised.

Engagement: This work involves the characterisation expertise of our PI Prof Pat Unwin at Warwick to understand the function of the catalysts. Commercialisation options have been discussed with True North Venture Partners.

Impact: The electrochemical reduction of CO_2 into renewable fuels and materials is one of a number of methods currently being researched into reducing the impact of CO_2 on an international scale. Crucial to this is finding catalysts that make this process practical, affordable and efficient.

printing 3D structured electrodes and scaffolds.

We have synthesised thermally responsive N-isopropylacrylamide (NIPAM) based tough hydrogels using acrylamide and alginate. In order to employ these materials for a practical actuation concept, we have used a 'soft wire' material, eutectic gallium indium alloy (eGaIn), to activate the 3D printed hydrogel structures using Joule heating. In order to enhance the resolution of the soft wire, new extrusion tips have been developed for eGaIn printing based on a modified green Nordson EFD tip. These tips not only have allowed a multidirectional flow of the metal into its own oxide skin, but also are used to print inside the hydrogel.

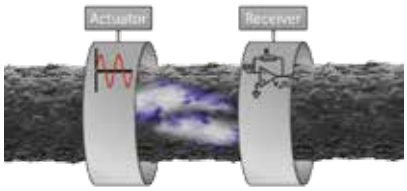
Nanostructuring of electromaterials has been achieved by the judicious selection of materials with different properties. In an international collaboration that was reported as a cover story and 'hot paper' in the Journal of Materials Chemistry A, this was beautifully illustrated through the polymerisation of a protic ionic liquid that resulted in an all solid polyelectrolyte with self-assembled nanochannels, a highly conductive anhydrous proton conductor.

CHARACTERISATION

The objective of the ACES characterisation program is the development of innovative tools to map charge transfer and transport processes in the 3D structures under development. The initial focus has been inline contactless, nondestructive characterisation tools for use during fabrication.

The first of these tools is the capacitively coupled contactless conductivity detection (C4D) system that has been used to measure the conductivity of wet spun graphene composite fibres. This technique is also being explored as a fast and nondestructive method to control processing parameters for the production of liquid crystalline graphene oxide (LCGO).

The second example of a contactless characterisation probe that began development in 2016 is ultrasound imaging of the mechanical properties of biological/soft samples. This probe is not only contactless, but also allows 3D imaging of complex structures under liquids and/or biological environments.



NMR protocols that enable the in situ interrogation of complete 3D electrochemical devices have also been developed.

With international collaborators, Rheo-SAXS has been used as a characterisation tool to reveal further fascinating properties of graphene oxide—a combination of strength and flexibility.

Microelectrode array protocols have been developed to interrogate 3D networks of nerve cells revealing marked differences in the signal firing patterns observed compared to 2D networks.

MODELLING

In 2016 a number of researchers skilled in various aspects of modelling joined ACES. The modelling expertise includes quantum chemical calculations on molecular systems, structural finite element modelling, density functional theory (DFT) modelling and molecular dynamics.

The value of combining modelling with experiments has been well demonstrated in an outstanding experimental and theoretical investigation into the catalysis and controls of non-redox reactions, in particular the Diels-Alder reaction, by an external electric field that was published in ***Nature 2016***. DFT modelling of changes in the activation energy of the reaction as a response to the strength and bias of an external electric field was the key to understanding the

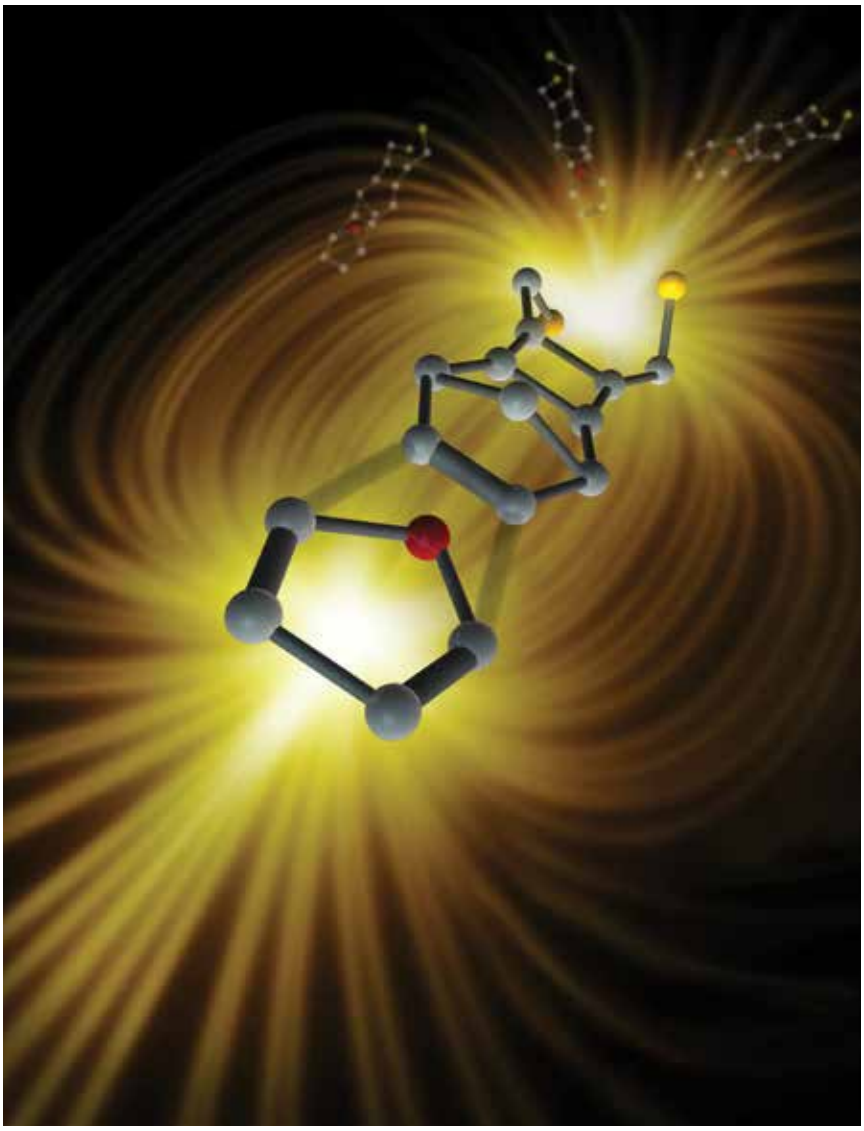
Research in action: The SwEatch

Challenge: Prof Dermot Diamond (ACES partner investigator) highlighted at a recent ACES event the importance of making things with properties that can be changed dynamically over time, and creating prototypes containing the most advanced materials that can open up new markets and change industrial work practices. This was illustrated using examples with new sensing technologies for environmental and biomedical monitoring.

Solution: The most recent example is a wearable monitor called SwEatch which analyses sweat electrolytes (ElectroAnalysis 2016) and provides early warning of dehydration in elite athletes. Using 3D printing, the integration of fluid management (sweat sampling) and sensors to rapidly provide analytical data was possible. A prototype device has been achieved, allowing real-time sampling and analysis of sodium levels in sweat through the combination of the specialities of industrial partner Shimmer, who provided the microchip, DCU, who generated the concept, system design, communications and sensors, and ACES through ANFF 3D printing and rapid prototyping expertise, which accelerated the project and packaged the device.

Engagement: This work involved Dublin based industrial partners Shimmer and PI Dermot Diamond at DCU.

Impact: An example of an international research collaboration. The sporting elite are not the only prospective benefactors of the device, with applications proposed for the medical field, including, for example, a monitor targeted at those living with cystic fibrosis. Further work will involve adapting the platform to create a sensor capable of detecting multiple substances.



experimental results. This work has subsequently been expanded to show that the electric field associated with a Debye layer on an electrode can catalyse non redox chemical reactions, in particular the ring opening reaction of spiropyran to its merocyanine form and that the redox potential of molecules can change significantly as a result of mechanical strain applied to the system. All of these results provide essential insights into how the reactivity of reaction centres might affect electric fields within electrochemical devices.

Modelling is proving important for understanding various aspects of electrolytes, especially ionic liquids. Ab initio and DFT calculations were used to predict acid dissociation constants in developing a methodology to allow accurate predictions of the redox potentials and pK_as of molecules that are large and have complex conformational spaces. This is an important step towards predicting proton transport in ionic liquids.

Molecular dynamics has been used to understand the electrode-electrolyte interface in ionic liquids in order to understand their behaviour in battery and thermocell environments. Preliminary modelling results indicate significant differences in both interfacial and bulk properties for a pair of structurally different ionic liquids (1-ethyl-3-methylimidazolium dicyanamide and N-butyl-N-methylpyrrolidinium dicyanamide). This is significant because when these ionic liquids were previously utilised as electrolytes in a rechargeable zinc battery, they showed starkly different electrochemical behaviour, despite their physicochemical similarities.

The modelling of other 3D electromaterials has yielded insights into their application as well. For example: (i) the superflexibility of graphene oxide has been explained using an atomistic continuum model and (ii) a DFT study of graphene-like carbon nitride (g-C_3N_4) has helped to explain its catalytic role in CO_2 conversion. Towards understanding the mechanism of water electrooxidation catalysed by transition metal oxides via advanced electrochemical analysis, modelling has provided unique mechanistic insights and quantitative data on the kinetic and thermodynamic parameters of the electrocatalytic water oxidation.

The effects of several key design factors for pneumatic actuators in the SR theme have been investigated using Finite Element Modelling (FEM). By analysing the key design factors, the structure of the actuator for the 3D printed bionic hand has been optimised. In addition, a single-helix analogy based theoretical model was developed to predict the torsional properties of twisted and coiled fibres. This model utilised the geometry and thermal properties of the material and fairly predicted the torsional actuation.

STRUCTURE AND FUNCTION

The creation of 3D electromaterial structures requires knowledge as to how the 3D spatial distribution of structure and function influences performance. This knowledge provides ACES researchers with an unprecedented capability for interphase engineering to ensure the seamless integration of components within devices for energy systems,

diagnostics and soft robotics, and within synthetic biosystems. Consequently, structure and function studies have been an integral component of each of the electromaterial application themes.

As mentioned above, finite element modelling was used to develop a 3D printed bionic hand. Using 3D printing, mechanical properties were distributed throughout the structure to ensure that application of force/tension results in being able to obtain the desired hand movement. Soft strain sensors were integrated on to each digit to obtain finger position/posture information. The organic conducting electromaterials that provide the sensing capabilities were amenable to fabrication using simple spray techniques.

A new methodology inspired by layer jamming methods has been established to mechanically augment and control the stiffness of a soft robotic finger (and similar soft robotic structures) using thin flexible polyvinyl chloride (PVC) sheets. In this method, there is no requirement for a pressure source to tighten the flexible sheets. We have experimentally quantified that the stiffness of the finger can be increased by 40%, depending on the material used and the layer thickness.

3D printing of titanium micro bore columns in the EFD theme was undertaken for new analytical chemistry devices. Various novel, and conventional 3D microfluidic structures such as 3D serpentine, astral, single and double handed spiral, and 2D serpentine were printed. The effect of these different 3D channel architectures on the chromatographic separation efficiency was investigated as was the effect of different flow cell designs such as astral, and spiral on the chemiluminescence detection efficiency.

We have demonstrated the practicality of electrophoretic techniques upon and within novel fibre structures to separate, pre-concentrate, move, split, stack or cut and collect zones of bioactive mixtures or separated biomolecules. While commercial fibres were initially used to demonstrate the viability of the technique, subsequent in house fibre development and modification with electromaterials has shown how the fibre structure can fundamentally alter this function. Our ability to strategically place fibres throughout 3D structures means that we now have a novel approach to controlled molecular (including fluid) transport throughout.

This concept of altered function with structural change has also been found to be critically important in developing materials for biosystems. In structure function studies in SBS, during the development of bioinks to support cell growth, we have shown that different cell types require different bioink materials. For example, a bioink containing crosslinked methacrylated gelatin (GelMA) is effective in supporting adipose stem cells and particularly their development into cartilage, whereas gellan gum based structures provide a more appropriate structured environment for primary neuronal cells and CMC-agarose based materials have proven to be superior for printing neural stem cells

Research in action: Fertiliser from the sun

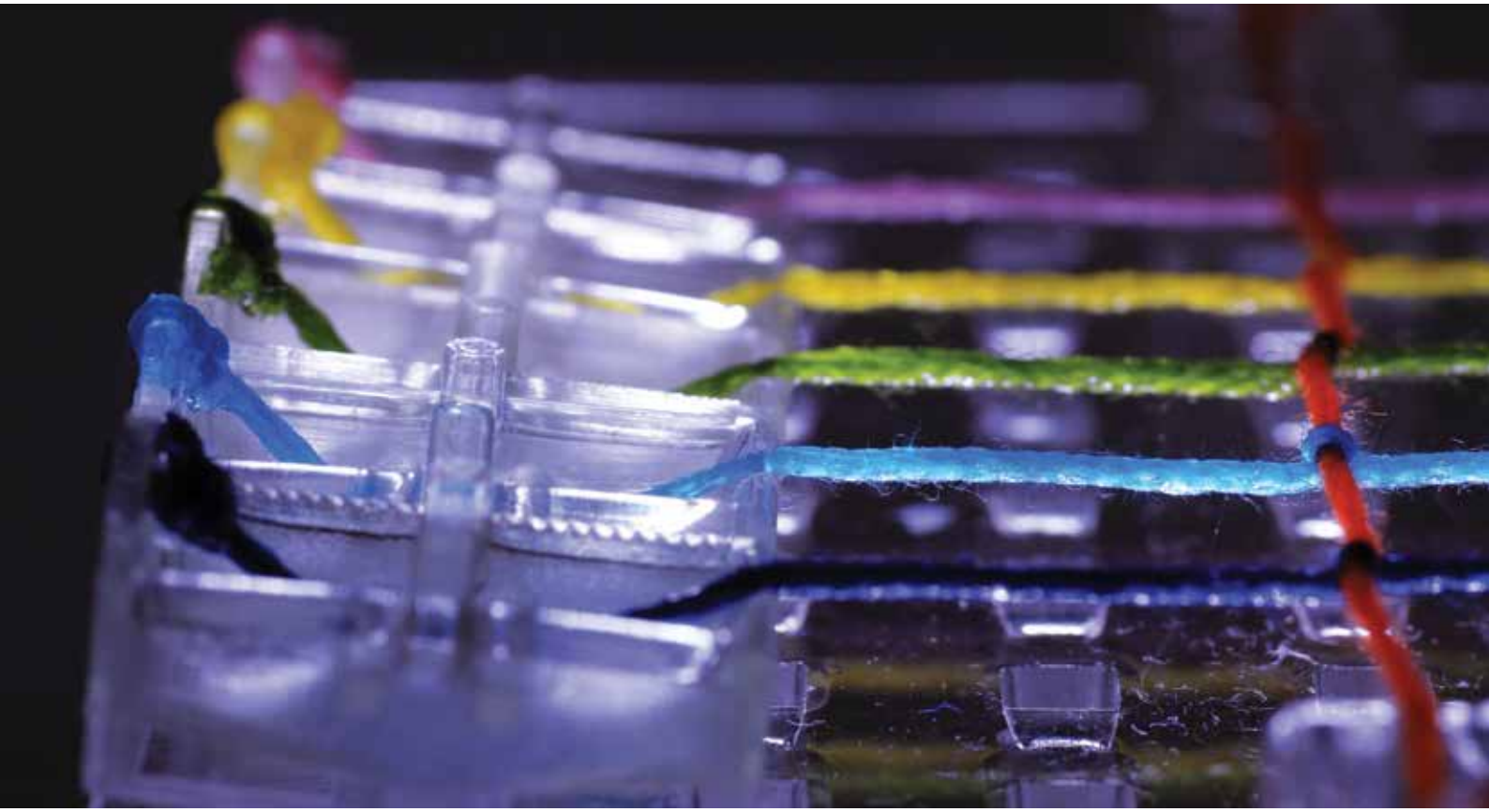
Challenge: Ammonia is a popular fertiliser that relies on huge amounts of coal-fired energy to make. Ammonia production for fertilisers produces about two percent of global carbon production and this figure will only increase to keep up with rising global demand. This is not sustainable in the long term.

Solution: ACES researchers have refined a way to make ammonia using energy from the sun (Nature Communications 2016). The ACES sun-driven process produces ammonia fertilisers without the carbon footprint. Harnessing photochemical conversion to convert nitrogen into ammonia via solar energy is not a new concept, but one that ACES researchers enhanced using a new phenomenon called surface plasmon resonance to improve the light absorption by the semiconductor material. Improved yields are the next step for researchers and will require improvement in the structure and the catalysis of the reduction reaction.

Engagement: This ACES research has attracted the interest of one of the world's largest ammonia producers and a working party involving a number of interested commercial parties has been formed.

Impact: The development is great news for the environment, and it also ties in nicely with ACES' goal of producing useful fuels and chemicals from solar energy. This device does just that, from nothing more than water and nitrogen from the atmosphere. Other applications ACES is pursuing include using this process as a means of generating ammonia in large quantities for use as a fuel.

The effect of assembling nanostructured catalysts.



and iPS cells. The 3D printing protocols developed are capable of providing structures containing living cells with high viability and that subsequently proliferate. The differentiation of cells in the 3D structures is strikingly different to that observed in 2D.

In an illustration of how fabrication can affect function, the proliferation and differentiation of neural stem cells can be effected on the surface of a GelMA scaffold rather than within the scaffold. We have unexpectedly discovered that iPS cells cultured on GelMA can ingress into these materials. We have also found that this environment encourages the growth of neuronal organoids resulting in an exciting new protocol for the development of such cellular arrangements.

Enhancing function with 3D structure has been a feature of a number of developments in the SES theme. The conversion of carbon dioxide (CO_2) to renewable fuels is a 'holy grail' in energy research. ACES researchers have shown that new catalysts for this process, that are cheaper and more effective than previous catalysts, can be obtained when 3D composite structures are fabricated. For example, copper oxide nanowires decorated with tin nanoparticles have proven to be highly effective nanocatalysts in CO_2 reduction studies. Another example is given in a Research In Action case study.

Structure function studies have been important in the development of thermocells. Significant advancements have been made in the redox electrolytes for thermocells as a result of electrolyte structure on the functioning of the electrolyte. This has not only provided new efficient ionic liquid-based thermocell electrolytes but paved the way for the fabrication of flexible thermocells using a cellulose—based solid electrolyte.

The study of water oxidation to produce oxygen is an important component of the production of hydrogen as a solar fuel. Using structure function studies to understand the mechanism of water electrooxidation catalysed by transition metal oxides via advanced electrochemical analysis has shown that ultra-thin cobalt, manganese and nickel oxide layers are highly efficient catalysts. However, it was only through such detailed studies that it was shown that ultralow loadings of Ni oxides achieved extraordinarily high specific catalytic activity that substantially surpasses that of other known water oxidation catalysts.

The study of the function of various 3D fabricated materials has not only been of benefit to ACES researchers but also to a number of ACES international collaborators. This has included: (i) the utilisation of ACES photoanode capability in the development of the highest energy density solar rechargeable redox battery reported to date with Canadian researchers; (ii) the use of graphene

and ACES fibre fabrication to create shape engineerable composite fibers for supercapacitors with Korean, Chinese and American researchers; (iii) cell growth and 3D printing to create 'the brain on the bench' with American researchers and (iv) a number of fibre based innovations in thermocells or artificial muscles with American collaborators.

ETHICS, POLICY AND PUBLIC ENGAGEMENT

The ethical challenges posed by ACES technology development are providing numerous avenues for high quality research in this area. Thus, the bulk of the research towards identifying the potential ethical responsibilities of manufacturers to end-users for prosthetic organs was completed, using pacemakers and Implantable Cardioverter Defibrillators as a comparable technology for assessing manufacturer responsibility for prosthetic organs. The assessment was informed through meetings with the TGA, Health Purchasing Victoria and Biotronik. Additional research in this area has been conducted on the effects of deep brain stimulation, along with ACES Associate Investigator Gilbert, and ethical and regulatory issues emerging from 3D bioprinting in medicine.

A recent cross theme, cross nodal collaboration between EPPE and SBS has created the opportunity for a philosophical assessment of the moral status and significance of neural organoids. It is likely that further publications will emerge as the science and clinical applications of 3D bioprinting develop further.

Research is now informing studies on regulation of neural enhancement and technology involving ethical issues associated with neural implants for children with cognitive disabilities. This in turn raises issues associated with

Implanted patients develop issues with their new "self", despite symptom improvements.

regulation of clinical trials involving children and those with cognitive disability.

In light of the findings from the above research activities subsequent activities have focused on the relationships among disability, therapy and enhancement. We have made progress specifically in relation to neural therapies and neural enhancement using 3D bioprinted implants. ACES early career researcher Goddard has refined her PhD outcomes from ACES 2013 to focus more specifically on an account of disability that cuts across the "therapy-enhancement" divide.

On the energy front we have progressed towards developing approaches to engagement of key stakeholders in new energy technologies.

ACES CI Linda Hancock was invited to provide Prof Robyn Dowling ACOLA (Australian Council of Learned Academics) advice on ACES EPPE work to inform ACOLA's advice to the Chief Scientist on issues relating to battery storage. CI Hancock also participated: (i) in a policy workshop: 'Australia's Electricity System: Transition to 2030', organised by Melbourne Energy Institute, the Grattan Institute, the EU Centre on Shared Complex Challenges, GEE-21, the Australian-German Climate and Energy College, and Australian Academy of Technological Sciences and Engineering (ATSE) in Melbourne, 27-28 September 2016 and (ii) the Australian CleanTech Network meeting, Melbourne Town Hall August 2016: a forum for investors, companies, government and academia interested in cleantech to meet, learn and collaborate.

ACES is exploring the engagement of government and non-governmental organisational (NGO) bodies charged with disaster recovery to ensure that renewable energy technologies are designed so as to promote disaster resilience and local community development. ACES researchers visited the Australian Department of Foreign Affairs and Trade in Canberra with Clair Cochrane, India Desk, Michael Costa, Policy Officer, and India Economic Section with the aim to build a relationship and discuss potential opportunities for government support for initiatives related to alternative energy and ethics. ACES CI Hancock has won an Asia India Institute@Delhi Fellowship to explore engagement between renewable energy researchers and community and NGO disaster resilience and recovery efforts. ACES PhD Cherian, has presented papers on government and NGO plans for disaster resilience and recovery through his work with HelpAge India and HelpAge International globally.

In addition to progress made towards the EPPE theme milestones, members have contributed to the work in other themes. This has involved discussing batteries, renewables and supply chain concerns with SES theme members; exploring the ethical status and significance of neural organoids as well as on ethical and regulatory issues of 3D bioprinting with SBS theme members and more recently with members within the SR theme towards assessing the assumptions shaping the design of wearable robotics.

Publications

Publishing ACES research is essential for knowledge translation. Publishing both in academic journals and explaining the potential impact of that research to our community through our website portal provides is an important means in which we disseminate the body of ACES knowledge.

Table 2: Overall publication and citation activity for ACES affiliated publications 2014-2016 (Source, Scival based on SCOPUS data 9.1.17)

Metric	2016	2014-2016
Number ACES publications (SCOPUS)	220	563
Number of ACES publications (SciVal)	206	544
Number of Subject areas (main categories) ACES published in	17	20
Publications in top 1% journals (SJR*)	23 (11.5%)	41 (7.9%)
Publications in top 10% journals (SJR*)	112 (56%)	280 (54.1%)
Publications in top 25% journals (SJR*)	180 (90%)	449 (86.7%)
^^ Views count	3,612	18,977
^ Views per Publication (articles and reviews)	18.5	37.2
Number of Citations	229	3,290
Number of citing Countries	39	77
Average citations/publication	1.1 (84 publications cited)	6.0 (355 publications cited)
Outputs in top 1% most cited	32 (5.9%)	10 (4.9%)
Outputs in top 10% most cited	84 (40.8%)	207 (38.3%)
Outputs in top 25% most cited	206 (100%)	434 (80.2%)
Field Weighted Citation Impact (#FWCI - for articles and reviews)	2.08	1.91
International Collaboration	116 (56.3%)	291 (53.5%)
National Collaboration	41 (19.9%)	109 (20%)

Legend:

***SJR - SCImago Journal Rank** is a prestige metric, whose methodology is similar to that of Google PageRank. It weights the value of a citation depending on the field, quality and reputation of the journal that the citation comes from, so that "all citations are not equal". SJR also takes differences in the behavior of academics in different disciplines into account, and can be used to compare journals in different fields. The average SJR value for all journals in Scopus is 1.000.

^^ **Views count:** Total views received by publications of the selected entities (Source: SCOPUS data, up to 30 Nov 2016)

^**The average number of views per publication** (Source: SCOPUS data, up to 30 Nov 2016)

The Field Weighted Citation Impact (FWCI) World Average is 1.00.

ACES RESEARCH OUTPUTS - HIGH QUALITY INTERNATIONAL STANDING

In 2016, 220 articles (based on SCOPUS data 9.1.17 and listed below) were published that have ARC Centre of Excellence for Electromaterials Science in the address line hence indicating ACES members' involvement in that research.

The overall publication and citation activity for ACES affiliated 2016 and 2014-2016 publications (source, Scival based on SCOPUS data 9.1.17) is shown in Table 2. Please note that not all publications (220) listed in Scopus were available in SciVal database (206) on 9.1.17.

Book Chapters

ACES members published 8 book chapters and have a further 4 book chapters accepted for publication (not listed).

1. G. Alici, R. Mutlu, D. Melling, E. W. H. Jager, and K. Kaneto, "Conducting Polymers as EAPs: Device Configurations," in Electromechanically Active Polymers: A Concise Reference, F. Carpi (Ed) Springer International Publishing, 2016, pp. 257-291.
2. M. Farajollahi, G. Alici, M. S. Sarwar, and J. D.W. Madden, "Conducting polymers as EAPs: Physical Description and Simulation", in Electromechanically Active Polymers: A Concise Reference, F. Carpi (Ed), Springer International Publishing, 2016.
3. Dodds, S. 'Participation and Trust: Conditions and Constraints on Democratic Deliberation' in Dodds and Ankeny (eds), Big Picture Bioethics: Developing Democratic Policy in Contested Domains, Switzerland: Springer Publishing, 2016, pp. 27-36.
4. E. Goddard and S. Dodds 'Consultation, Deliberation and the Review of the National Statement', in Big Picture Bioethics: Developing Democratic Policy in Contested Domains, Dodds S; Ankeny RA (Eds.), Switzerland Springer Publishing, 2016, pp 191-224.
5. K. Kaneto, E. W. H. Jager, G. Alici, and H. Okuzaki, "Conducting Polymers as EAPs: Applications", A Chapter in Electromechanically Active Polymers: A Concise Reference, F. Carpi (Ed), Springer International Publishing, 2016.
6. Officer DL, Wagner K, Wagner P. Properties and characterization of conductive polymers. Chapter 3 in Conductive Polymers: Electrical Interactions in Cell Biology and Medicine. Zhang Z, Rouabhia M, Moulton S (Eds), 2017; in press.
7. Sparrow, R. 'Human enhancement for whom?' in Steve Clarke, Julian Savulescu, C. A. J. Coady, Alberto Giubilini, and Sagar Sanyal (Eds.) The Ethics of Human Enhancement: Understanding the Debate. Oxford: Oxford University Press, 2016, 127-142.
8. J. Zhang, W. Li, and G. Alici, "Inertial Microfluidics: Mechanisms and Applications," in Advanced Mechatronics and MEMS Devices II, Dan Zhang & Bin Wei (Eds), New York: Springer, 2016.

Journal Articles

The journal articles reported within each group are listed in order from highest journal impact factor.

Reviews

As leaders on numerous fronts ACES researchers are often invited to contribute reviews in specific fields.

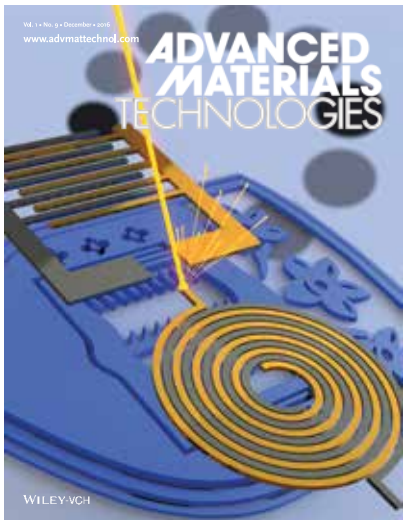
1. Taylor DL, in het Panhuis M. Self-Healing Hydrogels. Advanced Materials. 2016;28(41):9060-9093. IF= 18.960.
2. Haines CS, Li N, Spinks GM, Aliev AE, Di J, Baughman RH. New twist on artificial muscles. Proceedings of the National Academy of Sciences of the United States of America. 2016;113(42):11709-11716. IF= 9.674.
3. Gu Q, Zhu H, Li J, Li X, Hao J, Wallace GG, Zhou Q. Three-dimensional bioprinting speeds up smart regenerative medicine. National Science Review. 2016;3(3):331-344. IF= 8.000.
4. Jalili R, Aminorroaya-Yamini S, Benedetti TM, Aboutalebi SH, Chao Y, Wallace GG, Officer DL. Processable 2D materials beyond graphene: MoS_2 liquid crystals and fibres. Nanoscale. 2016;8(38):16862-16867. IF= 7.760
5. Stevens LR, Gilmore KJ, Wallace GG, In het Panhuis M. Tissue engineering with gellan gum. Biomaterials Science. 2016;4(9):1276-1290. IF= 3.614.
6. Kalsoom U, Nesterenko PN, Paull B. Recent developments in 3D printable composite materials. RSC Advances. 2016;6(65):60355-60371. IF= 3.289.
7. Yue Z, Liu X, Coates PT, Wallace GG. Advances in printing biomaterials and living cells: Implications for islet cell transplantation. Current Opinion in Organ Transplantation. 2016;21(5):467-475. IF= 2.680.
8. Breadmore MC, Wuethrich A, Li F, Phung SC, Kalsoom U, Cabot JM, Tehranirokh M, Shallan AI, Abdul Keyon AS, See HH, Dawod M, Quirino JP. Recent advances in enhancing the sensitivity of electrophoresis and electrochromatography in capillaries and microchips (2014-2016). Electrophoresis. 2016. IF= 2.482.
9. Forsyth M, Chen F, O'Dell LA, Romanenko K. New insights into ordering and dynamics in organic ionic plastic crystal electrolytes. Solid State Ionics. 2016;288:160-166. IF= 2.380.

10. Spinks GM. Stretchable artificial muscles from coiled polymer fibers. Journal of Materials Research. 2016;31(19):2917-2927. IF= 1.579.

Materials

Throughout 2016, ACES researchers have discovered new catalytic materials, composites and electrolytes. These discoveries combined with nano-micro structured 3D electrodes have enabled us to realise high performance electrochemical systems. New ink formulations as well as biomaterials that meet the stringent requirements to enable printing of living cells in mechanically robust 3D structures have been unearthed.

1. Aragonès AC, Haworth NL, Darwish N, Ciampi S, Bloomfield NJ, Wallace GG, Diez-Perez I, Coote ML. Electrostatic catalysis of a Diels-Alder reaction. Nature. 2016;531(7592):88-91. IF= 42.351.
2. Li F, Zhao SF, Chen L, Khan A, MacFarlane DR, Zhang J. Polyethylenimine promoted electrocatalytic reduction of CO_2 to CO in aqueous medium by graphene-supported amorphous molybdenum sulphide. Energy and Environmental Science. 2016;9(1):216-223. IF= 25.427.
3. Wang Y, Chen Y, Gao J, Yoon HG, Jin L, Forsyth M, Dingemans TJ, Madsen LA. Highly Conductive and Thermally Stable Ion Gels with Tunable Anisotropy and Modulus. Advanced Materials. 2016;28(13):2571-2578. IF= 18.960.
4. Yu C, Wang C, Liu X, Jia X, Naficy S, Shu K, Forsyth M, Wallace GG. A Cytocompatible Robust Hybrid Conducting Polymer Hydrogel for Use in a Magnesium Battery. Advanced Materials. 2016;28(42):9349-9355. IF= 18.960.
5. Lozano R, Stevens L, Thompson BC, Gilmore KJ, Gorkin R, Stewart EM, Panhuis MIH, Romero-Ortega M, Wallace GG. Brain on a bench top: Cortical neurons within a 3D printed structure. Materials Today. 2016;19(2):124-125. IF= 17.793.
6. Zhang Z, Wang Y, Li H, Yuan W, Zhang X, Sun C, Zhang Z. Atomic-scale observation of vapor-solid nanowire growth via oscillatory mass transport. ACS Nano. 2016;10(1):763-769. IF= 13.334.
7. Liu Y, Zhao SF, Guo SX, Bond AM, Zhang J, Zhu G, Hill CL, Geletii YV. Electrooxidation of Ethanol and Methanol Using the Molecular Catalyst $[\{Ru_4O_4(OH)_2(H_2O)_4\}(\gamma\text{-}SiW_{10}O_{36})2]^{10}$. Journal of the American Chemical Society. 2016;138(8):2617-2628. IF= 13.038.
8. Zhang L, Vogel YB, Noble BB, Gonçales VR, Darwish N, Brun AL, Gooding JJ, Wallace GG, Coote ML, Ciampi S. TEMPO Monolayers on Si(100) Electrodes: Electrostatic Effects by the Electrolyte and Semiconductor Space-Charge on the Electroactivity of a Persistent Radical. Journal of the American Chemical Society. 2016;138(30):9611-9619. IF= 13.038.
9. Jiang Y, Li H, Wu Z, Ye W, Zhang H, Wang Y, Sun C, Zhang Z. In Situ Observation of Hydrogen-Induced Surface Faceting for Palladium–Copper Nanocrystals at Atmospheric Pressure. Angewandte Chemie - International Edition. 2016;55(40):12427-12430. IF= 11.709.
10. Jia X, Wang C, Zhao C, Ge Y, Wallace GG. Toward Biodegradable Mg-Air Bioelectric Batteries Composed of Silk Fibroin-Polypyrrole Film. Advanced Functional Materials. 2016;26(9):1454-1462. IF= 11.382.
11. Gujral SS, Simonov AN, Higashi M, Fang XY, Abe R, Spiccia L. Highly Dispersed Cobalt Oxide on TaON as Efficient Photoanodes for Long-Term Solar Water Splitting. ACS Catalysis. 2016;6(5):3404-3417. IF= 9.307.
12. Xia J, Di J, Li H, Xu H, Li H, Guo S. Ionic liquid-induced strategy for carbon quantum dots/BiOX (X=Br, Cl) hybrid nanosheets with superior visible light-driven photocatalysis. Applied Catalysis B: Environmental. 2016;181:260-269. IF= 8.328.
13. Chowdhury DR, Spiccia L, Amritphale SS, Paul A, Singh A. A robust iron oxyhydroxide water oxidation catalyst operating under near neutral and alkaline conditions. Journal of Materials Chemistry A. 2016;4(10):3655-3660. IF= 8.262.



14. Wang Y, Wang C, Wang Y, Liu H, Huang Z. Superior sodium-ion storage performance of Co_3O_4@ nitrogen-doped carbon: Derived from a metal-organic framework. Journal of Materials Chemistry A. 2016;4(15):5428-5435. IF= 8.262.
15. Shah AH, Li J, Yang H, Rana UA, Ranganathan V, Siddigi HM, Macfarlane DR, Forsyth M, Zhu H. Enhancement of 'dry' proton conductivity by self-assembled nanochannels in all-solid polyelectrolytes. Journal of Materials Chemistry A. 2016;4(20):7615-7623. IF= 8.262.
16. Zhao Y, Wang C, Wallace GG. Tin nanoparticles decorated copper

oxide nanowires for selective electrochemical reduction of aqueous CO_2 to CO. Journal of Materials Chemistry A. 2016;4(27):10710-10718. IF= 8.262.

17. Wang MY, Zhu W, Ma L, Ma JJ, Zhang DE, Tong ZW, Chen J. Enhanced simultaneous detection of ractopamine and salbutamol - Via electrochemical-facial deposition of MnO_2 nanoflowers onto 3D RGO/Ni foam templates. Biosensors and Bioelectronics. 2016;78:259-266. IF= 7.476.
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24. Kar M, Ma Z, Azofra LM, Chen K, Forsyth M, MacFarlane DR. Ionic liquid electrolytes for reversible magnesium electrochemistry. Chemical Communications. 2016;52(21):4033-4036. IF= 6.567.
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Fabrication

Protocols that realise the ability to distribute appropriate mechanical properties, as well as active centres have been developed. Integration of advanced electromaterials into such structures has also been realised.

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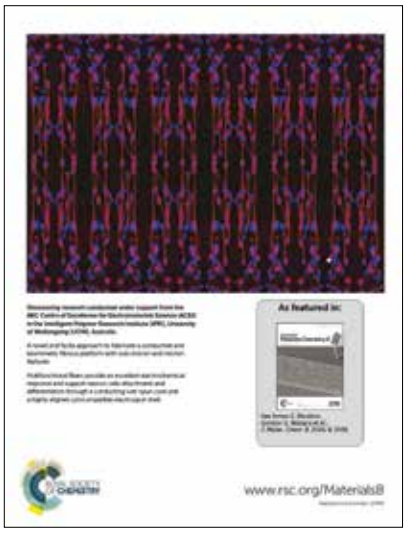

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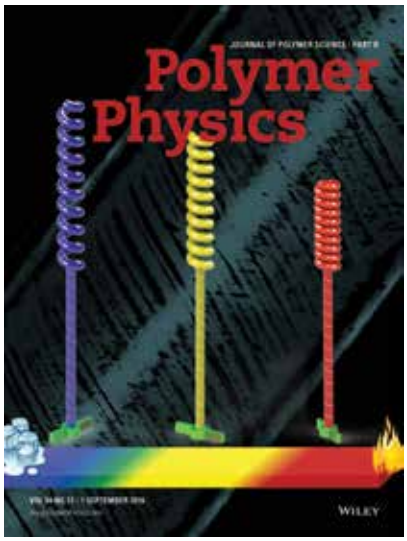

Characterisation

Modification of traditional tools such as AFM and AC voltammetry have enabled unprecedented insights into electrochemical properties and material surface properties. A contactless method for in-line conductivity measurement has been developed.

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Modelling

Our modelling team has engaged in projects to provide unprecedented insights into catalytic and electrochemical systems, electrolyte behavior and the electrode-electrolyte interface.

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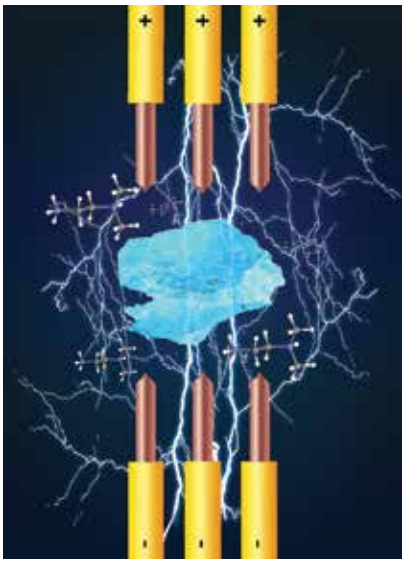

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Ethics, Public Policy and Engagement

Being at the forefront of advanced materials research targeted towards energy and health (including diagnostic and prosthetic systems) requires us to keep ethical and regulatory issues front of mind. ACES researchers provide information that assists with the development of appropriate policy and keeps the communities we work for informed and engaged.

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Non-core

ACES researchers bring core knowledge and world class expertise and facilities for use in other areas of interest that are complementary to the core activities described above. Also captured in this section are papers arising from core activities of ACES 2005-2013.

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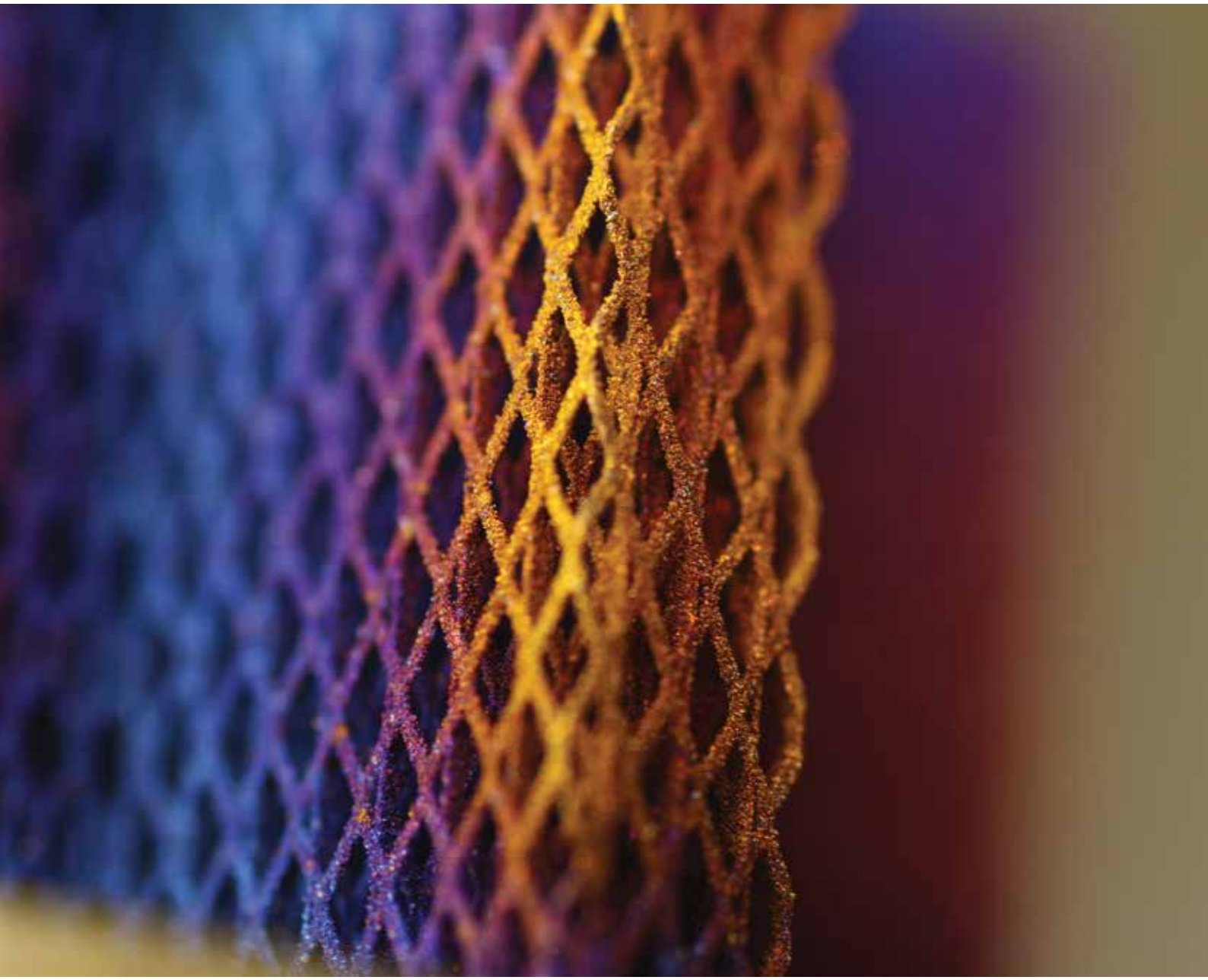

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REFEREED CONFERENCE PAPERS OR EXTRACTS

ACES members had 8 refereed conference papers and 5 refereed conference extracts published in 2016.

Refereed Conference papers

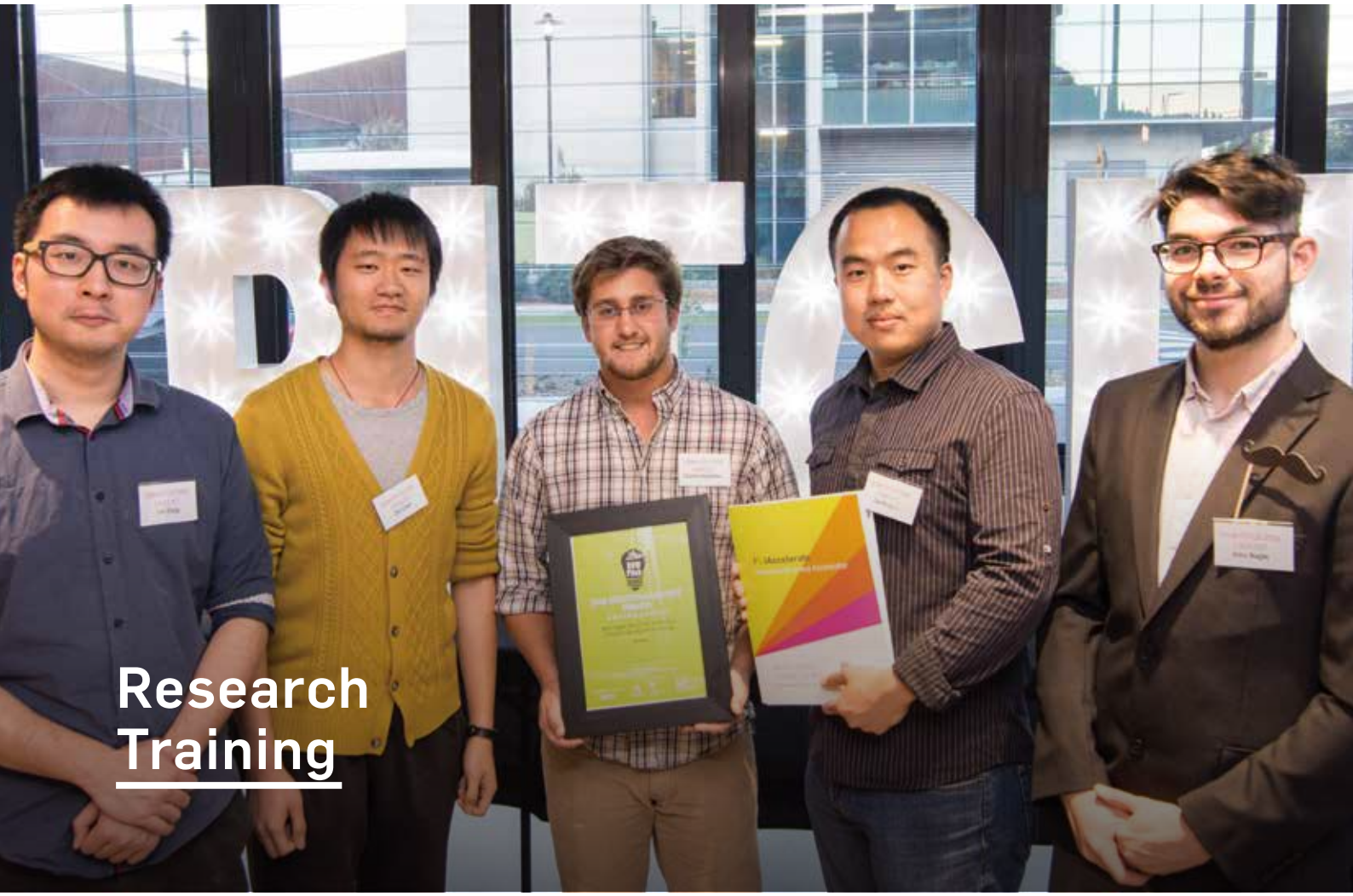
1. Hancock, L and N Ralph 'Governance and Regulatory Issues for Ethical Supply Chains in New Alternative Energy

Technology'. Paper presented at the Emerging Paradigms of Corporate Social Responsibility, Regulation and Governance conference, Special Thematic Symposium & Multidisciplinary Academic Dialogue, Indian Institute of Management Lucknow (IIML), Uttar Pradesh, India, 14-15 November, 2016.

2. Munoz F, Alici G, Zhou H, Li W and Sitti M, "Analysis of the Magnetic Torque on a Tilted Permanent Magnet for Drug Delivery in Capsule Robots", Paper presented at: IEEE/ASME International Conference on Advanced Intelligent Mechatronics, AIM, 2016. pp.1386-1391, Banff, Canada, July 2016.
3. Mutlu R, Yildiz SK, Alici G, In Het Panhuis M, Spinks GM. Mechanical stiffness augmentation of a 3D printed soft prosthetic finger. Paper presented at: IEEE/ASME International Conference on Advanced Intelligent Mechatronics, AIM, 2016. pp.7-12, Banff, Canada, July 2016.
4. Viaña JNM, Vickers J, Gilbert F. Ethical considerations for clinical trials of fornix DBS for patients with Alzheimer's Disease. Paper presented at the 10th FENS Forum of Neuroscience 2016, Copenhagen, Denmark. 2-6 July 2016.
5. Yildiz SK, Mutlu R, Alici G. Performance quantification of strain sensors for flexible manipulators. Paper presented at: IEEE/ASME International Conference on Advanced Intelligent Mechatronics, AIM, 2016, pp.584 -589, Banff, Canada, July 2016.
6. Zhang J, Yan S, Yuan D, Alici G, Nguyen N. T., and Li W. H., "On-chip manipulation of micro-particles by a novel viscoelastic-based ferrofluid". Paper presented at: 2016 International Conference on Microfluidics, Nanofluidics and Lab-on-Chip, pp., Dalian, China, June 2016.
7. Zhang J, Yan S, Yuan D, Alici G, Nguyen N. T., and Li W. H. "High Throughput Cell-Free Extraction of Plasma by an Integrated Microfluidic Device Combining Inertial Microfluidics and Membrane". Paper presented at: ASME 2016 5th International Conference on Micro/Nanoscale Heat and Mass Transfer, pp. V001T01A012; 6 pages, Singapore, January 4–6, 2016. doi:10.1115/MNHMT2016-6717
8. Zhang Y, Ogunbona PO, Li W, Wallace GG. Learning structured dictionary based on inter-class similarity and representative margins. Paper presented at: ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings, 2016.

Refereed Conference Extracts

1. Xiujuan J. Dai, Zhiqiang Chen, Gayathri D. Rajmohan, David R. de Celis, Sri B. Ponraj, Mohammad Maniruzzaman, Arun T. Ambujakshan, Xiao Chen, Peter R. Lamb, Kevin Magniez, Ladge Kviz, Robert Lovett, Marion L. Wright, Xungai Wang, Plasma Research at Deakin University, Gaseous Electronics Meeting GEM2016 Geelong, Australia, February 14-17, 2016.
2. Gu, Tomaskovic-Crook, et al. 3D printing human iPSCs for neural tissue engineering. World Life Science Conference (WLSC), Beijing, China, Nov 2016.
3. Tomaskovic-Crook et al. Defined induction of human neural organoids from induced pluripotent stem cells using gelatin methacrylate: a three-dimensional model for studying development, disease and regenerative medicine. Australasian Society for Neuroscience (ANS), Hobart, Dec 2016.
4. Rangam Rajkhow, Mehdi Kazemimostaghim, Xungai Wang Characteristics and Prospective Applications of Powders Derived from Natural Fibers, Fiber Society Spring Conference, ENSISA, Mulhouse, France, May 25-27, 2016.
5. Saeed Dadvar, Rangam Rajkhowa, Xungai Wang, Bio-renewable feedstock for 3D printing of carbon composites, The International Conference on Design and Technology (DesTech), Deakin University, Geelong, Australia, 5-8 December 2016.



Research Training

ACES STRATEGIC PLAN GOAL 2: RESEARCH TRAINING

Our goal is to deliver innovative research training and mentoring programs that ensure the development of world class graduates and early career researchers with excellent research skills as well as science communication, research management and commercialisation skills, coupled with an ethical awareness of the impacts of their scientific endeavour.

Our target audience is primarily prospective students. ACES provides an inclusive and supportive global research training opportunity; giving access to the most innovative and dynamic research training programs that are facilitated by our global connections.

TOWARDS OUR GOALS

To develop ideas into industries, agility is also required in the research environment wherein researchers can move along the commercialisation path with their concepts, and return to the idea generating cauldron of fundamental research (Linked In article *Agility in Research* published 6 April 2016 by Prof Gordon Wallace (https://www.linkedin.com/pulse/agility-research-gordon-wallace?trk=prof-post). Our research training systems in many research centres of excellence is delivering graduates ready for the task at hand. Graduates that are 'commercial ready' will be in high demand. Graduates with a track record showing the ability to adapt, re-skill and take on new challenges will be required.

A number of ACES (2005-2013) graduates form the technical backbone of the spin-off company Aquahydrex. ACES graduates have also progressed to important positions in research and academia, the commercial world (both as technical experts and investment advisers) and to roles in science communication (e.g. Cosmos magazine).

Where are ACES PhD Graduates if not in Academia?

- Altran Germany in semiconductor business (Technology consultant)
- ANFF Materials Node, Australia (Fabrication technicians)
- Aquahydrex
- Biofab3D@ACMD, St Vincent's Hospital, Melbourne (Centre Manager)
- BlueScope Steel, Australia
- Bostik Ltd, Leicester, U.K. (Development Chemist)
- COSMOS, Science Writer
- CSIRO
- Double A Research Center Co.Ltd. (CEO)
- DOW Electronic Materials, MA, USA
- DSTO
- Dulux Group
- Dyesol, Queanbeyan, NSW, Australia
- EnerG2, Inc., Washington, USA Electrochemistry & Device (Engineering Senior Manager)
- Ernst & Young, Australia
- GHD (Senior Engineer)
- Henkel Ltd, UK (Senior Development Scientist)
- Industry research, Singapore
- IMAGINE Pty Ltd
- Intel, Dublin, Ireland (PCD and CMP Process Engineer)
- Johnson Controls, China (Senior Product Engineer)
- Korea Electronics Technology Institute (KETI), Korea
- Laing O'Rourke, Sydney, Australia
- Memstar, Singapore (CEO)
- Metalysis Ltd, UK (Principal Scientist)
- Mobile Energy, Timcal Graphite & Carbon, Singapore (Product Manager)
- Panasonic Corporation, Kyoto, Japan (Advanced Technology Research Laboratories)
- Philip Morris International, Product Assessment & Compliance, Switzerland (Senior Scientist)
- Prachinburi, Thailand (www.doubleapaper.com)
- Rubber Research Institute, Jakarta, Indonesia (Principal Scientist)
- Sapa Technology, Sweden (Research Engineer)
- Servier Canada Incorporated (Medical representative)
- Shanghai Banzan Macromolecule Material Co., Ltd, China
- Shenzhen Economic and Trade Office (Senior Manager)
- Sober Steering Sensors Canada (Senior Program Director)
- Spraylat Coatings (Shanghai) Limited, China (Asia Pacific Technical Director)
- University of Sheffield, UK (Knowledge Transfer Partnership Associate)
- Vietnam Environment Administration, Pollution Control Department, Vietnam (Vice Head, Division of Pollution Control for Air, Recycling materials, and toxic chemicals)
- Wollongong City Council, Australia (Environment Department)

In his article *Is tertiary education agile enough to keep pace with the changing nature of professional work?* published 9 August 2016 (https://www.linkedin.com/pulse/tertiary-education-agile-enough-keep-pace-changing-nature-wallace?trk=prof-post) the Director of ACES, Prof Gordon Wallace, reports that the ACES research environment serves as an illustrative case study to highlight the importance of interdisciplinary training. Increasingly, we are seeing that new discoveries and new PhD projects are occurring in the convergence of chemistry, materials science, nanotechnology, biology and mechatronics.

ACES PhD students are offered additional skills training to their training in research activities. ACES provides in-house training, in the form of short courses, in science communications, ethics and public engagement, entrepreneurship and business management plus webinars given by ACES laureate fellows.

Entrepreneurship & Innovation Certificate

A successful pilot program to deliver a graduate certificate in entrepreneurship was conducted in 2015. ACES developed the Graduate Certificate in Entrepreneurship, in partnership with the University of Wollongong's Sydney Business School, to build up the business acumen of PhD and early career researchers and to boost employability post academia. The certificate continued in the second half of 2016 as a 'Certificate in Entrepreneurship and Innovation'.

Eighteen core funded PhD students and an ECR completed the certificate which involved receiving an intensive one-week overview on entrepreneurship and innovation, during which participants were taught how to work effectively in a team, given time management coaching and assignment of their tasks. Expert tuition was received from the Sydney Business School and industry professionals, plus each group was assigned ACES chief

investigators (CIs) as mentors on the research aspects of their project.

This non-academic award program was customised to place ACES projects in a business context with a commercial lab based opportunity; culminating with each group giving their feasibility pitch at the conclusion of the program.

A team of the ACES UOW students (Alex Nagle, Zhi Chen, Jianfeng Li, Charles Hamilton & Yan Zong) from the Entrepreneurship & Innovation certificate course entered as a team in the UOW pitch competition and won the encouragement award of $1500 in the postgraduate section for their presentation "Bioink". The UOW Pitch competition is designed to promote student and staff involvement in entrepreneurialism and the commercialisation of ideas, inventions and research outcomes.

ACES Communications Certificate

In line with the ACES commitment to upskill researchers through training complementary to their core research skills, the Media and Communication team ran a Communication Certificate in 2016.

Delivered online via email, video and slideshare, the course content covered topics including:

- How good scientists are great communicators
- The secret sauce in the recipe of great communication
- Telling your research as a story
- Elevator pitches
- Writing how you speak
- Personal branding
- Writing for blogs and social media

Of the eleven participants (ACES affiliate and core funded PhDs and ECRs) three finished the course content including developing short narrative based pitches of their research and updating their LinkedIn profiles, and eight are continuing.

Short courses can boost skills for research students and professionals

The use of training tools such as Massive Open Online Courses (MOOCs) and short courses undoubtedly add agility to ongoing training options.

In 2015-2016 ACES and ANFF (Materials Node) staff produced an eight hour (two hours per week for four weeks) MOOC on Bioprinting. The MOOC has been aired four times since November 2015, with just shy of 20,000 people registered to do the course from around the globe.

Our most successful event attracted over 7,000 registrations, with 26% of participants from the United Kingdom, 9% from the United States, 8% from Australia. On each consecutive run the majority of participants continued to be from the United Kingdom (20%, 26% and 26%). While this MOOC was aimed at a community level of understanding, it demonstrates the power of the medium to connect with a diverse range of individuals.

Masters training program in Biofabrication

Studying for jobs that don't exist...yet!
Throughout 2015-16 the MOOCS were run alongside the more formal qualification course of the Masters in Philosophy (Biofabrication). This world's first Master of Philosophy in Biofabrication run by the University of Wollongong, with ACES support, in collaboration with Queensland University of Technology, Utrecht University (Netherlands) and the University of Wurzburg (Germany) trains graduates for a future job that probably doesn't exist yet, in a field that's set to take off. The field of biofabrication is an emerging one in which a connection is made between medicine and technology. Think—prosthetic limbs controlled by thought alone, and bionic implants to restore lost senses, and of course—3D printing of human organs. One possible job description—biomedical engineer—is already taking off in the US. In fact, in 2012, Forbes rated biomedical engineer number one on their list of 15 most valuable college majors, and in the same year, CNN called it the "best job in America".

Three July 2016 graduates from UOW are studying their second year overseas at Utrecht and Wurzberg. Four new students started this masters degree at UOW in July 2016. Two Utrecht students commenced their UOW research exchange in September 2016 and are expected to complete their thesis in 2017.

Graduates of the Biofabrication masters program will have an international network, a track-record of collaboration with the world's leading bionics, fabrication and bioethics experts and an appreciation of all the processes involved in taking an idea through to commercial reality.

ARC Training Centre in Additive Biomanufacturing announced May 2016

ACES, through UOW, is partner in a new training centre that will position Australia as a world leader in 3D bioprinting for medical applications. Federal Government funding of $3.7M was awarded to establish the ARC Training Centre in Additive Biomanufacturing—a collaboration between universities, companies and clinicians, under the Industrial Transformation Training Centres scheme. Additive biomanufacturing, also known as 3D bioprinting, uses 3D printing technology to create medical implants, and is set to transform the foundations of manufacturing and medicine. ACES, in partnership with ANFF, are excited to be able to provide state-of-the-art 3D printing facilities and highly skilled personnel to this venture. Industry partners in the ARC Training Centre in Additive Biomanufacturing include Osteopore—one of the first companies to use resorbable 3D printed polymer implants to treat bone defects; Anatomics—a pioneer of patient-specific

custom surgical implants and surgical planning tools; and Cochlear—the world's leader in cochlear implants. Surgeons from St Vincent's Hospital Melbourne and the Peter MacCallum Cancer Centre will drive the introduction of additive biomanufacturing into clinical applications.

Masters Degree Electromaterials Science

In 2016 the ACES nodes at the University of Wollongong and Deakin University launched Australia's first joint postgraduate masters degree in electromaterials science, with an emphasis on the use of new fabrication tools to build devices containing next generation materials. The course was designed to ensure that the students gain maximum benefit from the unique multidisciplinary expertise in ACES in a bid to prepare skilled people who can progress the technology. The study of electromaterials has, until now, been confined within subjects like chemistry, electrochemistry or materials engineering, however a dedicated masters is needed to provide the depth required to take the technology to the next level.

The term electromaterials basically means 'high tech' materials in which ions or electrons carry out useful functions. These materials are set to play a key role in the global transition to sustainable energy, offering promise in areas ranging from electric cars, to solar fuels, to thermal energy harvesting, amongst many others. They are also having a big impact on health applications, from diagnostics to implantable devices. The ten research thesis projects ACES are offering represent the cutting edge of electromaterials technology: topics such as biocompatible batteries, redox flow-air batteries, harvesting waste thermal heat, developing soft robotics for prosthetic devices and creating implantable, self-powered structures to monitor neural tissue for treatment of conditions such as epilepsy or schizophrenia.

Although only one student was officially enrolled in the course in 2016, ACES PhD students welcomed the chance to refresh their electromaterials background knowledge.

Summer scholarship program

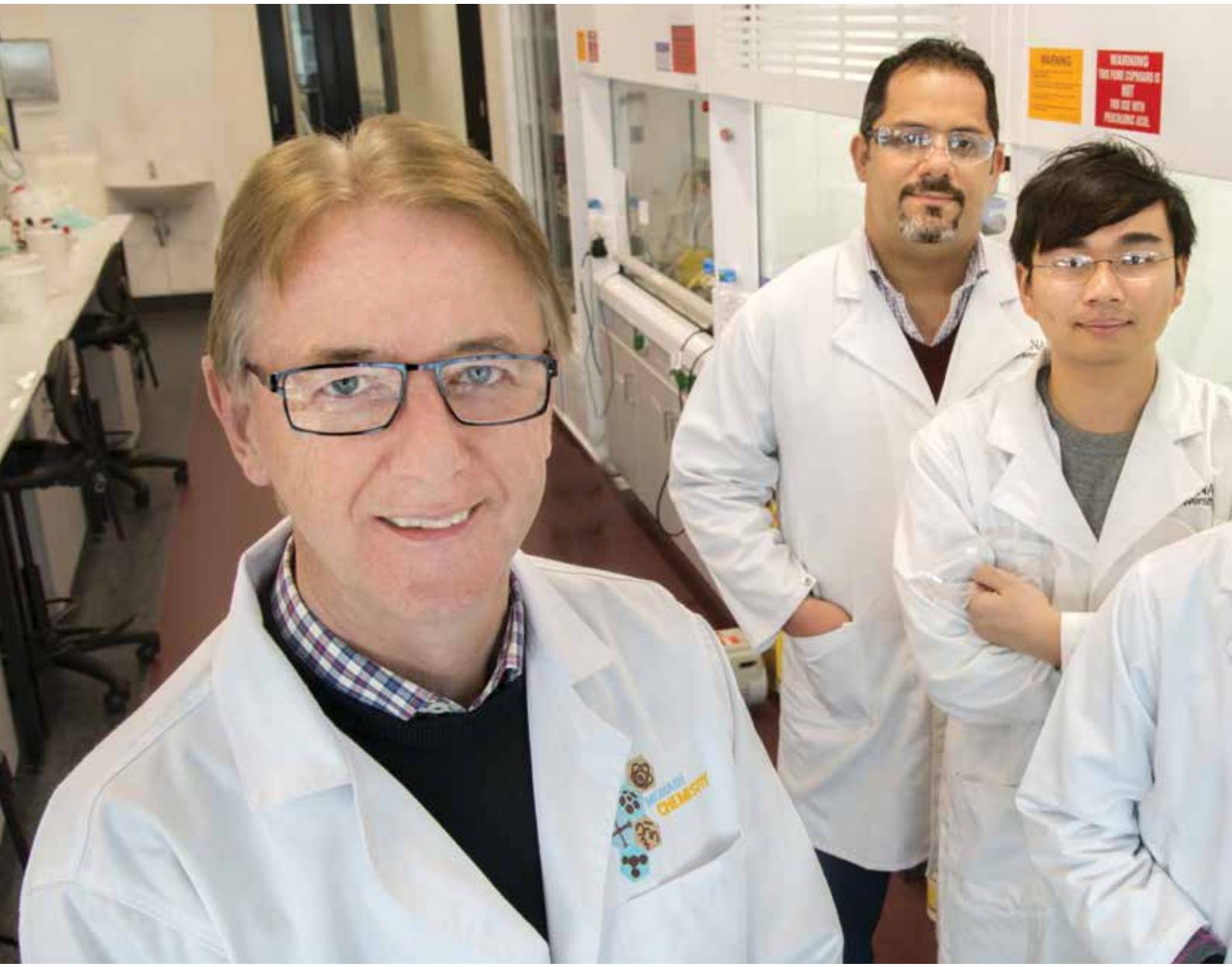
The summer scholarship program is designed to encourage undergraduates into ACES post graduate programs. In 2016-17, three undergraduate students are working at ACES as part of a ten week summer scholarship. The students and their projects are:

- Macleay Stephenson (ACES UOW) - Development of Integrated Printer
- Brodie Leeson (ACES UOW) - New 3D Printer Interface
- Jonathan Clark (ACES UOW) - Coaxial Printing Patterned Shell - variable cross-linking
- Chengcheng Wu (ACES Deakin) -Solid electrolytes for Na-Air batteries
- Yahui Tang (ACES Deakin) - Carbon materials as catalysts for Oxygen Reduction Reactions

Student Internships hosted at ACES

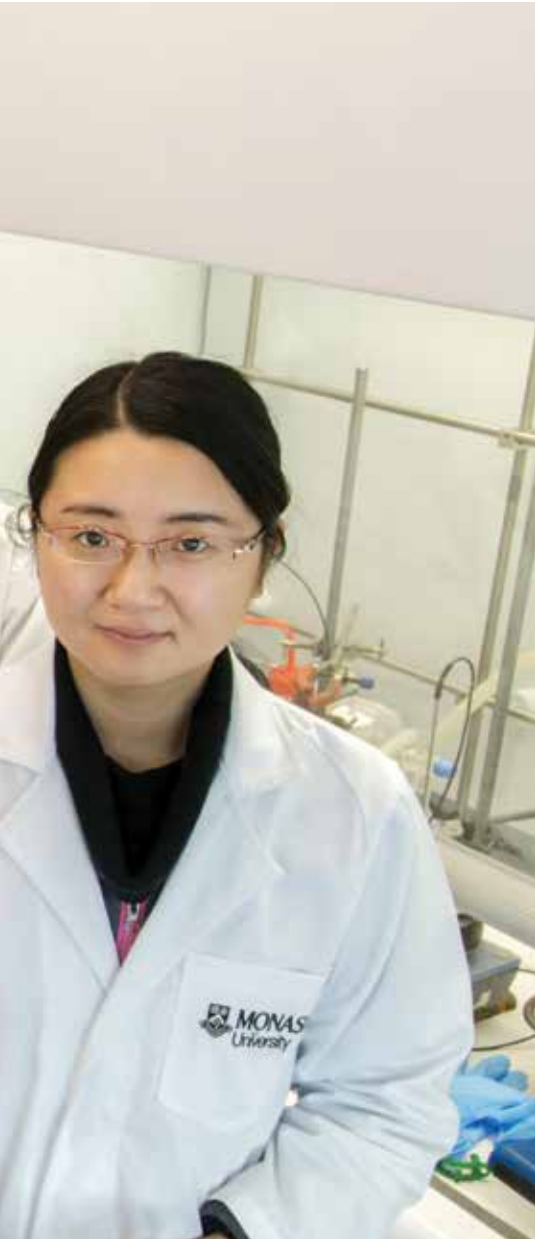
Twenty two students from international universities have chosen to study with ACES in 2016.

1. Yunfeng Chao, a CSC scholarship recipient, is with ACES at UOW for 3 years working on 'Fabrication of graphene structures for energy storage using roll-to-roll printing'.
2. Zan Lu received an 18-month CSC scholarship and chose to study at ACES in UOW from January on 'Mechanical-Electrical Properties of Carbon Nanotube Yarns and Applications in Smart Textiles'.
3. Kezhong Wang, a recipient of a 12 month CSC scholarship, spent 2016 in ACES at UOW working on wetspinning graphene fibers. In late 2016 Kezhong applied to UOW so he can now complete a PhD with ACES.
4. Alina Brzeczek, from Silesian University of Technology in Poland, spent 3 months from 4 January working at ACES UOW on 'Novel carbazole based materials for Optoelectronic applications' under the 'multicolcoured ambipolar conducting polymers for single polymer optoelectronic devices' (AMBIPOD) project approved from the European commission as part of the Seventh Framework program of the European community funded under the Marie Curie International Research Staff Exchange Scheme (IRSES).
5. Enrico Angioni, from University of Strathclyde UK, studied at ACES UOW for a month as part of the IRSES-AMBIPOD exchange from 18 January to 18 July.
6. Desire Tupia, master's student from Universita degli studi Milano-Bicocca in Italy, spent a 12 month internship working at ACES UOW from 18 January on the study of protein and cellular interactions with organic conducting polymer based biomaterials.
7. Vanessa Ortiz, from the Universite de Montpellier, spent her internship at ACES Deakin University from 2 February to 30 June working with ACES AI Wren Greene on development of an ultralow biofouling Lubricin-conductive polymer coating used for bionic electrodes.
8. Jeremy Guazzagaloppa, a French exchange student Université de Montpellier, spent six months from February working in ACES at Deakin University on Novel Organic Ionic Plastic Crystal electrolyte for sodium batteries.
9. Thomas Vroman, a French exchange student Université de Strasbourg, spent six months from February working in ACES at Deakin University on developing selective membranes based on organic ionic plastic crystals for CO_2/N_2 gas separation.
10. Emma Sackville, a PhD student from Bath University UK, spent from



22 February to 18 March at Monash University, to use FTAC voltammetry to study the active forms of the catalyst for water oxidation.

11. Corinna Stumm, an undergraduate student from ACES partner FAU at Erlangen, worked at ACES UOW from March to July on CO_2 reduction.
12. Gabrielle Newson and Mr Matthew Waddington, undergraduate students from ACES partner Warwick University, spent 4 April to 8 July at Monash University as part of an exchange through the Monash University-Warwick University Alliance.
13. John Will III, final year undergraduate student from The University of Texas at Dallas in the USA, spent 3 months from 10 May to 17 August working at ACES UOW on the chemical synthesis of PEDOT- Ulvan biocomposite materials.
14. Maria Nieves Lopez de las Salas, from Instituto de Ciencia de Materiales de Madrid in Spain, was hosted at ACES Monash University for her postgraduate research exchange from 25 May to 24 August.
15. Rachel Mathew, from University of Auckland in New Zealand, spent 2 weeks in July working at ACES UOW on Atomic Force Microscopic (AFM) studies of non-molecular biocide films and bacterial potency on 2D surfaces as part of her PhD project.
16. Rachel Waldrom, an undergraduate student from Cardiff University in Wales, spent nine months at ACES



UOW, from 1 August, working on graphene nanocomposites for photo-electrocatalytic water treatment.

17. Rasa Keruckiene, from Kaunas University of Technology in Lithuania, studied at ACES UOW for a month from 1 September as part of the IRSES-AMBIPOD exchange.
18. Celia Chari, from Trinity College in Dublin, spent 3 months from 10 September to 10 December at ACES UOW working on 4D printing of hydrogel structures.
19. Gearoid Collins, from Trinity College in Dublin, spent 3 months from 12 September to 2 December at ACES UOW working on electrocoagulation methods.
20. Yuka Shimazu, from ACES partner Yokohama National University in Japan, is working at ACES UOW between 25 September 2016 and 5 February 2017 on fabrication of a double layered vessel structure.
21. Xiaomin Zhang, from Nanjing University in China, is being hosted on a postgraduate research exchange at ACES Monash University from 29 September 2016 through to 3 March 2018.
22. Keana Erika de Guzman, from ACES partner Dublin City University in Ireland, was working at ACES UOW from 21 October to 16 December on 3D bioprinting for sensor testing and conducting materials as a temporary tattoo sensor platform for hydration sensing.

Honours Graduates

ACES at UOW graduated two honours students during 2016.

- Luke Garcia with a Medical Biotechnology honours class 1 completing his project 'Understanding the effects of external cues and substrates on neural cell behaviour'.
- Thomas Gray in Engineering completing his project 'Processing and mechanical analysis of PVC based 3D printed materials'.

ACES Research Theme Workshops

The ACES Research Training Group (RTG) is responsible for designing, establishing and implementing an innovative research training and career development program, including various industry and web-based programs. The highlights of the program are outlined below.

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

- PhD/ECR development day
- Full Centre meeting
- weekly theme meetings (18 February-14 December 2016) between all nodes within the Centre via video link
- a number of targeted ACES research theme workshops
- webinars

Targeted research theme workshops held in 2016 included: graphene synthesis scale-up and device fabrication; specific material workshops (collagen, GelMA, graphene); flexible electrode; modelling; solar fuels; carbon dioxide reduction; batteries; thermocells; bionics; applied 3D fluidics; chip and fibre based electrofluidics and ethical issues associated with maintaining synthetic organs. These workshops provide specialist research training for PhD and early career researchers, and include mentoring for research planning and positioning for career opportunities. Table 3 summarises these activities.

ACES staff and students are afforded opportunities to attend seminars delivered by numerous visitors and collaborators to the nodes throughout the year.

ACES X-Nodal Visits

Travel between nodes to undertake multidisciplinary research tasks is also encouraged and supported.

76 visits/interactions are summarised in Appendix 1.

Table 3: ACES Research Training and Mentoring Events 2016		When	Where
1.	ACES Collagen workshop ACES staff and students discussed current activities and progress related to collagen. The challenges of 3D collagen structure fabrication were identified.	13 January 2016	iC campus UOW Wollongong
2.	ACES GelMA workshop ACES-ANFF staff and students discussed current activities and progress related to use and supply of GelMA.	16 January 2016	iC campus UOW Wollongong
3.	ACES Graphene workshop ACES-ANFF staff and students discussed the different issues with graphene. Included were topics such as synthesis, scale-up, characterisation, composite preparation, cell studies and biodegradation.	21 January 2016	iC campus UOW Wollongong
4.	ACES Deakin NMR Capabilities workshop This workshop allowed ACES members to understand the NMR capabilities available at Deakin University	28 January 2016	IFM/ Deakin University, Melbourne
5.	ACES ECR mentoring forum ECR and students organised the program with the assistance of the ACES RTG director A/Prof Jenny Pringle	9 February 2016	Deakin University, Melbourne
6.	ACES Flexible Implantable Electrodes Workshop ACES staff, students and affiliate members welcomed insights from an international guest Louis Lemieux (UCL in the UK) and ACES members and affiliates introducing their current work in this area.	9 February	St Vincent's Hospital, Melbourne
7.	ACES Electromaterials Symposium Showcase of ACES research and networking event with ACES collaborators	10-12 February 2016	Deakin University, Melbourne
8.	ACES Chief Investigator meeting Items discussed: aims of ACES; research milestones; governance and ACES activities.	12 February 2016	Deakin University, Melbourne
9.	ACES Solar Fuels Workshop Research updates and future plans workshop.	12 February 2016	Deakin University, Melbourne
10.	ACES EFD milestone meeting Research updates and future plans workshop.	10 May 2016	iC campus UOW Wollongong
11.	ACES Flexible Electrode meeting A follow-up meeting to the meeting held in Melbourne in February.	10 May 2016	iC campus UOW Wollongong
12.	ACES Battery Workshop The workshop for ACES, affiliate and associate members concentrated on 4 main topics (metal air batteries, redox couples and batteries, batteries and organic conductor-based materials). Short talks were presented followed by discussion on ACES projects and milestones. It concluded with a brainstorming session on future technologies to be pursued.	17 May 2016	Video conference Deakin, Monash & Wollongong
13.	ACES CO_2 Workshop The workshop for ACES and affiliate members concentrated on ACES projects and milestones and identifying protocols for product analysis across the Centre.	20 May 2016	Video conference Deakin, Monash & Wollongong
14.	ACES Finite Element Modelling (FEM) workshop Covered Fundamentals of Finite Element Modelling; hands-on exercises using ANYSYS and case studies and applications.	7 June 2016	UOW main campus

Table 3: ACES Research Training and Mentoring Events 2016		When	Where
15.	Certificate in Entrepreneurship and Innovation intensive 5 day training program.	18 July -22 July	Sydney Business School, Sydney
16.	ACES-IHMRI networking event 'Materials in Medicine' on next generation medical devices and therapies. Discussions took place on current collaborative projects and the potential for future projects in next generation medical devices and therapies. *Outcome: 3 UOW matching PhD scholarships – for start 2017.*	25 July 2016	iC campus UOW Wollongong
17.	3D BioPrinting Ethical and Regulatory Matters Workshop The convergence of advances in biomaterials, stem cell biology and 3D Bioprinting has resulted in remarkable progress in our fundamental understanding of biological processes and how they might be manipulated to circumvent or remediate disease. As we see the establishment of 3D Bioprinting facilities and expertise in hospital environments we need to consider the issues around regulation and ethical matters associated with the development of these technologies into products for use in clinical contexts. Our current regulatory framework might not be appropriate. This workshop drew on the expertise of researchers in ethics and policy development together with those with regulatory and industry experience.	12 September 2016	iC campus UOW Wollongong
18.	ACES in-house Communications Certificate	Start week 26 Sept for 9 weeks	Online and webinars
19.	'Engaging with industry' by David Officer/ Gordon Wallace Hosted by Profs Gordon Wallace and David Officer, the webinar was aimed at PhD candidates and early career researchers to help them devise their own strategy for engaging with industry.	29 August 2016	Webinar
20.	ACES SBS Milestone meeting Research updates and future plans workshop.	21 September 2016	iC campus UOW Wollongong
21.	ACES Full Centre Meeting Research updates and future plans workshop.	22-23 September 2016	ANU, Canberra
22.	ACES Chief Investigator meeting Update on ACES research activities and discussion around revision of the ACES milestones 2017-2020.	23 September 2016	ANU, Canberra
23.	ACES and Surgeons at St Vincent's hospital Melbourne - Thoughts to Action Workshop Clinicians and researchers discussed BioElectronic Translation Technologies and BioRegenerative Componentry Fabrication Technologies.	13 September 2016	St Vincent's Hospital Melbourne
24.	ACES EFD Milestone meeting Research updates and future plans workshop.	7 November 2016	UTAS, Hobart
25.	Certificate in Entrepreneurship and Innovation- feasibility pitches, awards and certificates. *Outcome: 18 completions*	15 November 2016	Sydney Business School, Sydney
26	'Writing a High Impact Paper' Prof Doug MacFarlane	28 November 2016	Webinar

TRAINING OPPORTUNITIES

Continuing Professional Development (CPD)

ACES members are encouraged to participate in continuing professional development activities run by their host universities whilst others complete CPD activities run by external companies. Examples include:

Prof Mark Cook (ACES CI and Synthetic Biosystems theme leader) over 2015 and 2016 completed the Vincent Fairfax FellowshipTM Programme. The Fellowship™ is the flagship teaching program at the Centre for Ethical Leadership and aims to close the gap between the theories of ethics and actual practices to inspire transformational leadership.

Natalie Foxon-Phillips (ACES Communications and Media Officer) completed 'The recipe for SEO success'– a System Engine optimisation (SEO) course run by Kate Toon. This e-course is marketed as 'an achievable, easy to learn road map for your SEO success; teaching you how to create a technically sound, optimised website, improve your content marketing, build links and measure your achievements'. The online course was run over nine weeks from 2 June.

Patrick Howlett (ACES CI Deakin) participated in a 'Researchers Workshop for Senior Researchers' run by Prof Peter Hodgson, DVCR at Deakin University, on 28 June.

Xungai Wang (ACES CI) participated in the Senior Management Group (SMG) development program run by Deakin University.

Mentoring Activities for and by ACES members

ACES Mentoring Workshop

ACES Mentoring Workshop was held on the 9 February at Deakin University and attended by all ACES ECRs and PhD students. The program included presentations on: 'Mentoring, Career Development and Leadership' by ETHOS Australia; The SAGE (Science in Australia Gender Equity) pilot initiative of the Australian Academy of Science, in partnership with the Australian Academy of Technological Sciences and Engineering, that addresses gender equity in the STEMM sector; 'Planning your Grant Application'; 'Supervisory/ Student Relationships and how to manage difficult situations'; 'Engage, Collaborate, Participate: Exposing Yourself Online with Social Media (without sexting)' and an 'Unpacking Workshop' interactive session designed to help participants identify what skills they currently have, what skills they currently need, and what skills they will need in the future and guest presentations on different career pathways.

Webinars

In 2016 ACES ran two webinars as part of the ACES mentoring program.

'Engaging with Industry' by ACES CIs Profs David Officer and Gordon Wallace (32 attendees). The webinar was aimed at PhD candidates and early career researchers to help them devise their own strategy for engaging with industry.

'Writing a High Impact Paper' by ACES CI Prof Douglas MacFarlane (40 attendees). The webinar covered putting together a great paper by breaking down the process into the following digestible steps:

- What's the story of the paper?
- Writing the abstract
- Drafting the paper
- The intro
- Results and discussion
- Finishing it off
- Turning ordinary writing into great writing!

Other Mentoring Activities

Binbin Zhang (ACES ECR UOW) completed a ten month UOW Early Career Researcher Development Program (https://intranet.uow.edu.au/pods/ecrdprogram/index.html). This included workshops on: 'Understanding the roles of mentees/mentors and what mentoring is and is not'; a two day workshop covering topics such as Examine the characteristics of an academic career; discuss the skills and capabilities needed to be a successful researcher; formulate a personal career development plan and research plan; acquire new perspectives, tools and techniques to assist your career development; overcoming career derailers and building resilience; importance of networks and collaboration and a writing retreat for improving writing skills for publication and grants, as well as the assistance of experienced facilitators/ reviewers to review and discuss written manuscripts.

A/Prof Jeremy Crook (ACES CI) was a mentor in the UOW 2016 Early Career Researcher Development Program.

Dr Toni Campbell (ACES COO) and Karla House (ACES Professional Staff) attended the NSW Centres of Excellence Professional Staff Workshop, in Sydney on 27 April.

Prof Gordon Wallace (ACES Director) was an invited speaker at the ARC Directors Forum and Dr Toni Campbell

(ACES COO) attended the ARC COO and Director Forum in Sydney 22 and 23 June.

Siti Abdul Rahim (ACES affiliate student UOW) attended the Interuniversity school InSPiRE conference held at UNSW 4-6 July 2016. The program featured a three-day theme "Making Agility and Resourcefulness part of your Research Career". The three days focused on career development—increasing one's ability to articulate their research impact, influence and engagement. Sessions included Energise your Career; Research Impact—what is it and why does it matter?; So you want to be famous—approaches and considerations to building your profile; Researcher Resilience—Why is it important?; Engagement and Influence—Speed Dating for Researchers and 'Bringing it all together'.

Adam Taylor (ANFF-ACES fabrication technician) and Melanie Gilles (Biofabrication Masters student), were sponsored by ACES to attend the Mimics Innovation Course, held in Sydney over two days (0.5 day seminar, 1.5 days software training). The course introduced how anatomical scan data is currently being utilised by industry and researchers alike to produce patient specific implants, surgical models, cutting guides, as well as assisting in medical research. The training enhanced the ACES-ANFF ability to process CT and MRI data for use in additive fabrication processes. This will increase potential collaboration opportunities with clinicians looking to replicate anatomical models. The relevant software (Materialise Mimics and 3-Matics) is with UOW.

Dr Justin Bourke (ACES RF UOM) attended 'Women in STEMM Australia National Symposium' in Melbourne on 14 September. The aim of the symposium was to connect women in science, technology, engineering, mathematics and medicine (STEMM) regardless of their discipline or profession. The PROGRAM showed best practices and policies in academia and industry, as well as ground-breaking initiatives to foster an environment where more women in STEMM can lead and excel. Men who champion change and want to see equity and equality in the workplace were invited and encouraged to attend.

Prof Douglas MacFarlane was an invited mentor for Session IV: Balancing leadership and management at the Early and Mid-Career Researcher Forum—'Science Pathways 2016: Future Leaders' held at UNSW 26-27 September.

Anita Quigley (ACES RF UOW) and Alexandr Simonov (ACES RF Monash) attended the Early and Mid-Career Researcher Forum—'Science Pathways 2016: Future Leaders' held at UNSW 26-27 September.

Grant Barnsley (ACES PhD Affiliate UOW) was sponsored to complete the hands on training session using COMSOL Multiphysics, 25 November. This enabled Grant to better understand the modelling software and how it may be applicable to others within ACES.

ACES MEMBERS TRAINING OTHERS

Laboratory BioTechniques course

The ACES members at St Vincent's Hospital Bionics laboratory conducted a training course for 16 second year Medical Students from Universitas Indonesia, Indonesia as part of their Advanced Medical Science (AMS) year. The 'Laboratory Techniques' course introduced students to the theory and practice of conducting medical research.

Lectures at Hanbat University in Korea

Four ACES members A/Prof Michael Higgins, A/Prof Attila Mozer, A/Prof Peter Innis (ACES CIs at UOW) and Dr Caiyun Wang (ACES SRF UOW) gave a series of lectures to post graduate students at Hanbat University, Daejeon in South Korea 29 November to 8 December.

Lectures included background theory on origins of electrical conductivity in organic materials, their synthesis and application in electronic devices; organic conductors for novel energy storage applications; specifically batteries, including electrode and device fabrication and testing techniques, biobatteries, wearable/stretchable batteries and use of organic conductors in energy; fundamentals of solar energy conversion and solar cells and solar fuels; porphyrin-sensitised solar cells and Atomic Force Microscopy (AFM)—fundamental surfaces forces, biological interactions and forces and an overview on the use of Bio-AFM to study protein/cell interactions with electromaterials.

Knowledge Translation

ACES STRATEGIC PLAN GOAL 3: TRANSLATION COMMERCIALISATION

Our goals are:

- To implement strategies for effective industry engagement and knowledge transfer to industry partners.
- To utilise appropriate business tools to identify and select commercial opportunities in the early stages of ACES.
- To implement effective knowledge transfer strategies that facilitate the development of new business opportunities.

Our target audience is primarily investors. ACES can facilitate the development of technologies to create new disruptive business opportunities and to augment existing businesses.

TOWARDS OUR GOALS

As ACES creates new knowledge it is channelled into existing commercialisation networks (through Cooperative Research Centres (CRCs)); helps build new activities with existing companies (through ARC Linkage Hubs, other grant proposals and direct funding of commercial projects) and in collaborations with other end-users, such as clinicians (through NHMRC grants and Garnett Passe funding).

ACES has been an integral component in the building of new facilities such as the BatTRI Hub at Deakin and the 3DBiofab facility at St Vincent's Hospital in Melbourne, with a view to attracting further end-user engagement.

We have embarked on the journey to identify ACES activities that could result in new commercial ventures, through investment and partnerships. Local industry can also realise global opportunities by tapping into internationally recognised and networked research organisations. We at ACES are keen to take world class science and turn that into next generation manufacturing in partnership with local industries.

Our innovative training programs are preparing next generation researchers to ensure effective knowledge dissemination.

ARC Centres of Excellence are certainly open for business!

ACES—AUSTRALIAN NATIONAL FABRICATION FACILITY (ANFF) PARTNERSHIP

ACES is funded to translate materials science knowledge into practical, game changing devices that will have a significant impact in the areas of diagnostics, energy, health and soft robotics.

Rapid advances have been made possible through the integration of fundamental materials science research with cutting edge approaches to fabrication, including 3D printing. Our continued partnership with ANFF is critical to translating our research into real world devices.

The ANFF Materials Node is head-quartered alongside ACES at the UOW Innovation campus. ANFF provides ACES researchers, external collaborators, publicly funded researchers and end users with access to fabrication capabilities and materials synthesis through state-of-the-art facilities for the production of small to large scale research quantities of nanostructured materials (e.g. electronic polymers, conducting carbons, graphene and macromolecules) coupled with additive manufacturing facilities and expertise.

For more about Australia's Blue-Sky Future with the co-location of ACES-ANFF read the article co-written entitled 'What can we make in the Future?' showcased in the ATSE Focus magazine Dec 2016.

ACES has commissioned promotional videos to showcase the ACES-ANFF partnership.

AquaHydrex: An ACES and ANFF partnership case study. We've discovered new materials that facilitate the breakdown of water into important fuels—hydrogen and oxygen. This is commonly known as water splitting. View on the ACES YouTube channel at https://www.youtube.com/watch?v=uOQ5FwNGCPA

Cartilage Regeneration: An ACES/ANFF case study. In collaboration with Prof Peter Choong from Melbourne University, we're helping to repair defects seen in arthritic patients, with scaffolds and stem cells. We're recreating the exact type of cartilage that is missing. View on the ACES YouTube channel at https://youtu.be/cG06AzKRS2c

Islet Cell Transplantation: An ACES/ANFF case study. In collaboration with Prof Toby Coates from the University of Adelaide, we're producing 3D printed scaffolds containing islet cells to enhance the efficiency of cell therapy to treat type 1 diabetes. View on ACES YouTube channel at https://youtu.be/vva-evYAeEI

TOWARDS TRANSLATION

Our current activities towards translation of ACES fundamental research are summarised below.

Cooperative Research Centres

Cell Therapy Manufacturing (CTM) Cooperative Research Centre (CRC)

This ACES collaborative effort with the University of Adelaide and the CTM CRC is for printing cells in scaffolds, in partnership with clinical collaborator Prof Toby Coates.

CRC For Polymers

ACES involvement in the CRC for Polymers has resulted in new solar cell technologies.

Energy Pipelines CRC

ACES involvement in the Energy Pipelines CRC assesses materials, coating selection, application and testing.

Hearing CRC

ACES involvement with HEARing CRC has produced new electrode and controlled delivery technologies relevant to the Cochlear implant, in partnership with clinical collaborator Prof Stephen O'Leary.

Research in action

Improvements for Cochlear implants: Fundamental materials research at ACES is enabling developments for cochlear implant electrodes that could further improve an implantee's quality of life and hearing abilities. ACES in partnership with the HEARing Cooperative Research Centre (CRC) and ANFF-materials node have worked to devise a polymer drug delivery system that complements the design of a cochlear implant electrode to better control post-implantation inflammation, in addition to characterising electrode materials and processes, including protein adsorption onto electrodes.

Engagement: *"Working with ACES allowed us to access state-of-the-art technology and interdisciplinary know-how critical to solving a specific medical device problem"* CEO HEARing CRC Prof Robert Cowan.

Impact: Research towards (i) cochlear implant stimulation regimes leading to new electrode designs that produce improved power efficiency and more precise current distributions in the cochlea and (ii) the feasibility of using new materials and automated manufacturing processes to produce electrodes with increased capacity and reliability, and reduced power usage.

Australian Research Council (ARC) Linkage Hubs

ARC Research Hub for a World Class Future Fibre Industry

ACES involvement in the recently established ARC Research Hub for a World Class Future Fibre Industry at Deakin University is seeing the translation of fundamental findings into developing novel fibre technologies to facilitate more sustainable, advanced manufacturing of fibre materials and products.

ARC Steel Research Hub

ACES involvement in the Steel Research Hub at UOW is seeing the translation of fundamental findings into antimicrobial coatings.

ARC Training Hub for Biofabrication

ACES, through UOW, is partner in a new training centre that will position Australia as a world-leader in 3D bioprinting for medical applications. The ARC Training Centre in Additive Biomanufacturing involves collaboration between universities, companies and clinicians, under the Industrial Transformation Training Centres scheme.

National Health And Medical Research Council (NHMRC)

ACES materials continued to be developed and used in two NHMRC projects in 2016. This assists the translation of the research by taking the *in vitro* materials work and testing those materials as well as developing techniques *in vivo*. Grant 1065463 uses conducting polymers for the treatment of schizophrenia and allied disorders focusing on neuronal outgrowth, myelination and synaptogenesis. Grant 1062569 uses ACES materials in the development of a biopolymer conduit for peripheral nerve repair.

New Ventures

CtechBA Opportunity Report

A feature of our Centre of Excellence proposal was our commitment to identify new commercial opportunities. ACES carried out a two stage technology audit with CtechBA that was completed in 2016.

In stage 1 CtechBA considered all planned research under the 2014-2017 program and identified a number of commercially significant projects (opportunities) and made recommendations on how ACES can more effectively facilitate technology transfer through those opportunities. CtechBA also absorbed lessons from the experiences of executives of spinout companies that are currently commercialising the IP that was developed under the 2005-2013 ACES program.

The initial project list identified 19 commercial opportunities by loosely grouping activities undertaken by each ACES supported research project. Of the 19 opportunities, 16 were considered applied R&D. After further internal deliberations the following three areas were identified as areas presenting the most immediate commercial engagement opportunities for ACES:

- Thermal batteries for use in the wearable market
- Tough Hydrogels for a wide variety of applications ranging from 3D scaffolds to condoms
- Compounds and Structures of Biotechnology (3D bioprinting, hardware and bioinks)

Subsequent to this audit internal workshops have revealed that electrochemical reduction of carbon dioxide is an area wherein a commercial engagement plan should be developed during 2018.

The ACES commercialisation development group (CDG) held discussions to identify possible effective translation mechanisms for the three targeted ACES research outputs—not necessarily current institutional practices.

An options paper was drafted summarising those discussions and listing five commercialisation options to progress the three identified opportunities.

The five options were:

- Adhoc University lead per opportunity
- University lead per focus area
- External commercialisation leads
- IP Pooling
- ACES commercialisation business commercialisation

The decision following this process was that each of the three identified opportunities would need to be progressed using the option identified by the university(s) where the finalised list of researchers involved in the targeted projects come from.

In the latter part of 2016 a call was made for ACES members willing to contribute to developing and driving the three identified ACES opportunities (materials and design). A series of brainstorming meetings were held from which mentors, members with required expertise and development areas for the technology identified. Some areas of required expertise were not filled so personnel would need to be identified at a later stage.

In each of the three areas the following is progressing:

3D bioprinting
This will be led by UOW and championed by Dr Zhilian Yue and Prof Gordon Wallace. An internal technical liaison group has been established. An external consultant will be identified by ACES-UOW to develop a commercial engagement plan in the first half of 2017.

Tough gels
This will be led by UOW. A number of commercial linkages are emerging and include:

a. Gates Foundation Funding—Golden Project Materials (Prof Geoffrey Spinks)
b. Coatings on Stents—Feasibility Study funded by Cook Medical (Prof Geoffrey Spinks)

An internal technical group will be formed in the first quarter of 2017. A commercial engagement plan will be developed in the second half of 2017.

Thermo electrochemical cells
This will be led by Deakin University and championed by A/Prof Jennifer Pringle. An internal technical group has been established. Currently we are seeking funding for prototype development and preparing a commercial engagement plan via Deakin University.

Engagement

Allegra Orthopedics

ACES-ANFF materials node partnership is working towards the production of bone scaffold structures.

Ant- Applied Nanotechnologies

Working with ACES researchers to develop standard and novel energy generation technologies, for application in remote access areas.

Aquahydrex Pty Ltd

ACES hydrogen-production technology is being used to produce clean energy solutions in this spin out company. In 2016 ACES continued to support Aquahydrex through ARC linkage funded activities (Grant LP13010113, 'Highly-efficient, reversible fuel cell').

Austang

ACES researchers collaborate in the development of bespoke battery assembly and thermal safety testing equipment.

Bill & Melinda Gates Foundation

ACES' ultra tough hydrogel materials continue to be developed for use as a condom in a Bill & Melinda Gates Foundation grant project awarded to UOW.

Carbon Nexus

Carbon Nexus have large scale carbon fibre production and design embedded at Deakin University, Waurn Ponds campus, with possible application for battery electrodes and packaging.

Chemson

ACES-ANFF Materials Node are contributing to the testing and validation of new commercial PVC based materials for 3D printing.

Research in action

3D bioprinting with living cells is allowing the development of in vitro models that give us insights into disease development and provide readily accessible models, on the bench, to test intervention strategies.

Artificial skin bioinks: ACES are partnering with a local NSW seaweed production company Venus Shell Systems (VSS) to identify and extract valuable components used to synthesise new bioinks so as to fast-track the development and commercialisation of seaweed wound healing materials. The seaweed molecules are very similar to the natural molecular matrix that supports and repairs human skin cells and from there high-tech processing and fabrication techniques at ACES/ANFF, including a new customised 3D printer, is being used to turn the molecules into medical treatments.

Potential Impact: If successful there will be the production of artificial skin—a potential end product to treat burns.

Cook Medical

ACES is undertaking a feasibility study for coatings on stents.

DSTG

ACES researchers at Monash, UOW and Deakin have undertaken several projects on energy storage.

Enware

ACES members are involved in the development of material technologies related to tapware and plumbing systems.

Ergon Energy

Are in discussion with ACES researchers about energy generation and storage for remote access areas.

Evonik Industries

ACES members contribute by modelling reactions.

GTET

An industry partner for the development of energy conversion based on ACES thermal energy storage technology.

Hydro Quebec

Hydro Quebec specialise in Canadian battery technology and are collaborating with ACES researchers to develop high energy batteries. They have an interest in licensing advanced battery manufacturing technology to Australian manufacturers.

Imagine Pty Ltd

ACES continues to work closely with IMAGINE. ACES graphene processing technology has been licensed to this spinoff company.

Lincoln Agritech Ltd

ACES members collaborate on fibre materials production and application.

Reserve Bank Of Australia

ACES members collaborate on electromaterial research.

Romar

The ACES-ANFF materials node partnership work on 3D printing of biocompatible flexible materials.

SEA Electric

ACES researchers collaborate to identify and develop optimal battery technologies. SEA Electric has embedded Electric Truck manufacturing and testing capability at Deakin University, Waurn Ponds campus.

Siemens

ACES researchers at Monash University are engaging in the field of electrochemical ammonia production as a source of fuel to power electric energy needs.

Toyota Motor Engineering and Manufacturing

ACES members are involved in the development of ionic liquids and batteries.

Trajan Scientific Australia Pty Ltd

ACES members are involved in developing a method for specialty chemical purification.

Venus Shell Systems (VSS)

This Wollongong regional manufacturer is jointly funding a PhD scholarship at UOW. The collaboration is progressing to develop new methods to enable the extraction of high quality biomaterials (ulvans) from seaweed for wound healing.

Wilson Transformers

A local manufacturer interested in expansion into battery technologies and a possible partnership with ACES researchers at Deakin.

Yara

Potential ACES partner for developing the electrochemical production of ammonia to replace the current inefficient processes.

BUILDING ENDUSER NETWORKS

Indicators of the social impact of ACES can be measured through public outreach programs, contribution to policy development and influence on the national research strategy.

Energy Policy Makers and Power Supply

Patrick Howlett (ACES CI Deakin) visited parliament house to present to the 4th meeting of the Commonwealth Science Council including cabinet members (The Hon Malcolm Turnbull MP, Prime Minister (Chair), The Hon Greg Hunt MP, Minister for Industry, Innovation and Science (Deputy Chair), Senator the Hon Simon Birmingham, Minister for Education and Training, The Hon Sussan Ley MP, Minister for Health) and the Commonwealth Science Council (Dr Alan Finkel, Chief Scientist (Executive Officer) on 14 September. Discussions centered on of the future roles for energy storage technology in Australia and the Australian Council of Learned Academies forthcoming report on energy storage.

As stated in the research chapter ACES CI Linda Hancock was invited to provide Prof Robyn Dowling ACOLA (Australian Council of Learned Academics) advice on ACES EPPE work to inform ACOLA's advice to the Chief Scientist on issues relating to battery storage.

ACES EPPE members also participated: (i) in a policy workshop: 'Australia's Electricity System: Transition to 2030', organised by Melbourne Energy Institute, the Grattan Institute, the EU Centre on Shared Complex Challenges, GEE-21, the Australian-German Climate and Energy College, and Australian Academy of Technological Sciences and Engineering (ATSE) and (ii) the Australian CleanTech Network meeting, Melbourne Town Hall August 2016: a forum for investors, companies, government and academia.

ACES is exploring the engagement of government and non-governmental organisational (NGO) bodies charged with disaster recovery to ensure that renewable energy technologies are designed so as to promote disaster resilience and local community development. ACES researchers visited the Australian Department of Foreign Affairs and Trade in Canberra with Clair Cochrane, India Desk, Michael Costa, Policy Officer, and India Economic Section with the aim to build a relationship, and discuss potential opportunities for government support for initiatives related to alternative energy and ethics.

ACES EPPE members Natalie Ralph and Linda Hancock (Deakin) had their paper entitled 'Should companies profiting from new energy alternatives such as lithium-ion batteries be required to implement Corporate Peacemaking?' accepted and presented at the 'Exploring

Peace' International Studies Association (ISA) Annual Convention held 16-19 March in Atlanta, USA.

Assistive Health Technologies

Susan Dodds (ACES CI EPPE UNSW) worked on implications of new sensor and implantable technologies for community care provision. Discussions were held with Anne Livingston regarding the Queensland Government's Queensland Community Care Smart Assistive Technology Collaborative with the aim for: (i) a potential linkage between 3D additive fabrication technicians and community care service delivery organisations for assistive technology devices; (ii) potential for work with sensing technologies as assistive devices in community care; and (iii) broader ethical and social issues debate among patients, carers, care services and smart assistive technology developers.

The purpose of the Online Collaborative is:

- To promote the use of assistive technologies in service provision through knowledge sharing and collaboration;
- To raise awareness of the various roles of Smart Assistive Technology and its applicability in community care service provision;
- To provide practical information on how Smart Assistive Technology can be incorporated into service delivery and business models;
- To encourage collaboration and knowledge sharing;
- To gain an understanding of Service Providers and gauge their attitudes

towards Smart Assistive Technologies and importantly to

- Identify barriers to uptake of Smart Assistive Technology service delivery.

CI Dodds gave a webinar presentation entitled 'How wearable, implantable and sensing technologies are shaping the ethical landscape of community care provision' as part of this collaboration (http://satcommunity.com.au/news/6).

RF Hutchison (Monash) visited St Catherine's College, Oxford for the IDEAL Collaboration Meeting on 8 April. Members of the IDEAL Collaboration (http://www.ideal-collaboration.net/), including surgeons, research methodologists and industry representatives, have developed a framework for the evaluation of new surgical interventions. This particular meeting was held with the aim of improving the evaluation of new surgical procedures and devices, with focus on the role of clinical trials.

The ACES-ANFF Approach: Custom 3D printing solutions into clinical environments

Inspired by Prof Graeme Clark of Bionic Ear fame, ACES researchers have embarked on research into the use of newly discovered materials in medical applications. This has necessitated the parallel development of additive fabrication tools, such as customised 3D printing, in partnership with the ANFF Materials Node. Based on our clinical engagement approach developed at St Vincent's Hospital Melbourne with Prof Peter Choong and Prof Mark Cook, we have established a vibrant national and growing international network.

The ACES approach provides clinical solutions by identifying and customising materials and fabrication protocols that can be located within the clinical environment. This includes:

The Bio-Ink: We draw on decades of experience in materials science to understand the rheological properties required, the ability to induce phase transformations (liquid to solid) during printing and in interactions between materials and living cells.

The Machinery: Commercially available 3D printers enable us to design and develop customised technologies for the clinical challenge at hand. An example is the BioPen, a hand held 3D printer for cartilage regeneration. Another is the 3DIP (3D-integrated printer).

The Optimal Printing Protocol: Each application will require an optimal arrangement of structural and bioactive materials, to provide appropriate mechanical properties and appropriate bioactivity (drugs, growth factors, cells) arranged for optimal performance and development over the required time course.

The expected outcome is to deliver bespoke 3D printing solutions into clinical environments. This will require the ANFF—ACES partnership to ensure integration of materials development and processing, machinery development with clinicians and appropriate training for those to implement translation.

Critical Clinical Partnerships

This amazing journey, facilitated by converging technologies, has been driven by clinical partnerships with:

- Prof Chris Baker (St Vincent's Hospital Melbourne) to develop 3D printed scaffolds for wound healing.
- Prof Mark Cook (St Vincent's Hospital Melbourne) to develop implantable material structures for localised release of anti-inflammatory and anti-epileptic drugs.
- Prof Peter Choong (St Vincent's Hospital Melbourne) to develop 3D printed structures to facilitate adipose stem cell transformation to hyaline cartilage.
- Prof Stephen O'Leary (Eye and Ear Hospital) introducing new materials to facilitate electrode-cellular communication for the bionic ear and to develop new controlled drug delivery systems.
- Prof Michael Coote (Eye and Ear Hospital Melbourne) to develop novel glaucoma implant configurations using 3D printing.
- Prof Toby Coates (Royal Adelaide Hospital) to develop 3D printed structures as vehicles for islet cell transplantation.
- Prof Gerard Sutton (Lions NSW-Eye Bank Sydney) to develop 3D printed structures for corneal regeneration.
- Prof Stuart MacKay (Wollongong Hospital) to develop 3D printed airway models—understanding and rectifying collapse to treat sleep apnoea.
- Prof Morteza (Mori) Aghmesheh (Wollongong Hospital) to develop 3D fabricated systems for controlled delivery of multiple drugs for cancer treatment.
- Dr Payal Mukherjee (RPA Institute of Surgery/Sydney Adventist Hospital) to develop 3D printing techniques for prosthetic ears.

Thanks to the critical linkages and connections with clinicians, translation of the vast body of knowledge generated from ACES is a step closer to changing the landscape of healthcare as we know it.

CAPABILITY BUILDING FACILITIES

New facilities provide catalytic sites for the merging of fundamental research, end-users and commercial opportunities.

Hats off to a collaboration that will boost sustainable energy industries

Prof Maria Forsyth wears many hats. Most days she takes the humble title of researcher—AKA Australian Laureate Fellow, Australian Academy of Science Professor, Alfred Deakin Professor and Associate Director of ACES. These hats give her access to some of the most advanced research programs in the country and provide an opportunity to make vital collaborations with experts in similar fields.

(L to R) Prof Gordon Wallace and Anatomics Executive Chairman Paul D'Urso at the opening of the first 3D printing laboratory within Wollongong Private Hospital.

A great example of this is the collaboration between the Australia's national science agency, CSIRO, and Deakin University, called the Battery Technology Research and Innovation Hub (BatTRI Hub) that will develop the next generation of battery technologies. That's another hat for Maria—she's the Director of the new hub.

Aiming to accelerate the prototyping and commercialisation of energy storage technologies, the hub will boost sustainable power and energy industries, including an emerging electric vehicle industry. It draws on Deakin's critical mass of battery-related expertise, CSIRO's polymer research strengths and scale-up facilities and, through Maria, our own electromaterials expertise here at ACES.

ACES research will benefit from the concentration of efforts on ways to improve and prototype 'salt-based' batteries that use electrolyte materials such as ionic liquids.

"Two joint CSIRO-Deakin postdocs have been appointed to work on new structured polymer electrolyte materials for energy storage applications," Maria said. *"This may feed into the ACES Synthetic Energy Systems theme in terms of metal-air devices and improved binders for electrodes in other devices."*

ACES will be able to access the hub to prototype their energy storage devices.

Australia's First Robotics and Biomedical Engineering Centre, Embedded within a Hospital

ACES and ANFF members and collaborators are at the forefront of developing the BioFAb3D@ACMD.

The Aikenhead Centre for Medical Discovery (ACMD) is bringing together research and training from hospitals, universities and medical research institutes in a purpose-built, collaborative research centre. Through concurrent research and development collaborative work practices, the ACMD's goals are to reduce the burden of chronic disease in the community (such as arthritis, cancer, cardiovascular disease, diabetes, mental health, musculoskeletal disorders and dementia) through advances in biomedical engineering and create new, world-leading industries in device creation, tissue engineering and drug design and delivery.

St Vincent's Hospital Melbourne and

their partners, University of Melbourne, University of Wollongong, RMIT University and Swinburne University of Technology, are at the forefront of the 3D bioprinting revolution. Together they have opened the bioengineering facility BioFab3D@ACMD. BioFab3D@ACMD, officially opened 6 August 2016, is Australia's first robotics and biomedical engineering centre, embedded within a hospital.

Researchers, clinicians, engineers and industry partners will work alongside each other with a vision to build biological structures such as organs, bones, brain, muscle, nerves and glands: almost anything that requires repair through disease and physical trauma. ACES PhD graduate and ECR Dr Cathal O'Connell formally accepted the position of Biofab@ACMD Centre Manager in late 2016.

BioFab3D@ACMD is one of 14 national projects to receive funding over two years from MTPConnect - the Medical Technologies and Pharmaceuticals Industry Growth Centre. MTPConnect's Project Fund Program, is a "competitive, minimum dollar-for-dollar matched funding program that aims to invest in big, bold ideas to boost the innovation, productivity and competitiveness of Australia's MTP sector."

Wollongong's in-hospital 3D printing lab is a first for NSW

On 14 November 2016 Wollongong lived up to the title of City of Innovation, with the opening of the first 3D printing laboratory within a hospital in NSW. Housed in Wollongong Private Hospital's 'Innovation Hub', the lab is designed to bring together researchers, clinicians and industry representatives in one location to fast-track the development of next generation health devices that are inspired by the needs of the clinicians and patients within the hospital.

The hub contains a 3D printing facility that will be run by the ACES—ANFF Materials Node partnership. The lab is the brainchild of local Wollongong vascular surgeon Dr Arthur Stanton, who founded and funded the facility with the vision of providing a creative, collaborative and commercial space for clinicians and researchers.

ACES Director Prof Gordon Wallace said the hub is all about bringing the right people together in a focused, creative space to accelerate the development of new medical devices.

"Wollongong has an opportunity to be a world-class technology region," he said. *"We have all the right ingredients in a university recognised for its excellence in materials science, a national 3D printing facility and capabilities through the Australian National Fabrication Facility, along with a thriving medical sector. This hub brings all of those experts together to help clinicians turn their ideas about how to improve patient care into real-word devices".*

Importantly, the hub will also house industry experts, such as Australian company Anatomics, who are a leading 3D printing medical implant manufacturer and medical technology developer. Anatomics Executive Chairman Paul D'Urso said the facility was a new benchmark for Australian innovation collaboration.

"This hub is a real example of what can be achieved with collaboration and commitment to building a future industry not just for Wollongong, but for the Australian medical technology sector."

Research in action

Treatment for Glaucoma: The rapid development of prototypes is markedly accelerating progress in the field of glaucoma implants. Glaucoma, a hereditary disease of the eye which can lead to blindness, will affect one in 10 Australians over 80. It is also the leading cause of irreversible blindness world-wide. A range of treatments are available, depending on the progression and severity of the disease, including eye drops, laser surgery and surgical implants. The implants, which manage pressure in the eye by draining excess fluid via a small tube out through a reservoir that sits behind the eye, have been on the market for around 30 years.

Engagement: ACES is working with the Centre for Eye Research Australia (CERA) to develop an evolution in the design of the implant, to improve its function and production. The ACES team designed and produced an implant solution based on a biocompatible material, using 3D printing techniques. The first prototype has been validated by surgeons and following some modifications, in animal models which found an excellent comparison between the new printed material and the conventional implant. Further animal studies are in progress using different designs.

Potential Impact: If successful there will be an improved implant easily produced with increased functionality.

END-USER BRIEFINGS

ACES also disseminates knowledge to existing industry partners through information sessions, workshops and web-portal sessions. ACES works hard to raise the Centre's visibility outside the academic sector. The aim is to (i) showcase ACES research skills, technologies and facilities as well as to (ii) understand how ACES can better facilitate pathways and connections to maximise their research impact. To this end 50 business briefings took place via visits to ACES (see list in Appendix 2) and a further 29 briefings by ACES members visiting personnel within the government, industry or part of the business community (see list in Appendix 3).

ACES also hosted 9 events (see Table 4) to raise awareness of the facilities and research activities amongst end-users.

Table 4: ACES End-User Events 2016		When	Where
1.	ACES Australia Day Showcase- "Investing in a Healthy Future" (see international)	20-28 January	Dubai, Abu Dhabi, Kuwait and Riyadh
2.	Graphene Commercialisation - Challenges and Opportunities A discussion on the challenges & opportunities facing graphene commercialisation. Presentations were around raw material sources, chemical processes, fabrication tools, commercialisation opportunities and challenges. Representatives speaking included: AusIndustry; Office of Research UOW; ARC Steel Linkage Hub; The Sixth Element (Changzhou) Materials Technology Co. China, The University of Manchester UK; Monash Centre for Atomically Thin Materials; Imagine Intelligent Materials; Ionic Industries; Romar Engineering.	4 May	AIIM Facility, UOW Innovation Campus
3.	USA - Australia Enabling Technologies Workshop at the University of Wollongong hosted by ANFF and ACES A delegation from Air Force Research Laboratory, John Hopkins University, NASA Glenn Research Center, AFRL, Texas A&M University, Virginia Tech University and National Cancer Institute were introduced to the ACES-ANFF partnership, materials processing and additive fabrication capabilities.	27 May	AIIM Facility, UOW Innovation Campus
4.	Dublin Embassy - Ideas to industries Event (see international)	31 May	Dublin
5.	Japan Embassy event (see international)	11 October	Tokyo, Japan
6.	Obstructive Sleep Apnoea (OSA) Workshop OSA is a condition of upper airway collapse during sleep, characterised by stoppages or reductions in airflow that may be associated with repetitive oxygen desaturation. Anywhere from 4-24% of adult men and 2-9% of women are affected. Novel therapeutics are increasingly undergoing investigation and include hypoglossal nerve stimulators as well as transoral robotics. In Wollongong the focus is on the use of 3D printing to create experimental models wherein the airway collapse that causes sleep apnoea can be simulated and novel treatments investigated. The workshop brought together scientists/engineers and clinicians including international guests Prof Edward Weaver (University of Washington, Seattle) and Prof Stacey Ishman (Cincinnati Children's Hospital Medical Center) to explore the latest advances in research into the treatment of this debilitating condition.	17 October	AIIM Facility, UOW Innovation Campus
7.	Project Launch: Printing EarsLaunch of an exciting new collaboration between ACES and ear, nose and throat surgeon Dr Payal Mukherjee. This collaboration, with assistance from ANFF, will explore BioPrinting as an exciting avenue to offer customised solutions for patients who suffer from ear deformities or have missing ears.	4 November	AIIM Facility, UOW Innovation Campus
8.	Launch of the Medical Innovation Hub The Medical Innovation Hub is designed to bring clinicians, academic, medical design, government, R&D and Industry together in a focused creative space to accelerate the development of medical solutions and devices. The close location of the University of Wollongong's Innovation Campus to The Wollongong Private Hospital will enable close links to be established ACES and ANFF researchers and medical specialists at the hospital. By bringing ACES, ANFF and Wollongong Private Hospital clinicians together we will see the crystallisation and commercialisation of the medical solutions and devices of tomorrow come to fruition.	14 November	Wollongong Private Hospital, Crown St Wollongong

Table 4: ACES End-User Events 2016		When	Where
9.	Materials for 3D Printing – Facilitating Local Opportunities ANFF, Chemson, Romar engineering, Venus Shell Systems, Allegra Orthopaedics and AusIndustry in Commonwealth Department of Industry, Innovation and Science. This workshop illustrated how 3D printing can be used to create new structures and devices from old materials, such as PVC, silicone and the extraction of materials from seaweed for wound healing applications. It also showed how emerging materials such as graphene have benefitted from the advent of 3D printing, enabling rapid transition from discovery to device. As new materials continue to emerge and we embark on the fabrication of more challenging structures e.g. those containing living cells, the need for customised hardware has emerged. Case studies: This workshop highlighted the achievements of commercial entities, such as Chemson, Romar and Venus Shell Systems working alongside ACES and the ANFF Materials node in this emerging area.	14 November	AIIM Facility, UOW Innovation Campus

Global Engagement

ACES STRATEGIC PLAN GOAL 4: GLOBAL ENGAGEMENT

We are committed to connecting with the international research community and strategically expanding our global sphere of influence by investing in partnerships which add value to ACES.

Materials research heavily underpins the scientific, technological and industrial advancements that drive advanced economies and modern societies. As an endeavour, materials research is often highly collaborative, drawing upon skills from a wide variety of scientific disciplines to design and synthesise new materials, characterise their properties, and thereafter, develop new applications and technologies. Innovation in this domain is thus strongly reliant on healthy networks and strong partnerships towards ambitious common goals.

Our target is the scientific research community.

TOWARDS OUR GOALS

The ACES Global Engagement Group (GEG) determined that the most effective way to add to the international linkages program was to identify and pursue strategic alliances with appropriate Centres overseas.

In 2016 ACES has published 116 publications (56.3% of ACES 2016 publications) with international co-authors, from 35 countries and 124 institutions (Schematic 2), and 291 (53.5% of ACES publications) since 2014.

The average number of citations received by publications that have international co-authorship, and by inference the collaboration impact of that research, is greater (impact 7.8; ACES 2014-16) when compared to publishing with national (impact 5.8; ACES 2014-16) or institutional (impact 5.0; ACES 2014-16) co-authors or as an independent researcher (impact 0.8; ACES 2014-16) (Table 5).

Table 5: Publication and citation activity for ACES affiliated publications (Source, SciVal based on SCOPUS data 9.1.17)

	2016	2014-2016
Number ACES publications (SCOPUS)	220	563
Number of ACES publications (SciVal)	206	544
Number of citations	229	3,290
Number of citing countries	39	77
Outputs in top 25% most cited	206 (100%)	434 (80.2%)
Field Weighted Citation Impact (#FWCI – for articles and reviews)	2.08	1.91
International collaboration	116 (56.3%)	291 (53.5%)
International Field Weighted Collaboration	1.39	1.36
National Collaboration	41 (19.9%)	109 (20%)
National Field Weighted Collaboration	0.87	0.84
**Collaboration Impact – International	1.5	7.8
**Collaboration Impact – National	0.6	5.8
**Collaboration Impact – Institutional	1.1	5.0
**Collaboration Impact – Single authorship	0.0	0.8

Legend: ** Collaboration Impact: The average number of citations received by publications that have international, national or institutional co-authorship.

ACES international linkages comprise mostly researcher to researcher collaborations. ACES now aims to add to the global engagement activity by establishing a small number of strategic alliances with other international Centres. After consultation with the ACES membership these have been determined to be:

1. CIC Energigune (The Energy Cooperative Research Centre in the Basque area), Spain.
2. The Graphene Institute at Manchester University, UK.
3. The Institute of Materials Jean Rouxel, researchers from both the CNRS (The French National Centre for Scientific Research) and the University of Nantes, France.
4. Nanotechnology & Integrated BioEngineering Centre (NIBEC), Ulster University, Ireland.

The ACES Head Agreement was modified to enable the administrating node, UOW, to enter into strategic international alliances on behalf of the Centre via a non-binding Memorandum of Understanding (MOU).

Canada (3)
Czech Republic (1)
China (20)
Croatia (1)
Denmark (1)
Egypt (3)
Finland (3)
France (3)
Germany (6)
India (4)
Iran (3)
Iraq (1)
Ireland (4)
Japan (6)
Kuwait (1)
Malaysia (3)
Netherlands (5)
New Zealand (2)
Pakistan (2)
Poland (3)
Portugal (3)
Russia (1)
Saudi Arabia (2)
Singapore (3)
Slovenia (1)
Spain (6)
South Korea (7)
Sri Lanka (1)
Sweden (4)
Switzerland (1)
Thailand (1)
Turkey (2)
UK (4)
Ukraine (1)
USA (11)

Schematic 2: In 2016 ACES published 116 publications with international co-authors, from 35 countries and 124 institutions (number of institutions per country shown as numbers in brackets)

PARTNER INVESTIGATORS

ACES has five partner investigators, Dublin City University, University of Warwick, Friedrich Alexander University, Hanyang University and Yokohama University, that enhance the specialist expertise available to our researchers and ACES access to world class facilities. Our partner investigators have also been engaged with ACES through joint international workshops and embassy events as well as exchange visits.

ACES Partner Institutions	Country	Areas of Expertise
Dublin City University	Ireland	smart materials, stimuli responsive materials, sensors, health, and the environment
University of Warwick	England	electrochemistry
Friedrich Alexander University	Germany	molecular materials and nanotechnology
Hanyang University	South Korea	soft robotics and biomedical engineering
Yokohama University	Japan	ionic liquids and their electrochemical and materials applications, expanded in 2016 to also cover biomedical applications

Yokohama University

PI Watanabe and ACES work together on the development and use of a new range of ionic liquid electrolytes and their application in various electrochemical devices. Initially activities have been focused on Synthetic Energy Systems. However, through a number of workshops new areas of collaborative activity have been identified and each of these is being progressed.

i. A/Prof Junji Fukuda in bioprinting and biobatteries

ii. Prof Yuko Ichiyanagi in development of magnetic particles for bioapplications

iii. Prof Shoji Maruo in 3D printing

Yokohama National University students (Ayaka Tajima, Eisaku Tanaka, Kaori Nojima, Rena Shinohara, Yuka Sueyasu) spent 4-5 February at ACES UOW, visited ACES Monash 8 February, then attended the 11th Annual International Electromaterials Science Symposium, 10-12 February at ACES Deakin University.

Dr Caiyun Wang, a senior research

fellow at ACES UOW, visited PI Watanabe, Prof Shoji Maruo, Prof Yuko Ichiyanagi, A/P Junji Fukuda and Prof Mahito Atobe at Yokohama National University between the 8 and 11 March. She gave a presentation 'Bioprinting and biopolymer batteries in ACES/IPRI' whilst visiting A/Prof Junji Fukuda on 10 March and presented 'Electromaterials Developed in IPRI/ACES for Li-ion Batteries' during her visit with Prof Mahito Atobe on 11 March.

ACES led the organisation of an Australian Research Council (ARC) showcase 'OzBioNano' at the Australian Embassy in Tokyo Japan in October 2016. Charge d'affaires, Clare Walsh, welcomed participants from Japanese industry, government agencies and research institutions. Leanne Harvey (Acting CEO of the ARC) introduced the Centre of Excellence program-talking about that and other government support mechanisms for collaborative and international research programs.

Prof Nico Voelcker introduced the ARC Centre of Excellence in Convergent Bio-Nano Science and Technology, Prof Mark Hutchinson introduced the ARC Centre of Excellence for Nanoscale BioPhotonics and Prof Gordon Wallace spoke of the work done within ACES.

The Australian National Fabrication Facility CEO Rosie Hicks spoke about how ANFF's facilities and capabilities are being used to underpin Centre of Excellence activities.

Following on from the Embassy event, the next day ACES held a one day workshop with our international partner at Yokohama National University. With an excellent program put together by PI Watanabe, the event attracted more than 100 participants with Prof Gordon Wallace, CI Jeremy Crooks and AI Stephen Beirne from ACES at UOW as guest speakers.

Dublin City University

Since 2013 the ACES—Irish scientific community have celebrated ground breaking advances in medical science and healthcare delivery when researchers from ACES and their European collaborates meet in Dublin for a one day symposia at DCU followed by a special showcase event at the Australian embassy in Dublin, hosted to date by the Australian Ambassador to Ireland, Dr Ruth Adler.

In 2016 the symposia was 'Ideas to Industry, Dublin'. Gordon Wallace penned his summary on LinkedIn (9 June). In the article he discusses a few key points he took from that symposia under the topics of: advanced materials are opening up new markets; new technologies, such as 3D printing, are opening up new markets; big industries can, and want to, change; universities have a role to play in driving change and partnerships with industry and government drive change. The day ended at the Australian Embassy in Ireland for a celebratory evening hosted by Ambassador Adler.

ACES hosted PI Diamond in Australia for 2 weeks from 8 February for collaborative discussions. ACES Partner DCU hosted Prof Gordon Wallace, Prof Peter Innis, A/Prof Michael Higgins, Dr Zhilian Yue and Prof Douglas MacFarlane during the year.

ACES welcomed a new Associate Investigator from Dublin City University in 2016—Prof Robert Forster. Prof Forster will collaborate with ACES members primarily within in the ACES EM theme, but also contributing to EFD and SBS themes, on the development of characterisation tools as well as wireless bipolar electrochemistry for use in flow systems, for initiating and localising molecular transformations in samples, and development of precision surface modification and characterisation strategies (for example, with functional molecular subunits such as bioreceptors).

Prof Forster hosted Dr Zhilian Yue (ACES AI UOW) 19 September to 4 October, to progress ACES research in contactless drug delivery systems and to discuss new opportunities in biomedical research.

ACES continued to work with DCU AI Aoffie Morrin on sensing technologies for incorporation into wound healing systems. Morrin's PhD student Keana De Guzman spent 2 months in ACES at UOW, from late October, working on 3D bioprinted skin tissue as a model for sensor testing and assessment of materials as temporary tattoo sensor platforms. ACES at UOW supplied DCU with graphene for this project.

The ACES-DCU team celebrated four joint publications in the year.

Hanyang University

ACES at UOW is supplying LCGO and rGO to Hanyang University researchers for collaborative activities.

ACES partner investigator Prof Seon Jeong Kim, Hanyang University, spent a week with ACES in February to progress our joint collaborations. Prof Gordon Wallace visited PI Kim at Hanyang University on 18 May for a review of their 3D printing facilities and products; and Prof Gursel Alici CI ACES at UOW and soft robotics theme leader visited 2-3 October to update on progress within the ACES soft robotics theme and to discuss further involvement of Prof Kim's research group into those ACES activities.

ACES activities in 2016 with Hanyang and collaborators at University of Texas produced five publications.

Friedrich Alexander University

ACES UOW hosted two undergraduate students from Friedrich Alexander University for 6 month projects in 2016: Corinna Stumm working with Tania Benedetti on functionalisation of silver nanoparticles with ionic liquids for CO_2 reduction March-July and Christian Schuschke working with ACES CI Michael Higgins July-November on the development of

magnetoelectric composite devices for operation in liquids.

ACES PhD student Jaechoel Choi spent 11 days with our partner investigators at Friedrich Alexander University in September studying photo-electrochemical catalytic CO_2 reduction. Jaechoel learnt the techniques required to fabricate homogeneous electrodes. The fabricated electrodes showed possibilities as an electrocatalyst for CO_2 reduction. Further investigations are now in progress at ACES UOW.

Collaborators at Friedrich Alexander University received LCGO coated glass from ACES UOW.

Warwick University

ACES affiliate student Shannon Bonke, from Monash University, visited Prof Patrick Unwin at University of Warwick from 7 March - 1 May. Whilst at Warwick Shannon gave a seminar on 'Renewable fuels from concentrated solar power: towards practical artificial photosynthesis' and had collaborative discussions with Prof Julie MacPherson on the use of diamond electrodes.

ACES PhD Monash student Mr Fengwang Li spent two weeks working in PI Unwin's research group in August on a collaborative project characterising nanostructured catalysts.

University of Warwick student Nikita Hall visited ACES/UOW for a tour of the facilities and held discussions on ACES research, 13 April. Ms Gabrielle Newson and Mr Matthew Waddington, undergraduate students from Warwick University, spent 4 April to 8 July at ACES Monash working on projects.

PUTTING ACES ON THE GLOBAL STAGE

In the quest to consolidate existing collaborations and to initiate new ventures in research, ACES members

were actively out and about speaking of ACES New Dimensions to existing and potential collaborators as demonstrated by following information.

Plenary/Keynote Addresses

20 Plenary or Keynote addresses were given by ACES members in 2016-details are in Appendix 4.

Invited Talks at International Conferences

54 invited talks were given by ACES members at International Conferences in 2016- details are in Appendix 5.

Invited Presentations

(i) Distinguished Visitor Lectures

7 invited 'distinguished visitor' lectures were given by ACES members in 2016- see Appendix 6.

(ii) Invited Seminars Collaboration Visits

89 invited seminars and collaborative visits were given by ACES members in 2016- see Appendix 7.

These included visits organised as part of the Distinguished Visiting Professor and Visiting Associate Professor positions offered by Shinshu University to ACES members Prof Gordon Wallace, A/Prof Attila Mozer and Dr Pawel Wagner which were extended from 2014 through 2016. The purpose of the positions are to strengthen research collaborations in existing areas and to expand into new areas of carbon fibres, carbon dioxide reduction and water splitting, with a particular focus on developing advanced characterisation tools for 3D manufacturing.

ACES members, through reciprocal visits and discussions, have been working to forge new links over the last two years with researchers at Harvard University on materials for 3D printing and as a result ACES UOW student Charles Hamilton received an appointment as a Fellow of the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) 2017 to work on hydrogel materials from 5 December 2016 through to February 2017.

Conference Presentations by ACES members

54 Conference presentations given by ACES members in 2016-for complete list see Appendix 8. Please note that presentations given by ACES members at ACES events are not included in any of these lists.

ENCOURAGING RESEARCH COLLABORATION

Workshops

The advancement of the scientific knowledge that ACES generates is an important component of Centre activities. ACES international conferences, symposia and events provide ACES students and ECRs are given the opportunity to communicate their research in ACES showcase

sessions and poster sessions at ACES events. Networking by ECRs and students with international guests is encouraged. Over the years, ACES has developed a reputation for not only excellence in the educational quality of its conferences, but also the collegial atmosphere. Table 6 lists the ACES events which hosted international guest speakers or ACES sponsored events held internationally.

Visiting Academics

48 International academics, interns, undergraduate or post graduate students were welcomed to ACES in 2016 (see list in Appendix 9). Activities include (i) working alongside ACES members to further collaborative research or (ii) for the opportunity to present a research seminar to ACES members and view ACES facilities as a first step towards engagement.

ACES involvement in international funding schemes with collaborators allows for ACES to broaden the collaborative research base. For example, ACES members are part of the *7th Framework Programme - Marie Curie Action International Research Exchange Scheme IRSES-AMBIPOD project* (2014-2017): Dr Pawel Wagner (ACES SRF) hosted five researchers at ACES/UOW as part of the "Multicoloured Ambipolar Conducting Polymers for Single Polymer Optoelectronic Devices" (AMBIPOD) project, which is funded under 7th Framework Programme -Marie Curie Actions. From the Silesian University of Technology Poland ACES at UOW hosted Alina Brzeczek for 3 months from January; Mieczyslaw Lapkowski for 2 months from July and Rafal Jedrysiakfor 8 months from July; from University of Srathclyde Glasgow Enrico Angioni for 6 months from January; and from Kaunas University of Technology Lithuania Rasa Keruckiene for the month of September.

The project aims at development of novel conjugated polymers featuring multielectrochromic properties that can find application in polymer electrochromic or electroluminescent devices. The aim is to obtain new π-conjugated polymers, containing both electron-donor and electron-accepting units by first selecting their monomeric precursors using quantum chemistry tools.

As part of the Biofabrication for Future Manufacturing (BIOFAB) Master of Philosophy program two students, Sylvia van Kogelenberg and Sarah-Sophia Carter, both who have completed their coursework and thesis components at Utretcht, commenced their mobility component to ACES at UOW in 2016. Research topics offered as part of the thesis component align with their clinical mentors. Sylvia is mentored by Prof Chris Baker and working on 3D printing for wound healing. Sarah is mentored by Prof Toby Coates and working on 3D printing for diabetes.

Conversely, three BIOFAB masters students who completed their coursework and thesis component at ACES UOW- Ariel Cherny (3D printing for epilepsy), Malachy Maher (3D printing for cartliage repair) and Jeremy Dinoro (3D printing for wound healing) – are now in Utrecht (Malachy and Jeremey) and Wurzburg (Ariel) on their 10 month mobility exchange.

Once all components are completed the students will have a dual degree in Biofabrication.

23 national academic guests were also welcomed (see list in Appendix 10).

Table 6: ACES International Events for 2016		When	Where
1.	ACES Australia Day Showcase 'Investing in a Healthy Future' Advances in biomaterials science and software engineering have collided with the emergence of 3D printing technology in recent years, to enable rapid progress in a field known as 3D BioPrinting. 3D BioPrinting uses 3D printing technology to create implantable and wearable structures for medical purposes. Wearable 3D structures contain 'intelligent' sensing materials that monitor movement, track physiological parameters or even assist movement. Implantable 3D systems contain materials capable of providing structural support to replace defective body parts and/or stimulate biological processes to regenerate tissue.	20-28 January	Dubai, Abu Dhabi, Kuwait and Riyadh
2.	ACES 11th Annual International Electromaterials Science Symposium	10-12 February	Deakin University, Australia
3.	ACES - Shinshu Workshop	4-5 March	Shinshu University, Japan
4.	ACES - Institute of Chemistry, Chinese Academy of Science (CAS) Workshop A memorandum of understanding (MOU) was also signed between ACES and CAS.	14-15 April	UOW, Australia
5.	Ionic Liquid Symposium	22 April	Monash University, Australia
6.	2016 Brocher Workshop 3D Bioprinting: A New Medical and Ethical Frontier? This was the first international workshop to explore the ethics of bioprinting. The Brocher Foundation is an internationally renowned institution which hosts scientists and experts in the ethical, legal and social implications of the development of medical research and biotechnologies. Due to its close collaboration with major organisations like the World Health Organisation, the Brocher Foundation has become a critical meeting and reflection venue to debate emerging technologies. Prominent scientists, bioethicists, clinical trial specialists, neurosurgeons, philosophers and scholars from 10 countries attended, including a participant from the World Health Organisation, to discuss the legal, medical, social, and ethical issues raised by the potential use of 3D bioprinting in medical treatment and research. The workshop also allowed collaborative contacts to be made with policy analysts of the European Parliament.	24-25 May	Geneva, Switzerland

Table 6: ACES International Events for 2016		When	Where
7.	ACES –DCU 'Ideas to industries' Forum The one day forum at DCU explored the path from materials research to commercialisation and adoption by industry. Speakers from research and industry discussed commercialisation challenges and strategies as we all confront the challenge to carve more clear-cut pathways through the ideas-to-industries nexus. In the materials science area we have for decades amassed a stock pile of fundamental knowledge. We delved into the nanoworld, discovered new properties and unraveled new phenomena. The implementation of these discoveries has however been stymied by traditional approaches to manufacturing, delivery to markets and regulation. Forty six attendees welcomed speakers were from: Dublin City University, Tyndall National Institute, Amber Research Centre Trinity College in Ireland; National Chiao Tung University Taiwan; University of the West of England; GlaxoSmithKline UK; Henkel; Viska Systems Ireland; Boston Scientific and ACES.	31 May	Dublin, Ireland
8.	ACES showcase at Dublin Embassy	31 May	Dublin, Ireland
9.	Joint workshop ACES and the MacDiarmid Institute (MIAMN) The workshop was an excellent initial first step in gaining some insight into the research interests and capabilities of the two Centres of Excellence. 32 members from both groups heard 19 presentations plus a poster session was held which allowed further discussion on projects.	1 July	Queenstown, New Zealand
10.	Wearable and Implantable Sensors Workshop Collecting information on human performance is central to understanding malfunctions such as disease, or issues that arise due to traumatic injury. The advent of new materials and novel fabrication strategies has enabled rapid development in wearable and implantable sensors capable of monitoring human performance. This one-day workshop highlighted advances in the area and the exciting wearable sensing technologies that are emerging.	19 August	UOW, Australia
11.	Australian Research Council (ARC) showcase 'OzBioNano' ACES organised this event at the Australian Embassy in Tokyo. Ms Clare Walsh, Acting Head of Mission at the Australian Embassy, welcomed 65 guests to the Australian Research Council Centres of Excellence information session at the Embassy, highlighting the investment and training opportunities available in health and medical technologies, in Australia	11 October	Australian Embassy, Minato, Tokyo, Japan
12.	YNU-ACES workshop Workshop with our international partner at Yokohama National University. The event attracted more than 100 participants. Building on existing links in Energy materials ACES are now set to expand our links with Yokohama into 3D printing (Prof Shoji Maruo) and controlled/switchable cellular adhesion systems (A/Prof Junji Fukuda).	12 October 2016	Yokohama National University, Japan
13.	ACES - National Chiao Tung University, Taiwan Round Table Discussion ACES hosted our guests from Taiwan - Prof Peter Chung-Yu Wu, Prof Ker and Prof Cheng for discussions in the area of materials and material fabrication for Synthetic Biosystems.	8 November	UOW, Australia
14.	The Emerging Energy Technologies Summit and Exhibition 2016 (EETSE'16) ACES Associate Director Prof Maria Forsyth and ACES Synthetic Energy Program Theme Leader Prof Doug MacFarlane chaired the Emerging Energy Technologies Summit and Exhibition 2016. EETSE'16 brings together the energy science and technologies communities from around the globe, from the current world-leaders in energy research and industry to the future generations.	5-7 December	Melbourne, Australia
15.	3rd International Conference on Sodium Batteries ACES Associate Director Prof Maria Forsyth is hosting this conference in Geelong. It is a multidisciplinary forum focusing on novel sodium battery materials and components and their applications in renewable energy and energy storage systems. After successful meetings in Spain (2014) and USA (2015), this year's conference goal is to assess and communicate the current understanding and benchmark state-of-art science in this developing field.	7-9 December	Geelong, Australia

Communications

ACES STRATEGIC PLAN GOAL 5: COMMUNICATIONS

Our goals are to:

- Develop communication skills and protocols that ensure awareness of and commitment to the ACES vision across the research, research training and commercialisation platforms within the Centre.
- Create effective interfaces that disseminate the science and promote engagement effectively targeting the different stakeholders—in commercial sectors, healthcare, government and the community.

Our target audience is all ACES stakeholders—the global research community, students, investors, government and regulators and the community.

TOWARDS OUR GOALS

Effective communication is a critical component of all the strategic goals of ACES as it allows for:

- ACES to transfer the continually growing body of fundamental knowledge gained through undertaking our research to stakeholders and the broader community
- An increased awareness, understanding and support among various stakeholders and the community improve outcomes and benefits of the scientific research.

There is no benefit doing research and keeping the body of knowledge to ourselves. Working with end-users to identify solutions is vital for ACES research to have an impact and be used for improving outcomes for society.

Raising the profile of ACES also:

- Assists researchers to identify opportunities to progress the work; identify potential partners to translate the research as well as reduces the scope for 'misinformation' about the research and research outcomes.
- Helps to attract quality students and staff to the Centre—our next generation of research leaders!
- Helps the Centre to attract collaborators worldwide.

IN THE HEADLINES

ACES Media Summary	
105	On line stories
26	Print stories
22	Radio interviews
10	TV appearances

ACES materials

Graphene

Always a popular topic within the materials field, the 'wonder material' graphene featured in an online article for *Stories of Australian Science* highlighting its potential use as a foldable battery, and to help power brain probes and body parts. The story also celebrated that a company, Imagine Intelligent Materials, has a commercial licensing deal to use ACES graphene manufacturing technology.

ACES fundamental science discoveries

Electrostatic Energy Speeds Up Non-Redox Chemical Reactions

Research published by The Australian National University's ACES CI Prof Michelle Coote and ACES AI at UOW Dr Simone Ciampi received excellent coverage in science media about the new research at ACES that has challenged one of the hard and fast rules of chemistry by proving that electrostatic energy speeds up non-redox chemical reactions (*Nature* 2016).

The work, which described new ways to control chemical reactions with static electricity, was covered by *Chemistry World, Nanowerk, Gizmodo, Phys Org, ASO Materials and Chemicals Technology.*

Wearables

New Smart Textile Is The Muscle Behind Next Generation Devices

A new smart textile developed by ACES researchers from carbon nanotube and spandex fibres that can both sense and move in response to a stimulus like a muscle or joint, was covered by more than seven industry specific blogs including *Eureka Alert, Fibre to Fashion and Asian Scientist.*

ACES AI Dr Javad Foroughi said the textile had already been used to "*develop smart clothing that simultaneously monitors the wearer's movements, senses strain, and adjusts the garment to support or correct the movement*".

The research, published in *American Chemical Society* 2016, has many potential applications ranging from smart textiles to robotics and sensors for lab-on-a-chip devices.

Biosystems

ACES work in the field of biosystems is split into wearable and implantable devices.

The 'Bionic Bra' dominated the media coverage of wearable bionics research, with conversations carrying over from the bulk of the coverage in 2014-2015. ABC TV's *Catalyst* program devoted a feature segment to the bra, highlighting the artificial muscle technology behind the device in April 2016.

Today Tonight also featured the bionic bra in a story about wearable technology for women.

ABC Radio National ran a two-part series on implantable bionic technology and featured ACES work heavily through an in-depth interview with Prof Gordon Wallace.

Batteries for implantable bionic technology were in the media spotlight following the Bill Wheeler Student Award which showcased the work on biodegradable batteries by University of Wollongong's PhD student Xiaoteng Jia. The bio-battery received coverage on *WIN News* and in *The Illawarra Mercury*.

Biofabrication

The ever-popular topic of bioprinting—the process of 3D printing 'parts for bodies'—received regular media coverage throughout 2016, including an interview with ACES CI Prof Mark Cook on Channel Ten's '*The Project*'.

ACES researchers also spoke about the topic on radio—*ABC Sydney, ABC Radio National, ABC Illawarra*—and were quoted for *The Translational Scientist, Stories of Australian Science, The Herald Sun, The Illawarra Mercury* and Virgin's inflight magazine, *Voyeur*.

The BioPen device—a handheld '3D printer' designed to extrude living cells and growth factors into injury sites during surgery—was discussed on *ABC Canberra, ABC Adelaide, ABC Tropical North Queensland, WIN News, Southern Cross Austereo, the Kenya Broadcasting Association* and in *Cosmos, Venture Capital Post and the Surgical Tribune, Germany* as well as more than 20 industry specific blogs and publications.

Master of Philosophy in Biofabrication student Joanne Williams was interviewed on *ABC Illawarra radio* in a conversation about her pathway into the course and the career options that will be available.

The opening of Australia's first in-hospital 3D printing facility in Melbourne—of which ACES is a key partner—was covered by the *Sun Herald* and featured ACES ECR Dr Justin Bourke (University of Melbourne) and an interview with ACES AI Prof Peter Choong.

Australia's second in-hospital 3D Printing facility, this time in Wollongong but also involving ACES, was covered by the *Illawarra Mercury* and *WIN TV*. It was heralded by ACES Director Prof Gordon Wallace as an opportunity for *"clinicians [to] turn their ideas about how to improve patient care into real-world devices".*

A new 'brain in a box' that can be used to test brain disorder drugs was featured in the *Sun Herald*, and included an interview with clinician, ACES CI Prof Mark Cook, as well as contributing researcher ACES ECR Dr Justin Bourke. Prof Cook also appeared on *Today Tonight*.

The research that proved it was possible to print structures that support the growth of brain-like tissue from human stem cells was covered by industry specific blogs *TellMeBoss* and *Computer Scotland.*

3D printing has been used to create personalised surfboard fins to help surfers improve their performance. 3D printing capabilities at ACES and ANFF underpin the project, led by ACES CI Prof Marc in het Panhuis. Marc was interviewed by the *Illawarra Mercury* and *Australian Geographic* and the story appeared on a number of 3D printing blogs.

Soft Robotics

The Herald Sun reported that scientists [affiliated with ACES] are leading the development of a new robotic arm that

could return full human movement and the sense of touch to those who have lost limbs and tissues. St Vincent's Hospital neurologist and ACES CI Prof Mark Cook said the progress is based on breakthroughs allowing *"[us] to understand your thoughts and turn them into mechanical action"*. ACES Director Prof Gordon Wallace spoke about a further breakthrough that has seen muscles 3D printed onto microchips to allow communication between tissues in a limb and electrodes, allowing 'movement' messages to pass from the brain directly to the robotic machinery. ACES AI Prof Peter Choong and CI Prof Rob Kapsa also featured in the story.

Synthetic Energy

Better Batteries

Prof Doug MacFarlane, ACES CI from Monash University, was called upon to provide comment for media stories on new battery technology, including *J-AIR Radio* and an industry specific blog.

Artificial Leaf

The ACES Monash University node produced artificial leaf technology that broke a world record for energy efficiency.

When the story first broke in 2015 the global audience ran into the millions, and interest has continued this year, with ACES CI Prof Doug MacFarlane interviewed for a feature in *Stories of Australian Science*.

Clean Fuels

ACES affiliate PhD student Shannon Bonke, from Monash University, wrote an opinion piece for *The Conversation* highlighting the urgent need to pursue clean fuels, outlining a potential solution that advocates chemically rebuilding fossil fuels. *"What if, instead of burning ancient fossils fuels, we could put the ingredients back together to reassemble the fuel?"* It's possible, he argued, outlining work already underway to produce a clean hydrogen fuel. The next step, he said, which is again already in progress, is to combine hydrogen with carbon to produce artificial fossil fuels. Read the full article: (http://theconversation.com/lets-chemically-rebuild-fossil-fuels-to-create-sustainable-energy-63642)

Shannon was also called on by *ABC Science Online* to provide expert comment on new research emerging from the United States that could bring us a step closer to a carbon-neutral energy future.

Ethics

ACES Ethics, Engagement and Public Policy theme representatives regularly

provided comment on the impact new energy and health innovations can have on individuals and society.

ACES CI Prof Rob Sparrow from Monash University contributed to the conversation about the ethics of robotics and the bionic body on *ABC Hobart, ABC Melbourne, ABC Radio National (The Minefield Program* and *Big Ideas)* as well as *New Scientist Magazine* and the *Brisbane Times.*

ACES CI Prof Susan Dodds from the University of New South Wales contributed to a panel discussion on *ABC Radio's The World Today* program about the challenging ethics posed by brain chips and other neurotechnologies that offer the possibility not only of reversing injuries but of creating super-humans.

ACES AI and ARC DECRA Fellow Dr Frederic Gilbert from the University of Tasmania shared his expertise on the ethical questions related to medical bionics on a number of radio programs, including *German Radio Culture, ABC Radio Hobart, ABC Radio National* as well as in *New Scientist.*

Personal Achievements

ACES Director Prof Gordon Wallace received a number of accolades this year including the prestigious Eureka Prize for Leadership in Innovation and Science. In accepting the award, he acknowledged the pioneering work undertaken by his collaborative team.

Prof Wallace's contribution to science was covered by the *Sydney Morning Herald, the Illawarra Mercury* and *ABC Online.*

Prof Wallace's appointment as the 2017 Illawarra Australia Day Ambassador made headlines in December 2016, with coverage of his vision for the city as a hub for future jobs in science and engineering appearing in the *Illawarra Mercury* and on *WIN News.*

The *Illawarra Mercury* also supported Prof Wallace's fundraising efforts to help develop a new BioPen, calling for donations from the community in support of his virtual bike ride across Australia.

ACES COMMUNICATION PLATFORMS

The ACES Website - electromaterials.edu.au

A website is your window for the world—a virtual storefront. Not only that your website becomes an archive and an on-line portfolio.

The ACES website has many functions. It:

Showcases ACES Research for our Stakeholders

The research ACES does is interesting!

As mentioned above our ACES research attracts international headlines on occasions but not all ACES stories can be covered by media outlets so the ACES website provides another forum for us to showcase our work. A story on the handheld BioPen—a device that can be used during surgery for clinicians to extrude formulations into injury sites—topped the list of research stories on the site, with over 1,500 people reading about this research during 2016.

An added advantage to showcasing ACES research in publications or through events is that our ACES members learn the skill of putting their research findings in plain English and in context for our community.

Read our stories on electromaterials.edu.au. A summary of those blogs are provided in Table 7.

Is there to attract our next generation of research leaders

ACES can't achieve high quality research outputs without attracting and inspiring high quality students to work with us. To showcase our talented members and also to assist us attracting future research leaders our

website highlights events, opinions and information on what is on offer should you join the team (Table 8).

Celebrates ACES successes and supports ACES members

ACES is proud of its members and supports them in their endeavours. Most awards would not have been possible without the ACES team inspiration, dedication and commitment to hard work. Also true is the support of ACES collaborators—as ACES member Leone Spiccia once stated an "*award recognises the tremendous contributions made to our research by our collaborators from many parts of the world, including many members of ACES*". We celebrate with everyone—read the stories on our website—Table 9.

Traffic to the ACES website averaged 2,866 sessions per month in 2016.

The ACES team of researchers and students is the most popular content on the ACES website followed by the Master Degree and PhD opportunities.

Social Media

Facebook, YouTube and Twitter followings have increased above the ACES target of 10% in 2016 and have proven to be an excellent tool to engage an audience—in particular, future students—with our research and to communicate opportunities to involve themselves further with ACES.

A. Youtube

The most popular content on the ACES YouTube channel continued to be dominated by artificial muscles, which is a reflection on the attention given to creating excellent video content for this particular research area.

The BioPen video was also heavily viewed, with more than 50,000 views.

Views to ACES channel: 308,500—above our KPI for 2016 which was 261,684—represents a 10% increase on the 2015 KPI.

B. Facebook

Facebook continued to be an effective platform on which to promote ACES work to an audience of primarily 25-34 year olds, mostly men in Australia.

Video content on Facebook far out performed other types (photo, text or links), with an average reach of 1,836 people compared to the next best—photo posts with an average reach of 621.

Likes to ACES page: 1000 followers—above our KPI for 2016 which was 862, which represents a 10% increase on the 2015 KPI.

C. Twitter

The ACES Twitter account is used particularly for research outcome and grant/project/funding announcements, however as more ACES Chief Investigators become active on Twitter, the corporate account is arguably less warranted, as personal accounts are inherently more engaging.

Followers to ACES page: 511—our KPI for 2016 was 389, which represents a 10% increase on the 2015 KPI.

PUBLIC ENGAGEMENT

ACES researchers took part in a number of public lectures (complete list in Table 10), media interviews and public engagement events, in which they described fundamental scientific advances, and the implications for improving health and energy technologies.

Table 7: Showcasing ACES Research on ACES Website	
SBS: Coming soon to a hospital near you: 3D printed body parts. Reported by SBS.	8 January 2016
The Saturday Paper: 3D printing for surgery: 3D printing is revolutionising surgery, from implants to regeneration. Might organ donation become a thing of the past? Reported in The Saturday Paper.	13 February 2016
New chapter in controlling chemical reactions: New research has challenged one of the hard and fast rules of chemistry by proving that electrostatic energy speeds up non-redox chemical reactions.	3 March 2016
Studying the human brain using 3D printing technology: We're excited to win the Elsevier Atlas Award—given for research that could significantly impact people's lives around the world.	23 March 2016
Handheld surgical 'pen' prints human stem cells: In a landmark proof-of-concept experiment, Australian researchers have used a handheld 3D printing pen to 'draw' human stem cells in freeform patterns with extremely high survival rates.	24 March 2016
ABC Catalyst: The Bionic Bra: A high tech bra that responds to your physical needs. Most bras are designed for aesthetics, to look good. See the full story on ABC TV's Catalyst.	12 April 2016
Bioengineers create synthetic brain-like tissue by 3D printing human stem cells to develop better treatments for brain disorders: In a world-first, researchers have 3D printed structures that support the growth of brain-like tissue from human stem cells, paving the way for an improved understanding of neural disorders like schizophrenia, epilepsy and post-traumatic stress.	12 May 2016
Thermocell promises clean, continuous energy: ACES researchers are refining a clean energy device called a thermocell, which converts heat directly into energy and can maintain a charge as long as one electrode is hot and the other is cold.	9 June 2016
Ethics: Managing the impact of innovation: If you had epilepsy, and a doctor told you she could implant a device in your brain to predict an oncoming seizure, you probably wouldn't stop long to think about the unintended consequences.	28 June 2016
Cultivating seaweed to make skin from the sea: Researchers from the South Coast of NSW are hoping to develop new treatments for burns and wounds, by using the most plentiful resource at their fingertips – the sea.	26 July 2016
New graphene based electrode to power medical implant: "*Put a few stitches in her, mate,*" builder and father of three Peter Beames told the Doctor attending to his bloodied calf, "*I've got a concreter coming in half an hour*".	16 August 2016
Tapping into the power of 'waster' energy: ACES Chief Investigator Prof. Doug MacFarlane from Monash University and his team have developed and patented new materials that can store energy, and are designed to ultimately transform 'wasted' energy into useable electricity.	26 August 2016
BioPrinting: This was science fiction not long ago: It's a fascinating field, learn more in this podcast developed by the DC Public Library and featuring ACES Director Prof Gordon Wallace.	2 September 2016
Better outcomes for cochlear implant patients: Promising new research suggests electrodes that slowly release drugs to the inner ear can improve cochlear implant performance.	19 September 2016
3D Bioprinting: can we create the hierarchical structures needed for tissue regeneration? ACES Director Prof Gordon Wallace talks about on his upcoming 3D bioprinting presentation at the BioFest 2016 conference, 24-27 October to one of the event's organisers, Elle Kress.	14 October 2016
Better outcomes for amputees within reach: Len Snowdon has a dancing arm, an activities arm and an everyday arm. He also has an everyday leg. The 54-year-old's collection of parts is one of necessity, after he lost his arm, leg and hip in a horrific workplace train accident twenty four years ago.	18 October 2016
Let's chemically rebuild fossil fuels to create sustainable energy: When we burn a fossil fuel – coal, oil or gas – it produces energy that we use, and byproducts such as water and carbon dioxide. It's the CO_2 that's proving to be a problem – humans have increased the amount of it in the atmosphere by about 40%, causing the planet to warm by around 1^0 so far. This means we must act quickly, given that the Paris Agreement aims to limit temperature increases to 1.5^0.	26 October 2016

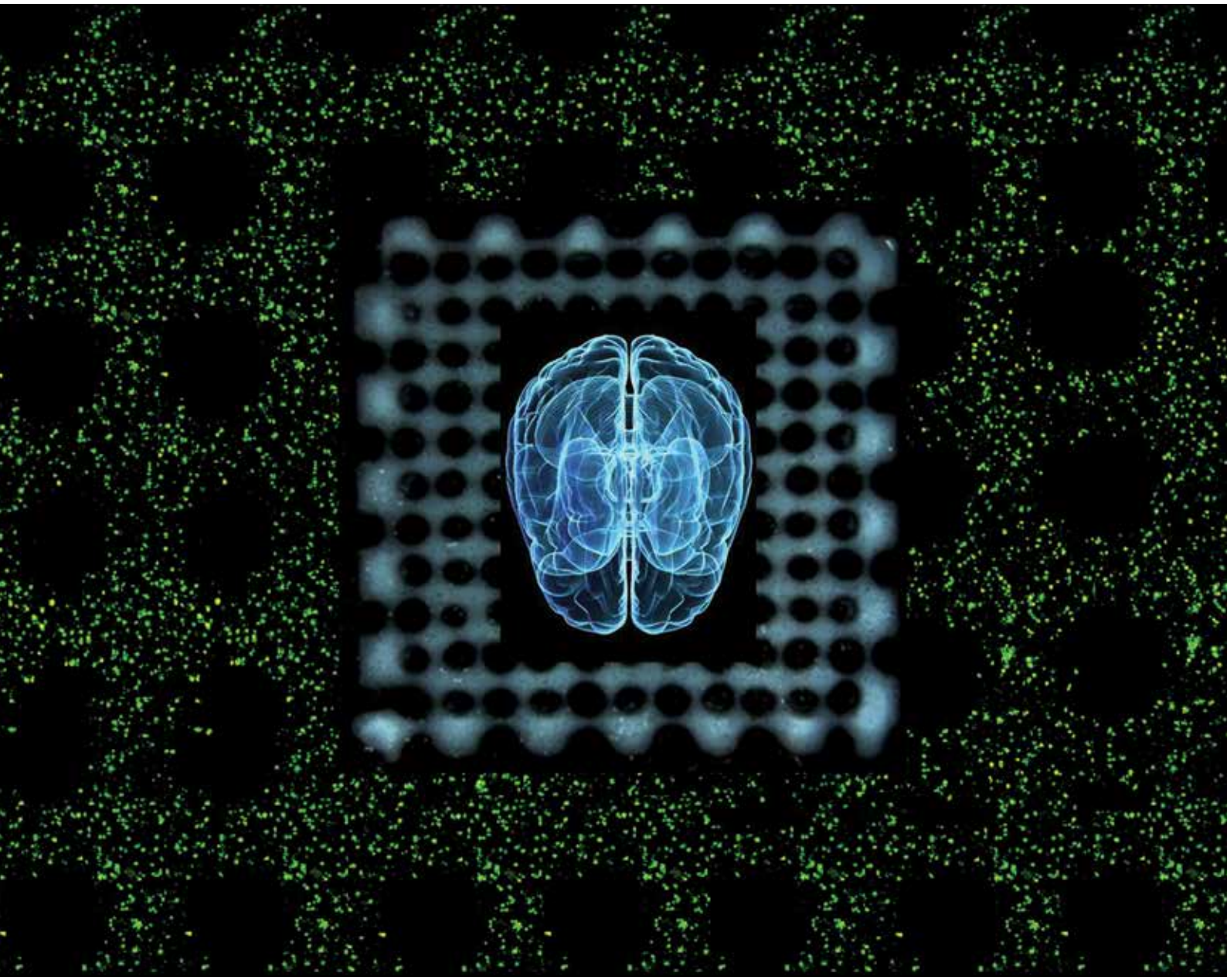


Table 7: Showcasing ACES Research on ACES Website	
Toward a cure for diabetes A new treatment is on the horizon for the 140,000 diabetics in Australia who rely on insulin for survival. The ARC Centre of Excellence for Electromaterials Science (ACES) is developing a 3D printer that can print insulin-producing islet cells for transplant.	1 November 2016
Wollongong's in-hospital 3D printing lab is a first for NSW Wollongong lives up to the title of City of Innovation today, with the opening of the first new 3D printing laboratory within a hospital in NSW.	14 November 2016
Reliable renewables on the horizon New research characterising a key component of an emerging renewable energy storage system could help make large scale solar and wind power more reliable in the future.	22 November 2016

Table 8: Stories aimed to attract future students	
Next Master in Biofabrication course starts June 2016 Students are studying new degree at the University of Wollongong, for a future job that probably doesn't exist yet, in a field that's set to take off.	29 January 2016
Friendship, mentors and discovery - remembering Leon Kane-Maguire As we travel the research road, we discover new things about science and engineering; We discover new things about people, and the skills required for success; We discover new things about ourselves.	29 January 2016
Agility in research Agility is the ability to be quick and graceful. Prime Minister Turnbull has said that in order to create an economy based on innovation, a more agile approach to business is required. To develop ideas into industries, agility is also required in the research environment wherein researchers can move along the commercialisation path with their concepts, and return to the idea-generating cauldron of fundamental research.	6 April 2016
Fresh start for physicist Biofabrication Masters student Ariel Cherny says the best part about his day is that he doesn't know what will happen.	11 July 2016
Student masters the 3D printing of cartilage If you're an avid fan of 3D printing technology, chances are you've already heard about our revolutionary BioPen that allows surgeons to sculpt customised cartilage implants in theatre.	19 July 2016
Collaboration is KING in the world of research talking to researchers from both IHMRI and ACES at a networking event that highlighted our existing work together as well as encouraged researchers to think about more joint projects.	26 July 2016
Tour the Labs: Open Day At an Open Day on Tuesday August 16, during National Science Week, UOW researchers on Innovation Campus will open the doors to their labs to welcome visitors – future students and our community.	5 August 2016
Research training opportunities-Open Day at ACES headquarters (UOW) An opportunity to research alongside globally recognised researchers in state-of-the-art facilities. You can contribute to research into big global challenges in Energy and Health.	30 August 2016
UOW Bionics research student? Apply now for a $2000 travel prize The Bill Wheeler Award is open to University of Wollongong PhD students undertaking medical bionics research.	20 September 2016
Two minute taxi ride with: Rodrigo Lozano Where are you going? I have recently submitted my PhD thesis and I'm looking forward to graduating. In the meantime, I was offered a Postdoctoral position at a great institution, Karolinska Institutet, with a worldwide reputation in Stockholm, Sweden. I'll be working with a younger researcher, very enthusiastic and full of good ideas, his	27 September 2016
A week in the life of a research scientist I've just returned from South Korea and Japan where I met existing ACES research collaborators and pursued new strategic partnerships through the Australian Embassies in each country. Take a look behind the scenes...	17 October 2016
Two minute taxi ride with: Dr Liyu Jin ACES PhD graduate Dr Liyu Jin (pictured) has taken up a postdoctoral research position at the prestigious Oxford University to further his research into battery performance and safety.	31 October 2016
Powering faster recovery times for cancer patients The winner of this year's Bill Wheeler Award for excellence in bionics research, Ms Changchun Yu, said her new biocompatible battery could help cancer patients heal after having a tumour removed.	14 November 2016
ACES welcomes Huaqiao University from China A delegation from Huaqiao University, China, visited ACES HQ recently, to develop future student-exchange opportunities and joint research programs.	7 December 2016

Table 9: ACES Celebrates and supports our Member's Endeavours	
New Graphene journal launched with ACES Director at the helm ACES Director Prof Gordon Wallace has been appointed Editor in Chief of an exciting new scientific journal, Graphene Technology, which will keep researchers in the loop about the latest commercial and practical applications of graphene materials.	22 January 2016
New $3.7M training centre to bring 3D bio-printing to patients ACES, through the University of Wollongong, is partner in a new training centre that will position Australia as a world-leader in 3D bio-printing for medical applications.	6 May 2016

Table 9: ACES Celebrates and supports our Member's Endeavours	
Next generation condom wins People's Choice A next generation condom promising to revolutionise safe sex has won the People's Choice award at the 2016 Building Better Futures for Health Challenge.	23 June 2016
ACES Director a finalist in the Australian Museum Eureka Prizes ACES Director Prof Gordon Wallace is a finalist in the Australian Museum Eureka Prizes, for his role in pioneering the use of nanotechnology and additive fabrication in renewable energy and medical science.	29 July 2016
Prof Forsyth wins Galileo Galilei Award ACES Associate Director Prof Maria Forsyth from Deakin University has won the Galileo Galilei Award at the International Symposium on Polymer Electrolytes (ISPE-12) held in Uppsala, Sweden.	23 August 2016
New appointment for our very own Prof. Brett Paul ACES Chief Investigator and Electrofluidics and Diagnostics Theme Leader Professor Brett Paull has been appointed as Director of the ARC Training Centre for Portable Analytical Separation Technologies (ASTech).	20 September 2016
Research and infrastructure funding success Chief Investigators (CI) involved in the ARC Centre of Excellence for Electromaterials Science (ACES) today welcomed more than $2.3 million in funding for projects through the Australian Research Council Discovery Projects scheme.	1 November 2016
Royal reception for academics' initiative Standing four shoulders away from the Dutch King and Queen while being photographed by the press, ACES Chief Investigator Prof Marc in het Panhuis bet his parents would be proud.	22 November 2016
Professor Wallace admitted to the Academy of Sciences of Bologna ACES Director Prof Gordon Wallace this month joined science luminaries like Luigi Galvani, Albert Einstein and Marie Curie as a member of the Academy of Sciences of Bologna in recognition of his 'high merits in medical sciences and in numerous representative roles' in his life as a scientist.	19 December 2016

Table 10: ACES Outreach Activities in 2016		When	Where
1.	**LKM Public Address** This is a free, public event to celebrate the life of one of Australia's great scientific minds. Leon Kane-Maguire was one of Australia's leading scientists, based at the University of Wollongong. Leon's pioneering research in nanomaterials was balanced by his down-to-earth attitude and a wicked sense of humour. In 2016 the audience was addressed by Professor of Bio-engineering at the University of Pisa, Prof De Rossi. His work deals with the physics of organic and polymeric materials, and the design of sensors and actuators for bioengineering and robotics.	2 March	iC campus, UOW, Wollongong
2.	**Science in the Pub Event** ACES AI and DECRA fellow Frederic Gilbert was an invited panel member for 'How technology is advancing (and ruining?) our lives' at the Science in the Pub Event.	4 March	The New Sydney Hotel, Hobart
3.	**Rotary and Business Chambers Speaker night** ACES-ANFF additive fabrication technician Chris Richards presented ACES 3D printing, smart garment and biofabrication demonstrations at the Rotary and Business Chambers Speaker night.	8 March	Ulladulla, NSW
4.	**3D BioPrinting and your career webinar** ACES, through the University of Wollongong, has joined forces with three leading research universities to offer the world's first Master of Philosophy in BioFabrication to award qualifications in both Australia and Europe. UOW welcomes applicants with (four year) degrees in science, mechatronics and materials engineering to apply for the Masters course. Being associated with the ACES brand will put graduates in a strong position to take a lead role in future industries, created by 3D bioprinting technologies.	14 March	Public Webinar
5.	**Rotary District Conference** Prof Gordon Wallace gave a seminar on '3D Bioprinting: Printing Parts for Bodies' and along with ANFF members showed the 300 attendees examples of 3D printing at the Rotary District Conference.	18-20 March	Shepparton, Victoria
6.	**UOW Vice Chancellor early career researcher (ECR) Presentations** ACES ECR Ashley Walker was invited to present his research on 'Improving methods for the synthesis and functionalisation of porphyrins' for the UOW audience.	21 March	iC campus, UOW, Wollongong
7.	**Promotional Video** ACES CI Douglas MacFarlane was featured on a promotional video about electrolyte water for eWater Systems – 'The Future of Food Safety' (http://www.ewatersystems.com/media).	March	
8.	**UOWx Interactive Seminar Series** Profs Gordon Wallace and Katina Michael were invited guest speakers at the UOWx Interactive Seminar Series. Titled 'The Ethics of Technology', the seminar gave students a chance to explore the future of healthcare. Gordon and Katina discussed the impact of wearable technologies for tracking and managing health; self-diagnosing technology and data chip implantation. With 49 students in attendance, the audience consisted of undergraduate, postgraduate, international and domestic students from a broad cross-section of discipline areas. Students were divided into interdisciplinary teams to work on developing an ethical product or service that could be offered by a Fortune 500 company. Over the course of three hours, students delighted in the opportunity to discover Prof Wallace's ground-breaking research and were challenged by Prof Michael to identify the ethical implications of technological advancements. The seminar concluded with a number of student presentations and feedback from our special guests. Student feedback from the event was extremely positive with many students noting Prof Wallace's discussion of 3D printing as the highlight of the session.	11 April	iC campus, UOW, Wollongong
9.	**Questacon Exhibit** ACES fabrication technician Cathal O'Connell visited Doug Newton-Walters at Questacon to help develop a new exhibit on augmentation of the human body, 13 April so as to promote ACES work through an exhibit at a national science centre.	13 April	Questacon, Canberra

Table 10: ACES Outreach Activities in 2016		When	Where
10.	**Invited Panel member** ACES AI and DECRA fellow Frederic Gilbert was an invited panel member on 'concussion' at the Novel Tech Ethics Public Event.	18 April	Halifax, Canada
11.	ACES ECR Rahim Mutlu gave a keynote address at the UOW Materials Engineering Society (MetSoc) meeting.	4 May	iC campus, UOW, Wollongong
12.	**Science at the Shine Dome 2016 'Human PLUS',** featured the most cutting-edge work being done today in bionics, robotics, printed organs, artificial limbs and manipulation of brain signals with a sneak preview of what the future will bring. ACES Director Gordon Wallace talked on 3D bioprinting: printing parts for bodies. Speaking on the most recent ACES studies on printing stem cells and the impact of the printed environment on stem cell development as well as touching on some non-technical challenges arising in this rapidly developing area of medical research: ethical and regulatory issues. ACES Associate Director Maria Forsyth was inducted into the Academy of Science and spoke on 'Materials for Advanced Energy Storage', explaining how her ongoing energy materials research continues to look for new electrolytes with high conductivity and improved safety and reliability, and how advanced characterisation and molecular modeling have contributed to the understanding and continued optimisation of next generation electrolytes including polymer electrolytes, ionic liquids and plastic crystals.	24-26 May	Australian Academy of Science Canberra
13.	ACES PhD candidate Matthew Cherian visited **UNESCAP** to present on Ageing Policy in India.	12-14 July	Bangkok
14.	ACES CI Maria Forsyth gave an invited talk 'Energy Storage for a Sustainable Environment' at **Royal Society of Victoria** (http://rsv.org.au/events/energy-storage-for-a-sustainable-environment/).	14 July	Melbourne, Victoria
15.	**Opening of BioFAb3D@ACMD** ACES fabrication technician Cathal O'Connell was demonstrating the 'biopen' at the opening of new BioFab3D@ Aikenhead Centre for Medical Discovery (ACMD) facility.	10 August	St Vincent's Hospital in Melbourne
16.	**'ACES / IPRI open its doors to the Public'** as part of National Science Week. 64 community members were taken on tours of ACES at UOW research facilities and given an overview of the work.	16 August	iC campus, UOW, Wollongong
17.	**ACES /IPRI Student Open Day** Invitation for prospective students to come view our facilities and talk to our staff and students with discussions of research opportunities over a BBQ lunch.	13 September	iC campus UOW Wollongong
18.	ACES CI Douglas MacFarlane gave the talk 'Sustainable Energy Technologies for the "Sustainocene"' at the **ANZAAS Victorian Division Science Talk**. The ANZAAS Association aims are: to promote communication and interaction between scientists in different disciplines; to foster public interest in science and technology, and awareness of their role in everyday life and to encourage the curiosity of children about the natural and man-made world around them.	19 October	Melbourne
19.	CI Gursel Alici gave an invited talk 'Robotik Sistemlerde Son Gelişmeler' to the **Chamber of Mechanical Engineers.**	8 November	Gaziantep, Turkey
20.	**Bill Wheeler Symposium and Student Award- Community Event** Each year, the Illawarra community donates a $2000 prize in memory of Mr Bill Wheeler to acknowledge student excellence in bionics at the University of Wollongong. The prize is awarded at the Bill Wheeler Community Symposium, which also features presentations on cutting-edge bionics research. This year's guest speaker is Prof Toby Coates. Prof Coates has leveraged the capabilities at ACES to develop a specialised 3D printer that can produce new, transplantable formulations to assist in the management of chronic diabetes. Type 1 diabetes is a chronic, life-long autoimmune disease affecting over 140,000 Australians, where the insulin-producing islets of Langerhans in the pancreas are destroyed. The incidence of this disease is increasing and, even with daily insulin therapy, diabetic patients are at greater risk of serious complications including heart attack, stroke, ocular damage and kidney disease. Prof Coates is focused on the isolation and transplantation of healthy pancreatic islets as an innovative treatment and potential cure for type 1 diabetes. His work with ACES is breaking down one of the main barriers to the success of this treatment—donor rejection—as the 3D printer will eventually create healthy islets using the patient's own cells.	11 November	iC campus UOW Wollongong

Table 10: ACES Outreach Activities in 2016		When	Where
21.	Prof Gordon Wallace spoke on 'BioPrinting: 3D Printing Parts for Bodies' at **The Royal Society of NSW,** Southern Highlands Branch.	17 November	Bowral, NSW
22.	Prof Gordon Wallace spoke on 'ACES and 3D BioPrinting' at **UOW Innovation Campus 10th Anniversary Open Day.**	18 November	iC campus, UOW, Wollongong
23.	ACES ECR Justin Bourke (Uni Melbourne) gave a presentation of his research on electrophysiology towards neural modelling for neural disorder and robot limb control at the **Aikenhead Centre for Medical Discovery (ACMD) Open Day.**	25 November	St Vincent's Hospital Melbourne
24.	Prof Gordon Wallace spoke on 'BioPrinting: 3D Printing Parts for Bodies' at **The Wollongong Probus Meeting.**	28 November	Wollongong

INSPIRING THE NEXT GENERATION OF SCIENTISTS and their Teachers

Reconceptualising Maths and Science Teacher Education Programs (ReMSTEP)

ReMSTEP responds to the need for improved competence and confidence in the teaching of science and maths, as a pre-service focus, across the Australian Curriculum.

ReMSTEP involves four Victorian Universities (Deakin, Monash, Melbourne and La Trobe) and stems from the desire to increase science, technology, engineering and mathematics competencies in school children. At the core of ReMSTEP initiatives is the introduction of new science and maths course electives and or student learning pathways. Equally important is the building of collaborative relationships across faculties, universities and specialist science and maths centres.

Nine ACES members at Deakin University supported REMSTEP again during 2016. Three activities were run during the year, where the students and ECRs presented their work and from these interactions trainee teachers were developing new teaching resources. These included:

- Begic S (2016) Theoretical Physics and Chemistry for Advanced Batteries, 15 April
- Periyapperuma K., Rao J., Taheri A. (2016) 'Working as a Scientist' - 20 minute presentation followed by question and answers for 1.5 hour
- Taheri, Abuzar (2016) Research and Scientific Practice, 19 July
- Yunis, Ruhamah (2016) to develop school activities in contemporary science: included developing an activity around synthesis of materials for 7th grade students, 19 July, 2 & 5 August, 24 October.
- Forsyth, Maria (2016) gave a talk 'Teaching STEM in the context of scientific research (e.g. Clean Energy)' on 7 November.

Student Interactions

ACES at Deakin University hosted Ashwood High School Year 12 Chemistry class for two laboratory practical classes designed to support their school work: the first on spectroscopy (including NMR and IR) and the second on electrodeposition, 24 February and 7 September.

Charles Hamilton, ACES UOW PhD, hosted the Principal Ulladulla High School at UOW IPRI labs to demonstrate 3D printing, 10 March.

Dr Kerry Gilmore, ACES UOW RF, hosted medical student Rudi Wang for work experience, 29-30 March.

ACES Monash University (2016) hosted two high school students from the John Monash Science School for one day as part of their work experience, 20 June.

Frederic Gilbert, ACES AI and DECRA fellow at UTAS, was interviewed about 3D Bioprinting by students in Journalism, from University of Technology Sydney, and Cabra Dominican College in Adelaide, September.

ACES AI Dr Stuart Thickett, UTAS node (2016) co-ordinated three local primary school visits to the Discipline of Chemistry at UTAS (Albuera St Primary School, Lenah Valley Primary, Howrah Public) for hands-on chemistry activities which included Vipul Gupta (ACES affiliate PhD student) using 3D printed molecular models to teach the students about atoms and molecules, September

Awards

Professor Forsyth wins Galileo Galilei Award

ACES Associate Director Prof Maria Forsyth from Deakin University has won the Galileo Galilei Award at the International Symposium on Polymer Electrolytes (ISPE-12) held in Uppsala, Sweden.

The Scientific Committee of the Symposium awarded Prof Forsyth the prize, which is to recognise scientists who, through brilliant and innovative research outcomes, have made essential contributions to the understand and improvement of ion-conducting materials.

The Award is established in the city of Padova, Italy, one of the most significant locations in the tradition of Classical and Humanistic culture worldwide. Galileo Galilei lived and taught in Padova for eighteen years; and it was in Padova that his brilliant research efforts consolidated and revolutionised the experimental inductive method of science. In the course of the following centuries, this method transformed the various fields of science into the propulsive hearts of modern human technology and lifestyle.

The Award is named after Galileo Galilei for the historical reasons mentioned above, and to emphasise the fact that ion conductors are the "center of the universe" in the development of devices for the conversion and storage of energy. Michel Armand, Michael Gratzel and Peter Wright (the first discoverer of conduction in PEO complexes) were the first Galileo Galilei winners in 2010.

Maria Forsyth inducted into the Australian Academy of Science

Maria Forsyth was inducted as an Australian Academy of Science Fellow

at the annual Shine Dome event in Canberra 23 May 2016. Prof Maria Forsyth's area of research - energy - is one of the most important in the world and her good work has been rewarded, the Australian Laureate Fellow receiving one of the highest science honours in Australia. (https://www.science.org.au/fellowship/fellows/professor-maria-forsyth)

Only about 450 Australian scientists have received this lifetime honour since the Academy was established in 1954 by Australian Fellows of the Royal Society of London. Members are selected by Australian and international peers from within their discipline.

CSIRO Eureka Prize for Leadership in Innovation and Science

Prof Gordon Wallace, Director of ACES at the University of Wollongong, won the prestigious CSIRO Eureka Prize for Leadership in Innovation and Science.

Recognised for his work as an internationally renowned researcher in the field of electromaterials science, Prof Wallace was commended at the Eureka Prize gala dinner in Sydney, for his cultivation of a research vision in the area of 'intelligent polymers.'

The Eureka Prizes are Australia's most comprehensive national science awards, presented annually by the Australian Museum to reward outstanding achievements in Australian science. Prof Wallace said his Eureka Prize acknowledged the pioneering work undertaken by his collaborative team, in the use of nanotechnology and additive fabrication in renewable

energy and medical science.

"*This award acknowledges the ability of ACES and its partners to take fundamental discovery to real applications*," Prof Wallace said. *"It takes an integrated, cohesive and committed team to achieve this. A great team can make most people look like a good captain."*

"Thank you to the hundreds of people I've worked with around this country, especially those at ACES and the Australian National Fabrication Facility. Thank you also to the community we work for. You can be assured that you have around this country, research scientists totally committed not only to discoveries in the lab, but to translating those discoveries to practical outcomes in the most effective and efficient way possible, so that we can all lead better lives."

ACES Director admitted to the Academy of Sciences of Bologna

In December 2016 ACES Director Prof Gordon Wallace joined science luminaries like Luigi Galvani, Albert Einstein and Marie Curie as a member of the Academy of Sciences of Bologna in recognition of his 'high merits in medical sciences and in numerous representative roles' in his life as a scientist.

The Academy, set up three centuries ago to reinvigorate scientific discovery, admitted Prof Wallace to the Physical Science division, as a Corresponding Member. The membership was poignant, as it was Luigi Galvani's pioneering work into bioelectricity or 'animal electricity' that inspired Prof Wallace to venture into electromaterials science.

Today, the Academy's scientific work aims at providing the learning opportunities for PhD students and the faculty, as well as promoting the scientific culture and its dissemination into society.

"To be elected to the Academy in Bologna is a tremendous honour," Prof Wallace said.

First international workshop to explore the ethics of bioprinting

Frederic Gilbert, ACES AI and DECRA fellow, was competitively awarded a grant from the prestigious Brocher Foundation which allowed him to organise the first international, interdisciplinary workshop on the ethics of bioprinting.

Frederic's research tackles the ethical questions around emerging medical technologies that are being used to treat neurological or psychiatric conditions.

"It's now possible to implant a device in the brain of someone with a neurological disease," Frederic said. *"Most patients love the results, however a significant number have seen their lives fall apart. Invasive brain technologies present some profound ethical questions. As a society, we must remember that all great and current medical technologies that can be used to treat us have been at a certain point experimental. In other words, before becoming a standard intervention, a new medical treatment has to be tested first and it's often during this phase that we discover unexpected consequences."*

Protecting trial participants, and future patients matters enormously to Frederic and he is interested in establishing and discussing ethical considerations ahead of time. He and ACES colleagues found there have been significant medical innovations in this technology, especially the use of 3D bioprinted biomaterials in patients with life-threatening conditions, but little discussion about the ethical issues that are related to bioprinting and he felt it was important to initiate the first international discussion.

The Brocher Foundation is an internationally renowned institution which hosts scientists and experts in the ethical, legal and social implications of the development of medical research and biotechnologies. Due to its close collaboration with major organisations like the World Health Organisation, the Brocher Foundation has become a critical meeting and reflection venue to debate emerging technologies.

The two day workshop, held May 2016, at the Foundation's grounds in Geneva, Switzerland generated wide international interest and active exchange across a range of disciplines. Prominent scientists, bioethicists, clinical trial specialists, neurosurgeons, philosophers and scholars from 10 countries attended, including a participant from the World Health Organisation, to discuss the

legal, medical, social, and ethical issues raised by the potential use of 3D bioprinting in medical treatment and research. The workshop also allowed collaborative contacts to be made with policy analysts of the European Parliament.

ACES affiliate student takes out top poster prize for diagnostic device research

From a field of more than 400 contenders, ACES affiliate PhD candidate Vipul Gupta took out the top poster prize, as judged by a panel of over 20 international experts, at the prestigious HPLC symposium for separation scientists in June. The conference attracted around 1000 delegates from 40 plus countries, including pioneers in the field of chromatography, microfluidics, and mass spectroscopy.

Vipul's research forms part of the ACES Electrofluidics and Diagnostics theme, which aims to develop new medical and environmental diagnostic devices using 3D printing techniques. The development of such devices—which seek to move analysis out of the traditional laboratory setting—will inevitably provide more robust and reliable in-site, at-site, and personalised analytical and diagnostic capabilities.

Vipul's poster explored novel applications of metal 3D printing to produce high-pressure miniaturised columns with highly complex internal architectures, for application in portable analytical systems.

"Conventional manufacturing techniques have limited capacity to fabricate complex structures in materials such as titanium, and would require multiple stages and generation of individual component parts," he said. *"Hence here we have explored the use of 3D printing to overcome these limitations. We have used 3D printing to fabricate complex miniaturised chromatographic columns, which would simply be impossible to generate using alternative approaches."*

Electrofluidics and Diagnostics Theme Leader Brett Paull said the win was a great acknowledgement of Vipul's scientific achievements.

"*It's also great to see how much further students such as Vipul can progress when part of a successful collaborative network, such as that underpinning ACES,*" Brett said.

Elsevier Atlas Award

We were excited to win the Elsevier Atlas Award – an award given for research that could significantly impact people's lives around the world. The winning research is presented alongside interviews, expert opinions, multimedia and much more on the Atlas website.

Prof Gordon Wallace and his colleagues have come up with a way of creating layered 3D structures that mimic the brain more closely, using 3D printing. ACES and ARC Laureate researchers at the University of Wollongong and their collaborators at the University of Texas at Dallas in the US have figured out how to make more accurate models of the brain – using 3D printing. Their Elsevier Atlas award-winning article was published in Biomaterials (http://www.sciencedirect.com/science/article/pii/S0142961215006043)

The following is an excerpt from the full article and podcast published on Elsevier.

At two percent of our body weight, and made up of 100 billion nerve cells, the brain is a hugely complex organ. Scientists can study the brain using animal models, but in recent years much work has gone into seeking alternatives, with the support of organisations like the National Centre for the Replacement, Refinement & Reduction of Animals in Research (NC3Rs). One such alternative is creating models of brains in the lab: growing brain cells in a structural material that lets scientists observe what happens in the tissue. Until now, it has only been possible to do this in two dimensions, producing sheets of cells.

Next generation condom wins People's Choice

A next generation condom promising to revolutionise safe sex has won the People's Choice award at the 2016 Building Better Futures for Health Challenge.

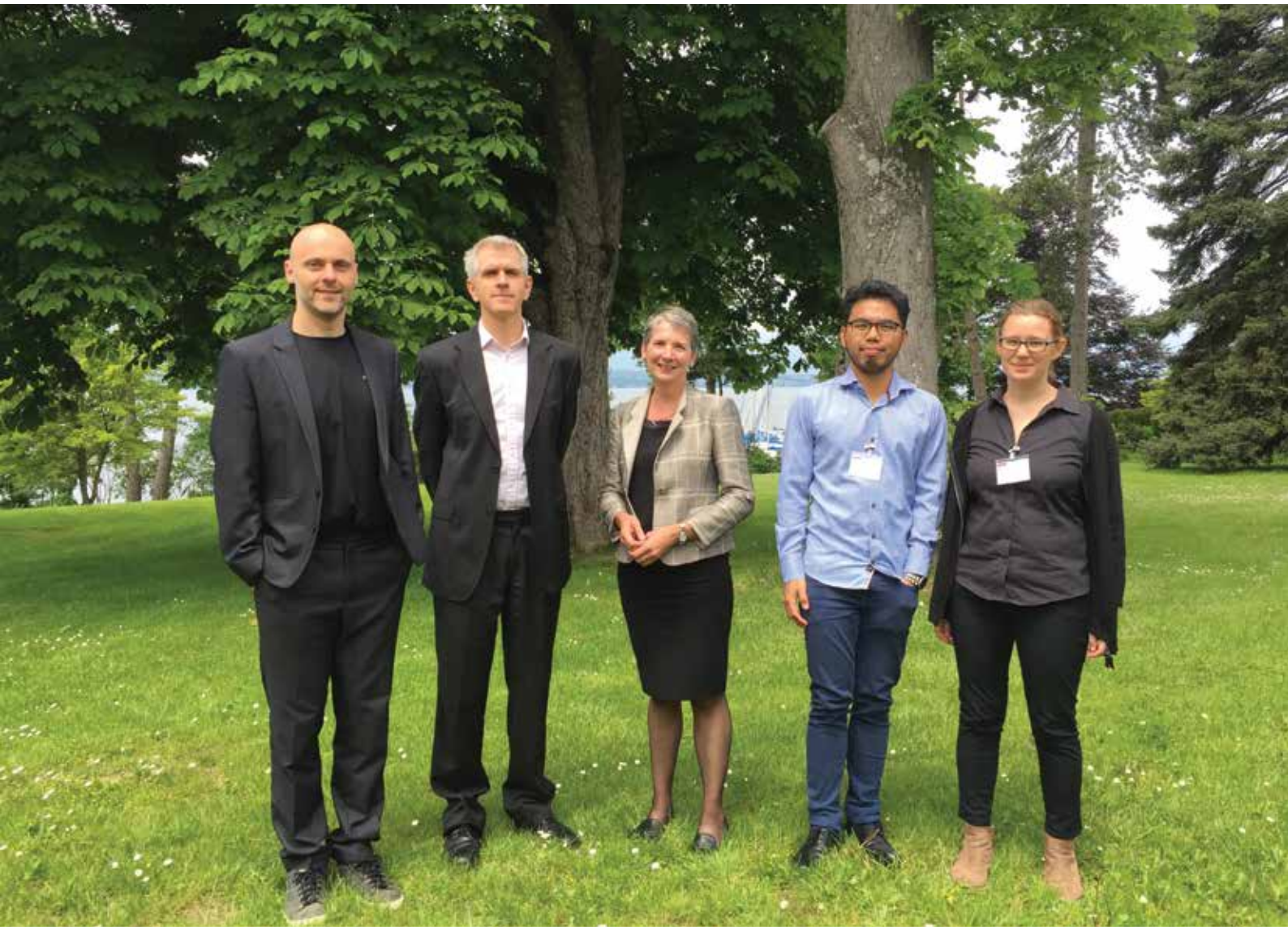
Dr Robin Gorkin presented his Project Geldom concept to an audience of 200 people at the Challenge finals on 2 June at the Museum of Contemporary Art in Sydney. The Geldom is made with tough hydrogels developed in conjunction with ACES material scientists. The material has enhanced feel and lubrication compared to latex, and may be able to release pharmaceutical and stimulation agents directly from the condom itself.

The Building Better Futures for Health Challenge was held as part of Vivid Ideas Exchange. It invited entrepreneurs from across Australia to submit ideas that could make a significant different to people's health. A panel of seven Medtech industry leaders selected four finalists to present at the MCA event. Each finalist gave a ten minute presentation, followed by a question and answer session.

As the People's Choice winner, Project Geldom receives $5,000 worth of services to propel development of the project.

Editorial appointments

ACES Director Prof Gordon Wallace was appointed Editor in Chief of an exciting new scientific journal, Graphene Technology, which will keep researchers in the loop about the latest commercial and practical applications of graphene materials in January 2016.



The journal, which is a joint initiative between The Graphene Council and Springer Publications, is calling for submissions now and will be published four times per year. His appointment recognises ACES' preeminent position in graphene research.

Prof Maria Forsyth was appointed Senior Editor of the Journal of Physical Chemistry, American Chemical Society.

Dr Caiyun Wang is an editorial Board Member of Scientific Reports.

Dr Rahim Mutlu is an editorial board member of the Soft Robotics (SoRo) - Mary Ann Liebert, Inc.

Conference Awards

Dr Anita Quigley, ACES UOW RF, was awarded the best Moderated Oral Presentation 2016 for 'Remodelling skeletal muscle: getting the cell niche right' at the Aikenhead Centre for Medical Discovery (ACMD) research week held at St Vincent's Hospital.

Justin Bourke, ACES UOM RF, was awarded the Junior Investigator Oral Presentation Prize for his presentation 'Three dimensional neural microenvironments enable functionally relevant construct-wide networks' at the ACMD research week.

Anita Quigley (UOW) and Alexandr Simonov (Monash) were recipients of travel awards to attend the Early Mid-Career Researcher Meeting – Science Pathway Future Leaders held at UNSW 26-27 September.

Funding for projects through the Australian Research Council Discovery Projects scheme

Chief Investigators (CI) involved in ACES welcomed more than $2.3 million in funding for projects through

the Australian Research Council Discovery Projects scheme. The scheme provides funding to support excellent basic and applied research projects to be undertaken by individual researchers or research teams.

The seven projects with ACES CIs involved funded to commence in 2017 are:

- a project, involving ACES CI A/Prof Jun Chen, to synthesise flexible redox gel-electrolyte interpenetrated electrodes for an eco-friendly prototype wearable thermo-electrochemical cell that can power body-worn low-power wearable electronics.
- a project, involving ACES CIs Prof Doug MacFarlane and AProf Jun Chen, to develop a hybrid ionic liquid-nanostructured electrode platform to electrochemically convert nitrogen gas to ammonia.
- a project involving ACES CI Prof Rob Sparrow to investigate the legal and ethical implications of technologies that allow inheritable modifications of the human genome.
- a project, involving ACES CI Dr Jie Zhang and ACES AI Prof Alan Bond, to develop and apply a highly advanced integrated research package in dynamic electrochemistry to molecules of biologically significance and ionic liquids of industrial importance.
- a project, involving ACES CIs Prof Brett Paull and A/Prof Peter Innis, to combine fibre-based electrofluidics and ambient ionisation mass spectrometry.
- a project involving ACES CI A/Prof Jenny Pringle to engineer electrolyte materials, based on organic ionic plastic crystals, and use isomeric doping to improve the ionic conductivity.
- a project, involving ACES CI Prof Xungai Wang to understand the fibre spinning process of nanomaterials to identify their true potential and limitations in wearable applications.

A successful proposal developed by Natalie Thamwattana and Jim Hill in association with ACES CIs Profs Gordon Wallace and David Officer will enable a new collaboration to develop mathematical models to ensure original performance in electromaterials containing devices and structures.

A further $5.8 million was awarded for infrastructure projects through the Linkage, Infrastructure, Equipment, and Facilities (LIEF) scheme for funding commencing in 2017. This scheme allows collaboration between universities and partner organisations to develop and support expensive research infrastructure.

The six infrastructure projects with ACES CIs involved include:

- a project, involving ACES CI Prof Leone Spiccia, to establish a transmission electron microscope facility to analyse materials structure at the atomic level.
- a project, involving ACES CI Prof Leone Spiccia, to create a facility consisting of a suite of tools to study light-matter interactions in materials, molecules and biological systems.
- a project, involving ACES CI Prof Leone Spiccia, to establish a transmission electron microscope facility to analyse materials structure at the atomic level.
- a project, involving ACES CI Prof Gordon Wallace, to establish a powerful multiple ion beam system for nanoscience research.
- a project, involving ACES CI Prof Maria Forsyth, to develop a high-performance cloud resource for computational modelling.
- a project, involving ACES CI Prof Michelle Coote, to establish Australia's first a high-field (3 T, 94 GHz) high-field pulse electron paramagnetic resonance (EPR) facility.

ACES Director Prof Gordon Wallace said the funding tranches reflect the calibre and relevance of research coming from and underpinned by ACES researchers.

"All of these funded projects reflect the strength of the ACES core program and the ability of our researchers to build on this to create new opportunities for Australia," he said.

Key Performance Indicators

Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
Research Findings						
Number of research outputs- Journal publications	50	80	105	190	110	220
Number of research outputs- Book chapters	0	1 ebook 2 book chapters	0	6 book chapters	1	6 book chapters
Number of research outputs- Conference publications	10	61 8 refereed papers 53 unpublished abstracts*	20	133 9 refereed papers 124 unpublished abstracts*	30	152 6 refereed papers 146 unpublished abstracts*
Number of research outputs- Patents (filed)	0	0	0	2	1	0
Quality of research outputs	50% with impact factor >2.9	57 (72%)	50% with impact factor >2.95	138 (73%)	50% with impact factor >3.00	165 (75%)
Quality of research outputs - H index (ISI) Centre Researchers	NA	NA	5 > 50 4 > 30 6 > 25 6 > 20 3 > 15	5 > 50 7 > 30 9 =or > 25 5 =or > 20 3 > 15	5 > 50 6 > 30 8 > 25 8 > 20 1 > 15	6>50 11>30 5>25 4>20
Number of invited talks/papers/ keynote lectures given at major international meetings.	10	33 8 Plenary/Keynote 25 invited	30	94 20 Plenary/Keynote 57 invited 17 'distinguished visitor' lectures	30	81 20 Plenary/Keynote 54 invited 7 'distinguished visitor' lectures
Number and nature of commentaries about the Centre's achievements	50 web 10 print 5 radio 2TV	83 web 23 print 6 radio 4TV	100 web 20 print 10 radio 5 TV	209 web 40 print 18 radio 12 TV	100 web 20 print 10 radio 5 TV	105 web 26 print 22 radio 10 TV

Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
Quality of research outputs - Overall publication and citation activity of ACES publications since 2014 (SciVal Scopus). World average field weighted citation impact is 1.00.	NA	NA	Field weighted citation impact : • Overall • Materials Science • Engineering Outputs in : • top 10% most cited • top 10% journals	Field weighted citation impact for ACES 2014-15 (SciVal, Scopus data 25.1.16) • Overall 1.81 (328 pubs) Outputs in : • top 1% most cited: 17 (5.2%) • top 10% most cited: 140 (42.7%) • top 10% journals: 164 (52%)	Field weighted citation impact - all research areas Overall: Outputs in : • top 10% most cited • top 10% journals	Field weighted citation impact for ACES 2014-16 (SciVal ,Scopus data 9.1.17) • Overall 1.91 (563 pubs) Outputs in : • top 1% most cited: 10 (4.9%) • top 10% most cited: 207 (38.3%) • top 10% journals: 280 (54.1%)
Citation data for publications	0.5 Average citation (ISI) per published journal article (WOS 2014 list)	1.64 Average (Av) cites per publication 120 articles	1.5 Av cumulative citations per publication (SciVal 2014-2015 SCOPUS list)	3.6 Av cumulative citation per publication 354 articles 1258 citations	3 Av cumulative citations per publication (SciVal 2014-2016 SCOPUS list)	6.0 Av cumulative citation per publication 544 articles 3290 citations
Research training and professional education						
Number of professional training courses for staff and postgraduate students attended	3	5	6	16	9	25
Number of Centre attendees at all professional training/ development courses offered by the Centre	25	20	40	360	40	>330
Number of new postdoctoral researchers recruited to the Centre working on core Centre research	9 FTE Total	New to Centre in 2014 19.2 FTE Total 19.3 FTE post doc researchers	16.4 FTE Total	New to Centre in 2015 4.7 FTE Total 24 FTE post doc researchers	16.4 FTE Total	New to Centre in 2016 3 FTE Total 27 FTE post doc researchers. Note: some members were in ACES for only part of the year.

Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
Number of new Honours students working on core Centre research and supervised by Centre staff	0	0	0	1	0	2
Number of new postgraduate students working on core Centre research and supervised by Centre staff	9	14 Total 14 post graduates	24	13 Total 27 post graduates	0	3 Total 30 post graduates
Number of postgraduate completions and completion times, by students working on core Centre research and supervised by Centre staff	0	0	0	0	0	3 Noble: Feb12–Jun16 Lee: Mar13-July16 Wright: Aug12-Aug16 Grants needed to be relinquished when Centre started in mid-2014. Students on those grants continued their PhD studies with the Centre and submitted in 2016.
Number of Early Career Researchers (within five years of completing PhD) working on core Centre research	12	12	8	15.5 FTE	Once recruited maintain levels across Centre lifetime; noting some may no longer be ECR	15.6 FTE
Number of mentoring programs offered by the Centre	0	0	2	21 events see Appendix 6	2	24 events see research training chapter
Establish international masters course	NA	NA	1 within first 2 years of operation	1	1 within first 2 years of operation	2
International, national and regional links and networks						
Number of international visitors and visiting fellows (VF)	20	29	30	57	40	71 (48 visitors / VF and 23 student interns)

Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
Number of national and international workshops held/ organised by the Centre	1	6	2	7	2	15
Number of visits to overseas laboratories and facilities	10	30	20	66	30	89
Examples of relevant interdisciplinary research supported by the Centre	30% of journal publications each year will be apportioned across at least 2 FOR codes at the 2 digit level	68% *ERA ARC journal FOR codes were used for ACES publications Jan-Dec 2014*	30% of journal publications each year will be apportioned across at least 2 FOR codes at the 2 digit level	64% *ERA ARC journal FOR codes were used.*	30% of journal publications each year will be apportioned across at least 2 FOR codes at the 2 digit level	66% *ERA ARC journal FOR codes were used.*
End-user links						
Number of government, industry and business community briefings	8	3.6	15	48	18	50 business briefings at ACES 29 visits by ACES members to stakeholders 9 ACES events held for end-users
Number and nature of public awareness/outreach programs	3 2 public lectures 1 open day	7	5 3 public lectures 1 open day 1 school visit	24 13 public lectures 2 open days 9 school visits	5 3 public lectures 1 open day 1 school visit	28 19 public lectures 3 open days 6 school visits
Number of website hits	Average 1000 sessions/month	Average 2543 sessions/month	Average 1300 sessions/month	Average 3230 sessions/month	Average 1600 sessions/month	Average 2866 sessions/month
Number of talks given by Centre staff open to the public	2	19	3	12	3	14
Establish Fabrication Fellow program	1 within first 2 years of operation	0	1 within first 2 years of operation	0	1 within first 2 years of operation	Established

Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
Governance						
Breadth, balance and experience of the members of the Advisory Committee (IAC)	The IAC will be made up of 12 people: 7 with R&D backgrounds and 5 with business/ enduser connections	11 R&D background: 7 enduser connections: 4	The IAC will be made up of 12 people: 7 with R&D backgrounds and 5 with business/ enduser connections	14 R&D background: 10 enduser connections: 4	The IAC will be made up of 12 people: 7 with R&D backgrounds and 5 with business/ enduser connections	13 R&D background: 9 enduser connections: 4
Frequency, attendance and value added by Advisory Committee meetings	1 per year	Feb 2014	2 per year	Feb & May 2015	2 per year	Feb & May 2016
Effectiveness of the Centre in bringing researchers together to form an interactive and effective research team	40% of researchers to have cross-nodal supervision	62%	40% of researchers to have cross-nodal supervision	63%	40% of researchers to have cross-nodal supervision	63%
Effectiveness of the Centre in bringing researchers together to form an interactive and effective research team	35% of ACES publications co-authored with international collaborators	50%	35% of ACES publications co-authored with international collaborators	79%	40% of ACES publications co-authored with international collaborators	56.3% (SciVal-SCOPUS list 9.1.17)
Effectiveness of the Centre in bringing researchers together to form an interactive and effective research team	15% of ACES publications co-authored with national collaborators	41%	15% of ACES publications co-authored with national collaborators	33%	19% of ACES publications co-authored with national collaborators	19.9% (SciVal-SCOPUS list 9.1.17)
The adequacy of the Centre's performance measure targets	KPIs reviewed annually at the February IAC meeting; with any changes requested through the ARC	Adequate reviewed by IAC Feb 2015	KPIs reviewed annually at the February IAC meeting; with any changes requested through the ARC	Adequate reviewed by IAC 11 Feb 2016	KPIs reviewed annually at the February IAC meeting; with any changes requested through the ARC	Adequate Reviewed by IAC 9 Feb 2017

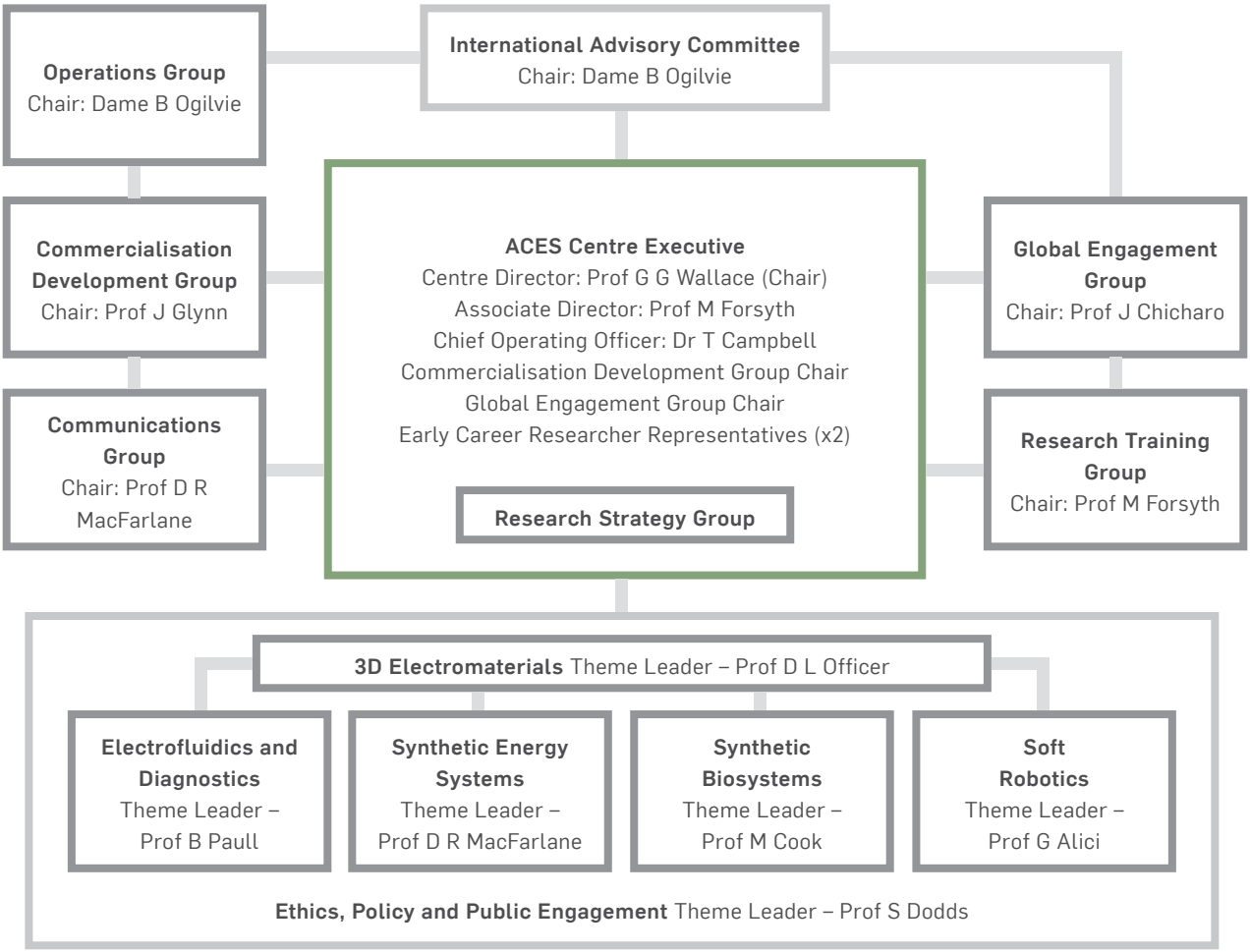
Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
An annual survey of Centre members re interaction effectiveness	-	-		An 'open to the floor' session, entitled '*What is ACES? How can we make it better?*' was run at the ACES Full Centre meeting 12 August 2015		The ACES Full Centre meeting is the forum where members are asked for their views on interaction within the Centre. Meeting 21-22 September 2016.
Vision and usefulness of the Centre strategic plan	NA	NA	By end of 2015 have a draft ACES strategic plan developed in consultation with the IAC	ACES Strategic Plan approved by IAC in Oct 2015 and submitted to ARC in Nov 2015	By mid 2016 have integrated new business development activities into the ACES strategic development plan in consultation with the IAC	ACES end-user network has grown substantially in 2016 -events with clinicians, industry and government entities. ACES staff are active and thoughtful in their efforts to translate – CRCs, ARC linkage hubs, ARC linkage projects, NHMRCs and direct links with Industry. Opportunity audit completed and mechanisms to action in train.
National Benefit						
Contribution to the National Research Priority-Frontier Technologies for Building & Transforming Australian Industries in the goal areas of Advanced Materials, Frontier Technologies, Breakthrough Sciences.	10% of public conferences, government and industry briefings, and communiques	60% (12 of the 20 events held)	10% of public conferences, government and industry briefings, and communiques	49% of ACES conferences, government and industry breakfasts symposia	10% of public conferences, government and industry briefings, and communiques	56% of ACES conferences, government and industry breakfasts symposia

Key Performance Indicator (KPI)	Target 2014 (Jul-Dec)	Actual 2014	Target 2015	Actual 2015	Target 2016	Actual 2016
Contribution to the National Research Priority-Frontier Technologies for Building & Transforming Australian Industries in the goal areas of Advanced Materials, Frontier Technologies, Breakthrough Sciences.	20% of ACES publications	>60% 15 Pubs 'multidisciplinary' 70 pubs Materials Chemistry 41 pubs Engineering	20% of ACES publications	50% of ACES publications were coded with FOR codes of: '03' -Chemical Sciences '09'-Engineering '10'-Technology MD-multidisciplinary	20% of ACES publications	76.5% of ACES publications were coded with FOR codes of: '03' -Chemical Sciences '09'-Engineering '10'-Technology MD-multidisciplinary

Key Performance Indicator (KPI) Description - Level and quality of infrastructure provided to the Centre	
On an annual basis in the ARC report ACES will report on additional i. laboratory space available at the various nodes ii. comment on additional successful funding for new equipment or facilities	
Actual Reporting per Year of Centre	
2014	ANFF materials node, a partnership with ACES at UOW, purchased a Twin Screw Extruder $179,450. LEIF 2014 Prof Shi Xue Dou, Dr Germanas Peleckis; Prof Xiaolin Wang; Prof Roger Lewis; Prof Geoff Spinks (ACES CI) collaborating with UNSW, Uni Sydney, Deakin: $420,000- New Generation Cryogen-Free Physical Property Measurement System.
2015	Deakin University have new characterisation tools available: I. a Netzsch DSC 214 Polyma used to study thermal phase change behaviour in samples II. a JEOL JSM-IT300LV a low vacuum scanning electron microscope with a sample transfer chamber for air-sensitive samples III. a differential scanning calorimeter for use in measuring a number of characteristic properties of a material IV. UV-VIS spectrophometer and electrochemistry flow cell Melbourne University (St Vincents Hospital) have for characterisation a FACS analyser for rapid through-put characterisation of stem cells and cells differentiated from them plus the effects of materials and fabrication on cell phenotype ARC LIEF16 (LE160100063) grant awarded to purchase an advanced focused ion beam microscope with secondary ion mass spectrometer for trace element analysis and nanomachining of soft and hard matter to be located at UOW. ARC LIEF16 (LE160100120) grant awarded to purchase a dynamic nuclear polarisation system for molecular structure determination to be located at Deakin University.

Key Performance Indicator (KPI) Description - Level and quality of infrastructure provided to the Centre	
2016	**Deakin University** (Burwood campus) have two new laboratories that consist of 4 rooms (hand-over on the 17 November and full operation mid-December). • Analysis lab - 25m^2. • Battery and Corrosion characterisation and analysis lab - 77m^2 New equipment in the space includes: • 5-Digit Mettler Toledo Dual Range Analytical Balance • Lovis rolling ball viscometer / DMA Density meter Deakin University (Waurn Ponds campus) – two new wet spinning lines were installed in 2016. ARC LIEF (LE160100120): ACES CI Forsyth was an investigator named on this LEIF for a Dynamic Nuclear Polarisation System for molecular structure determination. CI Forsyth was also on a successful ARC LIEF (LE170100200; $635,000) with the University of Melbourne for a high-performance cloud resource for computational modelling to provide high-fidelity predictive models and simulations that will underpin research in critical fields of science and engineering. **Monash University** has provided new laboratory space for the MacFarlane Group in the Green Chemical Futures building – the facilities are significantly more modern with a small increase in the space available. New equipment in this space includes: • Battery Testing Equipment (BTS4000-5V1mA-8CH from Neware Technology Ltd) - an array of analytical equipment testing the charge/discharge performance for electrochemical devices (i.e. batteries, supercapacitors, etc.) able to conduct up to 64 different experiments concurrently. • Argon glovebox (Korea Kiyon) - this glovebox compliments the Monash already extensive collection of inert atmosphere gloveboxes. The glovebox is state of the art is specifically for electrochemical reactions and analysis, with a heavy emphasis on lithium, sodium and magnesium battery research. CI Spiccia was part of a successful ARC LEIF (LE170100233; $1.8m) at Monash University for installation of an UltaTEM facility to analyse materials structure at the atomic level. **UOW**: ACES Director G Wallace was part of a successful ARC LIEF (LE170100140; $1.06m) with The University of Sydney for a multiple ion beam facility for microscopy and nanofabrication. This project would increase the ability to observe and manipulate the structure of materials at the nanometre length-scale. UOW purchased a range of new 3D printers and accessories: • Markforged Mark2 Carbon fibre 3D printer • 4x Inkredible Bioplotters • ABB IRB120 Robotic arm • Blueprinter M2 • EF010-00281R LED light meter **Swinburne:** ACES welcomed Swinburne as a node in 2016. They have PC2 labs, characterisation and general chemical labs of approx 1000m^2. Characterisation tools include: Raman, HPLC, SEM, EChem, AFM, plasma polymerisation systems, QCM, Elipsometry and XPS. **ANU:** ARC LIEF (LE170100023; $650,000) Prof Michelle Coote et al to establish Australia's first a high-field (3 T, 94 GHz) high-field pulse electron paramagnetic resonance (EPR) facility. Accurately determining molecular structure and understanding how molecules interact with light is important to design and optimise new materials. The facility will allow the creation of new materials with application in pharmaceuticals, separation science, organic optoelectronics and magnetic materials.

Governance

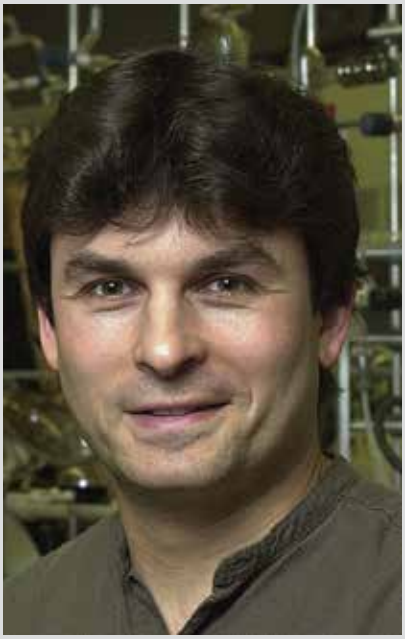


ACES Governance Structure

The Centre's governance structure aims to ensure the efficient operation of the Centre across multiple locations and is focused on achievement of Centre objectives through specialist committees and advisory groups informing the Centre Executive. The Governance arrangements provide the appropriate mix of strategic planning and day to day management and ensure proper engagement with key stakeholders. The diagram below illustrates the structure and relationships in place from 2014 to 2016.

The University of Wollongong is the administrating organisation with the Centre Director, Prof Gordon Wallace providing the leadership necessary to make ACES a pre-eminent global centre for electromaterials research. Prof Maria Forsyth, the Associate Director, works closely with the Centre Director to oversee the ACES research program. Dr Toni Campbell, the Chief Operations Officer manages the Centre's day-to-day operations in consultation with the Centre Director.

External Advisors are of invaluable assistance to ACES and is provided by a number of eminent advisors drawn from the scientific, business, academic and government communities. The specific contributions include Dame Bridget Ogilvie (FRS and former Director, UK Welcome Trust), Chair of ACES International Advisory Committee; Prof John Glynn (Executive Dean, Faculty of Business, UOW), Chair of ACES Commercialisation Development Group; and Prof Joe Chicharo (DVC-Academic, UOW), Chair of the ACES Global Engagement Group.



Prof Ric Kaner

Prof Kaner received a PhD in inorganic chemistry from the University of Pennsylvania in 1984 working with Prof Alan MacDiarmid (Nobel Laureate 2000). After carrying out postdoctoral research at the University of California, Berkeley, he joined the University of California, Los Angeles (UCLA) in 1987 as an Assistant Professor. He was promoted to Associate Professor with tenure in 1991, became a Full Professor in 1993 and a Distinguished Professor in 2012. He has published over 325 papers in top peer reviewed journals and holds 23 U.S. patents with 25 more pending. According to the 2014 and 2015 Thomson-Reuters rankings, he is among the world's most highly cited authors. Professor Kaner has received awards from the Dreyfus, Fulbright, Guggenheim and Sloan Foundations along with the Materials Research Society Medal, and the Exxon Fellowship in Solid State Chemistry, the Buck-Whitney Research Award, the Tolman Medal and the Award in the Chemistry of Materials from the American Chemical Society for his work on refractory materials including new synthetic routes to ceramics, intercalation compounds, superhard metals, graphene and conducting polymers. He has been elected a Fellow of the American Association for the Advancement of Science (AAAS), the American Chemical Society (ACS), the Materials Research Society (MRS) and the Royal Society of Chemistry (FRSC). Along with appointments in the Departments of Chemistry and Materials Science & Engineering, Professor Kaner served as the Associate Director of the California NanoSystems Institute from 2007-09. Professor Kaner's teaching has been recognized with the Hanson-Dow Award for Excellence in Teaching, the Harriet and Charles Luckman Distinguished Teaching Award and the Gold Shield Faculty Prize for Academic Excellence.

Prof Robert Cowan

In December 2016 Prof Robert (Bob) Cowan was welcomed as a member to the IAC. Prof Cowan is CEO of the HEARing Cooperative Research Centre and HEARworks, its commercial arm. A Professorial Research Fellow (The University of Melbourne) and Adjunct Professor (Macquarie University), he has extensive experience in management and commercialisation of hearing research, and has published in the fields of audiology, cochlear implants and hearing technology, bioengineering, health economics, and biomedical research management. He holds a number of Australian and international technology patents and trademarks. Bob holds a PhD (Melbourne), MBA (TechMgt), and Graduate Diplomas in Audiology, Technology Management and Health Economics, as well as BSc (Hons) in Physiology (Queen's). He is a graduate of the Institute of Company Directors. Bob joined Professor Graeme Clark's team in 1985, and with him, established the HEARing CRC in 1992. Now in its fourth term, The HEARing CRC brings together 25 members, representing Australia's leading research, educational, and clinical hearing health services and its international companies Cochlear and Syvantos. Bob is committed to the world-wide prevention of hearing loss and improved audiological clinical practice. Bob was President of the International Society of Audiology (2012-2014), and Congress President of the XXXII World Congress of Audiology (Brisbane, 2014) and XXV World Congress (Melbourne, 2002). He has received awards from Audiology Australia and the Deafness Forum for his work in professional audiology and is a current Board Director of both ISA and Audiology Australia.

CENTRE EXECUTIVE COMMITTEE

The Centre Executive Committee oversees the Centre's operations and reviews performance against defined indicators and is responsible for reporting outcomes to the ARC and other stakeholders and for setting strategic directions and broad budget allocations. The committee is advised by the International Advisory Committee. The executive committee met four times in 2016 (March, August, October and November) as well as attending the two IAC meetings (February and May). The committee reviewed and endorsed the activities of its sub-committees (Research Strategy Group, Commercialisation Development Group, Global Engagement Group, Research Training Group and Communications Group).

INTERNATIONAL ADVISORY COMMITTEE

The role of the International Advisory Committee (IAC) provides high-level strategic advice to the Centre Director into the positioning of the Centre's activities to secure and retain a position of global leadership in electromaterials science as well as ongoing input into the Centre's research programs.

The IAC elected Prof Ric Kaner (UCLA), to join the committee as deputy chair in February 2016.

The IAC met twice in 2016 (February and May) and again February 2017 to review ACES activities and outputs as well as advise on strategic directions.

Profs Daoben Zhu, Yoshihito Osada and Dr Ian Dagley completed their terms on the IAC at the February 2017 meeting. ACES sincerely thank them for their valued inputs into our Centre over the years, especially as members of the ACES IAC.

2016 Membership of the ACES International Advisory Committee

Dr (Dame) Bridget Ogilvie (AC, DBE, FAA, FRS, FMedSci), Chair

Prof Ric Kaner
University of California Los Angeles, (UCLA), USA

Prof Ray Baughman
Director, MacDiarmid Centre for Nanotechnology, USA

Prof Robert Cowan (December 2016)
CEO, Hearing CRC and HEARworks, Australia

Dr Ian Dagley
CEO, CRC for Polymers, Australia

Prof Hans-Joachim Freund
Director, Fritz-Haber-Institut der Max-Planck-Gesellschaft Germany

Dr Anita Hill
Division Chief, CSIRO Process Science and Engineering, Australia

Dr Russell Jones
Bio-MPD Leader Cell and Gene Therapy Platform, Biopharm R&D, GlaxoSmithKline, UK

Prof Yoshihito Osada
Former Deputy Director RIKEN Advanced Science Institute Japan

Prof Lee Won-Mook
President Hanbat University, Korea

Dr Jan Weber
Boston Scientific, Netherlands

Prof Chung-Yu (Peter) Wu
Chair Professor, National Chiao Tung University, Director, Nanotechnology Program, Taiwan

Prof Daoben Zhu
Former Director of the Institute of Chemistry, Chinese Academy of Science, China

OPERATIONS GROUP

The operations group comprises of the DVC (Research) from each of the collaborating organisations or an agreed representative. The meetings chaired by Dame Bridget Ogilvie (IAC chair) address cross-institutional matters. The Operations Group met on 24 February in both 2016 and 2017 to be apprised of ACES activities.

RESEARCH STRATEGY GROUP

The key goal of the Research Strategy Group (RSG) in 2016 was to drive ACES interconnecting theme projects, as well as coordinate theme activities to maximise synergies that arise from the diverse skill-sets of the researchers. This group also discussed emerging research opportunities. Chaired by the Centre Director Prof Gordon Wallace, the RSG met twice in 2016, May and September.

RESEARCH TRAINING GROUP

The Research Training Group (RTG) met three times in 2016, April, August and November. Chaired by A/Prof Jennifer Pringle, this group was responsible for designing, establishing and implementing the research training and career development program. Outside the research it was agreed that the most important contribution ACES could make is in delivering advanced teaching and learning practices; especially in post graduate training. The delivery of the two new Masters courses: Biofabrication and Electromaterials highlight these practices.

COMMUNICATIONS GROUP

The communications group met three times in 2016, May, July and November with a new look membership team. More junior ACES personnel were brought onto the group to replace more senior members who agreed to step down from their positions.

The Communications Group discusses issues and strategies around to goal of reaching our KPIs and achieving our overall mission as stated in the ACES strategic plan; that is to educate, inspire and engage stakeholders and the broader community, by effectively

communicating our research messages.

ACES has been enjoying good media coverage across a number of research topics. Facebook, YouTube, Twitter and LinkedIn platforms all have an increased ACES presence.

In 2016 this group surveyed all ACES members to gauge the level of understanding about the ACES structure and mission. Results from the survey were then used to form the agenda of the 2016 full centre meeting.

ACES Communications Group Member ship 2016	
Prof Douglas MacFarlane	Chair; CI Monash
Natalie Foxon- Phillips	Communications and Media Officer UOW
Sarah McMaster	Communications and Media Officer UOW
Gary Annat	Administration Monash
Niall Macdonald	ECR UTAS
Cristina Pozo-Gonzalo	RF Deakin
Justin Bourke	ECR UOM
Cathal O'Connell	ECR UOW
Charles Hamilton	PhD UOW

At the full centre meeting, through different mediums, members were asked to contribute to planning ACES research 2017-2020, not only within their themes but for the ACES mission to become the pre-eminent world centre for research in electromaterials science and integrated device assembly.

The communications group, also responsible for designing, establishing and implementing research training and a career development program in communication (2016 delivered an online course for interested ACES members and affiliates) liaises closely with the RTG group.

COMMERCIALISATION DEVELOPMENT GROUP

Chaired by Prof John Glynn, the CDG group convened three times in 2016 (February, April and December).

A feature of our Centre of Excellence proposal was our commitment to identify new commercial opportunities as early as possible in this new phase of ACES. In its role to assist the Centre to identify, review and advise on commercial opportunities, the group supported the ACES decision to undertake an audit of the ACES research and associated technologies/ capabilities and how those match the needs of the market.

After that report was delivered and the target list reduced to three, through 2016, the CDG held discussions on possible effective translation mechanisms for the three targeted ACES research outputs – not necessarily current institutional practices. An options paper was drafted with five different options identified, and a decision made that for each of the three identified opportunities each would need to be progressed using the option identified by the university(s) where the finalised list of researchers involved in the targeted projects come from.

Subsequently, internal ACES workshops have been run to further refine and progress those identified opportunities.

At the end of the December meeting it was confirmed that this group would cease to be part of the Centre's formal governance structure following the February 2017 IAC meeting. Going forward ACES will issue quarterly updates for the CDG group and provide an annual information session in December of each year. Prof Glynn has agreed to serve on the IAC from March 2017.

Prof Glynn and the Sydney Business School partnered ACES in running the Entrepreneurship and Innovation Certificate in 2016 which 18 students completed.

GLOBAL ENGAGEMENT GROUP

During 2016 the Global Engagement Group (GEG), chaired by Prof Joe Chicharo, Deputy Vice-Chancellor (Academic) and formerly (Global Strategy), University of Wollongong implemented the strategy, agreed upon in 2015, to add to the ACES global engagement activity by establishing a small number (four initially) of strategic alliances with other international Centres.

The ACES Head Agreement was modified to enable the administrating node, UOW, to enter into strategic international alliances on behalf of the Centre via a non-binding Memorandum of Understanding (MOU). Response from all four international Centres has been positive and ACES are working to have MOUs in place in 2017 so as to enable movement of staff and students between groups.

Having achieved the initial objectives, to review ACES Global engagement and provide advice on any mechanisms for improvement, the GEG is no longer part of the ACES formal governance structure. Prof Chicharo has agreed to serve on the IAC from March 2017.

Financial Statement

STATEMENT OF OPERATING INCOME AND EXPENDITURE FOR YEAR ENDED 31 DECEMBER 2016

Income	2016 ($)
ARC Centre Grant Funding	3,808,925
Institutional Cash Support	1,988,959
Total income	5,797,884

Expenditure-ARC and Institutional cash	2016 ($)
Personnel (salaries & stipends)	4,493,476
Equipment	119,663
Travel	470,580
Research maintenance & consumables	324,849
Other (3rd party expert services, administration, dissemination, outreach)	127,434
Total Expenditure	5,536,002
Surplus	261,882

OTHER RESEARCH 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 11.

The split of other research income secured by Centre staff is shown in the chart immediately below.

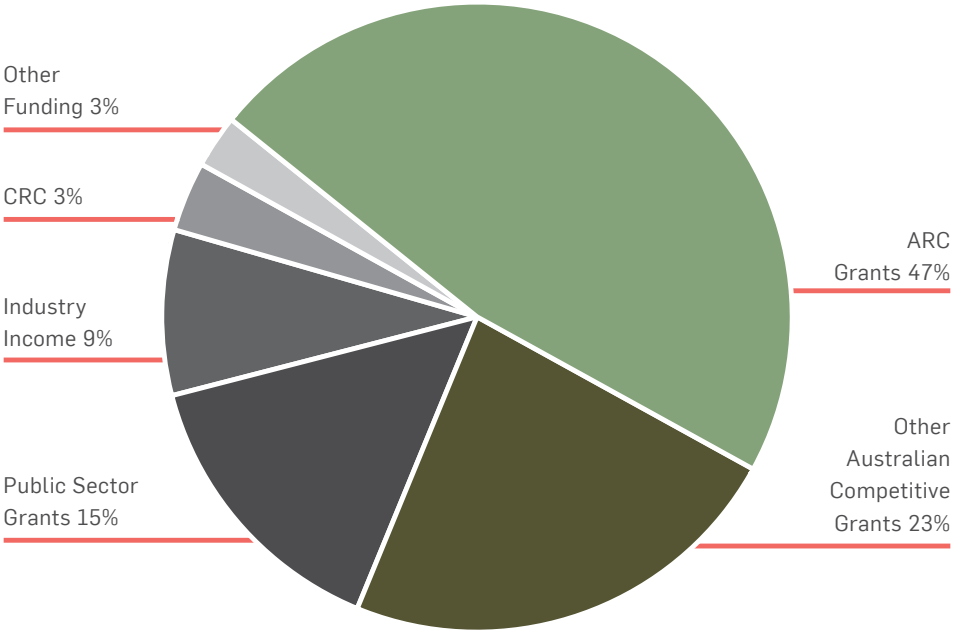


Table 11: Examples of other research initiatives where ACES members are involved.

ACES Research Area	Project	Researcher	Funding Body
Materials/ Fabrication	The true potential and limitations of fibres. This project aims to understand the fibre spinning process of nanomaterials to identify their true potential and limitations in wearable applications.	A/Prof Joselito Razal Prof Xungai Wang Dr Maryam Naebe	ARC Discovery grant DP 170102859
Materials	Increasing solid electrolyte conductivity through defect design. This project aims to engineer electrolyte materials, based on organic ionic plastic crystals, and use isomeric doping to improve the ionic conductivity.	A/ Prof Jennifer Pringle Prof Peter Bruce Dr Anthony Hollenkamp	ARC Discovery grant DP 170101087
Materials	A project to develop and apply a highly advanced integrated research package in dynamic electrochemistry to molecules of biologically significance and ionic liquids of industrial importance.	Dr Jie Zhang Prof Alan Bond Prof David Gavaghan Dr Alison Parkin	ARC Discovery grant DP 170101535
Ethics	A project to investigate the legal and ethical implications of technologies that allow inheritable modifications of the human genome	A/Prof Catherine Mills Dr Karinne Ludlow Prof Robert Sparrow Dr Narelle Warren	ARC Discovery grant DP 170100919
Materials/ Energy	Efficient ionic liquid-based reduction of nitrogen to ammonia. This project aims to develop a hybrid ionic liquid-nanostructured electrode platform to electrochemically convert nitrogen gas to ammonia.	Prof Douglas MacFarlane Dr Xinyi Zhang A/Prof Jun Chen Dr Suojiang Zhang	ARC Discovery grant DP170102267
Materials/ Energy	A project to synthesise flexible redox gel-electrolyte interpenetrated electrodes for an eco-friendly prototype wearable thermo-electrochemical cell that can power body-worn low-power wearable electronics.	A/Prof Jun Chen Dr Leigh Aldous	ARC Discovery grant DP170102320
Materials/ Characterisation	2017-2020: On-fibre separation science with ambient ionisation mass spectrometry. This project aims to combine fibre-based electrofluidics and ambient ionisation mass spectrometry.	Prof Brett Paull Prof Miroslav Macka Prof Dr Wolfgang Buchberger A/ Prof Peter Innis	ARC Discovery grant DP 170102572
Materials/ Energy	2016-2019: Towards high stability, high energy density Na batteries for widespread energy storage	Prof Maria Forsyth (ACES) A/Prof Patrick Howlett (ACES) Dr Alexey Glushenkov Prof Michel Armand	ARC Discovery grant DP160101178
Materials/ Modelling	2015-2017: Controlling polymer microstructure with structured Lewis acids	Coote, Prof Michelle L (ACES)	ARC Discovery grant DP150104454
Materials/ Characterisation	2015-2017: Electrochemical Resonance Energy Transfer	C Hogan L Spiccia (ACES) P Barnard J Jasieniak	ARC Discovery grant DP150102741
Materials/ Fabrication	2015-2017: This project will explore the potential and limits of chemopropulsion and its use as a driving mechanism for cargo-carrying vehicles in fluids. The resulting fluidic transport systems could be used to transport medicine in the human body, act as chemical messengers for signal transduction in sensing or other systems or move cargo around microfluidic devices.	Officer, Prof David (ACES) Wagner, Dr Pawel (ACES) Wagner, Dr Klaudia Diamond, Prof Dermot Gordon, Prof Keith Florea, Dr Larisa	ARC Discovery Grant DP150104532

ACES Research Area	Project	Researcher	Funding Body
Materials	2014-2019: ARC Research Hub for a World-class Future Fibre Industry. This research hub aims to transform the Australian fibre industry into a dynamic sector focused on high-performance and high-value fibres and fibre-based products. These materials are expected to help to reduce energy costs, minimise the environmental footprint of manufacturing processes and improve public health and safety. The hub will also train the next generation of industry-savvy fibre research leaders.	Prof Xungai Wang (ACES) et al	IH140100018
Materials/ Fluidics	2014: ARC Training Centre for Portable Analytical Separation Technologies. The aim is to discover and create new technologies to enable more portable separation science applications.	Prof EF Hilder A/Prof RA Shellie Prof PR Haddad Prof MC Breadmore Prof B Paull (ACES) Prof PN Nesterenko Dr RM Guijt	IC140100022
Medical Bionics	2014-2017: For the application of intelligent conducting polymers for treating schizophrenia and allied disorders focusing on neuronal outgrowth, myelination and synaptogenesis.	Prof Xu-Feng Huang A/Prof Jeremy Crook (ACES) A/Prof Robert Kapsa (ACES) Prof Gordon Wallace (ACES)	NHMRC grant 1065463
Medical Bionics	2014-2017: Biopolymer Conduit for Peripheral Nerve Repair	A/Prof Robert Kapsa (ACES) Prof Gordon Wallace (ACES) A/Prof Michael Murphy Prof Geoff Spinks (ACES)	NHMRC grant 1062569
Materials Engineering	2014-2017: This project aims to understand the behaviour of haematopoietic stem cells (HSC) in novel 3D scaffolds based on short silk nanofibres.	Wang, Prof Xungai (ACES) Sutti, Dr Alessandra Rajkhowa, Dr Rangam Wong, Dr Cynthia Kirkland, A/Prof Mark A	ARC Linkage Grant LP140100287 with partner Cytomatrix Pty Ltd
Materials Engineering	2014-2016: This project will design and characterise novel solid state electrolyte membranes composed of plastic crystals and polymer nanofibres.	Howlett, Dr Patrick (ACES) Pringle, Dr Jennifer (ACES) Armand, Prof Michel Greene, Dr George W	ARC Discovery Grant DP140101535
Materials	2013-2016: Phosphonium Ionic Liquids for Advanced Lithium Energy Storage Systems	MacFarlane (ACES) Forsyth (ACES) Izgorodina Howlett (ACES) Robertson	ARC Linkage grant LP120200181
Materials	2013-2015: Highly-efficient, reversible fuel cell	G. F. Swiegers G. G. Wallace (ACES) P. Barrett	ARC Linkage grant LP13010113 with partner Aquahydrex

ACES Research Area	Project	Researcher	Funding Body
Policy	2013-2016: Corporate political activity of tobacco, alcohol and gambling companies in Australia	Miller, A/Prof Peter Hancock, Prof Linda (ACES) Wakefield, Prof Melanie Kypri, A/Prof Kypros Livingstone, Dr Charles Daube, Prof Michael Giorgi , Ms Caterina Adams, A/Prof Peter McCambridge, Dr Jim	ARC Linkage grant LP130100046 with partner Cancer Council of Victoria, Foundation for Alcohol Research and Education, The University of Auckland
Materials	2013-2016: Functionalized nanomaterials for application as multimodal cancer imaging agents	Spiccia, Prof Leone (ACES)	ARC Discovery Grant and Discovery Outstanding Researcher Award DP130100816
Materials	2012–2017: Protonic materials for green chemical futures By emulating the structures that nature has evolved this project will create novel materials that will be used to develop new sustainable chemical technologies. Working with local and international collaborators, outcomes will include new approaches to the conversion of carbon dioxide into valuable chemicals and for renewable energy generation and storage.	Prof DR MacFarlane (ACES)	ARC Laureate FL120100019
Materials/ Energy	2011-2016: New materials for a sustainable energy future This project will research and develop new selective transport materials to create new sustainable technologies for energy storage (e.g. batteries and capacitors) which will allow greater use of renewable energy sources, desalination and CO_2 capture.	Prof Maria Forsyth (ACES)	ARC Laureate FL110100013
Bionics	2011-2016: New dimensions in organic bionics The advent of the next generation of medical bionic devices is critically dependent on advances in multifunctional organic materials that, like living systems, provide spatial and temporal control. These advances will provide a platform to revolutionise medical treatments such as nerve and muscle regeneration, with impact on neural prosthetics.	Prof Gordon Wallace (ACES)	ARC Laureate FL110100196

2016 Membership

ACES members in 2016 included: 24 Chief Investigators, 5 Partner Investigators, 1 Chief Operations Officer, 11 Research Fellows, 2 Engineers, 20 Early Career Researchers, 37 PhD students working on core funded projects. In addition ACES has 31 affiliate PhD students working on complementary projects and 36 associate investigators assisting with projects either as co-supervisors of students or through collaboration on specific ACES projects within the themes. The Centre also employed casual research assistants and administration staff members.

A list of ACES members indicating their involvement in the various ACES research themes is shown below.

ACES STAFF

Name	Node	Research Themes					
Chief investigators		**EM**	**SES**	**SBS**	**SR**	**EFD**	**EPE**
Wallace, Gordon	University of Wollongong	✓	✓	✓	✓	✓	
Officer, David	University of Wollongong	✓	✓				
Spinks, Geoffrey	University of Wollongong	✓	✓		✓		
Alici, Gursel	University of Wollongong	✓			✓		
Innis, Peter	University of Wollongong	✓				✓	
Higgins, Michael	University of Wollongong	✓		✓			
Mozer, Attila	University of Wollongong	✓	✓				
in het Panhuis, Marc	University of Wollongong	✓		✓	✓		
Kapsa, Robert	University of Wollongong	✓		✓			
Crook, Jeremy	University of Wollongong	✓		✓			
Chen, Jun	University of Wollongong	✓	✓				
Moulton, Simon	Swinburne University	✓		✓		✓	
MacFarlane, Douglas	Monash University	✓	✓				
Spiccia, Leone	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	University of Tasmania (Jan-March) University of NSW (April-Dec)						✓
Cook, Mark	University of Melbourne	✓		✓			
Coote, Michelle	Australian National University	✓	✓	✓			

Name	Node	Research Themes					
Partner Investigators		**EM**	**SES**	**SBS**	**SR**	**EFD**	**EPE**
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	✓	✓				
Postdoctoral researchers recruited to the Centre working on core Centre research							
Research Fellows		**EM**	**SES**	**SBS**	**SR**	**EFD**	**EPE**
Kerry Gilmore	University of Wollongong	✓		✓			
Pawel Wagner (0.5 FTE)	University of Wollongong	✓					
Caiyun Wang	University of Wollongong	✓	✓				
Eva Tomaskovic-Crook	University of Wollongong	✓		✓			
Anita Quigley (recruited to ACES April 2016)	University of Wollongong	✓		✓			
Paul Molino (0.1 FTE)	University of Wollongong			✓			
Alexandr Simonov (Sasha) (0.5 FTE)	Monash University	✓	✓				
Si-Xuan Guo	Monash University	✓	✓				
Jian Fang	Deakin University	✓					
Cristina Pozo-Gonzalo	Deakin University	✓	✓				
Natalie Ralph	Deakin University						✓
Naomi Haworth	Australian National University	✓					
Early Career Researchers		**EM**	**SES**	**SBS**	**SR**	**EFD**	**EPE**
Holly Warren (maternity leave Jan - Sept 2016)	University of Wollongong	✓		✓	✓		
Ashley Walker	University of Wollongong	✓					
Rouhollah Jalili	University of Wollongong	✓	✓	✓			
Andres Ruland	University of Wollongong	✓					
Binbin Zhang	University of Wollongong	✓		✓			
Rahim Mutlu	University of Wollongong				✓		
Fengling Zhou	Monash University		✓				
Maxime Fournier (Max) (0.5FTE)	Monash University	✓	✓				
Katrina Hutchison (Jan-June) (recruited by Macquarie University in July 2016)	Monash University						✓
Mary Walker (recruited to ACES in July 2016)	Monash University						✓
Liyu Jin (0.6FTE) (recruited as post doc by Oxford University UK in July 2016 to further his research into battery performance and safety)	Deakin University	✓	✓				
Ruhamah Yunis (0.5 FTE)	Deakin University	✓	✓				

Name	Node	Research Themes					
Erlendur Jonsson (recruited as post doc by Cambridge University UK in September 2016)	Deakin University	✓	✓				
Madeleine Dupont (recruited to ACES July 2016)	Deakin University		✓				
Yafei Zhang (0.5 FTE) (recruited to ACES September 2016)	Deakin University		✓				
Niall MacDonald	University of Tasmania	✓				✓	
Joan-Marc Cabot Canyelles	University of Tasmania	✓				✓	
Eliza Goddard (0.8 FTE)	University of Tasmania						✓
Justin Bourke	University of Melbourne			✓			
Benjamin Noble (recruited to ACES August 2016)	Australian National University	✓					
Technicians /Engineers/ Research Assistants		**EM**	**SES**	**SBS**	**SR**	**EFD**	**EPE**
Fletcher Thompson (Jan 2016)	Fabrication Engineer University of Wollongong	✓	✓	✓	✓	✓	
Cathal O'Connell (Feb-Dec 2016)	University of Wollongong	✓		✓	✓	✓	
Adam Taylor (Recruited to commence 2017)	University of Wollongong	✓		✓	✓	✓	
Armstrong Xie	Engineer Deakin University	✓					

Name	Node	Position
Non-Academic Positions		
Toni Campbell	University of Wollongong	Chief Operations Officer
Natalie Foxon-Phillips (0.8 FTE)	University of Wollongong	Communications & Media Officer
Sarah McMaster (0.4 FTE)	University of Wollongong	Communications & Media Officer
Karla House (Jan-Nov 2016)	University of Wollongong	Administration
Kim Twist (casual Dec 2016)	University of Wollongong	Administration
Sona Shekibi (0.2 FTE Centre)	Deakin University	Administration
Jacqui Sandilands (0.54FTECentre)	Deakin University	Administration
Gary Annat (0.4 FTE Centre)	Monash University	Administration
Eliza Goddard (0.2 FTE Jan- June)	University of Tasmania	Administration
Umme Kalsoom (0.15FTE July-Dec)	University of Tasmania	Administration
Naomi Morter (0.4FTE Centre)	University of Melbourne	Administration

ACES STUDENTS

Name	Node	Country of Origin	Research Theme
Core Funded ACES students			
Fahimeh Mehropouya	University of Wollongong	Iran	EM/SB
Zhi Chen	University of Wollongong	China	EM/SB
Joshua Brooks	University of Wollongong	Australia	EM/EFD/SR

Name	Node	Country of Origin	Research Theme
Hadis Khakbaz	University of Wollongong	Iran	EM/EFD
Syamak Farajikhah	University of Wollongong	Iran	EM/EFD
Christina Puckert	University of Wollongong	Germany	EM/SB
Alex Nagle	University of Wollongong	Ireland	EM
Cody Wright Completed thesis 2016. Technical position at Waters Pty Ltd	University of Wollongong	USA	EM
Liang Wu	University of Wollongong	China	EFD
Jaecheol Choi	University of Wollongong	Korea	EM/SES
Tom Barsby	University of Wollongong/ St Vincent's Hospital Melbourne	UK	SB
Jianfeng Li	University of Wollongong	China	SB
Charles Hamilton	University of Wollongong	USA	SR
Charbel Tawk	University of Wollongong	Lebanon	SR
Dijon Hoogeveen	Monash University	New Zealand	EM/SES
Fengwang Li	Monash University	China	SES
Changlong Xiao	Monash University	China	EM/SES
Nhien Le withdrawn from PhD 2016	Monash University	Vietnam	EM/SES
Manjunath Chatti	Monash University	India	EM/SES
Ying (Sherry) Zhang	Monash University	China	SES
Diogo Cabral	Monash University	Brazil	SES
Ken Chun	Monash University	China	SES
Abuzar Taheri	Deakin University	Iran	SES
Shannon Biddulph deferred PhD for a year	Deakin University	Australia	EM/SES
Sujay Kumar withdrew from PhD July 2016	Deakin University	India	EFD
Mary Kalani Erangi Periyapperuma Achchige	Deakin University	Sri Lanka	SES/SR
Mathew Cherian	Deakin University	India	EPPE
Jun (Rossie) Rao	Deakin University	China	EM
Danah Al-Masri	Deakin University	Jordan	SES
Srdan Begic	Deakin University	Sweden	EM/SES
Anna Blum	University of Tasmania	USA	EPPE
Sidra Waheed	University of Tasmania	Pakistan	EFD
Catherine Simpson Part time 2016	Australian National University	Australia	EM/SES
Richmond Lee Completed thesis 2016. Research position Singapore	Australian National University	Singapore	EM

Name	Node	Country of Origin	Research Theme
Benjamin Noble Completed thesis 2016. ECR position in ACES ANU	Australian National University	Australia	EM
Lilith Caballero Aguilar	Swinburne University	Mexico	SBS
Daniela Duc	Swinburne University	Mauritius	SBS
Shaun Gietman	Swinburne University	Australia	EFD/SBS
Affiliate ACES students			
Aziz, Shazed Md	University of Wollongong	Bangladesh	EM/SR
Barnsley, Grant	University of Wollongong	Australia	EM/SES/SBS
Chao, Yunfeng	University of Wollongong	China	EM/SES
Feng, Lei	University of Wollongong	China	EM
Gately, Reece (completed mid 2016)	University of Wollongong	Australia	SR
Ge, Yu	University of Wollongong	China	EM/SES
Gu, Qi	University of Wollongong	China	EM/SBS
Javadi, Seyed	University of Wollongong	Iran	EM
Jia, Xiaoteng	University of Wollongong	China	EM/SES
Lu, Zan	University of Wollongong	China	EM/SES
Salahuddin, Bidita Binte	University of Wollongong	Bangladesh	SR
Sangian, Danial (completed mid 2016)	University of Wollongong	Iran	SR
Rahim, Siti Abdul	University of Wollongong	Malaysia	SBS
Vijayakumar, Amruthalakshmi	University of Wollongong	India	EM/SES
Wang, Kezhong	University of Wollongong	China	EM
Xiao, Yang	University of Wollongong	China	EM
Yu, Changchun	University of Wollongong	China	SES/SBS
Zarghami, Sara	University of Wollongong	Iran	EM
Zhang, Long	University of Wollongong	China	EM
Zhao, Yong	University of Wollongong	China	EM/SES
Zheng, Tian	University of Wollongong	China	EM/SBS
Ali, Muataz	Monash University	Iran	SES
Bonke, Shannon (Jan-Oct)	Monash University	Australia	SES
Halima, Ahmed	Monash University	Egypt	SES
Li, Haitao (Jan-July)	Monash University	China	SES
Viana, John	University of Tasmania	Philippines	EPPE
Gupta, Vipul	University of Tasmania	India	EFD
Li, Feng	University of Tasmania	China	EFD
Mladenovska, Tajanka (Oct-Dec)	University of Melbourne	Macedonia	SBS/EPPE
Ngan, Catherine (Dec)	University of Melbourne	Australia	SBS

ASSOCIATE INVESTIGATORS

Name	Investigator Affiliation	Research Theme
Associate Investigators		
Beirne, Stephen	University of Wollongong, ANFF materials node	EM/EFD/SBS
Ciampi, Simone	University of Wollongong (Jan-June) Curtin University (July-Dec)	EM
Foroughi, Javad	University of Wollongong	EM/SR
Huang, Xu-Feng	University of Wollongong	SBS
Kim, Benny	University of Wollongong	EM/SES
Lee, Chong Yong	University of Wollongong	SES
Lui, Xiao	University of Wollongong	SBS
Naficy, Sina	University of Wollongong	EM/SR
Nattestad, Andrew	University of Wollongong	SES
Onofrillo, Carmine	University of Wollongong/St Vincents Hospital	SBS
Sencadas, Vitor	University of Wollongong	SR
Yue, Zhilian	University of Wollongong	SBS
Chen, Fangfang	Deakin University	EM
Haswell, Stephen	Deakin University	EFD/SBS
Greene, Wren	Deakin University	EM/SBS
Rajikhowa, Rangam	Deakin University	EM
O'Dell, Luke	Deakin University	EM
Zhu, Haijin	Deakin University	EM/SES
Azofra, Luis	Monash University	SES
Bond, Alan	Monash University	EM/SES
Sun, Chenghua	Monash University	EM/SES
Hutchinson, Katrina	Monash University; Macquarie University	EPPE
Breadmore, Michael	University of Tasmania	EFD
Lewis, Trevor	University of Tasmania	EFD
Neilsen, Jane	University of Tasmania	EPPE
Nesterenko, Pavel	University of Tasmania	EFD
Thomson, Colin	University of Tasmania	EPPE
Thickett, Stuart	University of Tasmania	EFD
Oetomo, Denny	University of Melbourne	SR
Choong, Peter	University of Melbourne	SBS
DiBella, Claudia	University of Melbourne	SBS
Duchi, Serena	University of Melbourne	SBS
Morrin, Aoife	Dublin City University	EM/EFD
Forster, Robert	Dublin City University	EM/SBS
Atobe, Mahito	Yokohama University	SES
Fukuda, Junji	Yokohama University	SBS

2017 Activity Plan

GOAL 1: RESEARCH

END 2017 Research Milestones

Model and probe the effect of 3D electromaterial structure on the common functions of charge transfer, reaction centres and structural support.

Develop new characterisation tools to probe 3D electromaterial structure.

Themes

Electromaterials
Milestone EM4: Developed initial model to understand spatial distribution of composition.

Milestone EM5: Developed the 2nd example of a contactless characterisation probe.

Milestone EM6: Supplied 2nd Generation structural, reaction centre and electro- materials for the application themes projects.

Electrofluidics and Diagnostics
Milestone E&D2: Determined the effect of distributed electro-materials on electro fluidic behaviours in 3D Structures.

Synthetic Energy Systems
Milestone SES2: Characterised and optimised reactive site connectivity.

Synthetic Biosystems
Milestone SB2: Determined the impact of electromaterial distribution on cell behaviour.

Milestone SB3: Determined impact of reactive centre and living cell distribution on neural tissue formation & function.

Soft Robotics for Prosthetic Devices
Milestone SR2: Determined the impact of electromaterials distribution on mechanical and electromechanical properties.

Ethics, Policy and Public Engagement
Milestone EPE1: Identified the potential ethical responsibilities of manufacturers to end users for prosthetic organs.

GOAL 2: RESEARCH TRAINING

Have implemented a Masters training program in Electromaterials Science.

Introduced the most appropriate training programs for entrepreneurship and innovation as well as communications.

GOAL 3: TRANSLATION COMMERCIALISATION

END 2016

Produce a development plan for new venture opportunities

FROM 2017

Lodge ARC Linkage proposals

GOAL 4: GLOBAL ENGAGEMENT

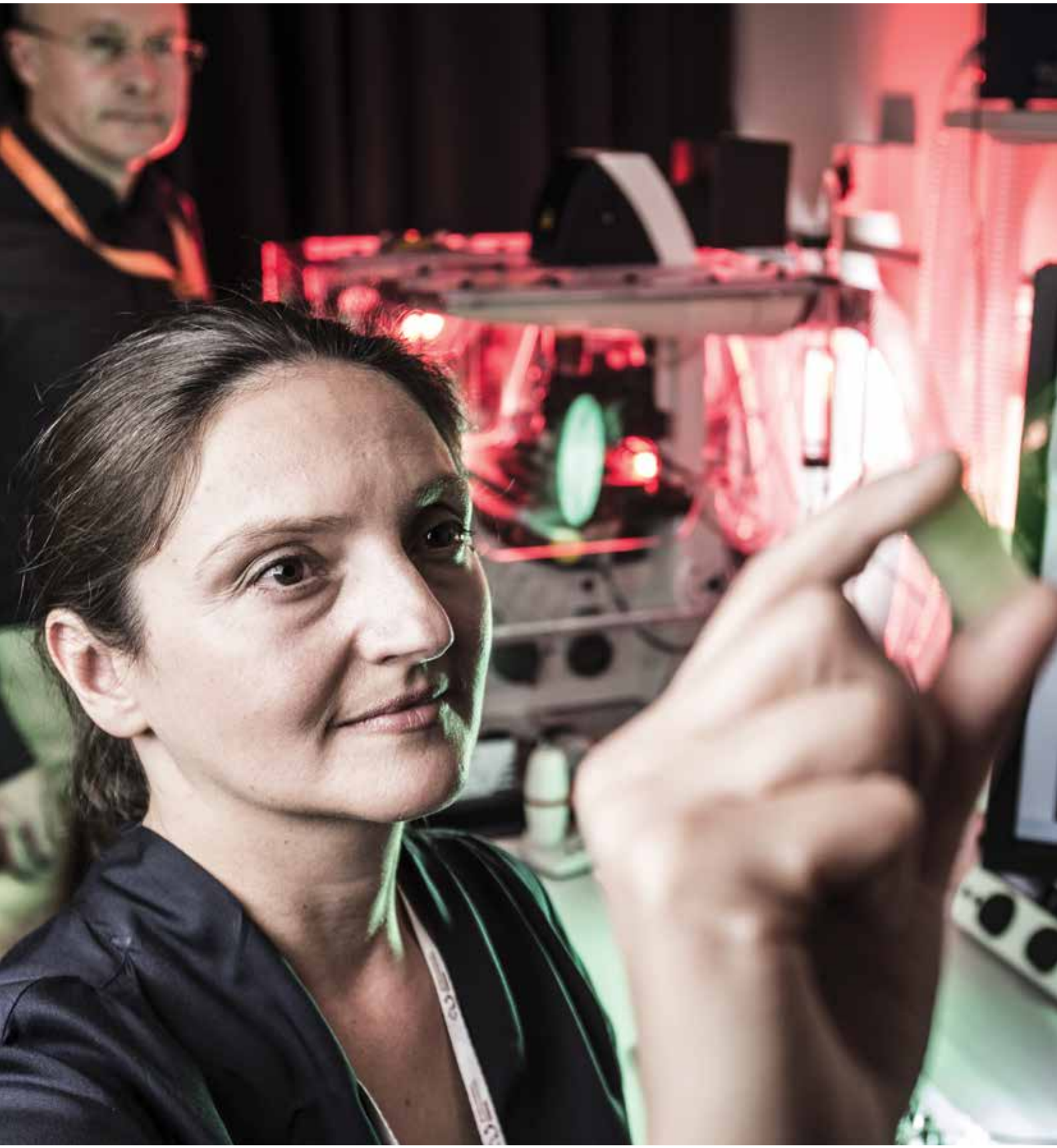
Develop strategic partnerships with select research countries across the globe.

Develop International Training opportunities.

GOAL 5: COMMUNICATIONS

Implement communication strategies to maximise visibility and coherence of the ACES message to key target audiences.

Host annual community awareness outreach events.



Supplementary Information

APPENDIX 1: A TABLE LISTING 79 ACES X-NODAL VISITS AND INTERACTIONS

Appendix 1: Table listing ACES X-Nodal visits and Interactions during 2016		Research area
1.	ACES AI Prof Peter Choong and ACCES CI Prof Mark Cook visited ACES at UOW for discussions on collaborative projects, including the BIOFABrication Master projects, 18 January.	EM/SBS
2.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi, 27-28 January.	EM/SES
3.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash university to synthesise materials with Dr Tanmaya Joshi, 1-3, 8, 15, 17-18 February.	EM/SES
4.	Students Ayaka Tajima, Eisaku Tanaka, Kaori Nojima, Rena Shinohara, Yuka Sueyasu from Yokohama National University spent 4-5 February at ACES/IPRI	EM/SBS
5.	O'Connell, C (2016) ACES ECR Melbourne to UOW for meetings to plan next 6 months of biopen experiments at St Vincent's Melbourne.	EM/SBS
6.	Aziz, Shaziz (2016) ACES affiliate student visited Dr Laurence Brassart Monash University to explore possible research collaborations 5 February.	EM/SR
7.	Prof Watanabe PhD students (x8) from Yokohama National University visited Monash University, 8 February. They all attended the 11th Annual International Electromaterials Science Symposium, February 10-12, Deakin University, Burwood, VIC, Australia.	EM/SBS
8.	Bourke, Justin (RF UOM) ACES mentoring workshop (member of organising committee) at Deakin University, 9 February.	Mentoring activities
9.	Blum, Anna PhD UTAS and Goddard Eliza (RF UTAS) (2016) meeting with EPPE group at Deakin University, 10 February.	EPPE
10.	Guo, Si-Xuan Monash RF and Zhou, Fengling, Monash ECR (2016) organised and presented at the ACES Solar Fuels workshop at Deakin University, 12 February.	SES
11.	Nattestad, Andrew (2016) ACES AI attended and presented 'Which is better?' at the ACE S Solar Fuels meeting at Deakin University, 12 February.	SES
12.	Hoogeveen, Dijon (2016) PhD Monash University finalised a project plan in collaboration with Dr Attila Mozer at UOW February.	SES
13.	Wang C. (2016) SRF UOW collaboration meeting with Deakin on the application of NMR for investigation of Li-ion movement in MoS_2/PEDOT composites during the charge/discharge processes, 12 February.	EM/SES
14.	Wang, C (2016) collaboration meeting with Prof Lei Jiang at faculty of engineering at Monash University discussing collaborative projects in biobatteries and carbon dioxide reduction, 12 February.	EM/SES
15.	ACES PI Prof Dermot Diamond from Dublin City University spent a week at ACES UOW from 16 February reviewing current projects and discussing further collaborative research opportunities.	EM/EFD
16.	Ralph, Natalie (2016) RF Deakin University visited Monash University for fieldwork to solar research laboratory for lab procurement database, 26 February.	EPPE
17.	Wallace, G. (2016) visited Deakin University at Warun Ponds to review progress in Centre activities and to discuss the nonprinting platform development, 26 February.	EM
18.	Corinna Stumm, undergraduate from FAU Erlangen working with Tania Benedetti at UOW/IPRI, March-July.	SES

Appendix 1: Table listing ACES X-Nodal visits and Interactions during 2016		Research area
19.	Bonke, Shannon (2016) Affiliate PhD Monash visited Prof Patrick Unwin at University of Warwick 7 March – 1 May. Gave seminar on 'Renewable fuels from concentrated solar power: towards practical artificial photosynthesis' at University of Warwick, 18 March. Had collaborative discussions with Prof Julie MacPherson at University of Warwick.	SES
20.	O'Connell, C (2016) ACES ECR Melbourne to UOW for biopen meeting with SMR, co-ordination of next phase of biopen development ; co-ordination for development of GelMA hydrogels; modification of bioink composition to achieve 'core-shell' bioprinting for various hydrogel compositions and characterisation of hydrogels in 3D using the AFM, 7-11 March.	EM/SBS
21.	Wang, Caiyun (2016) SRF UOW visited Prof Masayoshi Watanabe, Prof Shoji Maruo, Prof Yuko Ichiyanagi, A/P Junji Fukuda and Prof Mahito Atobe at Yokohama National University 8-11 March. Gave presentation 'Bioprinting and biopolymer batteries in ACES/IPRI' whilst visiting A/Prof Junji Fukuda 10 March. Gave presentation 'Electromaterials Developed in IPRI/ACES for Li-ion Batteries' whilst visiting Prof Mahito Atobe 11 March.	EM/SES
22.	Yue, Zhilian (2016) ACES AI UOW presented 'Multi-functional Bioinks for Cell Printing' at a Skin Workshop at St Vincents Hospital Melbourne and review progress of ACES research activities with ACES members UOM, 16 March.	EM/SBS
23.	Al-Masri, Danah (2016) PhD student from Deakin visited Diogo Cabral, Monash University to work on 'diffusion coefficient measurements using the Cottrell method', 21 March.	SES
24.	Periyapperuma, Kalani (2016) PhD student Deakin University visited Prof Douglas MacFarlane at Monash University to discuss her project on zinc batteries, 22 March.	EM/SES
25.	Haworth, Naomi (2016) RF ANU visited Monash University to meet with Prof Douglas MacFarlane to discuss work published in Nature paper and implications for surface reactions in ionic liquids, 23 March.	EM/SES
26.	Hutchison, Katrina (2016) RF Monash University early stage collaboration with Justin Bourke, Rob Kapsa and Anita Quigley (ACES St Vincents) on ethical issues associated with SBS ACES research, March.	EPPE/SBS
27.	Ms Gabrielle Newson and Mr Matthew Waddington, undergraduate students from Warwick University, taking part in exchange through the Monash University-Warwick University Alliance, 4 April – 8 July.	SES
28.	Nikita Hall a project engineer from Warwick University visited ACES at UOW to view the facilities and discuss possible research opportunities, 13 April.	EM/SES
29.	Periyapperuma, Kalani (2016) PhD student Deakin University visited Prof Douglas MacFarlane at Monash University to discuss zinc morphology, 19 April.	EM/SES
30.	Ralph, Natalie (2016) from Ethics Deakin University visited Matthias Hilder, Batteries lab Deakin University to identify materials the lab uses for their research and which companies they buy from, to inform paper, 'In the Lab', 4 April.	EPPE
31.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi, 5 and 8 April.	EM/SES
32.	Nagle, Alex (2016) PhD UOW spent one week with Zhigang Xie at Deakin University on collaborative research, 18-22 April.	EM/SBS
33.	Yunis, Ruhamah (2016) Deakin RF to Monash University - Ionic Liquid, 22 April.	EM
34.	Periyapperuma, Kalani (2016) PhD Deakin University visited Prof Douglas MacFarlane at Monash University to discuss zinc morphology, 3 May.	EM
35.	Mladenovska, Tajanka (2016) Affiliate UOM student visited UOW to meet with the BIOPEN engineering and development team and UOW RF Ashley Walker on ulvan project, 5-6 May.	SBS
36.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi, 5 and 12 May.	EM
37.	Macdonald N., Cabot J.M., Sidra W. (2016) from UTAS to UOW for EFD discussions, 10 May.	EFD

Appendix 1: Table listing ACES X-Nodal visits and Interactions during 2016		Research area
38.	Kapsa, R. (2016) from UOW at St Vincent's Melbourne to UOW or collaboration meetings with SBS members, 10 May.	SBS
39.	Quigley A. (2016) from St Vincent's Melbourne to UOW for collaboration meetings with SBS members, 10-11 May.	SBS
40.	Macdonald N (2016) RF UTAS fabricated parts for collaborations with ACES Deakin and Trajan, June.	EFD
41.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi, 9, 21 & 23 June.	EM/SES
42.	Ralph, Natalie (2016) Deakin RF visited PhD Ruhamah Yunis Monash University to discuss the ethics regarding chemicals used in his project in June.	EPPE
43.	Bourke, Justin (2016) from UOM visited ACES RF Katrina Hutchison at Monash University to discuss considerations for iPSC applications, 21 June.	EPPE/SBS
44.	O'Connell, C (2016) ACES ECR Melbourne to UOW for biopen co-ordination meeting with regards to implementation fo LED ; GelMA face to face meeting; and to carry out experiments at characterisation of materials, 26 June-1 July.	EM/SBS
45.	Xie, Zhigang (2016) visited UOW from Deakin University as part of the collaboration on building a nanoprinting platform, 13 July.	EM
46.	Blum, Anna (2016) PhD UTAS visited CI Susan Dodds at UNSW for discussions, 21 July.	EPPE
47.	O'Connell, C (2016) ACES ECR Melbourne to UOW to give 4 lectures as part of the Biofabrication Master's degree; biopen update meeting and to carry out in situ rheology of hydrogel crosslinking with GelMA, 25-29 July.	EM/SBS
48.	Dr Simone Ciampi (2016) ACES AI spent a week at ACES/UOW undertaking experimental analysis with PhD student Long Zhang, 26-30 July.	EM
49.	Viaña, JNM (2016) affiliate PhD from UTAS is working with Prof James Vickers (UTAS) and Prof Mark Cook (University of Melbourne) on work for a paper on 'Ethical considerations for clinical trials of deep brain stimulation of the fornix for Alzheimer's disease' in June - July.	EPPE/SBS
50.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise cobalt materials with Dr Tanmaya Joshi, 5,8,12,13,14, 21 & 22 July.	EM/SES
51.	Goddard, Eliza (2016) UTAS RF visited CI Susan Dodds at UNSW for collaboration on an approach towards caring ethics: disability, vulnerability and epistemic injustice, 21-22 July.	EPPE
52.	O'Connell, Cathal (2016) Visited ACES at UOW from ACES UOM to give lectures for the UOW Biofabrication course and to conduct collaborative laboratory experiments in UOW ACES/ANFF facilities, 24-31 July.	SBS
53.	Blum, Anna (2016) UTAS PhD student met CI Susan Dodds UNSW during August.	EPPE
54.	Macdonald, Niall (2016) RF UTAS continued 3D printing design, and fabrication work with ACES PhD Kalani Periyapperuma from ACES Deakin node on the flow cell battery prototype, August.	EFD/SES
55.	Pozo-Gonzales, Cristina (2016) SRF Deakin worked with RF Simonov at Monash University on eQCM measurements, 4 August.	SES
56.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi, 12 and 15 August.	EM/SES
57.	Mr Fengwang Li (2016) PhD Monash spent two weeks in PI Prof. Pat Unwin's research group at the University of Warwick working on a joint research project in August.	SES
58.	Barnsley, Grant (2016) ACES Affiliate PhD from UOW worked with Doug MacFarlane from Monash node to produce electrode structures tailored to his application with steel materials, September.	EM
59.	Choi, Jaechol (2016) UOW PhD visited ACES partner investigator Prof Dirk Guldi at Erlangen in Germany to undertake (photo) electrocatalysis experiments, 5-14 September.	EM/SES

Appendix 1: Table listing ACES X-Nodal visits and Interactions during 2016		Research area
60.	O'Connell, Cathal (2016) ACES ECR UOW working from UOM visited ACES UOW to fabricate hydrogels with graded stiffness and attend the SBS milestone meeting, 19-21 September.	EM/SBS
61.	Yue, Zhilian (2016) ACES AI at UOW visited Dublin City University to progress ACES research in contactless drug delivery systems as well as to identify new opportunities for collaboration in the area of biomedical research, 19 September to 4 October.	EM/SBS
62.	Bourke, Justin (2016) ACES RF UOM visited ACES at UOW and worked with ACES ECR Rouhollah Jalili to synthesise new graphene electrodes, 20 September.	EM/SBS
63.	Kapsa R; Bourke J; Quigley A; Barsby T; O'Connell C (2016) ACES members St Vincents Melbourne to UOW for SBS theme face to face meeting, 20 September.	SBS
64.	Shimazu, Yuka (2016) PhD at Yokohama University, Japan visiting ACES UOW for 6 months from 27 September working on fabrication of *in vitro* vascular tissue using hydrogels.	SBS
65.	Mutlu, Rahim (2016) RF at UOW working with AI Vitor Senadenos through August and September on printable soft sensors and DEA actuators.	SR
66.	Noble B, Simpson C (2016) RF and PhD at ANU are working with AI Simone Ciampi on 2 projects involving effect of electric fields on chemical reactions in September.	EM
67.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi and Prof Leone Spiccia, 8, 16 and 26 September.	EM/SES
68.	Fang, Jian (2016) ACES RF Deakin Geelong visited ACES RF Yafei Zhang, Cristina Pozo-Gonzalo at Burwood Melbourne to discuss the possible collaboration opportunities for making carbon nanofibers with catalysts as air cathodes, 28 September.	SES
69.	Alici, G (2016) ACES CI and soft robotics theme leader visited PI Kim at Hanyang University to give an update on the progress of SR theme milestones and to discuss how to actively involve Prof Kim's research group more into ACES activities, 2-3 October.	SR
70.	Higgins, Michael (2016) visited collaborators Dermot Diamond (ACES PI), Robert Forster (ACES AI) at DCU for review of ACES projects, 13-18 October.	EM/SBS
71.	Macdonald, Niall (2016) ACES RF UTAS worked with PhD student from Deakin Kalani Periyapperuma on Dual-channel flow cell design for Kalani's flow cell battery prototype in October.	EFD/SES
72.	Nattestad, Andrew (2016) ACES AI Nattestad worked with ACES UOW PhD student on EPD of porphyrins for carbon dioxide photo reduction during October.	EM
73.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise materials with Dr Tanmaya Joshi and Prof Leone Spiccia,3, 6, 7, 14, 18, 20, 21 & 27 October.	EM/SES
74.	Bourke, Justin (2016) ACES UOM RF visited ACES team led by CI Prof Brett Paull in UTAS to discuss fluidics for neural modelling on 7 November.	EFD/SBS
75.	Gietman, Shaun (2016) Swinburne PhD visited ACES team led by CI Prof Brett Paull in UTAS to discuss fluidics for use in optically active drug delivery systems on 7 November.	EFD/SBS
76.	Yunis, Ruhamah (2016) Deakin RF collaborative visit to Monash University to synthesise cobalt complexes with Prof Leone Spiccia group 14, 18 & 28 November.	EM/SES

APPENDIX 2: A TABLE LISTING 50 END-USER AND GOVERNMENT VISITS TO ACES NODES IN 2016

Appendix 2: Table listing the End-User and Government Visits to ACES nodes in 2016	
1.	Jason Hinds, Enware visited ACES/IPRI to discuss a possible collaborative project, January.
2.	Gino Arcella from ACEIT visited ACES facilities and for discussions at UOW on 13 January.
3.	Michael Grey from Wollongong Private Hospital visited ACES facilities and held discussions at UOW on 27 January.

Appendix 2: Table listing the End-User and Government Visits to ACES nodes in 2016	
4.	Michael Allen from the Fred Hollows Foundation visited ACES/IPRI for a facilities tour and discussions on 24 February.
5.	A/Prof Christopher Maher from the University of Queensland and the Wesley Royal Brisbane Hospital, Womens Urogynaecology, visited ACES at UOW 26 February.
6.	Paul Carter & Bradley Leedham, Cochlear, visited ACES/IPRI for a facilities tour and discussions 29 February.
7.	Dr Michele Atkinson, Sydney Spine Surgery, visited ACES/IPRI for a facilities tour and discussions 1 March.
8.	Cherian, Mathew (2016) Meeting with funders in the International Aid, Disaster Resilience sector including President of the Bill and Melinda Gates foundation in India, April.
9.	Rana Mohtadi, Toyota visited Deakin University, April.
10.	Prof Suojiang Zhang and contingent, Industrial Process Engineering (IPE), China, to Monash University for the signing of the IPE-Monash University Memorandum of Understanding and the China-Australia Ionic Liquids Workshop, 22April.
11.	Dr Florian Lapierre, Trajan/AStech, visited UTAS to discuss UTAS 3D printing facilities in April.
12.	Group of DMTC personnel to ACES/UOW to view 3D printing facilities and ACES soft robotic theme work: a. Laxton, Greg — CASG — FFGSPO-D b. Moloney, Don — CASG — FFGSPO ESM c. Allica, Adam — Navy — Director Navy Continuous Improvement d. Edmondson, James — Navy — New Generation Navy - Innovation e. Pivato, Lou — BAE — Lead Engineering Function f. Sysouphat, Andrew — BAE — 3D Printing SME g. Connely, Shaun — BAE — Business Operations Manager h. Mansell, Kelvin — Thales — Platform Services Officer i. Jaksic, Zoran — Thales — Sustainment Management j. Warwick, Terry — Thales — Sustainment Management
13.	Peter Johnstone & Helen Mahony from Astellas Pharma, visited ACES/IPRI for a facilities tour and discussions 6 May.
14.	Robert Moran (LyondellBasell) and Ian Dagley (CRCP) visited ACES/IPRI for a facilities tour and discussions 9 May.
15.	John Pollaers, Australian Advanced Manufacturing Council visited ACES Deakin node in Geelong 19 May.
16.	Eight members of the UOW Power Department Meeting toured the ACES facilities at UOW, 20 June.
17.	Tony Blain, Steve Atherton and Alan Tooth (ShireBiz), Shaun Jenkinson and Tim Boyle (ANSTO executives), A/Prof Munjed Al Muderis (Orthopedic Surgeon), Belinda Bosley (RN and PNSA) and Gus Medina (Medina engineering) toured the ACES facilities at UOW and discussed ACES research activities, 2 July.
18.	Darling Rojas-Canales from the Royal Adelaide Hospital worked at ACES UOW on a collaborative project for 3 days from 4 July.
19.	Ray Aunei Mose and Mal Allen from the Hunter Clinical Technology, Hunter New England Local Health District visited ACES at UOW to view the facilities and an overview of the research activities on 6 July.
20.	Catrin Tilley from MORE Partnership visited ACES at UOW to view the facilities and an overview of the research activities on 6 July.
21.	Dr Trevor Gardner, Director of Trauma Anaesthetics at Wollongong Hospital, visited ACES at UOW to view the facilities and an overview of the research activities on 15 July.
22.	Julia O'Callaghan, Director of University Engagement at Defendtex, visited ACES at UOW to view the facilities and an overview of the research activities on 21 July.
23.	Dr Pia Winberg and five collaborative members with Venus Shell Systems visited ACES at UOW for a collaborative workshop and tour of the facilities, 25 July.
24.	Tina Cameron and Bret Shaw from Quest Worldwide visited ACES at UOW for a tour of the facilities on 25 July.
25.	Mr Sangsoo Yoon, Consul-General from the Republic of Korea, visited ACES at UOW for a tour of the facilities and an overview of the research activities, 27 July.

Appendix 2: Table listing the End-User and Government Visits to ACES nodes in 2016	
26.	Angela and Robert Richards, Pepperell and Associates, visited ACES at UOW for a tour of the facilities and an overview of the research activities, 29 July.
27.	Tina Cameron and Bret Shaw from Quest Worldwide revisited ACES at UOW for further discussions on 3 August.
28.	Richard Andrews, DFAT Ambassador designate to Ireland, visited ACES at UOW for a tour of the facilities and an overview of the research activities, 12 August.
29.	Andrew Stevens, Mike Grogan and Jens Goennemann from the Advanced Manufacturing Growth Centre (AMGC) visited ACES Deakin node in Geelong 19 August.
30.	Julian Sing, 3dChef, visited ACES at UOW for a tour of the facilities, 22 August.
31.	Steven Kennedy and Milind Raje from Cochlear visited ACES at UOW for collaborative research discussions, 22 August.
32.	Jamie Vandenberg, Mark Cowley & Roland Stocker from Victor Chang Cardiac Research Institute visited ACES at UOW for a tour of the facilities and an overview of the research activities, 22 August.
33.	Greg Hunt, Federal Minster for Industry, Innovation and Science visited ACES Deakin node in Geelong 25 August.
34.	Dr Alan Finkel, Chief Scientist visited ACES Deakin node in Geelong 2 September.
35.	Bill Ferris AC, Chair for Innovation Australia) toured BATRI-hub prototyping labs with CI Howlett, to discuss high energy battery technology, September.
36.	Nik Gurupaseed from Nik Guruprasad International Investment - Invest Victoria, Department of Economic Development Jobs, Transport and Resources, State Government of Victoria met with CI Howlett to discuss opportunities for engagement and promotion of industry partnerships with Victorian researchers, 1 September.
37.	Brad McDougall, CEO of One Degree Health, visited ACES at UOW for a tour of the facilities and an overview of the research activities, 6 September.
38.	Kelsey Krauter, Wisk E. Biskit Company, visited ACES at UOW for a tour of the 3D printing facilities, 7 September.
39.	Robert Zabara (Health Economic Analyst) and George Papadopoulos (Managing Director), Emerald Corporate Group Pty Ltd, visited ACES at UOW for a tour of the facilities and an overview of research activities, 20 September.
40.	Robert Thompson, Technology & Production Manager at Anatomics Pty Ltd, visited ACES at UOW for a tour of the facilities and an overview of research activities, 20 September.
41.	Prof Edward Weaver from University of Washington; Seattle Prof Peter Eastwood from University of Western Australia; Dr Rich Lewis Perth and Prof Stacey Ishman from Cincinnati Children's Hospital Medical Center in Ohio visited ACES at UOW for a workshop on sleep apnoea and a tour of the facilities, 17 October.
42.	Dr Alex Zelinsky, Chief Defence Scientist DSTG, visited ACES Deakin node in Geelong 17 October.
43.	Dylan Thorpe & Simon Belcher, SMR Technologies Adelaide, were hosted at ACES at St Vincents Hospital to discuss the design of the biopen, 17 October.
44.	Lawrence Crumpton, Academic Developer Evangelist at Microsoft, visited ACES at UOW to give a stimulating seminar and for a tour of the ACES facilities and an overview of ACES research, 21 October.
45.	Ms Sarah Henderson Federal MP and Ms Leanne Harvey, CEO ARC visited ACES Deakin node in Geelong 26 October.
46.	Dr Amanda Caples, Lead Scientist of Victoria, visited ACES Deakin node in Geelong 14 November.
47.	ArcActive met with CI Howlett to discuss possible materials collaboration and research relating to establishment of electrode manufacturing capability at Deakin Waurn Ponds campus, 15 November.
48.	Bill Ferris, Chairman Innovation Australia, visited ACES Deakin node in Geelong 17 November.
49.	St Vincent's Foundation industry benefactors (~25 investors and industry leaders) were given a demonstration of 'biopen' by ECR Cathal O'Connell, 25 November. Bohdan Durnota Millennium System Pty Ltd, a R&D company, specialising in data science, systems engineering and image processing visited ACES at UOW to investigate research ideas, 28 November.

APPENDIX 3: A TABLE LISTING 30 INDUSTRY OR GOVERNMENTAL VISITS UNDERTAKEN BY ACES MEMBERS

Appendix 3: Table listing Industry or Governmental Visits undertaken by ACES members	
1.	Officer, D. L. (2016) Research presentation and collaboration discussions with Pegasus Print Group, Blacktown, Sydney, Australia, 19 January.
2.	MacFarlane, Douglas (2016) Invited to give a talk on 'Sustainable Energy Applications of Ionic Liquids' as part of the Reliance Industries R3 lecture series held in Mumbai, India on 22 January.
3.	Officer, D. L. (2016) Research presentation and collaboration discussions with BJ Ball, Prospect, Sydney, Australia, 4 February.
4.	Officer, D. L. (2016) Research discussions with Pegasus Print Group, Blacktown, Sydney, Australia, 4 February, 17 March, 31 May, 20 October.
5.	Officer, D. L. (2016) Research presentation and collaboration discussions with Bright Print, Wetherill Park, Sydney Technology Park, Sydney, Australia, 5 February.
6.	Officer, D. L. (2016) Research presentation and collaboration discussions with Fuji Xerox, Epicentre, Sydney, Australia, 5 February.
7.	Cherian Matthew (2016) ACES PhD candidate met with funders in the International Aid, Disaster Resilience sector including the President of the Bill and Melinda Gates foundation in India, April.
8.	Innis P. Beirne S (2016) ACES/ ANFF partnership presence at National Manufacturing week, Homebush, Sydney, 12 May.
9.	MacFarlane, Douglas (2016) did a recorded interview with collaborator eWater Systems, Melbourne, Australia on 12 May 2016. Prof Doug MacFarlane, ARC Laureate Fellow and ACES CI from Monash University, caught up with eWater to articulate his impressions of electrolysed water and the eWater Systems company. (http://www.ewatersystems.com/newsblog/2016/5/12/professor-of-chemistry-at-monash-university-prof-doug-macfarlane-on-ewater)
10.	Officer, D. L. (2016) Introduction to the Intelligent Polymer Research Institute (IPRI) and the ARC Centre of Excellence for Electromaterials Science (ACES), Materials Australia AIIM visit, AIIM, Innovation Campus, 17 May.
11.	Wallace, G (2016) Invited talk '3D Bioprinting: Printing Parts for Bodies' at Henkel, Ireland on 3 June. Henkel specialises in adhesive technologies and currently employs approximately 1000 employees in the UK & Ireland across 6 sites, which include manufacturing, R&D and office facilities.
12.	Officer, D. L. (2016) Research presentation and collaboration discussions with Simplot, Melbourne, Australia, 8 June.
13.	O'Connell C, Beirne S (2016) ACES researchers and associate investigators met SMR representatives in Melbourne to discuss development plans for Biopen, 15 June.
14.	Forsyth, M (2016) spoke about 'Emerging Energy Storage Solutions for a Sustainable Environment' to CLSA consultancy in Sydney 16 June. CLSA is a collective of curious individuals who together, seek out and curate investible, tradable ideas for their clients.
15.	Gorkin, Robert (2016) was invited to present the gel condom work at the Medical Research Commercialisation Fund (MRCF) meeting held in Adelaide at University of South Australia, 22 June. The MRCF provides dedicated investment funding to support the commercialisation of early-stage medical research discoveries that originate from its member institutes.
16.	Forsyth M, Howlett P, Pringle J (2016) visited Boron Molecular facilities in Melbourne to discuss scale-up and synthesis of specialist electrolytes for batteries on 25 July.
17.	Wallace, G (2016) Invited talk 'New Electrodes, Controlled Delivery and Additive Fabrication' at Anatomics Breakfast Meeting, Melbourne, 18 August.
18.	MacFarlane, Douglas (2016) met with Austrade, Tokyo, Japan on 25 August.
19.	Wallace, G (2016) Invited talk 'Electromaterials: Linking Brain and Machine' at Thoughts to Action Workshop, St Vincent's Hospital Melbourne, 13 September.
20.	Beirne, S (2016) attended ROMAR / CSIRO equipment launch and demonstration, 21 September.
21.	Macdonald N, Breadmore M (2016) visited Dolomite, Blacktrace Holdings – Royston, Cambridge in the UK to discuss fabrication of 3D printed microfluidics from 4-6 October.
22.	MacFarlane, Douglas (2016) visited Baosteel Co. Ltd, Shanghai, China in October
23.	Howlett, Patrick (2016) toured new battery testing capabilities at DSTG and discussed potential funding opportunities with defence.

Appendix 3: Table listing Industry or Governmental Visits undertaken by ACES members	
24.	Forsyth M, Howlett P (2016) visited the HydroQuebec facilities in Canada for tour of battery testing and manufacturing facilities and collaborative discussions on lithium and sodium battery research and possible battery manufacturing opportunities in Australia
25.	Forsyth M, Howlett P (2016) visited Toyota Ann Arbor facilities in USA to review the manufacturing facilities and hold collaborative discussions on possible funding opportunities.
26.	MacFarlane, Douglas (2016) was with collaborators Toyota, Melbourne, and enjoyed test driving the Toyota hydrogen fuel cell vehicle, 14 November.
27.	Beirne, S (2016) Presented at the Advanced Manufacturing Summit on behalf of ACES and ANFF, 16 November.
28.	Officer, D. L. (2016) Research presentation (3D printing and Polymers) and collaboration discussions with AusPost, Melbourne, Australia, 17 November.
29.	Wang, Xungai (2016) gave an invited presentation at the Green & Recycling, Intelligent Manufacturing, Spinning Future Together – Urumqi Forum held in China on 18 September. The forum brought together some 400 textile experts, scholars, entrepreneurs and representatives from China and abroad. Wang, Xungai (2016) visited and held discussions with Lincoln Agritech Ltd, Lincoln University, NZ.

APPENDIX 4: A TABLE LISTING THE PLENARY/KEYNOTE ADDRESSES GIVEN BY ACES MEMBERS

Appendix 4: Table listing the 2016 Plenary/Keynote Addresses given by ACES members	
1.	MacFarlane, DR (2016) 'Ionic Liquids for Sustainable Energy Storage', International Symposium on Ionic Liquids (ISOIL), Mumbai, India, 21 January.
2.	Wallace, G (2016) '3D Bioprinting: Printing Parts for Bodies' Rotary District Conference, Shepparton, Victoria, 18-20 March.
3.	Forsyth, M. (2016) 'Electrolytes enabling Li and Na metal devices – from polymer electrolytes to ionic liquids' at the IBA16 held in Nantes France 20-25 March.
4.	Wallace, G (2016) '3D Bioprinting: Printing Parts for Bodies', ARCS Scientific Congress in Sydney, Australian Turf Club, Randwick, 11-12 May.
5.	Wallace, G (2016) '3D Printing -Putting the Ability to Create Back in the Hands of the Creative', Inside 3D Printing conference, National Manufacturing Week (NMW), Sydney, 11-13 May.
6.	Wallace, G (2016) 'Organic Bionics and 3D Printing: New Dimensions in Medicine', 27th International Conference on Molecular Electronics and Devices (IC ME&D 2016) Pusan National University, Busan, Korea, 19-20 May.
7.	Wallace, G (2016) 'Electrodes Based on Graphene - Processing and Device Fabrication' at European Society of Electroanalytical Chemistry (ESEAC2016), Bath, UK, 12-16 June.
8.	MacFarlane, D.R. (2016), 'Real World Applications of Liquid Salts - Potentials, Practicalities and Pitfalls', at EUCHEM, in Vienna, Austria, 3-8 July.
9.	Forsyth, M. (2016) 'Energy Storage Beyond Li-ion - New Developments in Electrolytes Enabling Li and Na metal devices' at the Energy Future (EF) conference, Sydney, 4-6 July.
10.	Wallace, G (2016) 'Graphene: The Journey From the Nanodomain To Macroscopic Devices' at 5th International Symposium on Graphene Devices (ISGD-5), Brisbane, Australia, 11-14 July.
11.	Howlett, P. (2016) 'Electrolytes for Lithium and Sodium Metal Batteries – Towards High Performance Devices' at the 2016 International Symposium on Next Generation Batteries held at University of Wollongong, 9-11 August.
12.	Forsyth, M. (2016) Novel Solid Electrolyte composites materials enabling Li and Na metal devices' at ISPE16 held in Uppsala, Sweden 14-19 August.
13.	Forsyth, M. (2016) 'Mixed salt electrolytes for Sodium battery applications' at the ISE conference held in The Hague, the Netherlands, 21 -26 August.
14.	MacFarlane, D.R. (2016), 'Pushing the Boundaries and Breaking the Shackles of Ionic Liquids', at 1st International Symposium on Hydrogen Energy Based Society, at Tokyo Metropolitan University (TMU), Tokyo Japan, 26-27 August.

Appendix 4: Table listing the 2016 Plenary/Keynote Addresses given by ACES members	
15.	Wallace, G (2016) 'Arranging Polymer Materials for Enhanced Performance 3D Printing, Spinning, Knitting and Braiding' at Emerging Polymer Technologies Summit, Melbourne, Australia, 14-16 September.
16.	Alici, G (2016) 'Are we there for site-specific drug delivery within human body: actively controlled robotic solutions?' at Science International Robotics Alliance Conference, Foshan, China, 28-29 September.
17.	MacFarlane, D.R. (2016), 'Pushing the Boundaries and Breaking the Shackles of Ionic Liquids', at 5th Asia Pacific Conference on Ionic Liquids & 2nd Joint Symposium of Korea-Japan-China on Ionic Liquids held in Hangzhou, China from 26 -29 October.
18.	Alici, G (2016) 'Robot bilimdeki akademik araştırma ve ilgili sanayi aynı amaçlara kilitlenebilir mi?' at National Robotics Conference (ToRK 2006), Istanbul, Turkey, 2-3 November.
19.	Officer, D. L. (2016) Functionalised Polythiophenes for Energy, Sensing and Bio- Applications at The Australian Polymer Symposium, Lorne, Australia, 20-23 November.
20.	MacFarlane, D.R. (2016) at the International Symposium on Renewable Energy Technologies, held at University of Technology Sydney (UTS), 30 November -4 December.

APPENDIX 5: A TABLE LISTING INVITED TALKS GIVEN BY ACES MEMBERS IN 2016

Appendix 5: Table Listing Invited Talks/Panels given by ACES members	
1.	Howlett, Patrick (2016) 'Organic Ionic Plastic Crystals – Novel Ionic Electrolytes for Alkali Metal Electrodes' at the Nanostructured Electromaterials for Energy Workshop, Curtin University held on 18-19 January.
2.	Wallace, G (2016) '3D Bioprinting: Advances and Opportunities' Healthcare Investment Forum, Dubai, 24 January.
3.	Wallace, G (2016) 'Role of Medical Research in Capacity Building' UAE-Australia Healthcare Education Forum, Dubai, 25 January.
4.	Wallace, G (2016) '3D Printing and Healthcare' Healthcare of the Future Conference, University of New South Wales, 19 March.
5.	N.P. Macdonald, J.M. Cabot, R. Gujit, M.C. Breadmore, B. Paull (2016) Invited talk 'Which 3D printer? Microfluidic applications'. 7th Australia and New Zealand Nano-Microfluidics Symposium (ANZNMF 2016), Brisbane, 21-23 March.
6.	Wang X (2016) 'Innovations in Natural Fibre Processing' at 85th ITWO Congress in Sydney, 4-6 April.
7.	MacFarlane, DR (2016) 'Sustainable Energy Applications of Ionic Liquids, Design and Applications of Ionic Liquids in Chemistry and Physics', Santiago, Chile, 4-8 April.
8.	Chen, J. (2016) 'Functionalised Graphene Aerogel for Energy Devices' at the 19th Topical Meeting of International Society of Electrochemistry, Auckland, New Zealand, 17-19 April.
9.	Wallace, G (2016) 'ACES: An ARC Centre of Excellence', SMART Hospital & Healthcare of the Future APAC 2016, Singapore, 25-26 April.
10.	MacFarlane, DR (2016) 'Pushing the Boundaries and Breaking the Shackles of Ionic Liquids', Australian Symposium on Ionic Liquids 7 (ASIL7), Newcastle, Australia, 23-26 April.
11.	Officer, D. L. (2016) Fabrication of graphene containing structures at the ACES Graphene Commercialisation - Challenges and Opportunities Symposium, AIIM Facility, Innovation Campus, Wollongong, Australia, 4 May.
12.	O'Connell C, Wallace G. (2016) invited talk 'Development of the Biopen: A Handheld Device for Surgical Bioprinting' at Science on the Swan, Perth 5 May.
13.	Cook, M. (2016) 'Invasive seizure monitoring', Asian Oceanic Epilepsy Congress, Hong Kong, 5 May.
14.	Cook, M. (2016) 'When and How to Withdraw long-term anti-convulsant therapy', Asian Oceanic Epilepsy Congress, Hong Kong, 6 May.
15.	Pringle J. (2016) 'Temperature dependence of the electrode potential of a cobalt-based redox couple in ionic liquid electrolytes for thermal energy harvesting' at Liquid Salts for Energy and Materials: Faraday Discussion held in Ningbo, China 11 - 13 May.

Appendix 5: Table Listing Invited Talks/Panels given by ACES members	
16.	O'Dell L, Forsyth M (2016) 'Magnetic resonance studies of alignment effects and phase transitions in organic ionic plastic crystals, Developments and Applications of Solid State NMR' to Materials Science, Chemistry and Engineering Conference, Bulgaria, 14- 17 May.
17.	Moulton SE. (2016) Effective Stimulation of excitable cells using electroactive materials, World Biomaterials Congress, Montreal, Canada 17-22 May.
18.	Pozo-Gonzalo C, Pringle J, Kar M, Jónsson M, Howlett P, MacFarlane D and Forsyth M (2016) gave 7 invited talks at 7th Australian Symposium on Ionic Liquids (ASIL), Newcastle, 23-26 May.
19.	O'Dell L, Forsyth M (2016) Magnetic resonance as a probe of dynamics and associations in lithium or sodium-containing ionic liquid electrolytes, Australian Symposium on Ionic Liquids, Newcastle, NSW, 23-26 May.
20.	Officer, D. L. (2016) Developing Nanostructured Electromaterials for Energy Applications, 2016 US-Australia Enabling Technologies Technical Meeting, UNSW, Sydney, Australia, 23-24 May.
21.	Wallace, G (2016) '3D Bioprinting: Printing Parts for Bodies', Australian Academy of Science Annual Symposium, Human PLUS, Shine Dome, Canberra, 26 May.
22.	Mozer A, Clarke T, Zhang G (2016) 'The Effect of Increased Dielectric Screening on Bimolecular Recombination of Photogenerated Charges in Polymer: Fullerene Bulk Heterojunctions' at the 229th Electrochemical Society (ECS) meeting, San Diego California, 29 May-2 June.
23.	Wallace, G (2016) 'Organic Bionics Enabled by 3D Printing' at 5th International Conference Smart and Multifunctional Materials Structures and Systems (CIMTIC) 2016, Perugia, Italy, 5-9 June.
24.	Fang, Jian (2016) invited talk 'Vibration energy to electricity conversion of electrospun PVDF nanofibres' at CIMTIC 2016, Perugia, Italy, 5-9 June.
25.	Higgins, Michael (2016) 'Bio-AFM and High Speed AFM' at 7th International nanomedicine Conference, Coogee, Sydney 27-29 June.
26.	Pozo-Gonzalo C., Howlett P. C., MacFarlane D.R., Forsyth M. (2016) 'On the recharge-ability of sodium-metal and sodium-air cells using ionic liquid electrolytes' at the International meeting on ionic liquids for electrochemical devices, Rome, Italy, 11 -13 July.
27.	Viaña, JNM. (2016) Neuroethics at Neurasmus 5th Annual Workshop, Budapest, Hungary, 11-14 July.
28.	Alici, G (2016) Organised and ran half-day tutorial entitled 'From soft Actuators to Soft Robotics: Where are we?' at 2016 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, Banff, Canada, 12-15 July.
29.	Wallace, G (2016) 'Materials, Machinery and Clinical Science' St Vincent's Hospital Surgical Forum 2016, Melbourne, Australia, 25-27 July.
30.	Officer, D. L. (2016) New organic dyes for dye sensitised solar cells at the CRC for Polymers Annual Meeting, Melbourne, Australia, 2 August.
31.	O'Dell L, Forsyth M (2016) 'Magnetic resonance studies of alignment effects and phase transitions in organic ionic plastic crystals', PRICM9, Kyoto, Japan, 2- 5 August.
32.	Wallace, G (2016) 'ACES' at Canberra ARCS Scientific Congress (ASC), Australia, 10-11 August.
33.	Wang C, Yang Y, Jia X, Yu C, Wallace G (2016) 'Conducting Polymers with Tunable Properties for Batteries', at the 2016 International Symposium on Next-Generation Batteries, Wollongong, 10-12 August.
34.	Chen, J. (2016) 'Flexible Supercapacitors for Wearable Electronic Devices', International Symposium on Next-Generation Batteries, Wollongong, 10-12 August.
35.	Pringle J (2016) 'Ionic Liquid Based Redox Electrolytes for Thermal Energy Harvesting' at the Gordon Research Conference Ionic Liquids for Future Technologies held in Newry, ME, USA between 14-19 August.
36.	Officer, D. L. (2016) Photochemopropulsion, NZIC-16, Queenstown, New Zealand, 21-24 August, 2016.
37.	Cook, M. (2016) Symposium on Parameter estimation in Epilepsy, Biodynamics Conference, Exeter University, Exeter, UK, 9 September.
38.	Higgins, Michael (2016) invited talk on behalf of Gordon Wallace at 5th Congress of the World Union of Wound Healing Societies, 26-29 September.

Appendix 5: Table Listing Invited Talks/Panels given by ACES members	
39.	Wallace, G (2016) '3D Bioprinting: Printing Parts for Bodies', Yonsei University, Korea, 8 October.
40.	Cook, M. (2016) Dynamics of Epilepsy, Epilepsy Frontier International Forum, Zhongshan Hospital and Shanghai Municipal Committee of Science and Technology, Shanghai, China, 11 October.
41.	Cook, M. (2016) 'New insights into the dynamics of epilepsy and seizure prediction through long-term invasive monitoring', Melbourne Brain Symposium 2016, Melbourne, Australia, 13 October.
42.	Wallace, G (2016) '3D Bioprinting: Scientists, Engineers and Clinicians Collide', Sleep Apnoea - Beyond CPAP Workshop, Innovation Campus, Wollongong, Australia, 17 October.
43.	Wallace, G (2016) '3D Bioprinting: Can we create the hierarchical structures found in living cells', 17th International Biotechnology Symposium (IBS2016), Melbourne, Australia, 24-27 October.
44.	Wallace, G (2016) '3D Bioprinting: Controlling the Environment for Cellular Development' at World Life Science Conference (WLS2016), Beijing, China, 1-3 November.
45.	Cook, M. (2016) 'Seizure prediction systems: new approaches', SKKU Translation Medicine Symposium, Seoul, 19 November.
46.	Cook, M (2016) 'Approaches to the treatment of epilepsy' at Medical Bionics, Brisbane, Australia, 22 November.
47.	Wang X (2016) 'Natural and Highly Protective Composite Structures – Wild Silkworm Cocoons' at the 1st International Symposium on Advanced Composites, University Southern Queensland, Brisbane, 24-25 November.
48.	Chen, J. (2016) 'Metal-Carbide as Cathode for Rechargeable Lithium-Air Battery', the 2nd International Symposium on Renewable Energy Technologies, Sydney, 30 November - 4 December.
49.	Wallace, G (2016) 'From Metscan to the Biopen: A journey forged in the hallowed halls of Waurn Ponds' An Electrochemical Symposium - to celebrate Alan Bond's past, present and future contributions, University of Melbourne, Australia, 1-2 December.
50.	Mozer A, Zhao L, Wagner P, Barnsley J, Clarke T, Gordon K, Mori S (2016) 'Enhanced Dye Regeneration Kinetics in Dichromophoric Porphyrin -Carbazole Triphenylamine Dyes with exposed Tridimensional Radical Cation Orbitals' at 9th Asian Photochemistry Conference (APC2016), Singapore, 4-8 December.
51.	Pringle, J (2016) 'Electrolytes for advanced metal batteries – Towards high performance, high energy density devices' at the Emerging Energy Technology Summit and Exhibition, Melbourne, 5-7 December.
52.	Howlett, P. (2016) 'Ionic liquid-based redox electrolytes for thermal energy harvesting' at the Emerging Energy Technology Summit and Exhibition, Melbourne, 5-7 December.
53.	Zhang, J. (2016) 'Is the imidazolium cation a unique promoter for electrocatalytic reduction of carbon dioxide?' at the Emerging Energy Technologies Summit and Exhibition, Melbourne, 5-7 December.
54.	Crook Jeremy (2016) Invited talk on 'Defined induction of human neural organoids from induced pluripotent stem cells using gelatin methacrylate: a three-dimensional model for studying development, disease and regenerative medicine' Tomaskovic-Crook et al. at the Australasian Society for Neuroscience (ANS), Hobart, 7 December.

APPENDIX 6: A TABLE LISTING DISTINGUISHED VISITOR LECTURES GIVEN BY ACES MEMBERS

Appendix 6: Table listing Distinguished Visitor Lectures given by ACES members	
1.	MacFarlane, DR (2016) ' Sustainable energy Applications of Ionic Liquids', Reliance Industries R3 Lecture Series, Reliance Industries, Mumbai, India, 22 January.
2.	Wallace, G (2016) 'Advanced Materials and Fabrication Tools Enabling Opportunities in Energy and Health', University of Wollongong Dubai campus, Dubai, 25 January.
3.	Higgins, M (2016) Colloquium presentation 'Advances in Bio-Atomic Force Microscopy for Biological and Materials Research' at University of Auckland, New Zealand, 14-17 March.
4.	Cook, M. (2016) Clinical application of closed loop seizure suppression systems, Medtronic Inc., Minneapolis, Minnesota, USA, 5 April.

Appendix 6: Table listing Distinguished Visitor Lectures given by ACES members	
5.	Cook, M. (2016) Seizure prediction, Mayo Clinic, Rochester, Minnesota, USA, 6 April.
6.	Cook, M. (2016) 'New approaches to epilepsy management - stimulation and prediction' at Exeter University, Exeter, UK, 8 September.
7.	Innis P; Higgins M, Mozer A, Wang C (2016) Hanbat University Special lecture Series, at Hanbat University , Daejeon, South Korea, 29 November-8 December.

APPENDIX 7: A TABLE LISTING ACES WORK SHOWCASED IN INVITED SEMINARS OR COLLABORATIVE RESEARCH VISITS

Appendix 7: Table listing Invited Seminars and Collaborative visits related to ACES work	
1.	Howlett, P (2016) visited Curtin University in Western Australia to review fuel cell testing facilities and hold collaborative discussions on air oxygen cathode materials and electrolytes, 18-19 January.
2.	MacFarlane, Douglas (2016) to visit PhD students at IITB Mumbai, India, 19 January.
3.	Wagner, P (2016) worked with collaborators at Massey Univeristy and Otago University, New Zealand, 28 January - 3 February.
4.	Wagner P and Mozer A (2016) worked with collaborators at Shinshu University, Ueda, Japan, on an ARC discovery application, 4-14 February.
5.	Chen, Zhi (2016) visited Prof Gerard Sutton's team at the NSW Lions Eye Bank, Sydney to collect human cornea tissue and show ACES material samples, 18 February.
6.	Cabot J.M. (2016) visited Tarl Prow at Uni Qld to talk about microbiopsy and microfluidics, 23-24 February.
7.	Wagner P and Wang C (2016) visited Shinshu University giving presentations at the UOW-Shinshu University workshop, 1-8 March.
8.	Wang C (2016) visited Dr Kiyoshi Ozawa at NIMS, Tokyo Japan to discus collaborative research possibilities, 8 March.
9.	Zhao, Shufeng (2016) from Monash University finished specialised GC installation for CO_2 reduction and the related training at CSIRO, February.
10.	Gilbert, F (2016) Collaborated with Freitas L from Institute of Bioengineering, Center for Neuroprosthetics, École Polytechnique Fédérale de Lausanne (Switzerland) and Severo MC from Department of Experimental Clinical and Health Psychology, University of Ghent (Belgium) on ethical issues in clinical trials of neuroprosthetics, March.
11.	Patton, Molly (2016) ACES EM masters student visited Alessandra Sutti at Warun Ponds campus of Deakin University to synthesise pilk nanofibers, March.
12.	Wang, Caiyun (2016) Oral 'Electromaterials Developed in IPRI/ACES for Li-ion Batteries' at ACES-Shinshu Joint workshop, Shinshu, Japan, 4 March.
13.	Wang, Caiyun (2016) Visited and met with Dr Fumitaka Hayashi, Prof Katsuya Teshima and A/Prof. Nobuyuki Zettsu at Shinshu University, 7 March.
14.	Cherian, M (2016) PhD Deakin visited HelpAge in the Irrawady district Myanmar to study Disaster Risk Reduction work after Cyclone Nargis, 21-28 March.
15.	Ralph, Natalie (2016) Organising 2nd edition book chapter and potential presentation on 'Stakeholder Engagement and Corporate Peacemaking' (which will include an ACES focus) for Nottingham Trent University, UK.
16.	MacFarlane, Douglas (2016) to visit Prof Maurichio Issacs and his group at the Chilean Ionic Liquids Centre (CILIS), Santiago, Chile, 10 April.
17.	Jia, Xiaoteng (2016) UOW PhD student visited Prof Fiorenzo Omenetto's group in silk lab within the Department of Biomedical Engineering, Tufts University to learn the technique of laminating silk films and gave presentation on 'Biodegradable and Compact Mg Batteries using Silk Fibroin-Ionic Liquid Polymer Electrolyte', 11 April.
18.	MacFarlane, Douglas (2016) to visit and present his research to Prof Carlos Carlesi at Pontificia Universidad Catûlica de Valpara, Brazil, 13 April.

Appendix 7: Table listing Invited Seminars and Collaborative visits related to ACES work	
19.	Innis, Peter(2016) ACES CI sandpit meeting with Dr Munjed Al Muderis ANSTO, Sydney to discuss 3D printing of prosthetics, 13 April.
20.	Bonke, Shannon (2016) Affiliate ACES PhD student visited Prof Emad F. Aziz, Dr Kathrin Lange and Dr Alexander Schnegg and gave presentation at Helmholtz-Zentrum Berlin focused on catalysis and energy conversion, specifically solar energy conversion, 2 May-8 June.
21.	Ralph, N. (2016) 'ACES Research, Stakeholder Engagement and Corporate Peacemaking', presented to the Nottingham Business School/PRME Staff Development Day, Nottingham Trent University, 6 May.
22.	Moulton, Simon (2016) visited Dr Rikky Muller at UC Berkley to discuss possible projects around optical stimulated drug delivery for neurological conditions, 23 May.
23.	Innis, P (2016) visited Prof Robert Forster DCU for collaborative development of ideas on how DCU sensing technologies can be incorporated into ACES fibre base electrofluidic structures and Prof J Coleman at Trinity College Dublin to determine if their graphene materials may be of use in melt extruded composite materials used by ACES in electrofluidic devices, 30 May-3 June.
24.	Dodds, Susan (2016) Discussions with Anne Livingston regarding the Queensland Government's Queensland Community Care Smart Assistive Technology Collaborative, June.
25.	Hancock, Linda (2016) worked with Prof Xavier Labandeira and Prof Claudio Marcantonini, Florence School of Regulation (FSR) Climate Unit, European University Institute (EUI), San Domenico, Florence to discuss potential collaborative work, 7 June.
26.	MacFarlane, Douglas (2016) to visit and present his research Dr Michael Scanlon at Tyndall National Institute, Ireland, 8 June.
27.	Hancock, Linda (2016) worked with Prof Ian Thynne Co-editor, Asia Pacific Journal of Public Administration (APJPA) and attended Hong Kong University- University of Southern California- International Public Policy Association Conference on Public Policy, Hong Kong, 9-11 June.
28.	Goddard, Eliza (2016) Seminar Presentation 'Developments in Prosthetics: Reflections on Disability and Enhancement' to the School of Humanities, University of Tasmania, 10 June.
29.	Wang, Caiyun (2016) from UOW visited Prof Yun Lu at Southern Illinois University to review facilities and discuss potential collaborations, 14 June.
30.	Wang, Caiyun (2016) ACES SRF from UOW visited Prof John Rogers at University of Illinois, discussing potential collaborations in stretchable electronics and biodegradable batteries, 15-17 June.
31.	MacFarlane, Douglas (2016) to visit and present his research to Prof John Holbrey and Dr Gosia Swadzba-Kwasny at Queens University Ionic Liquids Laboratory (Quill), at Queens University, Belfast, 15 June.
32.	Simonov, Alexandr N (2016) Visited Prof. H. Freund and Dr. S. Shaikhutdinov at the Fritz Haber Institute of the Max Planck Society, Berlin, to give a lecture and discuss collaboration projects on 24 June.
33.	Simonov, Alexandr N (2016) Visited Dr. K. Aziz-Lange and Mr. C. Schwanke at the BESSYII Synchrotron Facility, Berlin to undertake in situ XAS experiments on water oxidation electrocatalysts, 25 June- 4 July.
34.	Pozo-Gonzalo, Cristina (2016) from Deakin University visited Dr Alberto Garcia at Tecnalila to discuss catalysts and air cathodes and Prof David Mecerreyes at Polymat to discuss iongel electrolytes and redox polymers, 27-30 June.
35.	Kapsa, R and Offcier D (2016) ACES CIs (St Vincent Melbourne and UOW) to the MacDiarmid Institute for Advanced Materials and Nanotechnology collaboration symposium, Queenstown, 1 July.
36.	Barsby, Tom (2016) Oral and poster given at MacDiarmid Institute for Advanced Materials and Nanotechnology collaboration symposium, Queenstown, 1 July.
37.	Jalili, Rouhollah (2016) Oral given at MacDiarmid Institute for Advanced Materials and Nanotechnology collaboration symposium, Queenstown, 1 July.
38.	Rao, Jun (2016) Poster at MacDiarmid Institute for Advanced Materials and Nanotechnology collaboration symposium, Queenstown, 1 July.

Appendix 7: Table listing Invited Seminars and Collaborative visits related to ACES work	
39.	J.M. Cabot, N.P. Macdonald, M.C Breadmore, B. Paull. MacDiarmid Poster at MacDiarmid Institute for Advanced Materials and Nanotechnology collaboration symposium, Queenstown, 1 July.
40.	Gilbert, Fredric (2016) visited collaborator Dr Andrej Vranic at the Brain and Spine Institute, Paris to examine questions regarding novel invasive brain therapies, 1-9 July.
41.	Simonov, Alexandr N (2016) Visited Dr. K. Aziz-Lange, Dr. A. Schnegg, Prof. K. Lips, Dr. M. Tech & Dr. A. Bande at Helmholtz Zentrum Berlin to discuss progress of existing collaborations and expanding interactions by establishing new links, 5-6 July.
42.	Alici, G (2016) visited research collaborator Prof John Madden at University of British Columbia to exchange ideas on global research challenges in soft materials and their applications in soft robotic devices, 10 July.
43.	Pozo-Gonzalo C. (2016) visited Prof Stefania Panero at University of Rome to discuss novel highly fluorinated ionic liquids for metal air batteries, 13 July.
44.	Pozo-Gonzalo C. (2016) visited Dr Lee Johnson at Oxford University, UK to use rotating ring disk electrodes and EQCM to characterise discharge products, 15 July.
45.	Four ACES members from UOW attended at UOW-CSIRO workshop on 3D printing in Melbourne to identify possible collaborative PhD projects, 18 July.
46.	Al-Masri, Danah (2016) Research visit to Prof Tom Welton at Imperial College London to conduct polarity measurements of ionic liquids, 18-30 July.
47.	Chen, Zhi (2016) visited Save Sight Institute and gave an update on corneal bioengineering, 28 July.
48.	Chen, Zhi (2016) Save Sight Institute to undertake cell culture of HCET and investigate cell proliferation on EC membrane, 2, 3, 8, 9, 10,12& 15 August.
49.	Walker, Mary (2016) RF Monash visited ANU School of Regulation and Global Governance to attend a workshop on 'Best in class regulation', 8 August.
50.	Fang, Jian (2016) RF Deakin visited the laboratory of Prof Xuebin Zhang from School of Materials Science & Engineering, Hefei University of Technology, China for collaborative research discussions, 11-12 August.
51.	Fang, Jian (2016) RF Deakin visited the laboratory of Prof Chunye Xu from National Laboratory for Physical Sciences at the Microscale, University of Science and Technology of China for collaborative research discussions, 15 August.
52.	O'Connell, Cathal (2016) ECR UOW visited Conor Buckley at Trinity College Dublin to give a seminar on ACES research and discuss bioreactor design and possible collaborations, 15 August.
53.	Fang, Jian (2016) RF Deakin visited the laboratory of Dr Guotao Duan from Key Laboratory of Materials Physics, Institute of Solid State Physics, Chinese Academy of Sciences (CAS) for collaborative research discussions, 16-17 August.
54.	Hancock, Linda (2016) CI Hancock visited Prof Robyn Dowling ACOLA (Australian Council of Learned Academics) at University of Sydney to inform of ACES EPPE work on energy storage policy and ethics for ACOLA briefing to the Chief Scientist on issues in battery storage, 17 August.
55.	Howlett, Patrick (2016) met with Andrew Stevens, Chair for Advanced Manufacturing Growth Centre, and Mr Michael Grogan, Director Advanced Manufacturing Growth Centre, for collaborative discussions on 19 August.
56.	MacFarlane, DR (2016) ACES CI Monash visited Professor Hiroyuki Ohno laboratories at the Tokyo University of Agriculture and Technology on 25 August.
57.	Bonke, Shannon (2016) ACES affiliate student continuing collaboration with E. F. Aziz (Helmholtz-Zentrum Berlin) including video-conferencing to plan and discuss joint experiments undertaken at BESSY-II during 2016, September.
58.	Chatti, Majunath and Dijon Hoogeveen (2016) ACES/ Monash PhD student did a lab tour and held collaborative discussions with Antonio Tricoli at ANU, Canberra on 8 September.
59.	Chen, Zhi (2016) ACES UOW PhD student visited Save Sight Institute in Sydney to undertake cell culture of HCET and investigate cell proliferation on EC membrane, 29 September.
60.	Halima, Ahmed (2016) ACES affiliate student at Monash collaborated on metal-phosphides research with a graduated ACES PhD student Dr Usman Ali Rana who is now working at King Saud University.
61.	Macdonald, Niall (2016) ACES RF at UTAS collaborated on 3D printing of multi-level PDMS moulds for capillary based pumping microfluidics with collaborator Olanrewaju, Ayokunle at McGill University, Canada; comparing between Polyjet(Eden) and DLP-SLA(MiiCraft).

Appendix 7: Table listing Invited Seminars and Collaborative visits related to ACES work	
62.	Pozo- Gonzales, C (2016) ACES SRF at Deakin visited Prof Markus Antonietti at Max Planck, Colloidal and interfaces, Germany to work on N and P-doped carbon materials characterisation, 9 September to 7 October.
63.	Pozo- Gonzales, C (2016) ACES SRF at Deakin held collaborative discussions with the Energy and Environment Division at Research Center Tecnalia, San Sebastian and Prof David Mecerreyes University of the Basque Country, San Sebastian during visits in September.
64.	Chen, Jun (2016) ACES CI worked on supported collaborative project (NSFC5157020938) at Zhejiang University of Science and Technology in September.
65.	Higgins, Michael (2016) visited University of Wurzburg as part of the international exchange program for the Masters in Biofabrication, 29 September to 5 October.
66.	Higgins, Michael (2016) visited collaborator Prof Christine Kranz at the University of Ulm, 5-6 October.
67.	Higgins, Michael (2016) visited Utrecht Medical School, Netherlands, as part of the international exchange program for the Masters in Biofabrication, 6-9 October.
68.	Higgins, Michael (2016) visited collaborator Prof Senentxu Lancerso-Mendez Electroactive Smart Materials Group at University of Minho, Braga, Portugal to discuss characterisation of magneto-electric materials and collaborative funding opportunities, 9-13 October.
69.	Higgins, Michael (2016) visited collaborators Dermot Diamond (ACES PI), Robert Forster (ACES AI) for review of ACES projects and Prof Gil Lee and Suzi Jarvis at UCD to give an overview of ACES research activities, 13-18 October.
70.	Crook, J (2016) Visited Prof Junji Fukuda at Yokohama National University, Faculty of Engineering, Bio Microsystem lab, 13 October.
71.	Crook, J (2016) Visited A/Prof. Yuko Ichiyanagi, Yokohama National University, Research Center for Nanoscopic Physics and Biomedicine, 13 October.
72.	Crook, J (2016) Visited Prof. Shoji Maruo, Yokohama National University, Faculty of Engineering, Division of Systems Research, 13 October.
73.	Cabot, Joan Marc (2016) ACES RF at UTAS visited Prof Jasmina Casals-Ferrer at Universitat Politecnica de Catalunya (UPC) in Terrassa, Spain to give a seminar on ACES research, visited their facilities and meet with researchers to discuss possible common research areas, 17-18 October.
74.	Cabot, Joan Marc (2016) ACES RF at UTAS visited Profs Marti Roses and Elisabet Fuguet at Universitat de Barcelona (UB) in Spain to discuss possible common research areas, 19 October.
75.	Cabot, Joan Marc (2016) ACES RF at UTAS visited Dr Mariano Campoy-Quiles at The Materials Science Institute of Barcelona (ICMAB-CSIC) in Bellaterra, Spain to give a seminar on ACES research, visited their facilities and meet with researchers to discuss possible common research areas, 20-21 October.
76.	Chen, Zhi (2016) ACES UOW PhD student visited Save Sight Institute in Sydney to undertake cell culture of HCET and investigate cell proliferation on EC membrane, 6,7,20 and 24 October.
77.	Macdonald, Niall (2016) ACES RF at UTAS visited Prof Jon Cooper and Dr Julien Rebond in Biomedical Engineering at the University of Glasgow, Scotland to give a seminar on 3D printing microfluidics and for discussions, 17 October.
78.	Ralph, Natalie (2016) RF from Deakin University attended a seminar on 'Equality: Keywords for India' by Professor Steven I. Wilkinson from the India-Australia Institute and networked with attendees at University of Melbourne, 24 October.
79.	Crook, J (2016) Visited Dr Michael O'Connor, Regenerative Medicine Laboratory, Western Sydney University, 3 November.
80.	Ralph, N (2016) Gave a talk on 'Alternative Energy Supply Chains, Mining and Corporate Peacemaking' at the Sustainable Minerals Institute, University of Queensland, 3 November.
81.	O'Dell, L.A.; Forsyth M (2016) 'Some recent advances in solid-state 14N NMR' to CEMHTI, CNRS, France, 17 November.
82.	Rahim, Siti Abdul (2016) ACES Affiliate PhD at UOW presented her work at UOW's School of Medicine HDR Seminar Day, 28 November.
83.	Chen, Zhi (2016) ACES UOW PhD student visited Save Sight Institute in Sydney to undertake cell culture of HCET and investigate cell proliferation on EC membrane, 3 &24 November.

Appendix 7: Table listing Invited Seminars and Collaborative visits related to ACES work	
84.	Higgins, Michael (2016) visited collaborator Prof Takeshi Fukuma at Kanazawa University to undertake high resolution force measurements and Prof Takayuki Uchihashi to develop plans for a high speed AFM mounted on an optical microscope for imaging cells, 29 November to 8 December.
85.	Wang, Caiyun (2016) visited Prof Guoxiu Wang at University of Technology Sydney to view the facilities and discuss possible collaborative activities, 1 December.
86.	Zhang B (2016) Research visit to the Department of Polymer Science and Engineering at Zhejiang University, Hangzhou, China, 5-6 December.
87.	Wang, Xungai (2016) gave presentations during collaborative visits to Oxford, University in UK; Swiss Federal Laboratories for Materials Science and Technology (EMPA) and University of Applied Science North West in Switzerland during 2016.
88.	Haworth, Naomi (2016) visited ACES AI Simone Ciampi at Curtain University, Western Australia to work on a collaborative paper, 2 December.
89.	Wang, Caiyun (2016) visited Prof Chunyang Jia at University of Electronic Science and Technology China to present ACES research activities, view the facilities and discuss possible collaborative activities, 1 December.
90.	Hamilton, Charles (2016) ACES PhD at UOW received an appointment as a Fellow of the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) 2017 to work on hydrogel materials from December 5, 2016 through February 17.

APPENDIX 8: CONFERENCE PRESENTATIONS

A list of ACES conference presentations not listed in previous tables. Note that the lists included in this report do not contain presentations by ACES members at ACES run events.

Appendix 8: ACES Conference Presentations	
1.	Puckert, Cristina (2016) ACES PhD unpublished abstract + oral on "Nanomechnical Properties of GelMA by using AFM" at the 30th Australasian Colloid and Surface Science Student Conference (ACSSSC), Kiola, NSW, Australia, 1-4 February.
2.	Higgins, Michael (2016) ACES CI gave an oral presentation on 'Nanobio-interactions at cell-electrode interface' and chaired sessions in the bionanotechnology theme at ICONN, Canberra, 8-9 February.
3.	Ralph, N. and L. Hancock (2016) 'Should companies profiting from new energy alternatives such as lithium-ion batteries be required to implement Corporate Peacemaking?', unpublished paper accepted and presented at the 'Exploring Peace', International Studies Association (ISA) Annual Convention, , Atlanta, USA, 16-19 March.
4.	Jia, Xiaoteng (2016) UOW PhD gave an oral 'Silk Fibroin based Biodegradable Mg Primary Batteries for Implantable Medical Devices' at Materials Research Society (MRS) 2016 Spring meeting, Phoenix, 30 March.
5.	Hutchison, Katrina (2016) Oral 'Access to innovative treatments and device support during IDEAL stages 2b – 4', IDEAL Conference 2016: Evaluating innovation in surgery and therapeutic technology, Oxford,UK, 7 April.
6.	Bennedetti, Tania (2016) Oral 'Exfoliated MoS_2 and ionic liquids for catalysis of CO_2 electro-reduction', 19th topical meeting of International Society of Electrochemistry (ISE), Auckland, New Zealand, 17-20 April. 220 delegates came from 35 countries - 44 % Asia, 24 % Australia and New Zealand and 22 % Europe.
7.	S. A. Bonke, A. N. Simonov, T. Gengenbach, A. M. Bond, L. Spiccia (2016) Oral presentation by Alexandr Simonov "A.C. voltammetric water oxidation by metal oxides at low loadings: new mechanistic insights and riddles" at the 19th topical meeting of the International Society of Electrochemistry (ISE), Auckland, New Zealand, 17-20 April.
8.	Cherian, Mathew (2016) presented 'How can we be a Developer, Innovator and Service Provider?' on "Social Innovation" at President's National conference on Innovation, April.
9.	J Bourke, A Quigley, C O'Connell, G Wallace, M Cook, R Kapsa.,(2016) Oral 'Three-dimensional microenvironments enable neuronal cultures with functionally relevant outcomes' World Biomaterials Congress, Montreal, Canada, 17-22 May.
10.	Gu, Q., Tomaskovic-Crook, E., Lozano, R., Chen, Y., Kapsa, R.M., Zhou, Q., Wallace, G.G., and Crook, J.M. (2016) Poster 'Bioprinting 3D functional neural tissue using human neural and induced pluripotent stem cells' at 10th World Biomaterials Congress, Montreal, Canada, 17-22 May.

Appendix 8: ACES Conference Presentations	
11.	Moulton S, Zuzic A, Wade S, Foroughi J, Aghmesheh M, Vine KL (2016), Poster 'Changing the Treatment Paradigm: Ex vivo Assessment of Gemcitabine-Eluting Degradable Polymeric Fibres for the Treatment of Pancreatic Cancer DOX Uptake', World Biomaterials Congress, Montreal, Canada 17-22 May.
12.	Gilbert F (2016) Oral 'Are Predictive Brain Implants a Menace to Autonomous Decisions? Results from a first-in-human study' given at Frontiers in Neuroethics, Meetings on Neuroscience and Society VIII Edition, University of Padua, Italia, 18-20 May.
13.	Innis, P (2016) US-Australia Enabling Technologies meeting, UNSW, Kensington 23-24 May.
14.	Gilbert F (2016) Organised workshop on 3D Bioprinting at the Brocher Foundation, Geneva, Switzerland, 23-26 May.
15.	Gilbert, F. and Viaña, JNM (2016) Oral 'Enthusiastic Portrayal of 3D Bioprinting in the Media' at 3D Bioprinting: A New Medical and Ethical Frontier, Brocher Foundation Workshop, Switzerland 23-26 May.
16.	Hutchison K, Sparrow R (2016) Oral 'Artificial Organs, Contract and Consent' 3D Bioprinting: A New Medical and Ethical Frontier" Brocher Foundation Workshop, Geneva, Switzerland, 23-26 May.
17.	Dodds, S. (2016) oral 'Ethical challenges for 3D Bioprinting: organ replacement vs. function?' at 3D Bioprinting: A New Medical and Ethical Frontier. Brocher Foundation Workshop, Switzerland, 23-26 May.
18.	Cherian, Mathew (2016) Colloquim, 'Leave no one behind 'World Humanitarian Summit, Istanbul 23 -25 May.
19.	Begić S, Jónsson E, Chen F, Forsyth M (2016) Poster 'Molecular Dynamics Studies of Pyrrolidinium and Imidazolium based Ionic Liquids towards development of a Rechargeable Zinc Battery', 7th Australian Symposium on Ionic Liquids, Newcastle, NSW, Australia, May 23-26.
20.	Cabral D.M. (2016) Oral 'Electrochemistry of tris(2,2`-bipyridine) complexes of Co(II), Ni(II) and Fe(II) in ionic liquids and aprotic solvents' at 7th Australian Symposium on Ionic Liquids, Newcastle, NSW, Australia, 23-26 May.
21.	Yunis, R (2016) Poster about tribology work at 7th Australian Symposium on Ionic Liquids (ASIL), Newcastle, Australia, 23-26 May.
22.	Zhou, F (2016) Oral 'Enhanced Photo-Electrochemical Water oxidation on MnOx in Buffered Organic/Inorganic Electrolytes' 7th Australian Symposium on Ionic Liquids (ASIL), Newcastle, Australia, 23-26 May.
23.	Jónsson, Erlendur (2016) Unpublished presentation (poster) 'Modelling of Li+ and Na+ conduction under electric fields in organic ionic plastic crystal', International Meeting on Lithium Batteries (IMLB), Chicago, 19-24 June.
24.	Wang, Caiyun (2016) Unpublished presentation (poster) 'Conducting Polymers with Tunable Properties for Sustainable Energy Storage' at IMLB, Chicago, 19-24 June.
25.	Gupta V, Talebi M, Beirne S, Nesterenko P, Wallace G, Paull B (2016) Poster '3D Metal Printed Miniaturized Chromatographic Columns' at 44th International Symposium on High Performance Liquid Phase Separations and Related Techniques, 2016 in San Francisco, CA, USA, 19-24 June.
26.	Gilbert F. (2016) Oral 'Predictive Brain Implants: A Potential Threat to Autonomy and Self?' Minds, Selves and 21st Century Technology, Nova University of Lisbon, 23-24 June.
27.	Viaña JNM, Vickers J, Gilbert F.(2016) 'Ethical considerations for clinical trials of fornix DBS for patients with Alzheimer's Disease' at 10th FENS Forum of Neuroscience 2016, Copenhagen, Denmark, 2-6 July.
28.	Officer, D. L., P. Wagner, K. Wagner, N. Roach, R. Mitchell, C. Hobbs, H. v. d. Salm, J. E. Barnsley, K. C. Gordon, G. Kodali, C. Moser, P. L. Dutton (2016) Developing an Artificial Photosynthetic Reaction Centre Based on Porphyrin-Maquette Ensembles at 23rd IUPAC Conference on Physical Organic Chemistry, Sydney, Australia, 3-8 July.
29.	Wagner, P (2016) gave oral at 23rd IUPAC Conference on Physical Organic Chemistry, Sydney, Australia, 3-8 July.
30.	Walker, Mary (2016) Oral 'Diagnosis, identity, and asymptomatic disease' at the Australasian Association of Philosophy Conference, Monash University, Melbourne, 3-7 July.
31.	Jónsson, Erlendur (2016) Oral 'Modelling of Li+ and Na+ conduction under electric fields in organic ionic plastic crystal', Oz Energy Future Conference, Sydney, 4-6 July.
32.	Begic, Srdan (2016) Poster at the Oz Future Energy Conference, Sydney, 4-6 July.
33.	Pozo-Gonzalo C., MacFarlane D.R., Forsyth M. (2016) Oral 'Ionic Liquid electrolytes for rechargeable metal air batteries' at conference on Molten Salts and Ionic Liquids (EUCHEM2016) Vienna, Austria, 4-8 July.

Appendix 8: ACES Conference Presentations	
34.	Hancock, L. and N. Ralph. (2016) '"Trust me – I'm the Government"-Contestation over Trust and Public Interest in Regulatory Regimes that Favour Big Carbon Energy', paper presented to The Standing Group on Regulatory Governance of the European Consortium for Political Research (ECPR) Conference, Tilburg University, Netherlands, 6-8 July.
35.	Viaña, JNM. (2016) 'Neuroethics' at Neurasmus 5th Annual Workshop, Budapest, Hungary, 11-14 July.
36.	Gilbert F.(2016) 'How Predictive Brain Implants Impact Moral Decision-Making: Results from a First-in-Human: Designing Moral Technologies – Theoretical, Practical and Ethical Issues', Monte Verità, Ascona, Switzerland, 10-15 July.
37.	Mutlu, R (2016) 'Mechanical Stiffness Augmentation of a 3D Printed Soft Prosthetic Finger' at 2016 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2016), Banff, Canada, 12-15 July.
38.	Mutlu, R (2016) 'Performance Quantification of Strain Sensors for Flexible Manipulators' at 2016 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2016), Banff, Canada, 12-15 July.
39.	Cherian, Mathew (2016) Paper 'Impact of Natural disaster on Older persons in Uttarakhand' at the International Federation on Ageing (IFA) 13th Global Conference, Brisbane, 21-23 July.
40.	Blum, Anna (2016) attended 'Social Imaginaries Dominance and Resistance Conference' at Justice and Police Museum in Sydney, 22nd July.
41.	Bourke, Justin (2016) gave 2 presentations; 'Three dimensional neural microenvironments enable functionally relevant construct-wide networks' & 'Construct-wide multi-channel electrophysiological recordings from muscle cultures provides critical functional information' plus submitted an artwork 'Bioelectric Flow' at the Aikenhead Centre for Medical Discovery Research Week (ACMD16), Melbourne, 8-12 August.
42.	Quigley A, Kita, M, Bourke, J, Sweerts, K, Crook J, Wallace, GG and Kapsa RMI (2016) Oral 'Remodelling skeletal muscle: getting the cell niche right' at the Aikenhead Centre for Medical Discovery Research Week (ACMD16), Melbourne, 8-12 August. AWARDED best Moderated Oral Presentation 2016.
43.	O'Connell, Cathal (2016) Oral presentation 'Development of the Biopen: A Handheld Device for Surgical Bioprinting' at the Aikenhead Centre for Medical Discovery Research Week (ACMD16), Melbourne, 8-12 August.
44.	Tom Barsby (2016) poster at ACMD Research Week, St Vincent's Hospital, Melbourne, 8-12 August.
45.	Rao, Jun (Rossie) (2016) Poster presentation at 15th International Symposium on Polymer Electrolytes (ISPE), Sweden, 15-19 August.
46.	Lui, Yuqing (2016) ACES affiliate PhD at UOW presentation on 'Flexible Supercapacitors for Wearable Electronics' at the 67th Annual Meeting of the International Society of Electrochemistry, Hague, Netherlands, 21-26 August.
47.	Cabral, Diogo Moulin (2016) ACES PhD Monash presentation on 'Electrochemistry of tris(2,2`-bipyridine) complexes of cobalt(II), nickel(II) and iron(II) in ionic liquids and aprotic solvents' at the 67th Annual Meeting of the International Society of Electrochemistry, Hague, Netherlands, 21-26 August.
48.	Chen, Kun (2016) ACES PhD Monash presented his poster on 'Cu-based Ordered Nanomaterials for CO_2 Reduction and Surface-enhanced Raman Spectroscopy' at the 67th Annual Meeting of the International Society of Electrochemistry, Hague, Netherlands, 21-26 August.
49.	Lui, Yuqing (2016) Oral 'Flexible supercapacitor designs based on rGO-PEDOT/PSS film', 67th annual meeting of the international society of electrochemistry, Den Haag, The Netherlands, 21-26 August.
50.	Choi, Jaechol (2016) Presentation 'High Performance Fe Porphyrin/Ionic Liquid Co-catalyst for Electrochemical CO_2 Reduction' at the CO_2 summer school in Villars-sur-Ollon, Switzerland, 29 August-2 September.
51.	Lui, Yuqing (2016) Attended 'International Summer School on CO_2 conversion' in Villars-sur-Ollon, Switzerland, 29 August -2 September.
52.	Viaña JNM, Gilbert F. (2016) Affiliate ACES members presented 'Ethical implications of novel neurotechnologies for Alzheimer's disease' at the Graduate Research Conference at University of Tasmania, Hobart, Australia, 1-2 September.
53.	Chatti, Majunath and Dijon Hoogeveen (2016) ACES/ Monash PhD students gave oral presentations of their research at 'Advancing Energy Sustainability by Governance Leadership in Artificial Photosynthesis' Workshop at ANU, Canberra on 7-8 September.
54.	Bourke, Justin (2016) oral 'Electrophysiology in neural and muscle constructs in two and three dimensions' at the St Vincent's Hospital 'Thought to Action Workshop', Melbourne, 13 September.

Appendix 8: ACES Conference Presentations	
55.	Quigley, Anita (2016) oral at St Vincent's Hospital 'Thought to Action Workshop' on advanced limb reconstruction, Melbourne, 13 September.
56.	Alici, G (2016) ACES CI and soft robotics theme leader presented at t St Vincent's Hospital 'Thought to Action Workshop' on advanced limb reconstruction, Melbourne, 13 September.
57.	Macdonald Niall, J.M Cabot, P. Smejkal, R. M. Guijt, M.C. Breadmore, B. Paull (2016). Gave a 3D printed microfluidics workshop and presented his poster 'Microfluidics – Which 3D printer?' at MicroTAS 2016 held in Dublin, 9-13 October.
58.	Cabot Joan Marc, N.P. Macdonald, M.C. Breadmore, B. Paull (2016). Presented his work on 'Fibre-based Platforms for Microfluidics, Biosensing and Diagnostic applications' at microTAS 2016, held in Dublin 9-13 October.
59.	Rahim, Siti Abdul (2016) Affiliate ACES PhD student presented a poster at the Biological Psychiatry Australia 2016 conference held in Newcastle on 13-14 October.
60.	Gilbert F., Viana JNM, (Accepted) Enthusiastic Portrayal of 3D Bioprinting in the Media: Ethical Side Effects. Biofabrication 2016, Winston-Salem, NC, USA 29-31 October.
61.	Barsby, Tom (2016) Poster Presentation of his research won 'Highly Commended Poster Prize' at Biomed Link 2016: A conference for students by students, University of Melbourne, 4 November.
62.	Gilbert, F, Cook, M, O'Brien T (2016) Are Predictive Brain Implants a Menace to Autonomous Decisions? Results from a first-in-human study. International Neuroethics Society Annual Meeting, San Diego, US, 10-11 November.
63.	Gilbert, Frederic (2016) Participated at the Genome Editing Workshop at the Centre for Law and Genetics in Hobart, 12-14 November.
64.	Wang, Caiyun (2016) Presented 'Versatile Conjugated Polymers for Biocompatible/Biodegradable Batteries' at the 2nd International Symposium on Renewable Energy Technologies at the University of Technology Sydney, 30 November-2 December.
65.	Hancock, L and N Ralph (2016) Paper on 'Governance and Regulatory Issues for Ethical Supply Chains in New Alternative Energy Technology' presented at the Emerging Paradigms of Corporate Social Responsibility, Regulation and Governance conference, Special Thematic Symposium & Multidisciplinary Academic Dialogue, Indian Institute of Management Lucknow (IIML), Uttar Pradesh, held in India on 14-15 November.
66.	Molino P, Zhang B, Knowles B, Wagner P, Wallace G, Higgins M, Hanks T (2016) Presented 'Nanomaterial based antifouling coatings: materials development, fabrication and biological characterisation' at 21st China coat exhibition and conference, Guangzhou China, 29 November-2 December.
67.	Waheed S.; Cabot J. M.; Macdonald N. P.; Lewis T., Breadmore M.; Paull B.(2016) Poster 'Enhanced thermal conductivity of polydimethylsiloxane (PDMS)-diamond composite fabricated via 3D printed template for low cost microfluidic platforms' at International Symposium on Advances in Separation Science (ASASS 2016) held in Hobart between 30 November-2nd December.
68.	Haworth NL, Wang Q, Coote ML (2016) 'Predicting pKa - Beyond Small Rigid Molecules', Australian Symposium on Computational Chemistry, Perth, 1-2 December.
69.	Barsby, Tom (2016) ACES UOW PhD student presented his research into generating forebrain neural cell types differentiated from human induced pluripotent stems cells (iPSCs) in 2D and 3D at 2016 Australasian Society for Stem Cell Research (ASSCR) annual meeting held in Bunker bay, Western Australia, 4-7 December.
70.	O'Connell, Cathal (2016) ACES ECR UOW working from UOM presented ACES research activities at the 2016 Australian Biomechanics Conference, Melbourne, 4-6 December.
71.	Farajikhah S, Cabot J M, Sayyar S, Paull B, Innis P and Wallace GG (2016) Oral presentation 'Fabrication of 3D textile based fibre microfluidic structures utilising thermally conductive graphene-filled fibre composites' at 2016 MRS conference fall meeting, Boston, 27 November-2 December.
72.	Hamilton C, Alici G, Spinks G, in het Panhuis M (2016) Oral presentation 'Thermal Actuation of 3D printed hydrogel MAteriasl by Joule Heating of Eutectic Gallium-Indium Alloy' at 2016 MRS conference fall meeting, Boston, 27 November-2 December.

APPENDIX 9: A TABLE LISTING THE INTERNATIONAL ACADEMIC VISITORS TO ACES

Note that this list does not include visitors to ACES as part of events or conferences that ACES organised throughout the year.

Appendix 9: Table Listing International Academic Visitors to ACES in 2016	
1.	Dr Shu-Ni Li from Shaanxi Normal University in China was hosted at ACES Monash University to undertake collaborative research from 1 December 2015 to 18 November 2016.
2.	Prof Timothy Hanks, Furman University, SC, USA visited ACES IPRI for collaboration on biofouling project and to organise student exchange, 18 January to 12 February.
3.	Prof John Terry, from at University of Exeter UK, was at ACES UOM node working on Biomedical Modelling from 1 February to 1 March.
4.	Professor Yijing Wang, Institute of Applied Chemistry at Nankai University in China, visited ACES at UOW to view the facililities and discuss research, 3 February.
5.	Prof Frank Marken and Dr Ulrich Hintermair from Bath University UK were at Monash University for discussion of the projects and possible collaboration, 3 February.
6.	Prof Yijing Wang, Institute of Applied Chemistry, Nankai University, China visited ACES IPRI for collaboration and discussions, 5 February.
7.	A group of 8 Japanese undergraduate students from PI Masayoshi Watanabe's group at Yokohama National University visited Monash University to review the facilities, 8 February.
8.	David Mecerreyes, Polymat at Deakin University for collaboration and discussions in Zn electrochemistry, 10 February.
9.	Prof W. H. Casey, University of California, Davis, USA at Monash University for collaboration and discussions, 10-15 February.
10.	Dr A Schnegg, Helmholtz-Zentrum Berlin für Materialien und Energie, Germany at Monash University for collaboration and discussions, 11 February.
11.	Dr K. Aziz-Lange Helmholtz-Zentrum Berlin für Materialien und Energie, Germany at Monash University for collaboration and discussions, 12 February.
12.	Prof R Abe, Kyoto University, Japan at Monash University for collaboration and discussions, 12 February.
13.	Prof Weimin Kang, Harbin Institute of Technology, visited ACES IPRI for collaboration and discussions, 15 February.
14.	Prof Won Mook Lee (ACES IAC member) and Prof Dong Soo Kim visited ACES IPRI for a tour of the facilities and discussions with the Director, 15 February.
15.	Michel Armand, CIC Energigune at Deakin University for collaboration and discussions in Ce electrochemistry, 23 February then Monash University on 25 February.
16.	Dr Jane Scott Bath University UK at Monash University for collaborative talks 25 February.
17.	Emma Sackville, Bath University, spent one month at Monash University to use FTAC voltammetry to study the active forms of the catalyst for water oxidation, 22 February -18 March.
18.	Corinna Stumm, undergraduate from FAU Erlangen working with Tania Benedetti at UOW/IPRI, March – July.
19.	Prof Danilo De Rossi, University of Pisa, visited ACES/UOW for a tour, discussions and to give the LKM lecture for 2016, 1-2 March.
20.	Richard Spontak, North Carolina State University, visited ACES IPRI for a tour of the facilities and discussions in soft robotics, 8 March.
21.	Prof Gregory Rutledge, MIT, USA, visiting Thinker in Residence at Deakin University visited ACES/fibre spinning labs in Geelong, 17 March.
22.	Prof Lei Zhang, Hebei University of Technology China visited ACES/UOW to give a presentation, had a tour of the facilities and discussions, 22 March.
23.	Mr Matthew Waddington and Ms Gaby Newson completed their undergraduate research exchange from Warwick University, Warwick, UK at Monash University from 4 April to 11 June.
24.	Nikita Hall, University of Warwick, visited ACES at UOW for a tour of the facilities and held discussions on ACES research, 13 April.

Appendix 9: Table Listing International Academic Visitors to ACES in 2016	
25.	Prof Erwin Reisner, University Reader in Energy and Sustainability, Fellow of St. John's College, the head of the Christian Doppler Laboratory for Sustainable SynGas Chemistry and co-director of the EPSRC Doctoral Training in Functional and Sustainable Nano at University of Cambridge, UK, visited ACES/UOW to give a presentation, tour the facilities and hold research discussions, 21 April.
26.	Roberto Torresi and Susana Torresi from University of Sao Paulo visited ACES at UOW for lab tour, meetings on materials and carbon dioxide reduction and seminar, 22 April.
27.	Prof Daoben Zhu, Deqing Zhang, Shu Wang, Xiaohong Fang, Huimin Ma, Chongan Di, Chinese Academy of Science (CAS) visited ACES IPRI 14-15 April.
28.	Prof Roberto Torresi and A/Prof Susana Torresi, Universidade de São Paulo, Brazil, visited Monash University for informal discussions and presentation of his research, 20 April.
29.	Luis Fernando Arenas, University of Southhampton, UK, visited ACES/UOW for a tour of the facilities and discussions in materials for energy, 29 April.
30.	Prof Ed Castner, Rutgers, USA, visited Deakin and Monash University, 18 & 20 May respectively.
31.	Prof Tom Welton, Imperial College London, visitor Monash University 19 May then Deakin University 20 May to give a seminar and collaborative discussions.
32.	Ken Luca Abel from Leipzig University visited Monash University to as part of his Masters project, 23 May to 31 July.
33.	Ms Maria Nieves Lopez de las Salas from Instituto de Ciencia de Materiales de Madrid, Spain was hosted at ACES Monash University for her postgraduate research exchange from 25 May to 24 August.
34.	Agilio Padua, Blaise Pascal University, Clermont-Ferrand and a senior member of the Institut Universitaire de France was visitor Deakin University, 30 May.
35.	Prof Tadaharu Ueda from Kochi University and Dr Shuntaro Tsubaki from Tokyo Institute of Technology, Japan visited with AI Alan Bond and CI Jie Zhangs groups at Monash University to discuss existing collaborative projects and talk about future collaborations, 31 May-4 June.
36.	Fabio Di Francesco, University of Pisa, visited ACES at UOW for collaborative research discussions on 5 July.
37.	Rosalie Hocking from James Cook University visited Monash University to perform collaborative experiments, 20 July.
38.	A/Prof Ayman Nafady from King Saud University in Saudi Arabia visited ACES at Monash University for collaborative discussions on 23 August.
39.	A/Prof James Blakemore from Kansas University, USA visited the laboratories at Monash to discuss possible interactions and future joint projects, 7 September.
40.	Mr Xiaomin Zhang from Nanjing University, China is hosted on a postgraduate research exchange at ACES Monash University from 29 September 2016 to 3 March 2018.
41.	Prof Edwin Jager from Linkoping University in Sweden worked with ACES at UOW on new actuating systems and 3D printed soft robotic devices for 3 months from October.
42.	Prof Gour Prasad das, Senior Prof Department of Materials Science, Indian Association for the Cultivation of Science, Kolkata, India visited ACES at UOW for a tour of the ACES/ANFF facilities and discuss research collaboration, 4 November.
43.	Prof Peter Chung-Yu Wu (ACES IAC member), Prof Ming Dou Ker & Prof Yu Ting Cheng from National Chiao Tung University in Taiwan visited ACES at UOW for a collaborative workshop on biomedical electronics translation and a tour of the ACES/ANFF facilities, 7 November.
45.	Dr Cristina Italiano from the Istituto di Tecnologie Avanzate per l'Energia "Nicola Giordano" working at ACES Monash node with Alexandr Simonov on characterisation of the Ce-based screen-printed (photo)anodes for water oxidation, 8-25 November.
46.	Prof Federico Rosei Director, INRS–EMT, Univ. du Québec, Varennes, Canada visited ACES Monash node with Alexandr Simonov to discuss possible collaboration opportunities on 17 November.
47.	Delegation from Huaqiao University, China, to ACES at UOW to view ACES/ANF facilities and research activities with view to discuss future collaboration opportunities, 22 November.
48.	Dr Yulin Zhong, senior lecturer at Griffith University, visited ACES at UOW for a tour of the ACES/ANFF facilities and an overview of the ACES research, 25 November.

APPENDIX 10: TABLE LISTING THE NATIONAL ACADEMIC VISITORS TO ACES

Note: this list does not include visitors to ACES hosted as part of events or conferences that ACES organised throughout the year.

Appendix 10: Table listing National Academic Visitors to ACES in 2016	
1.	Prof Laurence Brassart, Monash University, visited ACES at UOW and gave a seminar, 29 January.
2.	Dr Rosalie Hocking, James Cook University, at Monash University for collaboration and discussions, 12 February.
3.	Dr Stefano Palomba, Nanophotonics and Plasmonics Advancement Lab Institute of Photonics and Optical Science, University of Sydney visited ACES IPRI for a tour of the facilities and discussions with the Director, 18 February.
4.	Bijan Shekibi, undergraduate student from Monash University, visited ACES at UOW to discuss the possibility of completing his PhD at ACES in UOW in 2017, 22 February.
5.	Chinmay Sonawane, Monash PhD student, visited ACES/UOW to use the UOW facilities, 17 March.
6.	Dr Lucas Blanes, UTS, visited UTAS to give a presentation and discuss research, March.
7.	Prof Tiffany Walsh and PhD student Anas Sultan from Deakin University visited ACES/UOW for a tour of the facilities and discussions in graphene, 22 March.
8.	Prof Amanda Lawson (UOW) & her guest Dr Douglas Kagi visited ACES/UOW for a tour of the facilities and discussions in biomaterials, 22 March.
9.	Laszlo Frazer & Joe Gallaher, UNSW, visited ACES/UOW for a tour of the facilities and held research discussions, 14 April.
10.	Catherine Ngan, ACES affiliate PhD student St. Vincent's Hospital Melbourne Department of Orthopaedics, visited ACES/UOW for a tour of facilities and collaborative discussions, 28 April.
11.	Dr Yang Liu, Curtin University, Western Australia, visited Monash University for informal discussions and presentation of her research, 29 April.
12.	Dr Yang Liu from Curtin University in Western Australia visited ACES at Monash University to give a seminar and for collaborative discussions, 1 May.
13.	Tajanka Mladenovska, ACES affiliate PhD student St. Vincent's Hospital Melbourne Department of Orthopaedics, visited ACES/UOW for a tour of facilities and collaborative discussions, 5-6 May.
14.	Prof Toby Coates, Director of Kidney and Pancreatic Islet transplantation and Professor of Medicine, Royal Adelaide Hospital & The University of Adelaide, CTM CRC, visited ACES/UOW for a tour of facilities and collaborative discussions then gave a seminar, 27 May.
15.	Jingjing You and Simon Cooper from Save Sight Institute, visited ACES/IPRI for collaboration of migration component of corneal cells on scaffolds, 14 June.
16.	Prof Sam Berkovic, Laureate Professor, Dept Medicine, University of Melbourne and Director Epilepsy Research Centre, Austin Health, visited ACES/IPRI, 20 June.
17.	Seven members from IHMRI visited ACES at UOW for a collaborative workshop and tour of the facilities, 25 July.
18.	Dr Drew Evans & Prof Matt Anderson from University of South Australia visited ACES Deakin node to discuss research collaboration opportunities in solar energy research, 3 August.
19.	Dr Steven Harvey and twenty undergraduate students in Mech 482/Mech919 at UOW visited ACES at UOW for a tour of the 3D printing facilities, 10 October.
20.	Marina Pilz da Cunha, Master student Technical University of Eindhoven, visited ACES at UOW to vewi the ACES/ANFF facilities and engage in research discussions, 28 October.
21.	Daniel East, Director Lab22 Innovation hub visited ACES at UOW to view the ACES/ANFF 3D printing facilities and discuss possible collaboration between CSIRO and ACES in the area of metallic 3D printing, 2 November.
22.	Juewan Kim & Danny Kang, masters students at Clinical Centre for experimental transplantation (CCET) Adelaide, spent 2 days at ACES UOW working on a collaborative project, 10-11November.
23.	Prof Toby Coates, Royal Adelaide Hospital & University of Adelaide, visited ACES at UOW to discuss collaborative projects and give the Bill Wheeler public address, 11 November.

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