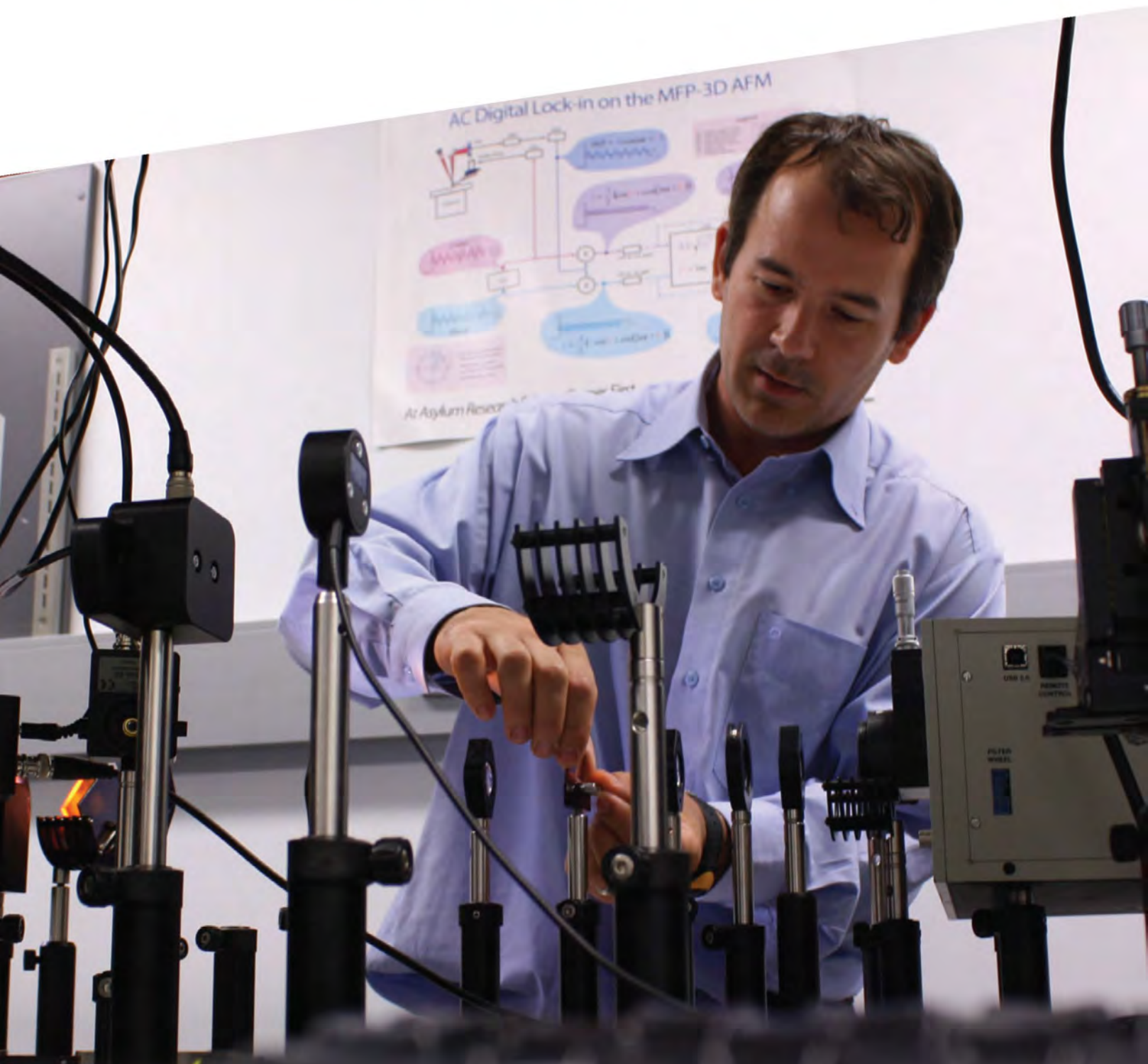
ARC Centre of Excellence for
Electromaterials
Science

Annual Report 2012



creating advanced materials

materials synthesis · energy conversion · energy storage · bionics

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Supplementary Information

Welcome to ACES

The Australian Research Council Centre of Excellence for Electromaterials Science (ACES) brings together eminent scientists to develop the nanoscience and nanotechnology related to the movement of charge within and between materials.

The approach provides an alternative to varying the composition of a material to alter physical and biological properties – instead we alter dimensions and shape in the nanodomain. These processes are fundamentally important to a diverse array of phenomena important in medicine and industry.

We have now achieved international recognition and consolidated links around the world. ACES is well placed to assure a global leadership role in electromaterials science.

The Partners

The Centre currently comprises of six organisations: University of Wollongong (including the Intelligent Polymer Research Institute and the Institute for Superconducting & Electronic Materials), Monash University (Clayton), St Vincents Health (Melbourne), La Trobe University (Melbourne), University of Tasmania and Deakin University (Clayton).

These organisations draw together researchers from a range of disciplines; including biologists, clinicians, chemists, physicists and engineers. Each of the nodes possesses key research strengths, which, when combined places ACES in a powerful position to design, discover and develop new electromaterials.

Research Programs

The core research programs supported by the ARC Centre of Excellence are: Electromaterials, Energy, Bionics and Ethics. The integrated research projects within each program provide the capability to design, synthesise and characterise new electromaterials.

Electromaterials: The key is the development of innovative routes to functionalised nanomaterials that enhance both the chemical and physical properties required for the targeted areas of application. This program continues to encompass materials synthesis, fabrication and characterisation.

Energy: The Energy program utilises advances in our design, synthesis and fabrication of new light harvesting and electrocatalytic materials as well as organic nanostructured electrodes for applications such as solar hydrogen generation and metal/air batteries.

Bionics: The Bionics program exploits new electromaterials in the areas of stimulation and neuromuscular repair and in the design and development of an advanced cochlear electrode implant.

Ethics: The Ethics program drives the development of a social and ethical response to the emerging science and its applications, particularly in Bionics.

Funding

ACES was established in 2005 with $12 million in federal funding from the Australian Research Council (ARC) over five years.

From July 2010 until December 2013 ACES receives a further $7.7 million in federal funding from the ARC.

ACES also receives support from the NSW Department of State & Regional Development to achieve technology transfer to NSW and Australian industry via a SLF grant 2010-2013: $360k.

Message from the Director

It has been a privilege to serve as the Executive Research Director of ACES since we commenced operations in 2005. Together, our researchers continue to deliver high impact outputs to build the body of knowledge in fundamental electromaterials science. Through the growth of multidisciplinary research teams we are able to apply this knowledge in areas critical to today's society, namely, Energy and Medical Bionics.

In the energy area this has been exemplified in 2012 by the establishment of the spin-out company Aquahydrex. This venture is built on fundamental findings that have been applied in innovative ways. Equally important the venture is built on the enthusiasm and team spirit that the ACES research culture has fostered. The science, combined with these personal attributes, has attracted significant investment from an American Venture Capital company.

It is most satisfying to see that our highly talented individuals, working within our extraordinary facilities, are able to produce globally competitive research that attracts such attention. Indeed, as detailed in these pages, across our research programs there have been some amazing results, with outputs in 2012 exceeding all expectations.

I am also proud of the engagement network we have put in place and the spirit of communication that has been instilled in all of our researchers, from undergraduate interns to the most seasoned researchers. This has enabled profitable engagements with other research institutions and industry, resulting in ACES involvement in a number of ARC linkage grants, Australian Co-operative Research Centre (CRC) projects and other end-user projects.

As we have grown as a Centre, we have gathered the experience and resources to be able to develop exciting new training opportunities for our student researchers as well as attracting the next generation of electromaterials researchers.

Consequently, this year we initiated a pilot-scale program - *the Transition Project* - that enables our research students to engage directly with industry. This unique program creates opportunities for our students to 'interview' industry executives to ascertain what industry needs in respect to the skills and attributes of researchers. The impact on the individual researchers involved has been profound and they have disseminated the findings of the project to others in ACES.

Funding is fuel

Supporting

- Training
- Research
- Communications

Leading to

- Global credibility
- Global footprint
- Global leadership

Exciting young students about research and electromaterials through undergraduate internships this year has also proved highly beneficial to both ACES and the students themselves. Highly talented (second year undergraduate) students were selected to undertake science communication projects throughout the university term, followed by summer research projects in the ACES laboratories. The enthusiasm and excitement of these students has already affected those of us that have been associated with them. These students will continue to have an active engagement with ACES through 2013, developing skills in project planning, with the internship culminating in a final summer research project.

In 2012, we also expanded our efforts to convey the excitement of electromaterials research and applications to the general public through:

- The launch of the ACES- University of Wollongong (UOW) Science Centre Technology Exhibition
- PhD Scholars Awards for Science Communication to undertake projects with the UOW Science Centre
- Several public engagement workshops in the area of Bionics
- Community tours of the ACES facilities.

We are very proud of the individual achievements of our researchers, many being acknowledged with important Fellowships during 2012. Special congratulations to Prof Doug MacFarlane on the receipt of an Australian Laureate Fellowship.

As we enter 2013, we begin the final year of the current ARC funding for ACES. Through the assembly of an extraordinary team of individuals we have achieved amazing things. Our innovative research, research training and engagement programs have established not just our national but also our global reputation.

ACES continues to expand its global presence through the Marie Curie International Research Staff Exchange Scheme (IRSES) program; where collaborative activities in Ireland, France and Finland have been consolidated. Highly successful collaborative research workshops were held in China, Korea and Taiwan in 2012.

Through these tremendous efforts and much patience our centre staff, research staff and research students have laid the foundations for a truly global engagement program.

I would like to thank all of the individuals who have made all of these achievements possible. A special thanks to our International Advisory Board (IAB) and to Dame Bridget Ogilvie (chair of the IAB).

I look forward to working with you all during 2013 and beyond, should the privilege be extended.

Best wishes

Professor Gordon Wallace

Executive Director ACES.

IAB Chair Report

The International Advisory Board reviewed the 2012 progress of the ARC Centre of Excellence for Electromaterials Science (ACES) on 15 February 2013 and received updates on the next ACES Centre of Excellence bid. Those in attendance were: Dr (Dame) Bridget Ogilvie (Chair), Prof Richard Kaner, Prof Ray Baughman, Prof Dermot Diamond, Mr Greg Smith, Prof Dirk Guldi, Dr Anita Hill, Prof Judy Raper, Prof Lee Astheimer and Prof Patrick Nixon.

The Board congratulated Prof Gordon Wallace and the ACES team on the quality and range of outcomes achieved by the Centre in 2012.

Research Progress in 2012

ACES produced high impact research outputs. The ACES level of research is among the highest in the world! In 2012, 47% of the 138 ACES research articles published were published in peer reviewed journals with an impact factor >4.

There was impressive progress in all three interconnected research programs, especially with respect to the fundamental research outcomes.

The overall message from all the research programs was that during the lifetime of this current centre the team has developed chemistries and physical processes to isolate nanomaterials and study their amazing properties and behaviour but still have work left to do so as to enable them to elegantly reassemble those different nano and microcomponents into functional macrostructures.

The ability to control the dimensional structure of the individual components and understand the fundamental, yet complex processes, to enable this to occur will be crucial to the next set of developments.

In 2012, the centre produced and optimised a wide range of materials, electrolytes and electromaterials (e.g. porphyrins, metal complexes and oxides, conducting polymers, nanostructured carbons, ionic liquids and plastic crystals) as well as functionalised post fabricated structures; for both their research and for international collaborators.

The facilities provided within the centre are certainly world class and built around cutting edge technologies; a sentiment felt by politicians (both federal, state and local) as well as other visitors who have had the opportunity to tour the facilities.

The research team should be commended on their forethought and aptitude in having been able to build up such an impressive array of research tools for synthesis and characterisation of nanomaterials (some courtesy of ARC LIEF grants) as well as a suite of fabrication equipment (often custom developed to allow for processing of the new materials developed) in association with Australian National Fabrication Facility (ANFF).

The ACES Bionics program continued to use polymer platforms (both non-conducting and conducting) to promote controlled growth of nerve and muscle cells *in vitro*. With NHMRC support this work can be undertaken *in vivo*. The development of 'bioinks' that enables (individual) living cells to be spatially distributed using ink-jet printing is an exciting advance. This takes ACES closer to a range of practical devices.

New improved conducting electrodes, using materials developed within ACES, are being tested for stability and reproducibility as well as electrochemical and electrophysiological properties. New testing protocols have been developed to evaluate the use of these electrodes with respect to developing new imaging techniques as well as surgical approaches for insertion.

Participants at the International Advisory Board meeting held 15 February 2013.

Although ACES has developed encapsulation methods to extend the operating lifetime of actuators in liquids, their translation as a mechanism to improve guidance for the insertion of the cochlear electrode, has not been successful to date.

Meanwhile the Ethics team worked alongside the Bionics team looking at the impact that these new technologies, involving nanotechnologies or nanoscience, may have on related regulatory and social aspects. Three main areas studied in 2012 were related to: when bionics may shift the person's sense of self, health and wellness; issues related to clinical trials for these proposed technologies /devices and public democratic deliberation about what the impact those devices may have.

The IAB acknowledged that having this perspective raised now during device development was important as it may assist in directing the research efforts; depending if the results considered a potential device either favourable or unfavourable, as well as assisting with the community and regulatory bodies' understanding on potential impacts these technologies may have once available.

Much of the research on water-splitting in the Energy Program was focussed on developing high efficiency oxygen-generating anodes that are amenable to 'wireless' coupling to hydrogen-generating cathodes, with the ultimate aim to split water at zero bias using light illumination only.

In 2012, ACES work was still very focussed on the materials and understanding the electrode reactions in both water splitting and for metal/air battery applications. ACES work has used several different combinations of catalysts, electrode materials (including breathable membranes made from Goretex), and cell configurations to investigate the processes involved in the generation of hydrogen and oxygen from water. Some light assisted processes have already been shown to facilitate oxidation in near- neutral conditions; including seawater.

ACES aims to produce highly efficient catalysts that can handle both oxygen reduction and oxygen evolution; so that there is a greater possibility to be able to get most of the energy put into the system back out of the system again. The oxygen reduction reaction is highly electrolyte dependent, so ACES has also been looking at novel ionic liquids to act as electrolytes.

Towards the development of metal/air batteries (focussing mainly on zinc and magnesium metals) researchers looked at controlling (protecting) the morphology/ integrity of the metal using overlayers of materials in association with non-aqueous electrolytes to get improved cycling; investigated the use of the bi-functional nature of some oxygen reduction catalysts to improve efficiencies and to gain an improved understanding of the oxygen reduction reaction in ionic liquids as opposed to aqueous solutions.

Other battery work involved looking at new materials for use in lithium batteries; designing flexible/bendable polymer batteries and looking to produce an all polymer battery system suitable for bionic applications.

To view the batteries whilst they are working is difficult. ACES showed that MRI technology can be used to give information about the battery as it charges and discharges- a first!

Thermoelectrochemical cells based in ionic liquid electrolytes are also being studied.

International & National Collaborations

The IAB thought the integration of ACES with national and international collaborators was exceptional and the research is at a high standard which is recognised globally.

Testimony of this was that, in 2012, ACES hosted 41 international researchers from 17 countries to access the world class ACES facilities at the various nodes.

16 ACES members were invited to give 59 lectures at international conferences (45 held abroad and 14 held within Australia) and another 11 members travelled worldwide to present 38 invited talks at Universities and Research Organisations (25 abroad and 13 within Australia).

ACES members also undertook 63 visits to leading international laboratories (in 17 countries).

In addition ACES hosted 5 international workshops in Australia and 2 international delegation workshops; in Taiwan and China.

National engagement was also impressive. In addition to the invited talks above, another 32 ACES members presented ACES research at 36 separate national conferences or events.

Furthermore, students and staff of ACES were given as much opportunity, as finances allowed, to travel between the domestic nodes as well as visiting other laboratories within Australia, to undertake multidisciplinary research tasks or to talk and work with domestic collaborators. In 2012 ACES and associated project members undertook 37 trips for this purpose. This domestic travel was in addition to monthly trips to Melbourne and/or Tasmania by Prof Gordon Wallace, the Executive Director of ACES.

End-User Engagement

The fundamental knowledge accrued is being effectively disseminated through the highly effective ACES end-user network, which to date has 900 members.

The IAB was pleased to see ACES reporting a high level of activity in developing the end-user network during 2012, with 96 government, industry or business briefings; along with running 6 specific end-user targeted engagement events (composed of AdFab, AdBioFab workshops and industry breakfasts). In addition to the work directed into developing strategies for selected projects in both the Energy and Bionics programs, the IAB was excited to note the successful start-up of a spin-out company 'Aquahydrex' with True North Venture Partners in the area of water-splitting. This spin-out will be the first step towards commercialisation of some of the ACES technology that seeks to identify disruptive innovations and work with management teams to build companies for the long-term in the areas of energy and medical bionics.

AquaHydrex is a great example of a university technology that has been developed to become an investable opportunity. The education for the researchers in just bringing to fruition such a company is invaluable towards understanding the difficulties and pitfalls that can be encountered in such ventures.

Evidence that other fundamental research has been moving towards translation is that the ACES solar cell work has been further developed by the CRC-Polymers; some Bionics research by the Hearing CRC and successful funding from the ARC for linkage projects with industry partners (3 in 2012; 2 in 2011 as well as in 2010).

Education & Training

ACES continued to develop intensive, efficient and effective education and training programs for both staff members and students of all the nodes. The depth and breadth of education and training in ACES for students and early career researchers in 2012 was encouraging.

There were numerous scientific workshops, seminars, and research program meetings that were complemented by training programs on career development, leadership, and commercialisation. The technical and scientific programs of the many symposia and seminars were varied and topical. Inter-nodal visits are being encouraged as much as finances allow.

Teaching students and staff the value of fundamental research and the application/ translation to the next phase is being tackled well by ACES with the resources available. The IAB particularly appreciated the benefits of the introduction of the 'transition project'.

In this new initiative, the two students chosen to participate, were able to interview a number of company executives and identify if 'gaps' exist after completing a PhD and being highly placed to gain an industry placement. Their success and enjoyment of this project was evident and will have secondary effects for ACES. It will encourage other PhD students to expand their skill set if looking for work in industry, as well as to introduce the work from ACES to a wider end-user network via this project.

Communication & Outreach

The communications strategy has begun to enhance the reputation of ACES and is helping ACES to become recognised as an authority on electromaterials science.

ACES should continue to disseminate the ACES message on current technology and communication platforms; especially building their online presence. ACES has shown they are keen to create content ranging from videos to generating and producing their own news stories on its website, digital newsletters and more general articles that reach wider audiences than just their academic peers.

Key Performance Measures

The performance of the Centre has exceeded the 2012 targets.

Publications included 2 books, 6 book chapters and 136 journal articles published (62 or 46% with impact factor >4; 103 or 76% with impact factor >2); 6 postgraduate students were recruited, 10 postgraduate completions, 118 media interest stories published (40 print, 51 online/web, 19 radio and 8 TV) and 12 patent updates. In 2012, ACES continued to hold much larger numbers of government, industry and business briefings; 95 in total. ACES also hosted 88 international visitors.

The ACES entity enabled success in the following initiatives in 2012 that were in addition to the core funded activities reported: 1 ARC laureate fellowship; 1 ARC DORA fellowship, 2 ARC DECRA fellowships; 1 ASI fellowship; 2 UOW Vice-Chancellor Fellowships and 3 ARC linkage grants.

The ACES team has excelled in developing all aspects of the Centre's operation. In research, end-user engagement, outreach and research training the outcomes have been impressive – the impact has been widespread.

The facilities created are world-class and central to the team approach that has been cultivated to provide a unique environment in which to carry out research.

"Once again the IAB was most impressed to find that ACES has excelled in its work, increasing its impact even more than in previous years.

The highly successful cross nodal working nationally and also internationally is, as always, an excellent indication of the success of this group.

The work on nanomaterial synthesis, characterisation and fabrication to new materials has received a huge boost with new research tools and equipment in association with ANFF.

The IAB expects to see even greater success in the coming year."

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

Chair International Advisory Board for ACES.

Overview

ACES core funded projects from 2010-2013 are set to enable development of:

- a knowledge base in electromaterials science that is utilised in Energy and Medical Bionics
- an efficient, easily manufactured water splitting device
- a high capacity printable metal-air battery
- an effective nerve repair conduit (proven) in an animal model
- an advanced cochlear implant electrode

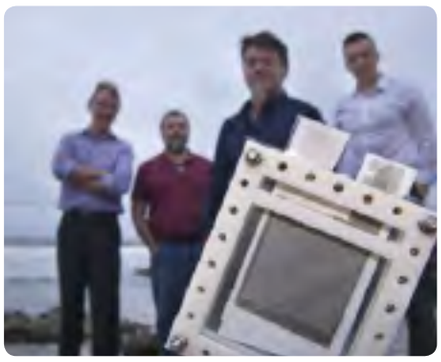
Advances in materials synthesis and assembly in 2012 have enabled the realisation of enhanced performance systems for water splitting (Energy program) and for nerve regeneration conduits (Bionics program) as well as advanced cochlear electrode studies (Bionics program) in 2012.

The experimental advances, the materials developed and the knowledge accrued by the core funded ACES research team also continues to have a significant impact on a range of other areas separately funded but carried out under the centre umbrella.

This includes significant advances in: next generation solar cells; fuel cells; energy storage technologies; platform for epilepsy detection and control; development of 'bio-inks' and composite materials to enable creation of 3D structures; development of nanoscale characterisation tools and techniques for probing cell and material interactions as well as the development of stronger hydrogels (soft materials) for bionic applications.

In addition and in partnership with the Australian National Fabrication Facility (ANFF) we have developed leading edge fabrication capabilities. The $40 million facility opened in 2012, housed with state-of-the-art customised fabrication and characterisation tools; some that have been developed in house. This facility now provides an unprecedented capability enabling assembly of highly functional materials.

Consequently, we are now well placed to tackle the 2013 milestones as outlined in the table below.



The ACES research milestones for 2011 to 2013.

	END 2011	END 2012	END 2013
MATERIALS	Supplied 1st Generation porphyrin monomers, porphyrin dimers, solid electrolytes, polythiophenes and graphenes for the electromaterials, energy and bionics programs. Supplied printed electrodes using 1st Generation materials. Developed and supplied 2nd Generation Electromaterials to Energy and Bionics programs. Refined and applied new characterisation methods.	Refined and supplied optimal materials to Energy and Bionics programs. Supplied selected printed devices to Energy and Bionics programs.	Supplied optimal materials to Energy and Bionics programs.
ENERGY	Completed metal air battery using 2nd Generation materials. Refined water splitting device characteristics using 2nd Generation materials.	Incorporated optimised 2nd Generation materials and printed components into metal air battery. Incorporated optimised 2nd Generation materials and printed components into water splitting devices.	Developed printed metal air battery prototype using optimised materials. Developed printed water splitting device prototype using optimised materials.
BIONICS	Completed evaluation of appropriate 2nd Generation Electromaterials for neuromuscular regeneration and advanced cochlear electrode. Optimised control and sensing mechanisms for steerable electrode using polymer actuators. Developed actuator technologies for steerable cochlea implant.	Established in vivo work with 3D structures. Established work on functional nerve repair (with NHMRC support). Completed studies using optimal Electromaterials for advanced cochlear electrode. Applied steering – sensing system to advanced cochlear electrode.	Established in vivo functional nerve repair studies (with NHMRC support). Completed design and fabrication of 3D bionic structures with spatial control over the location of bioactive molecules, stem cells, biodegradable and electronically conductive elements. Completed in vivo testing of advanced cochlear electrode.
ETHICS	Evaluated current research ethics guidelines (e.g. National Statement) to assess appropriateness for clinical trials of bionic devices and other nano-medical treatments. Identified and analysed range of approaches to public engagement in development of nano-medicine.	Designed and conducted public engagement event(s) on bionic devices.	Evaluated public engagement processes on nano-medicine.

Materials

ACES core activities

Synthesis Milestone: Refined and supplied optimal materials to Energy and Bionics programs.

PORPHYRINS

A wide range of porphyrins continued to be developed and supplied for Energy projects for use as light harvesting materials or catalysts. The 2nd generation tin and manganese water soluble porphyrins developed in 2011 continued to prove effective for water splitting applications (***Aust. J. Chem. 2012, 65, 577***) including sea water oxidation (***Angew. Chem., Int. Ed. 2012, 51, 1907***) and hydrogen production.

Consequently, new higher oxidation potential porphyrins were developed (Figure 1) and are being explored in the Energy program.

Of equal significance is the wide range of porphyrins still being utilised for their light harvesting efficacy, either for photoassisted water splitting or solar cells. A range of light harvesting porphyrins were provided to researchers in ACES as well as internationally (Japan, Poland) for these Energy applications. With the need to utilise the light harvesting materials in water, a range of water soluble porphyrins have also been developed and are being investigated.

The planar nature of porphyrins also makes these materials suitable for graphene exfoliation and this has been successfully carried out with collaborators in Germany (***Chem. Commun. 2012, 48, 8745***) using the butyl porphyrins shown in Figure 2.

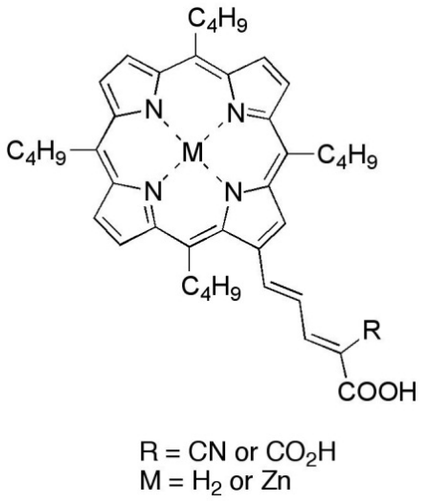


Figure 1: New porphyrin catalysts.

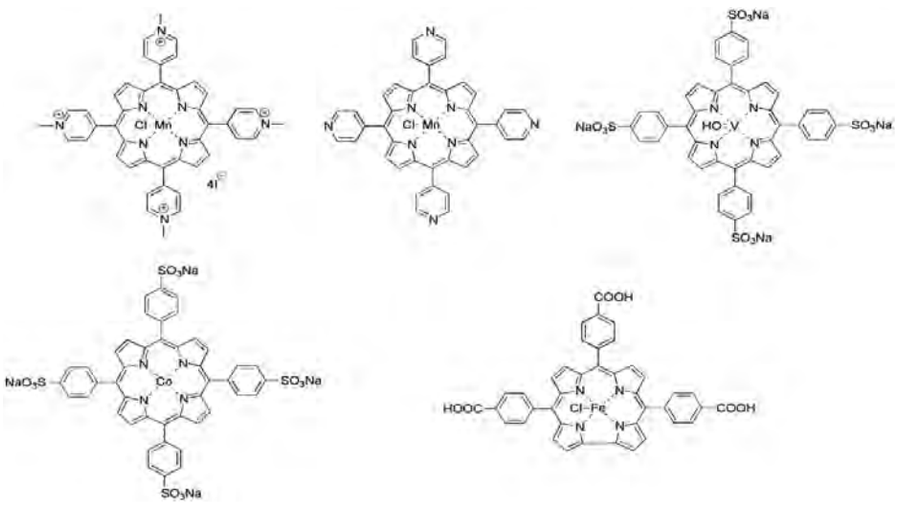


Figure 2: Porphyrins used for graphene exfoliation.

Polymers

POLYTHIOPHENES

A key advance in 2012 involved the development of new materials based on poly(3,4-ethylenedioxythiophene) [PEDOT].

PEDOTs with biopolymer counterions such as dextran sulphate (DS) have been made and are being utilised in a variety of composite developments with graphene or carbon nanotubes (CNTs), particulary for bionic applications.

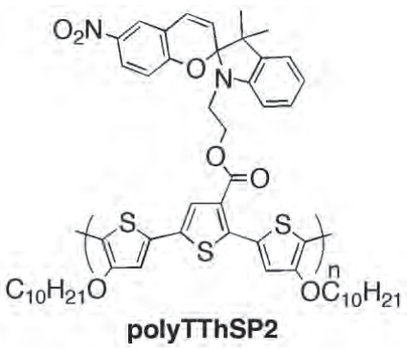


Figure 3: The thiophene based spiropyran is one of the novel electro-optical materials developed.

In collaboration with Prof. Dermot Diamond at Dublin City University (***Phys. Chem. Chem. Phys. 2012, 14, 9112***) we have developed novel electro-optical materials that should prove useful for the next generation bioplatforms, see Figure 3.

Nanocarbons

GRAPHENES

During 2012 a number of innovative protocols enabling the assembly of graphene-containing structures have been developed. Single or few layer graphene sheets have been prepared by chemical vapour deposition (CVD-graphene), as well as liquid crystalline graphene (LC-graphene) and chemically converted graphene (CCG), as both aqueous and organic (DMF) dispersions. All of these materials, plus the CCG precursor, graphene oxide (GO), have been incorporated into composites.

A number of graphene and graphene oxide polymer composites have been prepared including hydrogels, biodegradable materials and engineering polymers for industrial applications.

A polypyrrole/graphene composite film for lithium batteries has been prepared using the electrochemical reduction of GO as a polypyrrole (PPy) dopant (***Adv. Energy Mater. 2012, 2, 266***).

We have developed polycaprolactone graphene composites for use as materials in conducting biodegradable cell scaffolds. A simple blending method with well dispersed highly reduced graphene oxide resulted in graphene/ polycaprolactone composites being produced with good mechanical and conducting properties. Covalently linking the polymer to the graphene chains resulted in improved mechanical properties, conductivity and homogeneously dispersed graphene nanosheets. The composites also retained the excellent biodegradability and biocompatibility of the pristine polymer in addition to its processability resulting in facile fabrication using melt extrusion printing (***Carbon, 52, 2013, 296–304***).

Fibres

In 2012, wet-spinning of various CNT-reinforced fibres were developed including surfactant-dispersed carbon nanotube PEDOT:PSS fibres (***J. Mat. Chem. 2012 22 25174-25182***) and polyethylene glycol (PEG)-functionalised carbon nanotube PEDOT:PSS fibres (manuscript in preparation). Demonstrated in these reports are enhancements in mechanical, electrical and electrochemical properties suitable for flexible electrochemical devices (i.e. supercapacitors) upon the addition of a very low CNT loading.

A similar wet-spinning set-up was employed for fabricating coaxial fibres based on a PEDOT: PSS/chitosan inner core and PPy outer layer. This structure was investigated as a drug delivery system using the model drug ciprofloxacin (Cipro). Cipro was used as a dopant in the electrochemical synthesis of PPy/ Cipro and was found to be bioactive when electrochemically released in PBS from the fibres (***J. Controlled Release***, dx.doi.org/10.1016/j.jconrel.2013.01.022).

Inorganic Materials

INORGANIC METAL COMPLEXES

The development of new inorganic metal complexes for light harvesting applications in the Energy program has also been explored in 2012. The synthesis has been achieved of a wide variety of new Ru(II) complexes as listed:

- Ru(4-phterp)(terpCOOH)$(PF_6)_2$
- Ru(4-phterp) (dqpCO_2Me) $(PF_6)_2$
- Ru(4- CO_2Meterp) (dqp)$(PF_6)_2$
- Ru(dqp)(dqpCO_2Me)$(PF_6)_2$
- Ru(dqp)(dqp)$(PF_6)_2$,
- Ru(4phterp)(terpPO$(OH)_2$)$(PF_6)_2$
- Ru(4-CO_2terp)(NCN)(PF_6)
- Ru(dqpCO_2Me)(NCN)(PF_6)
- Ru(4-CO_2tep)(dqbH)(PF_6)

All have promising absorption (UV-Vis) and life time excited states in comparison to other Ru(II) complexes.

Figure 4: Examples of organic ionic liquid plastic crystals (OIPCs). These materials present exciting potential for water splitting and other energy applications.

METAL OXIDES

A large number of metal oxide materials have been prepared in ACES, or obtained from international collaborators, and their efficacy as water splitting catalysts investigated. This has led to the submission of a patent on electrocatalysts and photoelectrocatalysts by Monash ACES researchers (***PCT International patent application WO2012126062, 2012, 34 pp***) as well as a number of high impact publications in this area (***Adv. Energy Mater. 2012, 2, 1013; Am. Chem. Soc., Div. Fuel Chem.2012, 57, 437; Aust. J.Chem. 2012, 65, 638; Ener. & Environ. Sci. 2012, 5, 9496***).

Thus, manganese oxide (MnOx), birnessite nanoparticles, iron oxide (Fe_2O_3), nickel oxides (NiOx), copper oxides (CuOx) and cobalt oxide nanoparticles were prepared locally. Nanostructured MnO_2 (Prof Francesco Arena, University of Messina, Italy), electrodeposited Al-doped ZnO (AZO) thin films (Dr Sophie Gledhill and Dr Wiebke Ludwig, Helmholtz Zentrum Berlin, Germany), and triple junction thin film silicon solar cells (Dr Onno Gabriel, Helmholtz Zentrum Berlin, Germany) were obtained from international laboratories.

MnOx films were electrodeposited from ionic liquid for electrocatalytic water oxidation (***Adv. Energy Mater. 2012, 2, 1013***). It has been demonstrated that highly active electrocatalytic films of MnO_2, birnessite and cobalt oxide can be screen printed for water oxidation (presented at 19th International Conference on the Conversion and Storage of Solar Energy, Pasadena, CA, 30th July 2012 and manuscript in preparation).

The AZO films were tested as photoelectrocatalysts for water oxidation (research presented at the HZB, Wansee, Berlin, 7 August 2012), and the triple junction silicon PVs fabricated into integrated `wireless` water splitting devices by depositing water oxidation catalysts on the back of the solar cell.

IONIC LIQUIDS

A new family of organic ionic materials (Figure 5) of the dicyano(nitroso) methanide anion has been developed (Figure 5(a) and (b)). Compounds liquid at room-temperature with low viscosity, and high conductivity have been discovered. We have also discovered dicyano(nitroso) methanide organic ionic plastic crystals, which have an advantageously wide plastic phase region.

The salts exhibit good conductivities and thermal stabilities making them suitable as liquid or solid-state electrolytes for a range of electrochemical devices (***ChemPlusChem. 2012, 77, 1039-145***).

PLASTIC CRYSTALS

A wide variety of plastic crystals continue to be explored within ACES, typically for electrolytes for lithium batteries as well as fuel cell applications (***Electrochim. Acta, 2012, 84, 213-222*** and ***J. Mat. Chem., 2012, 22 (7), 2965-2974***).

Our studies into the diethyl(methyl) (isobutyl) phosphonium hexafluorophosphate ([P1,2,2,4][PF6]) plastic crystal provided a basis for the design of future high performance plastic crystal electrolyte materials (***J. Am. Chem. Soc. 2012, 134(23), 9688***) and [P(Me)(Et)2(iBu)][PF6] for the development of plastic crystal electrolytes for lithium batteries (***J. Solid State Electrochem. 2012, 16(5), 1841-1848***).

Other Materials Research

The new materials inventory available due to ACES research has proven critical to other ARC Discovery and Linkage projects and CRC projects. Materials have been supplied to international collaborators in Ireland; Finland; France; New Zealand; Korea and Japan.

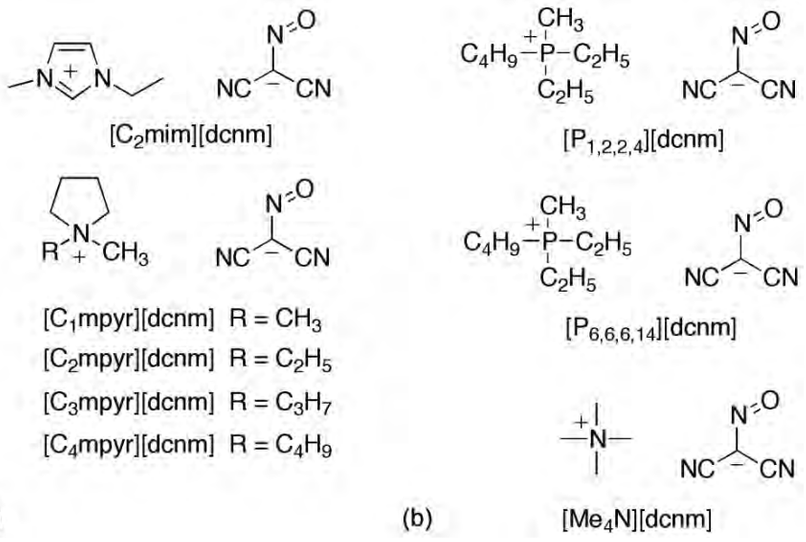


Figure 5: New ionic liquids have been developed in 2012.

Processing and Fabrication Equipment – 'A partnership with ANFF'

A suite of fabrication equipment has been developed in association with ANFF. This includes:

SPRAY COATING

The Sonotek FlexiCoat Ultrasonic Spray Coating system was chosen for the flexibility in options and the company's reputation in the spray coating field. The system is highly adaptable, having programmable 3-axis mounts that allow for attachment of multiple spray nozzles and spray shaping technology depending on the user's needs. A wide range of ultrasonic nozzles can be used to atomise an array of material options.

Each nozzle incorporates a "dual feed microbore" enabling spraying of up to 4 solutions in one build with precisely defined flow rates, and droplet size and distribution.

The system was installed in December 2012 and successful preliminary trials with spraying graphene have been completed.

INDUSTRIAL INKJET PRINTER

The Rau PixDRO LP50, a top of the line research and development machine, is designed for inkjet processes and applications, as well as evaluation and development of inkjet materials. A defining feature of the system is the ability to test almost any industrial printhead on the market, making it an ideal tool for evaluation before committing to a specific industrial configuration.

Additional features include a laser head and plasma head option; both unique to the PixDRO system. The ability to activate or etch with the laser and either activate, remove or add materials using the plasma printing option enables unparallelled material control in an ink-jetting environment.

ADDITIVE FABRICATION EQUIPMENT

The 3D Printing Systems UP Plus, was installed in March 2012 and is a single material system purchased as a training tool to allow students to become familiar with the basic design and part planning requirements necessary to allow production of components through additive fabrication. This printer has been used extensively throughout the year for training researchers.

The BFB 3D Touch has been configured with three separate extrusion heads, allowing for builds incorporating up to three distinct build materials. The system control software gives users flexibility in control of the build pattern. This flexibility is not easily achievable on other commercial fused deposition modelling systems.

The Realizer SLM-50 is the highest resolution SLM system currently accessible in Australia.

This system allows the production of components that are impossible through conventional fabrication techniques. One-piece co-axial hot-melt extrusion heads have allowed the development of a co-axial fused deposition modelling system for bio-polymers.

To date, this system has been used for easy and rapid production of coaxial extrusion printheads that can be used on other printing systems, as well as production of 3D interdigitated electrode structures.

Fabrication

KNITTING & BRAIDING

New equipment, including knitting, braiding, knit-braiding and winding, have been installed in 2012 to fabricate textiles These facilities allow us to create three dimensional (3D) structures from fibres, soft (spandex) or rigid (metal wire), with diameters from 1 mm upto 10 mm in different configurations. See some knitted examples in Figure 6.

As seen in Figure 7, we have also created 3D knitted structures of gel-spun biocompatible alginate fibres.

DIP PEN NANOLITHOGRAPHY

In 2012 researchers at ACES/IPRI directed efforts towards developing novel methods of using Dip Pen Nanolithography (DPN) to pattern electromaterials such as organic conducting polymers and metals. The goal was to build functional devices so as to

Figure 6: Knitting structure coated with conducting polymer for use as a textile sensor.

One-piece co-axial hot melt extrusion heads were produced.

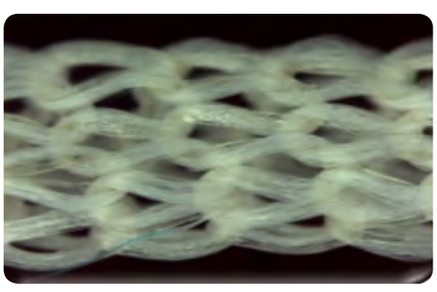


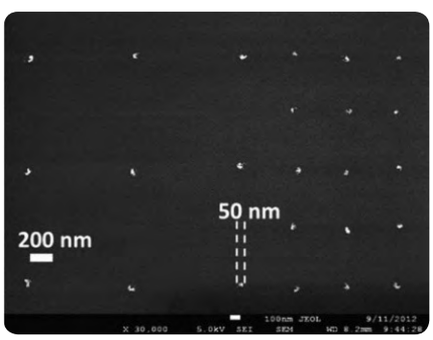
Figure 7: Knitted alginate fibres.

take advantage of the favourable scaling of conducting polymer performance approaching the nanoscale.

To date, they have printed a commercial PEDOT ink on a variety of hard and soft, flexible substrates including silicon, gold, indium tin oxide, silicone gum and polyethylene terephthalate at submicrometer resolution (***Langmuir 2012, 28: 804***).

A further method of DPN printing conducting polymers aimed to marry the superb resolution achievable by DPN with the rapid advances currently being made in the vapour phase synthesis of organic conducing polymers. We formulated a liquid ink based on the oxidant iron (III) tosylate stabilised by a block copolymer surfactant (***Langmuir, 2012, 28: 9953-9960***). Importantly, this methodology generated line patterns with widths down to 250nm.

Upscaling of the DPN technology has been achieved using linear arrays of cantilevers (to print a dozen simultaneous patterns) and, more recently, by the invention of polymer pen lithography (PPL) whereby millions of nanoscale features can be simultaneously printed over centimetre areas.



A SEM micrograph of an array of nanoscale platinum features on a silicon substrate.

BIO-ATOMIC FORCE MICROSCOPY (BIO-AFM)

Bio-AFM is a scanning probe technique that enables biological samples, including protein and living cells, to be observed under natural physiological conditions with nanometer lateral resolution. In addition to biological samples, the AFM systems were used extensively to characterise, in both air and liquid, the nanoscale surface properties of materials dedicated for the ACES Bionics Program (***Acta Biomaterialia, 2012, 8: 2538-2548***).

In another study, AFM imaging was used to determine phase separation in the material surface properties of conducting polymers (***J. of Phys. Chem.B 2012, 116, 13498-505***). It was found that phase separated regions were due to variations in sampling attractive and repulsive AFM tip-sample interactions across the polymer surface. These interactions were dependent on the redox state, degree of polymer doping, and most likely related to phase separation of surface charge or energy. Because variations in surface charge play a role in electrostatic interactions of biological entities (e.g. protein adsorption), the AFM studies were further extended to quantifying double-layer forces in liquids.

Specifically for Bio-AFM projects, a study was undertaken to reveal the nanoscale morphology of amyloid fibrils associated with Alzheimer's disease ***(Neuroscience, 2012, 210: 363-374)***.

An innovative use of Bio-AFM enabled the real-time detection of single molecule protein adhesion to conducting polymers as a function of electrical stimulation. This work was published in the journal ***Small*** as an early view online article (Dec 2012) and is expected to have a major impact in the field of electromaterials where electrical signals are used to control biomolecular interactions (***Small, 2013,11;9(3):393-401***).

Energy

Water-Splitting (Core ACES activity)

Research on water-splitting in the Energy Program has been focussed on developing high efficiency oxygen-generating anodes that are amenable to 'wireless' coupling to hydrogen-generating cathodes, to thereby split water using light. A significant overall outcome of the work in the energy program has been the creation of a spin-out company Aquahydrex in 2012 that will commercialise some of the ACES technology.

Milestone: Incorporated optimised 2nd Generation materials and printed components into water splitting devices.

POLYMER CATALYSTS FOR SOLAR OXYGEN-GENERATION FROM WATER

Light-assisted conducting polymer catalysts (based on polyterthiophene and PEDOT doped with metal porphyrins) have been developed that facilitate highly selective water oxidation in near-neutral solutions, including seawater. While it employs a different mechanism of action, this potential is comparable to that achieved by metal oxide semiconductors, like $BiVO_4$ and WO_3. Unlike such metal oxide semiconductors, the polymer systems split seawater cleanly and sustainably, without detectable chlorine formation.

While current densities are still orders of magnitude smaller than light-driven metal oxide systems, significant progress has been made toward the development of polymer solar water oxidation catalysts (***Angew.Chem. Int. Ed. 2012, 124, 1943; PCT Patent application 2012***).

CATHODE-DRIVEN SOLAR HYDROGEN GENERATION FROM WATER

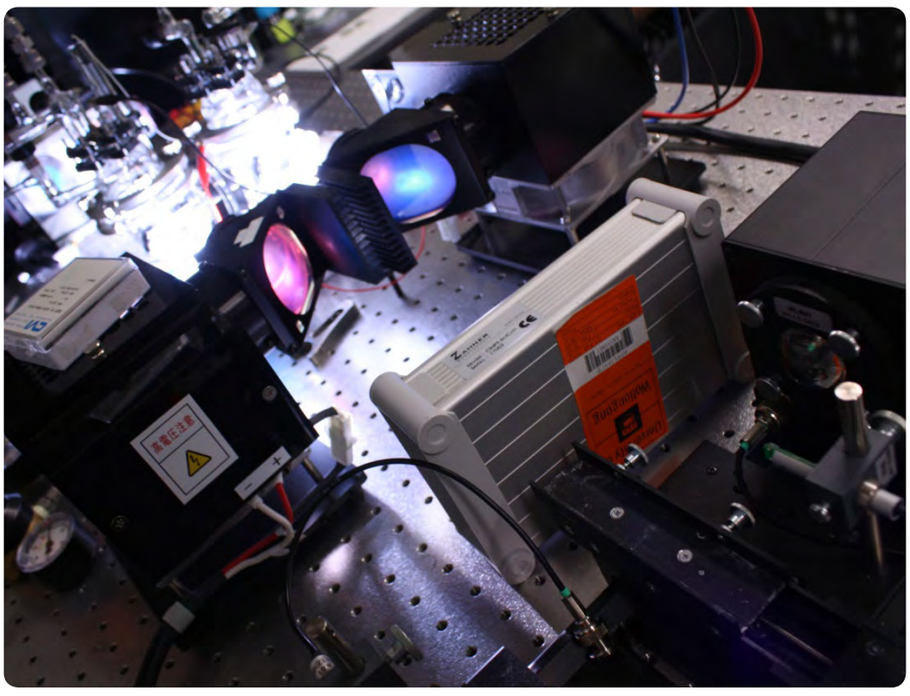
A dye-sensitised, nickel(II) oxide-based, hydrogen-generating photocathode has been developed and studied. When combined with an oxygen-generating $BiVO_4$ photoanode, the resulting device conforms to the requirements of an 'artificial leaf', in that it requires only light illumination and no externally applied bias to split water. This approach is novel in that it uses the hydrogen-generating electrode as the key driver for water splitting under light illumination.

Preliminary devices which combine the above, oxygen-generating conducting polymer catalysts with the hydrogen-generating photocathode are under study with a view to developing an artificial leaf capable of cleanly splitting seawater without chlorine formation (example: ***Energy & Env Sc 2012, 5, 7090***).

NOVEL METAL OXIDE WATER SPLITTING WATER OXIDATION CATALYSTS

High performance catalysts based on Mn, Co and Ni oxides have been developed. Heat treatment at moderate temperatures (<120°C) has been shown to significantly improve the water splitting performance of electrodeposited MnO_x films from aqueous electrolytes.

Investigation reveals that heat treatment results in dehydration and growth of reduced manganese state, without change in the morphology or bulk chemical composition. These films show good long-term stability.



Experimental setup of watersplitting via light

Several cations (Li^+, Na^+, K^+, Ca^{2+}, Co^{2+}, EA^+, BA^+) were added into the electrodeposited MnO_x films with those with organic cationic additives exhibiting better performance.

Photoanodes have been developed which contain embedded MnOx nanoparticles with a very high surface area that catalyse water oxidation with turnover frequencies at low overpotentials (350 mV), in the presence of visible light and under neutral operating conditions.

A low overpotential mechanism for water oxidation to hydrogen peroxide was discovered when protic ionic liquids are used as the electrolyte.

The electro-deposition of γ-NiOOH using nickel(II) amine complexes has been found to result in high surface area films that were 1.5 times more active than those prepared from $[Ni(H_2O)_6]^{2+}$ under similar experimental conditions, showing the benefit of applying molecular precursors in the deposition of the metal oxide catalysts.

The application of using screen-printing as a method to prepare nanostructured nickel oxide films was also demonstrated. The films were found to be an efficient water oxidation catalyst for a prolonged period of time (>15 hrs with no drop in current density) under near neutral conditions (pH 9.2, overpotential 600 mV).

This work has been published in several formats during 2012: ***Energy and Env Sci 2012, Aust J. Chem. 2012, Advanced Energy Materials 2012, Molecular Solar Fuels in Royal Society of Chemistry book series, 2012, Catalyst Today 2012, Australian Provisional and PCT Patent applications 2012***.

ELECTRODEPOSITED AL-DOPED ZINC OXIDES (AZO) AND TaON AS PHOTO-ELECTROCATALYSTS FOR WATER OXIDATION

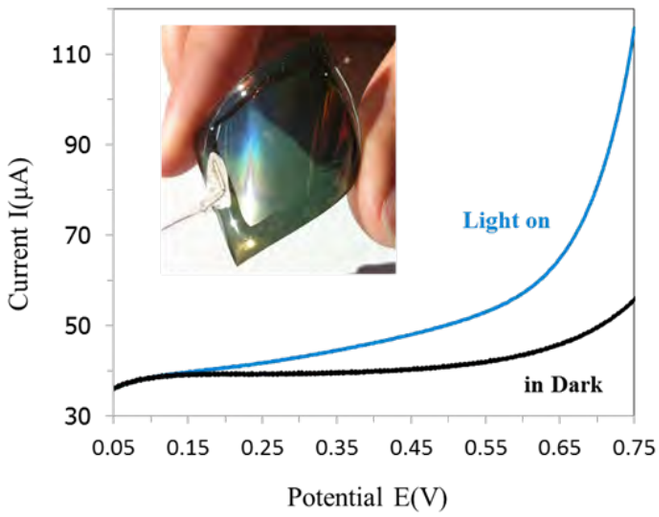
Electrodeposited AZO nanorods received from the Helmholtz Zentrum Berlin were tested for their potential as light-assisted water oxidation catalysts with promising results. The nanorods differed in the sputtered seeding layer, Al-concentration and size. As these materials were photoactive, light intensity dependence and IPCE studies were carried out. Currently, we are optimising electrolyte conditions and exploring protection methods to improve the stability of the AZO catalyst films.

The fabrication of TaON photoanodes via screen-printing has been investigated, applying methodology utilised in dye sensitised solar cell development (collaboration with Professor Ryu Abe Kyoto University).

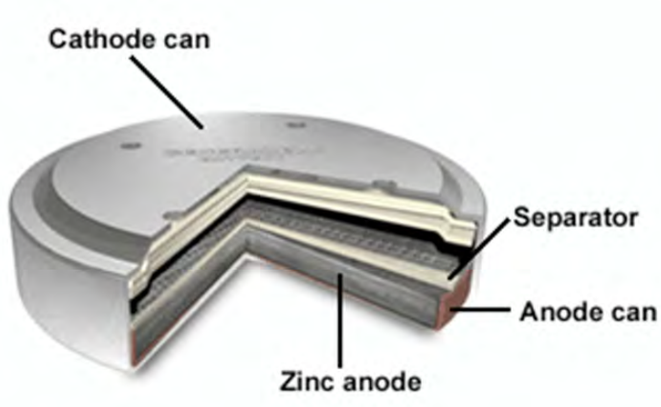
Optimisation of the post-treatment of TaON films with $TiCl_4$ solution has been successfully carried out and has resulted in improved connectivity between TaON nanoparticles and better photo-stability during testing. To achieve better catalyst performance and photo-stability, the electrodeposition of metal oxides on to the surface of TaON is in progress.

BREATHABLE ELECTRODES FOR WATER SPLITTING

Breathable electrode structures have been developed to allow the direct extraction of the gaseous products from the water splitting process. These electrodes are based on Goretex membranes which are coated with a conductor layer and then a water oxidation or reduction catalyst. (***Int J Hydrogen Energy 2012, Australian Provisional and PCT Patent applications 2012***).



Electrodes have been developed to split water using light.



A reversible zinc air cell under development in ACES

High energy density metal-air batteries

Milestone: Incorporated optimised 2nd Generation materials and printed components into metal air batteries.

ELECTRODE STRUCTURES FOR RECHARGEABLE ZN-AIR BATTERIES

To control the morphology of metal cycling during charge and discharge of a metal-air battery, novel structures for the electrode are being developed. These have included those based on graphene composites and zeolite over-layers (*PCCP 2012, Echem Acta 2012*).

NOVEL OXYGEN REDUCTION REACTION (ORR) CATALYSTS

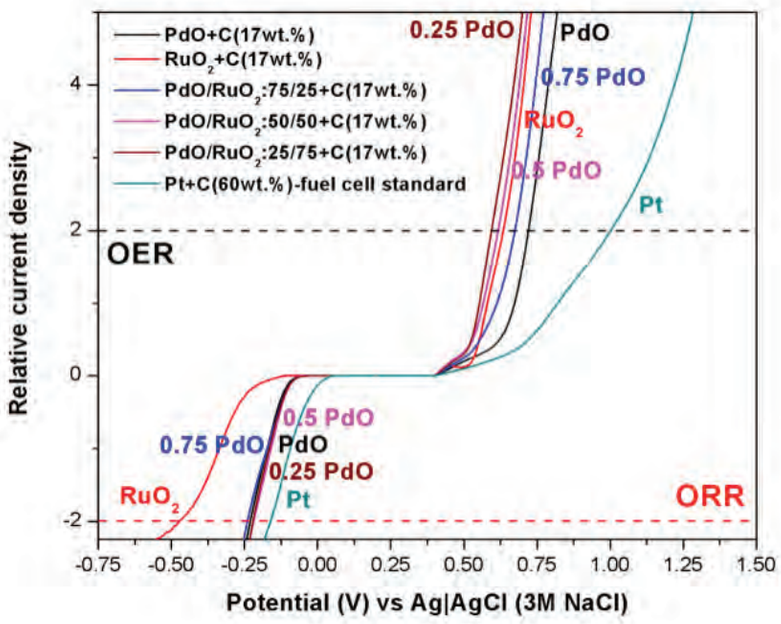
A key requirement for the cathode reaction in a metal air cell is the development of viable, low cost ORR catalysts. A study of nanostructured molybdenum, vanadium and tungsten oxynitrides, synthesised via temperature-programmed ammonia reduction, was performed. The molybdenum oxynitride exhibited superior electrocatalytic activity and was demonstrated to follow a 4-electron pathway. Similarly, it was shown that vapour phase polymerisation of poly(3,4-ethylenedioxythiophene) (PEDOT) resulted in a 4-electron pathway.

With a view to developing a rechargeable air cathode, bi-functional oxygen electrocatalysts based on PdO-RuO_2 composites were formulated. This work has been published in *J. Electrochem. Soc. 2012, Echem Commun 2012, J Mat Chem 2012, J Phys Chem 2013*.

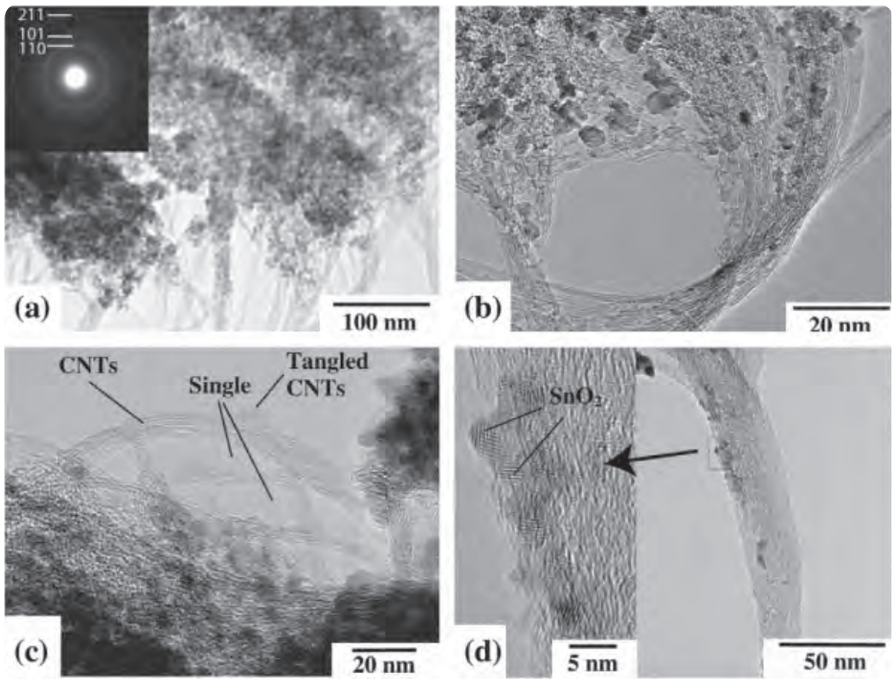
IONIC LIQUID ELECTROLYTES FOR METAL-AIR BATTERIES

A number of studies have elucidated the role ionic liquid electrolytes play in determining the performance of metal-air batteries (*Electrochemistry Communications 2012, Aust J Chem 2012, Echem Acta 2012*).

The devices, based on tri(hexyl)tetradecyl phosphonium chloride ionic liquid electrolyte showed lengthy and stable discharge potentials over several days.



Oxygen reduction reaction (ORR) and oxygen evolution current (OER) densities at a rotation rate of 1600 rpm and a scan rate of 20 mV s^{-1} in oxygen saturated 0.1M KOH at 17°C.



Morphological and microstructural features of the SWCNT/SnO2 sample from TEM images: (a) low magnification image and selected area electron diffraction pattern indexed according to tetrahedral SnO2 (inset); (b) distribution of SnO2 along bundles of SWCNT s; (c) SWCNT bundles plus isolated and tangled SWCNTs; (d) SnO2 particles attached to a tangled bundle of SWCNTs with high resolution image of indicated area in inset.

Other Activities and Developments

WATER SPLITTING SPIN OUT COMPANY -AQUAHYDREX.

ACES has secured venture capital investment from True North Venture Partners in a spin out company – AquaHydrex (more details are discussed in end-user section of this report).

The AquaHydrex technologies are the culmination of years of research that has taken place within the University of Wollongong (UOW) and Monash University nodes of ACES as well as in other Australian Research Council (ARC) supported projects at Monash University.

The research teams have developed new electrochemical systems for splitting water, with and without the use of sunlight. The technologies involve novel catalytic processes that enhance the efficient electrolysis of water to produce hydrogen. A second set of technologies are inspired by photosynthesis to assist the production of oxygen gas from water under sunlight

LI BATTERIES

Work has continued in a number of student projects on lithium battery materials. This has included novel cathode and anode materials as well as ionic liquid and solid-state electrolytes.

A significant outcome was our report of an all solid state lithium cell based on a plastic crystal electrolyte (***Echem Acta 2012, J Solid-state Electrochem 2012***).

FLEXIBLE AND BENDABLE POLYMER BATTERIES

Free-standing single-walled carbon nanotube/SnO_2 (SWCNT/SnO_2) anode paper was prepared by vacuum filtration of SWCNT/SnO_2 hybrid material.The SWCNT/SnO_2 flexible electrodes can be bent to extremely small radii of curvature and still function well, despite a marginal decrease in the conductivity of the cell. The electrochemical response is maintained in the initial and further cycling process. Such capabilities demonstrate that this model holds great promise for applications requiring flexible and bendable Li-ion batteries (***Carbon, 2012, 50(3), 1289-97***).

Highly flexible and bendable free-standing polypyrrole-para (toluene sulfonic acid (PPy-pTS) films were also prepared.

The films are soft, lightweight, mechanically robust, and highly electrically conductive. The films display a cauliflower-like structure consisting of micron-scale spherical grains, which are related to dopant intercalation in the polymeric chains.

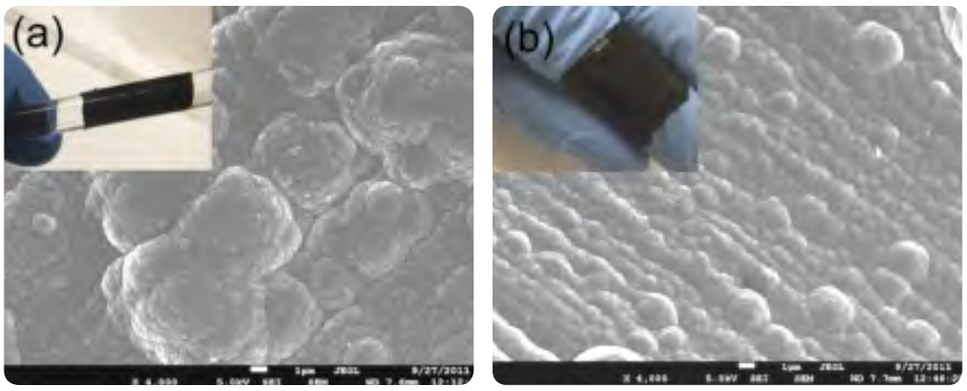
The electrochemical behaviour of the free-standing films was examined as the cathode against a lithium counter electrode (***Electrochim. Acta 2012, 60, 201-205***).

Flexible free-standing polypyrrole-indigo carmine (PPy-IC) films were designed as an additive-free anode material for lithium secondary batteries (***Solid State Ionics 2012, 215, 29-35***).

ALL POLYMER BATTERY SYSTEM

A novel all-polymer battery system was based on conducting polymer (polypyrrole, PPy) doped with dopants of para (toluene sulfonic acid) (pTS) and indigo carmine (IC), respectively.

A novel all polymer battery system, with significant advantages in terms of capacity and stability was realised. This may lead to a future generation of all polymer batteries that are suitable for implanted medical devices used in biological and biomedical systems (***Electrochim. Acta 2012, 83, 209-215; Solid State Ionics 2012, 215, 29-35).***



Left: FESEM images of the films: (a) PPy–pTS film with photograph of rolled-up film (inset). Right: PPy–IC film with photograph of rolled-up film (inset).

Bionics

Milestone 1:- Established *in vivo* work with 3D structures

NERVE REPAIR CONDUIT

A conduit has been generated to specifically promote the growth of functional nerve cells *in vivo*. This has been achieved through careful selection of materials and fabrication processes that collectively deliver a nerve repair conduit that promotes regeneration of damaged nerve through several independent repair processes (***J. Neural Eng. 2013, 10(1):016008***).

Milestone 2: Established work on functional nerve repair (with NHMRC Support)

This section of work has been concentrated around the use of microstructured and nanostructured conducting and non-conducting (biodegradable) polymers as part of the ongoing development of nerve regeneration technologies. Both *in vitro* and *in vivo* modeling of nerve regeneration has been well established at the St. Vincent's node in 2012.

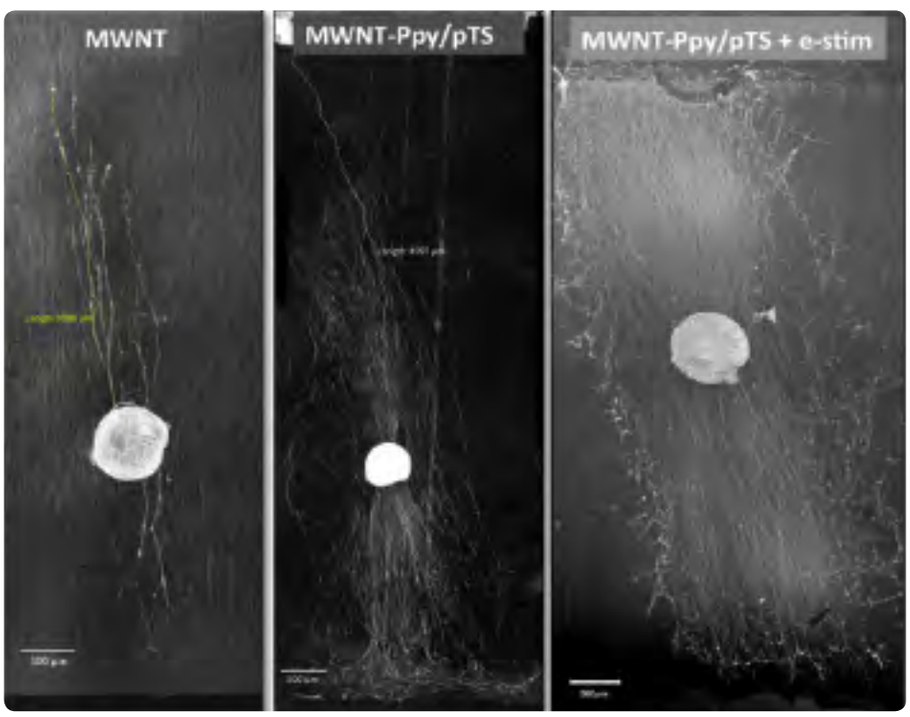
In vivo work on 3D structures capable of electrical stimulation will be delayed due to the lack of NHMRC funding.

In vitro analysis of sensory neuron growth on nanostructured polymers (ACES core funding)

CONDUCTING SUBSTRATES

Nanostructured scaffolds were synthesised from conducting polymer materials (MWNT and MWNT with PPy-pTS coatings) for analysis of neural growth. The main focus of these activities was to use orientated nanostructure to guide the regeneration of axons and the migration of Schwann cells, both desirable features of co-ordinated nerve regeneration. Results from these studies have demonstrated that the nanostructure provided by MWNT fibres provides excellent topographical cues for the guidance of axons as well as Schwann cells. Further to this, coating MWNT scaffolds with a thin layer of polypyrrole improves the compatibility of the scaffolds, however the mechanisms responsible for this have yet to be elucidated.

Continuing studies are investigating whether electrical stimulation can be used via these scaffolds to improve the rate and extent of differentiation (axonal growth) and Schwann cell migration using these scaffolds. Initial studies indicate that this is the case and concurs with other observations reported by our group with muscle cells (myoblasts) as well as with the work of other laboratories. This work is being carried out in collaboration with Prof Ray Baughman's group (University of Texas at Dallas, USA).



Axonal growth (DRG explants) on nanostructured conducting polymer platforms.

Milestone: Completed Studies using optimal Electromaterials for Advanced Cochlear Electrode

The ACES team at La Trobe University has tested PEDOT-pTS, PEDOT-PSS, PEDOT-CS and PEDOT-DBS for neural recording electrode coatings. These coatings displayed a range of properties, with PEDOT coatings far superior to polypyrrole coatings in terms of reproducibility as well as electrochemical and electrophysiological properties. PEDOT-pTS possessed larger spike count, lower background noise, improved signal-to-noise ratio and low biofouling during acute implantation. The development of reproducible electrochemical, surgical and electrophysiological techniques now allows large numbers of new materials developed within ACES to be tested. This work is currently in press in ***Journal of Neural Engineering***.

Different surgical approaches for comparing between these organic conducting polymer (OCP) film electromaterials for neural stimulation has been trialled. Future work will focus on patch-clamp techniques to provide an in-depth understanding of electrode properties on neuron behaviour.

New testing protocols have been developed to evaluate approaches to use conducting fibres for neural stimulation and recording. These ultra-small, soft, flexible electrodes have the potential to evade the body's immune response, creating extremely biocompatible bionics.

A clear 3D print of a human cochlea model has been achieved. This model will be used to practice insertion of cochlear implants and allows visualisation of the electrode position. It is helping design a more ergonomic cochlear implant and improve surgical implantation techniques.

Manufacture of cochlear implants has begun, with thin metal films deposited onto a flexible polymer.

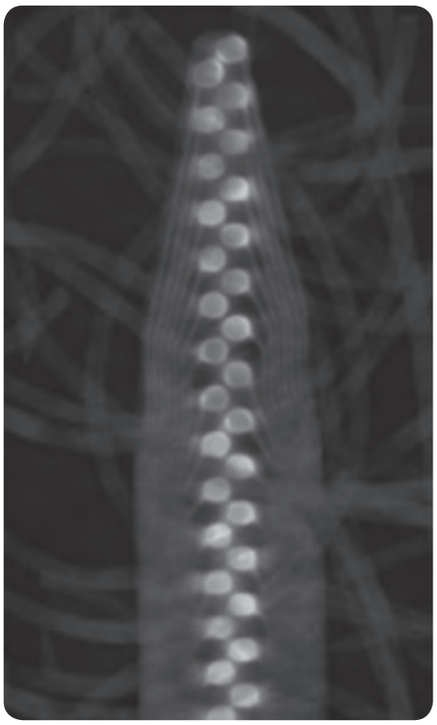
Micro-CT imaging of the thin film cochlear implant has been undertaken at La Trobe University and new image processing methods developed to allow simultaneous visualisation of both low and high density materials (***Journal of Applied Physics, 2012, 111(11), 114904***).

The newly established Imaging and Medical Beamline (IMBL) at the Australian Synchrotron has a much higher source of X-rays and is able to perform live animal CT imaging. Methods to mount an animal in the beamline are being investigated. Once established, the cochlea and cochlear implant can be imaged, allowing direct feedback so as to enable better implant design and surgical implantation techniques.

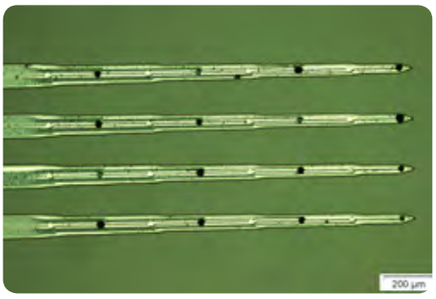
In 2012 the La Trobe team have acquired and tested commercial thin film electrodes and compared them to the traditional ring electrode cochlear implants (***Hearing Research, 2012, 287(1-2),30-42***). The benefits of thin-film electrode arrays include reducing the current required for neural threshold, increasing neurophysiological dynamic range and localising frequency responses when compared to a traditional platinum ring electrode array.

Currently we are testing the thin-film array in a deafened population of rat animal models.

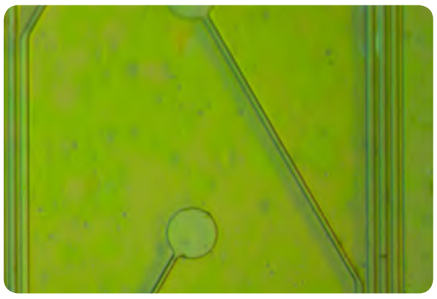
Preliminary results indicate that the benefits of these arrays are transferable to animals with profound sensorineural hearing loss.



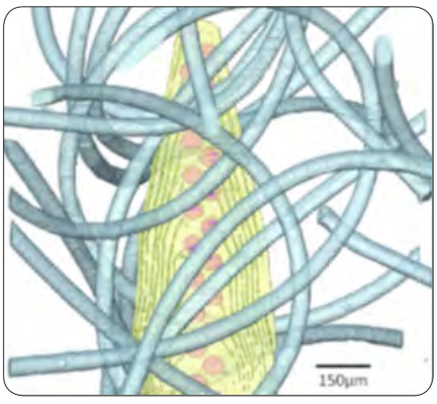
3D Tomographic image and volume rendering of a thin film cochlear implant after signal processing to allow visualisation of low and high X-ray absorbing materials simultaneously.

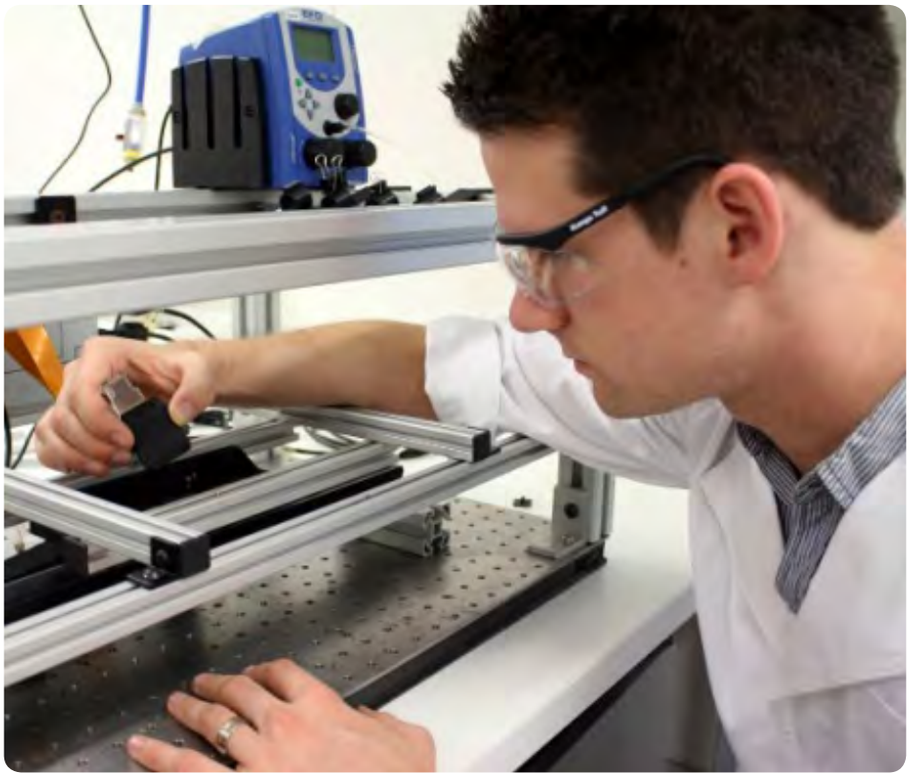


Optical micrograph of four thicknesses of PEDOT-pTS deposited on a NeuroNexus probe.



Metal electrodes patterned on polyimide developed through the Australian National Fabrication Facility (ANFF).





Scientists are one step closer to being able to print tissue replacements for diseased or damaged body parts using inkjet printers, thanks to the development of a specialised ink formulation.

Milestone: Applied steering – sensing system to advanced cochlear electrode

We have developed encapsulation methods to extend the operating lifetime of these actuators in liquids (submitted ***Smart Materials and Structures 2012***). Without barrier coatings, the actuators cease operation within a few minutes after immersion in an aqueous environment – as encountered in the cochlea. Thin elastomeric coatings and their spray application were developed and proven to greatly extend the operating lifetime of the actuators in water.

However, the barrier coating decreases electromechanical performance to the extent that there is insufficient force to manipulate even thin film electrodes. This aspect of the ACES work will be postponed as we now envisage the new fabrication tools (described previously in Materials program) will allow us to design and implement fully integrated electrode structures.

Mathematical modelling of the bending behaviour of tri-layer polypyrrole based actuators has been completed as part of the development of the advanced cochlea implant. The bending actuators are required for accurate positioning of the electrode array within the cochlea and modelling of the bending behaviour allows the sensor-less control of the actuator position (***Sensors and Actuators A: Physical, 2012,185, 82-91***). The control model was developed using a coupled electrical model (capacitor with diffusion impedance) and mechanical (viscoelastic) response and was demonstrated to accurately produced the desired bending amplitude and frequency in evaluation tests (***Smart Material and Structures, 2013, 22, 025004***).

Other Bionic Activities

BIOINKS FOR CELL PRINTING

Researchers have been aware for some time of the potential for using commercially available inkjet printer heads to print living human cells into 3D structures, but design of the actual ink capable of carrying cells through the printer has been a challenge.

ACES at UOW has led a team of scientists to develop a new bio-ink that improves the viability of living cells and allows better control of cell positioning through the printing process. Results of the research have been published in ***Biomaterials Science*** (DOI:10.1039/C2BM00114D) and highlighted in Chemistry World.

The 2D structures being printed with the bio-ink enables exquisite control over cell distribution and this already presents exciting opportunities to improve drug screening and toxicology testing processes. Building on this, 3D bio-printing, with which patient-specific tissue replacements could be fabricated, is within the grasp of researchers.

The development of chemistries that enable fabrication protocols not only takes us closer to practical devices but gives us experimental protocols that allow previously unexplored areas of fundamental science to be explored.

Ethics Activities

Milestone: Designed and conducted public engagement event(s) on bionic devices.

A public engagement event on Clinical Trials for Emerging Nano-bionics: Testing Wearable and Implantable Medical Devices was designed by the ACES Ethics Program and the National Enabling Technologies Strategy—Public Awareness and Community Engagement (NETS-PACE) program within DIISRTE (Department of Industry, Innovation, Science, Research and Tertiary Education).

The objectives of the engagement were:

- To discuss developments in emerging nanobionic medical devices in the context of medical developments generally;
- To find out publics' concerns and hopes with respect to these devices as well as about clinical trials involving these devices;
- To articulate publics' views about regulation and access to such devices and how this applies to clinical trials; and
- To feed into, and help shape, the research agenda at ACES and to provide advice to the National Health and Medical Research Council (NHMRC) and Therapeutic Goods Administration (TGA) on community concerns regarding regulation of bionics.

The event was held in the AIIM Building on the Innovation Campus, University of Wollongong, on Saturday 22nd September 2012. The engagement was facilitated by Max Hardy (Twyfords), with support from Susan Dodds, Ethics Program Leader, ACES.

A range of participants (29 in total) attended the event: academics from science, ethics, law, medicine, IT and social sciences, health care workers, people working for the medical device industry, regulators, ACES research leaders, patients/ potential device recipients, their carers, consumer advocates and interested members of the public.

The event was designed around discussion about the regulation and development of new devices, and ways of ensuring community concerns shaped the development and regulation of new devices. The outcomes of the day were a number of recommendations to the ACES executive, to the TGA, NHMRC and DIISRTE regarding the development and regulation of research on bionic devices. ACES researchers involved in the day as participants were challenged to consider the impact of their research on patients and to consider the potential social impact of the research development cycle.

Further details and reports on Ethics Program public engagement event on Clinical Trials for Emerging Nano-bionics: Testing Wearable and Implantable Medical Devices can be found in Goddard, E. 2012, Clinical Trials for Nano-Bionics: Testing Wearable and Implantable Medical Devices, Project Report on Public Engagement Event, 22nd September 2011 posted on the ACES website.

The Ethics team published 7 peer reviewed publications in 2012 covering a range of topics such as: Trust, accountability and participation: conditions and constraints on 'new' democratic models; Involuntary & Voluntary Invasive Brain Surgery: Ethical Issues Related to Acquired Aggressiveness; Efficacy Testing as a Primary Purpose of Phase 1 Clinical Trials: Is it Applicable to First-in-Human Bionics and Optogenetics Trials?; The need to tackle concussion in Australian football codes; Imaging the brain: The inheritance, power and predicaments of the "brain reading metaphor" and Correcting our Blurred Vision on Football Concussions. They also presented their work at 12 conferences during the year.

Other Activities

The Ethics team are also involved in collaborations on the social and ethical impacts of nanotechnologies.

Program leader Prof Susan Dodds, Emeritus Prof Ian Lowe (Griffith University) and Prof Alan Petersen (Monash) are currently collaborating to produce a Socio-Economic Impact Framework commissioned by Department of Industry, Innovation, Science, Research and Tertiary Education DIISRTE), National Enabling Technologies Strategy (NETS). This project will continue into 2013.

From March-November 2012 Prof Susan Dodds served as Chair of the National Enabling Technologies Strategy (NETS) Stakeholder Advisory Council; an appointment bestowed upon her by Greg Combet, Minister for Industry and Innovation. Her original appointment for this committee was as an Invited member (ethicist) National Enabling Technologies Strategy Stakeholder Advisory Council by Senator Kim Carr, Minister for Innovation, Industry, Science and Research, 2010-2012.

From July 2012- June 2015, Prof Susan Dodds has been appointed as a Member (with experience in social science research) of the Australian Health Ethics Committee (AHEC) by Tanya Plibersek, Minister for Health.

Participants in discussion at the public engagement event on Clinical Trials for Emerging Nano-bionics: Testing Wearable and Implantable Medical Devices.

Industry/End-User Interactions

Engagement with industry and the community are critical to ensure effective use of the powerful knowledge base ACES has been developing.

Targeting specific areas of invention focus, in 2012 ACES has developed an understanding of the market gaps and competitive threats. In addition we have conducted market analysis and focussed on producing prototypes to communicate to potential clients and/or investors a given concept.

ACES has identified one area of invention focus for each program that had the potential for substantial value creation by addressing national and international market needs.

These areas are:

- Materials: graphene
- Energy: water splitting
- Bionics: (still under review)

In 2012, ACES established partnerships that enabled a spin out in water splitting.

Supplementary to the focused projects, the additive fabrication facilities within ACES formed the basis for holding workshops and seminars to assist current and potential end-users to understand the growing capabilities of ACES in association with the Australian National Fabrication Facility (ANFF). Engagement with end-users was also established through networking breakfasts and other events.

To pursue the goal of a more cohesive end-user engagement and commercialisation strategy among each of the ACES nodes an ACES internode "A roadmap for commercialisation" meeting was held in June 2012.

Research Program Developments

The Energy Program

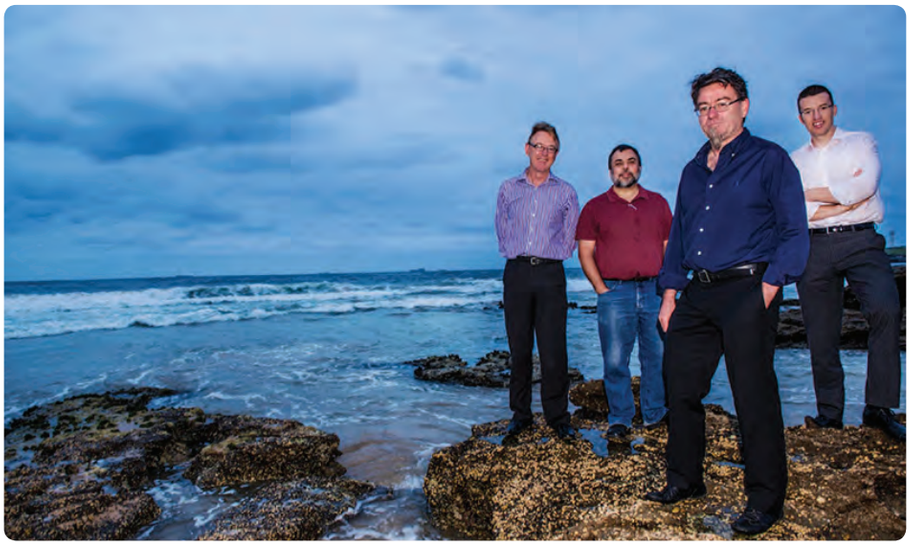
The energy program has seen significant development in the manufacture of second generation materials for input into water splitting devices and metal-air batteries, which were identified in the ACES Strategic Plan as areas of research activity where innovation may be possible.

Water-Splitting

Water splitting is a process of extracting the formative elements of water, hydrogen and oxygen, using sunlight as the principal energy source for the work, and leveraging the research capabilities of ACES nodes in biomimetic catalysis, organic photovoltaic research and novel polymers.

UPDATES TO THE ACES RELATED PATENT PORTFOLIO 2012.

APPLICATION NO.	TITLE	INVENTORS
2012902448	Membrane based electrochemical cells	Swiegers, Beirne, Chen, Wang
2012902441	Breathable electrode structure and method and system for use	Winther-Jensen, Winther-Jensen, MacFarlane
2012901138	Process and catalyst-electrolyte combination for electrolysis	MacFarlane, Winther-Jensen, Izgorodin
2012905597	Cobalt oxide catalysts and method for their synthesis	MacFarlane, Izgorodin
61/586,329	Method for producing a polymer using electrochemical polymerization	Zheng, Whitten, Truong, Spinks, Wallace, Razal
2012153182	Self-powered sensing devices	Innis, Wallace
PCT/AU2011/001602	Improvements related to multi-layer, light-modulating devices and the manufacture thereof	Swiegers, Wallace, Officer
PCT/AU2011/001603	Multi-layer, water-splitting devices	Swiegers, Wallace, Officer
PCT/AU2012/000324	Cathode-driven or assisted solar cell	Mozer
PCT/2011/001414	Method and system for catalysis	Winther-Jensen, MacFarlane, Winther-Jensen
PCT/AU2012/000302	Catalysts and methods of use	MacFarlane, Winther-Jensen, Izgorodin
PCT/AU2012/000668	Breathable electrode structure and method and system for use in water splitting	Winther-Jensen, Winther-Jensen, MacFarlane



Members of ACES and Uniquest announced the successful spin out of the ACES water splitting technology in a company called Aquahydrex.

Based on the initial business case developed by ACES in 2011 and assistance from Mr Paul Barrett (UniQuest), in 2012 ACES secured venture capital investment from True North Venture Partners in a spin out company - ***AquaHydrex***.

The AquaHydrex technologies are the culmination of years of research that has taken place within the lead node of ACES and and the Monash University ACES node as well as in other Australian Research Council (ARC) supported projects at Monash University. The research teams have developed new electrochemical systems for splitting water, with and without the use of sunlight. The technologies involve novel catalytic processes that enhance the efficient electrolysis of water to produce hydrogen. A second set of technologies are inspired by photosynthesis to assist the production of oxygen gas from water under sunlight.

This investment underlines our strategy at ACES. Our research is targeted at addressing the needs of society. In addition, ACES aims to build the skills and infrastructure required to translate the research into commercially viable opportunities.

This new investment adds, in a material and very substantial way, to the investment that the ARC has made in ACES. It holds the future promise of a major technological and social impact, with accompanying benefits to Australia.

UniQuest, one of Australia's leading technology transfer companies, partnered with the University of Wollongong and Monash University to develop the business plan and raise capital for AquaHydrex. According to UniQuest Managing Director David Henderson, the investment highlights the strength of Australian university inventions. "AquaHydrex is a great example of a university technology that has been developed to an investable opportunity. It is really a credit to the expertise and determination of the research teams at UOW and Monash," Henderson said.

True North Venture Partners lead a $300 million venture capital fund that seeks to identify disruptive innovations and work with management teams to build companies for the long-term in the areas of energy, water, waste, and agriculture.

AquaHydrex was described as an example of the interesting and globally relevant innovation in Australia, by Steve Kloos, Partner at True North Venture Partners.

The experience and knowledge gained of spinning out AquaHydrex has provided ACES with valuable skills and partnerships to assist in the exploitation of other outcomes in the energy, bionics and materials research programs.

The CRC Polymer research funding commenced in July 2012 that ensured work will continue in the area using polymers for solar cells; namely fundamental and applied research related to the manufacture of polymer-based dye-sensitised solar cells and the development of encapsulants for solar cells.

METAL-AIR BATTERY

Further developments of the metal-air battery have been achieved in 2012. A current research and development agreement is under discussion with Samsung for potential commercial uptake in 2013. The improvement in the rechargeable performance of the battery due to the use of zinc, graphene and magnesium needs confirmation and further understanding for this to occur.

The Bionics Program

The medical bionics program at ACES has the potential to deliver significant solutions in the near term that will help reduce the costs of care for aged people. As the water splitting project was built into an investible proposition, the primary focus in 2012 was to identify a spin out opportunity that could be nurtured in the Bionics program.

Initial business development discussions took place with several financial institutions, including Sydney Capital Partners, with an interest in the Life Science sector. Discussions have taken place with Commercialisation Australia. Clinicians have also been interviewed, through ACES collaborators and via OGL Ortho Group, to ascertain the level of functionality required in any product. These discussions have led to insights into what the opportunities are, who potential partners are and what the pre-requisites would be for attracting capital investment or strategic agreements with existing businesses.

As in the case of water splitting technology, what is clear, is that without a working prototype it will be extremely difficult to move past the initial level of communications in both industry and finance.

However, in parallel, ACES have been developing strategic research partnerships, for example with Shimmer, a developer and international distributor of wearable

sensors, to enable the production of a prototype device which will require a systems integration approach.

Additionally, discussions on wireless communication are being initiated at both a governmental and industry level within Taiwan, where there is potential for a research and development partnership as well as industry investment. All discussions to date have highlighted that any resulting product will be a global leader in the medical device industry assisting mobility of post-operative orthopaedic patients.

OTHER BIONICS

The opportunity to submit projects to the NSW Medical Device Fund was taken up in the areas of wearable bionics and implantable nerve conduits. Although not successful in moving to the next stage of application, both applications were in the top 30% of applications and were invited to be resubmitted in the next round. The process also allowed feedback to be harnessed in subsequent submissions and required researchers to vocalise projects as an investible proposition to government.

Delegations to Taiwan and China have established contact with influential leaders in research and government. Possibilities for collaboration with government, researchers and industry within Taiwan, China, Korea, Japan, India and the US will assist to identify and meet regulatory requirements for any device within different countries as well as advance the research outcomes and commercial development of any device. Workshops with identified partners in each of these countries are targeted for 2013 to facilitate this process.

Recent developments in bioinks identified towards the end of 2012 are also poised to make an impact in the market place. Work will take place in 2013 to determine the optimal process to follow to exploit the work being conducted in this area.

Prof David Officer and Dr Sanjeev Gambhir with Dr Chetan Maini, Founder and Chief of Technology and Strategy, Mahindra Reva Electric Vehicles Pvt. Ltd., in the new Mahindra Reva assembly plant.

Engagement within and beyond the walls of ACES

In 2012, ACES was actively engaged in activities aimed at increasing the ACES end-user base. We aimed to develop and grow our networks of people and companies interested in developing research and commercial links with ACES.

In 2012, ACES hosted and engaged with a total of 198 end-user and academic visitors. These visitors are vital to communicate our science, develop collaborations and investigate potential commercial opportunities arising from ACES research. The complete list of these visitors to all six ACES nodes can be viewed in Appendix 1.

In addition ACES showcased its facilities and expertise to industry. To this end ACES hosted and participated in a number of end-user events as well as initiated the AdFab and AdBioFab workshop series aimed as marketing ACES capabilities in additive fabrication to end-users (see Appendix 2).

ACES members also attended meetings nationally and internationally with potential end-users to discuss research directions. Some examples are listed below.

- Assoc Prof Peter Innis accompanied Mr Pat Mooney, Mr Nigel Hennessy and Ms Topaz Conway (Commercialisation Australia), and Mr Peter Masterson (Ausindustry) on a laboratory tour of the facilities on 17 January 2012.
- Prof David Officer and Dr Sanjeev Gambhir visited three research institutions (12-15 March 2012): the Tata Research Institute, the National Chemical Laboratory and the Indian Institute of Science; and three companies: Larsen and Tourbro Ltd, Syngene and Mahindra Reva in India. Prof David Officer gave presentations to each institution, for example "Introduction to IPRI/ACES, Energy and Bionics Research, and Fabrication and Printing" (Tata Research Institute) and "Intelligent Polymer Research Institute (IPRI) / the ARC Centre of Excellence for Electromaterials Science (ACES) Capabilities" (Larsen and Tourbro Ltd) discussing the technical aspects of ACES research with the aim of developing links and collaborations with excellent Indian researchers.
- James Nicholson & Dr Seshu Bhagavathula (SMR Automotive Services) had a laboratory tour followed by discussions on 16 March 2012.
- 20 March 2012, Arun Kumar Jagatramka (Chairman & Managing Director, Gujarat NRE Coke Ltd) visited the solar cell water splitting area, synthesis & fabrication.

- Mr Greg Pearce, Minister for the Illawarra visited ACES synthesis and fabrication laboratories on 22 March 2012.
- Prof Don Iverson, Dr Caiyun Wang, Dr Bridget Munro and Ms Emily Zeng met with Dr He FuXiang, on 23 March 2012 at the Chinese Consulate, Sydney to discuss avenues to seek China-Australian collaborations in medical bionics.
- On the 26 March 2012, Assoc Prof Peter Innis hosted Seung Ho Yoon (Team Manager), David Hwang (Chief of Centre) and Dong Guk Yoo (CEO) of Gwangju Technopark for a laboratory and facility tour.
- On the 30 March 2012, Mr Uday Bhende, Director from Tidal & Marine Technologies Kriloskar Integrated Technologies Limited, in Mumbai visited ACES.
- IBM Distinguished Engineer, Glenn Wightwick together with SMART CEO, Garry Bowditch and COO, Tania Brown were taken on a tour of the ACES facilities and then were involved in presentations & discussions of ACES research on 7 May 2012.
- On the 10 May 2012, Dr Lee, (Executive Director, Economic Division, Taipei Economic and Cultural Office), visited ACES together with his team to initiate strategic discussions on a potential relationship between ACES and ITRI.
- In July, Prof David Officer met with the owner of British company Paintbox, Mr James Sharp, in Banbury to discuss the development of solar cells for automobiles.
- Whilst in Dublin in August, Prof David Officer and PhD Student Joseph Giorgio visited the company SolarPrint to observe their module designs targeting indoor sensing applications and to discuss possibilities of collaborative research /end-user opportunities.
- On the 15 August 2012, ACES hosted Jim Patrick, Milind Raje, Frank Risi and Martin Svehla from Cochlear.
- On the 16 August 2012, Peter Vogel from Vogel Instruments toured the facilities followed by discussions.
- Prof Gideon Levy, Additive Manufacturing and Electro Physical & Chemical Processes (inspire AG, irpd (www.inspire.ethz.ch/irpd) was involved in a laboratory tour and discussions on the 26 September 2012.

Staff Development & Training in commericialisation

Training in commercialisation has been detailed in the Education & Training section of this report. However, in 2012, the need for mentoring of not only PhD candidates but also ECR staff with an interest in commercialisation, and who could adopt future roles in this area in ACES was identified.

To this end, an ECR will be employed part-time to both receive mentoring and training from ACES personnel in commercial ventures as well as focus on identifying short-term commercial opportunities in the Bionics program; beginning early 2013. There will also be an undertaking to review the procedures so that there is better integration between all ACES nodes and an easier process to follow by ACES members for the protection and exploitation of IP and market directed research projects.

To promote the exchange of ideas and expertise between research and industry, Industry Fellowships will also be instigated in 2013, with interest from industry already highlighted from the multiple end-user activities that have been held in 2012.

Education and Training

ACES is committed to the development of innovative and effective education and training programs for both staff and students.

Education

ACES WORKSHOP PROGRAM 2012

The ACES workshop program targets both the professional development of research staff and postgraduate students as well as key areas of continuing technical and scientific education. These workshops are undertaken in the form of: one full centre meeting each year; two face to face program meetings for co-ordination of each program's research and planning of future directions as well as monthly program meetings (total 3 per month) between all nodes within the centre.

In addition, students and staff are supported to travel between nodes to undertake multidisciplinary research tasks. In 2012 ACES members this involved 37 trips.

ACES staff and students also received the opportunity to attend many seminars/ lectures (85 in 2012) from numerous visitors and collaborators to the nodes throughout the year.

'In House' Meetings and Visits

ACES 'IN HOUSE' WATER SPLITTING CO-ORDINATION DAYS (10 MAY, 4 DECEMBER)

The first co-ordination meeting in May 2012 involved participants from Monash and UOW nodes and they reviewed the potential spin out opportunity (Aquahydrex).

The second meeting on 4 December 2012 again involved participants from Monash and UOW nodes and focussed on the technical progress made in research during 2012.

ACES 'IN HOUSE' ENERGY STORAGE CO-ORDINATION DAY (31 MAY)

This meeting involved brainstorming 'energy storage' and was held at Deakin University. ACES members from Deakin University, Monash University and the University of Wollongong attended.

ACES BIONICS CO-ORDINATION DAYS (7 MAY AND 17 SEPTEMBER)

Two Bionics co-ordination days were organised in 2012. The first Workshop was held at La Trobe University and the second at Wollongong Innovation Campus.

Both workshops gave each ACES participant within the Bionics program an opportunity to update the group on their research in relationship to the milestones. National collaborators were also invited to these events to discuss opportunities in common research areas.

ACES FULL CENTRE WORKSHOP (18 SEPTEMBER 2011)

The full centre workshop was held at University of Wollongong with 79 centre staff and students in attendance.

The Deputy Director of Research, Prof Maria Forsyth, commenced proceedings by highlighting how the ARC Centre operations was undertaking to provide a dynamic, multidisciplinary research training environment for graduate students, with focus in 2012 on effective communication, emphasising the need to be able to discuss the impact of their research to a general audience, and a taste of insight about understanding industry culture.

Belinda Bright from Kepner-Tregoe, Sydney, then gave an introduction to project management; relating many of the concepts back to the project of 'completing a PhD'. Belinda is a senior consultant with a proven track record of initiating, analysing, leading and driving strategic business improvement.

The group also had a recruitment perspective for applying for jobs in research and industry given by Cara Dobinson, from UOW recruitment unit. A Bachelor of Commerce Human Resource Management UOW graduate, Cara Dobinson has worked as a recruiter for a variety of companies and organisations in Australia and the UK, including Citi Bank, financial services, insurance and consulting and community service.

A Q&A forum was then hosted by Prof Geoffrey Spinks, with panellists Marc in het Panhuis (UOW researcher with domestic & international research as well as a commercial background), Gerry Sweigers (UOW academic, Datatrace and previous CSIRO academic), Troy Lowe (BlueScope employee and former PhD member of IPRI), Kerrylee Rogers (UOW academic with SEES, with past experience of having worked within the government), Chris Gilbey (Perceptric and director of strategic development at ACES). The audience fired many questions from the floor to the panellists asking about their experiences in many situations as well as their perspective on many issues related to a PhD and job prospects.

The afternoon session provided the opportunity for graduate students to communicate their technical training and demonstrate to the group their inter-laboratory collaborative research. The students were grouped into threes and given instructions to present a talk of 15 mins consisting of a common introduction which sets all of their research in context of the bigger picture topic given; have a common conclusion with their individual technical research results discussed concisely in between.

The day concluded with participants getting together for dinner and discussions.

'OPEN' WORKSHOPS/ SYMPOSIUMS/ LECTURE SERIES HOSTED OR CO-HOSTED BY ACES

In addition to the 'in house' research meetings, several open workshops were hosted. These provide the participants the opportunity to hear and see research being done nationally and internationally (reported in international chapter of this report) as well as the chance to talk and build upon collaborative research links where commonality exists. Often participants come back recharged with a bundle of fresh new ideas or approaches for their work.

FLOW CHEMISTRY WORKSHOP (2 MARCH 2012)

This workshop was presented by Dr Kristian Knudsen a chemistry consultant with Uniqsus (a commercial company).

The workshop started with a general introduction to flow chemistry; an overview of the Uniqsis range; new flow microwave technology; a range of chemistry examples followed by a hands-on chemistry demonstration in the lab and Q&A.

ACES ETHICS WORKSHOP: 'PUBLIC ENGAGEMENT EVENT (22 SEPTEMBER 2012)

Clinical Trials for Emerging Nano-bionics: Testing Wearable and Implantable Medical Devices – a public engagement event organised by ACES (ARC Centre of Excellence for Electromaterials Science) and the NETS-PACE program within DIISRTE (Department of Industry, Innovation, Science, Research and Tertiary Education), was held on Saturday 22 September, on the Innovation Campus at the University of Wollongong.

Twelve of the 29 participants in this public event were ACES staff or students. This event was unlike any other event held within ACES. The engagement method was facilitated by Max Hardy of Twyfords with support from Susan Dodds, Ethics Program Leader, ACES and the process used was a Pro Action Café methodology, specifically designed for hosting conversations. Participants were seated at round tables of 6 and after an initial round where the questions for the day were designed by the participants a further 2 rounds of more in depth discussion on those questions took place before a final wrap up and check out.

The background provided to the event was in the development and use nano-bionic medical devices has potential to enhance future medical treatments. Existing devices include the bionic ear and significant research is being undertaken into the bionic eye and devices to treat epilepsy. Then an outline of ACES research in this area was presented.

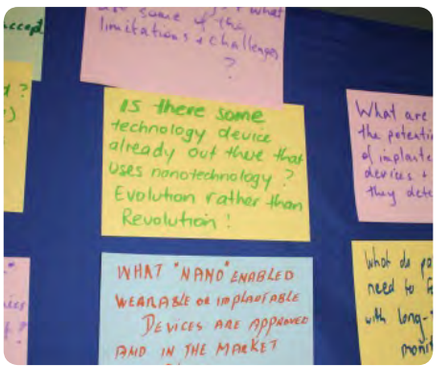
Participants included: medical researchers; science researchers; engineers; social science, legal, IT and humanities academics: representatives from regulatory bodies and research ethics committees; research leaders from ACES; policy makers; recipients, and representatives of recipients, of medical devices, including carers and consumer advocates; as well as, interested persons from Wollongong and Sydney. Participants ranged in age from late teens to mid-seventies, were almost equally distributed with respect to gender (16 of 29 participants were women, 55%) and came from Adelaide, Canberra, Hobart, Melbourne, Sydney and Wollongong

International Symposia

In addition to these training workshops, the international symposiums hosted and co-hosted by ACES are outlined in the International or End-User sections of this report. These events included:

- 7th Annual International Electromaterials Science Symposium held at Deakin University, Geelong, VIC
- Processing and Fabrication: The ultimate challenge for functional materials 2 day symposium held at, Australian Institute for Innovative Materials (AIIM), Innovation Campus, Wollongong
- Inaugural AdFab2012: The Additive Fabrication Prototyping Conference & Workshop held at University of Wollongong
- The 5th Australasian Symposium on Ionic Liquids (ASIL-5) jointly organised by the Monash Ionic Liquids Group, CSIRO and the ARC Centre of Excellence for Electromaterials Science
- 3rd Asia-Pacific Symposium on Nanobionics held 19-21 September 2012 at Innovation Campus Wollongong.

Clinical Trials for Emerging Nano-bionics: Testing Wearable and Implantable Medical Devices - a public engagement event organised by ACES (ARC Centre of Excellence for Electromaterials Science) and the NETS-PACE program within DIISRTE (Department of Industry, Innovation, Science, Research and Tertiary Education), was held on Saturday 22 September at Wollongong.



Questions were formulated from the audience to discuss during the event.

Training

Seminar programs at the various ACES nodes have presented opportunities for all ACES staff and students to have a mix of research and commercial topics. For example, students and staff at ACES/IPRI were given a large range of research topics to attend as well as a lecture from Dr Stephen Livesey who spoke about commercialisation of his research to produce Alloderm, a regenerative tissue matrix. Then Alexander Gosling and Andrew King at Capstone Partners shared experiences with researchers from their vast forays in the commercialisation of technology, and business & technology strategy, as well as the development of an incubator (Turnstone) designed to strengthen research-industry links.

THE TRANSITION PROJECT (2012)

2 ACES PhD students Willo Grosse and Dennis Antihos participated in a pilot project, 'The Transition Project', run by Perceptric and independently funded by UOW. The aim was for the students to ask what skills they needed to be competitive in industry rather than academia. The students interviewed strategic directors of companies to find out what skill set these directors thought were essential if students were to find employment in industry.

For the PhD candidates, this project enabled a unique opportunity to develop personal relationships at a strategic level inside industry, building insights about the impact of government policy as well as a new understanding of company culture in delivering performance. More importantly they appreciate what they each individually need to do to transition successfully from academia into industry.

The pilot program was considered to be successful and beneficial so will be expanded to allow a couple of interested PhD students from other nodes of ACES to participate in 2013.

OTHER COMMERCIALISATION TRAINING

ACES/IPRI PhD student Willo Grosse completed the Graduate Certificate in Research Commercialisation run at University of Wollongong in 2012.

As part of this course Willo developed a marketing plan for '3D printing of living cells' then presented the plan to the group.

As well as undertaking his PhD studies Dennis Antihos (PhD IPRI) completed a graduate certificate in business administration in 2012 with the Sydney Business School at UOW.

The course focused on economics and financial strategy and Dennis commented that the advantage of the course was that it provided a broader skill set which is needed in industry in terms of projects, budgets and strategy.

Cameron Ferris (PhD ACES/IPRI) is also undertaking the Graduate Certificate in Business Administration at Sydney Business School at UOW. Cameron has found the course to be an excellent introduction to business and management principles, and supplements his PhD degree by providing foundation knowledge of the business world that will be useful for any career, whether in research or industry. Cameron will graduate mid 2013.

Boeing Manager of Advanced Research Teams David Stein and the Advanced Research Team Lead Patrick Kinlen conducted a session on career opportunities at Boeing for interested PhD students at ACES/UOW in November 2012.

TRAINING SUPPORT

Our aim at ACES is to maintain a vibrant supportive network.

As our ACES enterprise has grown from strength to strength the contribution of PhD students has become even more important.

The director of research strongly encourages "all of the ACES members to make all students welcome, to keep an eye out for those who might need that extra bit of encouragement and to be proactive in providing support. Even for those students not directly under ACES staff supervision you can provide valuable support by being proactive and assisting in their integration into ACES activities. Our success depends in no small measure on the success of our students".

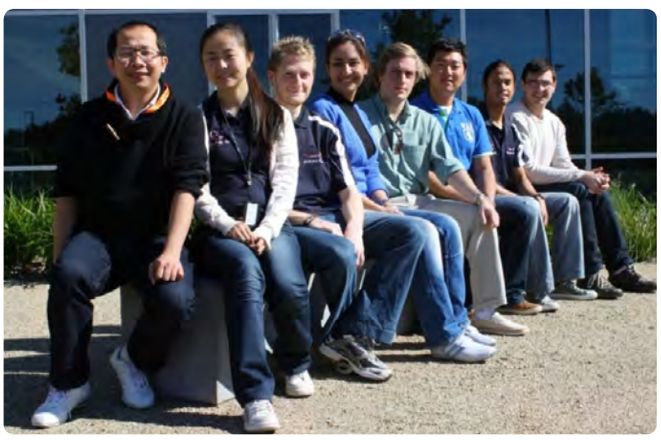
ATTRACTING PHD STUDENTS

ACES provides an exceptional research environment, with a collection of research training skills and facilities that is internationally renowned. A recent case study in 2012 highlighted this.

PhD student Sara Ahmadi told the Sydney Morning Herald reporters about her motivation to come to ACES to study a PhD.

For Sara's thesis, through ACES, she is trying to develop a polymer drug treatment for the 30 per cent of epilepsy sufferers who cannot take traditional oral medications.

Ahmadi is part of a project being undertaken by several research groups that aims for a molecular carrier to deliver a drug directly into the brain tissue and release it whenever a seizure is about to occur, in effect stopping it.



ACES at UOW is lucky to have attracted many international students: from Thailand, China, Ireland, Iran, USA, Korea, Philippines, to name a few.

Her role is to design an effective gate for the carrier that will open and close to dispense the drug only as needed.

Ahmadi studied chemical textile engineering in Iran. Typically, graduates end up in some of Iran's many textile factories developing fibres, dyes and procedures to produce beautiful fabrics.

But when Sara decided to pursue her education internationally for the cultural experience it would offer, she chose her unrelated PhD thesis based on which researchers she wanted to work with. Having sought feedback from friends at universities around the world, it was those involved with Prof Gordon Wallace and Assoc Prof Simon Moulton at the centre that stood out as the most satisfying and inspiring.

Ahmadi expects to return to Iran upon graduation and continue in the field of medical engineering.

PHD STUDENT TRAINING SCHEME 2012

Here at ACES we concur with the aim under vision as outlined in the research skills for an innovation future booklet produced by the Australian government in 2012, where at the end of their ACES PhD, the aim is for these graduates to have the skills and attributes to both engage in world-class research and make productive contributions in a wide spectrum of professional roles.

A PhD candidate in ACES will always be required to develop the skills needed to carry out independent research at the highest level possible by the end of their candidature. That will at times mean – exposure to areas of research that take the candidate outside the "comfort zone". The candidate is required to learn the skills needed to develop collaborations and to work effectively with the supervisory team to ensure progress in sometimes unfamiliar areas. These are vital skills for future researchers!

In 2012 ACES/IPRI introduced a Student Training Scheme, to ensure a more consistent training environment for all PhD students. During the first semester (March–June) students were given 3 hours of lectures each week with a range of diverse topics: from rules, policy; defining your research topic; sourcing literature; getting to know your supervisor through to more technical topics such as synthesis of conducting polymers; conduction mechanisms; carbon nanotubes, meso-carbon and graphene; biomaterials; electrochemistry of conducting polymers; introduction to spectroscopy and microscopy. Our expert in residence for 2012, Prof Dennis Tallman (USA), also ran a very comprehensive electrochemistry lecture series for these students from 6-23 March, giving 14 x 4 hour lectures in this area. Prof George Malliaras (France) gave a lecture on organic conductors.

Upon completion of the lecture series each student sat an exam and was provided with feedback on their progress and areas where possible improvement could occur were highlighted.

In addition, in 2012, early career research (ECR) fellows were asked to organise technical session talks as part of the weekly ACES/IPRI seminar program. The ECR's liaised and hosted lab tours for many of the international and national guests as part of this weekly seminar series; giving them the opportunity to engage directly with high profile career researchers.

FOURIER TRANSFORMED AC VOLTAMMETRY (FTACV) WORKSHOP

Prof Alan Bond and Kiran Bano ran a hands-on Fourier Transform workshop for ACES/IPRI in June at Wollongong. Prof Bond also gave a lecture, entitled 'Advances in Applications of Electrochemistry Made Possible by Integrated Instrumentation, Theory and Data Analysis that Exploit Fourier Transform Based Protocols '. In this lecture he described on how Fourier Transform Techniques have revolutionised Nuclear Magnetic Resonance Spectroscopy. He showed how equally significant advances in Electrochemistry can be achieved by use of Fourier transformed large amplitude AC voltammetric methodology that allows resolution of large data sets into their DC, fundamental and up to ten or more higher order AC harmonic components.

ACES staff and students use FTACV, the electrochemical technique designed by Prof Alan Bond that uses Fourier Transform Analysis of Cyclic Voltammograms to separate faradaic and non-faradaic components of their electrochemical data.

TIME-MANAGEMENT WORKSHOP

PhD student Cathal O'Connell (ACES/IPRI) ran a time-management workshop for all interested ACES students on 17 July at Wollongong. Several final year students each gave 3 min presentations on time-management strategies they used to increase their own effectiveness during their PhDs. Open discussions were held after the presentations. The workshop aimed to disseminate practical techniques which are specifically tailored to a laboratory-research setting. It also started each student thinking critically about this aspect of their day-to-day work.

STAFF TRAINING

Three forums were held in late 2011 where current ACES/UOW PhD students were given the opportunity to provide a 5-7min presentation on 'Effective PhD student supervision - the student's perspective', in the presence of the Director of ACES research.

In a follow-up during 2012 two further forums were held specifically for staff on 'effective student research supervision'.

Dr Kerry Gilmore (ACES/IPRI) also attended a Research Supervision Masterclass, held at UOW on 11 October. This class was given by Hugh Kearns, recognised internationally as a public speaker, educator and researcher. This masterclass updated participants on policies and procedures but mostly it looked at how to help the student get the most out of the post-graduate research experience.

INTERNSHIPS

Six high performing University of Wollongong Science Faculty undergraduate students were selected in December 2011 for the 2012 ACES internship program (Work Integrated Learning Scheme).

As ACES is a multidisciplinary team we were able to attract interest in these scholarships from undergraduate students studying a range of degrees (Bachelor of Science-Arts; Bachelor of Medical and Health Sciences Advanced (Hons); Bachelor of Medical Biotechnology Advanced, Bachelor of Nanotechnology, Bachelor of Science/Commerce, International Bachelor of Science).

Prof Wallace noted it was important to engage with the best and brightest students in the early stages of their undergraduate degrees and that the program was expected to reap tremendous rewards for both UOW and the individuals involved.

The interns started with ACES during the University session in 2012, with a brief to complete one project per session plus an 8 week research project over the summer session.

- Michael Diamond, a second year Medical Biotechnology (Advanced) student, investigated the topic of Cell Culturing on Novel Conducting Surfaces.
- Second year Medicinal Chemistry (Advanced) student Brooke Besser hoped the experience would affirm her desire to pursue research as a career after university.
- Rachael Zuzek, who is completing her second year of study in the Medical and Health Sciences (Advanced, Honours) course, research project was focused on controlled drug delivery systems.
- Vito Giorgio worked towards making a photoactive electrochemical sensor for biomolecules.
- Christopher Richards on adaption of commercial additive fabrication system to allow processing of developmental materials and
- Jacob Byrnes on twisting textile yarns (polyester, nylon, Spandex) with thin gauge stainless steel wire and coating textile yarns with conducting polymer.

SUMMER SCHOLARSHIPS

Each year ACES offers summer scholarships to work on a given project in the area of Advanced Materials, Medical Bionics or Energy.

For summer 2012-2013 ACES teamed with BlueScope, who have funded 3 scholarships to embark on important areas of research that will utilise the extensive ACES materials, fabrication & characterisation facilities and research platforms.

Each of the projects has been targeted at gaining a more detailed understanding of factors influencing bacterial/microbial adhesion and hence biofouling and more specifically biodriven corrosion. The knowledge accrued will be used to develop strategies (e.g. anti-fouling coatings and paints) to circumvent these adverse processes.

A further IPRI scholarship was granted for the summer 2012-2013; in the area of in the area of drug delivery using biofuel cells.

TOP-UP SCHOLARSHIPS ENGAGE PHD STUDENTS IN WOLLONGONG SCIENCE CENTRE PLUS MUCH MORE

ACES/IPRI PhD student Willo Grosse was involved in the design of a series of information panels for the new Nanotechnology Exhibit at the Wollongong Science Centre. This exhibit opened in 2012 by Australia's Chief Scientist, Prof Ian Chubb on 18 July.

As a joint project between the Wollongong Science Centre and the next-door ARC Centre of Excellence for Electromaterials Science (ACES), part of the exhibit was designed by ACES PhD students Joseph Giorgio, Cathal O'Connell, Yang Yang and Willo Grosse, who jumped at the opportunity to communicate her work with the public.

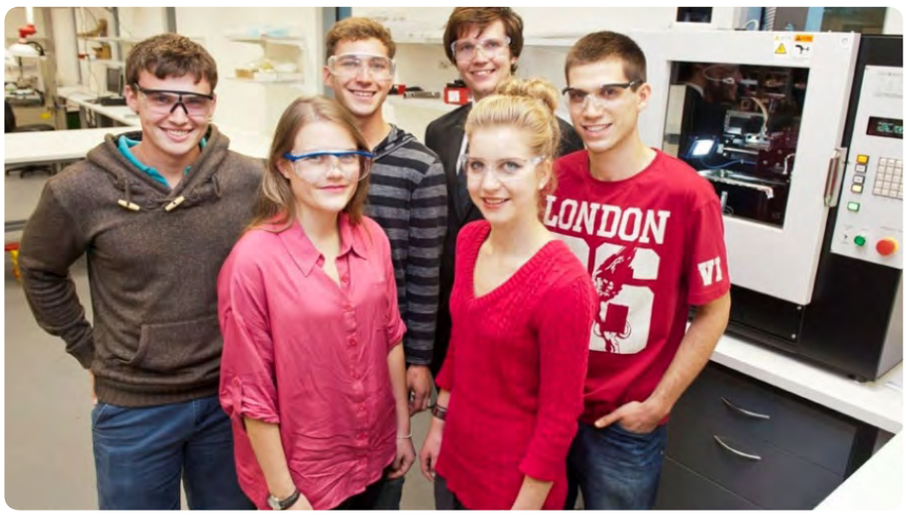
ACES Director Gordon Wallace addressed the capacity audience of 70 at the launch, commending the effort put in to the exhibit over a period of three years.

"This exhibition gives us researchers an opportunity to share our excitement and our vision with the community," said Prof Wallace.

Learning about something that is a million times smaller than the width of a needle point isn't easy, but the exhibit makes Nanotechnology easy to understand for everyone.

Cathal O'Connell (PhD student, ACES/IPRI) who is also a recipient of a top-up scholarship achieved a substantial list of outcomes in 2012:

- represented ACES at the NSW State Final of the Fresh Science competition
- initiated a PhD student support group at ACES/IPRI (known as Functionalised Coffee).
- been profiled by UOW Research & Innovation magazine.
- was interviewed by Nick Rheinberger presenter of ABC radio that was played on ABC Illawarra radio highlighting research at ACES/IPRI.
- assisted ACES Communication and Media Officer, Natalie Foxon, with a grant proposal for a 2013 science week event.
- assisted with various ACES outreach programs including running two days of hands-on nano-experience for local school groups in August.



ACES interns (back row left to right) Jacob Byrnes, Michael Diamond, Christopher Richards and Vito Giorgio with fellow interns (from left to right) Brooke Besser and Rachael Zuzek.

International Profile

ACES continues to build research excellence, attracting many international staff and students. The collaborative links that reach across international boundaries add a critical dimension to our research and training programs.

These links are built as a result of hosting and providing attendance at many events throughout the year.

In 2012 ACES hosted 5 international workshops, 2 international delegation workshops, accepted 45 invitations to present overseas at international conferences and 25 invitations to give invited seminars overseas and made 63 visits to leading international laboratories (in 17 countries).

In 2012 ACES nodes hosted 92 visitors from 23 countries. 41 of those international visitors (from 17 countries) used the ACES laboratories /facilities to participate in hands-on research work, confirming that the facilities built at ACES since inception are state-of-the-art and world class.

ACES has ongoing research collaborations with 81 international institutions in 22 countries. As a result of these collaborations 3 book chapters and 47 refereed journal articles were published in 2012.

Details of these events and international links are given in more detail in the supplementary information at the end of this report. In particular, reports on the workshops and delegations are in Appendix 3; ACES collaborations country by country can be viewed in Appendix 4 and a list of the invited talks ACES were asked to deliver in 2012 is in Appendix 5.

MONTHS	CONFERENCES	RESEARCH ORGANISATIONS
January	2	2
February	3	-
March	7	6
April	2	3
May	6	2
June	6	2
July	6	2
August	5	5
September	13	6
October	5	5
November	2	3
December	2	2
Total	**59**	**38**

Number of ACES invited talks each month International Conferences (not hosted by ACES) and to Universities and other Research Organisations

National Collaborations 2012

ACES provides the national focal point for electromaterials research. In 2012, 67 refereed journal articles were published in collaboration with 23 national institutions.

ANFF

ACES/IPRI hosts the Materials Node of the Australian National Fabrication Facility (ANFF) with the Newcastle-based CoE as a member. The Materials Node continued to provide a variety of electromaterials and characterisation services to both local and national researchers and industry groups throughout 2012.

Australian Nuclear Science and Technology Organisation (ANSTO)

PhD student Cameron Ferris completed his work aimed at detecting and optimising the coupling of RGD to gellan gum at ANSTO, courtesy of an $8K AINSE grant (ALNGRA11049-2011).

ACES and ANSTO also collaborate together within the CRC polymer research program.

Australian Solar Institute (ASI)

An ASI PhD top-up scholarship was awarded to Joseph Giorgio (ACES/IPRI) and will assist to further the research into examining light-weight and flexible solid-state dye-sensitised solar cells.

BlueScope Steel

For summer 2012 ACES has teamed with BlueScope Steel, who has funded 3 scholarships in the area of microbial fouling of coatings.

ACES is also working with BlueScope within the CRC for Polymers on developing new polymer encapsulants for flexible solar cells on steel.

CSIRO

ACES researchers have ongoing collaborations with researchers from CSIRO.

Prof Maria Forsyth is working with Dr Adam Best and Dr Tony Hollenkamp in the area of Lithium metal batteries.

Prof Maria Forsyth (ACES) and Dr Anita Hill (CSIRO) collaborate on the characterisation of plastic crystal electrolytes using positron annhiliation lifetime spectroscopy.

Prof Douglas MacFarlane has ongoing collaboration with CSIRO researchers Drs Mike Horne and Theo Rodopoulos in the area of application of ionic liquids and carbon dioxide reduction.

Prof Leone Spiccia has been collaborating with Assoc Prof Udo Bach and Prof Yi-Bing Cheng, Prof Andrew Holmes University of Melbourne/CSIRO) and Dr Richard Evans (CSIRO) on new materials for dye sensitised solar cells.

Prof Maria Forsyth (CI, ACES/ Deakin) along with Dr Tony Hughes and Dr Ivan Cole at CSIRO collaborate in the area of corrosion mitigation of aerospace alloys.

Dr Angel Torriero commenced a collaboration with Dr Miao Chen (CSIRO minerals, Clayton) studying the 'Passivation and rate-determining factors in bio-leaching of minerals' in 2011 which continued throughout 2012.

ACES Bionics researchers are actively collaborating with Dr Pascal Vallotton, who heads the Biotech Imaging Group (CSIRO Mathematical & Information Sciences - Sydney) in creating customised image analysis software to characterise neurite outgrowth.

ACES Bionics researchers are actively collaborating with Dr Louis Kyratzis, who heads the Biomedical Textiles Materials Science and Engineering Group (CSIRO Materials Science and Engineering – Geelong) in the refinement of a nerve repair prototype for peripheral nerve injury. This project involves the development of microstructured biodegradable materials for nerve regeneration and the synthesis of a nerve repair conduit which is being tested in vitro as well as in a rat model of nerve repair ***(J. Neural Eng. 2013 10(1):016008)***.

Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE), Monash and Griffith University

Prof Susan Dodds, Prof Ian Lowe (Griffith University) and Prof Alan Petersen (Monash) are collaborating to produce a Socio-Economic Impact Framework commissioned by Department of Industry, Innovation, Science, Research and Tertiary Education DIISRTE), National Enabling Technologies Strategy (NETS); this project will continue into 2013.

Defence Materials Technology Centre (DMTC)

ACES researchers Prof Maria Forsyth, Dr Patrick Howlett, Dr Jim Efthimiadis and Dr Paul Bayley are part of a team from Deakin working with the Victorian Centre for Advanced Materials Manufacturing and Horizon Energy Systems Pty Ltd to develop 'Portable Power Generation and Storage'. The project is funded by the Defence Materials Technology Centre Limited (DMTC). The project commenced in October 2012 and ACES researchers will contribute to the development of a 'Soldier Borne Energy Generation and Storage' system.

DSTO

Working with DSTO, ACES/IPRI researchers continue to optimise actuator technologies for the Wireless Aquatic Navigator for Detection and Analysis (WANDA), an autonomous mobile fish with sensing capabilities. Dr Tan Truong from DSTO spent two weeks in 2012 with researchers in ACES/IPRI. A patent has been lodged on the Rapid Preparation of Polypyrrole Films and Coatings from this collaboration. The joint work also resulted in a paper published in ***Langmuir*** (***2012, 28, 29, 10891-10897***) on 'The role of unbound oligomers in the nucleation and growth of electrodeposited polypyrrole and method for preparing high strength, high conductivity films'.

Hearing CRC

The research with Hearing CRC continued in 2012 to modify the surface of cochlear implants with the aim to achieve improved neural interfacing was published in ***Electrochemistry Communications (2013, 27, 54-58)***. This work involved close interactions with Dr Claudia Tasche, Mr Freddy Dueck and Dr Martin Svehla from Cochlear Ltd.

Monash University (Prof Alan Bond's Electrochemistry Group)

Prof Leone Spiccia has been collaborating with Prof Alan Bond and Assoc Prof Lisa Martin (Monash University), Dr Conor Hogan (La Trobe University) and Dr Paul Francis (Deakin University) in the area of electroactive ruthenium complexes and the uptake of peptide nucleic acid conjugates by biomimetic membranes.

Prof Leone Spiccia has been collaborating with Assoc Profs Udo Bach (Monash Engineering and Tony Patti (Monash Science), and Drs Will Gates (Monash Engineering) and Shery Chang (Monash Centre for Electron Microscopy) on water oxidation catalysis.

Polymer CRC

ACES research into polymer-based dye sensitised solar cells has been incorporated into the CRC polymers.

The new five year CRC for Polymers extension research program began in July with ACES/IPRI researchers to be involved in Program 3: Polymers for Solar Cells. Prof Officer leads this program that includes three projects. Project 3.1 is a program of fundamental research, which involves the CRC-P PhD students, Project 3.2 aims to develop a manufacturing process for polymer-based dye sensitised solar cells and involves researchers in IPRI, ANSTO, University of Newcastle (UNew), University of Queensland (UQ) and the University of New South Wales (UNSW), and Project 3.3 involves researchers at IPRI, ANSTO, UNSW, UNew, QUT, UQ and BlueScope working on the development of polymer encapsulants for solar cells. With the majority of staff still to be appointed on these projects, it is anticipated that project work will begin in earnest in 2013.

St Vincents Health Melbourne (Prof Choong) and University of Melbourne (A/Prof Damian Myers)

In 2012 ACES continued to build collaborative activities with the department of medicine and orthopaedics. This collaboration involves surgeons, researchers and clinicians working together to improve osteochondral bone defect repair. In 2012, 3D chitosan scaffolds fabricated via extrusing printing was examined as an initial step towards tri-structure implantable scaffolds. The post printing process of these scaffolds was optimised to prevent inconsistent/ uncontrolled swelling during rehydration. The seeding of stem cells derived from infrapatella fat pads (IPFP) onto these scaffolds demonstrated promising results with signs of hyaline cartilage production.

University of Newcastle - Centre for Organic Electronics

Dr Patrick Howlett (RF, ACES/ Deakin) has collaborated with Dr Rob Atkin in the Centre for Organic Electronics studying the 'double layer structure of ionic liquids at surfaces using atomic force microscopy'.

University of NSW

ACES/IPRI undertook a collaborative project in the area of water splitting with Prof Rose Amal's group at UNSW (part of ARC Centre of Excellence for Functional Nanomaterials (ARCCFN)). The work was published in ***Energy & Environmental Science*** in 2012.

University of Queensland

In 2012 researchers at ACES/IPRI began collaboration with Dr Victoria Flexer, from the Advanced Water Management Centre at The University of Queensland, on Microbial Bioelectrochemical Systems using CNT NanoWeb /RVC Porous Electrodes (***Energy & Environmental Science, DOI:10.1039/C3EE00052D***)

Dr Frederic Gilbert from the ACES Ethics Program has been actively collaborating with Dr Brad Partridge from Centre for Clinical Research of the University of Queensland, on challenges to protect (i.e. with new helmet technology) Australian codes football rule players from concussion.

University of South Australia - Mawson Institute (Prof Rob Short, Prof Hans Greisser, Dr Rick Fabretto)

Our investigations in 2011-2012 have included looking at the influence of glycol incorporation on protein and cell attachment to conducting materials as well as the effect of biasing substrates on protein presentation. This work was published in ***Biomaterials Science in 2012*** (DOI: 10.1039/c2bm00143h).

University of Sydney

ACES/IPRI researchers are continuing to collaborate with Prof Marcela Bilek from the School of Physics at the University of Sydney on the plasma immersion ion implantation (PIII) of conducting polymers for linker free covalent attachment of proteins and enhanced cell adhesion. The merging of ACES/IPRI work on conducting polymers with Prof Bilek's pioneering methods for manipulating ionised matter (plasma) by means of electric and magnetic fields has led to the development of high-performance biocompatible and conductive surface coatings for medical implants (***Acta Biomaterialia***, ***2012, 8: 2538-2548***).

Visiting fellow Dr Weimin Zhang, from the laboratory for sustainable technology at University of Sydney, performed catalytic fuel cell experiments in ACES/IPRI laboratories for 8 months of 2012, to determine the quantity and electro-catalysis of the products from catalytic materials produced at Sydney University. As a consequence of this collaboration researchers from ACES/IPRI have enjoyed access to techniques and equipment available within Assoc Prof Andrew Harris's group and analytical centre at University of Sydney. Two joint publications on this work are in progress.

During 2012 the collaboration between ACES/IPRI and the Group of Tim Schmidt at the University of Sydney progressed. This collaborative research focussed initially on integrating photon upconversion systems into dye sensitised and organic solar cells. More recently this expanded to look at other projects, including printing of luminescent solar concentrators. The collaboration has combined the manufacturing technologies and device fabrication expertise at the University of Wollongong, along with the characterisation facilities and theoretical work from University of Sydney.

University of Wollongong

ACES researchers worked with Prof Huang, Director of the Centre for Translational Neuroscience, Director of the Schizophrenia Research Institute and Scientific Director in the School of Health Sciences, in the past year, to establish whether conducting polymers are able to be used effectively for directing neural arborisation.

Dr Michael Higgins (ACES/IPRI) has undertaken collaborative research with Dr Jenny Wong from the Illawarra Health and Medical Research Institute (IHMRI) on a project involving AFM of amyloid fibres in Alzheimer disease (***Neuroscience***, ***2012, 210: 363-374***).

Profs Geoffrey Spinks, Gursel Alici and Gordon Wallace and Drs Wen Zheng and Bridget Munro (ACES/IPRI) have continued collaborative work to develop conducting polymer actuators for the 'Wearable Lymph Sleeve' with Prof Julie Steele (Biomechanics Research Lab, UoW) and Prof Philip Clingan (Illawarra Health and Medical Research Institute, UoW). The work has produced a publication in ***Journal of Polymer Science Part B: Polymer Physics*** in 2012.

Victorian Organic Solar Cell Consortium (VICOSC)

Prof Leone Spiccia and colleagues from Monash University are involved in a collaborative project with Melbourne University and CSIRO, which seeks to develop flexible organic photovoltaics and dye-sensitised solar cells on plastics and steel. The project has received funding from the Victorian State Government, the Australian Solar Institute, Bluescope Steel, Securency, Innovia and Bosch.

In Appendix 6 there is a summary of the national engagement by ACES members and associates, at conferences, symposia and collaborative visits.

Prizes & Awards 2012

ARC Laureate Fellow: Professor Doug MacFarlane

Prof Douglas Macfarlane was a recipient of one of the 17 fellowships with a total value of $46,654,655 over 5 years that have been awarded by the Australian Research Council (ARC) under the Australian Laureate Fellowships scheme for 2012. The scheme is designed to attract world-class researchers and research leaders to key positions, and create new rewards and incentives for the application of their talents in Australia.

Doug's Australian Laureate Fellowship will help him create novel materials that will be used to develop new sustainable chemical technologies. The project will incorporate local and international collaborators and will focus on new approaches to the conversion of carbon dioxide into valuable chemicals and for renewable energy generation and storage.

"I am pleased this fellowship will allow me to focus entirely on my research goals and provide an exceptional research training opportunity for the next generation of Australian scientists," Doug says.

Doug was awarded his PhD in 1983 from Purdue University, United States in the field of Chemistry.

Prof Douglas MacFarlane receiving his ARC Laureate Fellowship from the Federal Minister for Tertiary Education, Skills, Science and Research, Senator Chris Evans.

He held postdoctoral positions in France and New Zealand before coming to Australia to take up an appointment at Monash University. He is also currently an International Fellow of Queen's University Belfast, United Kingdom, an Adjunct Professor at the Centre for Green Manufacturing at the University of Alabama and a Visiting Professor of the Chinese Academy of Science in Beijing.

Doug commented that "These international experiences have tremendously broadened my perspectives on research in other parts of the world, as well as the different cultural, political and economic factors that drive their research priorities."

Discovery Outstanding Researcher Award (DORA)

The DORAs provide opportunities for mid to late career academics. Selection is based on the needs of the project in addition to the excellence of the researcher. DORAs are available for up to three years and up to 70 awards are funded each round.

ACES chief investigator Prof Leone Spiccia received a DORA for his project 'functionalised nanomaterials for application as multimodal cancer imaging' (DP130100816, $850k).

Incoming Short Term Travel Fellowship

Prof David Officer was awarded Incoming Short Term Travel Fellowship 2011 to support international collaborations to spend 3 months at Dublin City University from July to October 2012.

In order to increase the transfer of skills and knowledge to Irish research groups, the SFI launched the Incoming Short Term Travel Fellowship programme.

The programme aims to facilitate collaborations with world-class centres of research excellence and raise international awareness and recognition of Irish science and high-quality research.

The Science Foundation Ireland advances national scientific progress by awarding grants for research on a competitive basis in those fields of science and engineering that underpin biotechnology, information and communications technology, and sustainable energy and energy efficient technologies.

The Fellowship gave a unique opportunity for Prof David Officer (CI, ACES/UOW) to integrate the multifunctional polymer design and synthesis capabilities developed by him with the sensing devices and platforms developed by Prof Diamond (DCU).

During his time at DCU in 2012 David worked with Prof Diamond's researchers in the Clarity research centre, presented ACES research at two conferences, visited and presented ACES research at 8 research institutions in Ireland and Europe, and visited 2 companies.

Japan Society for the Promotion of Science (JSPS) Fellowship

Dr Michael Higgins (SRF, ACES/IPRI) was nominated by the Australian Academy of Science (AAS) to the Japan Society for the Promotion of Science (JSPS) for the prestigious JSPS Invitation Fellowship for Foreign Researchers to commence in the Japanese 2012-2013 Fiscal Year. Dr Higgins was awarded the fellowship by the JSPS and visited the laboratories of Prof Takayuki Uchihashi (Kanazawa University) from 1-21 November 2012, to work on the development of high-speed electrochemical Atomic Force Microscopy (AFM) to directly visualise real-time (video-rate) dynamics of conductive interfaces and their interactions with biomolecules.

Bob Frater Award

Dr Stephen Beirne (RF, ACES/IPRI) was the recipient of the Australian National Fabrication Facility (ANFF) Frater Award 2012 for staff development. He receives $5000 towards 'Advanced metal additive fabrication system training at Realizer GMbH'.

Bill Wheeler Prize

Unique bionics research taking place at University of Wollongong's Intelligent Polymer Research Institute (IPRI) continues to be highlighted on the international stage thanks to the Bill Wheeler Award.

The annual Bill Wheeler Award offers $2,000 of community raised funds to a University of Wollongong PhD student engaged in a Medical Bionics project of significance to the larger community. The Illawarra community has raised funds to support local young University of Wollongong researchers, all inspired by the late Bill Wheeler.

Presented at the annual Bill Wheeler Symposium on August 6, the 2012 Award was won twenty six year old UOW PhD student Willo Grosse, who works in the world renowned ARC Centre of Excellence for Electromaterials Science Bionics program on Innovation Campus.

"It's important for us researchers to remember that what we do is for the community," said Willo. "The Bill Wheeler Award reminds us of this, and gives as extra incentive to deliver results."

Willo used the funds to travel to Hanyang University in Korea to undertake further work on fuel cell powered controlled release, a project which focuses on controlled release of anti-epileptic drugs through brain implants.

Three Minute Thesis (3MT) Winner

Tristan Simons (PhD, Deakin) was selected as the People's Choice award winner at the national three minute thesis finals held in Queensland for his presentation: 'Sun to Socket: The Zinc-Air rechargeable battery'. To gain entry into the national finals Tristan was the winner of Deakin University's Three Minute Thesis Competition.

State finalists in the Fresh Science competition

Cathal O'Connell and Matt Griffiths (both PhD students ACES/IPRI) were selected as State finalists in the Fresh Science competition. This competition is a great Science Communications opportunity for our PhDs/ ECRs to get media attention and media training. It's a national program in which ECRs are chosen from each state to participate in state finals and which culminates at the national event.

Conference Awards

Dr Frederic Gilbert (ACES/UTas) was awarded an Australian Nanotechnology Network (ANN) presentation/registration award to present his research on 'Moral hazards related to nano-bionics implants in the brain: Ethical issues for clinical trials' at the International Conference on Nanoscience and Nanotechnology (ICONN) held in Perth, Australia from 3-5 February.

Mega Kar (PhD ACES/Monash) was judged to have given the best oral presentation at the ACES Symposium held Feb 15-17 in Geelong when she spoke about 'Ionic Liquids for Rechargeable Metal/air batteries'.

Matthew Gustafson (PhD ACES/Monash) and Yang Yang (PhD, ACES/IPRI) were awarded the two poster prizes at 7th Annual Electromaterials Science Symposium in Geelong, 15-17 Feb 2012, for their work entitled 'Electrocatalytic bulk heterojunction materials for water oxidation' and 'Novel co-doped PPy/reduced graphene oxide-dextran sulphate composite applied in bioelectric battery' respectively.

At the 5th Australasian Symposium on Ionic liquids (ASIL-5), held at Monash University Clayton from 3-4 May ACES students were winners of the best poster awards. Theodore Abraham (ACES/Monash) won for his poster presentation on 'Ionic liquid electrolytes in a thermo-electrochemical device' as well as 2 runners up awards to Liyu Jin (ACES/Monash) and Fengling Zhou (ACES/Monash) for her poster presentation 'Electro-Deposited MnOx Films from Ionic Liquid for Water Oxidation'.

Dr Frederic Gilbert (ACES/UTas) was awarded a University of Tasmania travel award to present his research into 'Ethical issues raised by proposal to treat unacceptable social conduct using medical brain devices' at the 11th World Congress of Bioethics held in Rotterdam, Netherland on 29 June 2012.

Eliza Goddard (ACES/UTas) and Alex Harris (ACES/LA Trobe) were awarded free registration to 3rd Asia-Pacific Symposium on Nanobionics held from 19 - 21 September 2012 at Innovation Campus, North Wollongong Australia thanks to the Australian Nanotechnology Network and the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE).

Willo Grosse (PhD, ACES/IPRI) won a best Poster Prize for her work entitled 'Fabrication and Characterisation of Chemically Converted Graphene (CCG) Enzymatic Hydrogel Electrode' at this Asia Pacific Nanobionics symposium, as did Dr Robert Gorkin for his poster entitled 'Fabrication of 3D-Printed Metal Microstructures using Selective Laser Melting'.

Tristan Simons (PhD, Deakin) was named the People's Choice winner at the national three minute thesis finals

Communications

Communication strategy

The ACES Communications strategy aims to keep the target groups informed, updated and engaged, as well as attract potential partners for collaborative and commercial opportunities that will benefit ACES. Tools included face-to-face meetings, website, brochures, flyers, newsletters, invitations to presentations and key ACES events and public/visitor tours of the laboratories.

During 2012 we have improved on the content and distribution of the e-newsletter. This involved migration of the ACES contact database from a manual email system to an online-hosted service and providing opportunities for automatic subscription.

ACES E-NEWSLETTER

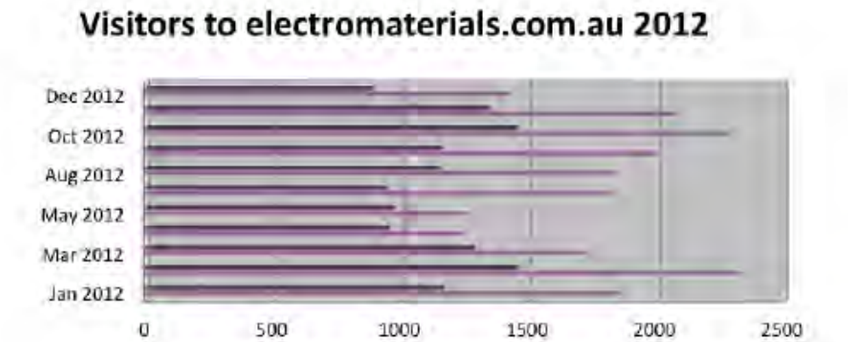
The format of the external newsletter, "ACES News", was changed in July 2011 to an online-hosted e-newsletter format. The new format better reflects the ACES website content, encourages the user to click from one piece of content through to another, and allows for accurate reporting of readership as well as an up to date database management system.

Bi-monthly print newsletters (500 per print run) have also been produced and have been effectively utilised at outreach and symposium events.

DVD 'ACES: FROM MOLECULES TO DEVICES'

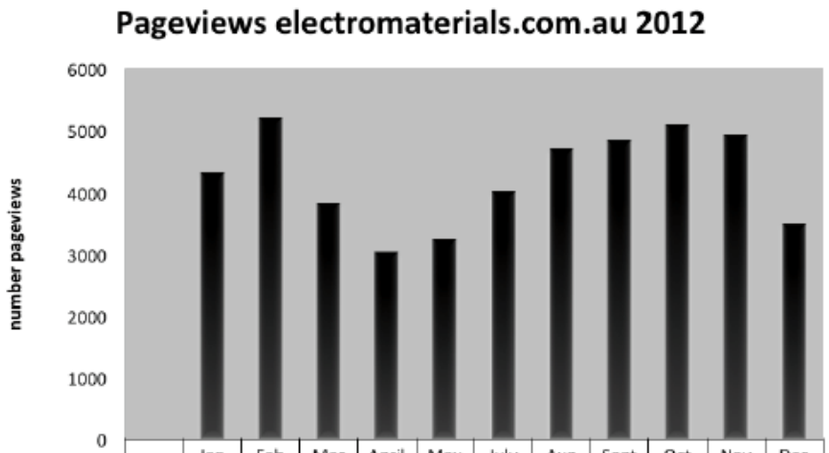
In 2012, the ACES introductory DVD was updated to include new key capabilities, particularly in the areas of additive fabrication. The updated video is used on all ACES USB drives (given to visitors and collaborators) and online on the YouTube channel.

The introductory videos have been viewed almost 400 times on YouTube and printed onto 1,000 USB which have been distributed to visitors.



	Jan 2012	Feb 2012	Mar 2012	April 2012	May 2012	July 2012	Aug 2012	Sept 2012	Oct 2012	Nov 2012	Dec 2012
New visits	1170	1458	1287	956	981	944	1150	1164	1461	1349	889
Total visits	1860	2334	1723	1244	1267	1818	1847	2002	2289	2077	1429

Figure 1: Between January and December 2012 the ACES website (electromaterials.com.au) averaged 1808 visits each month, with an average of 1164 new visits each month.



Date	Jan 2012	Feb 2012	Mar 2012	April 2012	May 2012	July 2012	Aug 2012	Sept 2012	Oct 2012	Nov 2012	Dec 2012
Pageviews	0	4290	5205	3819	3011	3221	3992	4690	4827	5090	4915	3472

Figure 2: In 2012, the ACES website (electromaterials.com.au) averaged 4230 page visits each month.

SOCIAL MEDIA PRESENCE

The ACES facebook page was started in 2012. Twitter accounts were established mid 2012. ACES members are establishing LinkedIn accounts.

ACES YOUTUBE CHANNEL

Since it was established in June 2011, the ACES YouTube Channel (youtube.com/user/ACESElectromaterials) continues to be used and has now just fewer than 25,000 video views. 12 videos were added to this channel in 2012.

The channel includes an introductory ACES video, a NanoBionics video; demonstrations of some of the additive fabrication technologies. ACES has added in 2012; meet a researcher; a video explaining new tough hydrogels; and an animation depicting a nano-bot for which the channel received the vast majority of views following significant media coverage of the related 'Twisting artificial muscles' Science journal paper. Another YouTube channel that showcases this aspect of ACES research shown is the BionicMuscle's channel (youtube.com/user/bionicmuscles). 13 video segments were added here in 2012, with 2,159 video views to date.

ACES WEBSITE

Improvements in the content uploaded onto the ACES website, www.electromaterials.edu.au, in 2012. Improvements have included continued frequent uploading of news items, upgraded 'people' pages including professional photographs, upgraded research program pages, upgraded commercialisation pages and continued integration with e-newsletters and social media. Ongoing improvements to the website will include addition of multimedia elements.

The traffic on the website has been monitored during this reporting period, although the methodology for collecting data on unique visits was altered mid-2012.

In 2012, between January and December the ACES website electromaterials.com.au averaged 1,808 visits each month; with the highest number of visits in February (2,334) and October (2,289) and the lowest in April (1,244) and May (1,267). See Figure 1.

On average this website attracted 1,164 new visits and 4,230 page visits each month. See Figure 2.

MEDIA COVERAGE

In 2012 ACES work was covered on 118 media outlets (40 print, 51 online/web, 19 radio and 8 TV).

During the year ACES gained coverage in significant outlets including The Herald Sun, The Age, international websites and blogs.

Researchers also were heard on numerous national radio channels (ABC NSW, ABC Adelaide, ABC Science, ABC Gippsland, ABC statewide afternoons, Radio National -The Science Show, ABC Illawarra and WaveFM. Magazines that stories were published in included: COSMOS, Australian Popular Science, Chemistry in Australia, NanoQ as well as a feature in 2012 Stories of Australian Science.

See Appendix 7 for the complete list of media hits in 2012 reporting period.

Communications training

Communications and Media Officer, Natalie Foxon attended the 2011 National Science Communicators Forum in Sydney in November, at which she discussed ACES media activities with communications personnel from prominent Science and Innovation organisations in addition to editors from major media outlets. The forum gave ideas on applying innovative strategies for dealing with the media, negotiating the science communication spectrum for better results, maintaining scientific integrity and communicating complex information with creativity.

Students were encouraged to participate in conferences and symposia to get their research message out beyond ACES. For example, ACES students engaged in the Fresh Science and 3 minute thesis competitions as well as some Alumni networking nights.

Top 10 visits by Country	Jan	Feb	March	April	May	July	Aug	Sept	Oct	Nov	Dec
Australia	981	1418	1021	741	758	925	937	843	1112	956	607
USA	106	131	106	118	106	185	153	154	176	158	150
South Korea	85	82	39	16	19			47	52	65	
Germany	71	60	36	36	22	41	34	43	49	46	43
India	67	68	66	42	34	93	73	88	114	87	100
Russia	59										
China	44	55	55	29	31	84	51	154	92	95	103
Iran	42	51	34	23	23	65	87	97	72	100	116
France	33	31						30	36	42	34
Japan	32	37		14		32	34		21	40	43
Switzerland		72	34								
UK		50	48	34	30	36	67	43	82	54	37
Ireland	20	22	39	26				35	37		
Malaysia				17							
Canada			32	28	18						
Taiwan					18						
New Zealand						25	30				
Singapore						37	28				
Total number of visiting countries	**66**	**65**	**61**	**55**	**60**	NA	NA	NA	NA	NA	NA

A list of the number of website visits to the ACES website by location. On average the number of visits each month in the first half of 2012 originated from 62 countries (as indicated by the NA these statistics were not available for the second half of 2012).

AUSTRALIAN SCIENCE MEDIA

Dr Toni Campbell, Assoc Prof Simon Moulton and Dr Paul Molino (ACES/IPRI) all attended an Australian Science Media (AusSMC) session on 13 September at Wollongong University. Participants were given the opportunity to discuss the aims and objectives of their research group, highlighting some areas of research strengths. AusSMC spoke about: what they do, how researchers can better engage with the media and raise their profile, and ways in which they can assist UOW with facilitating their research 'media' objectives.

Communication of the Research

'NANO-DOODLING LANDS ACES AT FRESH SCIENCE STATE FINALS'

ACES PhD student Cathal O'Connell represented the ACES team at the Fresh Science NSW State Finals for his research project about 'Doodling on the Nano-scale'.

Cathal was amongst a few outstanding PhD and early career researchers to make the State Finals following an application process involving pitching his research project as a great media story.

Held at ANSTO, the Fresh Science State Final was a day of workshops to further enhance skills in science communication.

"The Fresh Science NSW state final was a fascinating and eye-opening experience," said Cathal.

"At a media training workshop, we learned from professional TV, radio and print journalists exactly what each medium is looking for in a science story. We were plonked in front of TV cameras and microphones and advised on how best to craft our stories to appeal to the general public - essential skills for promoting scientific research!"

You can read Cathal's pitch online electromaterials.edu.au/news/UOW134652.html.

A 3MT PRESENTATION ON SUN TO SOCKET: THE ZINC-AIR RECHARGEABLE BATTERY.

Deakin University PhD student with ACES, Tristan Simons, has won the Peoples' Choice Award at the TransTasman Final of the Three Minute Thesis competition.

Called Sun to Socket: The Zinc-Air Rechargable Battery, Tristan's presentation stems from his work with ACES' Prof Maria Forsyth in Melbourne. View Tristan online: http://www.youtube.com/watch?v=RBvExE0zls4 and see more under 'Awards'.

Cathal O'Connell, ACES PhD student, speaking at the Fresh Science State Finals.

At the University of Wollongong PhD student Mark Romano (ACES/IPRI) won selection into the UOW finals of the three minute thesis by winning the Science faculty selection process with his presentation on 'Electrical Power from Thermal Energy Harvesters'. Willo Grosse (PhD, ACES/ IPRI) was second place in the inaugural AIIM Three Minute Thesis Competition.

Meanwhile Mega Kar (PhD, ACES/Monash) progressed to the Monash University Faculty of Science round of their three minute thesis competition in 2012.

Networking events

Willo Grosse (ACES/IPRI PhD student) attended both the Cleantech and University of Wollongong Alumni networking nights where she discussed ACES research activities, including her own PhD project on biofuel cells.

STUDENTS TO ACES INTERN OPPORTUNITY WORKING OVER 2 YEARS TO HONE COMMUNICATION AND RESEARCH SKILLS

As part of their first session internship in 2012, the work integrated learning scholarship (WILS) students were asked to create short educational videos of 1-2 minute duration. They were given instructions on how to create a successful self- contained video for a general audience.

The WILS program arose from the awarding of an Australian Research Council (ARC) Laureate Fellowship to Prof Gordon Wallace and research activities within ACES.

Prof Wallace said he hoped the science communications training aspects of the program and the development of research skills in the company of internationally acclaimed researchers would invigorate and inspire the interns, the next generation of researchers.

"Their science communication will be put to practical use, with the outcomes of the interns' projects to be publicised through traditional media and the Wollongong Science Centre," he said.

The students worked on a range of projects in the electromaterials area alongside mentors who are world leaders in the field.

The students selected to undertake internships were Jacob Byrnes, Brooke Besser, Michael Diamond, Rachael Zuzek, Christopher Richards and Vito Giorgio. They were matched with an ACES supervisor and began work at the Intelligent Polymer Research Institute with a session 1 project involving interviewing 10 ACES researchers each and developing a one page 'media release' style document on the research. To prepare for their project, students attended an internally run communications workshop and their finished projects were presented at a luncheon.

In session 2, 2012, the students were to take their session 1 project one step further and plan, produce and deliver a one to two minute informative video on the research. The videos were to be presented in such a way that they may be useful for ACES communications activity including use on the electromaterials website.

Outreach

Community awareness & outreach

ACES researchers regularly engage with the community through hosting site visits, participation in Science Centre events, involvement in community-based focus groups and through the print, radio and television media.

'Out and About' - ACES Research at Public Forums

TEDˣUWOLLONGONG

ACES was thrilled to be involved in TEDˣ, the international phenomenon of ideas worth spreading, which hit the University of Wollongong on Tuesday 29 May 2012.

Attended by 100 invited 'big thinkers', Profs Mark Cook and Gordon Wallace were invited to speak at the TEDˣ event, centred on the topic of Medical Bionics:

An Interdisciplinary Approach. Prof Mark Cook spoke specifically about 'Getting ahead in epilepsy'.

Hosted by ABC science broadcaster Dr Robyn Williams, the evening also featured industry leader Prof Rob Shepherd from the Bionics Institute, ethicist Assoc Prof Katina Michael and a moving presentation from cochlear recipient Sue Young.

Talks were videoed and published on YouTube. These can be accessed on the ACESElectromaterials channel and have been viewed 1040 times to date.

NANOTECHNOLOGY EXHIBIT AT WOLLONGONG SCIENCE CENTRE LAUNCHED AFTER 3 YEARS OF PLANNING

Australia's Chief Scientist, Prof Ian Chubb, officially opened the NANOtechnology Exhibit at the Wollongong Science Centre in early July after 3 years of planning and development.

As a joint project between the Science Centre and ACES, part of the exhibit was designed by ACES PhD students Joseph Giorgio, Cathal O'Connell, Yang Yang and Willo Grosse. All these students received ACES top-up scholarships so they could work on the communication of Science, in particular that relating to ACES research.

ACES Director Gordon Wallace addressed the capacity audience of 70 at the launch, commending the effort put in to the exhibit over a period of three years.

This exhibition gives ACES researchers an opportunity to share our excitement and our vision with the community. The exhibit is incorporated into community events and international visits hosted at ACES.

Learning about something that is a million times smaller than the width of a needle point isn't easy, but the exhibit makes Nanotechnology easy to understand for everyone.

Full of easy-to-understand information all about Nanotechnology, the exhibition also features an exciting Nanocam show in the Planetarium where you can see into the tiny and wonderous Nano-world, plus many interactive exhibits including a microscope through which you can read a complete copy of the bible printed on the area of a small coin.

Science Centre Director, Glen Moore explained "It is intended to address the need for both the general public and school students, to understand important new technologies and also to appreciate Australia's role in researching and developing practical applications for these technologies."

Gordon Wallace (Director ACES) and Mark Cook (PI ACES/SHVM) presenting ACES research at the TEDx (x = independently organised) event, centred on the topic of Medical Bionics: An Interdisciplinary Approach.

SCHOOL OUTREACH PROGRAM BY THE WOLLONGONG SCIENCE CENTRE

During 2011 and early 2012, ACES/IPRI PhD student Cathal O'Connell has been assisting the Wollongong Science Centre in setting up of a new School Outreach program whereby the Science Centre will visit high schools in the Illawarra and Sydney areas and provide local planetarium and science shows. This assistance has involved helping to reconcile the proposed shows with the current NSW high school syllabus and with the implementation of the new software required to run the mobile planetarium.

FEDERAL GOVERNMENTS AUSTRALIAN HEALTH ETHICS COMMITTEE MEMBER

Prof Susan Dodds was appointed as a Member (with experience in social science research) of the Australian Health Ethics Committee (AHEC), by Tanya Plibersek, Minister for Health, for the term July 2012-June 2015.

JOINT MEETING OF THE NANOTECHNOLOGY OVERSIGHT COMMITTEE & WORKING GROUP

Prof Gordon Wallace serves on the Nanotechnology working group. This joint meeting was held 1 August 2012 at Australian Academy of Science.

PhD student Willo Grosse (left) with Science Centre Director Glen Moore at the opening of the new nano-exhibtion opening at the Wollongong Science Centre.

FEDERAL GOVERNMENT'S NATIONAL ENABLING TECHNOLOGY STRATEGY STAKEHOLDER ADVISORY COUNCIL

Susan Dodds (ACES CI, UTas) served as invited member (ethicist) on the Federal Government's National Enabling Technology Strategy Stakeholder Advisory Council by Senator Kim Carr, Minister for Innovation, Industry, Science and Research, 2010-2012.

Following this original appointment Prof Susan Dodds was then appointed as Chair of the National Enabling Technologies Strategy (NETS) Stakeholder Advisory Council by Greg Combet, Minister for Industry and Innovation; March-November 2012.

DINNER SPEAKER AT BIONIC VISION AUSTRALIA'S RESEARCH RETREAT DINNER

Prof Gordon Wallace was the after dinner speaker the Bionic Vision Australia Research retreat Dinner held in Wollongong on 7 June. He spoke on 'Medical Bionics: What do people really think- an after dinner perspective!' The audience of 100 researchers with Bionic Vision Australia came from very different backgrounds; ophthalmology and vision neuroscience to materials science and physics, to electronic and biomedical engineering.

A BODY OF KNOWLEDGE SYMPOSIUM

Medical Science is much more than a single discipline, it intersects with art, technology philosophy and history. This symposium considered the medical body from a number of perspectives. The morning sessions explored forensic and scientific innovations as well as considering the social and cultural history of the Melbourne Medical School.

The afternoon sessions probed what happens when artists investigate the boundaries of anatomy, historically through models and images, and in the future, where technological evolution challenges our ideas of what it is to be human.

In session one Prof Mark Cook (PI, ACES/St Vincent's) spoke on 'The Demon in the Body'. Attitudes to epilepsy provide an excellent perspective on the collision between magic and science, the earliest records attempting to distinguish between disease and demonic possession. This interpretation of the origin of seizures influenced significantly the management of the illness over the ages, and continues to inform popular conceptions.

This symposium was held, to commemorate 150 years of medicine at the Melbourne Medical School, at The University of Melbourne, Australia on 15 September.

IHMRI'S QUARTERLY SEMINAR

On 13 July Prof Gordon Wallace delivered a joint presentation – the second of the Illawarra Health & Medical Research Institute's (IHMRI) quarterly seminars – with Melbourne neurologist Dr Mark Cook. The topic, 'Translational research' was chosen in response to feedback received by IHMRI at its strategic planning day held earlier in the year, that the term 'translational research' is much used but little understood. Profs Cook and Wallace took a case study approach to illustrate the translational research process, focusing on their collaborative development of a polymer brain implant to control epilepsy.

COMMUNITY EPILEPSY SYMPOSIUM

Australia's leading experts in the field of Epilepsy participated in a half day community symposium held on 2 November in Hobart.

The event was run on behalf of the Tasmanian epilepsy society and featured ACES partner investigator Mark Cook. Mark gave 2 talks entitled 'Non-pharmacological Therapy' and 'Improving outcomes for people with epilepsy: strategies for general practice'.

OTHER OCCASIONS…

29 March: Assoc Prof Simon Moulton gave a dinner talk to the Engineers Australia Southern Highlands & Tablelands Regional Group at Mittagong, NSW. He spoke on 'Advanced in Bionics Research for Medical Applications'.

25 May: Prof David Officer (CI, ACES/IPRI) gave a talk entitled 'I C the Future: Bionic Bodies, Artificial Muscles, Plastic Plants - 2 Years Later 'to the Central Illawarra University of the 3rd Age Group in Wollongong.

15 August: Assoc Prof Marc in het Panhuis visited SS Peter and Paul primary school in Kiama and spoke to about 90 stage 1 and stage 3 children about hydrogels, what it is like to be scientist, ACES Materials and Bionics.

17 September: Dr Toni Campbell, Chief Operating Officer ACES, gave an overview of ACES/IPRI to a group of approximately 40 career advisors who were gathered for a meeting on innovation campus.

21 September: Assoc Prof Marc in het Panhuis was interviewed by Jake Lathan, a Bachelor of Journalism student at UOW, who was writing an article on hydrogels, the future of biotechnology and ACES Bionics.

27 September: Assoc Prof Marc in het Panhuis gave a demonstration on gels in the ocean, tissue engineering and ACES Bionics to the Royal Society of NSW in Bowral. Willo Grosse (ACES/IPRI PhD student) attended both the Cleantech and University of Wollongong Alumni networking nights where she discussed ACES research activities, including her own PhD project on biofuel cells.

Community Engagement Events/ Activities Hosted by ACES

UOW CELEBRATES 21 YEARS OF SCHOOL HOLIDAY SCIENCE

From the 17-19 January 2012 enthusiastic young scientists were busy examining the effect of lava flow on volcanic eruption styles, creating crazy chemical concoctions, and learning how computer scientists created applications for iPhones at the 21st annual University of Wollongong Science Experience.

Students from as far away as Western Australia and Queensland have joined their peers from the Illawarra, country NSW and the far South Coast for the specially education program aimed at students starting Year 9 and 10 in 2012.

Hosted by the university's Faculty of Science, students participated in a range of hands-on workshops under the direction of academic staff.

This year the program included a field trip to ACES/IPRI at the UOW Innovation Campus where students participated in a series of nanotechnology activities learning about bioprinting, nanobionics and dip pen nanolithography.

UOW Science Experience Director Lisa Hutton said the annual event provided high school students with the opportunity to meet other students with a passion for science, and get a taste for studying science at the University of Wollongong as they interact with student mentors, academics and researchers.

The science program, managed nationally by the Science Schools Foundation and coordinated locally by the UOW Faculty of Science is aimed at encouraging continued science studies in senior years at high school and, eventually, at university.

INAUGURAL LEON-KANE MAGUIRE ADDRESS

The Inaugural Leon-Kane Maguire (LKM) Address, held in February 2012, was given by Leon's brother Prof Noel Kane-Maguire. Attended by one hundred and twenty guests including UOW Vice-Chancellor Paul Wellings, former Vice-Chancellor Gerard Sutton and members of the Kane-Maguire family, the event was a happy celebration of Leon's contribution to research, the building of research teams and the communicating of science.

Barbara Kane-Maguire (wife of the late Prof Leon Kane-Maguire) and Prof Noel Kane-Maguire at the LKM address.

Prof Kane-Maguire was one of Australia's leading research scientists, his work led to many international awards and the development of several new fields of science. He was made an emeritus professor of the University when he retired in 2010, celebrating a lifelong commitment to science and education. Leon sadly passed away in 2011.

Director of ACES and great friend of Leon, Prof Gordon Wallace, commented that Leon had an infectious attitude to science and education.

"He instilled a spirit of adventure of scientific discovery, the excitement of sharing new knowledge with other people, he had unbelievable enthusiasm for communicating a wide variety of people about science," he said.

The audience at the inaugural Prof Leon Kane-Maguire address.

Pictured from left: A/Prof Simon Moulton, Prof Gordon Wallace, Prof Graeme Clark at the book launch in Melbourne.

Over 150 people enjoyed a 'mind blowing' Nanotech experience in the labs of ACES during science week.

GENERAL INTEREST, EXCITING SCIENCE!

On 22 February, 17 undergraduate students undertaking the Advanced Science program at the University of Western Sydney visited ACES/IPRI for the day.

This visit is one of a number that form part of the Advanced Science Course curriculum and the demand from the students was high, partly due to the positive feedback that came from the first group of students to tour in 2009. The students were 1st to 3rd year undergraduate science students from a range of disciplines including nanotechnology, biology and chemistry. Almost all Advanced Science students at UWS go on to graduate studies.

NEW BOOK FROM THE ACES TEAM LAUNCHED TO HIGH PRAISE FROM LEGENDARY SCIENTIST

Legendary Australian Scientist Prof Graeme Clark has praised a new book from pioneering researchers at the ARC Centre of Excellence for Electromaterials Science.

Speaking at the launch of Organic Bionics in Melbourne 12 June 2012, Prof Clark commended the book for its unique approach to the subject.

"There is a need to apply the new science of bionics to medicine," said Prof Clark. "Organic Bionics actually brings bionics science together with the clinical outcomes, the applications."

Assoc Prof Robert Kapsa from St Vincent's Hospital Melbourne, co-author of the book along with UOW's Prof Gordon Wallace, Assoc Prof Simon Moulton and Dr Michael Higgins, said the book was actually inspired by Prof Clark.

The first text of its kind, Organic Bionics focuses on the emerging interdisciplinary research area at the interface between materials science and biomedicine. It delves into areas of application for bionic developments including advanced bionic ears, spinal cord repair, muscle repair, bionic eyes and infection control, as well as emerging applications including neuromuscular repair, epilepsy and pain management, and bone regrowth.

During the book launch, co-author Prof Gordon Wallace spoke of the importance the ACES team places on working with collaborators including clinicians and end-users, to create a research model that works towards real applications and devices.

Invaluable reading for materials scientists, polymer chemists, electro-technicians, bioengineers, chemists, biologists and bioengineers, Organic Bionics is published by WILEY-VCH and available at wiley.com.

BILL WHEELER BIONICS AWARD AND PUBLIC LECTURE

Since its inception in 2009, the Bill Wheeler Award and Bill Wheeler Symposium has developed into a popular community event, each year featuring talks by leading Australian scientists and clinicians. There was a full house at this year's event, held on 6 August in Wollongong.

Bill Wheeler was a very active member of the Illawarra community who took a keen interest in new Bionics research at the University of Wollongong. Sadly, Bill passed away in 2007, however his passion for helping the community continues with the Bill Wheeler Award, assisting young researchers to develop real solutions for the community.

In addition to the presentation of the award to ACES PhD student Willo Grosse, the Bill Wheeler Symposium featured Professors Mark Cook and Peter Choong, leading clinicians from St Vincent's Hospital Melbourne as well as bi-lateral Cochlear recipient Sue Young.

National Science week ACES/IPRI opened their Doors

COMMUNITY DAY

Over 150 people enjoyed a 'mind blowing' Nanotech experience in the labs of the ARC Centre of Excellence for Electromaterials Science on Innovation Campus during National Science Week in August.

True to its strong focus on outreach activities, the Centre welcomed the visitors through a 3 day series of events.

The annual Community Open Day was fully booked-out in advance, with members of the local Illawarra community plus some keen travellers from Sydney attending to tour the working laboratories.

Inside the state-of-the-art AIIM Facility, researchers are working on projects such as medical bionics, in which they're developing brain implants for epilepsy patients, to safely delivery drugs directly to the site where they're needed, just as a seizure is imminent.

During the tour, participants spoke with researchers about research programs including Solar Energy, Materials Synthesis and 3D Printing. The Bionics program including Nerve and Muscle Regeneration research attracted much attention from visitors.

"The tour was wonderful," said participant Mrs Val Cook. "It made me realise how lucky we are to have this research in Wollongong."

"The Bionics was absolutely mind blowing," said another participant Nancy Brenton. "You've no idea what fantastic things are being done in the Illawarra!"

SCHOOLS DAYS

Following the Community Open Day, year 9 and 10 students from Sylvania High School and Corpus Christi Catholic High School flooded the Centre over 2 days of activities.

Students enjoyed workshops in the labs including Fibre Spinning and Electron Microscopy, plus an engaging presentation on Hydrogels from Prof Marc in het Panhuis (CI, ACES/IPRI), a part of his involvement with the Scientist in Schools Program. While on Innovation Campus, the students visited the Wollongong Science Centre for the new NanoTechnology exhibit and Nanocam show.

UNIVERSITY DAY

ACES/IPRI held an open day on 27 August for all interested 3rd and 4th year students interested in undertaking research within the centre. They were given tours of the facilities, met researchers and students over a BBQ lunch and were given the opportunity to discuss research projects with potential supervisors.

ACES BIONICS AT ST VINCENT'S CONDUCTS COURSE IN MEDICAL RESEARCH

The St Vincent's Hospital ACES Bionics laboratory conducted a training course for 25 Indonesian Medical Students as part of their Advanced Medical Science (AMS) year from 17-28 September 2012. The "Laboratory Techniques" course is designed to introduce students to the theory and practice of medical research. All students get "hands on" experience in the laboratory, learning the theory behind the methodologies, as well as how to conduct scientific research.

Hosting our Members of Parliament and Funding Bodies

MINISTER FOR THE ILLAWARRA TOURS FACILITIES

On 22 March Mr Greg Pearce, Minister for the Illawarra, visited ACES/IPRI and had a laboratory tour through the new synthesis and fabrication sections of the building.

AUSTRALIA'S CHIEF SCIENTIST TOURS ACES/IPRI

Prof Ian Chubb, Australia's Chief Scientist, visited on 17 July to open the Nanotechnology Exhibit at the Science Centre but prior to this event he toured ACES/IPRI on Innovation Campus.

In 2012 ACES/IPRI opened their doors to give Year 10 high school students a glimpse into scientific research.

MINISTER PRAISES UOW'S "WORLD-CLASS" INNOVATION FACILITY

The Minister for Tertiary Education, Skills, Science and Research, Senator Chris Evans (25 October) described the University of Wollongong's Innovation Campus as one of Australia's leading centres of innovation.

Senator Evans was speaking at the official opening of the second stage of the Australian Institute for Innovation Materials (AIIM) Building at the Innovation Campus, which he described as "world-class".

He was clearly impressed after inspecting some of the high-tech laboratories in the new building. AIIM's new Processes and Devices Facility is a federally-funded $47 million facility for researchers to develop their processes and devices and test them for real-world applications.

The Minister said the work being carried out at AIIM was playing an important role in bridging the gap between research and industry, and would generate significant economic activity and employment opportunities for the Illawarra region.

NEW ARC CHIEF MAKES WOLLONGONG FIRST STOP

The Australian Research Council's new Chief Executive Prof Aidan Byrne made the University of Wollongong his first stop as he moves around the country getting to know his "constituents" – the universities that receive the bulk of the $850 million that the ARC distributes in research funding each year.

Prof Byrne (9 August) visited and toured UOW's Innovation Campus, where he met with Vice- Chancellor Prof Paul Wellings,

New Australian Research Council Chief Executive Prof Aidan Byrne (centre) with Deputy Vice-Chancellor (Research) Prof Judy Raper and Vice-Chancellor Prof Paul Wellings at the Australian Institute for Innovative Materials building.

EXECUTIVE DIRECTOR, ECONOMIC DIVISION, TAIPEI ECONOMIC AND CULTURAL OFFICE

Dr Lee, Executive Director, Economic Division, Taipei Economic and Cultural Office visited Innovation Campus on 10 May. He was given tour of the ACES/IPRI facilities and held discussions with Prof Wallace and staff on a vision for the integration of materials research into the marketplace to help solve aged problems with a focus on wearable devices serving the orthopaedics sector.

(L to R) Member for Throsby Stephen Jones, Senator Chris Evans, Member for Cunningham Sharon Bird, UOW Chancellor Jillian Broadbent and UOW Vice-Chancellor Prof Paul Wellings at the AIIM opening.

ACN workshops - a view to further collaborations

Prof Tom Davis from Australian Centre for NanoMedicine (ACN) at the University of New South Wales visited ACES/IPRI with 18 of his staff and 6 students on 6 March to participate in a collaborative workshop in the field of nanomedicine (NanoMedicine is the application of nanotechnology to achieve breakthroughs in healthcare) and nanobionics.

A reciprocal workshop was then held at UNSW on 13 December where 8 staff and 5 students from ACES/IPRI and 20 staff and students from ACN attended a half day workshop showcasing a range of research activities being undertaken in the Bionics program. A friendly cricket game followed this half day workshop- ACN won!

At the unveiling of the plaque are (from left): Prof Shi Xue Dou, Chancellor Jillian Broadbent, UOW Deputy Vice-Chancellor (Research) Prof Judy Raper, Prof Elena Pereloma and Prof Gordon Wallace.

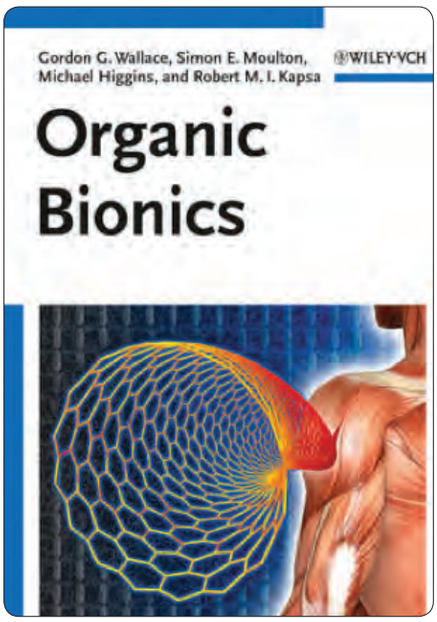
Publications

In 2012, ACES membership had 2 books, 6 book chapters and 138 journal articles published (65 or 47% with impact factor >4; 105 or 76% with impact factor >2) with another 19 published as advance articles (these are not included in the statistics above). Four journal articles were published as cover images and one other inside back cover. This exceeds the 2012 ARC target of 75 publications with at least 50% of journal articles with impact factor >2.

Books

Organic Bionics, Wallace, G.G., Moulton, S.E., Higgins, M.J., Kapsa, R.M.I., Wiley-VCH Verlag & Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany 2012.

Bioinspiration and Biomimicry in Chemistry, Swiegers G.F.(Editor), John Wiley and Sons, New York, 2012.



Book Chapters

Invited book chapter in "Ionic Liquids Further UnCOILed", Wiley, Edited by Prof Ken Seddon. Chapter 10 'Ionic Liquids in Dye-Sensitized Solar Cells'. J. M. Pringle, December 2012.

Gilbert, F., Burns, L., Krahn, T., Imaging the brain: The inheritance, power and predicaments of the "brain reading metaphor", In Medical Imaging and Philosophy: Challenges, reflections and actions, (Eds: H. Fangerau, R. Chhem, I Muller, S-C Wang), Franz Steiner Verlag, Stuttgart, 81-102 (2012).

M. in het Panhuis, 'Prospects and challenges for conducting carbon nanotube composite materials', in Nanofiber composites, edited by P. Calvert and R. Narayan, Hoboken, (ISBN: 978-3-527-40978-5), Wiley-VCH (2012).

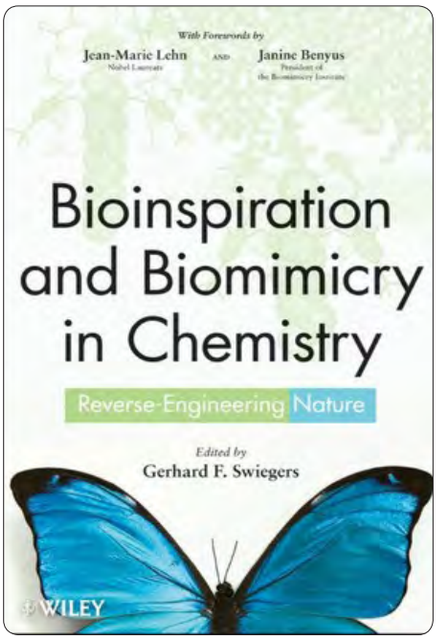
W.R. Small and M. in het Panhuis, 'Inkjet printing of transparent, electrically conducting single-wall carbon nanotube composites', in Nanofiber composites, edited by P. Calvert and R. Narayan, Hoboken, (ISBN: 978-3-527-40978-5), Wiley-VCH (2012).

Dodds S, Trust, accountability and participation: conditions and constraints on 'new' democratic models, In Public Engagement and Emerging Technologies Edna Einsiedel and Kieran O'Doherty (eds) Vancouver, UBC press: pp 69-79 (2012). [Research Book Chapter]

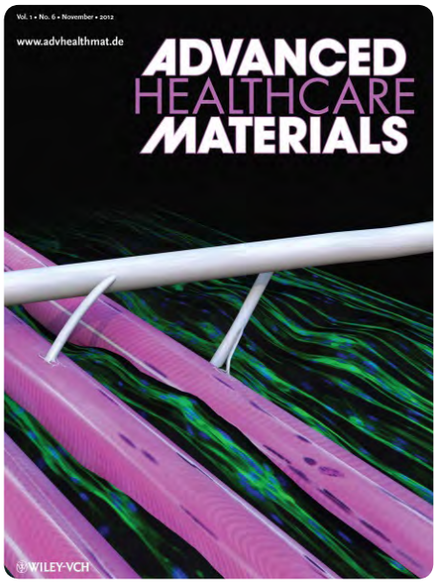
R. Brimblecombe, G. C. Dismukes, G. F. Swiegers and L. Spiccia, Energy from Photosystem II: Manganese water oxidation catalysts., Chapter 10 in "Molecular Solar Fuels" Edited by T. Wydrzynski and W. Hillier, Royal Society of Chemistry book series, pp 249-272 (2012). Invited contribution, ISBN: 978-1-84973-303-8, DOI:10.1039/9781849733038.

Journal Articles

1. Aldalbahi A, Chu J, Feng P, Panhuis MIH: Conducting composite materials from the biopolymer kappa-carrageenan and carbon nanotubes, Beilstein Journal of Nanotechnology 2012, 3:415-427. IF=3.979.
2. Aldalbahi A., in het Panhuis, M., Electrical and mechanical characteristics of buckypapers and evaporative cast films prepared using single and multi-walled carbon nanotubes and the biopolymer carrageenan: observation of contact angle scaling, Carbon, 2012, 50:1197-1208. IF=5.378
3. Allitt BJ, Morgan SJ, Bell S, Nayagam DA, Arhatari B, Clark GM, Paolini AG., Midbrain responses to micro-stimulation of the cochlea using high density thin-film arrays, Hearing Research, 2012, 287(1-2):30-42. IF=2.832



4. Amin KAM, Gilmore KJ, Matic J, Poon S, Walker MJ, Wilson MR, Panhuis MIH: Polyelectrolyte Complex Materials Consisting of Antibacterial and Cell-Supporting Layers, Macromolecular Bioscience 2012, 12(3):374-382. IF= 3.866
5. Amin KAM, in het Panhuis, M., Reinforced Materials Based on Chitosan, TiO_2 and Ag Composites, Polymers, 2012, 4(1):590-599.



6. Arhatari BD, Harris AR, Paolini AG, Peele AG: Enhanced x-ray imaging for a thin film cochlear implant with metal artefacts using phase retrieval tomography, Journal of Applied Physics, 2012, 111(11). IF=2.168

7. Bakarich SE, Pidcock GC, Balding P, Stevens L, Calvert P, Panhuis MIH: Recovery from applied strain in interpenetrating polymer network hydrogels with ionic and covalent cross-links, Soft Matter 2012, 8:9985-9988. IF=4.39

8. Badawy, R. A., Freestone, D.R., Lai, A., Cook, M. J. Epilepsy: Ever-changing states of cortical excitability, Neuroscience, 2012, 222C: 89-99. IF=3.380

9. Badawy, R. A., Macdonell, R. A., Vogrin, S.J., Lai, A., Cook, M.J. Cortical excitability decreases in Lennox-Gastaut syndrome, Epilepsia, 2012, 53(9):1546–1553. IF=3.961

10. Badawy, R. A., Johnson, K. A., Cook, M. J., Harvey, A.; A mechanistic appraisal of cognitive dysfunction in epilepsy, Neurosci Biobehav Rev. S, 2012, 36(8):1885-96. IF=8.650

11. Campbell JA, deBorniol M, Mozer AJ, Evans PJ, Burford RP, Triani G: Effects of atomic layer deposited thin films on dye sensitized solar cell performance, Journal of Vacuum Science & Technology A 2012, 30(1). IF=1.253

12. Chartarrayawadee W, Moulton SE, Li D, Too CO, Wallace GG: Novel composite graphene/platinum electro-catalytic electrodes prepared by electrophoretic deposition from colloidal solutions, Electrochimica Acta 2012, 60:213-223. IF=3.832

13. Chen J, Wagner P, Tong L, Wallace GG, Officer DL, Swiegers GF: A Porphyrin-Doped Polymer Catalyzes Selective, Light-Assisted Water Oxidation in Seawater, Angewandte Chemie-International Edition 2012, 51:1907-1910. IF=13.455

14. Chidembo A, Aboutalebi SH, Konstantinov K, Salari M, Winton B, Yamini SA, Nevirkovets IP, Liu HK: Globular reduced graphene oxide-metal oxide structures for energy storage applications, Energy & Environmental Science 2012, 5:5236-5240. IF=9.610

15. Chou S-L, Ionescu M, Wang J-Z, Winton B, Liu H-K: Irradiation Si on Carbon Nanotube Paper as a Flexible Anode Material for Lithium-Ion Batteries, Nanoscience and Nanotechnology Letters 2012, 4:169-172. No impact factor as yet

16. Chu J, Peng X, Aldalbahi A, Panhuis MIH, Velazquez R, Feng PX: A simple route to carbon micro- and nanorod hybrid structures by physical vapour deposition, Journal of Physics D-Applied Physics 2012, 45 (39). IF=2.544

17. Chuc Huu N, Alici G, Wallace GG: Modelling trilayer conjugated polymer actuators for their sensorless position control, Sensors and Actuators A - Physical 2012, 185:82-91. IF=1.802

18. Clarke TM, Peet J, Denk P, Dennler G, Lungenschmied C, Mozer AJ: Non-Langevin bimolecular recombination in a silole-based polymer:PCBM solar cell measured by time-resolved charge extraction and resistance-dependent time-of-flight techniques, Energy & Environmental Science 2012, 5:5241-5245. IF=9.610

19. Clarke TM, Peet J, Nattestad A, Drolet N, Dennler G, Lungenschmied C, Leclerc M, Mozer AJ: Charge carrier mobility, bimolecular recombination and trapping in polycarbazole copolymer:fullerene (PCDTBT:PCBM) bulk heterojunction solar cells, Organic Electronics 2012, 13:2639-2646. IF=4.047

20. Daeneke T, Mozer AJ, Kwon T-H, Duffy NW, Holmes AB, Bach U, Spiccia L: Dye regeneration and charge recombination in dye-sensitized solar cells with ferrocene derivatives as redox mediators, Energy & Environmental Science 2012, 5:7090-7099. IF=9.610

21. Daeneke T, Mozer AJ, Uemura Y, Makuta S, Fekete M, Tachibana Y, Koumura N, Bach U, Spiccia L: Dye Regeneration Kinetics in Dye-Sensitized Solar Cells, Journal of the American Chemical Society 2012, 134:16925-16928. IF=9.097

22. Daeneke T, Uemura Y, Duffy NW, Mozer AJ, Koumura N, Bach U, Spiccia L: Aqueous Dye-Sensitized Solar Cell Electrolytes Based on the Ferricyanide-Ferrocyanide Redox Couple, Advanced Materials 2012, 24:1222-1225. IF=13.877

23. De Silva KSB, Gambhir S, Wang XL, Xu X, Li WX, Officer DL, Wexler D, Wallace GG, Dou SX: The effect of reduced graphene oxide addition on the superconductivity of MgB2, Journal of Materials Chemistry 2012, 22:13941-13946. IF=5.97

24. D'Souza, W. J., Quinn, S. J., Fryer, J.L., Taylor, B.V., Ficker, D.M., O'Brien, T.J., Pearce, N., Cook, M.J., The prevalence and demographic distribution of treated epilepsy: a community-based study in Tasmania, Australia, Acta Neurol Scand, 2012, 125(2): 96-104. IF=2.469

25. Ellis, Shane R.; Ferris, Cameron J.; Gilmore, Kerry J.; Mitchell, TW, Blanksby, SJ, Panhuis, MIH, Direct Lipid Profiling of Single Cells from Inkjet Printed Microarrays, Analytical Chemistry, 2012, 84(22), 9679-9683. IF=5.874

26. Ellis S.R., Hughes J.R., Mitchell T.W., in het Panhuis M., Blanksby S.J., Using Ambient Ozone for Assignment of Double Bond Position In Unsaturated Lipids, Analyst, 2012, 137,1100-1100. IF=4.23

27. Fabretto MV, Evans DR, Mueller M, Zuber K, Hojati-Talemi P, Short RD, Wallace GG, Murphy PJ: Polymeric Material with Metal-Like Conductivity for Next Generation Organic Electronic Devices, Chemistry of Materials 2012, 24:3998-4003. IF=7.286

28. Foroughi J, Kimiaghalam B, Ghorbani SR, Safaei F, Abolhasan M: Effect of conducting polypyrrole on the transport properties of carbon nanotube yarn, Thin Solid Films 2012, 520:7049-7053. IF=1.89

29. Foroughi J, Spinks GM, Ghorbani SR, Kozlov ME, Safaei F, Peleckis G, Wallace GG, Baughman RH: Preparation and characterization of hybrid conducting polymer-carbon nanotube yarn, Nanoscale 2012, 4:940-945. IF=5.91

30. Fuller, K. L., Wang, Y. Y., Cook, M.J., Murphy, M.A., D'Souza, W.J. Tolerability, safety and side effects of levetiracetam versus phenytoin in intravenous and total prophylactic regimen among craniotomy patients: A prospective randomized study, Epilepsia 2013, 54(1):45-57. IF=3.961

31. Gao X-W, Wang J-Z, Chou S-L, Liu H-K: Synthesis and electrochemical performance of LiV3O8/polyaniline as cathode material for the lithium battery, Journal of Power Sources 2012, 220:47-53. IF=4.951

32. Ge L, Chen J, Chen J, Zhu Z, Rudolph V: Study on the Controllable Scale-Up Growth of Vertically-Aligned Carbon Nanotube Arrays, Journal of Nanoscience and Nanotechnology 2012, 12:2722-2732. IF=1.56

33. Gelmi A, Higgins MJ, Wallace GG: Attractive and Repulsive Interactions Originating from Lateral Nanometer Variations in Surface Charge/Energy of Hyaluronic Acid and Chondroitin Sulfate Doped Polypyrrole Observed Using Atomic Force Microscopy, Journal of Physical Chemistry B 2012, 116:13498-13505. IF=3.696

34. Gestos A, Whitten PG, Wallace GG, Spinks GM: Actuating individual electrospun hydrogel nanofibres, Soft Matter 2012, 8:8082-8087. IF=4.39

35. Gilbert, F., Vranic, A., Hurst, S., Involuntary & Voluntary Invasive Brain Surgery: Ethical Issues Related to Acquired Aggressiveness. Neuroethics, 2012, May, ISSN: 1874-5490 DOI: 10.1007/s12152-012-9161-9. IF= 0.917

36. Gilbert, F., The Burden of Normality: From 'chronically ill' to 'symptom free'. New Ethical challenges for Deep Brain Stimulation postoperative treatment, Journal of Medical Ethics. 2012, 38: 408-412. IF=1.363

37. Gilbert, F., Harris, A., and Kapsa, R., Efficacy Testing as a Primary Purpose of Phase 1 Clinical Trials: Is it Applicable to First-in-Human Bionics and Optogenetics Trials? American Journal of Bioethics: Neuroscience. 2012, 3 (2), 20-22. IF= 3.379

38. Gilbert, F., and Partridge., B., (2012) The need to tackle concussion in Australian football codes, The Medical Journal of Australia 2012, 196 (9), 561-563. IF=2.813

39. Gong Q, He Y-S, Yang Y, Liao X-Z, Ma Z-F: Synthesis and electrochemical characterization of LiFePO4/C-polypyrrole composite prepared by a simple chemical vapor deposition method, Journal of Solid State Electrochemistry 2012, 16:1383-1388. IF=2.131

40. Griffith MJ, Sunahara K, Wagner P, Wagner K, Wallace GG, Officer DL, Furube A, Katoh R, Mori S, Mozer AJ: Porphyrins for dye-sensitised solar cells: new insights into efficiency-determining electron transfer steps, Chemical Communications 2012, 48:4145-4162. IF=6.169

41. Halliday AJ, Campbell TE, Razal JM, McLean KJ, Nelson TS, Cook MJ, Wallace GG: In vivo biocompatibility and in vitro characterization of poly-lactide-co-glycolide structures containing levetiracetam, for the treatment of epilepsy, Journal of Biomedical Materials Research Part A 2012, 100A:424-431. IF=2.147

42. Halliday AJ, Moulton SE, Wallace GG, Cook MJ: Novel methods of antiepileptic drug delivery - Polymer-based implants, Advanced Drug Delivery Reviews 2012, 64:953-964. IF=11.502

43. Han D, Sunarso J, Tan X, Yan Z, Liu L, Liu S: Optimizing Oxygen Transport Through La0.6Sr0.4Co0.2Fe0.8O3-delta Hollow Fiber by Microstructure Modification and Ag/Pt Catalyst Deposition, Energy & Fuels 2012, 26:4728-4734. IF=2.721

44. He, R.; Hocking, R.K.; Tsuzuki, T., Local structure and photocatalytic property of sol-gel synthesized ZnO doped with transition metal oxides, Journal of Materials Science, 2012, 47 (7), 3150-3158. IF = 2.015

45. He, R.; Hocking, R.K.; Tsuzuki, T., Co-doped ZnO nanopowders: Location of cobalt and reduction in photocatalytic activity, Materials Chemistry and Physics, 2012, 132 (2-3), 1035-1040. IF=2.234

46. Higgins MJ, Molino PJ, Yue Z, Wallace GG: Organic Conducting Polymer-Protein Interactions, Chemistry of Materials 2012, 24:828-839. IF=7.286

47. Hilder, M., Winther-Jensen, O., Winther-Jensen, B., and MacFarlane, D. R. Graphene/ zinc nano-composites by electrochemical co-deposition, Physical Chemistry Chemical Physics , 2012,14, 14034-14040. IF=3.75

48. Howlett PC, Gramet S, Lin J, Efthimiadis J, Chen XB, Birbilis N, Forsyth M: Conversion coatings of Mg-alloy AZ91D using trihexyl(tetradecyl) phosphonium bis(trifluoromethanesulfonyl) amide ionic liquid, Science China-Chemistry 2012, 55:1598-1607. IF=1.042

49. Izgorodin, A; Winther-Jensen, O; MacFarlane, D. R., On the Stability of Water Oxidation Catalysts: Challenges and Prospects, Australian Journal of Chemistry, 2012, 65(6), 638-642. IF=2.342

50. Izgorodin, A., Izgorodina,E.,MacFarlane, D. R., Low overpotential water oxidation to hydrogen peroxide on a MnOx catalyst, Energy & Environmental Science 2012, 5, 9496. IF=9.610

51. Jalili, Rouhollah; Razal, Joselito M.; Wallace, Gordon G., Exploiting high quality PEDOT:PSS-SWNT composite formulations for wet-spinning multifunctional fibers, Journal of Materials chemistry, 2012, 22(48), 25174-25182. IF=5.97

52. Janikowski J, Razali MR, Batten SR, MacFarlane DR, Pringle JM: Organic Ionic Plastic Crystals and Low Viscosity Ionic Liquids Based on the Dicyano(nitroso)methanide Anion, Chempluschem 2012, 77:1039-1045. IF=3.345

53. Jin L, Nairn KM, Forsyth CM, Seeber AJ, MacFarlane DR, Howlett PC, Forsyth M, Pringle JM: Structure and Transport Properties of a Plastic Crystal Ion Conductor: Diethyl(methyl) (isobutyl)phosphonium Hexafluorophosphate, Journal of the American Chemical Society 2012, 134:9688-9697. IF=9.097

54. Joshi T, Barbante GJ, Francis PS, Hogan CF, Bond AM, Gasser G, Spiccia L: Electrochemiluminescent Monomers for Solid Support Syntheses of Ru(II)-PNA Bioconjugates: Multimodal Biosensing Tools with Enhanced Duplex Stability, Inorganic Chemistry 2012, 51:3302-3315 IF=4.601

55. Joshi T, Gasser G, Martin LL, Spiccia L: Specific uptake and interactions of peptide nucleic acid derivatives with biomimetic membranes, RSC Advances 2012, 2:4703-4712. No impact factor

56. Kamel, J. T., Degruyter, M. A., D'Souza, W.J., Cook, M.J. Clinical experience with using lacosamide for the treatment of epilepsy in a tertiary centre, Acta Neurol Scand, 2012, Jul 31. DOI: 10.1111/j.1600-0404.2012.01704.x . IF=2.469

57. Kim BC, Kim SJ, Chung JK, Chen J, Park SY, Wallace GG: Charge storage in carbon nanotube-TiO2 hybrid nanoparticles, Synthetic Metals 2012, 162:650-654. IF=1.871

58. Kim SJ, Park GJ, Kim BC, Chung JK, Wallace GG, Park SY: Investigations into the electrochemical characteristics of nickel oxide hydroxide/multi-walled carbon nanotube nanocomposites for use as supercapacitor electrodes, Synthetic Metals 2012, 161:2641-2646. IF=1.871

59. Kolodziejczyk B, Winther-Jensen O, MacFarlane DR, Winther-Jensen B: Conducting polymer alloys for photo-enhanced electro-catalytic oxygen reduction, Journal of Materials Chemistry 2012, 22: 10821-10826. IF=5.97

60. Kong Y, Wang C, Yang Y, Too CO, Wallace GG: A battery composed of a polypyrrole cathode and a magnesium alloy anode-Toward a bioelectric battery, Synthetic Metals 2012, 162:584-589 IF=1.871

61. Lee JA, Shin MK, Kim SH, Kim SJ, Spinks GM, Wallace GG, Ovalle-Robles R, Lima MD, Kozlov ME, Baughman RH: Hybrid Nanomembranes for High Power and High Energy Density Supercapacitors and Their Yarn Application, ACS Nano 2012, 6:327-334. IF=11.421

62. Liang J, Zheng Y, Chen J, Liu J, Hulicova-Jurcakova D, Jaroniec M, Qiao SZ: Facile Oxygen Reduction on a Three-Dimensionally Ordered Macroporous Graphitic C3N4/ Carbon Composite Electrocatalyst, Angewandte Chemie-International Edition 2012, 51:3892-3896. IF=13.455

63. Liang, X., Kuhlmann, L., Johnston, L.A., Grayden, D.B., Vorgin, S., Crossley, R., Fuller, K., Lourensz, M. Cook, M.J. Extending Communication for Patients with Disorders of Consciousness, J Neuroimaging, 2012 2012 Aug 28. DOI: 10.1111/j.1552-6569.2012.00744. IF=1.509

64. Lima M.D., Li N., de Andrade M. J., Fang S.I, Oh J., Spinks G.M., Kozlov M.E., Haines C.S., Suh D., Foroughi J., Kim S.J., Chen Y., Ware T., Shin M.K., Machado L.D., Fonseca A.F., Madden J.D.W., Voit W. E., Galvão W.E., Baughman R.H., Electrically, Chemically, and Photonically Powered Torsional and Tensile Actuation of Hybrid Carbon Nanotube Yarn Muscles, Science, 2012, 338 (6109): 928-932. IF=32.201

65. Lin Y, Zhou W, Sunarso J, Ran R, Shao Z: Characterization and evaluation of BaCo0.7Fe0.2Nb0.1O3-delta as a cathode for proton-conducting solid oxide fuel cells, International Journal of Hydrogen Energy 2012, 37:484-497. IF=4.504

66. Lowe TA, Wallace GG, Neufeld AK: Insights into the cut edge corrosion of 55% Al-Zn metal coating on steel from simultaneous electrochemical polarization and localised pH sensing experiments, Corrosion Science 2012, 55:180-186. IF=3.734

67. Lu L, Wang J-Z, Gao X-W, Zhu X-B, Liu H-K: Enhanced Cycling Performance of Nanocrystalline Fe3O4/C as Anode Material for Lithium-Ion Batteries, Journal of Nanoscience and Nanotechnology 2012, 12:1246-1250. IF=1.56

68. MacFarlane, D. R., Winther-Jensen, B., Izgordin, A. Jensen, O.-W., High efficiency water oxidation and reduction catalysts, Preprints of Symposia - American Chemical Society, Division of Fuel Chemistry 2012, 57, 437.

69. Malig J, Stephenson AWI, Wagner P, Wallace GG, Officer DL, Guldi DM: Direct exfoliation of graphite with a porphyrin - creating functionalizable nanographene hybrids, Chemical Communications 2012, 48:8745-8747. IF=6.169

70. Mawad, Damia; Molino, Paul J.; Gambhir, Sanjeev Locke, JM ; Officer, DL; Wallace, GG, Electrically Induced Disassembly of Electroactive Multilayer Films Fabricated from Water Soluble Polythiophenes, Advanced Functional Materials, 2012,22(23), 5020-5027. IF=10.179

71. Mawad D, Boughton EA, Boughton P, Lauto A: Advances in Hydrogels Applied to Degenerative Diseases, Current Pharmaceutical Design 2012, 18:2558-2575. IF=3.87

72. Mawad D, Stewart E, Officer DL, Romeo T, Wagner P, Wagner K, Wallace GG: A Single Component Conducting Polymer Hydrogel as a Scaffold for Tissue Engineering, Advanced Functional Materials 2012, 22:2692-2699 . IF=10.179

73. Meng X, Yang N, Meng B, Tan X, Yin Y, Ma Z-F, Sunarso J: Microstructure tailoring of the nickel-yttria stabilised zirconia (Ni-YSZ) cermet hollow fibres, Ceramics International 2012, 38:6327-6334. IF=1.751

74. Molino PJ, Higgins MJ, Innis PC, Kapsa RMI, Wallace GG: Fibronectin and Bovine Serum Albumin Adsorption and Conformational Dynamics on Inherently Conducting Polymers: A QCM-D Study, Langmuir 2012, 28:8433-8445. IF=4.186

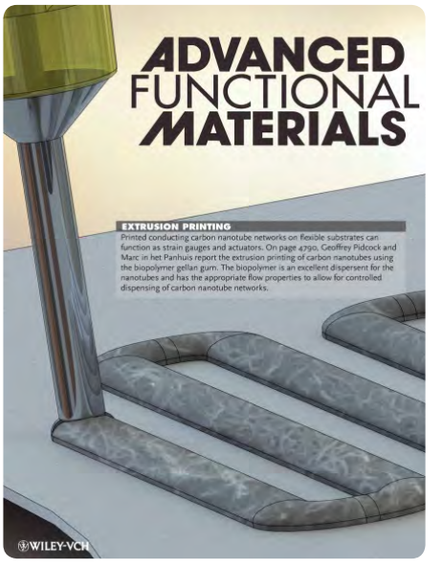
75. Molino PJ, Wallace GG, Hanks TW: Hydrophobic conducting polymer films from post deposition thiol exposure, Synthetic Metals 2012, 162:1464-1470. IF=1.871

76. Moulton SE, Higgins MJ, Kapsa RMI, Wallace GG: Organic Bionics: A New Dimension in Neural Communications, Advanced Functional Materials 2012, 22:2003-2014. IF=10.179

77. Mozer AJ, Clarke TM: Reduced Bimolecular Recombination in Conjugated Polymer Donor/Fullerene Acceptor Bulk Heterojunction Solar Cells, Australian Journal of Chemistry 2012, 65:442-447. IF=2.342

78. Naficy S, Razal JM, Spinks GM, Wallace GG, Whitten PG: Electrically Conductive, Tough Hydrogels with pH Sensitivity, Chemistry of Materials 2012, 24:3425-3433. IF=7.286

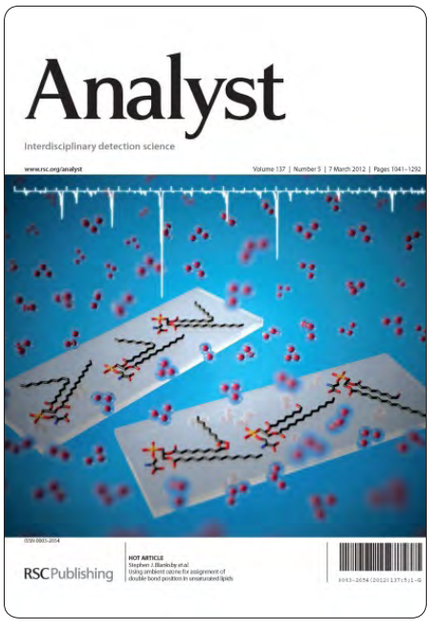
79. Naficy S, Razal JM, Whitten PG, Wallace GG, Spinks GM: A pH-sensitive, strong double-network hydrogel: Poly(ethylene glycol) methyl ether methacrylates-poly(acrylic acid), Journal of Polymer Science Part B-Polymer Physics 2012, 50:423-430. IF=1.5

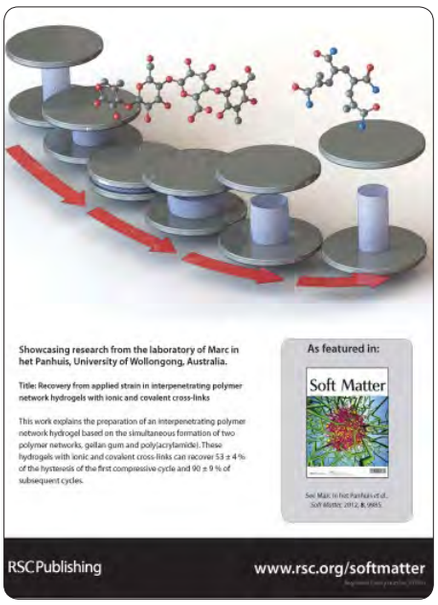


80. Nakashima H, Higgins MJ, O'Connell C, Torimitsu K, Wallace GG: Liquid Deposition Patterning of Conducting Polymer Ink onto Hard and Soft Flexible Substrates via Dip-Pen Nano lithography, Langmuir 2012, 28:804-811. IF=4.186

81. Nam H-S, Kim KM, Kim SH, Kim BC, Wallace GG, Ko JM: Supercapacitive properties of polyaniline/hydrous RuO2 composite electrode, Polymer Bulletin 2012, 68:553-560. IF=1.532

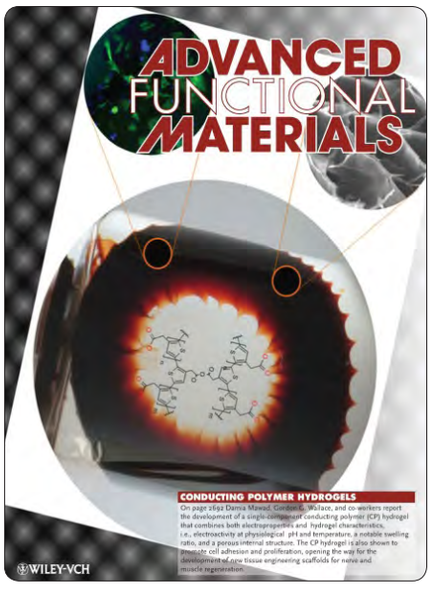
82. Niu Z, Chen J, Hng HH, Ma J, Chen X: A Leavening Strategy to Prepare Reduced Graphene Oxide Foams, Advanced Materials 2012, 24:4144-4150 IF=13.877.





83. Niu Z, Luan P, Shao Q, Dong H, Li J, Chen J, Zhao D, Cai L, Zhou W, Chen X, Xie S: A "skeleton/skin" strategy for preparing ultrathin free-standing single-walled carbon nanotube/polyaniline films for high performance supercapacitor electrodes, Energy & Environmental Science 2012, 5:8726-8733. IF=9.610

84. Noerochim L, Wang J-Z, Chou S-L, Wexler D, Liu H-K: Free-standing single-walled carbon nanotube/SnO2 anode paper for flexible lithium-ion batteries, Carbon 2012, 50:1289-1297. IF=5.378



85. Noerochim L, Wang J-Z, Wexler D, Rahman MM, Chen J, Liu H-K: Impact of mechanical bending on the electrochemical performance of bendable lithium batteries with paper-like free-standing V2O5-polypyrrole cathodes, Journal of Materials Chemistry 2012, 22:11159-11165. IF=5.97

86. Nguyen C. H., Alici G. and Wallace G. G., Modelling conjugated polymer actuators for their sensorless position control, Sensors and Actuators A: Physical, 2012, 185, 82-91. IF=1.802

87. O'Connell CD, Higgins MJ, Nakashima H, Moulton SE, Wallace GG: Vapor Phase Polymerization of EDOT from Submicrometer Scale Oxidant Patterned by Dip-Pen Nanolithography, Langmuir 2012, 28:9953-9960. IF=4.186

88. Pidcock GC, Panhuis MIH: Extrusion Printing of Flexible Electrically Conducting Carbon Nanotube Networks, Advanced Functional Materials 2012, 22:4790-4800. IF=10.179

89. Pierroz, V ; Joshi, T; Leonidova, A; Mari, C; Schur, J; Ott, I; Spiccia, L ; Ferrari, S; Gasser, G, Molecular and Cellular Characterization of the Biological Effects of Ruthenium(II) Complexes Incorporating 2-Pyridyl-2-pyrimidine-4-carboxylic Acid, Journal of the American Chemical Society, 2012, 134 (50), 20376-20387. IF=9.907

90. Quigley, A.F., Razal, J.M., Kita, M., Jalili, R., Gelmi, A., Penington, A., Ovalle-Robles, R., Baughman, R.H., Clark, G.M., Wallace, G.G., Kapsa, R.M.I. Electrical Stimulation of Myoblast Proliferation and Differentiation on Aligned Nanostructured Conductive Polymer Platforms, Advanced Healthcare Materials 2012, 1, 801-808. No impact factor as yet

91. Rahman MM, Wang J-Z, Zeng R, Wexler D, Liu HK: LiFePO4-Fe2P-C composite cathode: An environmentally friendly promising electrode material for lithium-ion battery, Journal of Power Sources 2012, 206:259-266. IF=4.951

92. Rana, U.A, Forsyth, M., MacFarlane, D. R., Pringle, J. M., Toward protic ionic liquid and organic ionic plastic crystal electrolytes for fuel cells, Electrochimica Acta, 2012, 84, 213-222. IF=3.832

93. Rana UA, Vijayaraghavan R, MacFarlane DR, Forsyth M: Plastic crystal phases with high proton conductivity, Journal of Materials Chemistry 2012, 22:2965-2974. IF=5.97

94. Rattanakit P, Moulton SE, Santiago KS, Liawruangrath S, Wallace GG: Extrusion printed polymer structures: A facile and versatile approach to tailored drug delivery platforms, International Journal of Pharmaceutics 2012, 422:254-263. IF=3.350.

95. Romano MS, Gambhir S, Razal JM, Gestos A, Wallace GG, Chen J: Novel carbon materials for thermal energy harvesting, Journal of Thermal Analysis and Calorimetry 2012, 109:1229-1235. IF=1.604

96. Salari, M, Rezaee, M,Chidembo, AT, Konstantinov, K, Liu, HK, Rietveld Analysis of the Effect of Annealing Atmosphere on Phase Evolution of Nanocrystalline TiO_2 Powders, Journal of Nanoscience and Nanotechnology, 2012, 12 (6), 4724-4728. IF=1.56

97. Seter M, Dakternieks D, Duthie A: Chiral rings from BINOL dicarboxylic acids and alkane ditin(IV) linkers, Main Group Metal Chemistry, 2012, 35:73-80. IF=0.207

98. Seter M, Hinton B, Forsyth M: Understanding Speciation of Lanthanum 4-Hydroxy Cinnamate and its Impact on the Corrosion Inhibition Mechanism for AS1020 Steel, Journal of the Electrochemical Society 2012, 159:C181-C189. IF=2.59

99. Shang J, Li G, Singh R, Gu Q, Nairn KM, Bastow TJ, Medhekar N, Doherty CM, Hill AJ, Liu JZ, Webley PA: Discriminative Separation of Gases by a "Molecular Trapdoor" Mechanism in Chabazite Zeolites, Journal of the American Chemical Society 2012, 134:19246-19253. IF=9.097

100. Shin MK, Lee B, Kim SH, Lee JA, Spinks GM, Gambhir S, Wallace GG, Kozlov ME, Baughman RH, Kim SJ: Synergistic toughening of composite fibres by self-alignment of reduced graphene oxide and carbon nanotubes, Nature Communications 2012, 3: IF=7.396

101. Simons TJ, Torriero AAJ, Howlett PC, MacFarlane DR, Forsyth M: High current density, efficient cycling of Zn2+ in 1-ethyl-3-methylimidazolium dicyanamide ionic liquid: The effect of Zn2+ salt and water concentration, Electrochemistry Communications 2012, 18:119-122. IF=4.859

102. Skrzypiec H, Mazurek R, Wagner P, Kubicki M: Isomorphism in Two (E)-1-(4-Halophenyl)-N-1-(4-Methylphenyl)-1H-Imidazol-4-yl Methanimines (Halide = Cl, Br), Journal of Chemical Crystallography 2012, 42:1036-1041. IF=0.566

103. Spinks GM: Deforming Materials With Light: Photoresponsive Materials Muscle In On the Action, Angewandte Chemie-International Edition 2012, 51:2285-2287. IF=13.455

104. Stewart, EM, Liu, X,Clark, GM, Kapsa, RMI, Wallace, GG, Inhibition of smooth muscle cell adhesion and proliferation on heparin-doped polypyrrole , Acta Biomaterialia, 2012, 8 (1), 194-200. IF=4.865

105. Sultana I, Rahman MM, Li S, Wang J, Wang C, Wallace GG, Liu H-K: Electrodeposited polypyrrole (PPy)/para (toluene sulfonic acid) (pTS) free-standing film for lithium secondary battery application, Electrochimica Acta 2012, 60:201-205. IF=3.832

106. Sultana I, Rahman MM, Wang J, Wang C, Wallace GG, Liu H-K: Indigo carmine (IC) doped polypyrrole (PPy) as a free-standing polymer electrode for lithium secondary battery application, Solid State Ionics 2012, 215:29-35. IF=2.646

107. Sultana, Irin; Rahman, Md Mokhlesur; Wang, Jiazhao; Wang, CY; Wallace, GG; Liu, HK; All-polymer battery system based on polypyrrole (PPy)/para (toluene sulfonic acid) (pTS) and polypyrrole (PPy)/indigo carmine (IC) free standing films, Electrochimica Acta, 2012, 83, 209-215. IF=3.832

108. Sunarso J, Shekibi Y, Efthimiadis J, Jin L, Pringle JM, Hollenkamp AF, MacFarlane DR, Forsyth M, Howlett PC: Optimising organic ionic plastic crystal electrolyte for all solid-state and higher than ambient temperature lithium batteries, Journal of Solid State Electrochemistry 2012, 16:1841-1848. IF=2.131

109. Sunarso J, Torriero AAJ, Zhou W, Howlett PC, Forsyth M: Oxygen Reduction Reaction Activity of La-Based Perovskite Oxides in Alkaline Medium: A Thin-Film Rotating Ring-Disk Electrode Study, Journal of Physical Chemistry C 2012, 116:5827-5834. IF=4.805

110. Sweetman LJ, Nghiem L, Chironi I, Triani G, Panhuis MIH, Ralph SF: Synthesis, properties and water permeability of SWNT buckypapers, Journal of Materials Chemistry 2012, 22:13800-13810. IF=5.97

111. Swiegers GF, MacFarlane DR, Officer DL, Ballantyne A, Boskovic D, Chen J, Dismukes GC, Gardner GP, Hocking RK, Smith PF, Spiccia L, Wagner P, Wallace GG, Winther-Jensen B, Winther-Jensen O: Towards Hydrogen Energy: Progress on Catalysts for Water Splitting, Australian Journal of Chemistry 2012, 65:577-582. IF=2.342

112. Tan X, Liu N, Meng B, Sunarso J, Zhang K, Liu S: Oxygen permeation behavior of La0.6Sr0.4Co0.8Fe0.2O3 hollow fibre membranes with highly concentrated CO2 exposure, Journal of Membrane Science 2012, 389:216-222. IF=3.850

113. Taylor DL, Ferris CJ, Maniego AR, Castignolles P, Panhuis MIH, Gaborieau M: Characterization of Gellan Gum by Capillary Electrophoresis, Australian Journal of Chemistry 2012, 65:1156-1164. IF=2.342

114. Tong L, Iwase A, Nattestad A, Bach U, Weidelener M, Goetz G, Mishra A, Baeuerle P, Amal R, Wallace GG, Mozer AJ: Sustained solar hydrogen generation using a dye-sensitised NiO photocathode/BiVO4 tandem photo-electrochemical device, Energy & Environmental Science 2012, 5:9472-9475. IF=9.610

115. Torriero AAJ, Howlett PC: Ionic liquid effects on the redox potential of ferrocene, Electrochemistry Communications 2012, 16:84-87. IF=4.859

116. Trung Duc T, Alici G, Zhou H, Li W: A Review of Localization Systems for Robotic Endoscopic Capsules, IEEE Transactions on Biomedical Engineering 2012, 59:2387-2399. IF=2.278

117. Velten J, Mozer AJ, Li D, Officer D, Wallace G, Baughman R, Zakhidov A: Carbon nanotube/graphene nanocomposite as efficient counter electrodes in dye-sensitized solar cells, Nanotechnology 2012, 23. IF=3.979

118. Viry L, Moulton SE, Romeo T, Suhr C, Mawad D, Cook M, Wallace GG: Emulsion-coaxial electrospinning: designing novel architectures for sustained release of highly soluble low molecular weight drugs, Journal of Materials Chemistry 2012, 22:11347-11353. IF=5.97

119. Wallace GG, Higgins MJ, Moulton SE, Wang C: Nanobionics: the impact of nanotechnology on

implantable medical bionic devices, Nanoscale 2012, 4:4327-4347. IF=5.91

120. Weidelener M, Mishra A, Nattestad A, Powar S, Mozer AJ, Mena-Osteritz E, Cheng Y-B, Bach U, Baeuerle P: Synthesis and characterization of perylene-bithiophene-triphenylamine triads: studies on the effect of alkyl-substitution in p-type NiO based photocathodes, Journal of Materials Chemistry 2012, 22:7366-7379. IF=5.97

121. Weng B, Liu X, Shepherd R, Wallace GG: Inkjet printed polypyrrole/collagen scaffold: A combination of spatial control and electrical stimulation of PC12 cells, Synthetic Metals 2012, 162:1375-1380. IF=1.871

122. Wetchakun N, Chaiwichain S, Inceesungyorn B, Pingmuang K, Phanichphant S, Minett AI, Chen J: BiVO4/CeO2 Nanocomposites with High Visible-Light-Induced Photocatalytic Activity, ACS Applied Materials & Interfaces 2012, 4:3718-3723. IF=4.525

123. Whitting JW, Steele JR, McGhee DE, Munro BJ: Effects of passive ankle dorsiflexion stiffness on ankle mechanics during drop landings, Journal of Science and Medicine in Sport 2012, 15:468-473. IF=3.034

124. Wild CY, Steele JR, Munro BJ: Why Do Girls Sustain More Anterior Cruciate Ligament Injuries Than Boys? A Review of the Changes in Estrogen and Musculoskeletal Structure and Function during Puberty, Sports Medicine 2012, 42:733-749. IF=5.1

125. Winther-Jensen O., Chatjaroenporn K., Winther-Jensen B., and MacFarlane D. R.,Towards hydrogen production using a breathable electrode structure to directly separate gases in the water splitting reaction, International Journal of Hydrogen Energy, 2012, 37, 8185-8189. IF=4.402

126. Wong J, Higgins M, Halliday G, Garner B: Amyloid beta selectively modulates neuronal TrkB alternative transcript expression with implications for Alzheimer's disease, Neuroscience 2012, 210:363-374. IF=3.380

127. Yang Y, Wang C, Yue B, Gambhir S, Too CO, Wallace GG: Electrochemically Synthesized Polypyrrole/Graphene Composite Film for Lithium Batteries, Advanced Energy Materials 2012, 2:266-272. IF due June 2013

128. Yue B, Wang C, Ding X, Wallace GG: Polypyrrole coated nylon lycra fabric as stretchable electrode for supercapacitor applications, Electrochimica Acta 2012, 68:18-24. IF=3.832

129. Yue, B., Wang, C., Wagner, P., Yang, Y., Ding, X., Officer, D.L., Wallace, G.G. Electrodeposition of pyrrole and 3-(4-tert-butylphenyl)thiophene copolymer for supercapacitor applications, Synthetic Metals, 2012, 162(24), 2216-2221. IF=1.871

130. Zamora-Ledezma C, Puech N, Zakri C, Grelet E, Moulton SE, Wallace GG, Gambhir S, Blanc C, Anglaret E, Poulin P: Liquid Crystallinity and Dimensions of Surfactant-Stabilized Sheets of Reduced Graphene Oxide, Journal of Physical Chemistry Letters 2012, 3:2425-2430. IF=6.213

131. Zanoni M, Coleman S, Fraser KJ, Byrne R, Wagner K, Gambhir S, Officer DL, Wallace GG, Diamond D: Physicochemical study of spiropyran-terthiophene derivatives: photochemistry and thermodynamics, Physical Chemistry Chemical Physics 2012, 14:9112-9120. IF=3.75

132. Zhang Q, Fan W, Wang T, Nan G, Sunarso J: Influence of emulsification on the properties of styrene-butadiene-styrene chemically modified bitumens, Construction and Building Materials 2012, 29:97-101. IF=1.834

133. Zhang YF, Hinton B, Wallace G, Liu X, Forsyth M: On corrosion behaviour of magnesium alloy AZ31 in simulated body fluids and influence of ionic liquid pretreatments, Corrosion Engineering Science and Technology 2012, 47:374-382. IF=0.658

134. Zhao J, Zhang W, Sherrell P, Razal JM, Huang X-F, Minett AI, Chen J: Carbon Nanotube Nanoweb-Bioelectrode for Highly Selective Dopamine Sensing, ACS Applied Materials & Interfaces 2012, 4:44-48. IF=4.525

135. Zheng W, Razal JM, Spinks GM, Van-Tan T, Whitten PG, Wallace GG: The Role of Unbound Oligomers in the Nucleation and Growth of Electrodeposited Polypyrrole and Method for Preparing High Strength, High Conductivity Films, Langmuir 2012, 28:10891-10897. IF=4.186

136. Zhong C, Wang J-Z, Gao X-W, Chou S-L, Konstantinov K, Liu H-K: One-Step Spray Pyrolysis Synthesized CuO-Carbon Composite Combined with Carboxymethyl Cellulose Binder as Anode for Lithium-Ion Batteries, Journal of Nanoscience and Nanotechnology 2012, 12:1314-1317. IF=1.56

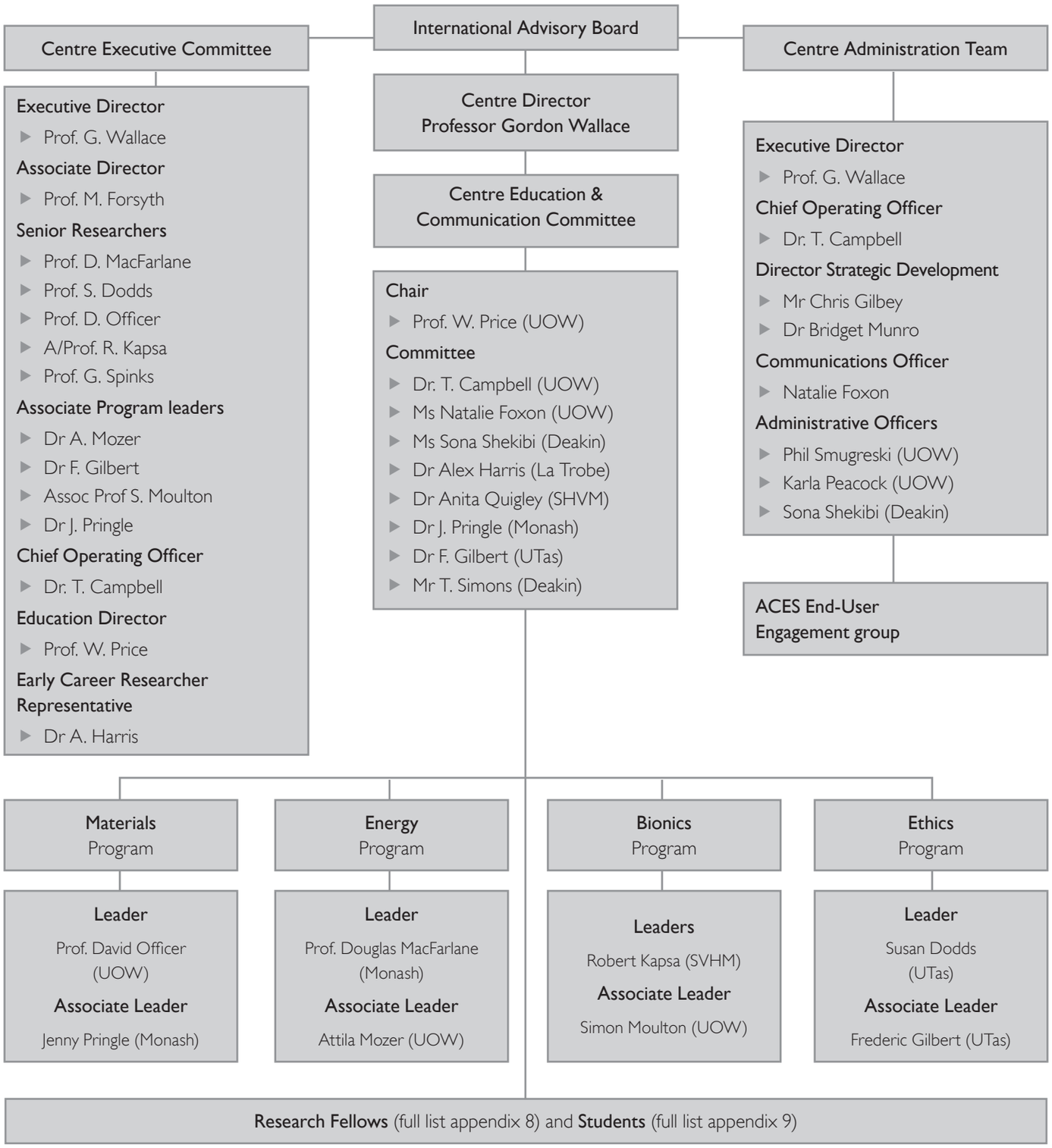
137. Zhou, FL; Izgorodin, A ; Hocking, RK; Spiccia, L; MacFarlane, DR, Electrodeposited MnOx Films from Ionic Liquid for Electrocatalytic Water Oxidation, Advanced Energy Materials, 2012, 2 (8), 1013-1021. IF due June 2013

138. Zhang H., Scholz A. K., de Crevoisier J., Voin-Loisel F., Bernard G., Hexemer A, Brown H. R., Kramer E. J. and Creton C.: Nanocavitation in carbon black filled styrene-butadiene rubber under tension detected by real-time small angle scattering, Macromolecules 2012, 45, 1529-43. IF=5.165

In Press

1. Antiohos, D., Pingmuang, K., Romano, M., Beirne, S., Romeo, T., Aitchison, P., Minett, A., Wallace, G., Phanichphant, S., Chen, J., Manganosite - microwave exfoliated graphene oxide composites for asymmetric supercapacitor device applications, Electrochimica Acta, 2012 October 11, DOI: 10.1016/j.electacta.2012.10.007. [Epub ahead of print].
2. Ferris, C.J., Gilmore, K.J., Beirne, S., McCallum, D., Wallace, G.G., in het Panhuis, M. Bio-ink for on-demand printing of living cells, Biomaterials Science, 2013,1, 224-230.
3. Gelmi, A., Higgins, M.J., Wallace, G.G., Resolving Sub-Molecular Binding and Electrical Switching Mechanisms of Single Proteins at Electroactive Conducting Polymers, Small, 2012 Oct 17. DOI: 10.1002/smll.201201686. [Epub ahead of print].
4. Gilbert, F, 'Deep Brain Stimulation for Treatment Resistant Depression: Postoperative Feelings of Self-Estrangement, Suicide Attempt and Impulsive-Aggressive Behaviours', Neuroethics pp. 1-12. ISSN 1874-5490 (In Press) [Refereed Article]
5. Gilbert, F, 'Deep Brain Stimulation and Postoperative Suicidality Among Treatment Resistant Depression Patients: Should Eligibility Protocols Exclude Patients with a History of Suicide Attempts and Anger/Impulsivity?', AJOB Neuroscience Journal, 4 (1) pp. 1-28. ISSN 2150-7740 (In Press) [Refereed Article]
6. Harris, A.R., Morgan, S.J., Chen, J., Kapsa, R.M.I., Wallace, G.G., Paolini, A.G., Conducting polymer coated neural recording electrodes, Journal of Neural Engineering, 2012 Dec 12, 10(1):016004. [Epub ahead of print]
7. Izgorodin, A., Hocking, R. , Winther-Jensen, O. , Hilder, M., Winther-Jensen, B. , MacFarlane, D. R., Phosphorylated manganese oxide electrodeposited from ionic liquid as a stable, high efficiency water oxidation catalyst, Catalysis Today 2013, 200, 36.
8. Khoo, T., Somers, A. , Torriero, A.A.J., MacFarlane, D.R., Howlett, P.C., Forsyth, M., Discharge behaviour and interfacial properties of a magnesium battery incorporating trihexyl(tetradecyl) phosphonium based ionic liquid electrolytes, Electrochimica Acta, 2013, 87, 701-708.
9. Kirchmajer D.M, Watson C.A., Ranson M. and in het Panhuis M., Gelapin, a degradable genipin cross-linked gelatin hydrogel, RSC Adv., 2013,3, 1073-1081.
10. Krishnan, Asha; Sreeremya, Thadathil S.; Murray, Eoin; Ghosh, S, One-pot synthesis of ultra-small cerium oxide nanodots exhibiting multi-colored fluorescence, Journal of Colloid and Interface Science, 2013,389:16-22.
11. Pringle J.M., Recent Progress in the Development and Use of Organic Ionic Plastic Crystal Electrolytes Phys. Chem. Chem. Phys., 2013, 15 (5), 1339 – 1351.
12. Quigley, A., Kyratzis, I.L., Bulluss, K.J., Gilmore, K., Kennedy, E.L., O'Shea, M., Truong, Y., Edwards, S., Razal, J., Campbell, T., Herwig, P., Staynes, L., Lowes, K.N., Sharma, D., Peeters, G., Abbott, A., Murphy, M.A., Cook, M.J., Clarke, G.M., Wallace, G.G., Kapsa, R.M.I. Engineering a Multimodal Nerve Conduit for Repair of Injured Peripheral Nerve, J Neural Engineering. 2013 10(1):016008. DOI: 10.1088/1741-2560/10/1/016008.
13. Sarvia F., Yue Z., Hourigana K., Thompson M., Chan P. P. Y., Surface-functionalization of PDMS for Potential Micro-bioreactor and Embryonic Stem Cell Culture Applications, J. Material Chemistry B, 2013, DOI: 10.1039/C2TB00019A.
14. Sayyar, S., Murray, E., Thompson, B.C., Gambhir, S., Officer, D.L., Wallace, G.G. Covalently linked biocompatible graphene/polycaprolactone composites for tissue engineering, Carbon, 2013, 52, 296-304.
15. Stewart, E., Fabretto, M., Mueller, M., Molino, P., Griesser, H.J., Short, R.D., Wallace, G.G., Cell attachment and proliferation on high conductivity PEDOT-glycol composites produced by vapour phase polymerisation, Biomaterials Science, 2012 Nov 20, DOI: 10.1039/C2BM00143H. [Epub ahead of print].
16. Sunarso, J., Glushenkov, A. M. ,Torriero, A. M., Howlett, P. C., Chen, Y., MacFarlane D. R., Forsyth, M.,Bi-functional water/oxygen electrocatalyst based on PdO-RuO2 composites, Journal of the Electrochemical Society 2013, 160, H74.
17. Thompson S. J., Pringle J. M., Zhang X. L., Cheng Y., A novel carbon-PEDOT composite counter electrode for monolithic dye sensitised solar cells Journal of Physics D: Applied Physics 2013, 46, 024007
18. Yue, Z., Molino, P.J., Liu, X., Wallace, G.G. PEGylation of platinum bio-electrodes, Electrochemistry Communications, 2013, 27, 54-58.
19. Yue, Z., Moulton, S.E., Cook, M., O'Leary, S., Wallace, G.G. Controlled Delivery for Neuro-Bionic Devices, Nanoscale, 2012 June 13, DOI: 10.1016/j.addr.2012.06.002. [Epub ahead of print]

Governance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Centre Administration Team
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A/Prof. R. Kapsa
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Energy Program
Bionics Program
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Prof. Douglas MacFarlane (Monash)
Associate Leader
Attila Mozer (UOW)
Leaders
Robert Kapsa (SVHM)
Associate Leader
Simon Moulton (UOW)
Leader
Susan Dodds (UTas)
Associate Leader
Frederic Gilbert (UTas)
Research Fellows (full list appendix 8) and Students (full list appendix 9)

The centre's governance structures involve stakeholders in planning and management processes. The chart on the previous page illustrates the current governance structure and relationships.

Centre International Advisory Board (IAB)

The Centre's Advisory board, listed below, provides valuable advice on scientific and commercial opportunities relevant to the centre, as well as monitoring the centre's progress. Members also provide regular comment and guidance to the Director, Prof Gordon Wallace.

ACES would like to thank retiring IAB members Prof K. Kaneto (Kyushu Institute of Technology, Japan), Dr I. Sare (DSTO) and Prof S. Roth Ogata (Korean University, Korea) for their contributions to ACES since its establishment in 2005.

Prof Dirk Guldi (Erlangen, Germany); Prof Yoshihito Osada (RIKEN, Japan); Prof Daoben Zhu (Chinese Academy of Sciences) and Dr Anita Hill (CSIRO) accepted the Chair's invitation to join the board in 2012.

The Centre Executive

The Centre Executive met 4 times in 2012 as well as attending the IAB meeting. The role of the executive was to provide ongoing operational management of the Centre; plan the Centre scientific program; review the progress of the Centre; as well as the procedures used to facilitate the dissemination of research findings and to maximise the use of skills within the Centre and externally.

Education & Communication Committee

This committee initiates and implements strategies to attract and engage high calibre research students to the centre, provide effective education and training programs for ACES members in both the research and communication areas. Chaired by Prof William Price, the committee met twice in 2012. For further information see Education & Training; Communication & Outreach chapters in this report.

INTERNATIONAL ADVISORY BOARD FOR ACES

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

Prof L. Astheimer
DVC Research Deakin University

Prof R. Baughman
University of Texas, Dallas

Prof D. Diamond
CLARITY, Dublin City University, Ireland

Prof D. Guldi
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Dr A. Hill
CSIRO

Prof P. Nixon
DVC research University of Tasmania

Dr G. Smith
SciVentures

Prof J. Raper
DVC Research, UOW

Dr A. Khan
Monash University

Prof R. Kaner
University of California

Prof T.W.H. Kay
St Vincent's Hospital, Melb.

Prof Y. Osada
RIKEN, Japan

Prof D. Zhu
Chinese Academy of Sciences

Supplementary Information Appendix 1: Visitors

As can be seen throughout this Annual Report, ACES has hosted and engaged a total of 203 end-user and academic visitors.

These visitors are vital to communicate our science, develop collaborations and investigate potential commercial opportunities arising from ACES research. The following presents a list of these visitors to all six ACES nodes in 2012.

TYPE	VISITOR	INSTITUTION
Industry	Dr Rajesh Thaper	Ranbaxy Labs Ltd
Academic/ Industry	Jeremy Crook	University of Melbourne, NICTA
Industry	Paul Barrett	UniQuest
Industry	Pat Mooney Nigel Hennessy Topaz Conway	Commercialisation Australia
Industry	Peter Masterson	AusIndustry
Industry	Dr Gideon Freeman	Quality Manager/ Validation Scientist, GMT Company
Industry	Patrick Carey	CPE Systems Pty Ltd
Academic	Prof Paul Calvert	University of Massachusetts, USA
Academic	Christianne Gilissen	Student, University Zuyd, the Netherlands
Academic	A/Prof Chongjun Zhao	School of Materials Science & Engineering, East China University of Science & Technology
Academic	Shota Kawakami	Student, Kyushu Institute of Technology, Japan
Academic	Dr Jani Pelto	Senior Scientist, VTT Technical Research Center of Finland
Academic	Dr Suvi Haimi	Department of Biomaterials Science and Technology, University of Tampere, Finland & University of Twente, The Netherlands
Academic	Miina Hamalainen	Student, University of Tampere, Finland
Academic	Natkritta Boonprakob	Student, Chiang Mai University, Thailand
Academic	Dr Kei Matsumoto	Tottori University, Japan
Academic	Dr Jan Novak	Department of Chemistry, College of Engineering and Physical Sciences at University of Birmingham, UK
Academic	Dr Tony Hollenkamp	Principal Research Scientist, CSIRO Energy Technology
Industry	Dr Dirk Fiedler	Cochlear Limited NSW
Industry	Ashish D Diwan	Chief, Spine Service, Department of Orthopaedic Surgery, St George Hospital Campus, Director Bone Biology, Orthopaedic Research Institute
Industry	Dr Michele Sessolo	Department of Bioelectronics, France
Industry	Dr Wren Greene	Institute for Technology Research and Innovation, Deakin University
Industry	Dr Adam Best	Energy Technology Division, CSIRO
Industry	Prof Sylvain Martel	Director NanoRobotics Laboratory, Department of Computer and Software Engineering, Institute of Biomedical Engineering École Polytechnique de Montréal
Industry	Dr Alan Bryson Dr Ankie Larsson	Corrosion Manager Asset Management and Engineering (Vic) APA Group
Academic	A/Prof Jeremy Crook	The University of Melbourne
Academic	Prof Mario Romero-Ortega	University of Texas at Arlington

TYPE	VISITOR	INSTITUTION
Academic	Prof Dermot Diamond	National Centre for Sensor Research, Dublin City University, Ireland
Academic	Prof Jooyul Lee	Visiting Fellow from Korea Institute of Materials Science (KIMS), Korea
Academic	A/Prof Michael Lyons	University of Dublin, Trinity College, Ireland
Academic	Mr Patrick O'Brien	U/G student, Trinity College Dublin, Ireland
Academic	Prof Ari Ivaska	Åbo Akademi University, Finland
	Prof Brett Paull Prof Pavel Nesterenko	University of Tasmania
Academic	Joffrey Champavert	Student, Montpelier University, France
Academic	Dr Michele Sessolo	Research Fellow, EMSE – Department of Bioelectronics, Gardanne, France
Academic	Annika Spies	Student, University Erlangen-Nuernberg, Germany
Academic	Prof Austen Angell	Arizona State University
Academic	Dr Luke O'Dell	Steacie Institute for Molecular Sciences, National Research Council Canada
Academic	Prof Simon de Leeuw	Leiden University, Netherlands
Academic	Dr Richard Chester	Research Leader – Materials, Maritime Platforms Division, DSTO
Academic	Dr Steven Galea	Research Leader – Materials, Air Vehicles Division, DSTO
Academic	Prof Rob Melchers	Department of Civil Engineering, University of Newcastle
Academic	Dr Yaiza Gonzalez-Garcia Prof Arjan Mol	Department of Materials Science and Technology Surfaces and Interfaces group in Corrosion Technology and Electrochemistry, Delft University of Technology, The Netherlands
Industry	James Nicholson	SMR
Industry	Dr Seshu Bhagavathula	Executive Vice President, Global Engineering, SMR Automotive Services, GmBH, Motherson Group
Industry	Prof Kenneth McKinnon	Former Vice-Chancellor, University of Wollongong
Industry	Arun Kumar Jagatramka	Chairman & Managing Director, Gujarat NRE Coke Ltd
Industry	Dr Kristian Knudsen	Chemistry Consultant, Uniqsus
Industry	Emeritus Prof Neville Stephenson	Alternative Energy International Limited
Industry	Mr Uday Bhende	Director, Tidal & Marine Technologies, Kriloskar Integrated Technologies Ltd
Industry	Greg Pearce	Minister for the Illawarra
Industry	Seung HoYoon David Hwang Dong Guk Yoo	Gwangju Technopark
Industry	Dr Raed Felimban	Department of Orthopaedics, St Vincent's Hospital
Industry	Dr Michael Newman Dr Youssof Shekibi	Maritime Platforms Division (DSTO)
Industry	A/Prof Morteza Aghmesheh	Staff Specialist Medical, Medical Oncology Department Illawarra Cancer Care Centre, Wollongong Hospital
Industry	Prof Philip Clingan	Head of Oncology, Illawarra Area Health Service and Figtree Private Hospital
Industry	Dr John Carmody	Staff Specialist Neurologist, Illawarra Shoalhaven Local Health District
Industry	A/Prof Andrew Miller Sherlyn Kang	Radiation Oncologists, Illawarra Area Health Service
Academic	Prof Charles Dismukes	Rutgers University, New Jersey, USA
Academic	Prof Dennis Tallman	North Dakota State University, USA,
Academic	A/Prof Stefan Adams	Nanying Technology University, Singapore
Academic	Prof George Malliaras	Ecole Nationale Supérieure des Mines de Saint Etienne, France
Academic	Dr Nao Kobayashi	NICTA and University of Melbourne
Academic	Yuen Yue Tham	PhD student, University of Tasmania

TYPE	VISITOR	INSTITUTION
Industry	Jim Patrick	Cochlear
Industry	Phil Prosser Peter Chaplin	PMB Defence Engineering
Industry	Mr Fu Chao	Director of Zuoyi Technology
Industry	Dr Andrew Bleasel	Head of the Department of Neurology and Director of the Epilepsy Unit, Westmead Hospital
Industry	Dr Sherine Fernando	Department of Dermatology, St Vincent's Hospital
Industry	Daniel Thompson	Regional Sales Director, Objet AP Ltd
Industry	Dr Vijayamohanan Pillai	CSIR, India
Industry	Prof Ramesh Budhani	Director CSIR-National Physical Laboratory, India
Industry	Glenn Wightwick	IBM Distinguished Engineer
Industry	Dr Lee	Economic Division, Taipei Economic and Cultural Office, Taiwan
Industry	Prof Navakanta Bhat	Centre for Nano Science and Engineering (CeNSE), India
Industry	Dr Anastasios Polyzos	CSIRO Material Science and Engineering
Industry	Garry Bowditch	SMART CEO
Industry	Tania Brown	SMART COO
Industry	Ahmed Halima	Ahmed Halima, Bionic Vision Australia (BVA)
Industry	Dr Claudia di Bella	Department of Orthopaedics, St Vincent's Hospital
Academic	Peter Murphy Ric Fabretto Drew Evans	University of South Australia
Academic	Prof Ben Li Luan	Chemistry Department, University of Western Ontario
Academic	Prof Samir Brahmachari	Director-General, CSIR
Academic	Dr Ali Hosseini	Stanford University, USA
Academic	Prof Stan Skafidas	The University of Melbourne
Academic	Prof Moser	University of Leoben, Austria
Academic	Prof Paul Mulvaney	University of Melbourne
Academic	Prof Edward Maginn	Department of Chemical and Biomolecular Engineering, University of Notre Dame, USA
Academic	A/Prof Azizan bin Ahmad	School of Chemical Science and Food Technology, Faculty of Science and Technology, Bangi Selangor, Malaysia
Academic	Prof Frank Enders	Chair of Metallurgy, Ionic Liquid Technology, University of Clausthal-Zellerfeld
Academic	Dr Craig Bonar	Manager, Asset Management & Engineering, APA Group
Academic	Dr Alan Bryson	Corrosion Manager, Asset Management & Engineering
Academic	Ashley Fletcher	General Manager Technical, Tyco Water Technologies
Academic	Dr Ranjith Pathegama Gamage	Civil Engineering, Monash University
Academic	Dr Steven Pas Dr Youssof Shekibi	Maritime Platforms Division, DSTO
Industry	Ian Hawkins	Greencorp
Industry	Kevin Culley	Underarmour
Industry	Matthew Broadhead	Department of Orthopaedics, St Vincent's Hospital
Industry	Dr Rosetta Marotta	Senior Scientist, St Vincent's Melbourne Neuromuscular Diagnostic Laboratory
Industry	Walter Oschmanns	Agricultural Organics
Industry	Mr Deepak Ganga	DMTC
Industry	Mr Greg Foreman	DMO/Diggerworks
Industry	Mr James Sandlin	VCAMM/DMTC

TYPE	VISITOR	INSTITUTION
Academic	Dr Dimitar Mitev	Visiting Fellow, University of Tasmania
Academic	Craig Milroy	PhD student, University of Texas at Austin, USA
Academic	A/Prof Edwin Jager	Linkoping University, Sweden
Academic	Dr Krishnaswamy Krishnamoorthy	Senior Scientist at the National Chemical Laboratory, Pune
Academic	Prof Dan Li Dr Nemai Karmakar	Monash University
Academic	Prof Alan Bond Kiran Bano	Monash University
Academic	Rauno Temmer	Estonia: PhD student, Rauno Temmer, from University of Tartu, Estonia
Academic	Dr Kim Miss Kim	Korea:Dr Kim (ETRI Korea) and his student Miss Kim spend 3 weeks in ACES/IPRI labs mid- year working on polymer deposition on MEAs
Academic/ Industry	Dr Michael Ling	DSTO
Academic	Russel Nainie	Facility Manager, VCAMM Limited
Academic	Tim Olding	Chief Engineer, EV Engineering
Academic	Iain Ralph	Enterprise & Business Manager
Academic	Dr Andrew Sullivan	Manager Electron Microscopy, Institute for Frontier Materials
Industry	James Nicholson Scott Edwards	SMR
Industry	Dr James Langridge	Member, Council of Distinguished Advisors at Australia Gulf Council
Academic	Prof. Gaoquan Shi	Department of Chemistry Tsinghua University Beijing China
Academic	Peter Knittel	PhD student, University of Ulm, Germany
Academic	Prof Yong Liu	Wenzhou Medical College, China
Academic	Prof Liming Dai	Case Western Reserve University (CWRU), USA
Academic	Mr Wonje Cho	PhD student, Dongguk University, South Korea
Academic	Prof Ian Chubb,	Australia's Chief Scientist
Academic	Park Hye Jin	Student, Sunchon University, Korea
Academic	Carina Bronnbauer	MSc student, University Erlangen, Germany
Academic	Kanlaya Pingmuang	PhD student, Thailand
Academic	Dr Miao Chen	CSIRO OCE Science Leader
Industry	Jim Patrick Milind Raje Frank Risi Martin Svehla	Cochlear
Industry	Ray Shaw	Varian
Industry	Barry Rees	Cathedral Valley Concepts P/L
Industry	Ken Ye	Department of Orthopaedics, St Vincent's Hospital
Industry	Dr Stephen Livesey	Centre for Clinical Neurosciences and Neurological Research, St Vincent's Hospital Melbourne
Academic/ Industry	Prof Stephen O'Leary	Chair and Head of Otolaryngology, University of Melbourne, Royal Victorian Eye and Ear Hospital
Industry	Dr Mirabelle Ho	BioVictus, St Vincent's Hospital
Academic	Yuen Yue Tham	PhD student, University of Tasmania
Academic	Prof Gyoujin Cho	Sunchon National University, Korea
Academic	Dr Jun Ma	University of South Australia
Academic	Prof Chang Ming Li	Nanying Technology University, Singapore

TYPE	VISITOR	INSTITUTION
Academic	Prof Xuebin Yu	Fudan University, China
Academic	Dr Jumi Yun	Chungnam National University, Republic of Korea
Academic	Prof Keith Gordon	University of Otago
Industry	Dr Nick Rufault	Department of Dermatology, St Vincent's Hospital
Industry	Nick Trost	St Vincent's Hospital
Industry	Prof Yoshi Osada	Riken Japan
Industry	Mr Kieran Daly	Shimmer Research, Ireland
Industry	Troy Lowe	BlueScope
Industry	Max Hardy	Twyfords
Industry	Dr Damion Milliken	Dyesol
Industry	Nicholas Duncan	General Manager, Water Treatment specialists, HydroChem
Industry	John Grace	Enterprise Connect
Academic/ Industry	Dr Geoff Hugo	Maritime Platforms Division, DSTO
Academic	Jullieth Gabriela Suarez Guevara	PhD student, Centro de Investigación de Nanociencia y Nanotecnología (CSIC-ICN) Institut de Ciencia de Materials de Barcelona
Academic	Patrick O'Brien	U/G student, Trinity College Dublin, Ireland
Academic	Hugh Manning	U/G student, Trinity College Dublin, Ireland
Academic	Prof Matt Trau	University of Queensland
Academic	Prof Gideon Levy	Prof Gideon Levy, ETH, Zurich
Academic	Prof Agneta Richter-Dahlfors	Swedish Medical Nanoscience Center, Sweden
Academic	Prof Tom Davis	University of New South Wales
Academic	Prof Irene Yavovsky	RMIT University
Academic	A/Prof Jadranka Travas-Sejdic	The University of Auckland, New Zealand
Academic	A/Prof Takayuki Uchihashi	Kanazawa University, Japan
Academic	Dr Peilin Chen	Research Centre for Applied Sciences
Academic	Mr Benjamin Johnston	University of Texas at Arlington, USA
Industry	Nick Rheinberger	ABC Radio Illawarra
Industry	Lee Liston	4 Design
Industry	Adrian van de Ven	Cammthane
Industry	Sandy Haig	I3net
Industry	Damien Myers	University of Melbourne
Industry	David Fuller	Focus Press
Industry	Bruce Thompson	University of Wollongong
Industry	Liz Fulton	Cardno
Industry	Frank Soto Jim Allen	Soto Engineering
Industry	David Varcoe Troy Coyle Adrian Tootell	Bluescope
Academic	Prof Tim Schmidt	University of Sydney
Academic	Brett Paull	University of Tasmania
Academic	Zhong-Ze Gu	Southeast University, China
Academic	Andreas Kunzmann	Student, Friedrich Alexander University
Academic	Prof Gerald Frankel	The OHIO State University

TYPE	VISITOR	INSTITUTION
Industry	Ian Dagley	CRC Polymers
Industry	David Stein Patrick Kinlen	Advanced Research Teams, Boeing
Industry	Dr Andy Kwon and representatives	Samsung SDI's Energy Solution Division
Industry	Jaako Välimaa	KSV NIMA Product Manager for Biolin Scientific, Finland
Industry	Alexander Gosling Andrew King	Capstone Partners, Technology transfer and commercialisation
Industry	Tina Soulis	General Manager, Neuroscience Trials Australia, St Vincent's Hospital
Industry	Innes Willox	Chief Executive of the Australian Industry Group
Industry	Matt Minio	Objective 3D Pty Ltd
Industry	Daniel Thomsen	Regional Sales Director, Objet AP Ltd
Industry	Mitchell Benness	Business Development Manager, 3D Printing Solutions, 3D Systems Asia-Pacific
Industry	Anthony Green	Sales & Marketing Director, dorsaVi
Academic	Prof Zhong Zhang	National Centre for Nanoscience and Technology of China
Academic	Larissa Florea	PhD student, Dublin City University
Industry	Dr Keith McLean	Biomedical Materials and Devices Theme Leader, CSIRO Materials Science and Engineering
Industry	Dr Laurence Meagher	Stream Leader in the Biomedical Materials Theme at CSIRO Materials Science and Engineering
Academic	Christianne Gilissen	U/G student, University Zuyd, Netherlands
Academic	Rikky Muller	University of California, Berkeley and University of Melbourne
Academic	Prof Michael Burgess	University of British Columbia
Industry	Jaakko Välimaa	KSV NIMA Product Manager for Biolin Scientific in Finland
Academic	Stephen Moratti	University of Otago, New Zealand
Academic	Prof Philippe Ryvlin	Dept of Neurology, University Hospital of Lyon
Academic	Prof Ken Dawson	School of Chemistry and Chemical Biology, University College Dublin, Ireland
Academic	Prof Mark Lew	Dept of Neurology, Keck School of Medicine of the University of Southern California
Academic	A/Prof. Stefan Adams	Nanying Technology University, Singapore

Appendix 2: ACES End-User Events

ACES Industry Engagement Breakfast Forum: "Energy Storage: Planning for the Future."

This breakfast event was held in Geelong on 16 February 2012 to encourage industry, government and research collaboration and partnership around clean technologies, energy storage, energy generation and renewables.

Prof Gordon Wallace (ACES/UOW), Prof Douglas MacFarlane (ACES/Monash University), ProfMaria Forsyth (ACES/ Deakin University) and Mr Chris Gilbey (Director of Strategic Development ACES) followed up on a range of advanced scientific tools and novel engineering materials with the audience.

A world-class team of research scientists and engineers that make up ACES are available for integrated energy storage at ACES nodes: Wollongong, Deakin and Monash Universities.

Participants were given an insight into how nanotechnology can improve commercial energy efficiency; how to reduce costs by using advanced scientific and experimental techniques; what funding opportunities and government initiatives are available towards energy storage and clean technologies and how to implement new materials system technologies.

Present were representatives from the Australian Industrial Services (AIS), ASIS Scientific, AVT Services, Sinclair Knight Mertz (SKM MMA), Solazone, Cochlear, CAPX, CSIRO, DSTO and others. A highly successful round table discussion ensued around furthering collaboration and moving one step closer to advances in cogeneration, battery storage, solar, wind, photovoltaics, solar, carbon dioxide/carbon capture.

Overall, this ACES initiative was highly beneficial, and once again hugely successful, with all attendees enthusiastic about promoting collaboration between government, industry and ACES research with the enhancement of Australian and International Collaboration around energy storage needs. Progress was therefore made in formalising partnerships to this effect between industry and ACES.

Processing and Fabrication: The ultimate challenge for functional materials

As detailed in Appendix 6 of this report a collection of leading researchers, practitioners and business people gathered (20-21 February 2012) at UOW to discuss how functional materials are changing their industries.

ACES drives global water splitting consortium: founding meeting (29 February 2012)

ACES scientists together with leading research scientists from USA (Rutgers, The State University of New Jersey), Germany (Stuttgart University) and India (Tata Institute of Fundamental Research; Indian Institute of Science), have established a global consortium, the International ElectroCatalysis Network (IECN; https://sites.google.com/site/interelectrocatnetwork/). The founding meeting held in February was an important step towards this establishment.

The aim of the initiative is to foster international educational and research collaborations between the institutions in the field of electrocatalysis, with a special focus on transformations involving water. A number of initial collaborations were identified in the founding meeting and in follow-up Skype sessions which will be pursued further in 2013.

AdFab2012
Additive Fabrication Prototyping Conference & Workshop
April 23rd/24th

ANFF

OBJET

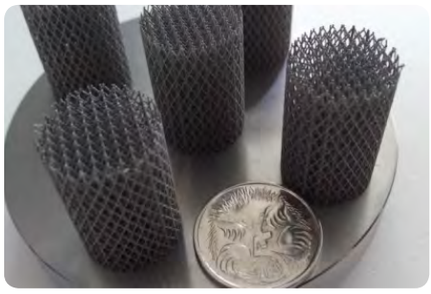
The Inaugural AdFab2012 Additive Fabrication Prototyping Conference and Workshop was held 23-24 April in Wollongong. Targeting the local manufacturing industry, the conference highlighted the ACES fabrication capabilities.

This event was focused on providing information about Additive Manufacturing and novel materials that can be applied now in manufacturing in order to create competitive advantage.

Those attending saw first-hand the $54 million prototyping facility on the innovation Campus of UOW and were given an outline on ways of access.

Businesses that are able to successfully integrate this technology into their value chain have been proved to have the ability to compete more effectively and competitively in domestic and global markets, according to the Director of Strategic Development at ACES, Chris Gilbey.

The event also provided networking opportunities for people in business to meet with each other and with the ACES researchers and engineers who are actively involved in additive fabrication at UOW.



A small wire frame support structure demonstrates the vast range of items that can be "printed" (the coin here used as a guide to size).

Dr Robert Gorkin (left) and Dr Stephen Beirne pictured with new hi-tech manufacturing equipment in ACES/IPRI Processing and Devices Facility at the Innovation Campus.

This Additive Fabrication conference's differentiating features included case studies about how the latest developments in additive manufacturing and prototyping could be useful for small and large businesses; developments in synthetic materials available that than can be incorporated into manufacturing now; as well as ways to leverage government grants to aid in funding access to this technology.

The second day consisted of a hands-on workshop for people who wanted to get direct experience working with the technology. This conference also provided opportunities to network with people who wanted to be more competitive and up to date with technology advances.

Fabrication expert and conference organiser Dr Stephen Beirne said Additive Fabrication allows 3D objects, including those with moving parts, to be swiftly printed through a design on a computer.

Representatives from the Illawarra manufacturing industry attended a networking breakfast at ACES to learn about the advanced manufacturing capabilities in the new AIIM P&D Building.

Additive Fabrication prints layer upon layer upon layer until an object is built. A variety of materials can be used including metals and functional conducting materials.

The conference featured leading manufacturing experts such as Alban Savage, Head of New Product Industrialisation at Cochlear; James Morrison, Lead Engineer Materials at ResMed; and Bruce Grey, Managing Director of the Advanced Manufacturing CRC.

Mr Savage commented that he would explore the relative competitiveness of additive manufacturing over traditional manufacturing; looking at the cost and beyond into customisation, time and so on, showing applications in different markets.

The AdFab initiative aimed to provide industry with an academic conference that alerted them to new research with near term potential for market impact. As a result of this focus, the conference attracted more than 60 attendees from more than 35 businesses from NSW and Interstate involved in manufacturing and other businesses that could be impacted by this technology.

Next Generation Manufacturing: Are you ready? Networking Breakfast (25 October 2012)

Representatives from the Illawarra manufacturing industry attended a networking breakfast at ACES to learn about the advanced manufacturing capabilities in the AIIM P&D Building.

ACES fabrication expert Dr Stephen Beirne said that the capability to produce on-demand products "from architectural models to jewellery to patient-specific orthopedics" is key to the ongoing success of manufacturing businesses.

The 12 attendees, representing 10 Illawarra businesses heard of opportunities for manufacturers to partner with ACES, including on a project to produce the first integrated bio printer.

On the back of the successful Inagural AdFab conference, to further engage with industry in the medical bionics space, two AdBioFab (additive biofabrication) conferences were run; one in Melbourne on 26 October 2012 and one in Sydney on 18 December 2012.

AdBiofab Melbourne (26 October)

A diverse group including some of Australia's best clinicians, medical device manufacturers, materials science researchers, policy makers and investors filled the conference room at St Vincent's Hospital to capacity to hear about how additive fabrication, coupled with advanced materials science and data communications, could radically transform medical treatment and produce a new generation of medical devices.

The keynote address was delivered by Emeritus Professor Chris Fell, the Chairman of the Australian National Fabrication Facility (ANFF), who highlighted to the audience the advanced fabrication capabilities and breadth of expertise already present in Australia.

Each presenter gave testament to this, showcasing exciting developments in the instrumentation and materials that are required to fabricate intelligent medical solutions, as well as their implementation in clinical settings. Prof Milan Brandt and Dr Stephen Beirne introduced a vast range of additive fabrication capabilities at both RMIT and ACES, respectively, and their utility in producing advanced structures for applications spanning from aerospace to biomedical engineering.

Dr Beirne and John Barnes (CSIRO) outlined how new polymeric and metal materials will enhance these manufacturing possibilities, and Matt Minio (Objective 3D) presented the current state and expected developments from commercial instruments.

From the clinical perspective, Prof Peter Choong (St Vincent's) and Prof Michael Coote (CERA) explained how these new technologies enable new treatment pathways through the fabrication of tailored constructs for limb reconstruction or outflow devices for glaucoma surgery, respectively. These examples highlighted how additive biofabrication will be used to deliver patient-specific implants and improved devices that promise to revolutionise medical treatment.

"Let's say a patient of mine might have a tumour," said Prof Choong, "I use all my sophisticated computer software to dissect the tumour, then move the CT scanner into theatre and take all the information, transfer it via the broadband network that the government is putting up, into a machine that prints out a part. Someone pops the part into a box and brings it into theatre for me. Real time. What we can do with technology today!"

Adrian Tootell from the University of Wollongong made note of the disruptive potential of these technologies in manufacturing, and discussed how collaborative and commercial opportunities might best be fostered in this environment.

A selection of mulit-material 3D printed parts provided courtesy of AdBioFab sponsor Objective 3D.

A panel (Dr Bill Petreski (AIG), Andrew McLellan (Advanced Manufacturing CRC) and Simon Rabl (Department of Business and Innovation, Victoria)) discussion chaired by Dr David Lester (ITHW) further explored this emerging industry in Australia.

Australia is well-positioned to become an important player internationally in this field, particularly through the development of biomedical devices. Along with the exciting potential, several key challenges were identified going forward. Particularly, there was a call for more open innovation policies and deepening ties between research and industry – while Australian research ranks highly in paper generation and collaboration, we perform poorly in the generation of new intellectual property and commercial outcomes. The need for federal and state government support in these matters was emphasised.

AdBioFab Sydney (18 December)

ACES hosted clinicians, device manufacturers, investors and government representatives to discuss the future trajectory of research and device development for medical use.

"Additive manufacturing means a lot of things for many sectors," ACES Executive Director Professor Gordon Wallace, said.

"The aim of this conference is to assist businesses to anticipate, understand and be adaptable to the large number of jobs additive manufacturing will create. Most importantly, it will aid in the development of policy and regulatory structures that invest in the ongoing research of a field which is also attractive to entrepreneurs and financial investors."

"This conference is essential for policy makers and investors to gain insights and understanding into convergent technologies that now, because of additive manufacturing, will be researched, developed and taken to market faster," he said.

Prof Don Iverson opened the conference delivering the keynote address that was followed by an introduction to additive fabrication by Prof Wallace.

In the first session there were presentations by Dr Stephen Beirne (ACES) on "Novel materials and additive bio fabrication"; Mr John Barnes (Titanium Technologies Theme Leader, CSIRO) on the importance of materials and design in biomedical additive manufacturing; Mr Rikky Muller (Electrical Engineering, University of California, Berkeley) on "Minimally invasive neural implants for epilepsy and beyond"; Mr Alban Savage (Head of New Product Industrialisation, Cochlear Ltd) on how to transfer research into marketable products; Mr James Morrison (Lead Engineer – Materials, ResMed Ltd) on the development and production of medical devices; Dr Lee (Taipei Economic and Cultural Office) on the science and technology industry and research in Taiwan; and Mr Bruce Grey (CEO, CRC for Manufacturing) on the future of additive manufacturing.

Attendees at Session 2 then heard Ms Rosie Hicks (CEO, Australian National Fabrication Facility) deliver the keynote address followed by Prof Richard Fox (Director of Research, St Vincent's Health) on "A teaching hospital-based campus for biomedical engineering"; Prof Peter Choong (Director of Orthopaedics, St Vincent's Hospital) on "Advanced limb reconstruction – From bench to bedside"; and Ms Anne Trimmer (CEO, Medical Technology Association of Australia) on "Building the next generation of medical devices".

After the official presentations a lively panel discussion ensued, chaired by Dr David Lester (ITHW) and included Mr Kris Gale (Michael Johnson Associates), Mr Jack Simos (CEO, Conrad Capital), Mr Bede O'Connor (Patient Dynamics) and Dr Ian Birkby (AZoNetwork) exploring the topic of "How policy makers, capital, research and industry can optimise societal/ economic benefit…".

Dame Bridget Ogilvie, Chairperson of the ACES International Advisory Board, then gave closing remarks before further networking opportunities.

Overall the conference addressed ways that state-based research institutes can work together to establish a medical device industry in New South Wales.

Attendees found their experience of the conference useful and indicated they would recommend the conference to a friend or colleague in the future with all presentations well received. A well-received conference was capped off with a fantastic venue with harbour views, making this another successful event in 2012 with exciting prospects for 2013.

Australian National Fabrication Facility (ANFF) Research Showcase (22-23 November 2012)

Assoc Prof Peter Innis and Dr Stephen Beirne attended the ANFF Research Showcase at the National Centre for Synchrotron Science in Clayton. Participation in this event led to national awareness of the fabrication facilities and expertise available at the ANFF materials node.

AdBioFab Webinar (3 December 2012)

Following the strong attendance at AdBioFab Melbourne ACES (Prof Gordon Wallace, Dr Stephen Beirne and Melissa Coade) hosted a live interactive webinar focused on additive manufacturing and the applications to medical devices and technologies.

Although not widely publicised, the webinar had 1 external and 12 ACES external participants who were able to ask questions during the session and interest ratings (calculated based on whether the participant has the webinar open as their main window or whether they are doing multiple things online and not giving the presentation their undivided attention) averaged at 41%.

As the first ACES webinar, the "trial run" was deemed successful.

ACES PARTICIPATION IN END-USER EVENTS IN 2012

Round Table – Advances in Fabrication for Functional Biomaterials (14 March 2012)

Held at St Vincent's Hospital Melbourne, this round table discussion of ACES researchers and St Vincent's Hospital researchers and clinicians showcased ACES work and investigated ways for collaborative engagement.

After an introduction on the need for customised biofabrication delivered by Prof Mark Cook and Prof Peter Choong, Dr Robin Gorkin discussed rapid prototyping for polymers and metals, Cameron Ferris and Dr Johnson Chung discussed extrusion and ink-jet printing and Dr Javad Foroughi discussed fibre spinning, knitting and braiding. The round table discussion ended with Prof Gordon Wallace presenting the plans for the "Eastern Hill Precinct" Biofabrication Unit and how the University of Wollongong would have a presence at St Vincent's in such an initiative.

"It is very exciting to see the ARC Centre of Excellence for Electromaterials Science, Intelligent Polymer Research Institute, ANFF Materials Node being situated at St Vincent's. It is compelling evidence of the Eastern Hill Precint in action and underscores the value of the precinct" said Assoc Prof Michael Coote . Assoc Prof Michael Coote is the Clinical Director Ophthalmology - Royal Victorian Eye and Ear Hospital, Glaucoma Clinic Consultant – RVEEH, Principal Research Fellow - Engineering Outflow - Centre for Eye Research Australia and Mercy Health - Board Member - Chair of Board Quality.

National Manufacturing Week (8-11 May 2012)

ACES in association with ANFF joined an exhibition at National Manufacturing Week (NMW) in Sydney. The week delivered strong results for both exhibitors and visitors.

Just under 8,000 manufacturing industry professionals attended NMW 2012, and with more than a third of visitors being decision makers, many exhibitors came away from the show with solid new business leads.

ACES chose to highlight the suite of additive fabrication tools it has built upon over the last year. Other contacts expressed interest in accessing the additive prototyping facilities.

A prize draw was run. Entrants provided contact details for our mailing lists in return for the chance to win $1000 worth of additive fabrication machine time. The prize draw was won by Christopher Bedford from Somnomed. Chris visited ACES after the show with 2 of his colleagues. They will be using the print time after design revisions of their prototype product are complete.

Taiwan Workshop (2 October 2012)

As reported in the International section of this report, ACES representatives travelled to Taiwan to investigate opportunities for collaboration within, and commercialisation of, the ACES Bionics Program. The organisation of the delegation was assisted by Prof Chung-Yu (Peter) Wu (Program Director, National Program on Nano Technology (NPNT)). Launched in 2003 NPNT of Taiwan has focused on pursuing technical collaboration between industry and academia to assist the nanotechnology industry in Taiwan.

The presenters from Taiwan included Dr Yuan-Hung Hsu (Pharmaceutical Optimisation Technology Division); Dr Pi Kan (Research & Development, TLC Biopharmaceuticals, Inc); Prof Gwo-Bin Lee, Prof Fan-Gang Tseng and Prof Hsin-Yi Hsieh (Institute of NanoEngineering and Microsystems, National Tsing Hua University); Prof Hermin Chiuh and Prof Chen-Yi Lee (Department of Electrical and Computer Engineering, National Chiao Tung University).

Following the one-day workshop 3 collaborative projects were identified with a follow up Taiwan delegation in 2013 to further explore the commercialisation opportunities within this field between countries.

NanoWeek (3 October 2012)

Speeches by members of government (Minister of Economic Affairs; Director, National Science Council; Director, Department of Health) and our own VIP, ACES Executive Director Prof Gordon Wallace, who gave an inspiring speech on the importance of nanotechnology in the world today, saw the 10th Anniversary of Taiwan Nano Week open in spectacular fashion.

The opening also included the Award Ceremonies for the 8th Nano Industrial Technology Excellence Award and the Nanotechnology Education and Training Project (the finalists of which were included as separate pavilions in the exhibition).

The exhibition, which had 10,000 pre-registrations, showcased nanotechnology research and development as inventions. This provided a platform to encourage international collaboration and business opportunities.

Additive Manufacturing CRC's Future in Additive Manufacturing Workshop & NSW Participant's Forum (21 November 2012)

ACES researchers attended the Advanced Manufacturing CRC (AMCRC) workshop and discussion forum regarding the future of Additive Manufacturing within the Advanced Manufacturing CRC held in Sydney. Andrew McLellan introduced the current activities of the AMCRC, followed by an outline of the future direction that would be taken by the group presented by Bruce Grey. A number of presentations were given by AMCRC partners to highlight their current experiences with additive manufacturing and how in the future additive manufacturing may provide cost-effective solutions to current manufacturing challenges. A closing Q & A panel discussion highlighted that there is broad concern within additive manufacturing user groups that, while additive manufacturing does provide huge capability, there are significant limitations in the materials that can currently be processed using additive manufacturing techniques.

China Workshop: Collaborations in Medical Bionics Conference (8 December 2012)

ACES, UOW and the Academy of Science academics travelled to Beijing to deliver a series of presentations on the emerging area of medical technology to explore the potential for future Chinese partnerships (see more in International section of this report).

The conference explored ways that researchers in Australia and China might collaborate in an emerging field of research where nanotechnology is being applied to improve and invent new medical bionic devices.

ACES Director Prof Gordon Wallace commented that he was really looking forward to commencing specific programs with our Chinese colleagues as we embark on the Memorandum of Understanding in 2013.

Events like this are critical to bringing together skills across the fundamentals of molecular design, to materials synthesis and processing, device fabrication and clinical testing so that effective advances are realised in the shortest time frame possible.

Chinese attendees at the event represented the following organisations: Institute of Chemistry and Institute of Zoology, Academy of Science, National Center for Nanoscience and Technology, Soochow University, Guangzhou Medical University, Wenzhou Medical College, Tsinghua University and Nankai University.

Appendix 3: International Symposia hosted/co-hosted by ACES

International symposia hosted by ACES attract clinical and scientific researchers focused on solving real problems with cutting edge technologies. These occasions provide a source of inspiration to all those in attendance and in addition ACES researchers are given the opportunity to liaise and form collaborations with a range of international visitors who are well renowned in their research areas.

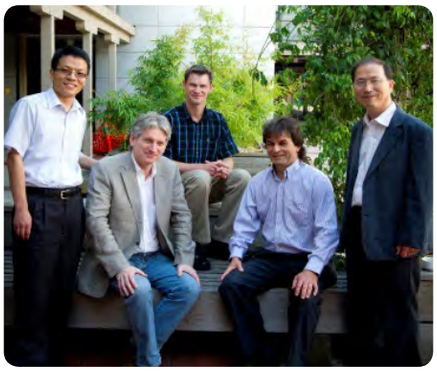
7th Annual International Electromaterials Science Symposium –'Energy, Bionics and Advanced Characterisation in Electromaterials Science' (15-17 February 2012)

The symposium attracted over 130 registrants and was held at Deakin University, Waterfront Campus in Geelong, Victoria. The research topics ranged from electromaterials research, energy storage and conversion devices, and advanced characterisation techniques.

Invited speakers from The Netherlands, USA, Ireland, Finland, UK, Korea, Taiwan, France and New Zealand attended.

The Symposium attracted sponsorships from ProDigital Company, Bruker, ASIS Scientifics, OnQ Softwares, AIS, Newspec, Scientix, Simultech and AVT.

The Early Career Researchers (ECR) award for best orals was awarded to Mega Kar (PhD ACES/Monash) and Amy Gelmi (PhD IPRI/UOW). The poster awards, sponsored by Newspec and Prodigital, were presented to Yang Yang from ACES at University of Wollongong for his work on novel co-doped polypyrrole/reduced graphene oxide-dextran sulphate composite applied in bioelectric battery and to Matthew Gustafson from ACES Monash University for his work on electrocatalytic bulk heterojunction materials for water oxidation.



Processing and Fabrication: The ultimate challenge for functional materials (20-21 February 2012)

This symposium was held at Australian Institute for Innovative Materials (AIIM) on the Innovation Campus at Wollongong, the home of the lead node of ACES.

A collection of leading researchers, practitioners and business people gathered at the University of Wollongong to discuss how functional materials are changing their industries.

Functional materials are materials that are able to perform a role such as in the human body where the material can 'communicate' with living cells and encourage growth. For twenty years, materials scientists have worked tirelessly to incorporate different levels of functionality into materials.

The Processing and Fabrication symposium was aptly held in the AIIM Processing and Devices building, a facility purpose built to fabricate 3D parts and devices from these functional materials.

One of Australia's leading orthopaedic surgeons, Prof Peter Choong from St Vincent's Hospital Melbourne, highlighted the need for continued developments in fabrication using functional materials if the true impact of current research into bionic devices and medical implants is to be realised. He explained that orthopaedic surgery could be revolutionised using these materials developed with nanotechnology.

Researchers from ACES are currently collaborating with Prof Choong to develop an implant to facilitate bone and cartilage regeneration. Chief Scientist at Cochlear, Prof Jim Patrick, highlighted the fact that even for established bionic devices such as the bionic ear, there are significant improvements that could be made from advances in fabrication and manufacturing.

Co-founder of the venture capital company SciVentures Investments, Dr Greg Smith, described a number of technology based start-up companies wherein success or failure hinged on the ability to fabricate the devices involved in an economic and scientifically effective manner.

The 5th Australasian Symposium on Ionic Liquids (ASIL-5) (23-24 April 2012)

This symposium was jointly organised by the Monash Ionic Liquids Group, CSIRO and ACES. This highly successful series of symposia has been running since 2003 and attracts interest from all over the Asia-Pacific region as well as further afield.

The symposium in 2012 was at full capacity, with over 100 delegates and six invited international speakers from Japan, Germany, China and the USA. A diverse range of topics were covered, from the electrochemical and physical chemistry of ILs and their mixtures, to advanced computational studies and a range of Green Chemistry applications.

A stimulating interactive poster session was also a highlight Invited papers from the symposia will feature in a special issue of the Australian Journal of Chemistry, with Guest Editors Jenny Pringle and Angel Torriero. Poster prizes were awarded to Deakin PhD student Taiwo Akanbi (Byrne Group, Deakin University) and two ACES PhD students Liyu Jin (Monash University and Fengling Zhou (Monash University).

ACES drives global water splitting consortium (28 February)

ACES scientists were behind the establishment of a global consortium to develop effective strategies to use sunlight to convert water into important chemical fuels such as hydrogen gas. The research promises a significant reduction of greenhouse gas emissions by reducing carbon dioxide from fossil fuel use. The process would have huge commercial benefits given that it would be a renewable and low-cost fuel option.

Leading research scientists from the USA (Rutgers and Princeton Universities) and Germany (University of Stuttgart) visited Wollongong in February in an important step towards establishing this consortium for water splitting. Scientists from India (Tata Institute of Fundamental Research and the Indian Institute of Science) will also be engaged in the project.

Participants at the 7th Annual International Electromaterials Science Symposium held in Geelong in February 2012

The aim of forming the consortium was to bring together the wide range of skills necessary to achieve the final goal – including the design of molecular catalysts, fabrication of nanostructured electrodes, cell design and practical implementation.

Advances in our understanding of Nature's catalytic principles coupled with advances in nanofabrication are bringing us ever closer to a truly sustainable energy future – but the challenge in delivering practical systems that can be economically implemented remains formidable. It is envisaged that the global consortium will make significant strides forward bringing together synergies that will provide more effective progress through an integrated team approach.

Broadly, the technologies involve the use of novel catalytic processes that enhance the efficient production of certain molecules of interest.

The first technology uses a highly-efficient chemical process, via novel electrocatalysts, to convert water into hydrogen gas.

The second technology mimics the water-oxidising centre in photosynthesis to produce oxygen gas from water under sunlight (i.e. splitting of water to form oxygen). Fully functional mimicry of this type has not previously been achieved.

The combination of these technologies offers a means of efficiently creating hydrogen gas (as a fuel) and then converting it into a powerful electric current by using it in a H2/O2 fuel cell.A Memorandum of Understanding was signed with Rutgers University to allow a joint Rutgers-ACES (University of Wollongong and Monash University) submission of an ARPA-E grant from the Department of Energy in the area of water electrolysis. While ACES cannot get direct funding from ARPA-E, which, if successful, can amount to USD10 million, Rutgers will assist ACES with obtaining funding as well as direct any capital raised as a result of ARPA-E funding to ACES. This application was unsuccessful in 2012, however the strong collaboration will continue and provide further opportunity in 2013.

Participants at the Processing and Fabrication: 'The ultimate challenge for functional materials' symposium.

The first global water splitting consortium meeting was held at Innovation Campus Wollongong on 29 February 2012.

Nanobionics Symposium (19-21 September)

Nanobionics is the merging of biology and electronics using the most recent advances in nanotechnology, so promises to revolutionise this exciting area. The potential implications for health and medical research and the increased quality of life for patients are highly significant. To achieve such goals there is a need to bring together clinicians, scientists, engineers and mathematicians in a collaborative environment. The purpose of the symposium held in September was to provide such a forum.

A total of 115 participants from all over the world gathered to hear from a line-up of world class researchers including but not limited to: Prof Agneta Richter-Dahlfors, Swedish Medical Nanoscience Center; Prof Tom Davis, University of New South Wales; Prof Yoshi Osada, Riken Japan; Prof Irene Yavovsky, RMIT University; A/Prof Jadranka Travas-Sejdic, The University of Auckland; A/Prof Takayuki Uchihashi, Kanazawa University, Japan; Dr Peilin Chen, Research Center for Applied Sciences, Academia Sinica, Taiwan; Mr Kieran Daly, Shimmer Research, Ireland and Mr Benjamin Johnston, University of Texas at Arlington, USA.

The poster session attracted 55 posters and provided the opportunity for many PhD students to show case their research. 12 selected PhD students were provided the opportunity to elaborate further on their poster (with 8 min talks) at the Burster Sessions held during the main program of the symposium.

ACES WORKSHOPS ABROAD

Establishing international collaborations in medical bionics has been the focus for ACES during 2012. To this end ACES participated in 2 delegations to Taiwan and China during the year.

It was anticipated that these delegation workshops would be the first step in promoting future academic exchanges; paving the way for the establishment of closer collaboration between ACES and their international counterparts.

Collaborations in Medical Bionics Taiwan (3 October)

The visit to Taiwan was organised with involvement from Prof Chung-Yu (Peter) Wu (Program Director, National Program on Nano Technology (NPNT)). Launched in 2003 NPNT of Taiwan has focused on pursuing technical collaboration between industry and academia to assist the nanotechnology industry in Taiwan. To further advance the technological and economic development of nanotechnology in Taiwan, the NPNT will begin to fund work in nanoelectronics, nano biomedical, nano optoelectronics and related areas in conjunction with their traditional areas.

A joint University of Wollongong (UOW-ACES) & National Program in Nanotechnology Nanobionic Symposium was held on 2 October 2012 at the National Chiao Tung University in Hsinchu. Prof Shyh-Jye Jou, Dean of the Office of International Affairs, introduced the National Chiao Tung University and highlighted their focus on innovative research and development by discussing attitudes to commercialisation; the focused groups in the bionics space; their perceived areas of research strength and weakness; their push for international collaboration and the success of their spin out companies. The National Chiao Tung University is an impressive and forward thinking institution in the bionics space.

This signalled the start of the scientific program whereby the speakers from ACES and UOW were counterbalanced with speakers from Taiwan, presenting from three research institutions

(National Chaio Tung University, National Tsing Hua University and the Industrial Technology Research Institute (ITRI)) and industry (Taiwan Liposome Company Ltd). Talks from ACES were given by Dr Bridget Munro (Director Strategic Development); Assoc Prof Simon Moulton, Dr Michael Higgins and Ms Amy Halliday.

Participants at the Joint University of Wollongong & National Program in Nanotechnology Nanobionic Symposium held on 2 October 2012 at the National Chiao Tung University in Hsinchu, Taiwan.

After the symposium all participants were invited to a reception and banquet for networking discussion. Also in attendance at the banquet were delegates from UCLA, who were participating in a parallel symposium with Taiwanese researchers, and a group from M-ERA NET (www.mera.net) who had developed a MOU with NPNT.

Collaborations in Medical Bionics (8 December)

ACES and the Institute of Chemistry from the Chinese Academy Science, co-hosted a workshop on 'Collaboration in Medical Bionics' on 8 December in Beijing, China.

Delivering a series of presentations about the field of Nanobionics, ACES researchers and their counterparts from the Chiinese Academy of Science explored the potential for a future Chinese partnership in this field – an emerging area wherein advances in nanotechnology are being applied to improve existing and to enable the realisation of new medical bionic devices. This workshop attracted 32 scientists from 7 universities and 3 institutes.

ACES Director Prof Gordon Wallace led the research sabbatical to address the group on the emerging area of medical technology. He is looking forward to commencing specific programs with our Chinese colleagues as ACES's embarks on a Memorandum of Understanding in 2013.

Prof Wallace believes that international collaboration is an essential feature for multidisciplinary areas of research such as Nanobioncs. Global challenges in the area of medical bionics require global solutions. Events such as this one are critical to bringing together skills across the fundamentals of molecular design, to materials synthesising and processing, device fabrication and clinical testing so that effective advances are realised in the shortest time frame possible.

Participants were welcomed by ACES IAB member Prof Daoben Zhu (Director of CAS Key Laboratory of Organic Solids). The opening address was presented by Prof Deqing Zhang the Vice director of the Institute or Chemistry at the Chinese Academy of Sciences. A further 12 talks were given throughout the day. ACES research was showcased by Prof Gordon Wallace, Prof Mark Cook (PI, ACES/ St Vincents Melbourne) and Dr Caiyun Wang (RF, ACES/UOW). Prof Iverson (UOW) gave an overview of UOW's Health research platform. Speakers from Chinese Academy of Science, Institute of Neuroscience, Guangzhou Medical College, Soochow University and Wenzhou Medical College all gave invited presentations.

Left: All the presenters speaking at the 'Collaborations in Medical Bionics meeting held in Beijing on 8 December. Right: Prof Mark Cook (PI, ACES/ St Vincents) presenting ACES research.

Appendix 4: International Collaborations by Country in 2012

Once again ACES personnel travelled to international institutions to work alongside their research peers on collaborative projects. In 2012, ACES personnel undertook 63 visits to leading international laboratories (in 17 countries) to further this goal.

ACES also encouraged international visitors to our Australian shores to work in our laboratories alongside our personnel. In 2012 ACES nodes hosted 41 visitors from 17 countries.

A summary of those collaborative trips and visits are listed below in alphabetical (country) order.

Belgium

Dr Angel Torriero and Dr Patrick Howlett (ACES) have established a collaboration with Prof Herman Terryn, from the Electrochemical and Surface Engineering Research Group, Vrije Universiteit, Brussels (VUB), to develop the application of Ionic Liquids to control the morphology of metal deposits. Dr Torriero visited Prof Terryn's group in 2012 to commence collaboration and planning, where he presented aspects of his Ionic Liquids research.

Frederic Gilbert (RF, ACES/UTas) visited and collaborated on a manuscript with Dr Farah Focquaert, from the Bioethics Institute Ghent in Belgium from 9-11 July.

Canada

Prof Ben Li Luan, from Chemistry Department, University of Western Ontario spent one week with ACES/ISEM working with Prof Liu (CI ACES).

Prof Michael Burgess from the W. Maurice Young Centre for Applied Ethics at the University of British Columbia visited University of Tasmania in December to discuss public involvement, ethics and governance in emerging health research with ACES researchers.

Dr Frederic Gilbert (RF, ACES/UTas) has ongoing collaborations with Prof Françoise Baylis from the Department of Bioethics, Faculty of Medicine at Dalhousie University, Canada.

ACES/IPRI has a strong ongoing collaboration with John Madden at University of British Columbia (Vancouver, Canada) on actuator applications. In 2012 this collaboration led to the highly successful work reported in ***Science*** on twisted carbon nanotube artificial muscles as well as work on an application to develop a 'steerable catheter'.

China

Assoc Prof Chongjun Zhao, from the School of Materials Science & Engineering, East China University of Science & Technology worked on supercapacitors within ACES/ISEM for 12 months from 9 January.

Prof Xuebin Yu, Fudan University, China, visited for one week in August to collaborate with ACES/ISEM on hydrogen storage materials research.

Dr Jun Chen (RF, ACES/UOW) travelled to Beijing in China 31 May-9 June to give an invited talk to Advanced Materials 2012 held 6-8 June, and to undertake a collaborative visit to Institute of Chemistry (Chinese Academy of Science). Jun works on nanocarbon materials for Energy applications.

Prof Leone Spiccia (CI, ACES/ Monash) visited Professor Licheng Sun, State Key Laboratory of Fine Chemicals, Dalian University of Technology (DUT), Dalian, China in September.

Prof Leone Spiccia (CI, ACES/Monash) visited Professor Can Li, Dalian National Laboratory for Clean Energy, Chinese Academy of Science, Dalian, China in September.

Prof Douglas MacFarlane visited Prof Suojiang Zhang at the Chinese Academy of Sciences Institute of Process Engineering, Beijing on the 20-21 September.

Estonia

Prof Gursel Alici (CI, ACES) is working with Andres Punning at **The University of Tartu** in Estonia testing the life of the electroactive polymer actuators for space applications. PhD student, Rauno Temmer, from University of Tartu, Estonia, spent from 1 March to 30 June working at UOW with Prof Alici.

Finland

Dr Jani Pelto, VTT Technical Research Center of Finland, Senior Scientist spent 5 weeks iin ACES/IPRI labs undertaking collaborative research on AFM imaging of electrical stimulation of cells in 3D from 30 January.

Dr Suvi Haimi, University of Tampere, Finland & University of Twente, Department of Biomaterials Science and Technology (BST), Enschede, The Netherlands spent 5 weeks, from 30 January, in ACES/IPRI labs working on electrical stimulation of adipose stem cells in three dimensions.

Her PhD student from University of Tampere, Miina Hamalainen, then spent 5 weeks from 27 February at ACES/IPRI continuing this research.

ACES researchers have had a long association with Prof Ari Ivaska's team from Abo Akademia University, developing new materials for sensing and diagnostics. Prof Ivaska's group is part of an international network program involving ACES researchers at IPRI, Monash University and Dublin City University (MASK (Materials and Advanced Sensor Knowledge Exchange) from the Marie Curie International Research Staff Exchange Scheme (IRSES)). Prof Ari Ivaska spent the month of February at ACES/IPRI as part of this project.Dr Klaudia Wagner (ACES/UOW) spent 2 weeks (1-11 May) with Prof Ari Ivaska's team from Abo Akademia University. Based on the previous collaborative studies between DCU and UOW, the continuation of the characterisation of polyTSP4, a spiropyran polythiophene, was undertaken with PhD student Michal Wagner using in situ spectroelectrochemical Fourier Transform Infrared Attenuated Total Reflection (FTIR-ATR) spectroscopy, a powerful specialist technique useful for studying doping-induced structural changes in conducting polymers. This trip was funded as part of MASK/IRSES.

Prof David Officer followed up on Klaudia's exchange in August when he visited Abo Akademia University for a couple of days and gave a lecture to the group on ACES research involving 'Developing Multifunctional Nanostructured Electromaterials' on 27 August.

France

Assoc Prof Paul Keller (ACES CI) and his ACES PhD student Sreenu Jennepali are currently developing the synthesis of octapeptidefullerene structures for co-ordination with porphryins as potential charge transfer catalysts. In 2012 they made smaller oligomers and are in contact with their French collaborator, Dr Nathalie Solladie, at the University of Toulouse in France, to look to trialling these units with porphryins.

Mr Joffery Champavert (PhD student Montpelier University) undertook an internship within ACES at Wollongong between February and June. Joffery worked on developing rGO/MWNT composites for use in the enzymatic biofuel development.

ACES groups at Monash and Wollongong have been able to strengthen the research collaboration with Prof George Malliaras's group at the Center Microelectronique de Provence (CMP) at Ecole Nationale Supérieure des Mines de Saint Etienne in France in 2012, also as a result of MASK/IRSES funding.

- Prof George Malliaras spent one week in IPRI in March working on the IRSES/MASK project.
- Dr Michele Sessolo, a research fellow working with Prof Malliaris spent one and a half months working on the project at Wollongong, from 20 February.
- Dr Michael Higgins from ACES visited the labs of Prof George Malliaras on 29 and 30 August. Dr Higgins presented a talk and was involved in student and staff meetings, which was a great forum to discuss research and initiate further collaborative ideas.

Prof David Officer (left) with Prof George Malliaris in the clean room at Centre Microélectronique de Provence (CMP), Ecole Nationale Supérieure des Mines, Gardanne, France during David's visit in September.

- Prof David Officer (CI, ACES) then visited the laboratories of Prof Malliaris in September. David gave a lecture entitled 'Developing Multifunctional Nanostructured Electromaterials" on 10 September and discussed the collaborative research projects being undertaken as part of the IRSES/MASK funding.
- Early career researcher Dr Vanessa Armel (Monash) visited CMP laboratories 9-20 January to continue with some biosensor development.
- Dr Orawan Winther-Jensen (APD ACES) visited CMP from 3-7 September to continue working on transport phenomena in conducting polymers.

ACES researchers have undertaken a number of highly productive research projects with Dr Philippe Poulin and Dr Nicolas Mano in Bordeaux in the area of nanostructured carbons in past years. In 2012 the collaboration with Philippe Poulin in the area of liquid crystal graphene dispersions and characterising their properties was published ***J. Phys. Chem. Lett. (dx.doi.org/10.1021/jz3008479)***.

Germany

More than 12 students have already been part of the exchange over the last 5 years between the FAU Department of Chemistry and Pharmacy and leading members of the German Cluster of Excellence "Engineering of Advanced Materials (EAM)" and University of Wollongong. During 2012 ACES/IPRI hosted 3 further students.

- Ms Annika Spies, an undergraduate student from University Erlangen, spent 6 months working on structural Modification of Porphyrin Chromophores: towards Enhanced Voc in Dye Sensitized Solar Cells in ACES/IPRI from 20 February.
- Carina Bronnbauer, a MSc student from University Erlangen spent 3 months from 25 July at ACES in Wollongong working with Marc in het Panhuis (CI ACES) on conducting hydrogels.

Andreas Kunzmann, a student from FAU, visited ACES in Wollongong for 4 months from October to work with David

Officer and investigate the use of cobalt electrolytes with porphyrin sensitised dye sensitised solar cells.

Prof David Officer visited Prof Dirk Guldi at Friedrich-Alexander-Universität Erlangen-Nürnberg, on 14 September, where he gave a lecture on ACES research entitled "Developing Multifunctional Electroactive Nanomaterials". He also held discussions to plan future exchange visits for students.

Members from the German Cluster of Excellence "Engineering of Advanced Materials (EAM)" also met with David to discuss the first joint Erlangen-University of Wollongong PhD student, as well as a joint FAU-UOW and Centres of Excellence (EAM-ACES) symposium proposed during 2013.

Prof Douglas MacFarlane visited Prof Barbara Kirchner and Prof Roger Glasser at the University of Leipzig 16-17 May to discuss collaborative research.

Mr Peter Knittel, a PhD student from University of Ulm, Germany spent 4 months from 1 July in ACES at Wollongong working on AFM related research.

From 31 August - 3 September, Dr Michael Higgins (RF, ACES/UOW) visited the labs of Dr Christine Kranz and Prof Boris Mizaikoff at Ulm University in Germany. Dr Higgins and Dr Kranz have been collaborating together for the past 2 years on the development of modified AFM probes for measuring nanoscale forces under electrical control. In addition to presenting recent work, the visit was aimed at discussing the exchange of students and further research directions for the collaboration. This trip was financed by Dr Higgins ARC fellowship.

Prof Leone Spiccia (CI, ACES/ Monash) has a collaborative project with Drs Klaus Lips and Alexander Schnegg, Helmholtz Zentrum Berlin for Materials and Energy on EPR spectroscopy of water oxidation catalysts.

Prof Leone Spiccia (CI, ACES/ Monash) has a collaborative project with Profs Wolfgang Eberhardt and Emad Aziz, HZ Berlin/ TU Berlin/Free University on electronic properties of water oxidation catalysts.

Prof Leone Spiccia (CI, ACES/ Monash) visited Drs Klaus Lips and Alexander Schnegg and Prof Emad Aziz, in May 2012.

Prof Leone Spiccia (CI, ACES/ Monash) visited Dr Holger Stephan, Helmholtz Zentrum Dresden- Rossendorf, Dresden, Germany in May 2012.

Ms Monika Fekete (PhD ACES/ Monash) visited Dr Onno Gabriel at HZB Berlin in Adlershof and PVComB, Germany, August 2012.

Ms Monika Fekete (PhD ACES/ Monash) visited Drs Sophie Gledhill, Wiebke Ludwig, Sebastian Fiechter, Peter Bogdanoff at HZB Berlin, August 2012.

Dr Shery Chang (RF, ACES/ Monash) visited Dr Chris Boothroyd and Professor Rafal Dunin-Borkowski, the Ernst Ruska-Centre (ER-C) for Microscopy and Spectroscopy with Electrons, Forschungszentrum Jülich, Germany, August-September 2012.

Ms Arachana Singh visited Prof Emad Aziz at the Department of Physics and Structure Dynamics of Functional Materials in Solution F-N1 Helmholtz- Berlin, Freie University Berlin in July-August 2012.

Iceland

Monash University hosted student Bartlomiej Kolodziejczyk, from the School for Renewable energy Science, Iceland, from April through October 2011. Bartlomiej returned to Monash in 2012 to begin a PhD.

India

Following the UOW delegation to India 3-7 December 2011, to promote ACES to both businesses and universities in India under the banner of establishing collaborations in the key area of 'Future Materials', Prof David Officer and Dr Sanjeev Gambhir (ACES/UOW) undertook a four day visit (12-15 March) to India funded by a University of Wollongong UIC grant. The aim was to further develop research collaborations with select Indian research institutions and industries.

During the course of this trip, they visited and presented ACES research at the Tata Institute for Fundamental Research (Mumbai), the National Chemical Laboratory (Pune) and the Indian Institute of Science (Bangalore). They also visited three companies, Larsen and Tourbro Ltd in Mumbai, and Mahindra Reva and Syngene, both in Bangalore.

As a result of these 2 trips there were 2 follow-up visits to ACES in Wollongong in 2012.

The University of Wollongong (UOW) and India's premier industrial research and development organisation, the Council of Scientific and Industrial Research (CSIR) agreed to work together to advance research collaborations and establish a dedicated CSIR Research and Development Centre at the University's Innovation Campus as well as to develop an academic exchange program for staff and students.

Prof David Officer and Dr Sanjeev Gambhir (ACES/UOW) present ACES research to Tata researchers in India.

This proposed arrangement between University of Wollongong Vice-Chancellor, Prof Paul Wellings, and Director - CSIR National Physical Laboratory Prof Ramesh C Budhani on behalf of CSIR, was entered into as part of a two-day visit (1-2 May) to Wollongong by the high-level delegation from India led by the Director-General of CSIR, Prof Samir K Brahmachari, and including Director CSIR - National Metallurgical Laboratory, Dr S Srikanth and Director CSIR – Central Electrochemical Research Institute, Dr Vijayamohanan Pillai.

As part of the agreement both parties agree to develop research and development collaborations in areas including advanced steel metallurgy, lithium-ion batteries, super capacitors and polymer-based nano-composites.

Dr K. Krishnamoorthy, Senior Scientist at the National Chemical Laboratory then visited ACES in Wollongong for two weeks in June to determine what collaborative research projects the two institutions might undertake.

Ireland

Assoc Prof Michael Lyons, University of Dublin, Trinity College, Ireland visited ACES/IPRI to discuss collaborative research opportunities in February.

Several other collaborative visits to Ireland in 2012 were associated with an international exchange program MASK (Materials and Advanced Sensor Knowledge Exchange) from the Marie Curie International Research Staff Exchange Scheme (IRSES).

Prof Dermot Diamond from Dublin City University (DCU) visited ACES/IPRI for a month from February to maintain and direct existing collaborative projects as well as to identify future funding opportunities.

DCU PhD student Larissa Florea visited ACES/IPRI for 3 weeks in November to complete research for a manuscript on chemopropulsion, a new research area developed with Prof David Officer during his visit to DCU mid-year.

Prof Gordon Wallace (ACES/UOW) spent from 29 March - 9 April) in Ireland strengthening research ties. Prof Wallace delivered a seminar (Nanofabrication for Organic Bionics), which was well attended by a number of researchers from DCU as well other Irish research institutions such as Trinity College Dublin, Maynooth University and The Tyndall National Research Institute (University College Cork).

Prof David Officer and Joseph Giorgio (ACES/UOW) demonstrating the result of integrating UOW materials into the next generation wireless sensors at CLARITY in Dublin City University.

Prof Wallace held discussions with Prof Dermot Diamond to further develop research links in the area of multi switching materials based on the electrically responsive conducting polymer polythiophene with pendant light responsive spiropyran entities attached.

Building on previous work, plans were put in place to further develop the materials synthesis/characterisation aspects of this program as well as to initiate studies into their use as a new platform for growth and differentiation of living cells.

Discussions with other DCU researchers highlighted the possibility of developing chemistries that improve the processability and hence the fabrication options available with these multifunctional materials.

Dr Klaudia Wagner (ACES/UOW) also spent a week in Ireland (21-27 May 2012). At Dublin City University, the electrochemical deposition of polyaniline films with recently synthesised sulfonated spiropyran (ACES/IPRI) as a dopant was investigated. In addition, the use of the sulphonated spiropyran as a light-controlled switch for microfluidic networks was also investigated. Dr Wagner held discussions with Prof Diamond and PhD students Larisa Florea and Michele Zanoni to discuss possible manuscripts from this and previous work.

Both Prof Wallace (9th April) and Dr Wagner (21st May) visited Queens University in Belfast, Ireland and held discussions with Prof Steven Bell and Prof Andrew Doherty on developing new collaborations that would support IRSES projects in the areas of superhydrophobic materials, catalytic nanoparticles and ionic liquids.

As a result of discussions with other Irish researchers, two research students from Trinity College took up research internships at ACES/IPRI from September.

Mr Patrick O'Brien, an undergraduate student from Trinity College Dublin, Ireland spent 3 months (from 17 September) at ACES/IPRI working on conducting hydrogels.

Dr Klaudia Wagner of ACES (centre) at DCU in Dublin in May.

Mr Hugh Manning, an undergraduate student from Trinity College Dublin, Ireland spent the same 3 months at ACES/ IPRI working on dip-pen nanolithography.

Prof Douglas MacFarlane (CI, ACES/ Monash) visited Prof Dermot Diamond at Dublin City University on 14 August to discuss research updates on the MASK/ IRSES.

Prof David Officer (CI, ACES/ UOW) spent 3 months at Dublin City University in Ireland in 2012 (July -October) on a Science Foundation Ireland Short Term Travelling Fellowship. The grant enabled him to share his expertise in organic synthesis, light harvesting materials, multifunctional electroactive polymer systems and solar cells with researchers from the CLARITY Centre for Sensor Web Technologies at DCU.

During the course of the Fellowship, Prof Officer worked with two CLARITY research students, Larisa Florea and Michele Zanoni continuing the joint DCU/IPRI developments on photoswitchable conducting polymers, polymers whose electrical conductivity and other properties can be controlled with light. During the course of this work, a new and exciting research area using a light switchable molecule to control the movement of liquid droplets – chemopropulsion – was developed. David gave a lecture on 'Developing Multifunctional Electromaterials for Energy-related Applications' at the School of Chemistry and Chemical Engineering at Queen's University in Belfast, Ireland on 17 August. Prof Officer's visit to CLARITY also presented the opportunity for ACES PhD candidate Joseph Giorgio (UOW) who is working on the development of a new type of solar cell, to spend a month in the CLARITY laboratories, from 29 August) investigating how the technology he is developing can be married with the remote sensing devices created at DCU.

The potential of this work was recognised by the award to Joseph of a 2012 DIISTRE Short-Term Mobility Grant to enable him to spend the time at DCU. This award was supplemented by student travel funding from the UOW Faculty of Science.

Whist in Ireland Joseph presented his research in a presentation entitled 'Re-engineering the Dye-Sensitised Solar Cell' at both Electrochem 2012: Electrochemical Horizons and the 2nd International Symposium on Functional Nanomaterials.

Joseph and David visited the company SolarPrint whilst in Dublin to observe their module designs targeting indoor sensing applications and to discuss possibilities of collaborative research /end-user opportunities.

While in Ireland, Prof Officer held research discussions with other Irish researchers including Dr Andreas Heiss and Dr Kieran Nolan of Dublin City University; Dr Andrew Dougherty, Department of Chemistry, Queen's University, Belfast; Prof Mike Lyons, Trinity College, Dublin and Prof Don MacElroy, University College Dublin.

In addition, he also visited European researchers, Prof Ari Ivaska at Abo Akamedi, Turku, Finland and Prof George Malliaris, CMP, Ecole Nationale Supérieure des Mines de Saint Etienne, Gardanne, France, and Prof Dirk Guldi at Friedrich-Alexander-Universitaet Erlangen-Nuernberg, Erlangen, Germany presenting IPRI/ACES research and discussing future collaborations.

During the course of his Fellowship, Prof Officer attended and presented his research at two international conferences in Dublin in September, the 2nd International Symposium on Functional Nanomaterials held at Dublin City University and Electrochem 2012 at Trinity College, Dublin.

Dr Michael Higgins (RF, ACES/ UOW) attended the 2nd International Symposium on Functional Nanomaterials at Dublin City University, Dublin, Ireland (6-7 September).

Dr Higgins gave an invited talk to showcase research on Nanobionics that is being undertaken in IPRI and ACES. The aim of the symposium was to act as a platform to present the latest advances in cutting edge nanomaterials research and comprised a series of invited presentations from leading researchers.

Assoc Prof Peter Innis (CI, ACES/UOW) visited Prof Robert Forster's research laboratories at Trinity College, Ireland in September to discuss research project collaborations. Project discussions covered the development of a new class of photo-active composite material that joins conducting polymers with bound photo-active and photo-redox functional centres. Significantly, the Forster group has photochemical characterisation tools available that are capable of making measurements in the solid-state. Additionally DCU has the capability to achieve spatial mapping of the fluorescence responses in a solid-state device. Peter also presented at the 2nd International Symposium on Functional Nanomaterials at Dublin City University.

Prof Leone Spiccia (CI, ACES/Monash) visited Prof Kenneth Dawson, UC Dublin, Ireland in October 2012.

Prof Doug MacFarlane is an International Fellow of the Queens University Ionic Liquid Laboratory in Belfast hence maintains close collaborative ties with this group.

Italy

Dr Frederic Gilbert (RF, ACES/UTas) has ongoing collaborations with Dr. Daniela Ovadia, Department of Cognitive Neuropsychology, Niguarda Ca' Granda Hospital, Milan, Italy; Zoe Agency for Science Information, Milan, Italy.

Dr Michael Higgins and Prof David Officer in discussions at the 2nd International Symposium on Functional Nanomaterials.

Japan

Shota Kawakami, a master's student from Kyushu Institute of Technology, Japan: worked in ACES/IPRI for 1 month from 17 January working on gradient hydrogels. The main goal of his research in Australia was to systematically study the swelling and mechanical properties of poly(acrylamide)-alginate and poly(acrylic acid)-alginate hydrogels. The results he obtained formed the foundation for further research on this topic.

Dr Kei Matsumoto, from Tottori University in Japan, was hosted by Monash University from April 2011 through to January 2012.

The long-time collaboration with Prof Shogo Mori from Shinshu University continued in 2012. Along with partner investigator Prof Keith Gordon (University of Otago, New Zealand), Prof Mori, Dr Pawel Wagner (ACES/IPRI) and Dr Mozer (ACES/IPRI) held a meeting at Shishu University in August involving their ARC Discovery Project which is aimed at developing multichromophore organic dyes for dye-sensitised solar cells.

Drs Mozer and Wagner visited Prof Akihiro Furube at AIST and Prof Mutsumi Kimora to hold fruitful discussions about possible collaboration.

Prof Leone Spiccia (CI, ACES/Monash) was appointed to the position of Specially Appointed Professor in the Catalysis Research Centre at Hokkaido University, a short term position that he took up early in 2012. Prof Spiccia spent Jan-February working with Prof Ryu Abe on their collaborative project involving solar driven water splitting devices.

Dr Robert Gorkin (RF, ACES) visited and held collaborative meetings with Prof Takayuji Uchihashi at Kanazawa University in June to establish further work for development of DPN equipment.

Prof Douglas MacFarlane (CI, ACES/ Monash) visited Prof Hiro Ohno at Tokyo University of Agriculture and Technology on 22-24 October.

Dr Michael Higgins (ARF, ACES/ UOW) was awarded the Japan Society for the Promotion of Science (JSPS) Invitation Fellowship for Foreign Researchers to commence in the Japanese 2012-2013 Fiscal Year. He visited the laboratories of Prof Takayuki Uchihashi (Kanazawa University) from 1-21 November, to work on the development of high-speed electrochemical Atomic Force Microscopy (AFM) to visualise real-time (video-rate) dynamics of conductive interfaces and their interactions with biomolecules.

During his visit to Japan, Dr Higgins gave a talk on 'The Cell – Electromaterial Interface' at the 3rd Kanazawa Bio-AFM workshop held from 5-8 November at Kanazawa, Japan.

Dr Higgins also visited the labs of Prof Hsiao-hua (Bruce) Yu (Advanced Science Institute, RIKEN, Wako), Prof Teruo Fujii (Advanced Microfluidics, University of Tokyo), Prof Hiroyuki Noji (Applied Chemistry, University of Tokyo) and Prof Yukiko Goda (Brain Science Centre, RIKEN, Wako). These visits have enabled opportunities for collaborations in the areas of bio-functionalised monomers of conducting polymers, electrode integrated microfluidic systems and neural adhesion peptides.

Korea

Prof Jooyul Lee, visiting fellow from Korea Institute of Materials Science (KIMS), Korea spent 3 months on a collaborative project involving electrospinning electrodes for water electrolysis at IPRI from 3 February.

Mr Wonje Cho (PhD student Dongguk University, South Korea) spent one month from mid-July working in ACES/IPRI with Dr Benny Kim on zwitter-ionic ion-polymer gel electrolytes towards lithium-ion conductivity at aqueous / non-aqueous electrolyte systems.

Park Hye Jin, a student from Sunchon University, Korea, spent 1 month in ACES/IPRI from 20 July working on wireless drug delivery with researchers.

Dr Kim (ETRI Korea) and his student Miss Kim spend 3 weeks in ACES/IPRI labs mid-year working on polymer deposition on MEAs. They also started to grow primary cortical neural cells onto the MEAs.

Dr Jumi Yun, Chungnam National University, Republic of Korea, began a 12 month stay in ACES/ISEM in August to work on carbon nanomaterials for batteries.

ACES/IPRI has enjoyed a continuing collaboration with Seon Jeong Kim at Hanyang University (Seoul, South Korea) for more than 10 years. The collaborations have involved numerous staff/student exchanges. In 2012, the joint work discovered and published (***Nature Communications 2012, 3, 650***) results showing the combination of carbon nanotubes and ACES-prepared reduced graphene oxide in a polymer matrix produced the toughest ever fibres. In addition, the collaboration discovered that conducting polymer coated carbon nanotube membranes generated a volumetric capacitance 80 times higher than activated carbon (***ACS Nano 2012, 6(1), 327-334***).

Prof Gordon Wallace with research collaborators in Korea.

ACES Director Prof Gordon Wallace travelled to Korea on three occasions in 2012; May, June and November.

Prof Gordon Wallace spent a constructive week from 24 May in Korea meeting with existing and building relationships with new collaborators. Prof Gordon Wallace gave an invited presentation, 'Building International Research Collaborations, Why, When and How?' at the City of Sejong in Korea on 24 May 2012.

As the Plenary Speaker at IRC 2012, the International Rubber Conference in Jeju, Korea, Prof Wallace addressed around 500 delegates from 20 countries on the topic

of stretchable conducting polymer systems and their application in energy and medical bionics.

Prof Wallace said that this was a great opportunity for ACES to tap into an extraordinary wealth of knowledge in the rubber research community.

While in Jeju, Prof Wallace signed a significant Memorandum of Understanding on behalf of the University of Wollongong with the ePrinting Research Centre at Jeju National University. Along with the Centre, ACES will develop new fabrication machinery for bionics, further boosting the already significant capabilities housed at the AIIM P&D facility which is home to the ACES Wollongong team.

Prof Gordon Wallace gave an invited presentation, 'Flexible, Wearable Electrodes based on Carbon Nanotubes and/or Graphene for Capacitor Applications' at the 16th International Meeting on Lithium Batteries (IMLB 2012) held on Jeju Island, Korea from 17-22 June 2012. Hyeon Jeong and Sha Li (PhD students ACES/UOW) both also attended this conference and presented their research posters.

Dr Robert Gorkin (RF, ALF/UOW) visited South Korea (12-20 June) where he carried out testing of second generation bioprinter (KIMM, Daegu) and then went to Jeju to attend meetings with Prof Gordon Wallace and potential collaborators at Jeju University to discuss printing technologies including experimental metal printing.

Dr Jaka Sunarso (ACES/Deakin) undertook research collaboration for electrocatalyst development at Dr Ho Seok Park's laboratory at Kyung Hee University, Suwon, South Korea (3 September-12 October) after he was awarded an Australia-Korea Foundation, Department of Foreign Affairs and Trade, Australian Government - Research collaboration grant for $11,000.

In early November Prof Gordon Wallace was once again in Korea to present an invited talk 'Emerging Medical Bionic Devices: Challenges and Opportunities for Novel Energy Supply Systems' at the Korean Electrochemical Society Meeting, held in Jeju ICC from 8-10 November 2012. He highlighted how critical the field of electronic materials is to the development of future bionic devices and for the field of science to realise its full potential as well as presenting the range of ACES Bionics research to the audience.

Willo Grosse (PhD, ACES/UOW) and Benny Kim (RF, ACES/UOW) followed on from Gordon by speaking more specifically about the actual research and challenges faced in the area. Willo presented her work on modified biofuel cell research for controlled drug delivery for epilepsy and Benny presented Caiyun Wang's (RF, ACES/UOW) research on the development of the biobattery.

Gordon joined Prof Lee Chi Woo, the chairman and president of the Korean Electrochemical Society, along with other VIP guests for dinner where they discussed the proposition of a new committee for the electrochemical society. Dr Benny Kim also discussed with Prof Shin Un Seop, who is in charge of international cooperation for the society, better approaches for the development of the two organisations.

Outside the conference room Prof Wallace met with Prof Choi (Jeju University) to discuss the joint collaboration. This work involves the next generation bio-printer (EHD printer). This will add to the ACES printing suite giving researchers the opportunity to print any inks, regardless of viscosity. Viscosity issues have been a significant limitation in live cell printing developments to date.

Prof Gordon and Prof Cho from Sunchon National University agreed to expand the new collaborative work on wireless actuation e-chromics and drug delivery.

Prof Gordon and Dr Jung from ETRI agreed to continue the collaborative research on some newly made MEAs.

Prof Doug MacFarlane has ongoing collaborative research with Prof Yong Soo Kang at Hanyang University in Korea.

Netherlands

Prof Simon de Leeuw, from Leiden University, Netherlands, was Deakin's inaugural 'Thinker in Residence' visiting the ACES labs at Deakin for six months from 15 September 2011 until 20 April 2012. Whilst in residence he worked with ACES students and researchers at both Deakin and Monash nodes to study of the structural, thermodynamical and dynamical behaviour of complex materials, in particular electrolyte materials such as polymer electrolytes and plastic crystals.

Mr Liyu Jin who was working with Prof de Leeuw in Australia visited Prof. de Leeuw at Leiden University for 2 months from September 2012. Prof de Leeuw will return to Australia for 10 weeks in February 2013 to undertake further work with the ACES students.

Prof Arjan Mol and Dr Yaiza Gonzalez-Garcia from the Department of Materials Science and Technology Surfaces and Interfaces group in Corrosion Technology and Electrochemistry at Delft University of Technology in the Netherlands visited the ACES/Deakin laboratories to have collaborative talks with Prof Forsyth and the team at Deakin.

Christianne Gilissen, undergraduate student from the University Zuyd, Netherlands, spent 6 months from November 2011 working at ACES/IPRI with Assoc Prof Marc in het Panhuis (CI ACES) working on interpenetrating polymer network hydrogels.

Prof Hugh Brown (CI, ACES/UOW) spent 19-30 March consulting at the research laboratories of DSM, in Geleen, The Netherlands on a range of topics including hydrogel contact lenses, cut resistance of high strength fibres, structure of Dyneema (highly oriented polyethylene) and electrospun fibres. Whilst in the Netherlands Hugh presented a paper on hydrogel toughness at the conference on Deformation, Yield and Fracture of Polymers held in Rolduc from 1-5 April.

Frederic Gilbert (RF, ACES/UTas) visited Department of Biotechnology, at Delft University 13-14 July to hold discussions about future collaborations with Assoc Prof Robin Pierce.

New Zealand

Research collaborations continue between Prof David Officer (ACES/UOW) and Prof Keith Gordon (University of Otago, New Zealand) both in the areas of porphyrin

and spiropyran chemistry. ACES/IPRI synthesised materials continue to be supplied to researchers at the University of Otago.

Prof Gordon also visited ACES/IPRI in August. Whilst here, he attended the first project meeting involving a new ARC Discovery Project, which is aimed at developing multichromophore organic dyes for dye-sensitised solar cells and then presented a series of lectures over two days on photoelectrochemical conversion of energy.

Dr Pawel Wagner conducted discussions with Prof Keith Gordon from Otago University and this opened a new field of collaboration that is currently being undertaken.

Poland

Materials exchange between long time collaborators of Pawel Wagner and David Officer (ACES/UOW) and Prof Mieczyslaw Lapkowski and Dr Malgorzata Czichy from Silesian University of Technology in Poland continued in 2012. This collaboration is in the area of plastic solar cells and electronic structures of conjugated polymers.

Dr Pawel Wagner also collaborates with Prof Maciej Kubicki from Adam Mickiewicz University (Poznan, Poland) on crystallography and molecular interactions in the solid state. This work was published in ***J. Chem. Crystallogr., 2012, 42, 1036.***

Slovenia

Dr Fredreic Gilbert (RF, ACES /UTas) has ongoing collaborations with Andrej Vranic, MD, PhD,

Department of Neurosurgery at the University Medical Centre Ljubljana.

Spain

Ms Jullieth Suárez Guevara, a Ph.D student from Centro de Investigación de Nanociencia y Nanotecnología (CSIC-ICN) Institut de Ciència de Materials de Barcelona Campus Bellaterra Barcelona, España spent 3 months from September,in ACES/IPRI, to work on electrochemical characterisation of hybrid metal/ cosnducting-polymer nanocomposites and hybrid graphene-based electrodes as active material to be used in symmetric and asymmetric supercapacitors.

Sweden

Edwin Jager, an Assistant Professor in the Organic Electronics Group, Dept. of Science and Technology (ITN), Campus Norrköping at Linköpings Universitet, spent 3 weeks in ACES/IPRI investigating micro-actuators. This has been an ongoing collaboration over the past 3 years.

Dr Michael Higgins (ACES/IPRI) visited the labs of Prof. Agneta Richtor-Dahlfors at the Karolinska Medical Intitutet in Stockholm, Sweden from 27-28 August. Prof. Richtor-Dahlfors is based in Department of Neuroscience and director of the Swedish Medical Nanoscience Center. Her research has focused on microbial pathogenesis and developing various microscopy techniques to visualise bacterial infection in tissues and animals. During the visit, Dr Higgins gave a talk on the use of AFM to study biological interactions with electromaterials and was involved in planning discussions with postgraduate students and staff for possible future collaborations.

Switzerland

Prof Leone Spiccia (CI, ACES/ Monash) has a current collaborative project with Prof Gilles Gasser (University of Zurich) on sensor applications based PNA-metal complex conjugates.

Dr Frederic Gilbert (RF, ACES UTas) visited (25 July-5 August) and collaborated on a manuscript with Prof Samia Hurst at the University of Geneva Switzerland.

Frederic also has ongoing collaborations with Dr Bernard Baertschi at the Institute for Biomedical Ethics, Faculty of Medicine, University of Geneva , Switzerland.

Taiwan

After the joint Nanobionic Symposium the ACES group attended the Taiwan Nano Week Exhibition held on the 3 October 2012. Prof Wallace gave an inspiring speech

on the importance of nanotechnology in the world today. The opening also included the Award Ceremonies for the 8th Nano Industrial Technology Excellence Award and the Nanotechnology Education and Training Project (the finalists of which were included as separate pavilions in the exhibition).

The exhibition had 10,000 pre-registrations, showcased nanotechnology research and development as well as new inventions. This platform encouraged international collaboration and business opportunities.

Also on the 3 October the group were hosted: (i) by Dr Zu-Hui Liu at the Biotechnology and Pharmaceutical Industries Promotion Office, MOEA

(http://www.biopharm.org.tw/) as well as (ii) by Dr Shang-Pwu Shia at the NanKang Biotech Incubation Center, SMEA. They received an overview of the biotechnology industry in Taiwan, providing the framework the government has developed to promote bio-industry in Taiwan plus tours of the facilities.

Thailand

Continuation of the research collaboration between Prof Sukon Phanichphant from Chang Mai University in Thailand and Dr Jun Chen (ACES/UOW) occurred in 2012.

Chiang Mai PhD student Natkritta Boonprakob was in ACES/IPRI for 12 months from January working on 'Modified TiO_2 for photocataytic degradation of methylene blue under visible-light irradiation'.

Chiang Mai University PhD student Kanlaya Pingmuang also worked in IPRI/ ACES as a visiting international student for 12 months from 8 July on photocatalysts for water cleaning.

Dr Jun Chen (RF, ACES/UOW) visited Chiang Mai University in June for 2 weeks to review the on-going collaboration project, "Nanostructured Metal Oxides for Photocatalytic Water Cleaning" with Dr Sukon Phanichphant.

United Kingdom

ACES/Deakin University has long standing collaborations with researchers from the Birmingham University in the UK. During the past year senior researchers visited the group in Melbourne.

Dr Jan Novak from Department of Chemistry, College of Engineering and Physical Sciences at University of Birmingham completed one month's research from 3 January with Dr Paul Bayley and Dr Jim Efthimiadis working on physicochemical characterisation of phosphonium based ionic liquids. Outcomes from this visit were recently published in an ionic liquids special issue of ***Aust. J. Chem***.

In July, Prof David Officer (CI, ACES/ UOW) visited Prof Neil Hunter and his research group at the University of Sheffield to discuss the printing of protein maquettes as both researchers work with Prof Les Dutton (UPenn) utilising maquettes. This work is part of Prof Officer's ARC discovery project on artificial photosynthesis. While in the UK, Prof Officer also met with (i) the owner of British company Paintbox, Mr James Sharp, in Banbury to discuss the development of solar cells for automobiles as well as with (ii) Prof Henry Snaith at Oxford to discuss materials for solar cells.

Dr Paul Bayley (ECR, Deakin) visited the University of Birmingham laboratories in October for 4 weeks and performed MRI on a Zn-air cell and SSNMR experiments on two plastic crystals to determine the dynamics of their re-orientational motion.

Liyu Jin (PhD, ACES) visited the solid-state NMR lab and the setups for in-situ NMR study of Lithium batteries at Prof Clare P. Grey's Lab, University of Cambridge on 17 October and discussed possibilities for further collaboration with Lina Zhou, Dr Yanyan Hu and Prof Clare P. Grey.

USA

Prof Charles Dismukes from Rutgers University, New Jersey, USA spent 1 week at IPRI from 28 February discussing collaborative opportunities.

Prof Dennis Tallman, North Dakota State University, USA, was the 'expert in residence' at ACES/IPRI for 2 months from 5 March. During his stay Dennis gave an extensive series of electrochemical lectures.

Mr Craig Milroy, PhD student from University of Texas, Austin, USA spent 6 months in ACES/IPRI after receiving a 2012 EAPSI fellow award and a Burroughs Wellcome Fund (BWF) 2012 Collaborative Research Award to travel and work on conducting polyurethane based composite biomaterials.

ACES/IPRI again hosted Prof Paul Calvert from the University of Massachusetts, USA. Paul spent 2 months December 2011 and January 2012 to continue the ongoing collaborative work on printing functional materials that was cemented in his year spent in IPRI in 2009 courtesy of his ARC International Linkage award.

Prof Austen Angell from the Arizona State University visited Monash University and Prof Doug MacFarlane in February 2012 for collaborative discussions on ionic liquids.

A long time collaboration has existed between ACES/IPRI and Prof Ric Kaner's laboratories at UCLA. On 19 June ACES/ IPRI PhD student Nicholas Roach visited Ric's labs at UCLA for the start of a new partnership involving incorporation of functionalised porphyrins and spiropyran into aniline oligomer materials.

PhD student Craig Milroy, from University of Texas, worked for 6 months in 2012 at ACES/IPRI.

Another collaborative project with UCLA and Prof Kaner has focussed on the development and implementation of CVD graphene systems at the University of Wollongong, followed by the application of the CVD graphene as a platform for nerve cell stimulation. The implementation of the CVD graphene was achieved by Dr Peter Sherrell (RF, ACES/IPRI) in 2012 after a visit to UCLA in November 2011 to work with Jonathan Wassei.

Prof David Officer travelled to the USA in April and attended the Australian National Fabrication Facility & US Defense Forces Joint Workshop 2012 held at the Four Points by Sheraton in Washington DC, USA from 30 April - 4 May presenting an

invited lecture entitled 'Nanostructured Electromaterials for Energy and Bionic Applications'. Prior to this workshop, he took the opportunity to meet with Prof Les Dutton and discuss their joint ARC discovery project. During this visit, Prof Officer presented a research lecture 'Artificial Photosynthesis: Porphyrins for Light Harvesting and Water Splitting' at the Johnson Research Foundation at the University of Pennsylvania in Philadelphia on 27 April.

Following the Washington workshop, Prof Officer joined Dr Ian Dagley, CEO of the CRC for Polymers (CRC-P) in visiting: (i) Prof Charles Dismukes at Rutgers University, New Jersey, to discuss possible collaborations on solar cell research and (ii) 3M in St Paul, Minnesota to explore the potential for collaboration on the CRC-P polymer encapsulation project.

On 9 May, Prof Officer then visited Prof Ric Kaner's laboratories at UCLA to discuss the opportunities for using graphene as electrodes in solar cells and to present ACES research on new electromaterials to Rics' group.

Following up on Prof Officer's earlier visit, ACES/IPRI PhD student Nicholas Roach visited Prof Les Dutton's group at the University of Pennsylvania from 27 June until 17 July. Along with Goutham Kodali, a post-doc within the group at UPenn, they undertook spectroscopic measurements of the interactions between the UOW made porphyrins and the UPenn protein maquettes. Nic was the recipient of a DSITRE mobility award that along with ARC discovery funding allowed him the opportunity to undertake such an important visit to this overseas laboratory.

Prof Hugh Brown (CI, ACES/UOW) worked at the University of California in Santa Barbara from the 18 July to 16 August. He mainly collaborated with Ed Kramer on coacervate hydrogels and on the interpretation of small angle X-ray scattering pattern from stretched filled elastomers. The main aim was to study the nanocavitation and work on this subject was published in ***Macromolecules 2012, 45, 1529-1543***.

Prof Hugh Brown (CI, ACES/UOW) then spent 22 October to 8 November at University of North Carolina in Chapel Hill working with Michael Rubinstein and his group on a polymer physics approach to measuring and understanding the mechanical properties of bronchial mucus and how it is moved by cilia. The work is relevant to cystic fibrosis and other congestive lung diseases. Whilst there Hugh also gave a seminar on ACES work 'the mechanical properties of hydrogels'.

Research collaboration with Prof Ray Baughman, from the Alan G. MacDiarmid NanoTech Institute at the University of Texas at Dallas, involved further work relating to carbon nanotube based materials. The highlight was the publication in Science of extremely fast and large torsional and tensile actuation in guest-filled twisted carbon nanotube yarns (***Science 2012, 338, 928***). Further, a publication in ***Nanoscale (2012, 4, 940)*** described the conductivity of polypyrrole coated carbon nanotubes yarns. Dr Javad Foroughi travelled to Prof Baughman's labs twice in 2012 (13 May- 10 June, courtesy of a Australian Nanotechnology Network travel grant, and 11-17 December) to continue with this collaborative research.

ACES is also undertaking collaborative work with Prof Ray Baughman's group at the Alan G. MacDiarmid NanoTech Institute at the University of Texas at Dallas (UTD), in the area of thermocell devices.

Bionics is yet another area of collaboration with Ray Baughman at the University of Texas, Dallas. This work on the use of conductive nanostructured platforms synthesised from carbon nanotube aerogel sheet and conducting polymers led to a publication in the November issue of Advanced Healthcare Materials (1(6): 801-808) and a journal cover in the same issue.

After Prof Tim Hanks from Furman University found himself back in the thick of it, undertaking a six month sabbatical, courtesy of a Fullbright scholarship, at ACES/IPRI starting 5 January 2011, the collaboration has continued with strength in 2012. As a synthetic chemist, Prof Hanks' expertise is in creating materials, specifically composite materials that can conduct electricity. Together ACES/IPRI and Tim have developed novel approaches to electrode surface modification that enable fine control of over the adhesion of important biomolecules and cells, and have developed novel conducting hydrogels that can be used to fabricate 3-dimensional scaffolds for biomedical applications. To date we have published 1 article in ***Synthetic Metals,*** with several further publications currently in preparation.

Prof Leone Spiccia (CI, ACES/Monash) has a collaborative project with Prof William H Casey at UC Davis, Davis California involving molecules as models for mineral surfaces and water oxidation catalysis. Leone has enjoyed very productive long-term collaborations with the UC Davis groups.

Prof Doug MacFarlane has ongoing collaborative research with Prof Gloria Elliott at the University of North Carolina in 2012 in the field of thermal energy storage.

Prof Doug MacFarlane is an Adjunct Fellow at the University of Alabama and so maintains close collaborative ties with this group of researchers in the field of ionic liquids.

Prof Maria Forsyth and Prof Doug Macfarlane had fruitful collaborative discussions with Prof Richard Noble and his group at the University of Colorado in Boulder, relating to CO_2 absorption materials. This work will progress under Prof Forsyth's Laureate fellowship in the coming year.

Dr Kerry Gilmore (ACES) travelled to San Diego in USA, for 3 weeks in January, to work on a collaborative project with Organovo on 'Investigations into the innate cellular response to electrical stimulation via bioprinting of 3D composite structures'. This trip was the result of a successful 2011 URC Research Partnerships Grant.

Tristan Simons (PhD, ACES) visited Virginia Tech for a week in September to work with Prof Lou Madsen, studying a novel electrochemical NMR technique.

Appendix 5: Invited Talks in 2012

ACES members were again very active in showcasing ACES research globally. ACES accepted 59 invitations to present at international conferences and 38 invitations to give invited talks at Universities and Research Organisations. These are listed below.

INVITED TALKS TO CONFERENCES & SYMPOSIUMS

January

Prof Leone Spiccia gave an invited keynote lecture 'Nanoparticulate Manganese Oxides as Water Oxidation Catalysts' at the Catalysis Research Centre International Symposium on Green & Sustainable Catalysis held at Hokkaido University, 26-27 January 2012.

Prof H.K. Liu gave an invited talk on 'Advanced materials for lithium rechargeable batteries, supercapacitors and hydrogen storage' at the 36th Annual Australian and New Zealand Condensed Matter and Materials Meeting held 31 January to 3 February 2012 at Charles Sturt University, Wagga Wagga, Australia.

February

Prof Gordon Wallace gave an invited presentation, 'Nanoscale Fabrication of Organic Conductors: Building More Effective Bionic Interfaces' at the International Conference on Nanoscience and Nanotechnology (ICONN-2012) Perth, Australia, held 5-9 February 2012. Note that the 10th Asia-Pacific Microscopy Conference (APMC 10), the 2012 International Conference on Nanoscience and Nanotechnology (ICONN 2012) and the 22nd Australian Conference on Microscopy and Microanalysis (ACMM 22) was held in Perth, Western Australia as a single, integrated event.

Dr Michael Higgins gave an invited presentation, 'Bio-nano-electrical Control of Single Protein Interactions' at the International Conference on Nanoscience and Nanotechnology (ICONN-2012) Perth, Australia, held 5-9 February 2012. Michael Higgins was a chair on the organising committee for symposium on scanning probe microscopy.

Prof Gordon Wallace gave an invited plenary presentation, 'Organic (Nano) Bionics' at the 33rd Australasian Polymer Symposium (33APS) Hobart, Tasmania, held 12-15 February 2012.

March

Prof Geoffrey Spinks gave an invited talk entitled 'Giant Torsional Actuation from Carbon Nanotube Yarns' at the SPIE 19th Annual International Symposium on Smart Structures and Materials + Nondestructive Evaluation and Health Monitoring held in San Diego, California, USA between 11-15 March.

Prof Mark Cook gave an invited talk on 22 March entitled 'Using Pharmacological and non-pharmacological therapies to treat drug resistant epilepsy' at the 9th Asian & Oceanian Epilepsy Congress held in Manila, Philippines.

Prof Gordon Wallace gave an invited presentation, 'Nanofabrication for Organic Bionics', at the 243rd ACS National Meeting (ACS Kaner Award Symposium) San Diego, CA, USA held on 25-29 March 2012.

Dr Jun Chen gave an invited lecture, 'Homogeneous Catalysts with a Mechanical ("Machine-like") Action. Catalytic Solar Water Splitting Inspired by Photosynthesis' at Symposium on 'Nanotechnology for a Sustainable Energy Economy' 243rd ACS National Meeting & Exposition, March 25-29, 2012, San Diego, California, USA (Division of Fuel Chemistry, American Chemical Society)

Prof Maria Forsyth gave an invited presentation at the 243rd ACS National Meeting, San Diego, CA, USA held on 25-29 March 2012.

Prof Douglas MacFarlane gave three invited presentations, 'Protonics in Ionic Liquids and Solids - Putting Protons to Work'; 'Ionic Biomaterials based on Ionic Liquids for Bio-medical Applications' and 'High Efficiency Water Oxidation and Reduction Catalysts' at the 243rd ACS National Meeting, San Diego, CA, USA held on 25-29 March 2012. ACES Energy Program leader Prof Doug MacFarlane from Monash University also participated in the American Chemical Society meeting press conference, speaking about Ionic Liquids and their application in batteries, solar cells, fuel cells and as catalysts for water splitting, which is on-line.

Dr Jenny Pringle gave two invited presentations, 'Organic ionic plastic crystals: Thermal and structural analysis and their application in electrochemical devices', and 'Use of ionic liquids in thermoelectrochemical cells' at the 243rd ACS National Meeting, San Diego, CA, USA held on 25-29 March 2012.

April

Prof Douglas MacFarlane gave an invited talk, 'High Efficiency Water Oxidation and Reduction Catalysts' at the Materials Research Society National Meeting held in San Francisco 11-13 April.

Prof David Officer gave an invited presentation, 'Nanostructured Electromaterials for Energy and Bionic Applications' at the Australian National Fabrication Facility & US Defense Forces Joint Workshop 2012, Washington DC, USA held on 30 April - 4 May 2012.

May

Prof Leone Spiccia gave an invited plenary lecture on 'Manganese Water Oxidation Catalysts' at Gordon Research Conference on Renewable Energy: Solar Fuels held in Lucca, Italy from 13-18 May 2012.

Dr Michael Higgins travelled to Strasbourg in France on 14-18 May to give an invited talk on 'Atomic Force Microscopy for Nanobionics' at the European Materials Research Society Meeting (eMRS) in a session on Biological Applications for Organic Electronic Devices.

Prof Douglas MacFarlane gave a plenary lecture, 'Ionic liquids and watersplitting for hydrogen generation' at Bunsentagung 2012 held from 17-19 May at the University of Leipzig, Germany.

Prof Gordon Wallace gave a plenary lecture, 'Stretchable Conducting Polymer Systems and their Application in Energy and Medical Bionics', at the International Rubber Conference 2012 (IRC 2012) held on Jeju Island, Korea from 21-24 May 2012.

Prof Gordon Wallace gave an invited presentation, 'Building International Research Collaborations, Why, When and How?' at the City of Sejong in Korea on 24 May 2012.

Prof Leone Spiccia gave 2 invited lectures on 'Bioinspired Manganese Water Oxidation Catalysis' and 'Ferrocenes as Efficient Dye-Sensitised Solar Cell Redox Mediators' at the Solar Fuels Symposium of the 95th Canadian Society for Chemistry (CSC) Conference held in Calgary, Canada from 26-30 May 2012.

June

Dr Jun Chen gave an invited oral presentation entitled 'Advanced NanoCarbon Composite Materials for Energy Applications' at BIT's 1st Annual World Congress of Advanced Materials 2012 (WCAM-2012) held in Beijing, China, from 5-8 June. There were 400 registrants from 33 countries in attendance.

Dr Attila Mozer was invited to give a presentation entitled 'Conjugated polymer donor/ fullerene acceptor bulk heterojunction solar cells' at the Nanofibers 2012 conference held 4-5 June at Tokyo Institute of Technology, Japan. Nanofibers 2012 is the 3rd International Nanofiber Symposium and was jointly held with 5th international conference of N3M "Nanofibers for the 3rd millennium" organized by Elmarco in 2012.

Prof Gordon Wallace gave an invited presentation, 'Flexible, Wearable Electrodes based on Carbon Nanotubes and/or Graphene for Capacitor Applications' at the 16th International Meeting on Lithium Batteries (IMLB 2012) held on Jeju Island, Korea from 17-22 June 2012.

Prof Maria Forsyth gave a plenary talk 'Solid State electrolytes for improved stability of electrochemical devices' M. Forsyth*, P. Howlett, D. R. MacFarlane, A. Noor, J. Pringle at the International Union of Pure and Applied chemistry(IUPAC) World Polymer Congress held in Blacksburg, Virginia from 24-29 June.

Prof H.K. Liu gave an invited talk on 'Carbon nanotube- metal oxide composites for lithium rechargeable batteries and supercapacitors' in the Functional Nanotube Composites: Energy Storage session at , Thirteenth International Conference on the Science and Application of Nanotubes held from 24 - 29 June 2012, at the Brisbane Convention and Exhibition Centre, Brisbane, Australia.

Prof Susan Dodds (ACES CI) was invited to give an oral Presentation 'Vulnerability and Research Ethics' (W. Rogers, C. Mackenzie, S. Dodds) and be a panellist at the Symposium for the 11th World Congress of Bioethics held in Rotterdam on 28 June 2012.

July

Prof Gordon Wallace gave a keynote presentation, 'Nanostructured Carbons – An important Addition to the World of Bionics' at OzCarbon2012, held at the University of Adelaide from 1-3 July 2012.

Dr Atilla Mozer gave an invited talk entitled 'Conjugated polymer donor/ fullerene acceptor bulk heterojunction solar cells' at the International Conference of Young Researchers on Advanced Materials (ICYRAM) held in Singapore 1-6 July. The aim of this conference was to give researchers under the age of 40 a chance to present technical findings of their research, to network within the international community of other young researchers, and to increase the breadth of their general materials-based knowledge. Dr Mozer was also the overseas chair of Session EM4:Ionic and Mixed Conduction Systems.

Assoc Prof Marc in het Panhuis gave an invited presentation, 'Hydrogel Composite Materials' at OzCarbon2012, held at the University of Adelaide from 1-3 July 2012.

Prof Gordon Wallace gave an invited presentation, 'Organic Nanobionics', at the 2012 International NanoMedicine Conference, held at Coogee Beach, Sydney from 2-4 July 2012.

Invited speakers at the 3rd International Symposium of Advanced Energy Science held in Kyoto in September.

Prof Gordon Wallace gave an invited presentation, 'Building More Effective Bionic Implant-Tissue Interfaces using Organic Conducting Polymers', at the International Conference of Science and Technology of Synthetic Metals, ICSM-2012, held in Atlanta, USA from 8-13 July 2012.

Prof Leone Spiccia, delivered a talk 'DSC Electrolytes Based on Organometallic Redox Mediators' at IPS-19 held at Caltech, Pasadena, USA, 30 July to 3 August 2012.

August

Prof Douglas MacFarlane gave a plenary lecture, 'Ionic Liquids for Splitting Water' at Euchem Conference on Ionic Liquids held in Wales 11-15 August.

Maria Forsyth gave an invited talk 'Ionic Liquid surface film formation on reactive metals for improved corrosion performance' by Maria Forsyth, Patrick Howlett, Julie-Anne Latham, Peipei Huang, and Douglas MacFarlane at the 63rd Annual Meeting of the International Society of Electrochemistry for Advanced Materials, Technologies and Instrumentation held in Prague, Czech Republic from 19-24 August 2012.

Prof Gordon Wallace gave an invited talk 'Organic Bionics' at the St Vincent's Hospital Medical Research week in Melbourne on 20 August 2012.

Prof Gordon Wallace gave a plenary talk 'Nanofabrication for Organic Bionics' at the CSIRO conference on Advanced Materials which was held in Melbourne 20-22 August 2012.

Prof Maria Forsyth gave a plenary talk at ISPE-13 XIII International Symposium on Polymer Electrolytes held in Selfoss, Iceland from 26-31 August.

September

Dr Attila Mozer gave an invited talk 'Charge photo-generation and recombination in novel push-pull low band gap conjugated polymer/fullerene bulk heterojunctions' at the 3rd International Symposium of Advanced Energy Science held in Kyoto, 2 - 4 September 2012.

Prof David Officer gave an invited presentation 'Controlling the Open Circuit Voltage in Porphyrin-Sensitised Solar Cell' at Electrochem 2012, held at Trinity College, Dublin, Ireland on the 2-4 September 2012.

Joseph Giorgio (PhD ACES/UOW) gave an invited presentation 'Re-engineering the Dye-Sensitised Solar Cell' at Electrochem 2012, held at Trinity College, Dublin, Ireland on the 2-4 September 2012.

Dr Attila Mozer gave an invited talk 'Driving-force Dependence of Charge Separation Kinetics in Conjugated Polymer Donor/Acceptor Bulk Heterojunction Solar Cells' at the International Organic Excitonic Solar Cells Conference held at Coolum Beach, Australia from 3-7 September.

Dr Michael Higgins gave an invited talk to showcase research on Nanobionics that is being undertaken in IPRI and ACES at 2nd International Symposium on Functional Nanomaterials held at Dublin City University, Dublin, Ireland in 6-7 September.

Prof David Officer gave Prof Wallace's invited presentation, 'Nanofabrication for Organic Bionics' at the 2nd International Symposium on Functional Materials 2012, held at Dublin City University, Ireland on 6-7 September 2012.

Prof Leone Spiccia gave an invited keynote lecture 'Water Oxidation Catalysis by Metal Oxides Derived from Molecular Precursors' at the 3rd International Symposium of Solar Cells and Solar Fuels held in Dalian, China from 8-10 September 2012.

Prof Leone Spiccia gave an invited keynote lecture 'Nanoparticulate Manganese Water Oxidation Catalysts Derived from Molecular Precursors' at the 40th International Coordination Chemistry Conference (ICCC40) held in Valencia, Spain in 9-13 September 2012.

Prof Gordon Wallace gave an invited presentation 'Controlled Delivery for Medical Bionics' at the 2nd Symposium on Innovative Polymers for Controlled Delivery (SIPCD 2012), held in Suzhou, China from 11-14 September 2012.

Prof Mark Cook gave an invited talk on 12 September entitled 'Pre-Ictal state-overview' at session C at the conference ME@MBC held in Melbourne, Australia.
Prof Douglas MacFarlane gave a plenary lecture 'Ionic liquids and watersplitting for hydrogen generation' at the 3rd Asian Pacific Conference on Ionic Liquids and Green Processes (APCIL 12) held in Beijing, China from 17-19 September.
Prof Gordon Wallace gave an invited presentation 'Additive Fabrication and New Bionic Devices' at the 15th International Conference AMPT 2012, held in Wollongong, from 23-26 September 2012.

Prof Mark Cook gave an invited presentation entitled 'Future directions in cortical excitability and seizures using Activa PC&S in a canine epilepsy model' at the Deep Brain Stimulation for Epilepsy Ambassadors meeting held in London, England on 30 September.

October

Prof Gordon Wallace gave an invited talk 'Nanobionics – Where are we Heading?' at the National Program on Nano Technology (NPNT), held in Hsinchu, Taiwan on 2 October 2012.

Prof Mark Cook gave an invited talk on 3 October entitled 'seizure prediction and other novel management strategies' at the 10th European Congress on Epileptology held in London, England.

Prof Hugh Brown (CI, ACES/UOW) gave an invited talk at the American Society of Mechanical Engineers Annual Conference held in Houston Texas from 12-15 October on the mechanical properties of double network hydrogels.

Prof Gordon Wallace gave a Keynote lecture 'Organic Conducting Biofunctional Polymers – Opportunities for New Medical Bionics' at the 8th IUPAC International Conference on Novel Materials and their Synthesis (NMS-VIII) & 22nd International Symposium on Fine Chemistry and Functional Polymers (FCFP-XXII), held in Xi'An, China from 14-19 October 2012.

Prof Gordon Wallace gave an invited presentation 'Nano-Bio Convergence: Opportunities and Challenges' at the workshop on Transforming Tools of Emerging and Converging Technologies for Societal Benefit, held in Beijing, China on the 18-19 October 2012.

November

Dr Cristina Pozo-Gonzalo (RF, ACES/ Deakin) gave an invited talk at the 5th International conference on electroactive polymers: materials and devices (ICEP) entitled 'Oxygen reduction reaction performance and mechanism in organic and inorganic based catalysts' held in Varanasi, India from 5-9 November.

Prof Gordon Wallace gave an invited talk 'Emerging Medical Bionic Devices: Challenges and Opportunities for Novel Energy Supply Systems' at the Korean Electrochemical Society Meeting, held in Jeju ICC from 8-10 November 2012.

December

Prof Gordon Wallace gave a plenary lecture, 'Fabrication of Multifunctional Structures : The impact on Medical Bionics' at the 5th International Symposium on Functional Materials 2012, held in Perth, Australia from 17-20 December 2012.

Prof H.K. Liu gave an invited talk on 'Functional nanostructured materials for lithium rechargeable batteries, supercapacitors and hydrogen storage' at the 5th International Symposium on Functional Materials held in Perth, Australia from 17-20 December 2012.

AT UNIVERSITIES AND RESEARCH ORGANISATIONSFEBRUARY

Dr Rosalie Hocking gave an invited presentation on 'Water Oxidation by Mn in a geochemical-like cycle' at UCBerkeley, Berkely, CA, USA in February 2012.

Dr Rosalie Hocking gave an invited presentation on 'Designing Catalysts for Clean Energy: A Challenge for X-rays and Electrons' at UC Davis, USA in February 2012. She also gave this invited talk at University of Queensland and James Cook University during 2012.

March

Prof Gordon Wallace gave an invited presentation, 'Nanofabrication for Organic Bionics' at NCSR, Dublin City University, Ireland on 30 March 2012.

Prof David Officer gave a presentation, 'Introduction to IPRI/ACES, Energy and Bionics Research, and Fabrication and Printing' at the Tata Research Institute, Mumbai, India on 12 March 2012.

Prof David Officer gave a presentation, 'Intelligent Polymer Research Institute (IPRI) / the ARC Centre of Excellence for Electromaterials Science (ACES) Capabilities' at Larsen and Tourbro Ltd, Mumbai, India on 12 March 2012.

Prof David Officer gave a presentation, 'Introduction to IPRI/ACES, Energy and Bionics Research, and Fabrication and Printing' at the National Chemical Laboratory, Pune, India on 13 March 2012.

Prof David Officer gave a presentation, 'Introduction to IPRI/ACES, Energy and Bionics Research, and Fabrication and Printing' at the Indian Institute of Science, Bangalore, India on 14 March 2012.

Prof David Officer gave a presentation, 'Solar Cell Research in the Intelligent Polymer Research Institute (IPRI) / the ARC Centre of Excellence for Electromaterials Science (ACES)' at the electric car company Mahindra Reva, Bangalore, India on 15 March 2012.

April

Prof Gordon Wallace gave a presentation, 'Organic Nanobionics', at Queen's University, Belfast, UK on 2 April 2012.

Prof Gordon Wallace gave a presentation, 'Nanofabrication for Organic Bionics', at University of Ulster, Northern Ireland on 3 April 2012.

Prof David Officer gave a presentation, 'Artificial Photosynthesis: Porphyrins for Light Harvesting and Water Splitting' at the Johnson Research Foundation, University of Pennsylvania, Philadelphia, USA on 27 April 2012.

May

Prof David Officer gave a presentation, 'Developing Multifunctional Electromaterials for Energy Applications' at UCLA, USA on 9 May 2012.

Prof Gordon Wallace gave an invited presentation 'Nanofabrication for Organic Bionics' at Jeju University in Korea on 23 May 2012.

June

Prof Gordon Wallace gave an invited talk, 'Medical Bionics: What do people really think – an after dinner perspective!" at Bionic Vision Australia's Retreat dinner held in Wollongong on 7 June 2012.

Prof Gordon Wallace (ACES CI) gave an invited talk 'Nanofabrication for Organic Bionics' at the University of Queensland on 27 June 2012.

July

Dr Pawel Wagner gave an invited talk entitled 'Porphyrins as light driven processes' at Pennsylvannia University, Philadelphia on 16 July 2012.

August

Patrick Howlett (RF, ACES/ Deakin) gave an Invited seminar on 'Ionic electrolytes for high energy density batteries' at the University of Technology Sydney on 16 August.

Prof David Officer gave a presentation, 'Developing Multifunctional Electromaterials for Energy-related Applications', at Queen's University, Belfast, UK on 17 August 2012.

Prof Mark Cook gave an invited talk at the Monash Leadership Seminar held in Melbourne on 18 August entitled 'How to be a leader in your career'.

Prof David Officer gave a presentation, 'Developing Multifunctional Nanostructured Electromaterials', at Åbo Akademi University, Turku, Finland, on 27 August 2012.

Dr Pawel Wagner gave an invited lecture on 'porphyrins as light harvesters' at AIST, Tsukuba on his trip to visit collaborators in Japan.

September

Prof David Officer gave a presentation, 'Developing Multifunctional Nanostructured Electromaterials' at the Centre Microélectronique de Provence, Ecole Nationale Supérieure des Mines, Gardanne, France on 10 September 2012.

Assoc Prof Marc in het Panhuis (ACES CI, UOW) gave an invited presentation to School of Chemistry, UNSW in Sydney followed by a day of discussion about potential collaborations on 13 September.

Prof David Officer gave a presentation, 'Developing Multifunctional Electroactive Nanomaterials' at the Department Chemie und Pharmazie, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, on 14 September 2012.

Prof Douglas MacFarlane gave an invited Seminar, 'Global Sustainability and Ionic Liquids' at the Chinese Academy of Sciences, Institute of Process Engineering on 20 September.

Prof Gordon Wallace gave an invited seminar, 'Nanofabrication for Organic Bionics', at the Centre for Advanced Nanomaterials, University of Adelaide in South Australia, on 28 September 2012.

Prof Leone Spiccia gave an invited seminar 'Bioinspired Water Oxidation Catalysts for Solar Hydrogen Production' at the Chinese University of Hong Kong, Hong Kong in September 2012.

October

Prof Douglas MacFarlane gave an invited seminar, 'Global Sustainability and Ionic Liquids', at Tokyo University Department of Chemistry on 22.

Prof Gordon Wallace gave an IHMRI Spring seminar, 'Will Nanotechnology Revolutionise Health Care?' at the University of Wollongong on 23 October 2012.

Prof MacFarlane and the Ohno-Nakamura Group, Tokyo University of Agriculture and Technology.

Prof Geoffrey Spinks gave an Invited Talk to IP Australia in Canberra on 23 October entitled 'Mechanical Properties of Materials and the role of Nanotechnology'.

Prof Leone Spiccia gave an invited seminar 'Water Oxidation Catalysts Inspired by Photosynthesis' at The University of Western Australia, Perth in October 2012.

Prof Leone Spiccia gave an invited seminar 'Nanoparticulate Manganese Oxides as Water Oxidation Catalysts' at Curtin University, Perth, WA in October 2012.

November

Prof Hugh Brown (CI, ACES/UOW) gave a seminar on ACES work 'the mechanical properties of hydrogels' at University of North Carolina in Chapel Hill, USA.

Prof Gordon Wallace gave an invited seminar 'Nanotechnology, Organic Conductors, Additive Fabrication and Medical Bionics' at RMIT for any interested participants at RIMT and other universities' in Melbourne on 29 November 2012.

On 21 November Dr Patrick Howlett (RF, ACES/Deakin) presented an invited talk at University of Sydney, ESTOREN on 'Ionic electrolytes for high energy density batteries'.

December

Prof Gordon Wallace gave an invited talk, "Nanofabrication for Organic Bionics" at CityU, Hong Kong on 6 December 2012.

Prof Gordon Wallace gave a talk "Organic Bionics" at the workshop on Collaborations in Medical Bionics, held in Beijing, China on 8 December 2012.

Appendix 6: 2012 Summary of National Engagement

In addition to the invited talks listed in Appendix 5, another 32 ACES members presented ACES research at 36 separate national conferences or events in 2012.

Note: Attendance presentations at ACES events are not included on this list, nor are established collaborator visits.

DATE	NAME/AFFILIATION	DESCRIPTION
5 - 9 Feb	Michael Higgins (RF,UOW/IPRI)	Invited talk: Bio-nano-electrical Control of Single Protein Interactions' by Christine Kranz, Amy Gelmi, Gordon Wallace, Michael Higgins*at the International Conference on Nanoscience and Nanotechnology (ICONN-2012) Perth, Australia, held 5-9 February 2012. Oral: 'Submolecular Insights into Fibronectin-Conducting Polymer Interactions Resolved with Atomic Force Microscopy' by Amy Gelmi, Michael Higgins*, Gordon Wallace presented at the International Conference on Nanoscience and Nanotechnology (ICONN-2012) Perth, Australia, held 5-9 February 2012. Note: the 10th Asia-Pacific Microscopy Conference (APMC 10), the 2012 International Conference on Nanoscience and Nanotechnology (ICONN 2012) and the 22nd Australian Conference on Microscopy and Microanalysis (ACMM 22) was held in Perth, Western Australia as a single, integrated event. Over 2,000 delegates from more than 30 nations attended to provide a unique and exciting forum.
5 - 9 Feb	Cathal O'Connell (PhD, ACES/UOW)	Oral: 'Vapour Phase Polymerization of Conducting Polymer by the Picogram Via Dip-pen Nanolithography' by Cathal O'Connell presented at the International Conference on Nanoscience and Nanotechnology (ICONN-2012) Perth, Australia, held 5-9 February 2012.
5 - 9 Feb	Javad Foroughi (ECR, ANFF/UOW)	Oral:' Carbon Nanotube Yarn as a Microscale Rotational Actuator' by Javad Foroughi, Geoff Spinks, Gordon Wallace, John Madden, Ray Baughman presented at the International Conference on Nanoscience and Nanotechnology (ICONN-2012) Perth, Australia, held 5-9 February 2012.
5-9 Feb	Frederic Gilbert (RF, ACES/UTas)	Oral: 'Moral hazards related to nano-bionics implants in the brain: Ethical issues for clinical trials' by Frederic Gilbert* and Susan Dodds at the International Conference on Nanoscience and Nanotechnology (ICONN), Perth, Australia.. F. Gilbert was awarded an ANN presentation/registration award.
12-15 Feb	Geoffrey Spinks (CI, ACES/UOW)	Oral: 'Optimal Design of Polymer Artificial Muscles' by Geoffrey M. Spinks, Gordon G. Wallace, Philip G. Whitten and Wen Zheng presented at the 33rd Australasian Polymer Symposium (33APS) Hobart, Tasmania, held 12-15 February 2012.
12-15 Feb	Damia Mawad (RF, UOW/IPRI)	Oral: 'One Single Component Conducting Polymer Hydrogel as a Scaffold for Tissue Engineering' by Damia Mawad*, Elise Stewart, David L. Officer, Gordon G. Wallace presented at the 33rd Australasian Polymer Symposium (33APS) Hobart, Tasmania, held 12-15 February 2012.
12-15 Feb	Bo Weng (ECR, UOW/IPRI)	Oral: 'Wholly Printed Polypyrrole-based Biosensors on Flexible Substrate' by Bo Weng*, Aoife Morrin, Roderick Sheppard, Karl Crowley, Anthony J. Killard, Gordon G. Wallace presented at the 33rd Australasian Polymer Symposium (33APS) Hobart, Tasmania, held 12-15 February 2012.
12-15 Feb	Hai Xin (PhD, ACES/UOW)	Oral: 'The Effect of the First Network Heterogeneity on the Mechanical Properties of PNVP-PAAc Double Network Hydrogels' by Hai Xin*, Hugh R. Brown, Sureyya Saricilar, Geoffrey M. Spinks, Philip G. Whitten presented at the 33rd Australasian Polymer Symposium (33APS) Hobart, Tasmania, held 12-15 February 2012.

DATE	NAME/AFFILIATION	DESCRIPTION
12-15 Feb	Sina Naficy (ECR, ACES/UOW)	Oral: 'Electrically Conductive, Tough Hydrogels with pH Sensitivity' by Sina Naficy*, Geoffrey M Spinks, Gordon G Wallace presented at the 33rd Australasian Polymer Symposium (33APS) Hobart, Tasmania, held 12-15 February 2012.
15-18 April	Dennis Antiohos (PhD, UOW/IPRI)	Oral: 'Composite carbon materials for supercapacitors' by Dennis Antihos*, G. Folkes, P. Sherrell, K.Pingmuang, S. Ashraf, G. Wallace, P. Aitchison, A.Harris, A. Minett, Jun Chen at the International Society of Electrochemistry 10th Spring Meeting: New approaches to nanostructuring electrodes for electroanalysis and energy storage in Perth. Whilst in Perth Dennis and Mark Romano visited Prof Colin Raston and the University of Western Australia's Centre for Strategic Nano-Fabrication facility.
15-18 April	Mark Romano (PhD, ACES/UOW)	Poster: 'Novel Carbon Nanomaterials for Thermal Energy Converters' by Mark S. Romano, Dennis Antiohos, Rouhollah Jalili, Andrew Nattestad, Na Li, Ray H. Baughman, Joselito M. Razal, Gordon G. Wallace, Jun Chen presented at the International Society of Electrochemistry 10th Spring Meeting: New approaches to nanostructuring electrodes for electroanalysis and energy storage in Perth. Whilst in Perth Dennis and Mark Romano visited Prof Colin Raston and the University of Western Australia's Centre for Strategic Nano-Fabrication facility.
7-8 May	Peter Innis (CI, ACES/UOW), Stephen Beirne (ECR, UOW/IPRI) Javad Foroughi (ECR, ANFF/UOW)	Hosted an exhibit on behalf of ACES/ANFF at National Manufacturing Week at Sydney. See more under end-user engagement.
25 May	Eliza Goddard (PhD ACES/UTas)	Presented a paper "'I no longer recognise myself ": practical identity, narrative embodiment and restoring selfhood' at the University of Tasmania Postgraduate Seminar Series.
24-29 June	Brianna Thompson (RF, ALF/UOW)	Oral presentation 'Graphene Composites: Biodegradable, Biocompatible and Electronically Conductive' by Brianna Thompson,* Peter C Sherrell, Jonathon Wassei, Richard B Kaner, Gordon G Wallace at NT12 (13th International conference on the Science and Application of Nanotubes), held in Brisbane 24-29 June.
24-29 June	Eoin Murray (RF, Superscience/ UOW)	Oral presentation 'Covalent modification of chemically converted graphene with polycaprolactone to produce conductive and biocompatible composites' at NT12 (13th International conference on the Science and Application of Nanotubes), held in Brisbane 24-29 June.
24-29 June	Pawel Wagner (RF, ACES/UOW)	Oral presentation ' A wet chemical approach towards single-layer graphene' by P Wagner*, D Kiessling, J Malig, R Costa, G Wallace, D Officer, D Guldi at NT12 (13th International conference on the Science and Application of Nanotubes), held in Brisbane 24-29 June.
24-29 June	Willo Grosse (PhD, ACES/UOW)	Poster: 'fabrication and characterisation of chemically converted graphene enzymatic hydrogel electrodes' at NT12 (13th International conference on the Science and Application of Nanotubes), held in Brisbane.
1-2 July	Marc in het Panhuis (ACES CI, UOW)	Invited presentation at OzCarbon conference in Adelaide. This trip was funded by Marc's ARC Future Fellowship.
2-4 July	Brianna Thompson (RF, ALF/UOW)	Oral: 'Graphene: A New Bionic Platform' by Brianna C. Thompson*, Peter C. Sherrell, Jonathan Wassei, Eoin Murray, Sepidar Sayyar, David L. Officer, Richard B. Kaner, Gordon G. Wallace presented at the 2012 International NanoMedicine Conference, held at Coogee Beach, Sydney.
2-4 July	Robert Gorkin (RF, ALF/UOW)	Oral presented ACES/IPRI new printing capabilities and recent results in additive fabrication in an oral entitled '3D Fabrication of Bioscaffolds for Regenerative Medicine' at the 2012 International NanoMedicine Conference, held at Coogee Beach, Sydney.
16 July	Joseph Giorgio (PhD, ACES/UOW)	PhD candidate attended the 'concentrating solar power research' showcase hosted by Australian Solar Institute at ANU in Canberra. Whilst there Joseph presented in the 3 minute solar thesis challenge and can be viewed online at: http://youtube/Ec-nbigVRwM

DATE	NAME/AFFILIATION	DESCRIPTION
20-22 July	Frederic Gilbert (RF, ACES/UTas)	Oral: Presented 'Treating aggressive criminal conduct by using medical-brain-devices: Any ethical issues ahead?' by Gilbert, F. at the Australian Society of Legal Philosophy Conference, Macquarie University, Sydney.
25-27 July	Antonio Paolini (ACES CI, La Trobe) Ben Allitt (ACES PhD, La Trobe)	Attended the Garnett Passe Frontiers 2012 Conference in Melbourne. This conference concentrates on the advancement of Otorhinolaryngology, from both its clinical and basic science aspects.
18 Aug	Prof Mark Cook (PI, ACES/St Vincents)	Prof Mark Cook gave an invited talk at the Monash Leadership Seminar held in Melbourne on 18 August entitled 'How to be a leader in your career'.
20-22 Aug	Catriona Sinclair (RF, ACES/SHVM)	Presented both an oral and poster presentation for St Vincent's Hospital Research Week 2012 entitled "The Effects of Nanostructured Scaffolds and Electrical Stimulation on Neurite Growth".
20-22 Aug	Tharun Mysore (ECR, SHVM) Magdalena Kita (RA, SHVM)	Oral and poster presentations for St Vincent's Hospital Research Week 2012: "Multimodal biodegradable alginate fibre conduit for muscle regeneration".
20-22 Aug	Anita Quigley (RF, SHVM) Magdalena Kita (RA, SHVM)	Oral and poster presentations for St Vincent's Hospital Research Week 2012: "Electrical stimulation of primary murine myoblasts on aligned nanostructured conductive polymer platforms".
2-8 Sept	Tracey Clarke (ARC Fellow, UOW)	Oral entitled 'Significantly reduced bimolecular recombination in a silole-based donor/ acceptor polymer blended with PCBM' by Tracey Clarke*, Deanna Rodovsky, Andrew Herzing, Jeff Peet, Gilles Dennler, Dean Delongchamp, Christoph Lungenschmied, Attila Mozer presented at International Organic Solar Cells Conference IOESC 2012 held at Coolum Beach Queensland.
2-8 Sept	Attila Mozer (ARC Fellow, UOW)	Oral at International Organic Solar Cells Conference IOESC 2012 held at Coolum Beach Queensland.
7 Sept	Eliza Goddard (PhD, UTas)	Poster presentation and defence 'Impacts of Nanobioncs on Selfhood', University of Tasmania Graduate Research SEIR Conference.
23-26 Sept	Sepidar Sayyar (PhD, ACES/UOW)	Oral presentation by PhD candidate at AMPT 2012 conference held in Wollongong entitled 'Extrusion printed graphene/ polycaprolactone/ composites for Tissue Engineering'.
10-11 Oct	Fengling Zhou (PhD, ACES/Monash)	Presented at poster "Metal Oxide Catalysts for Photo-electrochemical Water Splitting" at the AIE Postgraduate Student Energy Awards 2012 & the All-Energy Exhibition and Conference, Melbourne.
25-26 Oct	Frederic Gilbert (RF, ACES/UTas)	Presented 'Gilbert F., Partridge B., (2012) Football Related-Concussion in Pediatric Athletics' at the 3rd Australian Neurotrauma Symposium, School of Medicine, University of Tasmania, Hobart.
2 Nov	Ben Allitt (PhD, ACES/La Trobe)	Oral for students at the Brain Research (SOBR) conference, held at the Melbourne Brain Centre.
11-14 Nov	Sina Jamali (PhD, UOW/IPRI)	Present research on 'In vitro studying corrosion behaviour of bio-corrodible Mg alloys' at the ACA annual conference, Corrosion & Prevention 2012, 11-14 November, Melbourne; followed by a visit to the Deakin node of ACES to discuss further collaborations.

Appendix 7: 2012 ACES Media Summary

118 media interest stories were published (40 print, 51 online/web, 19 radio and 8 TV) in 2012: summary listed below. All the media stories were positive.

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
08 Jan 12	print	The Age	Geoff Spinks' carbon nanotube yarn torsional actuators research featured in a highlights package of 2011 research	Stephen Cauchi & Tim Thwaites	
19 Jan 12	web	Clarity Centre for Sensor Web Technologies	Clarity PI appointed to International Advisory Board for the Australian ACES Centre: Dermot Diamond appointed to ACES IAB		http://www.clarity-centre.org/content/clarity-pi-appointed-international-advisory-board-australian-aces-centre
01 Feb 12	print	UOW RAID News	Breakthrough ink for spinal cord repair - article featuring Gordon Wallace		
01 Feb 12	print	UOW RAID News	IPRI comes of age - Intelligent Polymer Research Institute turns 21		
01 Feb 12	print	UOW RAID News	Events notices: Processing and Fabrication Symposium and Leon Kane-Maguire Address		
03 Feb 12	web	Cosmos Magazine	Toughest fibre ever created in lab - story on Geoff Spinks' research	Renae Soppe	http://www.cosmosmagazine.com/news/5246/toughest-known-fibre
06 Feb 12	web	Australian Popular Science	Aussies help create new material from graphene that is tougher than kevlar		http://www.popsci.com.au/technology/military/aussies-help-create-new-material-from-graphene-that-is-tougher-than-kevlar
07 Feb 12	print	Illawarra Mercury	Scientists spinning tough stuff - news story about Geoff Spinks' research on tough graphene	Michelle Hoctor	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL1202078J501 2FABQI
10 Feb 12	web	iC news	iC Theatre named in honour of late Leon Kane-Maguire		http://www.innovationcampus.com.au/news/ic-theatre-named-in-honour-of-late-leon-kane-maguire/

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
13 Feb 12	web	ANFF Newsletter Summer 2012	Artificial muscles could propel nano-robots through blood: Twisting artificial muscles		http://www.anff.org.au/sites/all/files/anff-newsletter-summer-2012.pdf
26 Feb 12	radio	3AW, Melbourne	Mark Cook 'Talking Health' with Dr Sally Cockburn. Dr Sally Cockburn, known in the media also as Dr Feelgood, is Australia's leading health communicator. She is a GP with over 25 years' experience as a medical practitioner and over 18 years as a media presenter on TV, radio and in print.	Dr Sally Cockburn	http://www.3aw.f2.com.au/Podcast/Feeds/66.xml
28 Feb 12	web	iC news	New Bionic devices a reality? New Ink formulation to print platforms for nerve repair		http://www.innovationcampus.com.au/news/new-bionic/
01 Mar 12	print	UOW RAID news	Researchers develop bullet proof graphene - story on Geoff Spinks' tough fibres research		
01 Mar 12	print	UOW RAID news	Utilising sunlight to convert water into cleaner, greener fuels - story on global water splitting consortium		
01 Mar 12	print	UOW RAID news	5 minute with Attila Mozer - profile story		
02 Mar 12	print	Illawarra Mercury	UOW makes advances in nerve repair: New Ink formulation to print platforms for nerve repair	Michelle Hoctor	http://www.illawarramercury.com.au/news/local/news/general/uow-makes-advances-in-nerve-repair/2474269.aspx
04 Mar 12	radio	Radio National Future Tense	Maria Forsyth interviews about energy in the future		http://www.abc.net.au/radionational/programs/futuretense/energy-efficiency3dnew-technology-2b-people/3857446
06 Mar 12	web	Deakin University website	Maria Forsyth and team featured in story about green energy		http://deakin.edu.au/research/stories/2012/03/06/sodium-the-new-lithium
07 Mar 12	print	Illawarra Mercury	Prof Gerry Swiegers interviewed about water splitting technology	Kate McIlwain	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL120307CI6LD6R5FNL
09 Mar 12	web	sustainabilitymatters.net.au	Using sunlight to split water - news story on global water splitting consortium		http://www.sustainabilitymatters.net.au/news/51747-Using-sunlight-to-split-water-

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
14 Mar 12	web	Ecogeneration.com.au	NSW Scientists split water to cut emissions		http://ecogeneration.com.au/news/nsw_scientists_split_water_to_cut_emissions/066870/#
16 Mar 12	print	Illawarra Mercury	How to turn the best ideas into dollars - Report on event - Processing and Fabrication Symposium	Greg Ellis	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL120316FH4FA5A1K1N
19 Mar 12	web	Desalination.biz	Multinational consortium works on water-splitting prototype		http://www.desalination.biz/news/news_story.asp?id=6418
22 Mar 12	web	YouTube	Prof David Officer featured in a UOW YouTube video		http://www.youtube.com/watch?v=VjOK5SmLXNk
23 Mar 12	web	UOW media	Electromaterials students to ACE intern opportunity. Feature about ACES new interns participating in a new program funded under the ALF.	Jenna Bradwell	http://media.uow.edu.au/news/UOW121340.html
24 Mar 12	print	Illawarra Mercury	ACES mentioned in an article about UOW going from strength to strength	Michelle Hoctor	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL120324IC6GH17CPSP
06 Apr 12	print	Illawarra Mercury	AdFab manufacturing renewal - new story on the AdFab2012 conference	Greg Ellis	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL1204067K7LF6GHJQN
12 Apr 12	print	Illawarra Mercury	Upcoming event - Additive Fabrication conference		
19 Apr 12	web	UOW media	AdFab promises a manufacturing renewal		http://media.uow.edu.au/news/UOW122829.html
28 Apr 12	TV	WIN news	Gordon Wallace and Brianna Thompson interviewed about launch of ALF bionics project		
28 Apr 12	print	Illawarra Mercury	Gordon Wallace interviewed about launch of ALF bionics project	Bevan Shields	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL1204289F3CI7SS057

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
30 Apr 12	web	UOW media	$4.7 million Laureate research seeks medical bionics breakthroughs		http://media.uow.edu.au/news/UOW123189.html
01 May 12	print	Cosmos Magazine	Lab make world's toughest fibre - featuring Geoff Spinks, Sanjeev Gambhir and Gordon Wallace pictured.		
01 May 12	print	UOW RAID News	Profs Gordon Wallace and Marc Cook featured in story on TEDxUWollongong		
01 May 12	print	UOW RAID News	Pioneers launch first ever organic bionics reference book		
07 May 12	web	NanoMelbourne.com	Prof David Officer appeared in a story about Kim Beazley welcoming 30 of Australia's leading nanotech researchers to Washington DC for a week long meeting with US defense force agencies.		http://nanomelbourne.com/news/article/australian-nanotechnology-scientists-to-help-us-defense-force-research-agencies-in-solving-tough-challenges/
10 May 12	radio	ABC North and West SA	Gordon Wallace interviewed about 3D printing		
11 May 12	print	Cosmos Magazine	Marc in het Panhuis on nanoparticles and carbon nanotubes		http://www.cosmosmagazine.com/news/5574/nanoparticles-found-our-daily-food
13 May 12	web	Adelaide Now	Study of young footballers' brains - Frederic Gilbert's research	Adam Hegarty	http://www.adelaidenow.com.au/study-of-young-footballers-brains/story-e6frea8c-1226354267949
14 May 12	radio	ABC AM	Big hits and head injuries in sport - Frederic Gilbert's research	Lindy Kerin	http://www.abc.net.au/am/content/2012/s3501896.htm
14 May 12	print	Herald Sun	Head Injuries in sport spark safety debate - Frederic Gilbert's research	Lucie van den Berg	http://www.heraldsun.com.au/news/victoria/head-injuries-in-sport-spark-safety-debate/story-fn7x8me2-1226354332836
14 May 12	web	news.com.au	Footy codes warned on head knocks - Frederic Gilbert's research on footballing head injuries featured.		http://www.news.com.au/national/footy-codes-warned-on-head-knocks/story-fn7mjqus-1226354378821
14 May 12	web	The Conversation	ACES research fellow Frederic Gilbert co-authors a blog - Correcting our blurred vision on football concussions	Frederic Gilbert	http://theconversation.edu.au/correcting-our-blurred-vision-on-football-concussions-6926
16 May 12	web	Chemistry World	Prof Geoff Spinks quoted in an article - 'Polymer gel squeezes and strains like an intestine'		http://www.rsc.org/chemistryworld/News/2012/May/belousov-zhabotinsky-reaction-artificial-intestine.asp
21 May 12	web	UOW media	TEDx comes to UOW - Gordon Wallace mentioned in a story about TEDxUWollongong		http://media.uow.edu.au/news/UOW124230.html

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
22 May 12	web	Platinum Today	Prof Geoff Spinks quoted in an article - 'Ruthenium catalyst used to create intestine-like gel'		http://www.platinum.matthey.com/news-archive/ruthenium-catalyst-used-to-create-intestine-like-gel/801367331.html
23 May 12	web	The Concussion Blog	Rugby Concussion Discussion - featuring Frederic Gilbert's footballers' concussion research		http://theconcussionblog.com/2012/05/23/rugby-concussion-discussion/#comments
31 May 12	TV	ABC newsline	Mark Cook featured on Australia networks newsline		
01 Jun 12	print	Chemistry in Australia	Bullet Proof Graphene		
06 Jun 12	web	Nanowerk	Report on the biophysical research activities of Dr Michael Higgins		http://www.nanowerk.com/news/newsid=25563.php
06 Jun 12	print	NanoQ	Twisting Artificial Muscles	Hayley	
07 Jun 12	print	Dubbo Weekender	Geoff Spinks, Sanjeev Gambhir and Gordon Wallace included in a story about nanotechnology, for their strong graphene research		
30 Jun 12	web	Science in Public	On-demand Epilepsy Drug - profile of Simon Moulton's research		http://www.scienceinpublic.com.au/stories/2012/epilepsy-drug-031/
01 July 12	web	ANFF newsletter July 2012	Science and Technology - mending broken nerves with a 3D printer		http://www.anff.org.au/sites/all/files/anff-newsletter-winter-2012.pdf
05 July 12	web	Voice of America	Gordon Wallace interviewed for a story on research featured at Nanomedicine conference	Phil Mercer	http://www.voanews.com/content/australian-nanomedicine-conference-targets-radical-diseases/1363726.html
12 July 12	web	UOW media	Targeted drug delivery for epilepsy - features Marc Cook		http://media.uow.edu.au/news/UOW128819.html
13 July 12	web	Innovation Campus News	Story on Nanotechnology exhibit opening		http://www.innovationcampus.com.au/news/nano/
14 July 12	radio	Radio National The Science Show	Printing nerve and muscle cells to repair damaged tissue - Prof Gordon Wallace interviewed	Robyn Williams	http://www.abc.net.au/radionational/programs/scienceshow/printing-nerve-and-muscle-cells-to-repair-damaged-tissue/4129474
15 July 12	web	UOW media	Bionics book praised by Prof Clarke - story on the new ACES Organic Bionics book		http://media.uow.edu.au/news/UOW126297.html
16 July 12	web	UOW media	Come and take a NANO look into the future - story about upcoming Nanotechnology exhibit launch co-developed by ACES		http://media.uow.edu.au/news/UOW128791

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
17 July 12	radio	ABC Illawarra	ACES PhD student Willo Grosse and Australia's Chief Scientist Prof Ian Chubb interviewed about the ACES' nanotech exhibit launch	Tony Arthur	
17 July 12	TV	WIN news	ACES PhD student Willo Grosse and Australia's Chief Scientist Prof Ian Chubb and Wollongong Science Centre Director Glen Moore interviewed about the new nanotech exhibit	Natassia Apolloni	
18 July 12	Print	Illawarra Mercury	UOW exhibition turns microscope on nanotechnology - news story about opening of nanotech exhibit at Wollongong Science Centre	Kate McIlwain	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=electromaterials+science&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=ILL1207188FEI25GORQ7
18 July 12	web	UOW Media	Australia's chief scientist opens nanotechnology exhibition		http://media.uow.edu.au/news/UOW129212.html
24 July 12	print	The Age	An electric idea - story about PhD student Tristan Simon's Three Minute Thesis university final win		http://www.theage.com.au/national/education/an-electric-idea-20120723-22k7w.html
25 July 12	radio	ABC Illawarra	Prof Marc in het Panhuis interviewed on nanomaterials research and safety.	Presenter Fiona Poole	
26 July 12	radio	ABC Statewide Afternoons	Prof Marc in het Panhuis interviewed on nanoparticles and nanomaterials		
28 July 12	radio	Radio National The Science Show	Batteries for solar and wind generators - Tristan Simon's Three Minute Thesis presentation		http://www.abc.net.au/radionational/programs/scienceshow/batteries-for-solar-and-wind-generators/4159740
30 July 12	web	Monash University news	Prof Doug MacFarlane awarded Australian Laureate Fellowship		http://www.monash.edu.au/news/show/three-australian-laureate-fellowships-for-monash
01 Aug 12	print	UOW RAID News	Prof Marc Cook featured in story about TEDx and epilepsy project		
01 Aug 12	print	UOW RAID News	Story on Nanotechnology exhibit opening		
01 Aug 12	print	UOW RAID News	Story on ACES PhD student Joseph Giorgio winning grant for his solar cells work		
01 Aug 12	print	UOW RAID News	2012 Bill Wheeler Symposium and IPRI Open Day - upcoming events		

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
08 Aug 12	web	UOW media	Community offers critical support for young researchers - Bill Wheeler award story		http://media.uow.edu.au/news/UOW130805.html
10 Aug 12	print	Australian Doctor Magazine	Featured Mark Cook with article on 'Getting ahead of epilepsy'		
23 Aug 12	web	UOW media	IPRI a global drawcard for students		http://media.uow.edu.au/news/UOW132423.html
28 Aug 12	radio	ABC Gippsland	Prof Wallace interviewed about the future of electromaterials in clothing.	Presenter Gerard Callinan	
04 Sept 12	web	YouTube	Gordon Wallace and Mark Cook featured in a DIISTRE video project called Decoding Nano		http://www.youtube.com/watch?v=dMZphr05rDY
06 Sept 12	web	UOW media	research team unveils advance in medical biotechnology - story on Marc in het Panhuis' published hydrogels research		http://media.uow.edu.au/news/UOW133379.html
10 Sept 12	web	Cosmos Magazine	Gordon Wallace featured in the Cosmos iPad edition on bionics		http://www.cosmosmagazine.com/5960/cosmos-plus-2-more-than-human
11 Sept 12	print	Illawarra Mercury	Prof Marc in het Panhuis interviewed about hydrogels		http://www.illawarramercury.com.au/story/315127/uow-develops-gel-to-replicate-human-tissue/?src=rss
14 Sept 12	radio	ABC Illawarra	Prof Marc in het Panhuis interviewed in studio about hydrogels	Presenter Nick Rheinberger	http://www.facebook.com/media/set/?set=a.422531014459424.91839.134867026559159&type=1
15 Sept 12	print	Kiama Independent	Willo Grosse interviewed about the Bill Wheeler Award		
17 Sept 12	radio	ABC Illawarra	Sue Dodds and Gordon Wallace interviewed about Bionics research and the role of Ethics	Presenter Nick Rheinberger	
17 Sept 12	web blog	The Bulli Times	Ethics public engagement event write-up		http://thebullitimes.com/tag/ethics-program-at-the-arc-centre-of-excellence-for-electromaterials-science/
18 Sept 12	web	ABC Science	Marc in het Panhuis' hydrogels research featured	Stuart Gary	http://www.abc.net.au/science/articles/2012/09/18/3588700.htm
19 Sept 12	radio	ABC Adelaide	Marc in het Panhuis interviewed about hydrogels research	Presenter Deb Tribe	
19 Sept 12	print	Kiama Independent	Marc in het Panhuis interviewed about hydrogels research		

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
20 Sept 12	TV	WIN News	Gordon Wallace interviewed about research being presented at the Symposium on Nanobionics		
21 Sept 12	print	Illawarra Mercury	Gordon Wallace interviewed about epilepsy seizure prevention research		http://www.illawarramercury.com.au/story/346339/bionic-implant-offers-epilepsy-hope/
22 Sept 12	print	Sydney Morning Herald	Prof Geoff Spinks interviews about nanotechnology	Keeli Cambourne	http://newsstore.smh.com.au/apps/viewDocument.ac?page=1&sy=afr&kw=intelligent+polymer+research+institute&pb=all_ffx&dt=selectRange&dr=1year&so=relevance&sf=text&sf=headline&rc=20&rm=200&sp=nrm&clsPage=1&docID=SMH120922I57EK3CICM9
23 Sept 12	radio	ABC NSW	Gordon Wallace interviewed on the epilepsy project	Helen Clare	
25 Sept 12	web	UOW media	New UOW materials used in next generation technologies in Ireland - story featuring David Officer's research visit to Dublin		http://media.uow.edu.au/news/UOW134270.html
26 Sept 12	web	Composites Manufacturing Online	Geoff Spinks, Sanjeev Gambhir and Gordon Wallace included in a story about tough graphene composites	Susan Keen Flynn	http://www.compositesmanufacturingblog.com/2012/09/game-changing-research-tough-luck-for-researchers/
01 Oct 12	print	ATSE Focus Magazine	Is technology always interdisciplinary? Review of Organic Bionics book	Ian Rae	
8-13 Oct	radio	ABC Illawarra	Three separate interviews with ACES/IPRI PhD students were recorded and played on air over the course of the week.	Nick Rheinberger	
26 Oct 12	web	Health Canal	UTAS researcher warning on concussion injuries. Frederic Gilbert's research on head injuries.		http://www.healthcanal.com/public-health-safety/33341-UTAS-researcher-warning-concussion-injuries.html
27 Oct 12	web	ABC news	Head Injury Concerns. Frederic Gilbert's research on head injuries.		http://www.abc.net.au/news/2012-10-27/research-shows-head-injury-risks/4337078
27 Oct 12	print	The Examiner	Head-knock warning. Frederic Gilbert's research on head injuries.	Alex Fair	http://www.examiner.com.au/story/425201/head-knock-warning/
30 Oct 12	TV	Channel 9 – A Current Affair	A current affair featured Mark Cook talking about 'Getting ahead of epilepsy'		
07 Nov 12	web	Chemistry World	Marc in het Panhuis work as a Highlight in Chemistry World- on printing living cells – Bionics		http://www.rsc.org/chemistryworld/2012/10/bio-ink-print-living-cells

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07 Nov 12	TV	Southern Cross News	Football related concussion in pediatric athletics warning - Frederic Gilbert's research		http://www.youtube.com/watch?v=W2xbkyKgWr0&feature=youtube
12 Nov 12	TV	WIN News	Boeing flies into Wollongong - Gordon Wallace interviews on visit by Boeing research team	Natassia Apolloni	
15 Nov 12	web	UOW media	New bio-inks formulation for printing living cells - Cameron Ferris' research		http://media.uow.edu.au/news/UOW136812.html?utm_medium=banner&utm_campaign=spot_1&utm_source=uow_home
16 Nov 12	radio	WaveFM	Small muscles to have big impact on smart materials - Geoff Spinks interviewed about Hybrid yarn artificial muscles published in Science	Jocelyn	
16 Nov 12	web	Cosmos Magazine	Small muscles to have big impact on smart materials - Geoff Spinks interviewed about Hybrid yarn artificial muscles published in Science	Gemma Black	http://www.cosmosmagazine.com/news/6162/carbon-nanotubes-with-wax-next-step-artificial-muscles
16 Nov 12	radio	ABC Illawarra News	Small muscles to have big impact on smart materials - Geoff Spinks interviewed about Hybrid yarn artificial muscles published in Science	Emily	
16 Nov 12	web	ANFF news	Small muscles to have big impact on smart materials - Geoff Spinks interviewed about Hybrid yarn artificial muscles published in Science	Warren McKenzie (published press release)	www.anff.org.au
17 Nov 12	print	Illawarra Mercury	Small muscles to have big impact on smart materials - Geoff Spinks interviewed about Hybrid yarn artificial muscles published in Science	Chris Paver / Lisa Wachsmuth	
18 Nov 12	print	Connect: Research & Innovation News UOW	Student profile of Cathal O'Connell, who is interviewed about creating bionic devices so small they can plug into individual brain cells	Elise Pitt	
Dec 12	print	2012 Stories of Australian Science Magazine	Gordon Wallace featured in 'The smallest devices transform science and art' with story on 'made to order:printing of live cells'	Science in Public	

DATE	MEDIUM	SOURCE	DESCRIPTION	JOURNALIST	PAGE#/WEB LINK
11 Dec 12	web	UOW media	Scholarship opportunity gets student's hands on antimicrobial coating research - article about joint ACES/ BlueScope Steel summer scholarships		http://media.uow.edu.au/news/UOW138494.html
12 Dec 12	web	UOW media	'AquaHydrex' company a commercial first for Innovation Campus - article about first ACES spin-out company		http://media.uow.edu.au/news/UOW138920.html?ssSourceSiteId=UOW_Main
18 Dec 12	TV	SBS World news	Featured Mark Cook commenting on 'Anti-gambling' pill goes to trial'		
20 Dec 12	web	UOW media	Medical Bionics forges new links with China - article about Collaborations in Medical Bionics workshop held in Beijing, China (8.12.12)		http://media.uow.edu.au/news/UOW139848.html
31 Dec 12	web	PCB007	Print materials for soft robotics - Marc in het Panhuis quoted about his research paper in the publication 'Advanced Functional Materials (issue 22)		http://www.pcb007.com/pages/zone.cgi?a=88902&artpg=1&topic=17

Appendix 8: ACES Staff Membership

Researchers

In 2012 ACES membership comprised of 17 Chief Investigators, 1 Partner Investigator, 1 Chief Operating Officer, 2 part-time Director Strategic Development Officers and 34 research fellows (plus another 5 funded by ARC Laureate Fellowships who collaborate closely with ACES staff and students); who are listed by name below.

Chief and Partner Investigators

- Professor Gordon Wallace
  Executive Research Director and ARC Laureate
  University of Wollongong
- Professor Maria Forsyth
  Deputy Research Director and ARC Laureate
  Deakin University
- Professor David Officer
  Materials Program Leader
  University of Wollongong
- Professor Douglas MacFarlane
  Energy Program Leader
  Monash University
- Professor Robert Kapsa
  Bionics Program Leader
  St Vincents Health Melbourne
- Professor Susan Dodds
  Ethics Program Leader
  University of Tasmania
- Professor Will Price
  Education Program Leader
  University of Wollongong
- Professor Gursel Alici
  Chief Investigator Bionics
  University of Wollongong
- Professor Hugh Brown
  Chief Investigator Materials
  University of Wollongong
- Professor Mark Cook
  Partner Investigator Bionics
  St Vincent's Health, Melbourne
- Assoc Prof Peter Innis
  Chief Investigator Materials
  University of Wollongong
- Assoc. Professor Paul Keller
  Chief Investigator Materials
  University of Wollongong
- Professor Hua Kun Liu
  Australian Professorial Fellow (AFP), Chief Investigator Energy
  University of Wollongong
- Assoc Prof Marc in het Panhuis
  Future Fellow, Chief Investigator Materials
  University of Wollongong
- Assoc Prof Antonio Paolini
  Chief Investigator Bionics
  La Trobe University
- Dr Jenny Pringle
  Chief Investigator Energy
  Monash University
- Professor Leone Spiccia
  Chief Investigator Energy
  Monash University
- Professor Geoffrey Spinks
  Australian Professorial Fellow (AFP), Chief Investigator Bionics
  University of Wollongong

Research Fellows

- Dr Amy Ballentyne (ECR)
  Energy
  University of Wollongong
- Dr Paul Bayley (ECR)
  Energy, Laureate Fellowship
  Deakin University
- Dr Fangfang Chen
  Energy, Laureate Fellowship
  Deakin University
- Dr Jun Chen
  Energy
  University of Wollongong
- Dr Johnson Chung (ECR)
  Superscience Fellow, Bionics
  University of Wollongong
- Dr Jim Efthimiadis
  Materials
  Deakin University
- Dr Babita Gaihre (Jan-August)
  Bionics
  University of Wollongong
- Dr Frederic Gilbert (ECR)
  Ethics
  University of Tasmania
- Dr Kerry Gilmore
  Bionics
  University of Wollongong
- Dr Robert Gorkin III (ECR)
  Bionics, Laureate Fellowship
  University of Wollongong
- Dr Alex Harris (ECR)
  Bionics
  La Trobe University
- Dr Michael Higgins
  Australian Research Fellow (ARF), Bionics
  University of Wollongong
- Dr Matthias Hilder (ECR)
  Materials
  Monash University
- Dr Rosalie Hocking (0.2FTE)
  Energy
  Monash University
- Dr Patrick Howlett
  Materials / Energy
  Deakin University
- Dr Alexey Izgorodin (ECR)
  Energy
  Monash University
- Rouhollah Jalili (April-Dec, ECR)
  Materials
  University of Wollongong
- Dr Judith Janikowski
  Materials
  Monash University
- Dr Byul Chung Kim (0.2 FTE)
  Energy
  University of Wollongong
- Dr Julie Locke (Jan-Oct)
  Materials
  University of Wollongong
- Dr Simon Moulton
  QEII Fellow, Bionics
  University of Wollongong
- Dr Attila Mozer
  Australian Research Fellow (ARF), Energy
  University of Wollongong
- Dr Eoin Murray (ECR)
  Superscience Fellow, Materials/Bionics
  University of Wollongong
- Dr Tharun Mysore (Jan-Aug, ECR)
  Bionics
  St Vincent's Hospital Melbourne
- Dr Sina Naficy (ECR)
  Materials
  University of Wollongong
- Dr Katherine Nairn
  Energy
  Monash University
- Dr Chuc Nuygen
  Bionics
  University of Wollongong
- Dr Cristina Pozo-Gonzalo
  Energy
  Deakin University
- Dr Joselito Razal
  Bionics
  University of Wollongong
- Dr Sureyya Saricilar (Jan-June)
  Materials
  University of Wollongong
- Catriona Sinclair
  Bionics
  St Vincent's Hospital Melbourne
- Dr Brianna Thompson (ECR)
  Bionics Laureate Fellowship
  University of Wollongong
- Dr Klaudia Wagner (0.2FTE)
  Energy
  University of Wollongong
- Dr Pawel Wagner
  Materials
  University of Wollongong
- Dr Caiyun Wang
  Energy
  University of Wollongong
- Dr Andreas Wortmann (ECR)
  Bionics Laureate Fellowship
  University of Wollongong
- Dr Derrick Weis
  Energy
  Monash University
- Dr Orawan Winther-Jensen
  APD Fellow Energy
  Monash University

Business Team

- Dr Toni Campbell
  Chief Operating Officer
  University of Wollongong
- Mr Chris Gilbey (0.5 FTE)
  Director of Strategic Development
  University of Wollongong
- Dr Bridget Munro
  Director of Strategic Development
  University of Wollongong

Communications

- Ms Natalie Foxon
  (0.6 FTE ACES, 0.2 FTE ARC Laureate)
  Communications & Media Officer
  University of Wollongong

Appendix 9: 2012 ACES PhD Student Roll

In 2012, ACES has 40 PhD students enrolled, of which 29 are international students. In addition there were 7 new PhD students, courtesy of 2 ARC Laureate Fellowships to Prof Gordon Walalce and Prof Maria Forsyth, who collaborate closely with ACES students and staff (they are not listed below).

10 PhD students graduated in 2012, of which 7 were international.

STUDENT	COUNTRY OF ORIGIN	UNIVERSITY	THESIS TITLE	ACES SUPERVISOR	FINANCIAL ARRANGEMENT
1. Abraham, Ted (start 2010)	Canada	Monash	Ionic liquids in thermocells	Doug MacFarlane, Jenny Pringle	Scholarship alternative source/ ACES project.
2. Allitt, Ben (start 2010)	Australia	La Trobe	Micro stimulation of the cochlea: implications for better speech perception in background noise and music perception using cochlear implants	Antonio Paolini/ Graeme Clark	Scholarship alternative source/ ACES project.
3. Boskovic, Danijel (start 2011)	Australia	Wollongong	Developing and Studying Molecular Machines	Gerry Swiegers/ Jun Chen	Scholarship alternative source / ACES project
4. Chen, Yu (start 2012)	China	Wollongong	Fabrication of 3-dimentional polymeric drug delivery materials.	Simon Moulton / Gordon Wallace	Chinese Scholarship/ ACES project
5. Esrafilzadeh, Dorna (start 2009)	Iran	Wollongong	Conducting Fibres for Actuating and Release	Gordon Wallace, Joselito Razal, Simon Moulton	Scholarship alternative source/ ACES project.
6. Fekete, Monika (start 2010)	Hungary	Monash	Photoanodes for water splitting applications	Leone Spiccia	Scholarship alternative source/ ACES project.
7. Ferris, Cameron (start 2009)	Australia	Wollongong	Fabrication of 3D, cell-laden architectures by the controlled deposition of biopolymers, conducting polymers, cells and bio-molecules for the engineering of cardiac tissue.	Gordon Wallace, Kerry Gilmore	APA/ ARC top up ACES project
8. Giorgio, Joseph (start 2011)	Australia	Wollongong	Light weight and flexible solid state dye sensitised solar cells	David Officer	APA/ACES project
9. Goddard, Eliza (start 2010)	Australia	Tasmania	The Bionic Self - Implications of Bionics for Selfhood and Social Relations	Susan Dodds	ACES
10. Grosse, Willo (start 2010)	Australia	Wollongong	Controlled drug release powered by enzyme based bioelectrodes	Gordon Wallace, Simon Moulton	ARC Discovery

STUDENT	COUNTRY OF ORIGIN	UNIVERSITY	THESIS TITLE	ACES SUPERVISOR	FINANCIAL ARRANGEMENT
11. Gustafson, Matt (start 2011)	Australia	Monash	Investigation of photostimulated conducting polymer heterojunctions exhibiting electrocatalytic properties and their effectiveness in water oxidation	Doug MacFarlane	ACES
12. He, Jiangjing (start 2011)	China	Monash	Development of alternative counter electrode materials for dye sensitised solar cells	Jenny Pringle, Yi-Bing Cheng	Scholarship alternative source/ ACES project.
13. Iranipour, Nahid (start 2012)	Iran	Deakin	Novel Organic Ionic Plastic Crystal Electrospun Nanofibers Composites: Transport Behavior, Battery Applications	Maria Forsyth, Patrick Howlett	Scholarship alternative source/ ACES project.
14. Ishan, Mohammed (start 2012)	Thailand	Wollongong	Development of novel LI-based biodegradable polymer electrolyte for solid state rechargeable battery.	Hua Liu	ADS scholarship/ ACES project and support
15. Jennepali, Sreenu (start 2010)	India	Wollongong	The Synthesis of an Amino Acid/Fullerene Derivative for Potential use in Organic Solar Cell Applications	Paul Keller	ACES
16. Joeng, Hyeon (Jerry) (start 2011)	Korea	Wollongong	Fabricate Flexible Capacitor Using Nanocarbon Materials such as Nanotube and Graphene.	Gordon Wallace, Michael Higgins	ACES
17. Joshi, Tanmaya (start 2008)	India	Monash	Ruthenium metal complexes for biosensor applications	Leone Spiccia	Scholarship alternative source/ ACES project.
18. Jin, Liyu (Leo) (start 2011)	China	Monash	Organic Ionic Plastic Crystal Electrolytes	Jenny Pringle, Maria Forsyth, Patrick Howlett	Scholarship alternative source/ ACES project/ ACES top-up.
19. Kar, Mega (start 2011)	India	Monash	Novel Ionic Liquids for Zinc-Air Rechargeable Batteries	Doug MacFarlane	ACES
20. Kerr, Robert (start 2010)	Australia	Monash	Electrodes for Electrocatalysis	Doug MacFarlane	Scholarship alternative source/ ACES project/ ACES top-up.
21. Kirchmajer, Damian (start 2010)	Australia	Wollongong	Hydrogel based materials for bionics and tissue engineering	Marc in het Panhuis	ACES
22. Li, Sha (Esther) (start 2011)	China	Wollongong	Biocompatible Materials for Batteries	Hua Liu	ACES
23. Noerchim, Lukman (start 2009)	India	Wollongong	All solid-state lithium rechargeable battery	Hua Liu	UOW Matching scholarships/ARC Centre grant
24. O Connell, Cathal (start 2009)	Ireland	Wollongong	The effects of electromechanical stimulation and controlled drug release on muscle cell growth	Gordon Wallace, Michael Higgins	Scholarship alternative source/ ACES project.

STUDENT	COUNTRY OF ORIGIN	UNIVERSITY	THESIS TITLE	ACES SUPERVISOR	FINANCIAL ARRANGEMENT
25. Rahman, Md. Mokhlesur (start 2009)	India	Wollongong	Advanced Electrodes materials for Li-ion batteries	Hua Liu	UoW Scholarship/ ACES project
26. Roach, Nicholas (start 2011)	Australia	Wollongong	Artificial photosynthesis: Developing amphiphilic porphyrins for biomimetic structures.	David Officer, Pawel Wagner	ACES
27. Romano, Mark (start 2010)	Phillippines	Wollongong	Nanostructured Electromaterials for Thermal Harvesting System	Gordon Wallace, Jun Chen	Scholarship alternative source/ ACES project.
28. Sae-Kung, Chaiyuth (start mid 2012)	Thailand	Wollongong	Air and water stable polymer hybrid solar cells and their application to solar driven water splitting and fuel production	Attila Mozer	Thai scholarship/ ACES project
29. Sayyar, Sepidar (start 2010)	Iran	Wollongong	Development of novel polymer composites	David Officer	APA & IPTA Scholarship/ ACES project
30. Seyedin Ziabari, Mohammad Shayan (start 2010)	Iran	Wollongong	Reactive spinning of polymer systems	Gordon Wallace, Joselito Razal	UPA & IPTA Scholarship/ ACES project
31. Shu, Kewei (start 2011)	China	Wollongong	Carbon nanotubes / graphene composites and their application in energy storage	Gordon Wallace	China scholarship/ ACES project
32. Simons, Tristan (start 2011)	Australia	Deakin	Ionic liquid electrolytes for secondary zinc-air batteries	Maria Forsyth	Scholarship alternative source/ ACES topup and project
33. Singh, Archana (start 2009)	India	Monash	Revolutionary Manganese Clusters as Efficient Water Oxidation Catalysts	Leone Spiccia	Scholarship alternative source/ ACES project
34. Sullivan, Ryan (start 2011)	USA	Wollongong	Engineering biomimicry neural interfaces	Gordon Wallace	ACES
35. Tong, Lei (start 2010)	China	Wollongong	High Performance Research of Conducting Polymer Composites for Water Splitting	Gordon Wallace, Attila Mozer	ACES
36. Tubaford, Solmaz (start 2009)	Iran	Monash	Development of Bistridentate Ruthenium (II) polypyridyl complexes for Biological Application Based on PNA	Leone Spiccia	ACES
37. Yan, Jenny (start 2012)	China	Deakin	Magnesium-Air batteries using Ionic Liquids as electrolytes	Maria Forsyth	ACES
38. Yang, Yang (start 2010)	China	Wollongong	Develop innovative material for bio-batteries research	Gordon Wallace	UOW/ACES
39. Zhao, Chen (start 2012)	China	Wollongong	Stretchable electrode and electrolyte for energy storage devices	Gordon Wallace/ Caiyun Wang	Chinese scholarship/ ACES project
40. Zhou, Fengling (start 2011)	China	Monash	Investigation of inorganic metal oxides as catalysts for photo-electrochemical water splitting	Leone Spiccia, Doug MacFarlane	ACES