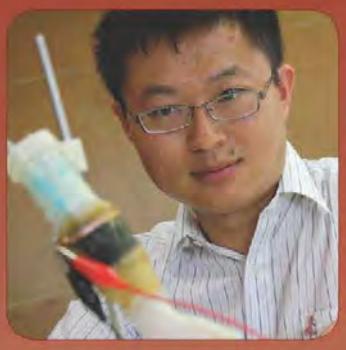
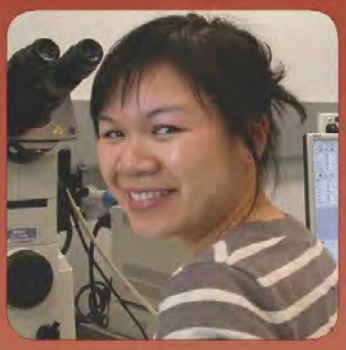




Annual Report 2011

ARC Centre of Excellence for
Electromaterials
Science

creating advanced materials

materials synthesis · energy conversion · energy storage · bionics

Contents

Welcome to ACES

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

Our Mission is to expand upon our reputation in electromaterials science and to see the Centre recognised as a world leader in the area.

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.

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 possess key research strengths, which, when combined with one another and developments in nanotechnology, will revolutionise the way we look at materials and future material applications.

Research Programs

The core research programs supported by the ARC Centre of Excellence are four in number: 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 challenge of this electromaterials program is the development of innovative routes to functionalised nanomaterials that enhance both the chemical and physical properties required for the targeted areas. 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 and organic nanostructured electrodes for applications such as solar hydrogen generation and metal/air batteries.

Bionics: The Bionics program continues to exploit 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 will continue its role in developing a critical social and ethical response to the emerging science and its applications.

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 (SLF grant 2010-2013: $360k).

Message from the Director

Our continued success requires the attraction and retention of highly talented researchers and the nurturing of our relationships with external groups. Building effective collaborative research teams requires the identification of the most appropriate people, then patience, persistence... and a lot more patience. We require individuals capable of working across traditional discipline-based research boundaries and with the interpersonal skills required to build and sustain internal and external collaborations.

We at ACES, are acutely aware of the importance of our collaborative activities. As such we have invested substantial time and energy into developing a collaborative culture as well as putting systems in place that allow us to promote and facilitate collaboration internally within ACES and externally, both nationally and internationally.

One could argue that such an approach is not the most effective way to achieve the highest number of publications in high impact journals in the shortest possible timeframe. However, if we wish to achieve realisation of high performance electromaterials for use in the highly diversified and challenging areas of energy and medical bionics, it is the collaborative approach that will ensure the most effective use of resources and that will provide impact beyond scientific journal publications.

The exchange visits by graduate students and early career researchers initiates new lines of thought, establishes new experimental protocols and enriches the research experience.

During 2011 we have made significant inroads on a number of fronts due to the collaborations already established. For example, in our bionics program, studies completed in association with the Bionics Institute in Melbourne, in the area of controlled release were published in the journal ***Biomaterials*** and *in vivo* safety studies on carbon nanotube structures were featured as a cover article in ***Small***.

Novel approaches to printing were developed with the University of Massachusetts and appeared in ***Soft Matter*** and ***Journal of Materials Chemistry***, while ***JACS*** published our collaborative findings on a new photoelectrochemically sensitive platform based on polythiophenes, developed with Dublin City University, in studies of relevance to our Energy Program.

Novel solar cell effects in mixed porphyrin systems were elucidated in work with Shinshu University in Japan and published in ***Applied Physics Letters***, and studies into improved porphyrin based solar cell performance, carried out with ANSTO, featured in the ***Journal of Physical Chemistry***. Important studies on dye sensitised solar cells were also carried out with the Korean Institute of Science and Technology and appeared in ***ACS Applied Materials and Interfaces***.

Findings on novel water splitting catalysts in collaboration with Rutgers University, USA, were published in ***Journal of Molecular Catalysts- A. Chemical*** **and** ***Chemical Science.***

Further, significant outputs from our collaborative research with UCLA, arising from the patterning of nanostructured conducting polymer films using low-energy infrared lasers, were published in ***Nanoletters***. The journal ***Science*** published our studies on novel actuators based on carbon nanotubes developed as part of long standing collaborative relationships with University of Texas at Dallas, Hanyang University in South Korea, and University of British Columbia***..... and these are just some examples!***

MANY EFFECTIVE LONG TERM PARTNERSHIPS HAVE BEEN ESTABLISHED!!

Effective integration of our talented researchers in the global research network will ensure that the most effective approach to tackling the big challenges in electromaterials research is adopted.

Engagement in these networking activities also equips our emerging researchers with skills critical for future success. We consider this as a very important element of our comprehensive PhD and Early Career Researcher training program.

2011 has been an important year in advancing our research. I am confident these advances will be even more significant in 2012 and beyond, as we build on the collaborative research platform that ACES has established. We are proud to have become an important cog in the electromaterials international research community and we are indebted to our many collaborators for making this possible.

As we map our road ahead we can be confident that we have a vibrant and global research network in place that will facilitate and take our research into unchartered waters, to discover the unknown and contribute to global progress in the crucial areas of energy and bionics.

Professor Gordon Wallace

Executive Director ACES.

From the International Advisory Board

The International Advisory Board met on 17 Feb 2012 and reviewed the annual progress of the ARC Centre of Excellence for Electromaterials Science (ACES). Those in attendance were: Dr (Dame) Bridget Ogilvie (Chair), Prof Richard Kaner, Prof Ray Baughman, Prof Dermot Diamond, Prof Tom Kay, Dr Abid Khan, Prof Judy Raper and Prof Lee Astheimer. Profs Siegmar Roth and Keiichi Kaneto provided written feedback to the Centre on progress for 2011 as they were unable to attend the meeting.

The Board congratulated Prof Gordon Wallace and the ACES team on the quality and range of outcomes achieved by the Centre in 2011.

KEY PERFORMANCE MEASURES

The performance of the Centre has exceeded the 2011 targets. ACES membership has had two books accepted for publication; 14 book chapters either published or in press; 91 refereed publications (74 (81%) with an impact factor >2, 48 (53%) with an impact factor >4); lodged 3 patents; recruited 13 PhD students & 3 masters students; had 15 PhD completions; published 149 media interest stories (51 print (1 magazine), 15 radio, 7 TV, 76 online/web) as well as holding 108 government, industry or business briefings.

The ACES entity enabled success in initiatives that were in addition to the core funded activities reported: 2 ARC Laureate fellowships, 2 ARC Discovery grants, 1 ARC Linkage grant, part of 5 ARC LEIF grants and 2 Co-operative Research Centres.

INTERNATIONAL & NATIONAL COLLABORATIONS

The IAB collectively expressed that they thought the integration of ACES with national and international collaborators was exceptional, indeed 'spectacular'.

In 2011, ACES hosted or co-hosted 4 national workshops, 3 international workshops, 7 in-house workshops; had 88 invitations to present ACES work at international conferences, visited 89 international laboratories, hosted 80 international visitors of which 45 used the state-of-the art laboratory facilities.

RESEARCH PROGRESS IN 2011

There has been impressive progress in all four programs, especially with respect to the fundamentals. As expected in the development of the complex devices targeted in the Energy and Bionics programs, there is an ongoing demand for a better understanding of the developed electromaterials before they can be successfully integrated into devices. The research in these three scientific programs has been well interconnected and, to the credit of the researchers in ACES, the same family of materials is used in both Energy and Bionics, fields of research which are both prospective and demanded.

The overall message from all the scientific research programs was that the ability to control the three dimensional (3D) nanostructure of materials was crucial to the next set of developments. Control of nanostructure allows one to build more functionality or biocompatibility where required.

As in previous years, in 2011, the Centre still produced and optimised a range of materials, electrolytes and electromaterials (e.g. porphyrin dyes, metal complexes, metal oxides, conducting polymers, nanostructured carbons & ionic liquids) as well as functionalised post fabricated structures. ACES also built up printing, spinning (electro and wet) and fabrication facilities, capable of building structures from the nanoscale up through the micro and onto the macro scale. In addition, characterisation equipment (e.g. atomic force and confocal microscopy), able to characterise these nanostructures, has been installed and characterisation techniques / methodologies are currently being developed.

The ACES Bionics program continued to use organic conducting polymer platforms to promote controlled growth of nerve and muscle cells. Originally the focus for ACES was on spinal cord nerve repair. More recently our attention has been directed towards the complementary areas of peripheral nerve and muscle regeneration.

Structuring micro-platforms of conducting polymers, using new custom made printing techniques, was shown to support nerve cell growth and control that process. Electrical stimulation of these platforms with muscle cells maintained the muscle cells in the required state for growth.

Another activity of the Bionics program involved developing an advanced cochlear electrode. In 2011, a prototype high resolution cochlear electrode array containing 32 electrodes was designed, fabricated and tested in rat trials. Early results indicated that the approach has great potential for improving electrical stimulation to the auditory system.

To provide the mechanism to improve guidance for the insertion of the cochlear electrode, a conducting polymer actuator system was developed and shown to bend the device in a suitable configuration.

Designs for a new thin film, rabbit animal model cochlear implant have been completed and the manufacturing steps and conditions for the construction of the new multi-layered actuator controlled implant addressed. Encapsulation techniques and methodologies are being developed.

Other program activities have looked at hydrogel materials and their use in the neural and muscle work; polymer networks capable of acting as flexible stretchable electrolytes; bio-ink suspensions are being tailored to deliver cells via custom made printing technologies and in 2011 ACES developed atomic force microscopy techniques capable of exploring the sub-molecular interactions of single proteins of a cell with the polymer materials.

Water splitting is one of the major ACES activities, where the aim is to ultimately make the energy source of hydrogen. With the present global issues on the environment and energy saving this research is topical and focussed appropriately. The US Department of Energy stated that if this technology was to be of value the total energy loss whilst generating hydrogen could not exceed 15-20%. ACES produced highly efficient catalysts for the oxygen electrode where the total energy loss was around 15%. These polymer and polymer junction catalysts, based on manganese oxide, outperformed some of the better known traditional precious metal catalysts (expensive) used to date.

ACES researchers showed that concentration of a sulfonated, monomeric Mn-porphyrin, which is normally catalytically inactive, within a thin layer of poly-terthiophene polymer yielded a remarkable light-assisted catalyst with a low overpotential for water oxidation at pH 7. This catalyst, under illumination, selectively oxidized water before chloride in seawater at 0.9 V vs Ag/AgCl ***(Angew. Chem. Int. Ed. Eng., 2011, DOI:10.1002/anie. 201107355)***.

Another achievement was the utilisation of a dye-sensitised NiO photocathode in tandem with a bismuth(III) vanadate photoanode to produce hydrogen without any external bias or sacrificial oxidant/reductant at pH 7 using visible light.

This year saw the establishment of the potential water splitting spinout company, Aquahydrex, based on ACES and other related research intellectual property. This company will focus on technology development for industrial hydrogen use. Even though the biggest volume hydrogen use is in the automotive area, it has the lowest value; hence the decision to target high value hydrogen for industry as the first target. This company will be able to provide the prototyping and demonstration avenue for ACES water splitting developments.

Other energy program activities included optimisation of a Lithium (Li)|organic plastic crystal|$LiFePO_4$ cell with an excellent discharge capacity of 126 mAh g^{-1} at 50 °C and 153 mAh g^{-1} at 80 °C. A novel nanocrystalline porous α-$LiFeO_2$–carbon composite battery electrode delivered a significantly higher reversible capacity with excellent cycle stability (230 mAh/g at 0.5 C after 100 cycles).

Flexible electrodes made from a highly stretchable 2D buckled polypyrrole microfilm endured 2000 stretching cycles with 30% tensile strain applied at a 5% s^{-1} elongation rate whilst retaining their electrical conductivity and electrochemical properties ***(Adv. Mater. 2011, 23, 3580-3584).***

The first report of a thermoelectrochemical cell based in ionic liquid electrolytes was published ***(Chem. Commun. 2011, 47(22), 6260-6262).***

COMMUNICATION & OUTREACH

The ACES communications strategy has begun to enhance the Centre's reputation within the academic and public spheres, with ACES becoming recognised as an authority on electromaterials science.

In this regard, IAB has asked ACES to be judicious in putting energies into selected activities that will benefit ACES and not try to be all things to all people.

ACES should continue to build its online presence. ACES has the resources and expertise to create content ranging from videos to new stories, blogs, digital newsletters and other articles.

END-USER

The IAB was pleased to see ACES reporting a high level of activity in developing the end-user network during 2011, in addition to the work undertaken into the strategies for the selected developments in Energy (Aquahydrex) and Bionics. ACES undertook 108 government, industry or business briefings in 2011 compared to 26 in 2010.

Expansion of the end-user network was realised as a result of having the equivalent of a full time director of strategic development in ACES, hosting industry focused breakfast events as well as hosting or attending other workshops and meetings with end-users. Many more general end-users are visiting ACES now with the completion of the new facilities to learn of the future opportunities that may be available to them. Further engagement with industry is anticipated through an improved online presence and additional visits to and from other countries.

ACES is in the process of securing the necessary funding for Aquahydrex to develop prototypes to demonstrate the validity of its technology. It was pleasing to note that the AquaHydrex business plan was selected as one of four finalists in the UQ Business School Enterprize Awards and also named amongst 11 other innovative green technologies as a finalist (out of 70 entries) in the 2011 Australian Clean Technologies Ideas Competition.

The strategic plan ACES decided to take forward in the bionics area involved the development of wearable biofeedback and monitoring devices able to prevent, diagnose and rehabilitate orthopaedic conditions. Orthopaedic conditions are a significant societal problem, as shown by demographic studies and given the known financial limitations on the Australian

health system. It is envisaged that this will provide a commercial platform from which to engage others interested in implantable devices.

An agreement with the Irish company Shimmer Research Ltd will facilitate the development of these devices. Shimmer provides vital manufacturing knowledge and brings experience of conducting clinical trials in other countries. ACES is currently in the process of developing a business case with a corporate advisory firm in an attempt to obtain financing to develop these devices.

Commercialisation in the area of dye sensitised solar cells is being led by the CRC for Polymers. Other developments in the area of large scale battery energy storage are progressing.

The materials node of the Australian National Fabrication Facility (ANFF), located at Wollongong, has presented commercial opportunities in materials development, especially through materials transfer agreements.

Despite all the achievements listed in this report it is important to mention that with the current funding mechanisms ACES could not progress its research along the whole commercialisation chain alone. It will take some time to achieve positive economic outcomes from its commercial developments, but the IAB and ACES are optimistic.

EDUCATION & TRAINING

ACES continued to develop intensive, efficient and effective education and training programs for both staff members and students of all the nodes. Numerous scientific workshops, seminars, and research program meetings were held, and these were complemented by training programs on career development, leadership, and commercialisation.

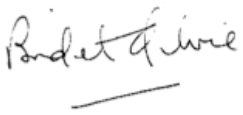
The technical and scientific programs of the many symposia and seminars held during 2011 by ACES were varied and topical. Hosting several in-house workshops to co-ordinate the work in individual scientific programs was a positive addition to previous years activities. Inter-nodal visits were also encouraged as much as possible.

The depth and breadth of education and training in ACES in 2011 was further enhanced with dedicated communications training for researchers on how best to represent ACES in public; and exploring why communicating research is an important element of their work at ACES. Top-up scholarships for PhD students were introduced so that they could become more involved in the planning of internal events and outreach activities. Increased training on the value of fundamental research and the application/translation into the next phase was also undertaken.

The governance structure of ACES is working well, the research is focussed with impressive progress in all four of the program areas, and the research has been well interconnected between programs.

The IAB recommends that ACES should balance the two sides of the research coin. Continue progress with the excellent fundamental research whilst in parallel attempting to take promising research outcomes to the next phase of prototype development for commercial and investor interest.

"The board members found it a pleasure to note the substantial progress in all areas of research, the excellent and supportive atmosphere in ACES and impressive integration across its several university sites".



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

Chair International Advisory Board for ACES.

ACES Core Funded Research Activity Report

The ACES core-funded research projects 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

ACES Milestones: 2011-2013

	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. Depends on collaboration with Social Scientists.	Evaluated public engagement processes on nano-medicine.

Materials Program Activity Report

Highlights

- During 2011, a wide range of materials continued to be produced across the Centre; ranging from porphyrin ruthenium metal complex dyes to functionalized conducting polymers and organic crystal electrolytes, highlighting the dependence of the ACES outputs on the development of exciting new materials.
- A new porphyrin conducting polymer composite catalyst for water splitting.
- Discovery of a new class of proton conductive plastic crystal (OIPC) electrolytes.
- Significant inroads made into the development of biodegradable conducting materials, including an erodible polythiophene hydrogel.

Milestones

- **Supplied 1st Generation porphyrin monomers, porphyrin dimers, solid electrolytes, polythiophenes and graphenes for the Energy and Bionics programs**
- **Developed and supplied 2nd Generation electromaterials to the Energy and Bionics programs**

1ST GENERATION PORPHYRIN MONOMERS AND DIMERS

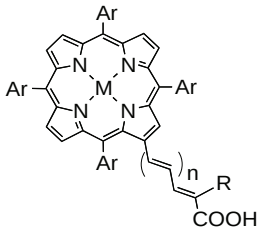
1st generation porphyrin monomers (Figures 1(a-c)) and dimers (Figures 1(d,e)) continued to be supplied to ACES and international researchers largely for the completion of research projects that commenced before 2011. This resulted in a number of high quality publications during the year (Appl. Phys. Lett. 2011, 98, (16), 163502/1; J. Phys. Chem. C 2011, 115, (1), 317; Langmuir 2011, 27, 12944; Chem. Commun. 2011, 47, (33), 9327).

A new route to ruthenium porphyrins was also developed in a project between Monash and UOW ACES researchers, affording substituted porphyrins (Figure 1(c)).

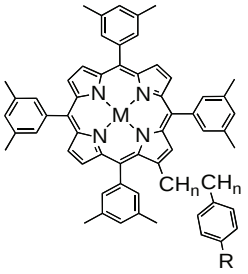
2ND GENERATION PORPHYRIN MONOMERS

A variety of 2nd generation porphyrin monomers (Figure 2) were developed. These include new alkyl porphyrins (Figures 2(a,b)) that are not only being investigated by Energy researchers for solar cells but are also proving effective graphene exfoliation agents by international collaborators in Erlangen (Prof Dirk Guldi). The two series of porphyrins in Figures 2(c) and 2(d) are under investigation by other international collaborators for energy transfer applications. Prof Keith Gordon (University of Otago, NZ) is working with ACES researchers in an ARC Discovery project to understand the utility of multiporphyrin arrays in solar cells, and Prof Les Dutton (University of Pennsylvania, USA) has been participating in an artificial photosynthesis project with Prof David Officer using porphyrins (Figure 2(d)) to establish a biomimetic photosynthesis reaction centre that would have application for water splitting and other catalytic reactions like the reduction of carbon dioxide.

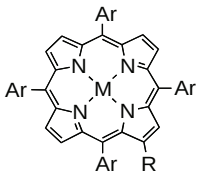
A number of new porphyrin structures were prepared with a view to developing new catalysts for water oxidation (Figures 3(a,b)) and reduction (Figure 3(c)). The water soluble manganese porphyrin in Figure 3(a) has proven to be particularly effective in association with poly(terthiophene) as a potential-driven water oxidation catalyst ***(Angew. Chem. Int. Ed. Eng., 2011, DOI: 10.1002/anie.201107355)***



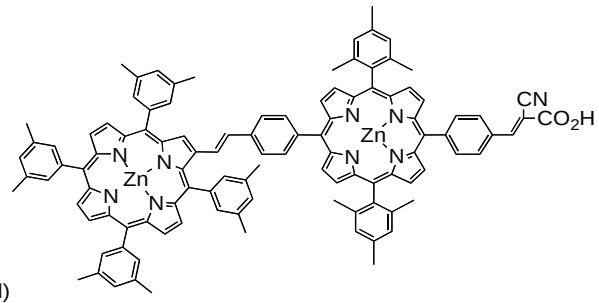
(a) Ar = ethylphenyl, octylphenyl, 3,5-^{t}butyl, or xylyl
n = 0 or 1
R = CN or CO_2H
M = H_2 or Zn



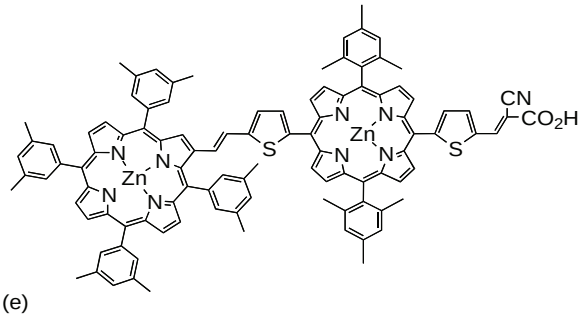
(b) n = 1 or 2
R = CO_2H, PO_3H or CH_2NH_2
M = H_2, Zn, Co or Ni



(c) Ar = ethylphenyl or xylyl
R = H, CHO, CH_2OH, $CH{=}CHCNCO_2H$, $CH{=}CHArCO_2Me$, $CH{=}CHArCO_2H$
M = H_2, Ru(CO), Ru(CO)(Py), $Ru(Py)_2$

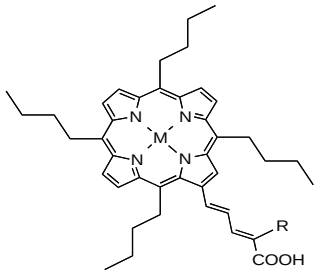


(d)

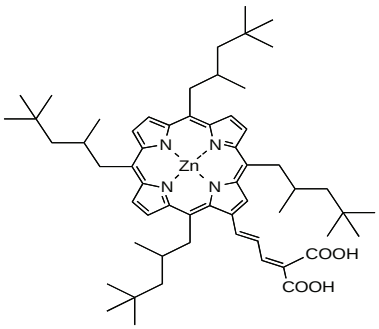


(e)

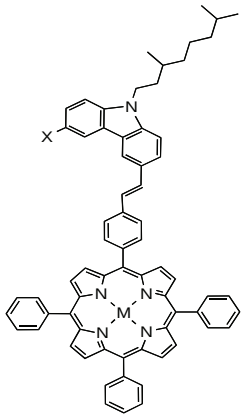
Figure 1: 1st generation porphyrin dyes



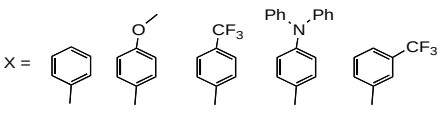
(a) R = CN or CO_2H
M = H_2 or Zn

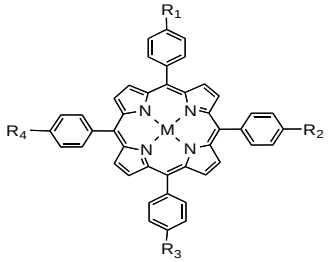


(b)



(c)





(d) R_1; R_2; R_3; R_4 = H or CO_2H
M = H_2 or Zn

Figure 2: 2nd generation porphyrin dyes

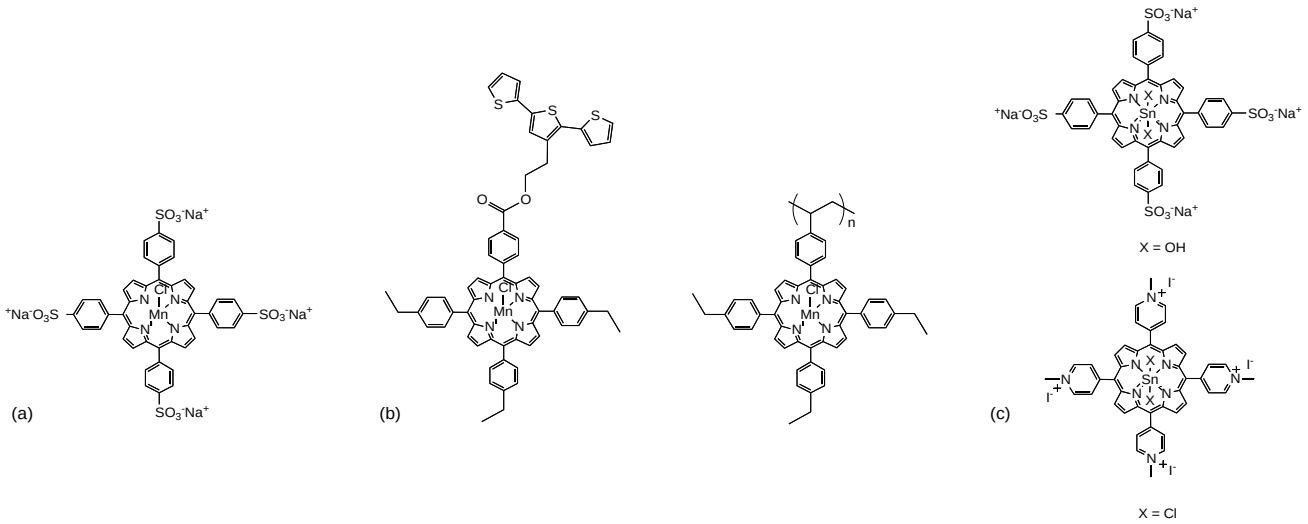


Figure 3: 2nd generation porphyrin water splitting materials

Polymers

POLYTHIOPHENES

Thiophene, bithiophene and terthiophene monomers (1st generation) continued to be used extensively throughout the Centre for polythiophene production. BisEDOT and trisEDOT (Figure 4(a)) were synthesised as precursors for photo initiated deposition of PEDOT for solar cells. An extensive study was undertaken into the production of PEDOT:PSS (Figure 4(b)) for a variety of ACES and external programmes. While this processable conducting polymer can be commercially obtained from a number of sources, it is not suitable for many Bionic applications. The in-house developed PEDOT: PSS is proving useful in that regard.

A number of substituted ProDOTs (Figure 4(c)) have been produced as well.

The production of functionalised terthiophenes (1st and 2nd generation) continued in 2011 with large scale syntheses of a number of thiophene precursors (Figure 5(a)) and terthiophenes (Figure 5(b)), which are being utilised for the development of biocompatible polymers in the Bionics program.

New branched chain substituted thiophenes (Figure 5(c)) are also being investigated for the development of more processible 2nd generation conducting polymers.

Spiropyran functionalised terthiophenes have been synthesised to produce novel opto-electro sensitive platforms for cell culturing.

The quest for more electroactive water soluble polymers as substrates for cell growth in the Bionics program has continued with the synthesis and optimisation of amino acid functionalised polymers. The known water soluble L-POWT (Figure 6) was synthesised from the precursors shown and was found to be oxidatively unstable. The introduction of an oxygen atom next to the thiophene to stabilise the oxidised polymer led to a complicated synthesis of 1st generation L-POMPT (Figure 7). These synthesis challenges have now been overcome with the introduction of 3 carbons into the side chain to give the monomers shown in Figure 8, providing a scalable route to a 2nd generation biocompatible polythiophene.

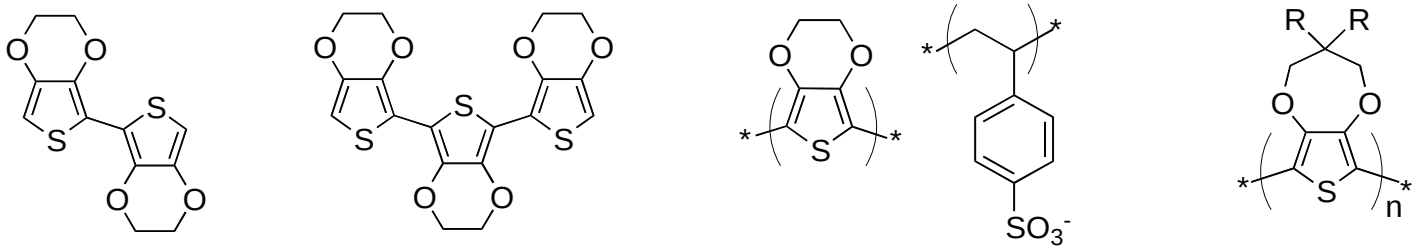


Figure 4: 1st generation thiophene monomers and polymer

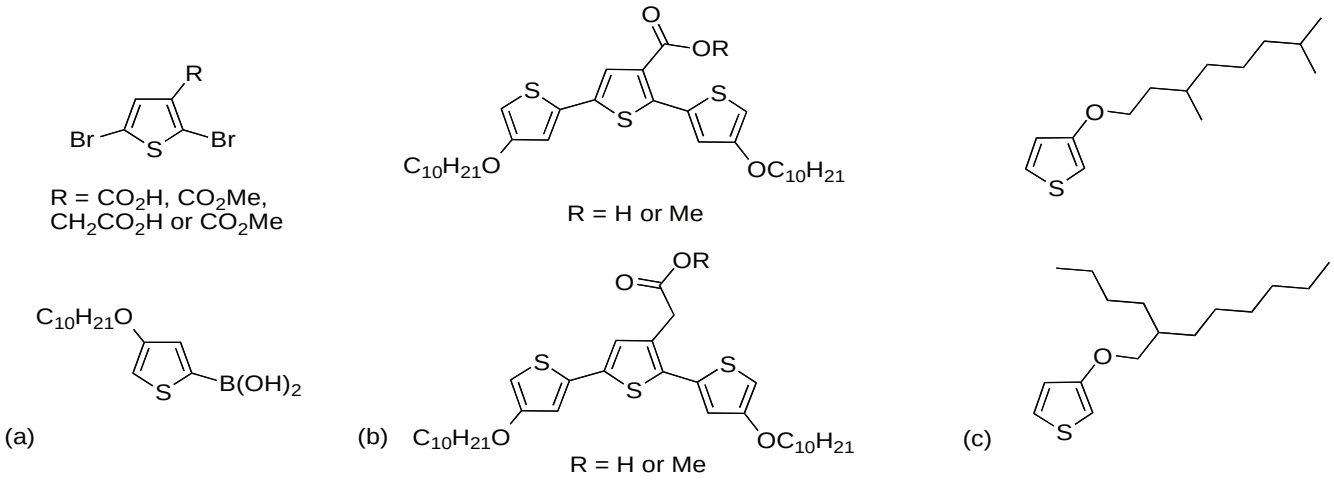


Figure 5: Functional thiophenes and terthiophenes for 1st and 2nd generation polymers

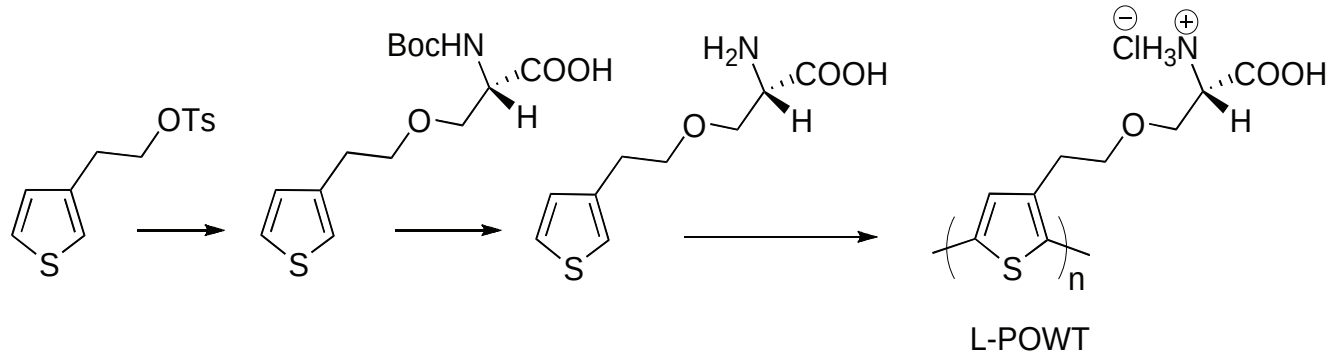


Figure 6: Route to 1st generation polymer L-POWT

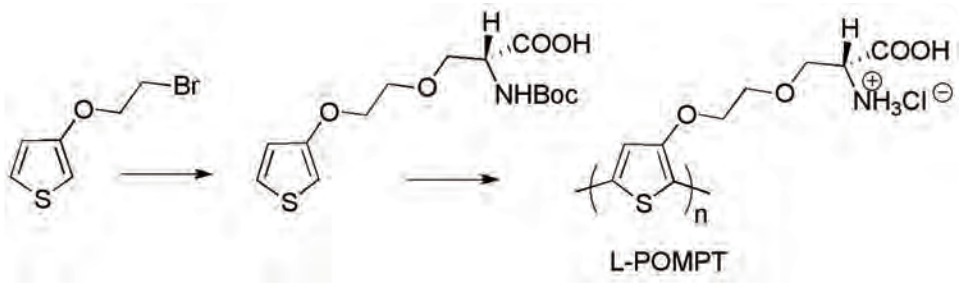


Figure 7: Route to 1st generation polymer L-POMPT

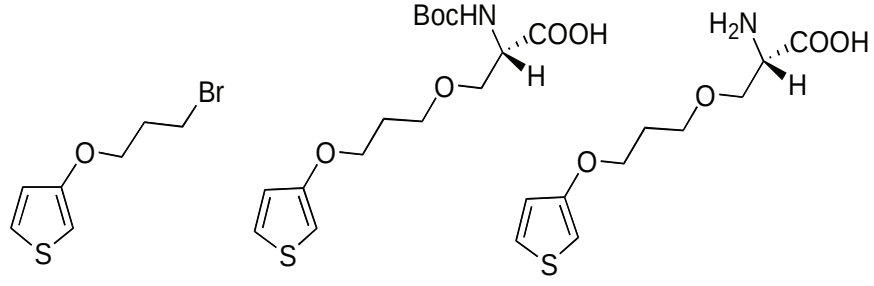


Figure 8: Precursors to 2nd generation biocompatible polythiophene

NANOSTRUCTURED POLYPYRROLES

We have used electrodeposition to create laminated nanostructured polymers with extraordinary mechanical and electronic properties ***(Adv. Mater., 2011, 23, 2966)***.

We have also used aligned CNT platforms to produce conducting polymers with nano-corrigation for bionic applications.

GRAPHENES

The production of graphene materials (Figure 9) continued, as well as their use both within the Centre and by our international collaborators. Both graphene oxide (GO) and anionic chemically converted graphene (CCG^-) were supplied in large quantities for the development of electrodes for Energy applications. The first generation aqueous dispersions of GO and CCG^- have been complemented with 2nd generation dispersions in organic solvents. Thus, stable dispersions of CCG^- have now been prepared in DMF, opening up new areas of application. This material was supplied to international collaborators in Korea (Prof. Seon Kim, Hanyang University) and France (Nicolas Puech, Centre de Recherche Paul Pascal, CNRS Bordeaux).

Investigations into the development of stable 2nd generation CCG^+ dispersions continued throughout the year.

The DMF dispersed CCG^- has also been used to develop composites for superconducting materials in association with the Institute of Superconducting and Electronic Materials (ISEM) at the University of Wollongong ***(Scripta Materialia, 2011, 65 (7), 634-637)***.

CCG^- papers have also been supplied to researchers in the USA (Dr Richard Fink, Applied Nanotech, Inc.) and show great promise as stripper foils for heavy ion accelerators. Dr Fink has successfully obtained US Government funding to continue this work in 2011.

Other 2nd Generation Materials

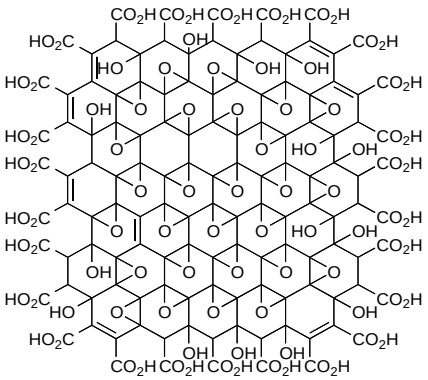
INORGANIC METAL COMPLEXES

Following the success of the ACES water splitting programme in 2010 using 1st generation metal complexes, the preparation of a wide variety of 2nd generation manganese, ruthenium and cobalt complexes have been investigated for catalysis or light harvesting. The ruthenium polypyridyl dyes consist of a terpyridine ligand bearing a functional group for attachment to titania, and either a second terpyridine ligand or isothiocyanate ligands. The functional group consists of either an acetylacetate group or a halide group (bromo or iodo). In the case of the latter, it is proposed that oxygen atoms of titania substitute the halide group, forming a direct link to the terpyridine linker of the complex.

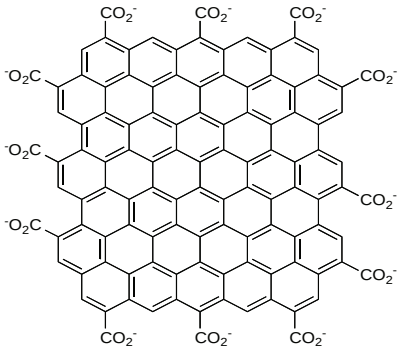
IONIC LIQUIDS

A wide variety of 1st generation standard as well as novel 2nd generation ionic liquids (examples shown in Figure 10) continue to be synthesised in ACES for many projects in the Energy and Bionics programs.

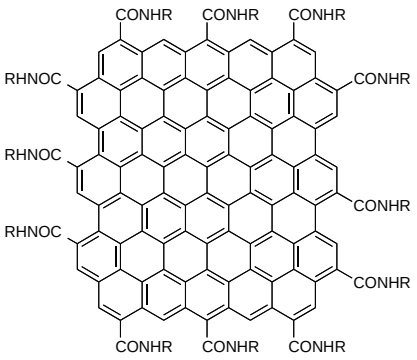
For the first time, we have synthesised and characterised a novel class of phosphonium cation based protic ionic liquids ***(J. Mat. Chem., 2011, 21, 19219-19225)***.



Graphene Oxide (GO)



CCG^-



CCG^+

Figure 9: Nanostructured graphenes for 1st and 2nd generation graphene dispersions

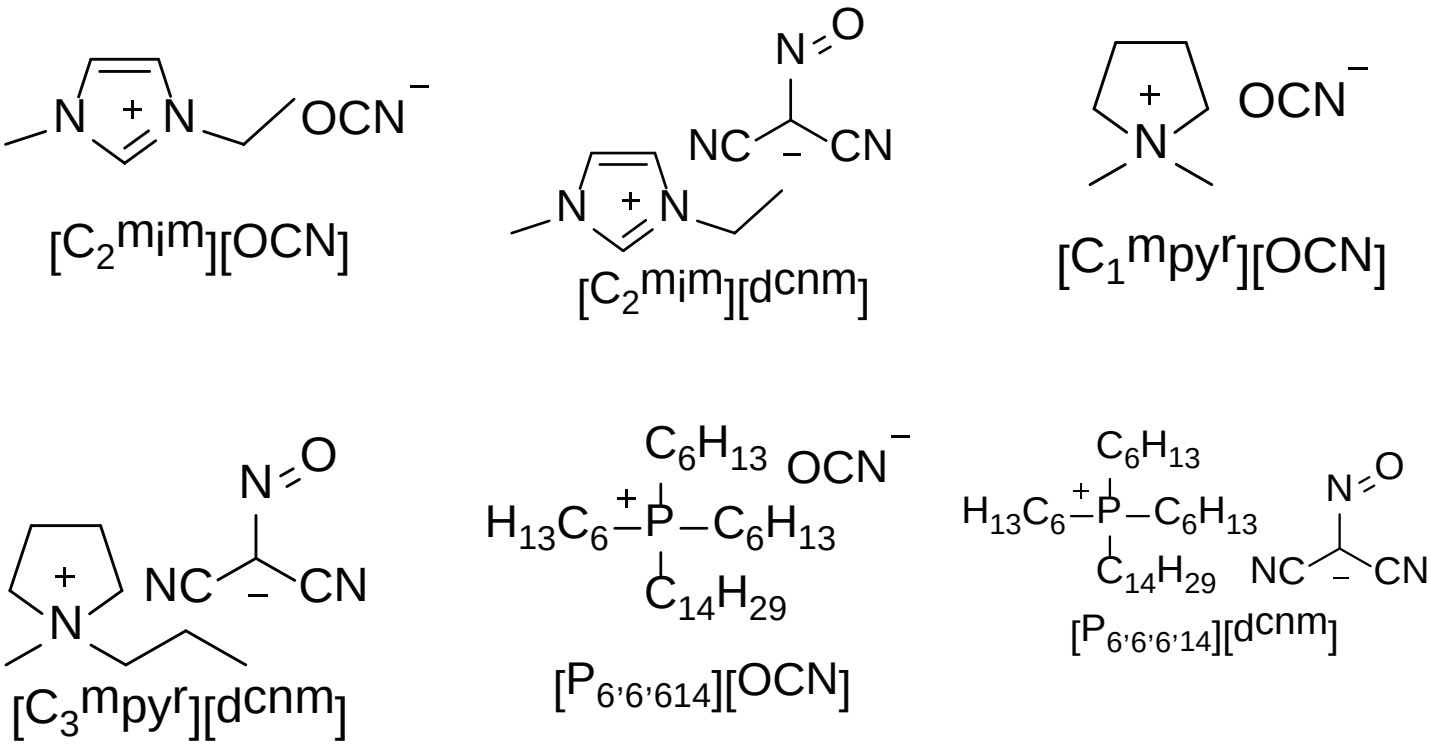


Figure 10: Examples of 2nd generation ionic liquids

ELECTROLYTES FOR WATER ELECTROLYSIS

Based on their low vapour pressure, good thermal and electrochemical stability, ionic liquids were investigated as electrolytes for water electrolysis. It was shown that these can significantly reduce the overpotential required to drive the water oxidation process. The performance of these systems was further enhanced through irradiation by visible light.

PROTON CONDUCTING PLASTIC CRYSTALS

We have discovered a new class of proton conductive plastic crystal electrolytes based on the triflate anion. The specific plastic crystal, choline triflate, displays highly crystalline solid phases with liquid–like conduction properties both in neat and HTf acid doped systems ***(Chem. Commun., 2011, 47, 6401-6403; Chem. Commun., 2011, 47, 11612-11614; J. Mat. Chem., 2011, 21, 7640)***. The diffusion studies revealed that the acid doped materials exhibit H^+ diffusion two times faster than the matrix ions at elevated temperatures. A detailed investigation of the transport mechanism in these materials suggests a defect mediated conduction mechanism in these systems.

2ND GENERATION MATERIAL STRUCTURES BY FABRICATION

An innovative approach to the introduction of nanostructure to organic conducting polymers involves deposition on to a novel aligned carbon nanotube mat developed by one of our collaborators at University of Texas at Dallas.

Printing Milestone: Supplied printed electrodes using 1st generation materials

A number of ink formulations have been optimised to enable inkjet printing of conducting polymers (particularly nanodispersions of PEDOT or polypyrroles) as well as graphene dispersions.

Characterisation Milestone: Refined and applied new characterisation techniques

A new NMR facility at the Deakin ACES node is being established after the successful LIEF bid by ACES researchers. The instrumentation is expected to be in place by early 2012. It will include 500 MHz wide bore with imaging facility as well as pulsed field gradient diffusion measurements.

The Kruss DSA100S Contact angle and wettability tool was upgraded to conduct complex liquid materials study with tilting arrangement for hydrodynamic evaluation of complex bubble, binary liquid interaction for the analysis of in-situ ionic liquids used in battery electrolytes.

The Bruker Veeco Wyko GT-K1 non-contact optical profilometer has been used systematically in the analysis of material substrates coated with ionic liquids for corrosion mitigation and inhibition, and battery work. An upgraded thick film module software version was added with greater parameter analysis capability.

The world class ACES solar cell characterisation facilities have also been extensively utilised in both national ***(IEEE Journal of Selected Topics in Quantum Electronics 2010, 16, (6), 1641; ACS Applied Materials & Interfaces 2011, 3, (5), 1585)*** and international research collaborations ***(Advanced Energy Materials 2011, 1, (5), 861; ACS Applied Materials & Interfaces 2011, 3, 1521-1527)***.

In 2011, both ACES/UOW and ACES/Monash established new solar water splitting characterisation facilities to support a rapidly expanding research effort into new catalyst, light harvesting materials and prototype water splitting devices.

The quantitative photoelectrochemical (PEC) characterisation systems, for detecting both hydrogen and oxygen gas evolution also measure the photo-electrochemical response of photocatalyst in aqueous electrolytes, including wavelength dependence, light intensity dependence and enables long-term testing of devices.

The Monash system includes a full solar simulator for precise measurement of solar spectral response.

The ACES facility at the University of Wollongong (UOW) has been developed in collaboration with Dr Iwase and the group of Prof Rose Amal at UNSW.

In the heart of its operation is a custom-built H-type photoelectrochemical cell that can accommodate fairly large samples, enabling convenient light access to both the anode and cathode, and has airtight gas connectors enabling independent sampling of both the anode and cathode compartments. This electrochemical cell is connected to a sampling loop and a GC, which gives access to in-line qualitative hydrogen and oxygen measurements without the need to stop the reaction. A variety of white and monochromatic light sources allow testing under standard illumination conditions or wavelength-dependent quantum efficiency in the same setup. Finally, the setup is combined with a commercially available photoelectrochemical workstation, which allows electron lifetime, diffusion coefficient and electrochemical impedance measurements to be combined with water splitting experiments. This powerful combination of techniques allows the characterisation of research samples as well as larger prototypes.

The laser spectroscopic facilities at ACES/UOW have received a major upgrade in 2011 to include new light sources, a crysostat enabling temperature dependent measurements and a nanosecond time-resolution switch. With this new upgrade, a combined charge extraction / transient absorption characterisation of solar cell materials and devices has become possible. This unique capability has the significant benefit of being able to characterise prototype solar cell devices, and therefore is highly attractive for ACES commercial and linkage partners. The new nanosecond charge extraction switch technique was discussed as a “Hot Topic” on the EES blog following the publication of our article in ***Energy Environ. Sci., DOI: 10.1039/C1EE02434E*** (see http://blogs.rsc.org/ee/2011/11/01/new-technique-to-study-charge-recombination-in-solar-cells/).

The ACES facility at UOW has also expanded its characterisation capabilities by key hardware upgrades to some of its existing equipment. Notably:

- an upgraded FTIR microscope characterisation tool (Shimadzu AIM8800) on the existing FTIR system providing reflection, transmission and Ge ATR measurements at 50 µm spots and correlating the acquired information to the captured microscope image or the sample.
- Thermolabs TGA upgrade to add a Hiden mass spectrometer analyser capable of identifying combustion gas components and relating this to the mass loss during analysis with applications in organic synthesis, graphene and CNT development.
- An upgrade to the Dektak stylus profilometer providing the capability to control the x-y stage to deliver 3D mapping of surfaces and digital stiching of multiple image acquisition to analyse larger areas.

New characterisation tools installed at ACES/UOW include:

- AR G2 Rheometer for analysis of electrolytes, gels and printing ink formulations.
- Agilent Capillary Electrophoresis system.
- Park Xe-Bio AFM system with an Automated Nikon TE2000 inverted high speed fluorescence microscope.
- Wyko NT9100 optical profilometer system.

Energy Program Activity Report

Highlights

- During 2011, several new highly efficient catalysts for water oxidation were discovered, including systems based on polymer materials, polymer junction materials and a large family based on manganese oxides.
- Catalysts enabling highly-selective, light-assisted water oxidation in seawater were developed.

Milestone: Refined water splitting device characteristics using 2nd generation materials

2ND GENERATION SYSTEM

MNO_x ELECTROCATALYST PREPARATION AND CHARACTERISATION

Our understanding of the mechanisms of operation of Mn based water oxidation catalysts advanced considerably during the year. Analysis of the fate of a series of Mn precursor complexes during photoelectrochemical water oxidation catalysis in Nafion by X-ray absorption spectroscopy (XAS) has been completed and a paper reporting that the active water oxidation catalyst is a manganese oxide has been published ***(Nature Chem., 2011, 3, 461-466)***. The work was highlighted in Chemistry in Australia, Science Daily and the Australian Research Council Annual report.

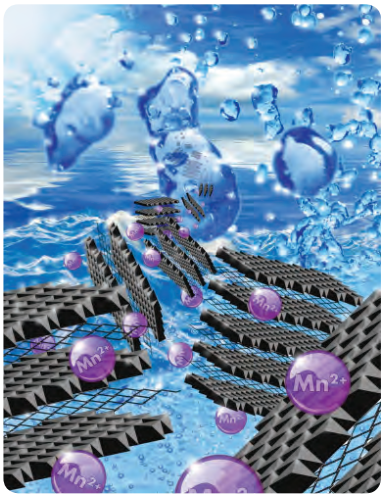


Figure 11: Graphic representing manganese based catalysts carrying out water oxidation in a water splitting cell.

A wider variety of other Mn clusters have now been examined and all catalyse water oxidation. Some of these compounds have in fact proven to be more active than the initial series investigated, even though the catalysis ultimately involves cycling between Mn(II) species and MnO_x. We have extended our examination of the fate of molecular catalysts during cycling to include clusters exchanged in layered materials, homogeneous catalysts based on iridium and ruthenium complexes, and inorganic clusters supported by polyoxometallates. Investigation of the fate of Mn precursors in Nafion by EPR spectroscopy has been continued in collaboration with Helmholtz Zentrum Berlin.

We have confirmed the catalytic cycle proposed from XAS studies and have shown that all Mn clusters dissociate in the presence of Nafion. $MnCeO_x$ materials produced at the University of Messina have been found to catalyse water oxidation efficiently at low overpotentials.

The development of dyes with the appropriate redox potentials and light absorption properties to drive light induced water oxidation in conjunction with various catalysts has continued.

Ionic liquid electrolytes were successfully used to electrodeposit a range of manganese based oxides as films that show high catalytic activity towards water oxidation. Significantly water oxidation at over-potentials is low enough to meet Department of Energy efficiency targets for hydrogen production for automotive fuel use.

Structure and chemical composition of the materials produced were analysed using scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy, X-ray absorption spectroscopy and X-ray photoelectron spectroscopy. The data suggests formation of Mn_3O_4, Mn_2O_3 and MnO_2 films by varying deposition conditions.

The electro catalytic activity of the MnO_x films tested in inorganic electrolyte (1M NaOH) show comparable performance to the (considerably more expensive) cobalt based catalyst previously reported by Nocera et al. These MnO_x materials are currently our materials of choice as we progress towards fully operational water splitting cells.

These are now capable of useful rates of water oxidation at <300 mV total overpotential.

These catalysts also show photo-catalytic activity that remains sensitive upon visible light irradiation, even to the near IR. These represent a step in the direction of a partially or fully solar driven water electrolysis cell.

A patent application has been filed on these important materials (March 2011) and a paper submitted to ***Energy and Environmental Science.***

In order to improve long term stability of the catalyst during water oxidation, phosphate containing buffered ionic liquid was used to modify the surface layer and prevent material deterioration. The mechanism of this utilises the high concentration of phosphate ions, provided by this ionic liquid, to react with mobile manganese ions, produced during water oxidation, and thus form a secondary network which inhibits further material dissolution.

SEA WATER OXIDATION

During 2011, several new 2nd generation efficient catalysts, capable of catalysing highly-selective light-assisted water oxidation in seawater, were developed. One involved a flexible, thin-film porpyrhin/polymer composite that spontaneously generated only oxygen gas under illumination in seawater (***Angew. Chem. Int. Ed. Eng., 2011, DOI:10.1002/anie.201107355***). Electrolysis in seawater normally yields toxic chlorine gas, not oxygen gas, so that the properties and operation of this polymer catalyst is significant.

We were additionally able to show that a number of the recently-discovered, efficient man-made water oxidation catalysts, both homogeneous and heterogeneous, were structurally virtually identical to the active site of the water-oxidizing complex of Photosystem II. This finding, which was published in the journal ***Chemical Science***, suggests that a so-called cubical M_4O_4 structure may be the optimum spatial arrangement for water oxidation catalysis. It also opens a prospective means to conceptually unify homogeneous, heterogeneous, and enzymatic catalysis in this particular field.

PHOTO-CATALYSED HYDROGEN GENERATION

Water soluble 2nd generation tin porphyrins (see Figure 3) immobilised in a Nafion film have been shown to produce a photocurrent when illuminated in an aqueous solution. The photocurrent appears to be dependent on the concentration of porphyrin in the film with a maximum photocurrent produced at 5% w/w porphyrin: polymer film. Studies into the mechanism behind the photocurrent, as well as the effect of pH, film thickness and film structure are underway.

PHOTO ASSISTED HYDROGEN GENERATION

We have developed a novel photocathode based on a dye-sensitised NiO cathode previously used in a tandem dye-sensitised solar cell ***(Nature Materials 2010)***. Un-assisted photo-electrochemical water splitting was achieved utilising this dye-sensitised NiO photocathode and a bismuth (III) vanadate photoanode connected in a series tandem configuration. The measured hydrogen evolution rate was 120 nmol h^{-1} without any external electrical bias or sacrificial oxidant/reductant at pH 7.0 using visible light (>420 nm). The observed photocurrent was stable for up to 4 hours and the faradaic efficiency was calculated to be >80%.

WATER-SPLITTING DEVICE FABRICATION

In order to fabricate the new catalyst technologies that we have developed in ACES for splitting water into hydrogen and oxygen, we have designed, built and tested a variety of prototype cells. The cells were originally built of glass, but we are currently in the process of migrating to all-polymer cells, which have been found to work equally efficiently. This work has involved developing scalable procedures for manufacturing the catalysts in large scale, applying them, and for establishing a mass production capability for the cells. Two patents have come out of this work to date.

Milestone: Completed metal air battery using 2nd generation materials

TOWARDS RECHARGEABLE ZN/AIR BATTERIES

Several approaches to improve the cyclability of Zn/air systems are underway within ACES. These are all based around the design and characterisation of novel 2nd generation electrolytes to improve Zn^{2+} transport as well as the Zn deposit morphology. We have shown that using ionic liquid based electrolytes, the anion of the IL plays a critical role in the deposition morphology and cycling efficiency. For example the chloride and dicyanamide anions in the ionic liquid lead to desirable plating and stripping in contrast to the sulphate anion.

A new approach to improve the performance of electrodes for rechargeable batteries is to capture the oxidised metal cation after discharge. Thus the active component is kept in close proximity to the electrode and prevented from being lost by leaching into the electrolyte. This should be beneficial for performance, including electrode kinetics and current densities. We have recently prepared materials based on an anionic inorganic network host into which we impregnate the positively charged zinc cation. Initial electrochemical characterisation shows promising behaviour indicating that reversible zinc oxidation/reduction is possible.

2ND GENERATION GRAPHENE/ZINC NANO-COMPOSITES FOR METAL / AIR BATTERY ELECTRODES

It has been successfully demonstrated that 2nd generation graphene/zinc nanocomposites can be prepared electrochemically from a one pot mixture for use as metal air battery anode materials.

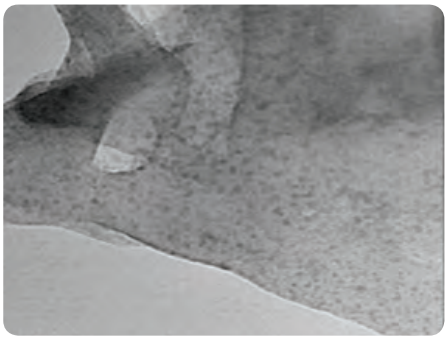


Figure 12: Graphene/Zn co-deposits for Zn/air electrodes. (*Hilder et al. PCCP 2011).*

For the first time, graphene metal composites have been prepared from a graphene oxide suspension containing positive metal cations, and incorporating electrochemically active base metals. The composition can be controlled by changing the relative concentration of the reactants in the starting mixture. The zinc is very evenly dispersed in the graphene sheets and making very uniform composites with the size of the zinc particles being as little as 2 nm (Figure 12).

TOWARDS IMPROVED STABILITY OF MAGNESIUM IN METAL/AIR BATTERIES

Magnesium/air batteries are a possible high-energy density power source that, to date, have not received strong commercial interest due to issues with the corrosion of the magnesium and evaporation of the electrolyte.

In this work, we have found that the use of 2nd generation ionic liquid based electrolytes can stabilise the metal/electrolyte interface and impact on the electrochemical performance of a magnesium cell. Galvanostatic measurements indicate that the water content of the ionic liquid electrolyte plays an important role in the cell discharge characteristics. Surface characterisation using EIS, ATR-FTIR and powder diffraction examined the unique properties of the surface film formed on the magnesium anode. The formation of this film was able to be correlated to cell performance.

IMPROVING OXYGEN REDUCTION REACTION KINETICS IN METAL/AIR BATTERIES

This work focused on: (i) developing new cathode materials for improved electrocatalytic performance and (ii) developing methodologies to reliably determine the oxygen reduction reaction (ORR) kinetics in non-aqueous electrolytes.

On the development of 2nd generation materials for cathodes, we are investigating novel PEDOT composite materials. Carbon black and bucky paper substrates have also been investigated as supports to develop 3D air electrodes based on PEDOT catalysts. 3D metal foams (Figure 13) are under investigation as scaffolds for active ORR catalysts. Preliminary work has been based on titanium alloys and we have shown that favourable porosity can be achieved. Plasma treatment is also being investigated to control the hydrophobicity across the electrode to avoid flooding issues.

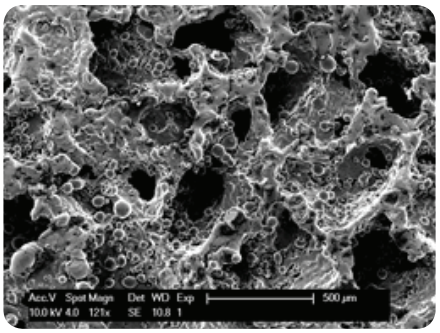


Figure 13: SEM image of a Ni-Ti metal foam indicating extensive micro-porosity for 3D air electrode substrate

Dr Jaka Sunarso joined ACES (Deakin) as an Alfred Deakin Fellow in 2011 and his work focuses on developing new ORR catalysts based on perovskite structures and understanding the influence of composition dependence on ORR kinetics. Cobalt is a promising substituent for enhancing catalytic behaviour of these materials. Composites made of substituted perovskite and carbon enhances performance still further, owing to improved electronic conductivity of the materials.

In order to investigate the kinetics of the oxygen reduction reaction in novel electrolytes being considered in metal/air batteries and fuel cells, we require a reliable, stable reference electrode. To date, this has not been available and therefore much of the data quoted in the literature cannot necessarily be relied upon. We have shown that the traditional ferrocene (Fc/Fc^+) based system is significantly affected (up to 100mV) by the chemistry of the electrolyte whereas the decamethyl ferrocene ($DmFc/DmFc^+$) provides a more reliable reference.

ACES Energy Program: Other Activities

ORGANIC IONIC PLASTIC CRYSTAL ELECTROLYTES FOR LITHIUM BATTERIES

Organic ionic plastic crystal (OIPC) electrolytes are among the key enabling materials for solid-state and higher than ambient temperature lithium batteries because of their excellent thermal and electrochemical stability and high solid state ionic conductivity (see Materials section). We have focused on studying the Li|OIPC interface using lithium symmetrical cells as well as the optimisation and performance of $Li|OIPC|LiFePO_4$ cells. We have demonstrated excellent discharge capacity attained in a $LiFePO_4$ cell; reaching 126 mAh g^{-1} at 50 °C and 153 mAh g^{-1} at 80 °C (when the electrolyte is in its liquid form) with excellent capacity retention on cycling.

POROUS CONDUCTIVE ARCHITECTURE α-LIFEO2–C COMPOSITE BATTERY ELECTRODE

A novel nanocrystalline porous α-$LiFeO_2$–C composite (Figure 14) with a high surface area of around 115 $m^2 g^{-1}$ was synthesised by a simple molten salt method, followed by a carbon coating process. Electrochemical measurements showed that the α-$LiFeO_2$–C nanocomposite delivered a significantly higher reversible capacity and excellent cycle stability (230 mAh/g at 0.5 C after 100 cycles). Even at the high rate of 3 C, the electrode showed more than 50% of the capacity at low rate (0.1 C).

The excellent electrochemical performance of the α-$LiFeO_2$–C nanocomposite electrode can be attributed to the porous conductive architecture among the nanoparticles, which not only has benefits in terms of decreasing the absolute volume changes and increasing the mobility of lithium ions, but also offers conductive pathways along the whole interconnected wall in the structure, which is favourable for the transport of electrons, promotes liquid electrolyte diffusion into the bulk materials, and acts as a buffer zone to absorb the volume changes.

FLEXIBLE ELECTRODES FOR ENERGY STORAGE

A highly stretchable 2D buckled PPy-*p*TS microfilm, prepared by simple electrochemical deposition on a pre-strained gold sputter coated SIBS substrate, endured 2000 stretching cycles with 30% tensile strain applied at a 5% s^{-1} elongation rate whilst retaining its electrical conductivity and electrochemical properties ***(Adv. Mater. 2011, 23, 3580-3584).***

A prototype biocompatible battery system was fabricated based on this stretchable buckled polypyrrole (PPy) and a bioadsorbable Mg alloy (AZ61) in phosphate buffered saline (PBS). This material endured an *in situ* strong and cyclic mechanical strain and retained its electrochemical properties in this biocompatible battery system.

SOLAR CELLS

Collaborative work with the VICOSC group, associates of ACES at Monash, exploits ACES work on ionic liquids and plastic crystal electrolytes for all-solid state solar cells. The work is continued via ACES PhD students producing several important publications ***(J. Mater. Chem. 2011, 21, 7640-7650; Energy & Environmental Science 2011, 4, 2234-2239, ACS Applied Materials & Interfaces 2011, 3, 1521-1527).***

Organic dye solar cell outputs continued from ACES PhD students leading to a number of excellent publications ***(J. Phys. Chem. C 2011, 115, (1), 317; Appl. Phys. Lett. 2011, 98, (16), 163502/1; Langmuir 2011, 27, 12944; Chem. Commun. (Cambridge, U. K.) 2011, 47, (33), 9327; J. Phys. Chem. C 2011, 115, (44), 22084; J. Org. Chem. 2011, 76, 4088-4093).***

THERMOELECTROCHEMICAL CELLS

Work of two new PhD students in ACES initiated a new project on the topic of 'Thermoelectrochemical Cells' in collaboration with Prof Ray Baughman at UT Dallas. The first report of such cells based in ionic liquid electrolytes was published ***(Chem. Commun. 2011, 47(22), 6260-6262).***

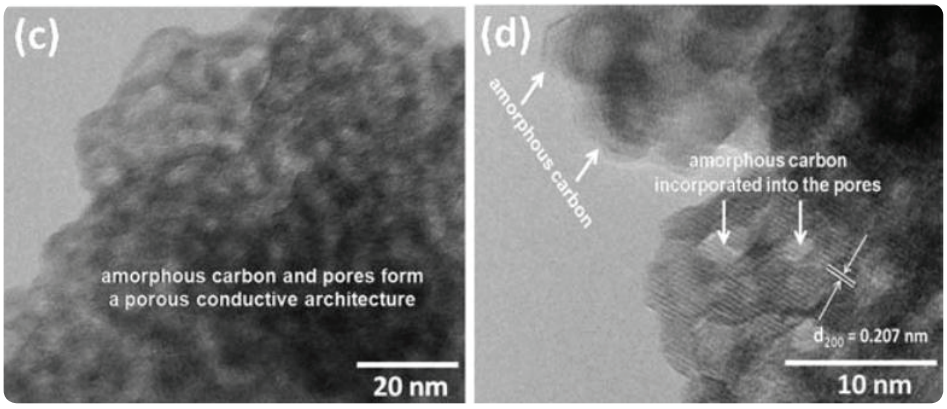


Figure 14: (c) TEM and (d) HRTEM images of the α-$LiFeO_2$–C sample *(Energy & Environmental Science*, 2011, 4(3) 952)

Bionics Program Activity Report

Highlights

- Organic Conducting Polymer (OCP) platforms have been established to promote and control growth effects in muscle and nerve cells by electrical stimulation.
- Electrical stimulation has been shown to promote significant benefits to maintenance of the proliferative state of muscle precursor cells under conditions that would otherwise promote their terminal differentiation into non-proliferative myofibre state. This effect is enhanced by stimulation on nanostructures.
- Growth of sensory neurons has been demonstrated to be significantly controlled by nanostructured surfaces.
- Ink-jet printing formulations that enable micro-dimensional structures of polypyrrole to be fabricated have been developed. These structures support nerve cell growth and provide directional cues.
- A prototype high resolution cochlear electrode array which contains 32 electrodes has been designed, fabricated and tested in rat trials. The early results indicate that the approach has great potential for improving electrical stimulation to the auditory system.
- A tri-layer inherently conducting polymer (ICP) actuator system has been produced. This actuator system has been shown to bend in a configuration suitable for use in guiding the prototype electrode into the cochlea.

Milestone: Completed evaluation of appropriate 2nd generation electromaterials for neuromuscular regeneration

The Regenerative Bionics platform has expanded from the original regenerative focus on nerve (spinal cord) into complementary areas of peripheral nerve and muscle regeneration.

The use of the functionalised thiophenes developed in the materials synthesis program continued to be investigated as stimulating platforms for both nerve and muscle repair.

The effects of nanostructure and electrical stimulation on the growth of primary skeletal muscle myoblasts and sensory neurons were evaluated on a nanostructured conducting platform constructed from multi-walled nanotubes overlaid with polypyrrole.

MUSCLE REGENERATION

Conducting substrata have been developed from aligned multi-walled nanotubes (MWNT) deposited onto gold mylar, and coated with polypyrroles. Primary myoblasts grown on these surfaces indicated that the MWNTs presented some impediment to myogenic cell attachment; growth and/or differentiation (Figure 15D). Coating of the MWNTs with the PPy-PTS alleviated this and improved the compatibility of the nanostructured surface with myoblasts (Figure 15: E&F).

The underlying nanostructure of the surfaces provided strong growth guidance cues that resulted in highly aligned growth and differentiation of myoblasts to myotubes, whilst limiting the branching evident on the myotubes (Figure 15: D to F compared to Figure 15: A to C). This result in itself provides an important indicator that nanostructured surfaces will facilitate the growth of physiologically relevant myofibres that will not form aberrant connections with tendon systems due to excessive branching and thereby, improper connections with contractile components when used *in vivo*. These exciting results are currently being developed for *in vivo* application.

In addition to facilitating linear growth and differentiation of fibres with minimal branching, the conducting nanostructured surfaces were able to improve the extent of proliferation and myotube differentiation when the myoblasts on the substrata were subjected to electrical stimulation of 50 mV/cm^2, an electrical stimulation of magnitude that emulated physiological neurostimulatory activity at the neuromuscular junction *in vivo*.

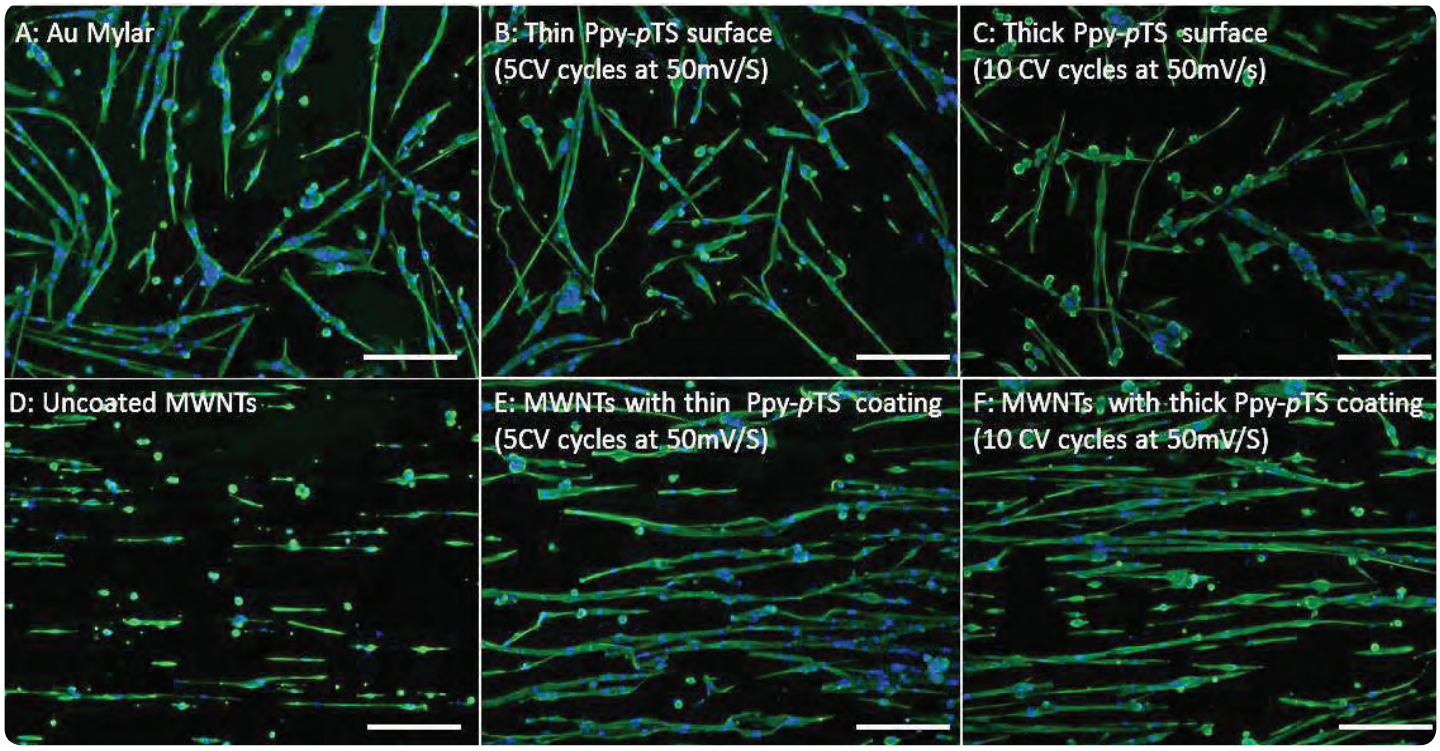


Figure 15: Formation of muscle fibres *in vitro* is enhanced by aligned nanostructured conducting (PPy-pTS) surfaces (D to F) compared to PPy-pTS without aligned nanostructure (B to C). In addition, the PPy enhanced the biocompatibility of the multi-walled nanotubes used to create the nanostructure (E & F compared to D).

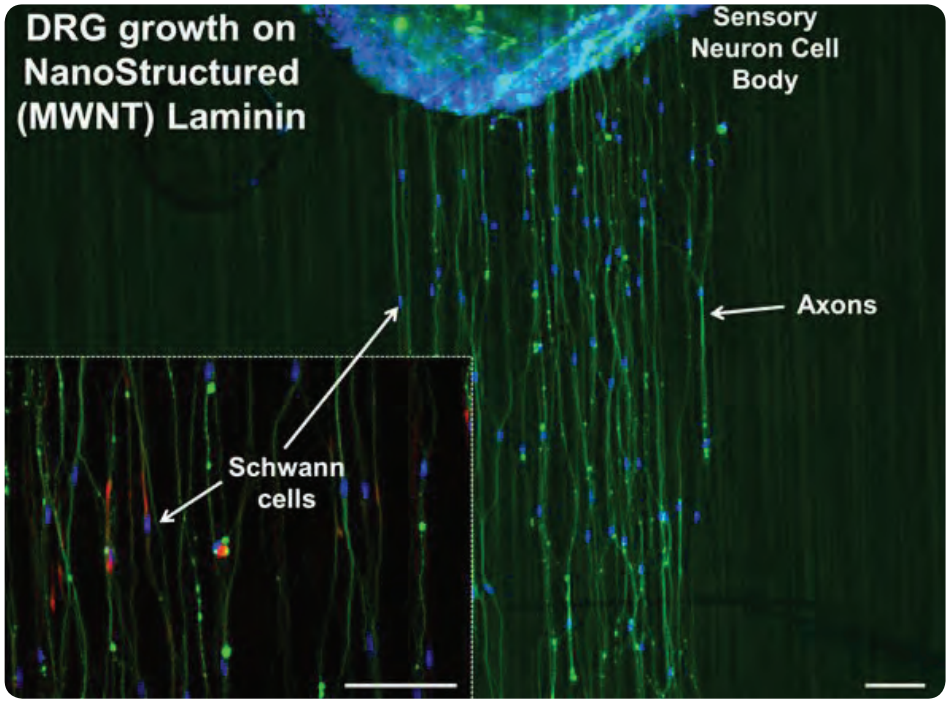


Figure 16: Dorsal root ganglion (DRG) explant growing on nanostructured MWNT/PPy-pTS substrate. The growth of sensory axons from the DRG is shown to be strongly influenced by the underlying nanostructure and is accompanied by co-migration/extension of Schwann cells (inset).

NERVE REGENERATION

The same principles applied to the myoregenerative aspects of the Bionics platform have been applied to the neuroregenerative studies initiated by the focus on injured spinal cord repair. The same nanostructured substrata (MWNT/PPy-PTS) used for the guided growth of myotubes has been used to grow primary sensory neuronal explants from rat dorsal root ganglia. This application of the one nanostructured substrate to two different excitable cell systems reflects the ultimate convergence of this system, perhaps in conjunction with further addition of microstructure overlays perpendicularly onto the aligned nanostructure to evaluate the efficacy of proposed methods for neuromuscular junction restoration in combined spinal cord (motor and sensory neurons)/muscle explants.

The aligned MWNT substrata were seen to provide guidance to axonal outgrowth that aligned significantly in the direction of the nanostructure surface corrugation. These structures promoted excellent axonal guidance in conjunction with associated

neuroglial migration from the DRG body (Figure 16). These findings indicate that the nanostructured surface promotes formation of properly myelinated axons.

Initial results obtained with application of electrical stimulation to a DRG growing on these nanostructured platforms suggest that electrical stimulation further enhances the growth behaviour of neuronal cells and the migratory behaviour of neuroglial cell types on the conducting nanostructured platforms.

A software module has been developed in collaboration with CSIRO scientists to facilitate high throughput quantitative analysis of this otherwise labour-intensive assessment of axon growth for future applications

Milestone: Completed evaluation of appropriate 2nd generation electromaterials for advanced cochlear electrode

The application of conducting polymers onto advanced cochlear electrodes was evaluated in animals by implantation of PEDOT and polypyrrole-coated electrodes into the rat auditory centre of CNS (cochlear nucleus). These studies showed that of several ICP electrode configurations, PEDOT doped with para-toluene sulfonate (PEDOT-pTS) returned impedance results better than other ICP electrodes and superior to those of standard metal electrodes. This provides a good basis for incorporating PEDOT-pTS into the design of advanced cochlear electrode systems.

The focus of ACES Bionics Cochlear Implant Electrode development focused on the design of a new high-fidelity multiple-electrode array format, an actuator function to aid in location of the electrode within the cochlea and gaining understanding of the effects of electrical stimulation via conducting polymer surfaces on the function and maintenance of neural networks. The new electrode has been fabricated and a trial of the accessory actuator system has likewise been conducted with a view for their convergence into an integrated electrode that delivers high-resolution electrical stimulation and is able to be guided into the cochlea space with minimal trauma to the tissue therein.

Designs for a new thin film, rabbit animal model cochlear implant have been completed and the manufacturing steps and conditions for the construction of the multi-layered actuator controlled thin film implant addressed. Critical decisions in the manufacturing protocol have been to:

- Spin cast polyimide rather than attaching preformed sheets of Kapton to the silicon substrate, to enable a flatter surface for subsequent lithography.
- Contact lithography will be used rather than direct write lithography to speed up manufacture, reduce costs and improve feature accuracy.
- Electron beam evaporation will be used to deposit metal features rather than sputter coating, as this generates thinner, more uniform coatings and is considerably cheaper.
- Low temperature glue will be used between layers to ease manufacturing.
- The actuator will be lithographically patterned onto the implant to improve alignment of the actuator to the electrodes, aid electrical connection to external circuitry and simplify encapsulation of the actuator without addition of considerable mechanical load.

Visualisation of the cochlear implant by micro CT imaging will enable correlation of electrode position and electrophysiological response.

Phase contrast X-ray micro CT imaging performed at La Trobe University has removed the metal artefact typically seen when performing CT imaging of the current human cochlear implants and demonstrates the high resolution possible with this technique (compare Figure 17(a) and (b)). Further work in this area will assess the abilities of the Medical Imaging Beamline (IMBL) at the Australian Synchrotron to perform CT imaging of the cochlea in rabbits.

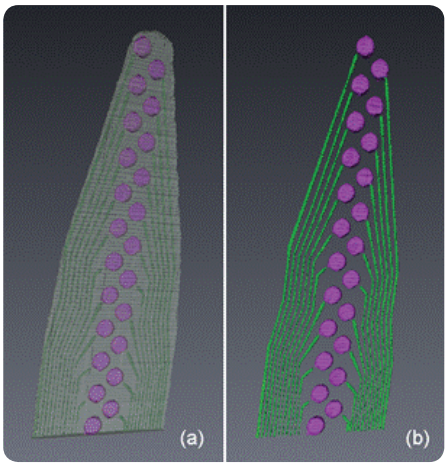


Figure 17: Phase contrast X-ray micro CT imaging performed at La Trobe University has removed the metal artefact typically seen in CT imaging of cochlear implants.

CONDUCTING POLYMER ELECTRODE-NEURAL INTERFACE

Conducting materials originating from the ACES Materials platform have been deposited onto trial electrodes and evaluated for their suitability to coat cochlear electrodes and thereby enhance function/stability through future application of bio-factors.

Previous testing of doped conducting polymer neural recording electrodes indicated PEDOT-pTS provided an improved signal/noise ratio compared to other PEDOT and polypyrrole coatings as well as uncoated metal electrodes. Variations of the polymer thickness have now indicated a range of charge capacitance and impedance responses are possible, with a 45 second deposition time providing the most stable response.

IN VIVO EVALUATION OF HIGH FIDELITY COCHLEAR IMPLANT PROTOTYPE

The first tests of the thin film, hi-fi cochlear implants in a rat model were completed and found to elicit better frequency specific neural coding than more traditional implants. High density electrode arrays with small iridium sites also possessed lower electrical thresholds for higher order activation and increased dynamic range. These results suggest that hi-fi cochlear implants may improve sound perception for future users. This work is currently

being prepared for publication. This year, testing has begun on a rabbit model, which more closely resembles human acoustics in terms of frequency range and anatomy. The necessary surgical equipment was sourced and assembled, and the surgical techniques for inserting cochlear implants developed. Preliminary results are promising, with rabbits proving to be more responsive to lower frequencies, in line with human auditory perception.

ACES Cochlear Electrode Actuators

Milestone: Developed actuator technologies for steerable cochlear implant

Using a 3D model of the rat cochlea, the actuator has been designed and shown to be able to bend under appropriate electrical stimulation in an appropriate dimension to steer the passage of electrodes within the cochlea.

Milestone: Optimised control and sensing mechanisms for steerable electrode using polymer actuators

An ICP actuator has been designed for incorporation onto a high-resolution advanced cochlear electrode. The design incorporates "reverse actuation" as a mechanism by which physical resistance due to contact between the actuation system and the wall of the cochlea is detected as an electrical signal that allows minimisation of the degree of contact with the cochlear wall.

Recent activity has been directed towards the integration of polypyrrole (PPy) based bending actuators into the advanced cochlear implant. The work has been in three main areas:

ENCAPSULATION

Completely sealing the actuator from the surrounding environment is essential for operation within the cochlea. Thin layer rubbery coatings have been evaluated for this purpose. Spray techniques have been developed along with simple evaluation methods to generate thin, pin-hole free coatings. Without the coating trilayer actuators degrade rapidly when immersed in water, due to the loss of electrolyte to the water. Optimised coated trilayer actuators could be operated in water for 30 plus hours.

DIRECTLY ATTACHING POLYPYRROLE (PPY) ONTO A POLYIMIDE SHEET

The current design of the advanced cochlear implant incorporates an encapsulated PPy actuator laminated to the underside of the thin film array. The preferred approach is to directly attach one PPy layer to the polyimide substrate.

We have started investigating methods to apply adherent gold layers to the polyimide and to generate adherent PPy layers on top of the gold and investigate displacement of the bender actuator (adherent PPy layer on polyimide film) at different frequencies and voltages. It was found that at ±0.5 volts and 0.001 Hz, the actuator of dimension 10 mm (l) x 1 mm (w) shows a tip to tip displacement of 8 mm. The displacement can be increased by increasing voltage or decreasing frequency. It is also found that roughening of the polyimide sheet before titanium and gold coating and plasma treatment of the gold coated polyimide sheet before polymerisation is the best way not only to improve adhesion of PPy onto the gold coated polyimide sheet but also to increase the tip to tip displacement of the actuator.

MODELLING AND CONTROL OF COCHLEAR ACTUATORS

The focus of this work is to develop a mathematical model in order to describe the response of the trilayer polymer actuators. The electrical properties of the actuator which are capacitive properties are modelled by the diffusion impedances combined with the double layer capacitors and the charge transfer resistors.

In addition to this, we have discovered that the inductive properties of the actuator should be included in the mathematical model when the actuator operates at the frequencies greater than 1-3Hz. Therefore, the electrical and inductive properties are included in this proposed model.

The displacement response of the actuator is modelled and compared to real experimental data. The results demonstrated that the proposed model was effective enough to accurately predict the behaviour of the current and deformation of the actuator for actuator tip deflections as large as 50% of the actuator length.

Based on the proposed model, an inversion-based controller was developed. The position control results obtained experimentally verified the feasibility of the proposed model in an inversion-based controller, without requiring an external sensor for feedback.

Bionic Program Other Activities

New materials for improved electronic-tissue interface

HYDROGEL POLYMERS (GELLAN GUM)

Traditional neural prosthetic electrodes (NPEs), exhibit a number of shortcomings which seriously limit the performance of devices in vivo. Surface modification of NPEs with polymeric materials has the potential to circumvent many of the technical pitfalls associated with currently used electrode platforms. It is clear that current NPE configurations leave much to be desired in terms of their establishment of an intimate and stable electronic interface with neural tissue. In this project we aim to develop a more functional and biologically compatible electronic-tissue interface by the formation of electrodes that couple natural hydrogel polymers such as gellan gum (GG) with the favourable electronic characteristics of conducting fillers such as the conducting polymers polypyrrole (PPy).

Gellan gum-doped polypyrrole electrode coatings significantly reduced the impedance encountered at frequencies relevant to neural cell communication, relative to uncoated gold electrodes. They are able to support clinically relevant stimulation over an extended period of time with no apparent decrease in performance. Accordingly, we have established that PPy/GG electrode coatings enhance the electrochemical characteristics of neural prosthetic electrodes, and as such may serve as an amenable platform for improvement of other important aspects of

neural prosthetic electrodes. In particular, these include optimisation of mechanical and biochemical characteristics of the interface to improve cell–electrode interactions.

SURFACE BIOENGINEERING OF IMPLANTABLE ELECTRODES

ACES/IPRI PhD student Ryan Sullivan is currently using conductive polypyrrole films with covalently bound adhesion proteins to increase the biocompatibility of neural electrodes. Most work to date has involved modelling equivalent circuits of electropolymerised conductive polymers with those reported in the literature.

Surface bioengineering of implantable electrodes to improve the biocompatibility was undertaken as part of the CRC Hearing project.

Surface modification of both the electrode carrier (PDMS) and the electrode (platinum) of cochlear implants was undertaken. PDMS was activated with oxygen plasma, treated with the silanes bearing ethylene imine units, and then sequentially grafted with hyaluronic acid and collagen. The influence of modification on surface physiochemical properties and protein adsorption were investigated and in vitro cultivation of rat pheochromocytoma cells on the bioactive PDMS showed a significant increase in cell growth and differentiation ***(Biomaterials 2011, 32(21), 4714-4724)***.

In parallel, protein-resistant polymeric layers have been immobilised on platinum electrodes. Small changes in AC impedance were noted in the low and medium frequency ranges. As characterised by quartz crystal microbalance with dissipation, the layers are highly hydrated and permeable with the thickness less than ~10 nm, and can effectively reduce more than 90% of the surface adsorption of both bovine serum albumin and fibrinogen. In vitro evaluation of the stability of the surface modification upon electrical stimulation and the influence of the modification on inflammatory response are currently underway.

PROBING BINDING OF PROTEINS WITH CONDUCTING POLYMER MATERIALS

Many bionic medical devices such as the Cochlear implant and nerve growth conduits require electrically conductive components (e.g. electrodes) to deliver electrical signals to the surrounding cells and tissue. To improve upon current traditional metal electrodes, new types of materials that are softer, more biologically compatible, and can control specific cellular function are in need of development.

ACES/IPRI is investigating the organic conducting polymer (OCP), polypyrrole. In this work the polymer is doped with biomolecules some of which are found in the extra cellular matrix (ECM). Living cells express proteins at their membrane surface that bind through various ECM components for cell adhesion.

Atomic Force Microscopy (AFM) protein functionalised probes are implemented to directly explore the sub-molecular interactions of single fibronectin protein and our polymer materials (see Figure 18).

AFM force spectroscopy resolved single molecule fibronectin interactions including domain unfolding and electrostatic binding at the conducting polymer surface. We have also demonstrated control of specifc fibronectin binding using biological dopants and electrical stimulation.

BIOPRINTING OF HYDROGELS AND CELLS

A bio-ink utilising gellan gum microgel suspensions has been developed with properties tailored to meet the stringent demands of fluid properties for inkjet printing and biocompatibility. The particle size and distribution of the microgel structure was optimised and visualised using fluorescence microscopy. The dual properties of low surface tension required for inkjet printing and protection of cells from fluid mechanical damage were achieved using a combination of polymeric non-ionic surfactants.

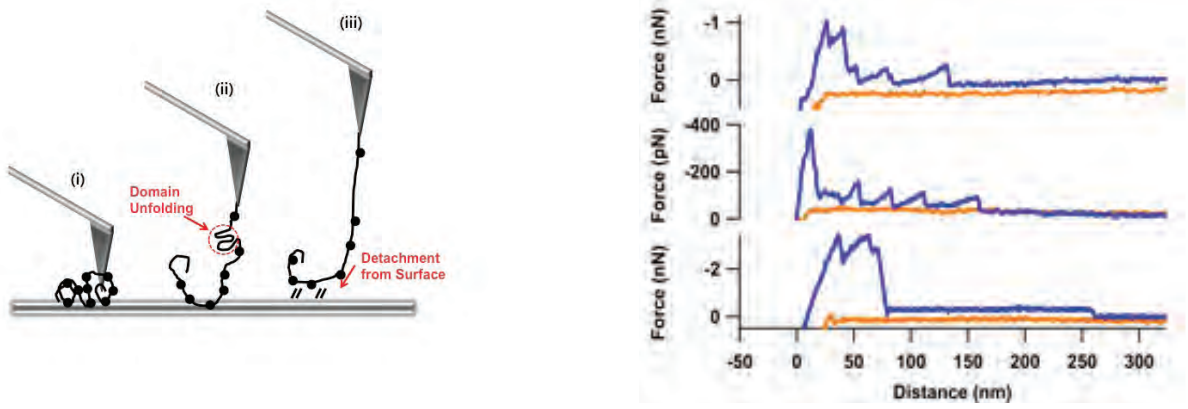


Figure 18: As the protein is pulled off the surface, several binding events occur that relate to how the protein binds to the surface: (i) Bulk detachment from the surface, (ii) domain unfolding and (iii) the final detachment all reveal information about the interaction between the protein and polymer. Related force curves are shown on the right.

Cell printing was achieved using a custom in-house inkjet printer based on modified commercial Xaar print heads. The internal filter was removed from the Xaar print head to allow passage of cells. The bio-ink allowed exceptional control of skeletal muscle and nerve cell printing from multiple-nozzle print heads with proliferation and differentiation of printed cells comparable to controls. Microgel suspensions were also investigated for their potential as 3D cell culture matrices. Continuing work involves modification of the microgel particles by binding peptides to improve cell adhesion.

Single cell printing has been achieved and samples of different cell types provided to Shane Ellis at the University of Wollongong who is investigating the definition of different cell types on the basis of ESA-MS determination of the lipid composition within cell membranes.

Flexible stretchable electrolytes

Flexible stretchable electrolytes are essential for many proposed applications of soft electronics including wearable bionics (see more research on this area in other developments). Research into ionogels, that is polymer networks containing a large volume fraction of ionic liquids, commenced this year with ACES. Two key strategies are currently being employed. In one approach, polymer networks with a bimodal strand length distribution between crosslinks employing PEG prepolymers resulted in exciting preliminary results demonstrating a dramatic increase in both strength and ductility. In the other approach, the relative high viscosity of ionic liquids relative to water is being exploited to produce single networks with few defects and surprisingly large elasticity.

Levi Olsen, an ACES Masters student is leading the investigation into polymer networks with a bimodal strand length distribution. Dr Sureyya Saricilar (ACES RF, UOW) is leading the investigation into single network ionogels by free radical polymerisation.

These strategies have arisen from our comprehensive review, published in 2011, of the literature concerning the mechanisms for producing tough gels ***(Aust. J. Chem., 64, 2011, 1007-1025)***.

Towards biofuel cells

One of the more exciting areas of biofuel cell research has been toward *in vivo* applications, that is, the integration of biofuels cells within the human body. These fuel cells are able to utilise naturally occurring fuels found within the bloodstream, such as the sugar β-D-glucose, to power devices. Such cells can be envisioned to eventually replace the current external power supplies associated with, for example, devices such as the cochlear ear implant which currently rely on bulky, external power packs.

If biofuel cell devices are to become viable alternatives for useful power production, new electrode materials are required that are able to produce more substantial current densities whilst still being able to be integrated within the ever-shrinking size of current devices. This issue is currently being addressed by employing high surface area electrodes that have nanostructured surface architectures.

Shannon Little (PhD, UOW) completed his PhD in August 2010 and graduated in 2011. His work investigated the nanostructured surface of an electrode comprising of an entangled web of carbon nanotubes that allowed for significant amounts of catalytic material to be effectively supported ***(Chem. Commun. 2011, 47 (31), 8886-8888).***

On the ARC Discovery Grant (DP0987344) PhD student Willo Grosse is looking at using enzyme-graphene bioelectrodes as the means with which to drive drug release from conducting polymers.

Ethics Program Activity Report

Further work on milestone: Developed position on the ethical issues surrounding clinical trials of medical bionics

Research on the "burden of normality" has been completed leading to one journal article ***(The Burden of Normality: From 'chronically ill' to 'symptom free'. New Ethical challenges for Deep Brain Stimulation postoperative treatment. This is currently under review)***.

Further work on the appropriate application of the *National Statement on Ethical Conduct of Research Involving Humans* for clinical trials involving medical bionics, in particular devices implanted in the brain continued, developing from Susan Dodds 2010 Asia-Pacific Symposium Nanobionics presentation.

Milestones: Identified and analysed range of approaches to public engagement in development of nano-medicine

Preparation and background research on theoretical and practical design of public engagement mechanism appropriate to nano-medicine

Research on public engagement, deliberative democracy and public trust in science has been completed ***(Trust, accountability and participation: conditions and constraints on 'new' democratic models in The Future of Public Participation Edna Einsiedel and Kieran O'Doherty (Eds) UBC, in press)*** as has research on the role of journalism in engaging the public on issues in innovative technology ***(Deep brain stimulation in the media: over-optimistic media portrayals calls for a new strategy involving journalists and scientifics in the ethical debate, Journal of Integrative in Neuroscience, 2011, 5: 16).***

Progress towards milestone: Designed and conducted public engagement event(s) on bionic devices.

ACES Ethics workshop held in 2011 focused on public engagement in the development of medical bionics. There was support from Department of Innovation, Industry, Science and Research (DIISR) Public Awareness and Community Engagement Section to collaborate in developing a public engagement event in 2012.

Education and Training

ACES is committed to the development of innovative and effective education and training programs for both staff members and students. To achieve these across 6 nodes, ACES provides forums to create an environment of 'open' communication between all members at every node within the centre.

ACES workshop program 2011

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/ meetings are undertaken in the form of: 1 x full centre meeting each year; 3 x face to face program meetings for co-ordination of each program's research and planning of future directions as well as monthly program phone meetings (total 3 per month; co-ordination workshop see Table 2) between all nodes within the centre, where monthly research highlights are shared and discussed. In addition, students and staff are given as much opportunity as finances allow travelling between nodes to undertake multidisciplinary research tasks.

Staff and students also receive many seminars/lectures from numerous visitors and collaborators throughout the year (see Table 1).

'IN HOUSE' MEETINGS AND VISITS

ACES 'IN HOUSE' WATER SPLITTING FORUMS (13 MAY, 15 SEPTEMBER, 15 DECEMBER)

Staff and students from the Monash and UOW nodes of ACES attended three half-day workshops during 2011. The first was held in Wollongong, on Fabricating Cells and Systems for Water Splitting, where participants provided updates on research progress and discussed the way forward on fabrication issues involved in the water splitting technology being developed.

The second event was held at Monash University where again each participant gave updates on their research and a discussion centred on measurements and reporting of results. Both these events had 15-20 participants involved.

The final round table discussion, held in Wollongong, focussed on recapping progress in 2011 and mapping the path forward with national collaborators present.

ACES BIONICS CO-ORDINATION DAYS (21 JUNE, 15 SEPTEMBER, 15 DECEMBER)

The first Bionics co-ordination workshop of 2011 was held at La Trobe University, the second at St Vincent's Hospital, Melbourne and the third at Wollongong Innovation Campus.

All workshops (25-40 participants) 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.

(Left) **The ACES directors and Research Program Leaders;** *(Right)* **representatives of the ACES Bionics team.**

ACES FULL CENTRE WORKSHOP (16 SEPTEMBER 2011)

The full centre workshop was held at Monash University with 75 centre staff and students in attendance.

The director of research, Prof Gordon Wallace, commenced proceedings by highlighting how the ARC Centre operations was undertaking to provide a dynamic, multidisciplinary research training environment for graduate students. He outlined some directions for the vision of the centre beyond 2013. Following this, 8 groups of 8 researchers were given the opportunity to brainstorm then put forward their ideas on what directions the centre should take beyond 2013.

The afternoon session provided the opportunity for postgraduate students to communicate their technical training and demonstrate to the group their inter-laboratory collaborative research.

'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 workshops 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.

ACTIVE AGEING WORKSHOP (14 FEBRUARY 2011)

ACES at UOW hosted a workshop on 14 February, bringing together scientists and workers from the aged care sector. The "Collaborative Research Opportunities: Enabling Technologies for Active Ageing' workshop attendees discussed the potential use of electromaterials to assist movement and active ageing as well as sensing technologies, advances in monitoring and information technology.

Director of ACES at the University of Wollongong, Prof Gordon Wallace, said with limits on current housing and care options, it is increasingly important to encourage active, independent ageing if older individuals are to live in their own homes for as long as possible.

"There are 2.8 million Australians (13% of the population) aged over 65 years and this number is expected to triple in the next 30 years, to 6.4 million. This will lead to an increased demand for aged care services, particularly as one in 10 older people will be accessing some type of aged care service at any one time," Prof Wallace said. "Although 3% of total Australian Government revenues are currently spent on aged care, this could increase to 9% by 2050, half of which is spent on community care".

The workshop involved scientists, engineers, clinicians and aged care workers developing strategies to deal with the emerging problems associated with aged care in Australia.

Presenters at the Active Ageing workshop are (from left) Prof Gordon Wallace (UOW), Scott Edwards (SMR-Automotive), Prof Deborah Sweeney (University of Western Sydney), Dr Bridget Munro (UOW) and Prof Dermot Diamond (Dublin City University) [Missing: Sharon Martin (UOW)]

ACES LECTURES SERIES ON PHOTO-ELECTROCHEMICAL CONVERSION OF SOLAR ENERGY. PHOTO-INDUCED ELECTRON TRANSFER: FROM FUNDAMENTALS TO DEVICES (11-12 AUGUST 2011)

A very successful 2 day lecture series on "Photo-induced electron transfer: From fundamentals to devices" was given in August by 3 ACES visitors, Profs Dirk Guldi (University of Erlangen, Germany), Shogo Mori (Shinshu University, Japan) and Keith Gordon (University of Otago, New Zealand) with 15 ACES and 28 external attendees.

This lecture series provided the opportunity to understand the fundamentals for photo-induced electron transfer process from two distinctly different perspectives.

Prof Guildi explained the factors controlling photoinduced electron transfer rate through donor-acceptor type molecular as well as molecule-carbon nanomaterial interfaces.

Prof Mori started with deriving the differential equations needed to understand electrochemical impedance spectroscopy of photo-electrochemical solar cells. He drives a constant approach to all the time-domain and frequency domain techniques to study electron lifetime and diffusion in photo-electrochemical cells. He finished with summarising his work on the factors determining electron lifetime in organic dye-sensitised titanium dioxide solar cells.

Prof Keith Gordon showed how DFT calculations coupled with Raman spectroscopy can be used to predict and enhance efficient dye-sensitised solar cells.

All speakers are distinguished lecturers at their home institution and gave important insights on how to advance ACES research in this area.

ACES ETHICS WORKSHOP: 'PUBLIC ENGAGEMENT AND PUBLIC TRUST IN EMERGING NANO-MEDICINE' (15 SEPTEMBER 2011)

The ACES Ethics Workshop was held at St Vincent's Institute of Medical Research, Melbourne.

The Workshop had two aims: first, it was part of the ACES education program workshop for PhD students and Early Career Researchers, second, the presentations and panel discussion were designed to help inform the design and development of a public engagement/ 'deliberative event' on nanomedicine to be conducted in 2012, one of the milestones for the Ethics Program.

The audience was primarily composed of early career researchers and PhD students working on issues in bionics and energy from ACES (Monash, La Trobe, Wollongong and St Vincents), as well as more senior ACES and St Vincents researchers.

(L to R): Dr Wendy Russell (Enabling technologies at DSIIR), Prof Susan Dodds (ACES, Uni Tasmania), Georgia Miller (Friends of the Earth Australia), Prof Robert K. Shepherd (Director, Bionics Institute, University of Melbourne) and Assoc Prof Robert Kapsa (ACES, St Vincents Hospital).

The Workshop was opened by Assoc Prof Robert Kapsa, program Co-leader Bionics, ACES/ St Vincents, who welcomed the four speakers:

Prof Susan Dodds (ACES/University of Tasmania) - "An overview of the theoretical directions and setting the stage", introduced some of the theory surrounding public participation in science policy making, deliberation and engagement and linked this to research agendas, government policy and public opinion discussion.

Prof Robert K. Shepherd (Director, Bionics Institute, University of Melbourne) - "The Development of Medical Bionics: from the lab to the clinic", offered a short discussion of where Bionics has been, where it is now and where it may go in the next 5-10 years, identifying some specific areas that merit broader public debate;

Georgia Miller, Nanotechnology Project Co-ordinator, Friends of the Earth Australia - "Perspectives from concerned members of the community", provided an overview of what FOTE see as the safety, environmental and equity and access concerns related to developments in medical bionics, as well issues about "ableisim" (ie the effects of bionics on people with disabilities and the assumption that disabilities should be eradicated) and research priorities;

Dr Wendy Russell, Enabling technologies (Public Awareness and Community Engagement section, Commonwealth Department of Innovation, Industry, Science and Research (DIISR)) - "On government engagement with 'citizen science' ", discussed recent developments in DIISR's public awareness and community engagement strategies, government interest in public engagement activity and the NETS strategy as well as the importance of public oversight of research and technology developments.

ACES COMMUNICATION WORKSHOP, 'ELECTRIFYING SCIENCE' (16 DECEMBER 2011)

Electrifying Science, an ACES science communications workshop was held at Wollongong Innovation Campus. The workshop allowed us to hone our skills in the important area of Science Communications. We heard tips from experienced communicators and took part in a hands-on workshop where each PhD student was aksed to present their research topic in a 'one minute elevator pitch' competition.

Participants were given the opportunity to view the new Nanotech exhibit at the Science Centre, sponsored by ACES.

Speakers at the ACES Photoelectrochemical Lecture Series Prof Dirk Guldi (2nd left), Prof Keith Gordon (3rd left) and Prof Shogo Mori (far right), along with lecture organisers Prof David Officer (far left) and Dr Attila Mozer (2nd right).

Table 1: Seminars provided for students/staff from research collaborators/visitors in 2011

Date	Speaker	Title Presentation
6 Jan	Prof Kyung Hyun Choi Jeju National University, Korea	Seminar given at Wollongong node.
14 Jan	Prof. Benjamin Arazi Ben Gurion University, Israel	Grounds for collaboration between system-level cryptographers and nanotechnology scientists given at Wollongong node.
20 Jan	Dr. Markus Berger Institute of Chemical Reaction Engineering University of Erlangen-Nuremberg	Seminar given at Deakin node
2 Feb	Dr. Jan Novak Department of Chemistry, College of Engineering and Physical Sciences, University of Birmingham	Seminar given at Deakin node
4 Feb	Edwin Jager Linköping University	Organic Electronics at Linköping University given at Wollongong node
23 Feb	Dr. Dirk Fiedler Principal Systems Engineer Cochlear Ltd	Hearing Systems and Their Batteries given at Deakin node
4 March	Hiroshi Nakashima NTT basic research Laboratories, Japan	Developing nanodimensional printing techniques, an ACES NTT collaborative research effort given at Wollongong node
4 March	Prof. Masa Watanabe University of Yokohama, Japan	Seminar given at Deakin node
14 April	Christoph Lungenschmied Konarka Technologies, USA	Organic solar cell manufacturing given at Wollongong node
2 May	Mirek Macka Sydney University	Around the world in four years twice: the science, the fun and the challenges of miniaturised analysis given at Wollongong node
18 May	Hsiao-hua (Bruce) Yu Yu Initiative Research Unit, RIKEN Advanced Science Institute, Japan	Nanostructured and Functionalized Conducting Polymers for Cell Engineering given at Wollongong node

Date	Speaker	Title Presentation
2 June	Professor Hans Coster Director of Biophysics and Bioengineering, School of Chemical and Biomolecular Engineering, University of Sydney.	Characterization of Self Assembled Molecular films, Solar Cells and Polymer films using High Resolution Electrical Impedance Spectroscopy (HiRes EIS) given at Wollongong node
14 June	Steven Wise Sydney University	Synthetic elastin-based vessels for vascular repair
24 June	Tim Hanks Fullbright Fellow Furman University, USA	Approach to building conductive, soft gels for use with implantable medical bionics given at Wollongong node (electromaterials.edu.au/news/UOW103796).
5 July	Yue Chan University of Adelaide	Research activities in Adelaide given at Wollongong node
20 July	Dr. Wanxin Sun Bruker (Veeco)	Seminar given at Deakin node
2 August	Eric Anglaret Laboratoire des Colloïdes, Verreset Nanomatériaux (LCVN) in the Département Matériaux, Polytech Montpellier. Université Montpellier II, France	Optical spectroscopic studies of single walled carbon nanotubes: growth mechanism, charge transfer and anisotropic composites given at Wollongong node
5 August	Sukon Phanichphant Chiang Mai University, Thailand	Research at Chiang Mai, past and future given at Wollongong node
12 August	Douglas J. Mills Senior Lecturer at University of Northampton	Monitoring of anti-corrosive coatings using electrochemical techniques given at Wollongong node
19 August	Paul F. Smith Fulbright Summer student Rutgers University New Brunswick, NJ USA	Electrolytic Water Splitting Device from a Bioinspired Catalyst given at Wollongong node
22 August	Molly Stevens Imperial College London, UK	Seminar given at Wollongong node
26 August	Shane Ellis PhD student Chemistry, UOW	Ambient Air for Ambient Ionization Mass Spectrometry: Method for Assigning Double Bond Positions in Unsaturated Lipids given at Wollongong node
29 August	Dr Yan Mulyana Postdoctoral Research Fellow, School of Pharmacy and Molecular Sciences James Cook University Townsville, QLD	Polynuclear ruthenium complexes: from pharmaceuticals to energetic materials applications given at Wollongong node
14 Sept	Dr. Nicholas Kirkland Department of Materials Engineering, Monash University	In Vitro Biocorrosion of Mg Biomaterials given at Deakin node
19 Sept	Pascal Vallotton Group leader Quantitative Imaging CSIRO Mathematics, Informatics and Statistics	Comparative study of automated and manual tracing for characterizing neuronal arborization patterns given at Wollongong node

Date	Speaker	Title Presentation
26 Sept	Dr Christine Kranz (Surface Sciences Group and Biosensing Research Activities at the Institute of Analytical and Bioanalytical Chemisty, Ulm University, Germany) (electromaterials.edu.au/news/UOW110021) Professor Boris Mizaikoff (Surface Sciences Group and Biosensing Research Activities at the Institute of Analytical and Bioanalytical Chemisty, Ulm University, Germany)	New Strategies towards Micro- and Nanobioanalytics given at Wollongong node On-chip Mid-infrared Waveguides:Toward Miniaturized Label-free Bioassays given at Wollongong node
29 Sept	Prof. John Sader Dept of Mathematics and Statistics University of Melbourne	Dynamics of Nanomechanical Cantilever Sensors given at Wollongong node
6 Oct	Dr.Guangling Song Chemical Sciences and Materials Systems Lab, GM Global Research & Development	Seminar given at Deakin node
11 Oct	George Zhao School of Chemical Engineering The University of Queensland	Modification of Graphene Oxide for Supercapacitor Applications given at Wollongong node
13 Oct	Michael Heimlich (Macquarie University) & Farzard Safaei (School of Electrical, Computer & Telecom Engineering (SECTE) at University of Wollongong)	A review of the Macquarie University Wireless CoRE including our CERT project with initial target application and related collaborations with UOW given at Wollongong node
31 Oct	Nao Kobayashi University of Melbourne	Stem Cells in Tissue Engineering given at Wollongong node
17 Nov	Thierry Seube Solutia Performance Films	An overall introduction to Solutia and some more detailed presentation on the precision coated films they are currently offering to the Flexible PV and other markets (transparent conductive films, UV films, barrier films) given at Wollongong node
18 Nov	John Dougherty & Kevin Kaye Ocean Optics	The story of Ocean Optics given at Wollongong node
1 Dec	Prof. Clare Grey Chemistry Department Cambridge University	Following Function in Real Time: New Methods for Studying Structure and Dynamics in Batteries and Fuel Cells given at the Deakin node
2 Dec	Dr. Alison Davenport School of Metallurgy and Materials, University of Birmingham	Synchrotron studies of localised corrosion given at the Deakin node
5 Dec	Dr. Melanie M. Britton School of Chemistry, University of Birmingham	Visualisation of Chemistry Using Magnetic Resonance Imaging given at the Deakin node

Other Research Training

EARLY CAREER RESEARCHER DEVELOPMENT PROGRAM

Elise Stewart (RF, IPRI) was one of twenty-two Early Career Researchers (ECRs) who undertook the Early Career Researcher Development Program, launched on 6 April by Professor Judy Raper, Deputy Vice-Chancellor Research at University of Wollongong. The program was the first of its kind to be held at UOW and was a joint initiative of Professional and Organisational Development Services (PODS) and the Research and Innovation Division (RAID).

Each ECR applicant was matched with mentors outside their faculty, so as to provide experiences not normally encountered within their own faculties. Elise's mentor was from the School of Physics and he provided a lot of insight into funding options outside the ARC and NHMRC.

The integrated 12-month program combined core and optional workshops on research grant writing and career planning, as well as a confidential coaching session and research mentoring and networking forums on a range of topics. The program aimed to provide both guidance and support to early career researchers with their career planning, as well as assisting the development of the skills and knowledge required to be a successful researcher. Throughout the program lunch-time networking forums were held to allow participants to meet in an informal setting and to benefit from presentations by experienced researchers on a variety of topics.

Elise stated that "Overall the programme benefited me in establishing a peer network from different faculties of the university, and provided me with the skills and confidence necessary for continuing to grow my career within the university and the Australian and International research communities".

PROGRAM FOR PREPARING EARLY LEADERS (PROPEL)

Dr Bridget Munro (UOW), graduated from the inaugural cohort (15 participants pre-selected) in the UOW Program for Preparing Early Leaders (PROPEL) in September 2011. This program was aimed at developing leadership abilities in outstanding pre-leadership academics through workshops, mentoring, project leadership and self-reflection (http://research.uow.edu.au/propel/index.html).

Being involved in the program provided Bridget with the opportunity to be linked with a mentor to discuss her career and options as well as potential leadership prospects. Bridget was fortunate to be mentored by the Emeritus Prof Leon Kane-Maguire and Associate Prof Jenny Beck who both enabled her to critique her CV and academic position.

Associated with the program, Bridget also participated in a project for the Faculty of Health & Behavioural Sciences, investigating methods by which new staff may be supported to immediately engage in research and produce research outcomes. This project involved interviewing a number of staff at different levels to see how they perceived they could be supported and resulted in finding opportunities that could be both used to support as well as encourage staff in their roles. Additionally, the struggles of academics in their roles were highlighted by what were perceived to be "changing goal posts" with respect to advancement in their careers and difficulty in finding an appropriate work-life balance or workload model that they perceived adequately captured their roles.

COMMERCIALISATION TRAINING

Deakin University PhD student Tristan Simons completed Graduate Certificate in Research Commercialisation through RMIT University on 26 October.

PhD students Willo Grosse and Cameron Ferris attended UniQuest Research Commercialisation workshop, 1-8 April on the Gold Coast.

Dr Grant Matheson (RF, IPRI) attended a commercialisation training presentation by ITT on 24 March in the Sydney Business School.

Seminar programs at the various ACES nodes have presented opportunities for all ACES staff and students to improve their communication skills as well as advance their understanding of the science being conducted by visiting research fellows and students. These seminars are a mix of research and commercial topics. For example, students and staff at ACES/IPRI

Early Career Researchers (ECRs) who undertook the Early Career Researcher Development Program, launched on 6 April by Professor Judy Raper, Deputy Vice-Chancellor Research at University of Wollongong.

were given a lecture from John Dougherty & Kevin Kaye of Ocean Optics, Florida, USA on 18 November 2011 on Ocean Optics' very interesting history as a start-up company. It started in the early 1990's with the invention of a miniature spectrometer at the University of Southern Florida and is now a $45 million p.a. enterprise employing 300 people.

OTHER TRAINING

In addition to training and education offered by ACES, each university offers training courses that ACES higher degree research students are able to attend.

For example in 2011:

Fengling Zhou (Monash) undertook SEM training in Monash Centre for Electron Microscopy (MCEM); Monika Fekete (Monash) completed SEM cross-training on the JEOL 7001F at MCEM (10-14 Oct 2011); Tim Khoo (Monash) and Tristan Simons (Deakin) attended Powder Diffraction Workshop on Powder Diffraction Analysis, and Joseph Giorgio (UOW) attended the workshop on Stages of Post Grad Progression and the Emotional Landscape Workshop, 16 August 2011.

VISITS BY ACES STAFF AND STUDENTS

ACES staff and students were given opportunities to discuss their research in different forums throughout the year. These ranged from attending conferences, workshops and collaborative lab visits.

A list of internodal collaborative research visits undertaken in 2011 is given in Table 3.

A list of conference and meeting presentations given by ACES staff and students is listed in Table 4. Note this list is additional to the list of invited talks reported in the International chapter.

The group of propel-'lers', including Dr Bridget Munro, after graduating from the PROPEL leadership course.

Table 2: ACES Research Program Meetings in 2011

Date	ACES program	Topic talks
4 March	Materials	One sentence highlights, Review of Materials targets and milestones (program leader David Officer UOW)
11 March	Energy	One sentence highlights, Review of Energy targets and milestones (program leader Doug MacFarlane Monash)
18 March	Bionics & Ethics	One sentence highlights, Review of Bionics targets and milestones (co-program leader Robert Kapsa SHVM)
1 April	Materials	One sentence highlights, Porphyrins – Beyond solar cells (Pawel Wagner UOW)
8 April	Energy	One sentence highlights, Solid Electrolytes for Fuel Cells (Usman Rana Monash), Electrodeposition of Graphene (Matze Hilder Monash)
15 April	Bionics & Ethics	One sentence highlights, Effect of electrical stimulation on the growth of PC12 cells on carbon nanotubes (Catriona Sinclair, SVHM)
29 April	Materials	One sentence highlights, Ferrocene based electrolytes for DSSC (Torben Daeneke Monash)
6 May	Energy	One sentence highlights, Bio-Batteries (Sha Li and Irin Sultana, UOW)
13 May	Bionics & Ethics	One sentence highlights, PEDOT and Uni SA collaboration (Elise Stewart UOW)
27 May	Materials	One sentence highlights, The potential of new graphenes (Sanjeev Gambhir UOW), Tailoring polythiophenes for your application (Julie Locke UOW)
3 June	Energy	One sentence highlights, Water Oxidation Catalysts (Alex Izgorodin Monash), Water Splitting Process Characterisation (Lei Tong UOW)

Date	ACES program	Topic talks
10 June	Bionics & Ethics	One sentence highlights, Developing Better Bionic Ears: Implications for Improved Sound Perception Using Hi-Fi Cochlear Implants (Ben Allitt, La Trobe)
24 June	Materials	One sentence highlights, What new characterisation toys do we have? (Peter Innis UOW, Patrick Howlett Deakin)
1 July	Energy	One sentence highlights, Thermocells (Mark Romano UOW), Metal-air Batteries (Tim Khoo Monash)
8 July	Bionics & Ethics	One sentence highlights, Neural Growth on microstructured biodegradable polymer fibres (Anita Quigley SHVM)
22 July	Materials	One sentence highlights, What have we made and what do you need? (David Officer UOW)
29 July	Energy	One sentence highlights, Cathode Materials (Yang Yang UOW), Polymerisation on Fabrics (Binbin Yu UOW)
5 Aug	Bionics & Ethics	One sentence highlights, Electrical Stimulation of Primary Muscle Myoblasts on Nanostructured Conductive Polymer Platforms (Anita Quigley SHVM)
19 Aug	Materials	One sentence highlights, Update on ACES research (Gordon Wallace UOW)
26 Aug	Energy	One sentence highlights, Solid State Li Batteries (Pat Howlett Deakin), Graphene Composite Electrodes (Mathias Hilder Monash)
2 Sept	Bionics & Ethics	One sentence highlights, Development Of Biodegradable PLA:PLGA Cell- seeded Muscle conduit Fibre (Tharun Mysore SHVM)
16 Sept	Materials	Full centre meeting held at Monash
23 Sept	Energy	One sentence highlights Bio-Batteries (Sha Li, UOW), Water Splitting Devices (Jun Chen UOW)
30 Sept	Bionics & Ethics	One sentence highlights, Tough Gels (Geoff Spinks UOW)
14 Oct	Materials	One sentence highlights, Beyond dinosaur heads – What are we printing now? (Stephen Beirne UOW)
21 Oct	Energy	One sentence highlights Water Splitting (Alex Izgorodin Monash)
28 Oct	Bionics & Ethics	One sentence highlights, Introduction to Optogenetics (Alex Harris, La Trobe)
11 Nov	Materials	One sentence highlights, Spinning a yarn - what can we now do? (Joselito Razal UOW)
25 Nov	Bionics & Ethics	One sentence highlights, Burden of Normality syndrome : Evidence that brain devices pose a threat to patient's identity? Frederic Gilbert Uni Tas & Eliza Goddard Uni Tas
9 Dec	Energy	One sentence highlights Polymer Water Splitting Catalysts (Orawan Winther-Jensen Monash), Review of Energy Program Goals (program leader Doug MacFarlane Monash)

Table 3: Internodal collaborative research visits undertaken in 2011. This list does not include the in-house meetings discussed above.

Date in 2011	ACES member	Visit and purpose
1 Feb	Robert Kapsa (CI, STV)	Visit to IPRI
8 Feb	Alex Harris (RF, La Trobe)	Visited Bandwidth Foundry and UNSW to discuss manufacture of cochlear implant
9-11 Feb	Alex Harris (RF, La Trobe)	Visited IPRI to discuss manufacture and modelling of tri-layer actuator, polyimide and glues for cochlear implant and polymer coatings for neural recording.
18-23 Feb	Andrew Nattestad (RF, IPRI)	Prepared coated substrates at the Melbourne Centre for Nanofabrication (MCN), using Atomic Layer Deposition process that allows for the creation of pinhole free layers of metal oxides at relatively low temperatures.
27-30 June	Pawel Wagner (RF, UOW) Jun Chen (RF, UOW)	Visited Australian Synchrotron Facility, Melbourne, to perform experiments
22 July	Michele Ma (RF, Monash)	Performing experiments on her synthesised compounds at the Syncatron, Melbourne.
25-28 July	Alex Harris (La Trobe)	Visited IPRI to discuss manufacture and modelling of tri-layer actuator, polyimide and glues for cochlear implant and polymer coatings for neural recording.
29 July	Alex Harris (RF, La Trobe)	Visited UNSW to discuss manufacture of cochlear implant
11 -12 Aug	Jiangjing He (PhD, Monash)	Attended workshop on photo-electrochemical conversion of solar energy, Innovation Campus, Wollongong
17 Aug	Alex Harris (RF, La Trobe)	Visited Swinburne to discuss waveguides for optical stimulation of neural tissue

17 Aug	Tanmaya Joshi (PhD, Monash)	At La Trobe University performing ECL experiments on Ru-PNA-peptide conjugates.
6 Sept	Alex Harris (La Trobe)	Visited UNSW to discuss manufacture of cochlear implant
6-9 Sept	Timothy Khoo (PhD, Monash)	Attended Powder Diffraction Workshop at Australian Synchrotron, titled: Powder Diffraction at Australia's Synchrotron and OPAL Facilities: Experiment Planning to Data Analysis. 4 day workshop on PD analysis.
13 Sept	Joseph Giorgio (PhD, UOW)	Attended the UNSW - ANFF Nanofabrication Workshop held in Sydney
19 Sep	Catriona Sinclair (RA, StVs), Robert Kapsa (CI, STV)	Visited IPRI to host collaborator visit by Pascal Vallotton, Dadong Wang & Matthew Payne, CSIRO

Table 4: Conference presentations at various non-ACES hosted functions and collaborative work nationally and internationally. Note: this list is additional to the list of invited talks reported in the International chapter.

Date 2011	ACES member	Visit and purpose
7-11 Feb	Pawel Wagner (RF, UOW)	Presented oral on New Porphyrin Structures for Light Driven Energy Conversion at 5th International Conference on Advanced Materials and Nanotechnology AMN-5, Wellington, New Zealand
21 Feb- 1 March	Frederic Gilbert (RF, UTAS)	Presented "Nano-Brain-Devices: From Parkinson Treatment to Cognitive and Personality Enhancement" at the Cognitive Enhancement Conference held at the University of Mainz, Germany
16 March	Marc in het Panhuis (CI, UOW)	Participant in workshop to identify the key drivers of successful Australian engagement with European COST actions, Australian Academy of Science, Canberra (media.uow.edu.au/news/UOW098452.html)
27-29 April	Kerry Gilmore (RF, IPRI)	Attended the Annual meeting of the Australasian Society for Biomaterials and Tissue Engineering, Queenstown, New Zealand. Presented oral "Growth and Alignment of Myogenic Cell Types on Polythiophenes". Travel funded by UOW Science Faculty Grant
4 May	Patrick Howlett (RF, Deakin)	Gave a talk on Ionic Liquids, Surface Interactions & Applications for the Nippon Steel visiting representative
6 May	Robert Kapsa (CI, SHVM)	Presented a rapid communication, "Nanostructured Conducting Polymer Scaffolds for Skeletal Muscle" at the 7th Meeting of the Australasian Gene Therapy Society in Melbourne on 6 May 2011
7 May	Robert Kapsa (CI, SHVM)	Presented a rapid communication, 'Improving Gene Mutation Correction in Muscle Disease' at the7th Meeting of the Australasian Gene Therapy Society in Melbourne on 7 May 2011
7-9 June	Susan Dodds (CI, UTAS) Frederic Gilbert (RF, UTAS) Eliza Goddard (PhD, UTAS)	Presented Burden of Normality: Ethical Challenges for Deep Brain Stimulation Treatment at the 18th Annual Conference Australian Association For Professional And Applied Ethics, held at the University of Tasmania, Australia
8 June	Timothy Khoo (PhD, Monash)	Attended Monash University Dept. of Materials Engineering Bi-Annual Winter Conference 2011 (Compulsory for all Monash PhD students). Presented 'Ionic Liquid Electrolytes for Mg/Air Batteries', and won 'Best Speaker and Presentation' Award
8 June	Jiangjing He (PhD, Monash)	Gave a presentation on his research at the Monash University Dept. of Materials Engineering Bi-Annual Winter Conference 2011
15-18 June	Maria Forsyth (CI, Deakin)	Presented a Plenary talk 'Ionic Liquid Based Electrolytes for Lithium and Magnesium Batteries' at the 4th Congress on Ionic Liquids (COIL-4), Washington, DC USA
15-18 June	Jenny Pringle (CI, Monash)	Gave invited talk 'New Materials for Dye-Sensitized Solar Cells' at the 4th Congress on Ionic Liquids (COIL-4), Washington, DC USA. Also presented poster 'Novel organic ionic plastic crystals with cyanate anions'
15-18 June	Paul Bayley (RF, Deakin)	Presented a poster 'Insights into Lithium Coordination in Ionic Liquid Electrolytes for Lithium Batteries' at the 4th Congress on Ionic Liquids (COIL-4), Washington, DC USA

Date 2011	ACES member	Visit and purpose
24-27 June	Jenny Pringle (CI, Monash)	Visited University College Dublin, as part of MASK grant. Meeting with Prof Dermot Diamond, Dr Kevin Fraser, and visiting Monash student Huy Ha
26 June- 1 July	Jim Efthimiadis (RF, Deakin)	Gave a talk on 'Characterisation of Surfaces of Relevance for Metal-air Batteries' at ICMAT 2011 conference held in Singapore
26 June- 1 July	Patrick Howlett (RF, Deakin)	Gave a talk on 'Organic Ionic Plastic Crystals in all solid-state lithium metal cells' at ICMAT 2011 conference held in Singapore
3-8 July	Susan Dodds (CI, UTAS) Frederic Gilbert (RF, UTAS) Eliza Goddard (PhD, UTAS)	Presented 'Brain Intervention and Selfhood: Burden of Normality and Deep Brain Stimulation', at the Australasian Association of Philosophy, University of Otago, New Zealand
3-8 July	Jaka Sunarso (RF, Deakin)	Presented a poster, Lithium doped N,N dimethyl pyrrolidinium tetrafluoroborate organic ionic plastic crystal electrolytes for solid-state lithium batteries, at the 18th International Conference on Solid State Ionics (SSI) held in Warsaw, Poland
17-23 July	Frederic Gilbert (RF, UTAS)	Participated in the 32nd International Congress of Law and Mental Health, held at Humboldt University, Germany
21-23 July	Tanmaya Joshi (PhD, Monash)	Attended a crystallography workshop at University of Western Australia, Perth. The UWA Crystallography Facility is located within the School of Biomedical, Biomolecular and Chemical Sciences
25 July- 5 Aug	Frederic Gilbert (RF, UTAS)	Visited University of Geneva, Switzerland to collaborate on a manuscript with Prof Samia Hurst
July 24- 6 Aug	Mark Romano (PhD, IPRI)	Spent 2 weeks undertaking collaborative work with Na Li, a PhD student working under Dr. Shaoli Fang and Prof Ray Baughman at the Alan G. MacDiarmid NanoTech Institute at the University of Texas at Dallas (UTD)
6-11 Aug	Mark Romano (PhD, IPRI)	Attended the 39th North American Thermal Analysis Society (NATAS) Conference, held in Des Moines, Iowa where he gave an oral presentation on 'Novel Carbon Materials for Thermal Energy Harvesting'
11 -12 Aug	Jiangjing He (PhD, Monash)	Attended workshop on photo-electrochemical conversion of solar energy, Innovation Campus, Wollongong
14-18 Aug	Rosalie Hocking (RF, Monash)	Gave and oral entiltied 'Water Oxidation by Mn in a Geochemical-Like Cycle' at the Towards Global Artificial Photosynthesis Conference held 14-18 August 2011 on Lord Howe Island, Australia
8-19 Aug	Frederic Gilbert (RF, UTas)	Visited the University Medical Centre Ljubljana Department of Neurosurgery to collaborate on a manuscript with Andrej Vranic, MD, PhD Slovenia
10 Aug - 7 Sept	Ted Abraham (PhD, Monash)	Ted travelled to Washington DC, USA to attend the 4th Congress on Ionic Liquids where he presented a poster titled "Seebeck Coefficients in Ionic Liquids-Prospects for Thermo-electrochemical Cells". He then did collaborative work with Prof Ray Baughman's group at the Alan G. MacDiarmid NanoTech Institute at the University of Texas at Dallas (UTD), testing ionic liquid electrolytes with dissolved ferri/ferrocyanide in a thermocell device
4-9 Sept	Robert Kapsa (CI, SHVM)	Rob delivered a rapid communication, "Hybrid Microstructured Biodegradable-Conducting Polymer Platforms for Skeletal Muscle Engineering" at the the 24th European Conference on Biomaterials, 4-9 September 2011, Dublin, Ireland
4-9 Sept	Elise Stewart (RF, UOW)	Elise delivered talk on 'Heparin-doped Polypyrrole for Selective Control of Neo-Intimal Cell Growth' at the 24th European Conference on Biomaterials, 4-9 September 2011, Dublin, Ireland
6-9 Sept	Timothy Khoo (PhD, Monash)	Attended Powder Diffraction Workshop at Australian Synchrotron, titled:Powder Diffraction at Australia's Synchrotron and OPAL Facilities: Experiment Planning to Data Analysis. 4 day workshop on PD analysis
13 Sept	Joseph Giorgio (PhD, UOW)	Attended the UNSW - ANFF Nanofabrication Workshop held in Sydney

Date 2011	ACES member	Visit and purpose
20 Sep	Timothy Khoo (PhD, Monash) Tristan Simons (PhD, Monash)	Attended Clean Vehicle Conference 2011 at Deakin University, Geelong
20-23 Nov	Cameron Ferris (PhD, IPRI)	2nd International Conference on Medical Bionics, Philip Island. Oral presentation titled "Bio-ink for inkjet printing of living cells". Awarded student prize of complimentary conference registration Also presented poster on behalf of Kerry Gilmore (RF, IPRI) titled "Mimicking the native nerve cell environment to investigate electrical stimulation in three dimensions"
20-23 Nov	Amy Gelmi (PhD, IPRI)	2nd International Conference on Medical Bionics, Philip Island. Awarded best poster prize $500 for conference
20-23 Nov	Alex Harris (RF, La Trobe)	Presented his work on 'Conducting Polymer Coated Neural Recording Electrodes' at the 2nd International Conference on Medical Bionics, International Conference, Phillip Island, Australia
20-23 Nov	Cathal O'Connell (PhD, IPRI)	2nd International Conference on Medical Bionics, Philip Island. Poster presentation
20-24 Nov	Patrick Howlett (RF, Deakin)	Attended the 18th International Corrosion Congress - Perth 2011
20-24 Nov	Yafei Zhang (PhD , Deakin)	Presented a talk on 'Control of Biodegradation of a Mg alloy in Simulated Body Fluid' at the 18th International Corrosion Congress - Perth 2011
28 Nov	Liyu Jin (PhD, Monash)	Presented his work on 'Solid-state NMR linewidth study of Molecular Motions in Organic Ionic Plastic Crystal Diethyl(methyl)(isobutyl) Phosphonium Hexafluorophosphate' at ANZMAG, Torquay, Australia
28 Nov-2 Dec	Elise Stewart (RF, UOW)	Elise's work on 'High conductivity PEDOT as a substrate for cell adhesion and proliferation' was presented in an oral by Gordon Wallace at the MRS Fall Meeting, Boston.
3-14 Dec	Kerry Gilmore (RF, IPRI)	Travelled to USA to work with Organovo Inc., on URC Partnership Grant project Investigations into the innate cellular response to electrical stimulation via bioprinting of 3D composite structures
Dec	Rosalie Hocking (RF, Monash)	Presented her research on 'Making and Characterizing Catalysts for Clean Energy: A Challenge for X-rays and Electrons' at the Australian Synchrotron User's Meeting held in Melbourne

Attracting PhD students

ACES provides an exceptional research environment, with a collection of research training skills and facilities that is internationally renowned.

EMPHASIS ON LINKS WITH INDUSTRY

'Built with strong links' by Keeli Camborne Sydney Morning Herald, 3 September 2011 (www.smh.com.au/national/postgraduate-education/built-with-strong-links-20110901-1jnmj.html#ixzz1fLYAGDFo)

ACES recognises that one of the most important aspects of the institute is the links to industry, which helps not only fund vital research but increase the intellectual capacity of the centre.

''Industry links like we have here not only provide PhD training but also provide an interface with industry and a lot of our PhD students are working with companies involved in the sector of their research,'' Gordon Wallace states.

''We have one student working with Cochlear doing research and another for CapXX, a Sydney-based company looking into new electrodes for supercapacitors. We are attracting PhD students from all over the world into the institute because we can provide state-of-the-art facilities and networks. But this would not be possible if not for industry links".

With an undergraduate degree in polymer engineering from Iran, a master's degree in materials science from Britain and more than 10 scientific publications to his name, Sina Jamali is a highly qualified student in his field.

Jamali's global network of contacts meant he could have gone anywhere to further his studies and complete his PhD in polymer engineering but the Iranian-born scientist chose the University of Wollongong's Intelligent Polymer Research Institute at the ARC Centre of Excellence for Electromaterials Science (ACES) because of the reputation of its director, Professor Gordon Wallace, and its extensive links to industry.

''I was looking for a PhD position all around the world and was always keen to work with Gordon Wallace,'' Jamali says. ''For a PhD position, there are not too many places around the world like Wollongong University that has such close links to industry.''

Jamali is part of a team of researchers - another PhD student is based at Deakin University - working on the long-term project for Boston Scientific through ACES.

STUDENT TRAINING SCHEME 2012

In 2012 ACES/IPRI introduces a Student Training Scheme, to ensure a more consistent training environment for all PhD students. It is proposed that all new PhD students will enrol in four fee-free, compulsory, coursework subjects that will provide core research skills relevant to ACES/IPRI research and combine theoretical and practical assessments.

INTERNSHIPS

ACES/IPRI has offered 6 internships to finishing first year students (tax free $ 10000 for the remaining 3 years of study); three in the area of nanobionics and 3 in the area of fabrication/prototyping and energy.

Those scholarships include:

- Summer Work within IPRI working in various areas such as the ACES outreach program and developing their own research project (2 periods of eight weeks work after their 2nd and 3rd years of study).
- During the year, they are mentored by an IPRI PhD student or research fellow to develop their professional, research and work skills.
- Active participation in IPRI events including weekly research seminars.
- A guaranteed place in an honours project within IPRI.

As ACES is a multidisciplinary team, in this inaugural year 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).

SUMMER SCHOLARSHIPS

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

In January 2011 two 3rd year communications students, were engaged on summer scholarships to create web-based communication packages; consisting of digital press kits on ACES Energy and Medical Bionics activities.

TOP-UP SCHOLARSHIPS ENGAGE PHD STUDENTS IN WOLLONGONG SCIENCE CENTRE

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 is due to open in 2012.

The information panels will be accompanied by interactive displays, engineered by Bluescope Steel cadets, for which IPRI supplied samples.

Another ACES PhD student Cathal O'Connell has been assisting the Wollongong Science Centre with the set 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 work has involved helping to reconcile the proposed shows with the current NSW high school syllabus; assisting with the implementation of new software to run the mobile planetarium and with the Peter Wothers Chemistry Show run in October at the science centre.

Cathal has provided custom printed Dip Pen Nanolithography samples for inclusion into the new Nanotechnology exhibit.

Throughout 2011, Cameron Ferris (PhD ACES/UOW) represented ACES through various outreach activities to the university, schools and local community. These included:

- presenting his research at the Bill Wheeler Award Ceremony on 14 July at the Wollongong Science Centre,
- presenting at the UOW Higher Degree Research Getting Published Workshop on 8 September,
- assisting Marc in het Panhuis (ACES CI, UOW) with the keynote address at Illawarra Coal Regional Science Fair on 2 October,
- giving the closing address about his time in ACES at the 'Elevate Young Leaders Forum' held on 4 October at UOW.

Cameron also assisted ACES Communications and Media Officer, Natalie Foxon, in planning internal events and outreach activities for undergraduate students. In addition, together they have drafted a video blog series which will communicate ACES research to the wider community. Filming will commence in 2012.

International Profile

ACES continued to attract research scientists from around the globe to participate in collaborative research.

In 2011 ACES scientists participated in 47 international laboratory visits (plus 11 additional visits courtesy of the IRSES exchange program); being privileged to have been invited to give 89 invited presentations/lectures and has developed global connections in 22 countries (and a number of universities within countries): Belgium (1), Canada (1), China (4), Estonia (1), Finland (1), France (5), Germany (8), Iran (2), Iceland (1), Ireland (3), Italy (1), Japan (7), Korea (4), Netherlands (2), New Zealand (2), Poland (1), Slovenia (1) Sweden (1), Switzerland (3), Thailand (1), United Kingdom (5) and USA (13).

In 2011 ACES nodes hosted 45 international researchers who used the ACES laboratories /facilities to undertake their research work, confirming that the facilities built at ACES since inception are state-of-the-art and world class.

International symposia hosted by ACES continue to 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.

International Symposia hosted/co-hosted by ACES

6TH ANNUAL INTERNATIONAL ELECTROMATERIALS SCIENCE SYMPOSIUM

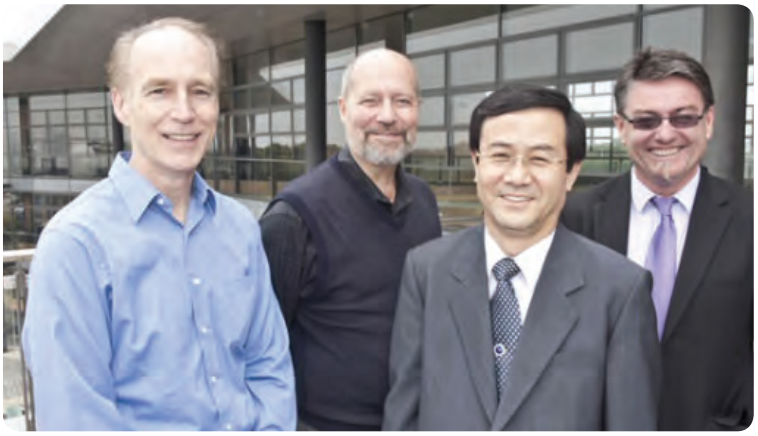
Spotlight on new materials for energy at international symposium(media.uow.edu.au/news/UOW095550.html)

More than 150 delegates from Australia and overseas attended the three-day International symposium 9-11 February which highlighted the latest advances in nanostructured electromaterials with a particular focus on their use in energy conversion and storage.

The 'Nanostructured Electromaterials / New Materials for Energy' themed event was conducted by ACES and co-hosted by the Korean Electrochemical Society (KES) and the Electrochemistry Division of the Royal Australian Chemical Institute (ED RACI). ED RACI represents all branches of electrochemistry in Australia and the KES electrochemical community actively explore and support global co-operation of green science and technology.

More than 20 researchers from Korea presented their latest findings. Active collaborative research links have been already established with a number of groups in Korea (at Hanbat, Hanyang and Gangneung University). The research involves development of new materials for energy conversion and storage as well as medical bionics. This has led to breakthroughs in the development of materials with high energy storage capacity, flexible materials for energy storage and new artificial muscle systems.

Other invited speakers included: Prof Charles Dismukes (Rutgers University, USA), Prof Dermot Diamond (Dublin City University, Ireland), Prof Dirk Guldi (ICMM, Germany), Prof Richard Kaner (UCLA, USA), Prof Ray Baughman (UTD, USA), Prof Philippe Poulin (CNRS, France), Prof Wolfgang Schuhmann (University of Bochum, Germany), Prof Alan Bond (Monash University, Australia) and Prof Roland De Marco (Curtin University of Technology, Australia).



Left: **Prof Jung-Ki Park (KAIST, President of Korean Electrochemical Society), Prof Gordon Wallace (Director ACES) and Prof Justin Gooding (UNSW and RACI) hosted the 6th annual international electromaterials symposium 9-11 February.** ***Right:*** **Among the symposium participants (from left) are Prof Charles Dismukes (Rutgers University, USA); Prof Ray Baughman (UTD, USA); Prof Jung-Ki Park (KAIST, Korea); and Prof Gordon Wallace (UOW).**

2ND INTERNATIONAL FORUM ON GREEN ENERGY AND ELECTRONIC MATERIALS

(UOW plays host to green energy forum http://media.uow.edu.au/news/UOW098833.html)

UOW's Innovation Campus (ACES/IPRI and ISEM) played host to participants involved in the 2nd International Forum on Green Energy and Electronic Materials which covered topics ranging from electric vehicles to nano-materials for energy and electronics on 28-29 March. The main goal of the forum was to promote national and international co-operation and partnership between academics and industry leaders in energy and electronic materials and applications. This forum brought together Australian and international experts as well as industry partners and end-users working in these challenging research fields.

Among the key delegates attending the forum were the President of Hyper Tech Research Inc from the US, Mr Mike Tomsic; Dr Yao Chen (CEO) and Dr Xue Feng Gao (CTO) from DLG Battery Ltd in China; the CTO of Hypres Ltd, Professor Oleg Mukhanov; the CEO of Columbus Superconductors , Italy, Professor Giovanni Grasso; Mr Michal Paay from Redarc Electronics Ltd; the Tech Manager of Galaxy Resources Ltd, Dr Yatendra Sharma; the President of Cens Energy Tech Co in China, Professor Gechen Li; the CEO of Auto CRC, Dr Mike Cuthbertson; and Prof Hideo Hosono from Japan who discovered iron based layered superconductors.

Invited ACES speakers included Prof Maria Forsyth and Prof David Officer.

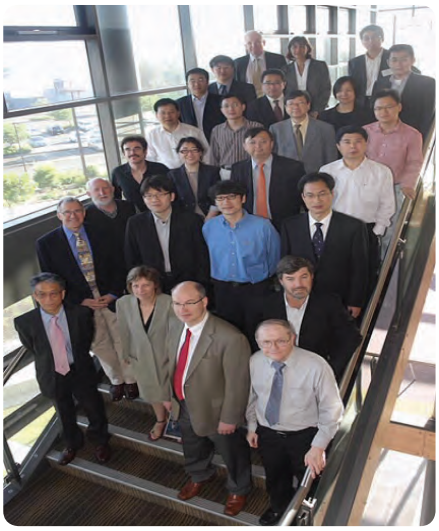
RHEOLOGICAL AND MECHANICAL PROPERTIES OF HYDROGELS WORKSHOP, UNIVERSITY OF WOLLONGONG

(UOW 'just right' for international workshop see at http://media.uow.edu.au/news/UOW108450.html)

The workshop, held 28 July, explored the understanding of these two fields of science and the opportunities available for the use of hydrogel structures in emerging applications such as medical bionics. One of the outcomes of the workshop was that a combined assessment of the rheological and mechanical properties of the hydrogels formed from seaweed derived biopolymers may provide a new and renewable source of biopolymers for medical applications.

Contributions on hydrogel devices was given by international experts on rheology Dr Ross Clark (CP Kelco, San Diego, USA), and Professor Paul Calvert (University of Massachusetts, USA). Resident UOW hydrogel experts Professor Hugh Brown and Dr Phil Whitten spoke about toughening mechanism in double network gels and fibres. Workshop organisers Professor Spinks and Associate Professor in het Panhuis gave overviews of their ARC funded research on polyelectrolyte hydrogels materials for mimicking muscles and soft tissue. Director of UOW's Shoalhaven Marine and Freshwater Centre Dr Pia Winberg and CP Kelco Asia Pacific Manager Phil Jackson addressed the question of 'where to from here?' in the workshop's final session. Both researchers recognised the need to tap into Australia's abundance of seaweed for providing hydrogel forming biopolymers.

The workshop was sponsored by Faculty of Science, Soft Materials Group, Intelligent Polymer Research Institute, ARC Centre of Excellence for Electromaterials Science and RACI NSW Polymer Group.



Key speakers at the 2nd International Forum on Green Energy and Electronic Materials held at Innovation Campus.

Speakers from Australia and around the world gave presentations at the hydrogels workshop held at UOW.

ACES Collaborations by Country

BELGIUM

After a visit from Prof. Herman Terryn and Dr. Yaiza Gonalez Garvvia, from the Electrochemical and Surface Engineering Research Group, Vrije Universiteit, Brussels (VUB) to ACES/Deakin University in November 2011, Dr Angel Torriero and Dr Patrick Howlett have established a collaboration with Prof. Herman Terryn to develop the application of Ionic Liquids to control the morphology of metal deposits. The team will lodge a joint ARC DP13 proposal in this area and a Research Fellow from Terryn's group will visit in February-March 2012. Dr Torriero will visit Terryn's group in 2012.

CANADA

ACES/IPRI has a strong ongoing collaboration with John Madden at University of British Columbia (Vancouver, Canada) on actuator applications. In 2011 this collaboration led to the highly successful work reported in ***Science (2011, 334 (6055), 494-497)*** on twisted carbon nanotube artificial muscles as well as work on an application to develop a 'steerable catheter'.

CHINA

Prof. Chunqi Feng from Hubei University, China, visited Prof Hua Liu (ACES/ISEM) for 6 months until January 2011 to work on the lithium ion battery project.

Libing Liu, an associate professor in the Institute of Chemistry at the Chinese Academy of Science, visited IPRI/ACES to conduct collaborative research on novel photoactive electromaterials for 8 weeks from 3 October. He worked with Dr Jun Chen (RF, ACES/UOW) and was supported by the ARC Discovery Grant (DP0877348).

Dr Jun Chen (RF, ACES/UOW) has had two joint publications in 2011 in the area of rechargeable batteries with collaborators at Shanghai Jiao Tong University; (i) a novel bath lily-like graphene sheet-wrapped nano-Si composite as a high performance anode material for Li-ion batteries (***RSC Advances, 2011, 1, 958-960***) and MWNT/C/$Mg_{1.03}Mn_{0.97}SiO_4$ Hierarchical Nanostructure for Superior Reversible Magnesium Ion Storage ***(Electrochemistry Communications, 2011, 13, 1143-1146).***

Binbin Yue, a PhD student studying under the direction of Professor Xin Ding at Donghua University, China, completed a one year attachment to ACES/IPRI, to allow her to continue with her project "building polymer batteries in textile structures using biocompatible materials". In ACES/IPRI she worked with Dr Caiyun Wang on polypyrrole coated fabrics as stretchable electrodes for supercapacitor applications (paper submitted to ***Electrochimica Acta***). Binbin was fully supported by the China Scholarship Council (CSC) program 'Chinese Top University Graduate Students Studying Abroad'.

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.

FINLAND

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.

A PhD student from Abo Akademia University Michal Wager worked at ACES/IPRI for 6 months from January, using Dip Pen Nanolithography (DPN) to print nanostructured electrodes as a new platform for sensing.

Michal Wagner from Abo Akademia University, Finland

Prof Gordon Wallace (ACES) visited Abo Akademia University in Turku, Finland (5 May 11) to present a talk on the centre's recent developments in producing new electromaterials for energy and medical bionics (electromaterials.edu.au/news/UOW100779).

PhD student Amy Gelmi spent 4 weeks with Prof Ari Ivaska's team from Abo Akademia University to investigate the electrochemical properties of PEDOT:PSS based inks developed for Dip Pen Nanolithography (DPN), in both the bulk material and printed arrays. This trip was funded by the international exchange program Materials and Advanced Sensor Knowledge Exchange (MASK) part of the Marie Curie International Research Staff Exchange Scheme (IRSES). See in section below a complete report on IRSES activities in 2011.

FRANCE

Ms. Maureen Tsagouria from European School of Chemistry, Polymers and Materials Science (ECPM), University of Strasbourg, France completed six months research (15 February -15 August) with Mr. Tim Khoo, Dr. Jim Efthimiadis, Dr. Patrick Howlett and Prof. Maria Forsyth on Ionic Liquid electrolytes for Magnesium/Air Batteries and solid plastic crystal electrolytes for Lithium batteries.

Assoc Prof Paul Keller (ACES CI) and his ACES PhD student Sreenu Jennepali are currently developing the synthesis of octapeptidefullerene structures for coordination with porphryins as potential charge transfer catalysts. To date they have

made smaller oligomers and are currently in contact with their French collaborator, Dr Nathalie Solladie, at the University of Toulouse in France, to look to trialling these units with porphryins.

Prof Gordon Wallace visited The Centre National de la Recherche Scientifique (National Center for Scientific Research or CNRS) in Bordeaux, France on 2 May 11 and presented the most recent developments in the ACES bionics program to an enthusiastic audience (electromaterials.edu.au/news/UOW100853).

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, resulting in a number of important publications.

The collaborative research programs have been supported by the Australian Research Council, the Australian Academy of Sciences and the French government via the PICs program and this has enabled exchange of staff and students over an extended period.

This relationship continued when Willo Grosse (PhD, IPRI) travelled to France and spent 6 weeks (20 May-30 June) working with Dr Nicolas Manu's group at the Centre de Recherche Paul Pascal, Bordeaux, France. Willo was working towards new bioelectrodes for biofuel cells, and whilst in France gained understanding and experience in two key techniques: enzyme purification/deglycosylation and Osmium redox polymer synthesis.

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 in 2011, mainly as a result of MASK IRSES funding.

GERMANY

PhD student Helger Hosse from LMU University Munich spent 3 months from 5 January in ACES/IPRI working with Dr Attila Mozer on dye-sensitised bulk heterojunction solar cells.

Katharina Schirmer from the University of Applied Sciences, Hochschule Bremen spent January and then again in August-September working in the area of Bionics with researchers at St Vincents Hospital Melbourne.

Monash University has strong collaborative links with the University of Leipzig, located in Leipzig, Saxony, Germany. In 2011 they hosted 3 students; Marieke Walther (Jan-August), Anna Gerbhardt and Martina Lichtnecker (Nov 11- Feb12). Prof Roger Glasser from Leipzig University visited Monash University on 5 October.

Prof Markus Berger from Institute of Chemical Reaction Engineering at Erlangen University visited Deakin University on 20 January and Monash University on 25 February.

Dr Klaus Lips and Alexander Schnegg, from the Helmholtz Centre Berlin for Materials and Energy, visited Monash University in the February -March 2011 period as part of a joint Australia-Germany Solar Photovoltaics Collaborative Research Grant looking at manganese water oxidation catalysts.

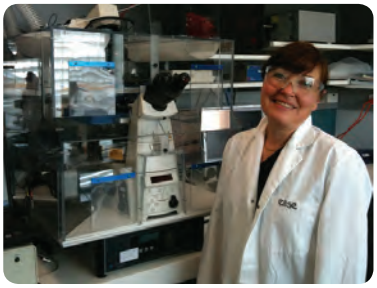
Dirk Guldi, Professor at Friedrich-Alexander-Universitaet in Erlangen, made two trips to ACES/IPRI in 2011; 8-27 Feb and 1 July to 15 September. Dirk's speciality is nanostructured carbons for solar energy. He was here to carry out research within ACES in the development and characterisation of novel materials for water splitting. This included preparation of novel metal oxides and attachment of porphyrin based catalysts. Whilst here Dirk also used the state of the art characterisation tools to assess these new materials for use in water splitting systems.

Whilst in Wollongong, Dirk was one of three presenters at the very successful 2 day lecture series on '*Photo-induced electron transfer: From fundamentals to devices*' (for more information see education section).

Following Prof Dirk Guldi's two periods of sabbatical leave and as part of the strengthening ties between Friedrich-Alexander-University Erlangen-Nuremberg (FAU) and the University of Wollongong, Prof David Officer (ACES, CI) went to Germany in December 2011.

Whilst in Germany, Prof Officer gave an invited lecture at the conference 'Next Generation Solar Energy – From Fundamentals to Applications'. He also held meetings with Profs Tim Clark, Rainer Fink (Professor of Physical Chemistry) and Dirk Guldi (HoD) from the FAU Department of Chemistry and Pharmacy and leading members of the German Cluster of Excellence "Engineering of Advanced Materials (EAM)" to discuss the first joint Erlangen-University of Wollongong PhD student, Markus Pfau. Markus will work with Profs Guldi, Clark and Officer starting in 2012. A joint FAU-UOW and Centre of Excellence (EAM-ACES) symposium is proposed for October, 2012. More than 10 students have been part of this exchange over the last 5 years.

Head of the Surface Sciences Group and Biosensing Research Activities at the Institute of Analytical and Bioanalytical Chemisty at Ulm University in Germany, Dr Christine Kranz, gained funding to facilitate a bilateral research project with Dr Michael Higgins (ACES/IPRI). Michael travelled to Ulm in December 2010 on an Australia-Germany Researcher Mobility Call 2010/11 and Christine spent 4 weeks in IPRI from 3 August (electromaterials.edu.au/news/UOW110021). The research was focused on the development of organic nanoelectrodes for better integration with single neural networks and the clinical treatment of neurological injury and disease. This involved developing new Atomic Force Microscopy probes which will be used in the new advanced Bio-AFM systems and will enable ACES researchers to explore the world where conducting nanomaterials meets biology.



Dr Christine Kranz from the University of Ulm in Germany

ACES/IPRI PhD student Amy Gelmi visited Ulm in September to continue research on functionalised AFM tips for Bionic applications.

Monash PhD student Archana Singh has been in Berlin performing experiments with Drs Alexander Schnegg and Dr Klaus Lips at the Helmholtz Zentrum Berlin for Materials and Energy for the last 4 months of 2011 as part of an Australia-Germany Solar Photovoltaics Collaborative Research Grant. Archana has been carrying out advanced EPR experiments on the manganese water oxidation catalysts.

Prof Leone Spiccia was on sabbatical with Prof AK Powell at the Karlsruhe Institute of Technology from March-June 2011 working on new materials for dye sensitised solar cells and water splitting devices.

At the end of March 2011, he attended the Humboldt Foundation meeting in Bamberg at which he was presented with a Humboldt Research Award.

He was subsequently on sabbatical at the Helmholtz Zentrum Dresden Rossendorf and Helmholtz Zentrum Berlin from August-November 2011, working on the application of nanoparticles in multi-modal diagnosis of cancer, mechanistic aspects of manganese water oxidation catalysis and tandem water splitting devices.

Whilst in Germany, Prof Spiccia visited a large number of universities and research organisations in Germany, France, Switzerland, Czech Republic and Poland to deliver seminars (see 2011 invited talks) and discuss potential areas of collaborations.

ICELAND

Monash University hosted PhD student Bartlomiej Kolodziejczyk, from the School for Renewable Energy Science, Iceland, from April through October.

INDIA

Led by Australian cricketer Adam Gilchrist, Prof Gordon Wallace formed part of a UOW delegation that travelled to India 3-7 December, to promote ACES to both businesses and universities under the banner of establishing collaborations in the key area of 'Future Materials'. Gordon also presented a keynote address at Bangalore Nano (www.innovationcampus.com.au/news/gilchrist-leads-scientific-team-on-indian-tour/).

IRAN

Dr. Masih Resaee from Amirkabir University of Technology, Iran is working on Titanium Dioxide with Prof Hua Liu (ACES/ISEM) for 12 months from August 2011.

Ms. Nahid Iranipoor from the Materials Engineering Faculty in Sahand University of Technology, Tabriz, Iran completed 9 months research (1 April- 20 Dec) with Prof. Maria Forsyth, Prof Bruce Hinton and Dr Patrick Howlett at ACES/Deakin University.

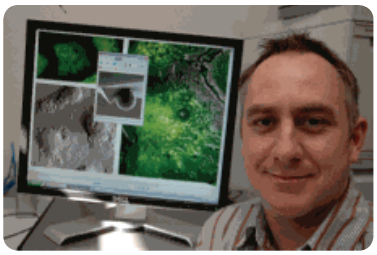
IRELAND

Prof Dermot Diamond from Dublin City University, Ireland visited ACES/IPRI from February for a month. During his time with ACES he participated in the 6th Annual International Electromaterials Science Symposium; the 'Collaborative Research Opportunities: Enabling Technologies for Active Ageing' workshop; participated in the launch of the IRSES MASK project (visiting Tasmania as well) and was instrumental in establishing a collaborative research project with the Illawarra Retirement trust and ACES/IPRI.

Presently in progress is development of a demonstration energy monitoring network in collaboration with CLARITY (Dublin City University) for deployment within Illawarra Retirement Trust (IRT) to establish the communications platform for wearable bionics (more about this project can be found in the End-User section).

Cormac Fay, a PhD student from Dublin City University, spent 3 months from February in ACES/IPRI, developing technologies to realise the transition from remote sensing, real time retrieval via the World Wide Web.

A significant publication on image analysis software has resulted from collaboration between ACES and Oscar award winning scientist Prof Anil Kokaram from the Department of Electronic and Electrical Engineering at Trinity College Dublin, Ireland. The publication involves the development of image analysis software, called 'Cellsnake', to quantitatively determine the extent of muscle fibre formation. The 'Cellsnake' software will significantly reduce the bottleneck in the development of bionic devices, by automating the imaging analysis process ***(IEEE International conference on Image Processing (ICIP) 2011, Brussels).***



Co-author of 'Cellsnake', ACES Research Fellow Dr Michael Higgins.

Other visits of ACES staff and students to Ireland in 2011 were associated with funding for an international exchange program MASK IRSES.

Artist and Scientists explore the Future of our Species at New Exhibition at the Science Gallery, Trinity College Dublin. During HUMAN+, Science Gallery hosted talks and performances from world-renowned artists, scientists and visionaries. Prof Gordon Wallace gave his presentation on Organic Bionics on 18 April.

What is the next step for humankind? Will we learn to take control of our own evolution or enhance our senses to allow us to see ultraviolet light, feel magnetic fields or hear ultrasound? Can we defeat ageing and extend our lives indefinitely? What would be the consequences for the environment and for our social relationships? These questions are explored in HUMAN+, a major new exhibition, supported by the Wellcome Trust, and has been developed as part of the Tercentenary celebrations of the Trinity College Dublin's School of Medicine and Trinity College's new centre for humanities.

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

Prof Spiccia visited Prof Francesco Arena at the University of Messina in July 2011 to discuss joint research on metal doped manganese water oxidation catalysts and waste water purification.

JAPAN

Yu Umemura, a student from University of Tsukuba in Japan, visited ACES/IPRI for 3 months from 12 January to work with Dr Attila Mozer doing solid-state dye-sensitised solar cells using a photo-electrochemical deposition method.

ACES/IPRI hosted Hsiao-hua (Bruce) Yu from the Yu Initiative Research Unit at the RIKEN Advanced Science Institute in May. Bruce works on 'Synthetic organic chemistry directed toward materials science', so took this opportunity to discuss collaborative synergies.

Dr Hiroshi Nakashima, from Nippon Telegraph & Telephone Corporation (NTT), completed his 12 month research visit to ACES/IPRI in May, where he worked on developing nano-dimensional printing techniques.

Dr Kei Matsumoto, from Tottori University in Japan, was hosted by Monash University from April 2011 and will be with the group through to January 2012.

Prof Watanabe and Naoki Tachikawa from Yokohama University visited Deakin University on 4 March and Monash University on 7 March.

Long-time collaborator Prof Shogo Mori from Shinshu University visited ACES/IPRI for two weeks in August to discuss ongoing projects with Dr Attila Mozer focused on dye-sensitised solar cells.

Along with partner investigator Prof Keith Gordon (University of Otago, New Zealand), Prof Mori and Dr Mozer held the first project meeting involving the new ARC Discovery Project which is aimed at developing multichromophore organic dyes for dye-sensitised solar cells.

Both these renowned international partner investigators then presented a series of lectures over two days on Photo-electrochemical conversion of energy.

Dr Mozer was granted a JSPS Short Term Visiting Fellowship (Invitation Only) by the Australian Academy of Science and JSPS and spent 60 days working on femto-second spectroscopy of donor/acceptor bulk heterojunction solar cells. During his stay Dr Mozer gave 3 talks (2 invited) and worked in 3 research laboratories; AIST, Tsukuba, Shinshu University and Nihon University.

ACES/IPRI PhD student Matt Griffiths, a recipient of an Australia Asia Endeavour Award in 2009, spent 6 months of 2010 in Prof Shogo Mori's laboratories developing his research in nanotechnology applied to solar energy, then in January 2011 visited Prof. Akihiro Furube and Dr. Ryuzi Katoh at AIST in Tsukuba, Japan, before returning to Australia.

Prof Gordon Wallace travelled to Japan twice in 2011. In February (14-18), he presented ACES research at RIKEN and at Sekesui. He returned to Japan in June, presenting the latest developments in nanostructured electromaterials for energy and medical bionics to both Sony and at the NTT Basic Research Laboratories.

Sony Senior Vice President, Corporate Executive Dr Kumugai hosted Prof. Wallace during his visit. ACES and Sony have established highly complementary research programs in the areas of solar cells, biobatteries and organic electronics.

At NTT, Prof. Wallace was hosted by a good friend of ACES, Hiroshi Nakashima, who had returned to Japan following a 12 month research visit at IPRI. ACES and NTT intend to continue to build on these exciting collaborative research developments.

Prof Leone Spiccia was appointed to the position of Specially Appointed Professor in the Catalysis Research Centre at Hokkaido University, a short term position that he will take up early in 2012.

KOREA

In February more than 20 researchers from Korea presented their research at the International Symposium hosted by the Intelligent Polymer Research Institute at Wollongong's Innovation Campus. IPRI has already established active collaborative research links with a number of groups in Korea (at Hanbat, Hanyang and Gangneung University). The research involves development of new materials for energy conversion and storage as well as medical bionics. This has already led to breakthroughs in the development of materials with high energy storage capacity, flexible materials for energy storage and new artificial muscle systems.

Collaborative agreement with KIMM
(electromaterials.edu.au/news/UOW100997)

ACES signed an important collaboration agreement with Korea on 13 May, which has resulted in development of revolutionary bio-printing equipment.

ACES hosted Dr. Sang-Chun Lee, the President of the Korean Institute of Machinery and Materials (KIMM), at the University of Wollongong for signing of the agreement that has enabled the Centre to forge ahead with its work in medical bionics.

Dr. Sang-Chun Lee commented on the 'huge synergy' between the two organisations. With their common philosophy of engaging in complex research challenges of global significance, the relationship between ACES and KIMM will be a long term one, with intentions to build new machinery together for a number of important applications.

"Fabrication of devices based on next generation materials, using old generation fabrication methods is not realistic," said ACES Executive Research Director Professor Gordon Wallace, "we must confront the reality that we need to develop new machinery to tackle these complex tasks".

Combining world class expertise in the fields of materials and machinery, the collaboration will initially focus on building new bio-printing technologies. This will feed directly into the ACES bionics program, specifically in the areas of nerve and muscle repair as well as detection and control of epilepsy.

Dr Stephen Beirne (RF, IPRI) travelled to KIMM in Daejon, Korea for 3 days in March and July to discuss specification of the multistage bio-extrusion printing system. In March, Stephen also visited Prof Choi's group at Cheju University, Jeju, Korea to see a demonstration of their printing capabilities. In July, Stephen had an initial inspection then training on the SPS1000 Bioprinter.

Prof Osada showing Prof Gordon Wallace the facilities at the Riken Institute in Japan and Prof Gordon Wallace in discussion with Riken colleagues.

Director of ACES/IPRI Professor Gordon Wallace (right) with KIMM President Dr Sang-Chun Lee after the signing of the research collaboration between KIMM and ACES.

Dr Byung Chul Kim visited Korean collaborators for the month of April (9-24). Collaborative experiments in the area of supercapacitors were undertaken at Hanbat National University and Gangneung TIC. Meetings with Korean Industry partners at Korean Chemical Institute (KIMM) took place for the establishment of international cooperation research project where, Gangneung TIC, Samsung Electricity Engineering, Chunbuk National University and KERI were all involved.

Prof David Officer (CI, ACES) was in Korea, 26-28 July, to present his invited lecture at the Sungkyun International Solar Forum 2011 (SISF2011). He then visited KIMM and KAIST to hold collaborative talks.

A team from ACES presented the latest research at several events in Korea in early October.

October 5, the team was at the Electronics & Telecommunications Research Institute (ETRI) in Daejeon, Korea, for the 2011 ETRI-ACES Workshop on Neuro-Convergence. Prof Gordon Wallace, Assoc Prof Rob Kapsa, Dr Simon Moulton and Dr Michael Higgins presented talks on advancements in the field of bionics research. The visit to ETRI presented an opportunity to build on exciting new collaborative research in the development of characterisation tools for ACES advanced nanostructured materials.

October 6, the 2011 Korean Electrochemical Society Fall Meeting (the 2nd Australia-Korea Joint Symposium) was held at the Korea Advanced Institute of Science and Technology in Daejeon. Prof Wallace delivered a Plenary Lecture on Nanostructured Electromaterials for Energy and Bionics. Dr Moulton presented an invited talk.

Prof Gordon Wallace was appointed special advisor on International Collaborations to the President of Hanbat University, Korea.

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, is Deakin's inaugural 'Thinker in Residence' visiting the ACES labs at Deakin for six months from 15 September and working 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.

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.

NEW ZEALAND

A number of research collaborations continue between Prof David Officer and Prof Keith Gordon (University of Otago, New Zealand). Prof Officer visited Gordon's laboratory at the University of Otago in May and presented a lecture on the IRSES research work involving spiropyrans, with a view to the Otago researchers contributing to the project. 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.

Monash University hosted PhD student Kelvin Walst from the Canterbury University from April through to June.

Prof Gordon Wallace and Dr Pawel Wagner (RF, IPRI) attended AMN-5 Fifth International Conference on Advanced Materials and Nanotechnology held 7-11 February 2011, Wellington, New Zealand. Prof Wallace also conducted a workshop on 'Building international research links' for 60 participants at this conference. 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

Prof Leone Spiccia visited Prof Bohdan Korybut-Daszkiewicz (Polish Academy of Sciences) in November 2011 to discuss collaborations in the water splitting and dye sensitised solar cell areas.

SLOVENIA

Dr Fredreic Gilbert (ACES RF, UTas) visited Andrej Vranic, MD, PhD, Department of Neurosurgery at the University Medical Centre Ljubljana, 8-19 August, and wrote a paper.

SWEDEN

Edwin Jager, an Assistant Professor in the Organic Electronics Group, Department of Science and Technology (ITN), Campus Norrköping at Linköpings Universitet, visited ACES/IPRI twice in 2011. Edwin's research is based on bio-electronics using conducting polymers. Edwin is also co-founder of the spin-off company Micromuscle AB in Linköping; a R&D company for the development of biomedical applications of polypyrrole (micro) actuators in collaboration with the medical device industry.

Edwin's first visit, 24 Jan to 11 Feb, established a collaborative research program aimed at producing dry-state microactuators for cutting-edge applications using conducting polymer actuators. For 12 weeks, from October, Edwin conducted laboratory-based research into the development of these novel micro-actuators using conducting polymers.

Edwin Jager working with staff members in ACES/IPRI

SWITZERLAND

Prof Gursel Alici (CI, ACES) is working with Herbert Shea of the Swiss Federal Institute of Technology EPFL in Lausanne on enhancing the actuation ability of ionic-type conducting polymer actuators using metal ion implantation.

Prof Leone Spiccia met with Prof Gilles Gasser (University of Zurich) in September 2011 to discuss a collaborative project focusing on imaging applications of ruthenium-peptide nucleic acid 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.

THAILAND

In 2010, for the period 2010/2011 Jun Chen and Andrew Minett were awarded a UOW Thai affiliated UIC grant for developing international research links and to work towards the design and development of novel metal alloy/metal oxide composites for photo-catalysed water cleaning applications.

Prof Sukon Phanichphant from Chang Mai University in Thailand spent 6 weeks from July with IPRI/ACES to further develop this collaboration between the two groups.

Dr Natda Wetchakun, a lecturer from Chiang Mai University spent 3 months, from 7 March, undertaking collaborative research with Dr Jun Chen on work towards the design and development of novel metal oxide composites for sunlight-driven water cleaning.

Chiang Mai University student Kanlaya Pingmuang is working in IPRI/ACES as a visiting international student for 12 months from 8 July on photocatalysts for water cleaning.

Dr Jun Chen visited Chiang Mai University from late November for 2 weeks to review the UOW UIC Inter-Link project as planned, in order to enhance the existing collaboration as well as to extend this collaboration into a longer-term relationship.

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 research from 3 January with Dr Paul Bayley and Dr Jim Efthimiadis working on physiochemical characterisation of phosphonium based ionic liquids.

Dr Alison Davenport from the School of Metallurgy and Materials gave a talk on her visit about synchrotron studies of localised corrosion and Dr Melanie Britton from the School of Chemistry gave a talk on the 'Visualisation of Chemistry Using Magnetic Resonance Imaging'.

Prof Clare Grey from Chemistry Department, Cambridge University in the UK spoke with researchers at ACES/Deakin University on 1 Dec about 'Following Function in Real Time: New Methods for Studying Structure and Dynamics in Batteries and Fuel Cells'.

Dr Paul Bayley (RF, 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.

Mr Usman Ali Rana (ACES PhD student at Monash) and Dr Paul Bayley also visited Prof Mark Smith at the Magnetic Resonance Centre at Warwick University to investigate structure and dynamics in plastic crystal electrolytes.

Prof Leone Spiccia visited the Departments of Chemistry at Durham and Nottingham University to present seminars and explore potential collaborations.

USA

ACES/IPRI hosted Paul Smith a visiting Student from Rutgers University, New Brunswick, NJ in the USA for 8 weeks from 8 June. Paul was the recipient of a US National Science Foundation (NSF) EAPSI fellow award to undertake collaborative work in Wollongong on an electrolytic water splitting device from a bioinspired catalyst; particularly to develop a more efficient system for hydrogen gas production.

Hui Zhou from State University of New York at Binghamton in USA completed one-month research, from August, with Mr. Martin Yoon and Dr. Patrick Howlett at ACES/Deakin University.

After drifting away from the field of conducting polymers several years ago, American researcher and Furman University lecturer Prof Tim Hanks found himself back in the thick of it, for a six month sabbatical, courtesy of a Fullbright scholarship, at ACES/IPRI starting 5 January.

As a synthetic chemist, Prof Hanks' expertise is in creating materials, specifically composite materials that can conduct electricity. During his six months at IPRI, Prof Hanks worked closely with Dr Paul Molino in the Bionics team, building 2D and 3D systems for use in medical bionics to channel and direct cell growth (electromaterials.edu.au/news/UOW103796).

Prof Timothy Hanks from Furman University.

"I chose IPRI because of the people and the location. The expertise in conductive polymers and the printing strengths at IPRI are world class and I was familiar with the location as I'd visited before, for a conference," said Prof Hanks.

ACES/IPRI again hosted Prof Paul Calvert from the University of Massachusetts, USA. Paul spent two weeks in January, two weeks in July and has again returned this December 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. In July, the ACES sponsored *Rheological and Mechanical Properties of Hydrogels Workshop* involved contributions on hydrogel devices from Paul.

Prof Austen Angell from the Arizona State University visited Monash University and Prof Doug MacFarlane on 20 July for collaborative discussions on ionic liquids.

Dr Christoph Lungenschmied, the industry representative of ARC Linkage Partner Konarka Technologies Inc, visited ACES/IPRI for two weeks in April. The main purpose for the visit was to transfer Konarka device fabrication know-how and to discuss the linkage project progress and plans for 2011.

Drs Mozer and Clarke attended Konarka Technologies 'in house' collaborator workshop on the 30 November at Konarka Headquarters in Lowell Massachusetts.

Prof Spiccia visited the laboratories of Profs Bill Casey and Dave Britt (UC Davis), Prof JR Long (UC Berkeley) and Prof Y Tor (UC San Diego) in January-February 2011 as part of his sabbatical to work on collaborative projects related to water splitting, ligand exchange on metal clusters and medicinal projects. He has a very productive long-term collaboration with the UC Davis groups.

A long time collaboration has existed between ACES/IPRI and Prof Ric Kaner's laboratories at UCLA. Following on from Ric's PhD student Jonathon Wassei's visit to ACES/IPRI late in 2010, ACES/IPRI PhD graduate Peter Sherrell travelled to the USA to develop techniques for producing CVD growth of single or bilayers of graphene from which we can make conducting bioelectrodes. To further advance this work Dr Brianna Thompson (RF, IPRI) will be undertaking cell work in 2012 with these electrodes.

Prof David Officer visited Prof Les Dutton, Director of the Stellar Chance Laboratory at the University of Pennsylvania on the 22-23 September to discuss their collaboration on an artificial photosynthesis research project. This project led to the award of a 2012 ARC Discovery Project led by Prof Officer and involved chief investigators Pawel and Klaudia Wagner from ACES/IPRI and partner investigators Prof Les Dutton and Prof Keith Gordon (Otago University, New Zealand).

ACES graphene researchers have continued to supply graphene papers to Applied Nanotech Inc, Austin, Texas, for stripper foils for the next generation rare isotope beam facility.

The toys are a way of explaining how the carbon nanotubes (the toy's body) cause rotation (the toy's head). Prof Geoff Spinks (right), Prof Gordon Wallace (left) and Dr Javad Foroughi.

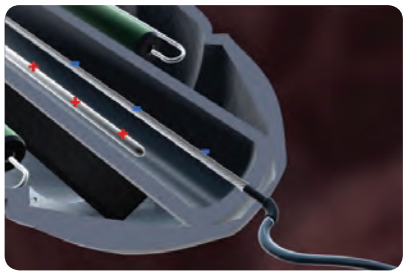


Image shows the tail region and insides of futuristic microbot with the flagella-like tail rotated by a length of the research team's new carbon nanotube yarn torsional muscles.

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 (2011, 334 (6055), 494-497)*** of the demonstration of giant torsional rotation based on twisted carbon nanotube yarns. This story generated a lot of media for the group – see outreach section. Further, a publication in ***Advanced Materials*** **(2011, 23(26), 2966-2970)** described the high work capacity generated from actuators made from a laminated composite of carbon nanotubes and polypyrrole.

ACES/IPRI PhD student Mark Romano travelled to the USA on 24 July and spent 2 weeks working with Na Li, a PhD student working under Dr. Shaoli Fang and Prof Ray Baughman at the Alan G. MacDiarmid NanoTech Institute at the University of Texas at Dallas (UTD). Mark analysed his composite material samples, composed of nanotubes and graphene oxide, using the newly developed T-Cell for thermal harvesting.

ACES/Monash PhD student Ted Abraham also spent 4 weeks (10 August -7 September) undertaking collaborative work with Prof Ray Baughman's group at the Alan G. MacDiarmid NanoTech Institute at the University of Texas at Dallas (UTD), testing ionic liquid electrolytes with dissolved ferri/ferrocyanide in a thermocell device. Prior to this visit Ted travelled to Washington DC, USA to attend the 4th Congress on Ionic Liquids where he presented a poster titled "Seebeck Coefficients in Ionic Liquids- Prospects for Thermo-electrochemical Cells".

Prof Doug MacFarlane has ongoing collaborative research with Prof Gloria Elliott at the University of North Carolina.

Prof Doug MacFarlane is an Adjunct Fellow at the University of Alabama and so maintains close collaborative ties with this group of researchers.

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

Paul Smith (centre) PhD student from Rutgers University, New Brunswick was the recipient of a US National Science Foundation (NSF) EAPSI fellow award to undertake collaborative work in Wollongong with Gordon Wallace and Gerry Swiegers.

Other international news

ESNAM COST ACTION MEMBER

Prof Geoffrey Spinks was accepted as a management committee member of the Materials, Physical and Nanosciences COST Action, in the European Scientific Network for Artificial Muscles (ESNAM).

The objective of this COST Action is to foster and accelerate long-term advancement of 'artificial muscle' science and technology based on electroactive polymers (EAPs) as smart actuation materials, through a scientific network among leading European institutions and industries.

A COST Action intends to provide content and form to this network through coordination of mutual research activities and creation of a common platform for education, dissemination, early-stage researcher training, standardisation of methods, techniques and processes, along with industrial exploitation. This will represent, at global level, the first example of its kind, able to strengthen the impact of European science and technology.

RESEARCHERS UNVEIL MASK INITIATIVE

In 2010 ACES was unable to gain concensus on the formation of a global research consortium on Electromaterials Science, however in the short term they obtained funding for an international exchange program MASK (Materials and Advanced Sensor Knowledge Exchange) from the Marie Curie International Research Staff Exchange Scheme (IRSES). Researchers from Wollongong, Monash University and University of Tasmania will form the integrated global network with scientists from Dublin City University (Ireland), Abo Turku (Finland) and CNMP (France).

The collaborative research initiative was officially unveiled on 11 February at the UOW Innovation Campus (http://media.uow.edu.au/news/UOW095662.html). The project is designed to investigate novel sensing technologies based on nanostructured materials. The team aims to develop sophisticated sensing materials using nanotechnology to uncover a more accurate and cost-effective means of complex chemical and biological measurement. The sensors are expected to find widespread application in environmental, energy and biomedical monitoring.

Prof Gordon Wallace, visited hosts Prof Dermot Diamond (Dublin City University) and Prof. Ari Ivaska (Finland) on a trip 9 April -12 May 2011.

In Ireland, Prof Wallace delivered a seminar and held discussions to identify further opportunities for new material design and applications. Specifically with:

- Prof Dermot Diamond / Dr Aoife Morrin on development of printing techniques for sensor development and organic electronics.
- Prof Noel Clark to further developments on wearable bionics and interfacing to video displays.
- Prof Robert Forster on applications of nanostructured electrodes for cell culturing.

In Finland, Prof Wallace delivered a seminar and held discussions with Prof. Ari Ivaska (Abo Turku) on the development of nanostructured electrodes produced using Dip Pen Nanolithography as a platform for new ion selective electrode sensors.

Dr Klaudia Wagner from IPRI visited Dublin City University (DCU), 23 March- 19 April 2011, to explore the possibility of developing a multifunctional material based on the monomer TSP_4 recently synthesised in the IPRI laboratories. This builds on previous collaborative studies between DCU and UOW that led to the following publication ***(J. Am. Chem. Soc. 2011, 133 (14), 5453-5462)***.

ACES/IPRI PhD student Bo Weng also visited DCU 10 April-6 May 2011. Whilst there she explored the feasibility of producing bioactive inks based on conducting polymers to allow the printing of sensors. A publication describing this part of the work is in progress.

ACES/IPRI PhD student Cathal O'Connell was hosted by Prof George Malliaras at Ecole Nationale Supérieure des Mines de Saint Etienne in Gardanne France from 9 June-9 July 2011. Cathal went to fabricate and characterise organic electrochemical transistors (OECTs) and investigate their application as novel bioelectronic sensors. Strategies for the fabrication of OECTs via other methods (dip-pen nanolithography, ink-jet printing) were formulated.

ACES/PhD student Amy Gelmi visited Prof Ari Avaska's group in Analytical Chemistry, the Process Chemistry Centre at Åbo Akademi in Turku, Finland from 7 August -10 September 2011. Amy investigated the electrochemical properties of PEDOT: PSS based inks developed for Dip Pen Nanolithography (DPN), in both the bulk material and printed arrays.

Prof David Officer, spent 26 September-1 October at DCU. He presented a research lecture entitled 'Developing Multifunctional Electromaterials for Energy-related Applications' and then held discussions with a number of researchers on current IRSES projects as well as new opportunities for the integration of IPRI materials into DCU devices and applications.

These discussions were as follows:

- Prof Dermot Diamond / Mr Michele Zanoni / Dr Simon Coleman discussed a second joint publication on terthiophene spiropyrans and the modelling work for this project undertaken.
- Prof Dermot Diamond / Ms Larisa Florea discussed development of active surface coatings on microfluidic devices. New spiropyrans developed at IPRI will be explored in this project.

Pictured at the MASK initiative unveiling are (L to R)- Prof Doug MacFarlane (Monash), Prof David Officer (UOW), Prof Gordon Wallace (UOW), Prof Dermot Diamond (Dublin City University), Rochelle Waren (UOW), Dr Jenny Pringle (Monash), Dr Trevor Lewis (UTAS) and Prof Pavel Nesterenko (UTAS).

- Prof Dermot Diamond / Mr Andrew Kavanagh – discussed development of photoactive ionogels and polymers.
- Dr Andreas Heise discussed development of dye-doped polymer nanoparticles. Porphyrin dyes being synthesised at IPRI will be incorporated into polymer nanoparticles prepared at DCU and their application in dye sensitised solar cells and on surfaces for sensor applications will be investigated.
- Furthermore, Prof Officer visited the Tyndall Institute in Cork and presented a lecture entitled 'Developing Multifunctional Electromaterials for Energy-related Applications'. Discussions with his host, Dr Michael Nolan, led to some spiropyran modelling, which will be incorporated into the DCU spiropyran work.

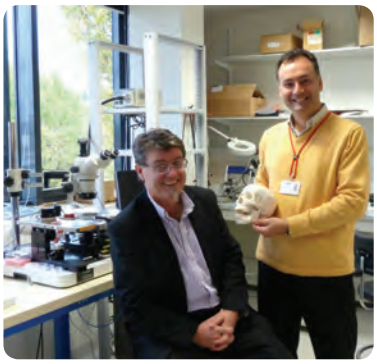
Further work with Dr Nolan will focus on the modelling of dyes for dye sensitised solar cells.

During the course of Prof Officer's visit, an interim MASK management committee meeting was held, attended by Prof Dermot Diamond (DCU), Mr Declan Moran (DCU), Mrs Mary Comeski (DCU), Prof David Officer (UOW), Prof Brett Paull (UTas) and Prof Pavel Nesterenko (UTas). Matters discussed included publication output, institution visits and reporting. After nine months of the MASK programme, almost all the participating institutions have exchange visits leading to a number of significant outcomes.

Monash PhD student Huy Ha visited DCU from 21 June-19 August 2011, to explore the feasibility of a bilirubin oxidase using phosphonium based buffered ionic liquids for their potential as a novel biosensor.

Dr Jenny Pringle (CI, Monash) visited University College Dublin, from 24-27 June where she met with Prof Dermot Diamond, Dr Kevin Fraser, and visiting Monash student Huy Ha.

- Prof Doug MacFarlane, visited the DCU co-workers on 28-29 August. He delivered a seminar 'Ionic Liquids: Applications in the Electro- and Bio-Sciences' and met with Prof Dermot Diamond and Dr Kevin Fraser to discuss the program.



Prof Gordon Wallace in Gardanne with Prof George Malliaris for 3 days to discuss IRSES research plan.

Prof Gordon Wallace visited Prof George Malliaris's laboratories in Gardanne to develop a research plan around nanofabrication of organic electronics for cellular communications. During a series of discussions with PhD students and research fellows, a number of shorter term opportunities that will lead to enhanced performance organic transistors were identified.

Invited talks 2011

JANUARY

Prof Gerhard Swiegers gave an invited talk on 'A Conceptual Unification of Homogeneous, Heterogeneous, and Enzymatic Catalysis using Sabatier's Principle. Homogeneous Catalysts with a Mechanical ("Machine - like") Action' at Kolloquium Sonderforschungsbereich 706, Universitaet Stuttgart und Hohenheim, Germany on 24 January 2011.

Prof Gerhard Swiegers gave an invited talk on Solar Water - Splitting Inspired by Photosynthesis" at Kolloquium: Gesellschaft Deutscher Chemiker, Fakultat Chemie der Universitaet Stuttgart, Germany on 25 January 2011.

FEBRUARY

Prof Leone Spiccia presented an invited lecture entitled 'Photo-electrochemical Devices for Solar Energy Conversion' to the UC Davis Environmental Institute, Davis, USA on 2 February 2011.

Prof Leone Spiccia presented an invited lecture entitled 'On the Origin of Water Oxidation Catalysis by Molecular Manganese Complexes' at UC Berkeley, San Francisco, USA on 3 February 2011.

Prof Gordon Wallace gave a plenary talk, 'Organic Bionics – Nanodimensional Cues for Nerve Cell Growth' [IPRI/1157] at AMN-5 Fifth International Conference on Advanced Materials and Nanotechnology held 7-11 February 2011, Wellington, New Zealand. Gordon also conducted a workshop on 'Building international research links' for 60 participants at this conference.

Prof Gordon Wallace gave an invited presentation, 'Nanostructured Electromaterials for Energy and Medical Bionics', at the 10th International Nanotechnology Exhibition and Conference, Nano tech 2011 held 15-18 February 2011, Tokyo, Japan.

(L-R): Prof Dermot Diamond, Dr Kevin Fraser, Simon Gallagher (all NCSR), Prof Doug MacFarlane (ACES at Monash University) and Dr Nick Gathergood (School of Chemical Sciences, DCU).

MARCH

Prof Gordon Wallace gave an invited seminar, 'Organic Bionics: From Materials to Devices' at Electronics & Telecommunications Research Institute (ETRI), Korea 9 March 2011 in Korea.

Prof Gordon Wallace presented ACES research entitled 'Organic Bionics' at UCB Australia Neurology Update meeting held at the Sheraton in Sydney 11-12 March 2011, with over 100 delegates.

Prof Leone Spiccia presented a lecture entitled 'Waste Water Detoxification by the Catalytic Wet Air Oxidation (CWAO)' at the WA Water Corporation, Perth, Australia, 14 March 2011.

Prof Leone Spiccia presented an invited lecture entitled 'Photo-electrochemical Devices for Solar Energy Conversion' at the University of Western Australia, Perth, Australia on 16 March 2011.

Prof Gordon Wallace gave an invited talk entitled 'Nanostructured Carbon Electrodes as Sensing Platforms' [IPRI/11008] at the Symposium on Nanomaterial-Based Sensors for Biomedical Applications held 17-18 March 2011, Sydney. The symposium was organised by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) with a Materials Science and Engineering Biomedical Manufacturing Theme.

Prof Gordon Wallace gave an invited talk on ACES-Innovative Energy Platforms at the 2nd International forum on Green Energy & Electronic Materials, and their Applications held 28-29 March 2011, Wollongong.

Prof David Officer (Nanostructured Materials for Solar Cells) and ***Prof. Maria Forsyth*** gave invited talks at 2nd International Forum on Green Energy and Electronic Materials and their Applications held in Wollongong on 28-29 March, 2011.

APRIL

Prof Leone Spiccia presented an invited lecture entitled 'On the Origin of Water Oxidation Catalysis by Molecular Manganese Clusters' at the Karlsruhe Institute of Technology, Karlsruhe, Germany on 18 April 2011.

Prof Gordon Wallace gave an invited presentation at the Science Gallery in Dublin, Ireland on 18 April 2011, entitled Organic Bionics - the fusion of man made and living systems.

Prof Gordon Wallace delivered the Tyndell seminar, 'Organic Bionics: Nanodimensional Cues for Nerve Cell Growth' in Dublin, Ireland on 26 April 2011.

Assoc Prof Robert Kapsa delivered an invited seminar, 'Challenges in Nerve and Muscle Repair: Building Optimal Materials as Bionic Scaffolds for Diseased and Damaged Muscle and Nerve' at the St Vincent's Institute of Medical Research Seminar Series, Melbourne on 27 April 2011.

MAY

Prof Gordon Wallace visited CNRS in Bordeaux, France on 2 May 11 and presented an invited seminar on the most recent developments in the ACES bionics program to an enthusiastic audience.

Prof Leone Spiccia presented an invited lecture entitled 'Photo-electrochemical Devices for Solar Energy Conversion' at the Institute of Nanotechnology, Karlsruhe Institute of Technology, Karlsruhe, Germany on 4 May 2011.

Prof Gordon Wallace gave an invited seminar, ACES - Novel Electromaterials for Energy and Medical Bionics: Materials Discovery, Fabrication and Characterisation, at Abo Akademia University at Turku, Finland 5 May 2011.

Prof Leone Spiccia presented an invited lecture entitled 'On the Origin of Water Oxidation Catalysis by Molecular Manganese Clusters' at the University of Heidelberg, Heidelberg, Germany on 6 May 2011.

Assoc Prof Robert Kapsa delivered an invited seminar, 'Conducting Polymer Platforms for Skeletal Muscle' at the 7th Meeting of the Australasian Gene Therapy Society held in Melbourne, on 4 May 2011.

Prof Doug MacFarlane gave an Invited talk on Ionic Liquids: Applications in Chemical, Electrochemical and Bio- Sciences, at the University of New South Wales, School of Chemistry, May 2011.

Prof Gordon Wallace gave an invited talk entitled, Nanostructured Carbon Electrodes, at the 9th Spring Meeting of the International Society of Electrochemistry held 8-11 May 2011, Turku, Finland.

Prof Hua Liu gave an invited talk, 'Advanced materials for lithium ion batteries', at the School of Materials Science & Engineering at East China University of Science and Technology on 12 May 2011.

Prof Hua Liu was a keynote speaker, giving her presentation on 'Nanomaterials for lithium ion batteries', at the 1st International Congress on Advanced Materials held in Jinan, China on 13-16 May 2011.

Prof Hua Liu gave an invited talk, 'Advanced materials for lithium ion batteries and supercapacitors', to Metallugy and Materials Physical Chemistry Department at Northeastern University, China on 17 May 2011.

Prof David Officer gave an invited lecture on 'Multichromism in Conducting Polymers - Spiropyran-substituted Polythiophenes', at the Department of Chemistry, Otago University, Dunedin, New Zealand, 23 May, 2011.

JUNE

Prof Leone Spiccia presented an invited plenary lecture entitled 'Manganese water oxidation catalysts' at the XXIII International Conference on Coordination and Bioinorganic Chemistry (ICCBIC) held in Smolenice Castle, Slovakia from the 5-10 June 2011.

Prof Hua Liu gave an invited talk, 'Nanomaterials for next generation of lithium ion batteries', at the Nanotechnology & Energy Workshop held at Deakin University, Geelong on 6 June 2011.

Prof Gordon Wallace gave an invited presentation, Nanostructured Carbon Electrodes, at the Nanotechnology & Energy Workshop held on 6 June 2011 in Geelong.

Prof. Maria Forsyth gave a plenary talk on Electrolytes for Lithium and Magnesium Batteries- Ionic Liquid Based at the 4th Congress on Ionic Liquids held 15-18 June 2011 in Arlington, Virginia, USA.

Dr Jenny Pringle gave an invited presentation, New Materials for Dye-Sensitised Solar Cells, at the 4th Congress on Ionic Liquids (COIL-4), 15-18 June, 2011, in Washington, DC USA.

Prof Doug MacFarlane was a plenary Speaker at the 4th Congress on Ionic Liquids, 15-18 June 2011, Washington DC and spoke on the "Biotechnology Applications of Ionic Liquids".

Prof Leone Spiccia presented an invited lecture entitled 'Photo-electrochemical Devices for Solar Energy Conversion', at the University of Strasbourg, Strasbourg, France on 18 June 2011.

Dr. Patrick Howlett gave an invited talk on 'Organic Ionic Plastic Crystals in all solid-state lithium metal cells' at ICMAT 2011 held from 26 June- 1 July in Singapore.

Prof David Officer gave an invited lecture on 'Porphyrin-sensitised titanium dioxide solar cells', at Sungkyun International Solar Forum held in Sungkyunkwan University, Suwon, Korea on 26-28 June, 2011.

Prof Gordon Wallace gave an invited seminar, ACES - Novel Electromaterials for Energy and Medical Bionics: Materials Discovery, Fabrication and Characterisation [IPRI/11070] at Sony, Japan on 27 June 2011.

Prof Gordon Wallace gave an invited seminar, Organic Bionics - Nanodimensional Cues for Nerve Cell Growth, at NTT, Japan on 28 June 2011.

Prof Geoffrey Spinks gave an invited talk at the EuroEAP conference on polymer artificial muscles hosted by the European Scientific Network for Artificial Muscles (ESNAM) and held in Pisa in June, 2011. University of Wollongong has since been admitted as an international member of ESNAM.

JULY

Prof. Maria Forsyth was a keynote speaker at SSI, the 18th International Conference on Solid State Ionics, held 3-8 July 2011 in Warszawa, Poland. Maria spoke on novel plastic crystal electrolytes - towards solid state devices.

Prof Doug MacFarlane gave an invited talk at PacRim 9: The 9th International Meeting of Pacific Rim Ceramic Societies, held 10-14 July in Cairns Australia, entitled "New Developments in Organic Ionic Glasses – Applications of Protonics".

Prof Gordon Wallace gave an invited talk entitled, Additive Fabrication at the Nanoscale, at the ANFF-AFOSR Joint Workshop held 18-19 July 2011, Melbourne, Australia.

Prof Gordon Wallace addressed the Industry networking breakfast event at the offices of NSW State & Regional Development on 20 July 2011, Martin Place, Sydney, Australia talking about Low Cost, High Quality Additive Prototyping.

Prof David Officer gave an invited lecture on 'Nanostructured Electromaterials for Emulating Photosynthesis: Light Harvesting and Water Splitting', at International Workshop on Advanced Materials and Energy (2nd International Workshop on Renewable Energy) held in Lintong Aegean Hot Spring Resort, Xi'an, China on 29-31 July, 2011.

AUGUST

Prof Leone Spiccia presented an invited lecture entitled 'Photo-electrochemical Devices for Solar Energy Conversion' at the University of Potsdam, Potsdam, Germany on 4 August 2011.

Prof Gerry Swiegers gave an invited talk on 'An Apparent Structural Convergence in Enzymatic, Homogeneous, and Heterogeneous Catalysts of Water Oxidation. Implications for the Unification of Catalysis Science at the Towards Global Artificial Photosynthesis Conference held on 14 - 18 August 2011, at Lord Howe Island, Australia.

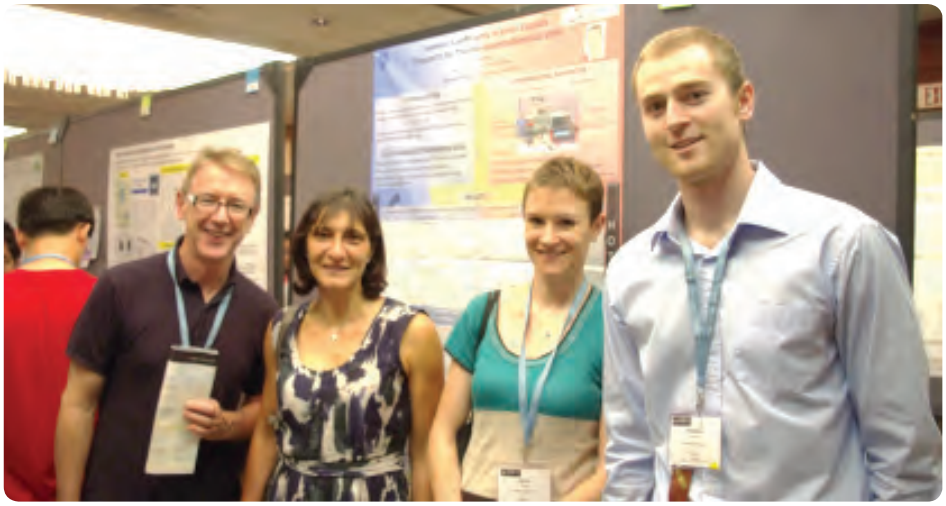
Prof David Officer gave an invited lecture on 'Artificial Photosynthesis: Porphyrins for Light Harvesting & Water Splitting', at Towards Global Artificial Photosynthesis: Energy, Nanochemistry & Governance held on Lord Howe Island, Australia on 14–18 August, 2011.

Prof Leone Spiccia presented an invited seminar entitled 'Application of Metal Complexes in Photo-electrochemical Devices' at the Helmholtz Zentrum Dresden – Rossendorf, Berlin, Germany on 15 August 2011.

Prof Leone Spiccia presented an invited seminar entitled 'Target-specific Ligands for Diagnosis and Treatment of HIV, Alzheimer Disease and Cancer' at the Helmholtz Zentrum Dresden – Rossendorf, Dresden, Germany on 16 August 2011.

Prof Susan Dodds gave an invited plenary presentation "It's not what it looks like" -- medical imagery and public policy debate at The Digitised Body: the Cultural and Clinical Impact of New Medical Imaging Technologies Symposium held at the University of Queensland, 30-31 August 2011.

Prof Doug MacFarlane was a Plenary Speaker at the Faraday Discussion on Ionic Liquids held in Belfast in August 2011 and spoke on "Pharmaceutical Ionic Liquids: Aspects of Protonics".



Prof Doug MacFarlane, Prof Maria Forsyth, Dr Jenny Pringle and PhD student Ted Abraham at COIL.

Prof Doug MacFarlane gave an invited talk at Dublin City University in August 2011 on "Ionic Liquids: Applications in Chemical, Electrochemical and Bio- Sciences".

SEPTEMBER

Prof Gordon Wallace gave an invited seminar, Nanobionics: Materials Science, Characterisation and Fabrication at Deakin University, Geelong, Australia on 1 September 2011.

Prof Doug MacFarlane gave an invited talk at Universite de Paris Sud in September 2011 on "Ionic Liquids and Solids: Aspects of Protonics".

Assoc Professor Robert Kapsa delivered an invited talk, 'Nanostructured Conducting Polymer-Carbon Nanotube Scaffolds for Skeletal Muscle Engineering' at the 24th European Conference on Biomaterials held in Dublin, Ireland, on 4-9 September 2011.

Prof Gordon Wallace gave an invited seminar, Nanobionics: From Materials to Device Fabrication at Mawson Institute, University South Australia, Adelaide, Australia on 5 September 2011. The seminar was attended by research staff, HDR students from Mawson Institute as well as to staff and HDR students across the Division of Information Technology, Engineering and the Environment.

Prof Leone Spiccia presented an invited seminar entitled 'Photo-electrochemical Light Harvesting Devices' at the Aziz summer workshop, Humboldt University and Helmholtz Zentrum Berlin, Berlin, Germany on 6 September 2011.

Prof Leone Spiccia presented an invited keynote lecture entitled 'Photo-electrochemical solar energy conversion' in symposium E22 - Materials for energy storage and conversion at EUROMAT 2011 held 12-15 September 2011 in Montpellier, France.

Prof Leone Spiccia presented an invited seminar entitled 'Recent Advances in Dye Sensitised Solar Cells and Water Oxidation Catalysis' at ETH Zurich, Zurich, Switzerland on 23 September 2011.

Prof Leone Spiccia presented an invited seminar entitled "Bioinspired Solar Water Oxidation Catalysis" at the BMBF workshop, Wannsee, Germany, 26 September 2011.

Prof David Officer gave an invited lecture on 'Developing Multifunctional Electromaterials for Energy-related Applications', at the National Centre for Sensor Research in Dublin, Ireland on 27 September, 2011.

Prof David Officer gave an invited lecture on 'Developing Multifunctional Electromaterials for Energy-related Applications' at the Tyndall National Institute, Cork, Ireland on 29 September, 2011.

OCTOBER

Prof David Officer gave an invited lecture on 'Porphyrin-sensitised titanium dioxide solar cells', at the Physics Department in Oxford University, Oxford, United Kingdom on 4 October, 2011.

Prof Gordon Wallace gave an invited talk entitled, Nanobionics-Challenges, Conquests and Confounding Issues, at the 2011 ETRI-ACES Workshop on Neuro-Convergence held 5 October 2011, ETRI (Electronics & Telecommunications Research Institute), Daejeon, Korea.

Assoc Prof Robert Kapsa gave a talk on Bionics for Neuromuscular Restoration at the 2011 ETRI-ACES Workshop on Neuro-Convergence held 5 October 2011, ETRI, Daejeon, Korea.

Dr. Simon Moulton gave a talk on Medical Bionics for Epilepsy Detection and Control at the 2011 ETRI-ACES Workshop on Neuro-Convergence held 5 October 2011, ETRI, Daejeon, Korea.

Dr. Michael Higgins gave a talk on Characterising the Bio-electrical Interface at the 2011 ETRI-ACES Workshop on Neuro-Convergence held 5 October 2011, ETRI, Daejeon, Korea.

Prof Gordon Wallace gave an invited talk entitled, ACES-Novel Electromaterials for Energy and Medical Bionics: Materials Discovery, Fabrication and Characterisation, at the 2011 Korean Electrochemical Society Fall Meeting (The 2nd Australia-Korea Joint Symposium) held 6-7 October 2011, Daejeon, Korea. He spoke in the session on Batteries, Fuel cells, Solar cells, Supercapacitors, Sensors and General Electrochemistry- a special session for Young Investigators; with 600 participants present.

Prof Leone Spiccia presented an invited seminar entitled 'Harvesting Solar Energy in Photo-electrochemical Cells' at the Max Planck Institute for Bio-inorganic Chemistry, Muelheim, Germany on 17 October 2011.

Prof Gordon Wallace gave an invited talk, 'Conducting Polymers (and nanostructured Carbons) for Energy and Medical Bionics', at the Aquitaine Conferences on Polymers held on 18-21 October 2011, in Arcachon, France. This 3rd edition conference focused on Hardcore Polymer Science and its contributions in the societal issues such as Energy, Environment, Renewable Resources, Life Sciences and Enabling Macromolecular Sciences and Engineering Technologies.

The Towards Global Artificial Photosynthesis conference participants on Lord Howe Island.

Prof Gordon Wallace gave an invited address, Organic Nanobionics, at the 6th World Congress on Biomimetics, Artificial Muscles and Nano-Bio in Cergy, France held on 25-27 October 2011.

Prof David Officer gave an invited lecture on 'Artificial Photosynthesis: The Future of Housing Energy?' at Bluescope Steel Research TechTalks, Bluescope Steel Research in Wollongong on 25 October, 2011.

Prof Leone Spiccia presented an invited seminar entitled 'Harvesting Solar Energy in Photo-electrochemical cells' at the German Chemical Society meeting at the University of Wuerzburg, Germany on 27 October 2011.

NOVEMBER

Prof Leone Spiccia presented the Humboldt Research Award Lecture entitled 'Harvesting Solar Energy in Photo-electrochemical Devices' at the Helmholtz Centre Berlin for Materials and Energy, Adlersof, Berlin, Germany on 2 November 2011.

Prof Leone Spiccia presented an invited lecture entitled 'Harvesting Solar Energy in Photo-electrochemical Cells' at the Fritz Haber Institute, Berlin, Germany on 3 November 2011.

Prof Hua Liu gave an invited talk, 'Nanomaterials and nanotechnologies for next generation of lithium ion batteries', at the China-Australia Symposium in Shanghai and Suzhou, China held 5-8 November 2011.

Prof Leone Spiccia presented an invited lecture entitled 'Harvesting Solar Energy in Photo-electrochemical Cells', at Durham University, UK on 9 November 2011.

Prof Leone Spiccia presented an invited lecture entitled 'Application of Transition Metal Complexes in Photo-electrochemical Devices' at Nottingham University, UK on 10 November 2011.

Prof Leone Spiccia presented an invited lecture entitled 'Application of Copper(II) Complexes as Nuclease Mimics and Cancer Imaging Agents' at Charles University, Prague, Czech on 14 November 2011.

Prof Gordon Wallace gave an invited talk, 'Nanobionics: The Challenges, the Conquests and the outright confounding!', at 2nd International Conference on Medical Bionics held on 20 -23 November 2011 at Silverwater Resort, Phillip Island, Australia.

Prof Maria Forsyth was a keynote speaker at the 18th International Corrosion Congress, held on 20-24 November 2011 in Perth. Maria spoke on Multifunctional Rare Earth Corrosion Inhibitors for Steel and Aluminium Alloys.

Prof Leone Spiccia presented an Invited Keynote Lecture, 'Applications of Transition Metal Complexes: From Artificial Nucleases to Biosensors to Water Oxidation Catalysis', at the IUPAC International Year of Chemistry Centenary celebration of the award of chemistry Nobel Prize to Marie Skłodowska-Curie and symposium on 'Supramolecular Chemistry in 21th Century', University of Warsaw, Poland, 26-27 November 2011.

Prof Gordon Wallace gave an invited talk entitled Organic Conducting Polymers: A Multifunctional Stimulus Platform for Mammalian Cells at the 2011 MRS Fall Symposium V: Multifunctional Polymer-based Materials held 28 November-2 December 2011, Boston, USA.

Prof Gerry Swiegers delivered three talks at the 2011 MRS Fall symposium: (i) A Flexible Polymer Catalyses Light-Driven Water Oxidation in Seawater and (ii) Advanced Materials for Solar-Fuel Generation and (iii) A New Approach to TCO-Free Dye-Sensitized Solar Cells.

Prof Doug MacFarlane gave an Invited talk, High Efficiency Water Oxidation and Reduction Catalysts for Solar Fuel Generation, at the Australia-India Joint Symposium on Smart Nanomaterials, held in Nov 2011 in Melbourne.

DECEMBER

Prof Gordon Wallace plenary talk on Nanobionics: Materials Science, Characterisation and Fabrication was delivered by Prof David Officer at the 3rd International Conference on Smart Materials and Nanotechnology in Engineering held 5-8 December 2011, Shenzhen, China.

Prof Leone Spiccia presented a talk entitled, Organometallics as Dye-Sensitised Solar Cell Redox Mediators at the RACI IC11, University of Western Australia, in Perth on 5-9 December 2011.

Prof Gordon Wallace gave an invited talk entitled Nanostructured Electromaterials: Energy to Medical Bionics at the 4th Bangalore Nano conference held on 8-9 December 2011 in Bangalore, India.

Prof David Officer gave an invited lecture on 'Porphyrin-sensitised Titanium Dioxide Solar Cells', at Next Generation Solar Energy - From Fundamentals to Applications held at Schloss Erlangen, Erlangen, Germany on 12-14 December, 2011.

Prof David Officer (left) with other conference speakers at SMN 2011.

National Collaborations

ACES researchers continue to build national collaborative activities with 21 other research groups around Australia. Some of these are highlighted below.

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION (ANSTO)

PhD student Cameron Ferris is working with ANSTO, courtesy of an $8K AINSE grant (ALNGRA11049-2011), radiolabelling short chain peptides, characterising their attachment to biodegradable matrices, with the view to use these matrices for much improved cell attachment.

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

BLUESCOPE STEEL

Discussions with BlueScope Steel early in 2011 led to their substantial commitment to fund a solar encapsulation project in the successful CRC for Polymers 5 year extension funding application, which will involve ACES and ANSTO researchers as well as researchers from four other universities.

CSIRO

Prof Maria Forsyth (ACES, CI Deakin) has ongoing collaborations with researchers from CSIRO. Maria works with Dr Adam Best and Dr Tony Hollenkamp in the area of Lithium metal batteries. In 2011 Dr Hollenkamp was appointed an Adjunct Professor at Deakin University and works in the Deakin laboratories one day per week.

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

Prof Forsyth along with Dr Tony Hughes and Dr Ivan Cole collaborate in the area of corrosion mitigation of aerospace alloys. In 2011 two PhD projects commenced: (i) Mr Infant Bosco on the project 'Strategies for developing self-repairing oxides to protect steel system' and (ii) Mr Rainier Catubig on the project 'Investigation of corrosion inhibition mechanisms of novel inhibitors for 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'. The collaboration began in November with the appointment of a PhD student (Ms Rachel Brokenshire) under the Supervision of Dr Torriero and Dr Chen.

Dr Patrick Howlett has established links with Dr Tim Muster (CSIRO, Materials Science & Engineering) to initiate a project exploring electrochemical mechanisms within porous electrodes at the air-water interface. A CSIRO post-doc position is planned to commence in 2012 to work on this project.

Working with Dr Pascal Vallotton, head of the Biotech Imaging Group of CSIRO (Mathematics, Informatics and Statistics Division, Nth Ryde), ACES Bionics have been developing high throughput methods for the evaluation of Bionic effects of electromaterials on the growth and differentiation of neurons. Pascal was accompanied to ACES/IPRI by Assoc Prof Rob Kapsa and Catriona Sinclair (St Vincents Health, Melbourne) on 19 September and spoke to the group about the comparative study of automated and manual tracing for characterising neuronal arborization patterns.

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.

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). ACES researchers will contribute to the development of a 'Soldier Borne Energy Generation and Storage' system. The project will commence early 2012.

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 four weeks in 2011 with researchers in ACES/IPRI. A publication describing the improved actuator work output from carbon nanotube – polypyrrole composites was published in Advanced Materials in 2011. A patent has been lodged on the Rapid Preparation of Polypyrrole Films and Coatings from this collaboration.

A new project has been initiated with DSTO and ACES researchers on novel battery structures (details confidential).

HEARING CRC

ACES/IPRI has a project within the Hearing CRC. In 2011 Dr Zhilian Yue worked on two directions: (i) development of drug-eluting silastic coatings, including a drug elution study for pharmaceutical intervention of the inflammatory response in relation to a cochlear implant and (ii) surface bioengineering of implantable electrodes to improve the electrode biocompatibility. Zhilian has published 3 journal articles on this work in 2011.

POLYMER CRC

ACES/IPRI has been involved on an organic solar cell project within the CRC polymers for the last 5 years. This year it was announced that the Federal government extended funding ($14.5 million) for the CRC for Polymers for another five years. Prof Officer will now lead the solar energy program (one of 4 programs in this new co-operative research centre) to fabricate inexpensive polymer-based dye sensitised solar cells and develop advanced polymer films for encapsulating and protecting solar cells.

"This research will not only lead to low cost solar cells that can be put on a wide variety of indoor and outdoor surfaces, but also provide the materials to ensure that those solar cells last for 20 years or more," Prof Officer said.

"The new funding provides an excellent opportunity to build on previous successes at UOW. This is a consequence of CRC researchers having worked alongside other ACES/IPRI researchers in an integrated and effective way for many years, with the Centre providing an obvious conduit for exploitation of the more fundamental discoveries."

The solar energy program also involves researchers at the University of Newcastle, the University of Queensland, the Queensland University of Technology, the University of New South Wales, Monash University and ANSTO.

AUTOMOTIVE CRC

The federal government awarded $26 million to the Automotive Australia 2020 CRC in November 2011.

The research team at UOW's Institute for Superconducting and Electronic Materials (ISEM) is set to play a key role in the Automotive Australia 2020 Cooperative Research Centre, driving the advancement of electrification technologies for use in electric and hybrid electric vehicles. The ISEM team, of which Prof Hua Liu (CI, ACES) is a Chief Investigator, will be the program leader for vehicle electrification within the Automotive CRC.

The new CRC will tackle the complex issues that are currently impeding the uptake of low-carbon vehicles worldwide. Over the coming years, research conducted by the Institute will be critical to producing more affordable and more reliable electric vehicle batteries and supercapacitors as well as thermoelectric modules.

The new state-of-the-art facilities at Wollongong are assisting to set world-class capabilities for processing and fabrication of high performance electrode and electrolyte materials as well as thermoelectric modules for waste heat recovery. New testing equipment will also raise the bar in effectively testing battery safety and performance.

UNIVERSITY OF SYDNEY

ACES/IPRI researchers are collaborating 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.

UNIVERSITY OF NSW (PROF MARGARET MORRIS) AND UNIVERSITY OF MELBOURNE (PROF TERRY O'BRIEN)

In 2011 ACES strengthened collaborations with Prof Margaret Morris (University of NSW) and Prof Terry O'Brien (University of Melbourne) in the design and synthesis of polymer micro- and nano-fibre electrospun materials for the delivery of anti-epilepsy drugs.

UNIVERSITY OF NSW- ARC CENTRE OF EXCELLENCE FOR FUNCTIONAL NANOMATERIALS (ARCCFN) (PROF ROSE AMAL)

ACES researchers are involved in active discussions and collaborations with ARCCFN.

ACES/IPRI has developed a collaborative project in the area of water splitting with Prof Rose Amal's group at UNSW.

ST VINCENTS HEALTH MELBOURNE (PROF CHOONG) AND UNIVERSITY OF MELBOURNE (A/PROF DAMIAN MYERS)

In 2011 ACES continued to expand on the collaboration with the department of medicine and orthopaedics. This collaboration involves surgeons, researchers and clinicians working together to improve osteochondral bone defect repair. Researchers in ACES are developing new materials and new fabrication methods to construct a polymer based tri-structure implantable scaffold to repair damaged osteochondral bone.

MONASH UNIVERSITY (PROF. ALAN BOND'S ELECTROCHEMISTRY GROUP)

Prof Leone Spiccia has been collaborating with Prof Alan Bond's electrochemistry group and Assoc Prof Lisa Martin in the area of electroactive ruthenium complexes and the uptake of peptide nucleic acid conjugates by biomimetic membranes.

UNIVERSITY OF NEWCASTLE - CENTRE FOR ORGANIC ELECTRONICS

Collaborative studies involving polymers and graphene for organic solar cells, which began in 2010, continued with Prof Paul Dastoor, at the Centre for Organic Electronics at the University of Newcastle, in 2011.

This group and ACES will also collaborated together within the new CRC Polymer research program mentioned above in 2012 in both solar cells and solar cell encapsulation.

Dr Patrick Howlett 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'. Outcomes from this work were recently published in the Journal of Physical Chemistry C. ACES/PhD student Tristan Simons has a visit planned for early 2012 to undertake work related to metal-air batteries.

UNIVERSITY OF SOUTH AUSTRALIA - MAWSON INSTITUTE (PROF ROB SHORT, PROF HANS GREISSER, DR RICK FABRETTO)

Our links with the Mawson Institute and UniSA expanded in June 2010 as we began collaborative research using the coating and surface modification technologies at Mawson with ACES activities influencing cell behaviour on conducting substrates. Our investigations in 2011 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 is currently being incorporated into a manuscript for publication.

UNIVERSITY OF WOLLONGONG (PROF XU-FENG HUANG)

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.

This team of researchers were successful in obtaining further funding ($9k, '*Designing a conducting polymer-based device to control Schizophrenia-related neuronal development'* IHMRI small grant) to continue this work in 2012.

Dr Jun Chen (RF, ACES) is co-supervising a master student Miss Jie Zhao with Prof Huang. Jie is working on producing 'Nanocarbon Materials for Biosensing' and a paper is currently in preparation.

UNIVERSITY OF WOLLONGONG (DR JENNY WONG)

Dr Michael Higgins (ACES/IPRI) has undertaken collaborative research with Dr Jenny Wong from IHMRI in a project involving AFM of amyloid fibres in Alzheimer disease.

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 is receiving funding from the Victorian State Government, the Australian Solar Institute, Bluescope Steel, Securency, Innovia and Bosch.

Communications and Outreach

The personnel

Ms Natalie Foxon was appointed as ACES communications officer in April 2011. A UTS Communications graduate, Natalie has 8 years experience in broadcast journalism and radio production at the ABC. She also has worked as a freelance writer and produced a series of instructional DVDs and live events for the Equestrian industry.

Communication strategies

The ACES Communication Strategy 2009-2012 was developed and implemented mid-2009, identifying five target audience groups [ACES Research Group (internal), Industry or End Users, Academic and Scientific Community, Community & Media and the Government & Regulators] along with objectives, strategies and communications tools. This strategy was designed to keep the target groups informed, updated and engaged, as well as attract potential partners for collaborative activities and commercial opportunities that will benefit the Centre. Tools included face-to-face meetings, website, brochures, flyers, newsletters, invitations to presentations and key ACES events and public/visitor tours of the laboratories.

Following feedback since inception from target audiences on the format and content of the newsletter, it was clear there needed to be a change made to the format, content and distribution of the e-newsletter, including having both internal and external newsletters; focusing on a particular theme for each edition; simplifying the email version of the newsletter into key points and links to the website, as well as growing the distribution list.

A focus on creating content in many formats has resulted in more opportunities to communicate ACES research in 2011. A semi-professional video camera was purchased, allowing key research moments and events to be captured on video and used online or given to media. Currently a video series is being developed featuring ACES PhD students explaining their research to a high school age audience. These videos will be used online and through ACES' social media channels.

Introductory DVD 'ACES: From Molecules to Devices'

ACES commissioned an introductory DVD in 2011, featuring interviews with several key personnel and footage from the laboratories. Published on DVD, branded ACES USB drives, distributed at events and footage used online and through social media, the video is an introduction to the research conducted at ACES with a focus on the capabilities of the new AIIM P&D Facility.

Social Media presence

A social media presence was established for ACES in 2011, including facebook, twitter and YouTube. Following the popular ACES introductory DVD on YouTube, the facebook account is the most active with 81 followers. Most content uploaded to the ACES website is also promoted through the social media channels. ACES' social media presence has allowed extensive 'sharing' of content including with the social media sites of Innovation Campus and University of Wollongong Research and Innovation Division. The social media presence will continue to be pushed in 2012 and will expand to include further connections with other sites and blogs.

Animations

ACES also commissioned professional animations for various uses, the highlight of which was an animation to accompany a key media story from ACES research published in Science. This video was picked up and used by media worldwide and to date has had over 15,000 views on the ACES YouTube channel.

Traffic through ACES website

Improvements in the content uploaded onto the ACES website, electromaterials.edu.au, in 2011 has resulted in an increase of traffic from 424 unique monthly visitors (4548 hits) in January 2011 to 2627 unique monthly visitors (68 423 hits) in November 2011. These improvements have included more frequent uploading of news items, better linking of content items, upgraded 'people' pages including professional photographs and integration with e-newsletters and social media. Ongoing improvements to the website will include an overhaul of the ACES research program pages, including addition of multimedia elements.

External e-newsletter

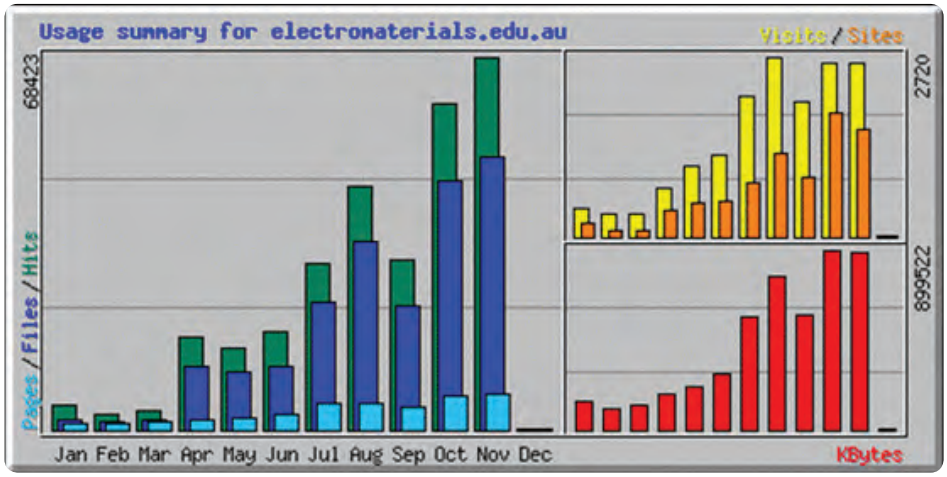
The format of the external newsletter, ACES News, was changed in July to an online hosted format. The new format better reflects the ACES website content, encourages the user to click from one piece of content through to another, and allows for accurate reporting of readership and an up to date management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

Website users can subscribe to the ACES Newsletter automatically through the website. The current external ACES database (not including ACES members) is confirmed as active and consists of 531 contacts. Strategies are currently being put in place to grow this database, including giving visitors the opportunity to sign up to the mailing list, and an automatic mailing list subscription form is now active on the website from which users can subscribe themselves. The October edition of ACES News has an 'open rate' of 28% (average open rates are around 20-25%) and a 'click through' rate of 32% (average click through rates are well under 10%), which tells us that the content in our newsletters is of high value to the reader.

Media Coverage

As a result of a more proactive approach to media coverage, ACES media hits increased from 91 in 2010 to 149 (51 print, 15 radio, 7 TV and 77 online/web) in 2011. In addition to the rise in actual media hits, the reach was also improved with coverage in several new significant outlets including the Sydney Morning Herald, Cosmos Magazine and several international websites and blogs. An increase in the number of press releases distributed directly from ACES in addition to key media contacts established resulted in a clear increase in coverage for Prof Gordon Wallace. This approach will be extended in 2012 with the intention to gain more coverage for a greater range of research and personnel within all the ACES nodes.

See Table 5 for the complete list of media hits in 2011. All the media coverage was positive for ACES.



A steady increase in traffic through the ACES website, electromaterials.edu.au, was observed in 2011.

Communications training

Communications and Media Officer 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.

PhD students, early career researchers, interns and staff (total 50), from across all the ACES nodes, attended the ACES Communications workshop, Electrifying Science, 16 December.

The half day workshop gave attendees information on how best to represent ACES in public, why communicating their research is an important element of their work at ACES, hints and tips for getting their work published and how to engage various audiences in their work.

PhD students took part in a light hearted 'Elevator Pitch' competition in which they were asked to communicate their research in lay-terms in one minute. Invited speakers included: Nick Rheinberger (ABC Radio personality); Mark Wilson (Faculty Science UOW) and Richard John (Griffith University and coordinator of the outreach program Science on the Go).

Community awareness & outreach

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

FEDERAL GOVERNMENT'S NATIONAL ENABLING TECHNOLOGY STRATEGY STAKEHOLDER ADVISORY COUNCIL

Susan Dodds (ACES CI, UTas) served as a member on the Federal Government's National Enabling Technology Strategy Stakeholder Advisory Council.

INVITED PANELLIST AT THE RIAUS (ROYAL INSTITUTE OF AUSTRALIA) ADELAIDE FESTIVAL OF IDEAS

Susan Dodds (ACES CI, UTas) participated as an invited panellist at the RiAus (Royal Institute of Australia)/ Adelaide Festival of Ideas event (8 October): "Three technologies that will change the way we live", which was presented by RiAus and Bridge8 for the National Enabling Technologies Strategy Expert Forum and the Department of Innovation, Industry, Science and Research (DIISR). (http://riaus.org.au/programs-and-events/three-technologies-that-will-change-the-way-we-live/)

Regenerative medicine, zero emission cities, and synthetic meat are three radical technologies with the potential to change our lives. They explored the contribution of 'enabling technologies' in driving rapid change, and look at the associated socio-

cultural, health, safety and environmental impacts. The panel asked participants whether these technologies excited or scared them, and used foresight approaches to demonstrate possible outcomes.

ABC Catalyst's Maryanne Demasi hosted the discussion.

NANOTECHNOLOGY EXHIBIT AT WOLLONGONG SCIENCE CENTRE

ACES/IPRI are working with the Wollongong Science Centre throughout the year to develop a new exhibit due to open in early 2012. This exhibit builds upon the ACES sponsored iDome located in the science centre.

The exhibit has a series of information panels giving visitors a brief overview of what Nanotechnology is all about and where nanotechnology can be used in society. The panels were designed by Willo Grosse, a PhD student from ACES. This student co-ordinated with and supplied research samples to Bluescope Steel cadets to engineer interactive displays that will accompany the panels. Another ACES PhD student supplied custom printed Dip Pen Nanolithography samples to be included into this new Nanotechnology exhibit.

In addition ACES purchased a fulldome show called 'Nanocam- a trip into biodiversity'. This video is an incredible journey through the microscopic structures (even to the 'nano' level) of the five kingdoms and is suitable for adults and children 7 years old and older.

SCHOOL OUTREACH PROGRAM BY THE WOLLONGONG SCIENCE CENTRE

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.

ACES OPENS IT'S DOORS

ACES/IPRI in Wollongong opened it's doors for public tours of the world class nanotechnology labs on the 24 May 11. Staff and students showcased their research to 40 participants.

As part of the Illawarra Innovation Festival, ACES work was showcased with an information stand in the iC Central building (Innovation Campus). Public tours of IPRI were booked out in advance, with members of the public learning about Synthesis, Printing and Bionics areas of research being undertaken.

On 18 July, Dr Toni Campbell hosted 12 Year 10-11 High school students, interested in ACES research at IPRI. They first learnt of ACES through their school career advisors network, who were themselves hosted for a tour in 2010.

At the opening of the UOW Soft Materials Group new laboratories on 29 July, co-founder Marc in het Panhuis (CI, ACES) had his hydrogel research, partially funded by ACES and other by his ARC Future Fellowship, on display.

The Soft Materials Group research encompasses three main areas; hydrogel materials, membranes and cage complexes, and was established in January 2008 by Assoc Prof Marc in het Panhuis and Assoc Prof Steve Ralph. The group has grown to include 15 researchers and has strong links with the Centre for Medicinal Chemistry (CMC) and the ARC Centre of Excellence for Electromaterials Science (ACES).

"The members of Kiama Downs Mens Probus Club wish to thank you for organising our tour of the Nanotechnology Laboratories. We found this to be of great interest and were most impressed with the research investigations underway to make our world a nicer place to live in. The very knowledgeable research staff certainly showed great enthusiasm for their projects. We look forward to being part of future tours of the Innovation Campus"

Alex Harris (RF, La Trobe) gave a laboratory tour at La Trobe University and spoke about the ACES Bionics work to seven Year 10 high school students from Santa Maria College on 19 October.

Dr David Officer (CI, UOW) gave a tour of ACES/IPRI for the 12 members of the University of Wollongong Faculty Of Science External Advisory Committee on the 28 November.

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

In the first week of December the St Vincent's ACES Bionics laboratory conducted a training course for 3rd year Indonesian Medical Students as part of their Advanced Medical Science (AMS) year. The 1 week course on 'Laboratory Techniques' forms part of the University of Melbourne AMS year, and is designed to introduce students to the theory and practice of medical research techniques. All students get "hands on" experience in the laboratory, learning the theory behind the methodologies, as well as how to conduct scientific research.

Marc in het Panhuis (CI, UOW) was interviewed by Jonathon Su, a Year 12 Design and Technology student from Cedars Christian College, Farmborough Heights, who chose to undertake a case study on the hydrogel research related to Marc's Future Fellowship program.

Hosting our Members of Parliament

Justine Elliot MP, Federal Parliamentary Secretary for Trade, included a tour of ACES/IPRI, along with Sharon Bird MP and Stephen Jones MP (9 June 11). Met by UOW Vice Chancellor Gerard Sutton, Justine Elliot toured the state-of-the-art AIIM building and was brought up to speed on the finishing touches being put on the brand new $43.8 million expansion, the AIIM-Processing and Devices Facility.

As Parliamentary Secretary for Trade, Ms Elliot is principally responsible, in conjunction with the Minister for Trade, the Hon Dr Craig Emerson MP, for trade and investment promotion, specifically Austrade (including the promotion of international education), the Export Market Development Grants Program and the Tradestart program (media.uow.edu.au/news/UOW104197.html)

Ms Elliot was updated on the important collaborative agreement recently signed, with the assistance of Austrade, between ACES and the Korean Institute of Machinery and Materials to enable development of next generation custom built fabrication equipment.

ACES GETS THE THUMBS UP IN FEDERAL PARLIAMENT

Following her visit, Sharon Bird MP has spoken in Parliament 22 June 11 in glowing terms about ACES work (see parliamentary speech in Appendix at the end of this chapter).

PRIME MINISTER GILLARD VISITS ACES HEADQUARTERS

Prime Minister Julia Gillard included ACES Headquarters at University of Wollongong's Innovation Campus in her first visit to the Illawarra 30 August. Following the announcement last week that the Illawarra based steelworks Bluescope Steel would slash one thousand jobs; Prime Minister Gillard made the trip to the Illawarra to speak with people who were affected by the job cuts. The Prime Minister met with local business leaders about the future of the region.

Her visit to the AIIM Facility on Innovation Campus coincided with the Illawarra Manufacturing Expo in the afternoon, launched by Minister for Innovation, Senator Kim Carr.

SENATOR KIM CARR, SHARON BIRD AND STEPHEN JONES HERE FOR THE ILLAWARRA MANUFACTURING EXPO

New cutting edge fabrication technology being utilised by ACES in the new AIIM Processing and Devices Facility on University of Wollongong's Innovation Campus was on show at the Illawarra Manufacturing Expo on August 30. Organised by the offices of local MPs Sharon Bird and Stephen Jones, the expo was launched by Minister of Innovation, Industry, Science and Research, Senator Kim Carr. The event highlighted a range of Government services available to the manufacturing industry, in addition to innovative fabrication techniques such as those offered by ACES (more in End-User section of this report).

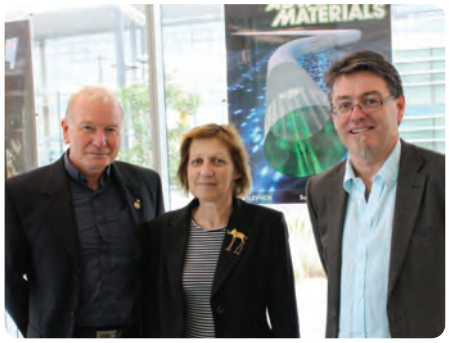
Prof Gordon Wallace talking with Prime Minster Julia Gillard. Prime Minister Julia Gillard included ACES Headquaters at University of Wollongong's Innovation Campus on her first visit to the Illawarra.

Left: **Senator Kim Carr and local MPs Sharon Bird and Stephen Jones organised the Illawarra Manufacturing Expo**

Right: **(L to R) ACES/IPRI Director Gordon Wallace, Federal Member for Cunningham Sharon Bird, Federal Parliamentary Secretary for Trade and NSW Justine Elliot, ISEM Director Prof Shi Xue Dou, Federal Member for Throsby Stephen Jones and Vice Chancellor Prof Gerard Sutton.**

WOLLONGONG LORD MAYORAL VISIT TO ACES

The new Wollongong Lord Mayor Gordon Bradbery toured the lead node of ACES at University of Wollongong's Innovation Campus on 28 September. During his tour, Mr Bradbery was given short presentations on the ACES research areas including Graphene, 3D Printing, Wearable Bionics, Nerve & Muscle Regeneration and Atomic Force Microscopy.



Hosting the newly elected Lord Mayor of Wollongong Gordon Bradbury pictured here with Prof Judy Raper (UOW Deputy DVC Research) and Prof Gordon Wallace (Director ACES)

Hosting International Representatives

CHINA'S SOUTHWEST JIAOTONG UNIVERSITY VISITS ACES

A delegation from one of China's leading Universities visited ACES/IPRI (10 May 11). The visit came about thanks to Professor Yuan Yong, an alumnus of the University of Wollongong who studied for his Doctoral Degree in the 1990s at IPRI and is now a professor in the school of Material Science and Engineering at Southwest Jiaotong University (SWJTU)(electromaterials.edu.au/news/UOW101715)

Profs David Officer and Geoff Spinks, both ACES Chief Investigators, led the delegation through a tour of the nanotechnology labs, giving information on ACES research programs including solar cells and water splitting, printing and bionics.

VIETNAMESE DELEGATION

ACES/IPRI hosted Dr Chu Duc Nha, the Counsellor of Education from the Embassy of Vietnam in Australia and his associates Mr VU Van Toi, First Secretary (Science and Technology) and Mr CHU Quang Hoa, First Secretary (Science and Technology) for a laboratory tour on 2 November.

TAIWANESE DELEGATION

ACES welcomed a Taiwanese delegation to ACES on 25 November 2011. The delegation included: Prof Peter (Chung-Yu) Wu, Ph.D., IEEE Fellow, Program Director, National Program on Nano Technology (NPNT), Taiwan and Chair Prof at National Chiao Tung University; Prof. Ming-Dou Ker, Department Manager in the VLSI Design Division, Computer and Communication Research Laboratories, Industrial Technology Research Institute (ITRI), Hsinchu; Prof Yu-Ting Cheng, Department of Electronics Engineering and Institute of Electronics at the National Chiao Tung University in Hsin Chu; Prof. Yang-Tung Huang, Chair of Electronics Engineering and Institute of Electronics at Chiao-Tung University and NPNT Program Convener, and Prof J. C. Chiou, Department of Electrical Engineering, National Chiao Tung University and Department of Medicine, China Medical University, the director of Biomedical Engineering Research and Development Center of China Medical University and the task force leader of National Program of Nano Technology.

Community Engagement Events/Activities Hosted by ACES

IN-HOME MONITORING FOR ACTIVE AGEING INTERNATIONAL COLLABORATIVE RESEARCH LAUNCH (14 NOVEMBER 2011)

Consider the regularity of your daily routine. As we age, often our daily routines become more regular. Being able to monitor these regular home activities could provide vital information on the day to day well-being of seniors who choose to remain in their own home, resulting in increased peace of mind for themselves and their families.

Along with Illawarra Retirement Trust (IRT), ACES has established a collaborative international team including Dublin City University, to work towards providing seniors with greater independence and peace of mind in their own home environment.

An in-home monitoring system could track the regular daily activities of individuals, based on their consumption of energy, and alert an organisation should an irregularity appear. This system will be trialled on selected volunteering IRT residents.

Dr Stephen Beirne providing a demonstration of the technology at the In-Home Monitoring Launch

Mr Luke Oborn, IRT's Manager of Strategic Initiatives, said the technology would help seniors take greater control of their independence and reflected the role technology will play in the future of aged-care, highlighting IRT's excitement at being involved in the research project.

Prof Susan Dodds from the University of Tasmania node of ACES discussed the ethical issues surrounding such a project via Skype and Professor Alan Smeaton provided further information on the technology via video from Dublin.

The technology will provide vital information on the day to day wellbeing of seniors who choose to remain in their own homes by recording data based on energy consumption in the household. By the end of 2012 ACES hopes to be developing wearable technology to assist seniors undergoing rehabilitation and study their movements (media.uow.edu.au/news/UOW114443; Monitoring technology to help maintain seniors' independence).

The delegation from China's Southwest Jiaotong University included Liya Gu, Hua Zhang, Jianxin Liu, Pan Wei, Yanjun Qiu and Yuan Yong shown here with Profs Officer and Spinks from UOW.

LAUNCH OF THE 'CONTROLLING LYMPHOEDEMA IN AN INTELLIGENT FASHION' RESEARCH PROJECT LAUNCH (16 NOVEMBER 2011)

(media.uow.edu.au/news/UOW114517; Innovative sleeve set to improve quality of life for breast cancer survivors).

A collaborative project between ACES and University of Wollongong's School of Health Sciences and Graduate Medical School, the research team aims to develop a 'Lymph Sleeve' which can be worn by breast cancer-related lymphoedema patients during their daily lives.

The project was launched at the Innovation Campus with speakers from the research team at ACES as well as breast cancer survivor Rosemary Paul, Australia's first Playboy Playmate and experienced lymphoedema massage therapist, Dr Philip Clingan from Wollongong Hospital's Oncology Unit and Director of Research from NBCF, Dr Alison Butt. The aim of the launch was to engage end-user interaction with the researchers from the outset of the project.

Funded by the National Breast Cancer Foundation (NBCF), Dr Alison Butt, commented that their aim in funding Novel Concepts Awards is to promote the latest, cutting edge research into breast cancer.

Given the attentive audience made up of community members, cancer support groups and researchers, calls for active end-user participation and support from the project was clearly evident. The stories provided by those members who suffer breast cancer-related lymphoedema has assisted the researchers in understanding the needs in a therapeutic device for this population

'Out and About' - ACES Research at Public Forums

NANO TECH EXPO, TOKYO JAPAN

As part of ongoing collaborations with Nippon Telegraph & Telephone Corporation (NTT) in the bionics area, Prof Wallace held a joint press briefing with Dr Keiichi Torimitsu (NTT Communications) at Nano Tech Expo, Tokyo Japan (14-18 February 2011). This briefing was hosted by the Australia-Japan Science Media Centre; supported through the Australia-Japan Foundation which is part of the Commonwealth Department of Foreign Affairs and Trade.

The Australian Ambassador to Japan hosted a dinner with Prof Wallace and leading scientists and industrialists in Tokyo the night after this event.

Dr Bridget Munro (ACES & School of Health Sciences), Professor Philip Clingan (Director of Oncology, Wollongong Hospital & Graduate Medical School), Dr Wen Zheng (ACES) and Mrs Rosemary Paul (NBCF Spokesperson) view an initial prototype of the device.

UNI IN THE BREWERY

Dr Simon Moulton gave his talk on Bionics, 'Polymer power to help put us together' at Uni in the Brewery on 25 May 2011. Uni in the Brewery is a regular event run by the UOW whereby academics give talks to the general public, as well as UOW staff and students at Five Islands Brewery, the first Brewery in the Illawarra (media.uow.edu.au/news/UOW102644)

Patrick Howlett (RF, Deakin) presented a talk to Engineers Australia at North Melbourne on new electrolyte materials in June

BILL WHEELER BIONICS AWARD AND PUBLIC LECTURE

(uow.edu.au/aces/news/UOW106406)

The popular Bill Wheeler Symposium featuring Professor Graeme Clark's public lecture was held on 14 July 2011 at the Wollongong Science Centre in front of an audience of around 100 members of the public.

Since it's inception in 2009, the Bill Wheeler Award has developed into a popular community event. World renowned Professor Graeme Clark, inventor of the Cochlear Implant and ACES co-founder, presented a fascinating talk about his work to an enthusiastic audience including several recipients of implants and students interested in the field of Bionics. Cameron Ferris and Amy Gelmi, two PhD students from ACES/IPRI, also presented their work in the Bionics area.

Bill Wheeler's enthusiasm for fundraising for Bionics research dates back several years. While a member of the board of the Australian Rotary Health Research Fund, Bill met Prof Graeme Clark and discussed his work and the need for more research. In 2003, with the support of Kiama Rotary, Bill was the instigator and the main organiser of a fund raiser at Hartwell House for Bionic Research. Both Prof Graeme Clark and Prof Gordon Wallace generously gave presentations on their research. It was very successful not only in raising money but also awareness.

Sadly, Bill passed away in 2007, however his passion for helping the community continues with the annual Bill Wheeler

Award, assisting young researchers such as this year's recipient, Amy Gelmi, to develop real solutions for the community.

RESEARCHERS JUMP ON BOARD THE TOUR DUCHENNE FOR MUSCULAR DYSTROPHY'

(uow.edu.au/aces/news/UOW110617)

ACES was involved with the charity bike ride, Tour Duchenne, which raises money and awareness for the Muscular Dystrophy Foundation. Three ACES researchers cycled into Innovation Campus in Wollongong with the tour, where they stopped for a break and learned from Professor Rob Kapsa about the relevant research being undertaken at ACES. The condition is close to the hearts of the ACES researchers, who are working on muscle and nerve regeneration in the Bionics Program; work which could ultimately assist in conditions such as Duchenne Muscular Dystrophy.

The Tour Duchenne's visit to Innovation Campus received coverage in television, print and online media locally and although the media hits did not refer directly to ACES, the event was a great example that ACES can piggy back on existing events for our own outreach activities.

THREE MINUTE THESIS

At the University of Wollongong's Three Minute Thesis final 30 June 2011, Damian Kirchmajer (ACES PhD, UOW) presented his research, involving developing a material used to grow new tissue and organs in a laboratory, which can be used to replace damaged or diseased ones in patients, and won the People's Choice Award.

The nationwide 3MT competition is an exercise in communicating complicated research concepts in a compelling format to a general audience.

UOW FACULTY OF SCIENCE 2011 'GET PUBLISHED' WORKSHOP (8 SEPTEMBER 2011)

The workshop was designed to give participants a 'heads up' in terms of getting their work published, especially during their candidature as higher degree research (HDR) students.

ACES/IPRI PhD candidate Cameron Ferris was asked to present his perspective as he was a candidate that has published his work during his PhD. Other talk topics included: 'Why publish? What makes a good track record'; getting published; perspectives from editors of scientific journals; and relationship of papers to thesis chapters and visibility and discoverability: ensuring your publications are findable.

The event was attended by 100 higher degree research students, including 6 students from ACES/IPRI.

2011 ILLAWARRA COAL REGIONAL SCIENCE FAIR

Marc in het Panhuis (CI, UOW) was the keynote speaker at the 2011 Illawarra Coal Regional Science Fair held at the University of Wollongong on 2 November 2011 (Illawarra Coal Regional Science Fair attracts record entries-see media.uow.edu.au/news/UOW113649.html).

His presentation was entitled "The wonderful world of hydrogels: what are they? where are they? and why should you care?" Also presenting as part of this keynote address were 2 PhD students Cameron Ferris and Damian Kirchmajer. The event attracted 530 students from 46 schools and the audience was a mixture of year 1 to year 12 school students as well as their parents and teachers.

Assoc Prof Simon Moulton (RF, IPRI) gave a talk on 'Organic Bionics: 'Polymer power to help put us together' to year 12 students at Oak Flats high school on 29 July.

On 4 October 2011, Cameron Ferris (PhD, UOW) gave a presentation on his research at ACES and leadership experiences at the Elevate Young Leaders Forum, held at UOW. The theme for the day was 'Inspire Action' and the audience was made up of 200 Year 11 SRC members from 58 high schools from the Illawarra, Sutherland Shire, SW Sydney, South Coast, and Southern Highlands.

Marc in het Panhuis (CI, UOW) spoke about ACES, how it functions, what it is, what it does, research opportunities and scholarships at the University of Wollongong (UOW) Nanotechnology Society (Nanosoc) meeting held on 22 September 2011.

Assoc Prof Simon Moulton gave an invited guest seminar, 'Conducting Polymer Bionics Research', to Engineers Australia at the University of Wollongong on 18 October.

Left: **Assoc Prof Rob Kapsa (CI, Bionics program leader) discussing the ACES Bionics research with a member of the touring cyclists.**

Right: **The Illawarra Coal Science Fair gave students the opportunity to attend a special Nanotechnology lecture about hydrogels given by Marc in het Panhuis (ACES CI) and 2 ACES PhD students, Damien Kirchmajer and Cameron Ferris.**

Table 5: ACES Media summary 2011

Date	Medium	Source	Description	Journalist	Page#/web link
02 Feb 11	web		Summer Scholarship Students news item		
09 Feb 11	web	UOW Media	Spotlight on new materials for energy at international symposium Report on ACES Electromaterials Symposium	Bernie Goldie	media.uow.edu.au/news/UOW095550.html
11 Feb 11	web	UOW Media	UOW undergraduate co-authors paper in Science journal	Bernie Goldie	media.uow.edu.au/news/UOW095675.html
11 Feb 11	web	UOW Media	Researchers unveil MASK initiative	Bernie Goldie	media.uow.edu.au/news/UOW095662.html
14 Feb 11	web	UOW Media	Introducing new technologies to the world of aged care	Bernie Goldie	media.uow.edu.au/news/UOW095726.html
14 Feb 11	radio	i98	Interview with Gordon Wallace about the advances in nanostructured electromaterials and their use in energy conversion and storage		
18 Feb 11	print	Sydney Morning Herald	Tribute to the life of Emeritus Professor Leon Kane-Maguire article featured in Obituary section. Leon was an ACES Chief Investigator.		
22 Feb 11	web	Government news.com.au	Professor Gordon Wallace building on international research links at NanoTech 2011 expo: Article on NanoTech 2011 in Japan discussing the important opportunity to increase investment in nanotechnology. (posted March 14, 2011)		www.governmentnews.com.au/2011/02/22/article/NSW-Government-sends-boffins-to-Japan/EPEOULCCAC.html
24 Feb 11	web	UOW Media	The brave new world of medical bionics	Bernie Goldie	media.uow.edu.au/news/UOW096369.html
11 Mar 11	web	Dublin City University	Dublin City University website featured the MASK meeting at ACES headquarters		www.dcu.ie/chemistry/asg/news.shtml#MASK1
16 Apr 11	print	Sydney morning Herald	Story on opportunities for researchers in the field of nanotechnology, includes quotes and information supplied by Prof Gordon Wallace.	Melinda Ham	
03 May 11	web	iC News	Life as a visiting researcher at IPRI/ACES. Excerpt of report by Hiroshi Nakashima from NTT.	Nat Foxon	www.innovationcampus.com.au/uploads/39485/ufiles/iC_News_-_April_2011.pdf
13 May 11	web	Campus Daily	Korean collaboration to revolutionise medical bionics research technology.	Nat Foxon	www.campusdaily.com.au/read_university_news.php?title=korean_collaboration_to_revolutionise_medical_bionics_research_technology_27296
May 11	web	NBS	Story about polymer photovoltaics in Sustainability article section, mentioned ARC grant received by IPRI, in relation to first trickles of fundings beginning to show for this field of research.	Michael Smith	www.thenbs.com/topics/Environment/articles/polymerPhotovoltaics.asp
13 May 11	web	UOW Media	Korean collaboration to revolutionise medical bionics research technology.	Nat Foxon and Nick Hartgerink	media.uow.edu.au/news/UOW101471.html
18 May 11	radio	ABC Illawarra	Assoc Prof Peter Innis (ACES CI) commented on the safety of nanoparticles in sunscreen	Jo Lauder	
19 May 11	print	Illawarra Mercury	Photo of Dr Sanjeev Gambhir (ANFF/IPRI) in lab with an accompanying story about UOW's great results in QS World University Rankings	Sam Hall	

Date	Medium	Source	Description	Journalist	Page#/web link
24 May 11	print	Illawarra Mercury	Bio of Dr Simon Moulton (ACES/IPRI) in lead up to his Uni in the Brewery presentation	Editor Ben Long	
25 May 11	web	UOW Media	"Polymer power to help put us together" story about medical bionics in the lead up to Simon Moulton's presentation at Uni in the Brewery	Melissa Coades	media.uow.edu.au/news/UOW102644.html
31 May11	print	RAID newsletter	Story about KIMM collaboration in the UOW Research and Innovation News	Nat Foxon	
02 Jun 11	web	iC news	Story about KIMM collaboration	Nat Foxon	
22 Jun 11	print	ATSE Focus	Story about KIMM collaboration	Nat Foxon	www.atse.org.au/resource-centre/func-startdown/443/
27 Jun 11	web	Plastics News	IPRI included in a wrap of Australian Research news. Dr Simon Moulton quoted.	Kate Tilley	plasticsnews.com/headlines2.html?id=11062701002&q=intelligent+polymer+research+institute
July	print	iC News	Bill Wheeler Award		
14 July 11	web	Nanowerk.com	Report on Dr Higgins' Shape Memory Polymers		
19 July 11	web	UOW Media Unit	Bill Wheeler Award	Nat Foxon	http://media.uow.edu.au/news/UOW106444.html
28 July 11	print	Kiama Independent	Bill Wheeler Award		
9 Aug 11	web	Deakin University media	Maria Forsyth named 2011 Australian Laureate Fellow		www.deakin.edu.au/research/stories/2011/08/09/professor-maria-forsyth-awarded-australian-laureate-fellowship?print_friendly=true
10 Aug 11	radio	ABC Illawarra	Gordon Wallace named 2011 Australian Laureate Fellow		
10 Aug 11	web	UOW Media Unit	Gordon Wallace named 2011 Australian Laureate Fellow	Bernie Goldie	http://media.uow.edu.au/news/UOW108360.html
17 Aug 11	print	The Illawarra Mercury	Gordon Wallace named 2011 Australian Laureate Fellow		
17 Aug 11	web	Research Career	2011 Australian Laureate Fellows announced		www.researchcareer.com.au/news/australian-laureate-fellows-for-2011-announced
18 Aug 11	print	Kiama Advertiser	Gordon Wallace named 2011 Australian Laureate Fellow		
21 Aug 11	radio	ABC	80 Days that Changed Our Lives - tribute to the discovery of the Bionic Ear with Prof Clark		
Aug 11	radio	Super Radio Network	Feature Interview with Prof Clark in Hearing Awareness Week	Meryl Swanson	
27 Aug 11	TV	Catalyst on ABC 1	ACES thanked for contribution to a story about Graphene	Dominique Pile	
30 Aug 11	print	The Age	Can we store solar energy for when the sun doesn't shine? Q&A with Prof Forsyth	Deb Anderson	www.theage.com.au/national/education/can-we-store-solar-energy-for-when-the-sun-doesnt-shine-20110829-1ji03.html
1 Sept 11	print	The Illawarra Mercury	Story about Illawarra Manufacturing Expo and business opportunities generated at ACES	Greg Ellis	

Date	Medium	Source	Description	Journalist	Page#/web link
1 Sept 11	print	The Illawarra Mercury	Story about Aquahydrex making the finals of the Enterprize award		
1 Sept 11	web	Barn Plantorna	Interview with Professor Graeme Clark		www.barnplantorna.se
1 Sept 11	TV	George Negus Tonight	Interview with Prof Mark Cook		
1 Sept 11	TV	Sky News	Interview with Prof Mark Cook		
3 Sept 11	print	Sydney Morning Herald	Built with strong links: article about IPRI's industry links attracting researchers and students		www.smh.com.au/national/postgraduate-education/built-with-strong-links-20110901-1jnmj.html
12 Sept 11	web	UQ News	Aquahyrdrex technology finalist in Enterprize competition		www.uq.edu.au/news/?article=23797
15 Sept 11	web	iC News	ACES cements its leading role in medical bionics: news story on the Shimmer Launch		www.innovationcampus.com.au/news/aces-cements-its-leading-role-in-medical-bionics/
15 Sept 11	web	UOW media	ACES cements its leading role in medical bionics: news story on the Shimmer Launch		http://media.uow.edu.au/news/UOW110409.html
15 Sept 11	print	The Illawarra Mercury	News story about ACES' collaboration with Irish wireless tech company Shimmer	Greg Ellis	www.illawarramercury.com.au/news/local/news/general/university-at-forefront-of-bionic-knee-technology/2292263.aspx
16 Sept 11	print	The Age	Built with strong links: article about IPRI's industry links attracting researchers and students	Keeli Cambourne	http://m.theage.com.au/national/postgraduate-education/built-with-strong-links-20110901-1jnmj.html
Sept-Oct edition	print	RAID news UOW	Issue featured several stories about ACES: Feature on Gordon Wallace named 2011 ALF; Prime Minister Gillard visits Innovation Campus; Launch of Shimmer collaboration; Bridget Munro new staff; story on Geoff Spinks' new role as AIIM Faculty Research Committee Chair.		https://www.uow.edu.au/content/groups/public/@web/@raid/documents/doc/uow110913.pdf
1 Oct 11	print	ATSE Focus magazine	Gordon Wallace named 2011 Australian Laureate Fellow	Editor	
1 Oct 11	print	Campus News UOW	Opinion piece on next generation manufacturing	Gordon Wallace	
Oct 11 edition	print	Australian Academy of Science magazine	Gordon Wallace named 2011 Australian Laureate Fellow		
11 Oct 11	web	Australian Science Media Centre	Twisting artificial muscles (Geoff Spinks) story featured in the AUSSMC Heads Up to Journalists alert.	Ed Sykes	
11 Oct 11	web	NanotechWeb	Twisting artificial muscles story in Institute of Physics website in the UK		http://nanotechweb.org/
11 Oct 11	web	Chemistry World	Twisting artificial muscles story		
11 Oct 11	radio	Naked Scientists	Twisting artificial muscles story		
13 Oct 11	print	Illawarra Mercury	Dr Bridget Munro featured in a story about the graduation ceremony held for those participating in the Program for Preparing Early Leaders		

Date	Medium	Source	Description	Journalist	Page#/web link
13 Oct 11	web	Science Debate	Twisting artificial muscles story		www.sciencedebate.com/science-blog/ultra-strong-flexible-carbon-nanotube-artificial-muscle-invented
13 Oct 11	print	Sydney Morning Herald	Twisting artificial muscles story, Prof Spinks interviewed		
13 Oct 11	web	Science Daily	Twisting artificial muscles story		
13 Oct 11	web	Scientific American Blog Network	Twisting artificial muscles story		
14 Oct 11	print	MX	Twisting artificial muscles story		
14 Oct 11	radio	ABC Illawarra	Twisting artificial muscles story		
14 Oct 11	web	UOW Media Unit	Twisting artificial muscles story		http://media.uow.edu.au/news/UOW112081.html
14 Oct 11	print	Courier Mail	Twisting artificial muscles story	AAP	www.couriermail.com.au/news/breaking-news/artificial-muscles-to-push-bots-in-bodies/story-e6freonf-1226166346679
14 Oct 11	print	Adelaide Advertiser	Twisting artificial muscles story	Julian Swallow	www.adelaidenow.com.au/news/technology/minuscule-robots-getting-some-muscle/story-e6freaal-1226166204265
14 Oct 11	radio	Wave FM	Twisting artificial muscles story		
14 Oct 11	radio	i98 FM	Twisting artificial muscles story		
14 Oct 11	print	Townsville Bulletin	Twisting artificial muscles story		
14 Oct 11	print	The Daily Telegraph	Twisting artificial muscles story		www.dailytelegraph.com.au/minuscule-robots-getting-some-muscle/story-fn6b3v4f-1226166955451
14 Oct 11	web	Nanotechweb	Twisting artificial muscles story	Belle Dume	
14 Oct 11	web	MedicalDaily.com	Twisting artificial muscles story	Angelina Tala	
14 Oct 11	web	ABC Science Online	Twisting artificial muscles story featured on the front page	Anna Salleh/ Darren Osbourne	abc.net.au/science/articles/2011/10/14/3336939.htm
14 Oct 11	web	Cosmos Online	Twisting artificial muscles story	Meera Senthilingam	www.cosmosmagazine.com/news/4849/twisty-carbon-nanotubes-mimic-muscles
14 Oct 11	web	The Conversation	Twisting artificial muscles story	Geoff Spinks	http://theconversation.edu.au/show-us-your-carbon-nanotube-artificial-muscles-3821
15 Oct 11	print	The Illawarra Mercury	Twisting artificial muscles story	Deborah Smith	www.illawarramercury.com.au/news/local/news/general/fantastic-voyage-comes-a-tiny-step-closer/2324319.aspx
15 Oct 11	web	FrogHeart	Twisting artificial muscles story		www.frogheart.ca/?p=4822

Date	Medium	Source	Description	Journalist	Page#/web link
15 Oct 11	web	London Free Press	Twisting artificial muscles story		lfpress.com/life/healthandfitness/2011/10/14/18826476.html
15 Oct 11	print	The Age	Twisting artificial muscles story	Deborah Smith	www.theage.com.au/technology/sci-tech/fantastic-voyage-comes-a-tiny-step-closer-20111014-1lo0x.html
17 Oct 11	web	Nanowerk.com	Twisting artificial muscles story		www.nanowerk.com/news/newsid=23070.php
17 Oct 11	web	Science Alert	Twisting artificial muscles story		www.sciencealert.com.au/news/20111610-22727.html
18 Oct 11	web	BioScholar News	Twisting artificial muscles story		http://news.bioscholar.com/2011/10/synthetic-muscles-make-nanobots-effective.html
18 Oct 11	web	inewsone.com	Twisting artificial muscles story		www.inewsone.com/2011/10/18/synthetic-muscles-make-nanobots-effective/83977
23 Oct 11	radio	Dr Feelgood	Interview with Prof Mark Cook		
23 Oct 11	web	AALAtimes.com	Twisting artificial muscles story		www.aalatimes.com/2011/10/23/new-twisting-artificial-muscles-propel-nano-robots-one-step-closer-to-medical-applications/
25 Oct 11	print	The Australian	Dr Swiegers' and Chris Gilbey's Enterprize Competition entry Aquahydrex mentioned in an regular business column	Peter Switzer	
31 Oct 11	web	The Foresight Institute	Twisting artificial muscles story		www.foresight.org/nanodot/?p=4834
11 Nov 11	radio	ABC Illawarra	In-home monitoring launch. Gordon Wallace interviewed.		
11 Nov 11	print	Illawarra Mercury	Device to help keep an eye on elderly. In-home monitoring launch		
15 Nov 11	web	UOW media unit	Monitoring technology to help maintain seniors' independence		http://media.uow.edu.au/news/UOW114443.html
16 Nov 11	TV	WIN TV	Bridget Munro, Phil Clingan and Rosemary Paul interviewed about launch of the Lymph Sleeve project		
17 Nov 11	radio	ABC Illawarra	Bridget Munro interviewed about launch of the Lymph Sleeve project		
17 Nov 11	web	UOW Media Unit	Innovative sleeve set to improve quality of life for breast cancer survivors		http://media.uow.edu.au/news/UOW114517.html
17 Nov 11	print	Illawarra Mercury	Lymph Sleeve launch	Michelle Hoctor	www.illawarramercury.com.au/news/local/news/general/former-playboy-playmate-backs-cancer-research/2360734.aspx

Date	Medium	Source	Description	Journalist	Page#/web link
21 Nov 11	web	Science in Public	Graeme Clark wins Florey Medal		www.scienceinpublic.com.au/media-releases/csl-florey-medal
21 Nov 11	radio	ABC PM	Graeme Clark wins Florey Medal		www.abc.net.au/pm/content/2011/s3372264.htm
21 Nov 11	TV	The Project, Channel 10	Graeme Clark wins Florey Medal		
21 Nov 11	print	Australian Geographic	Graeme Clark wins Florey Medal		www.australiangeographic.com.au/journal/cochlear-implant-scientist-wins-csl-howard-florey-award.htm
21 Nov 11	print	The Australian	Graeme Clark wins Florey Medal, feature in the Ambition column. Prof Clark's Florey Medal story also appeared from the AAP source in several other media		
22 Nov 11	print	Illawarra Mercury, and repeated in Camden Advertiser	Graeme Clark wins Florey Medal for bionic ear invention	Angela Thompson	www.aips.net.au/news/graeme-clark-wins-2011-csl-florey-medal
24 Nov 11	web	UOW Media Unit	Cochlear Pioneer named Florey Medalist		http://media.uow.edu.au/news/UOW114909.html
24 Nov 11	web	UOW Media Unit	CRC success research and innovation		www.uow.edu.au/research/news/UOW114955.html
28 Nov 11	print	RAID news	Twisting artificial muscles story	Natalie Foxon	
29 Nov 11	print	Illawarra Mercury	Research being conducted at IPRI and ISEM will further explore green technology for the automotive industry. Interview with Prof David Officer.		
29 Nov 11	TV	WIN TV	Research being conducted at IPRI and ISEM will further explore green technology for the automotive industry. Interview with Prof David Officer.		
1 Dec 11	print	Internal Medicine News	Implanted EEG Device Predicts Seizures in Early study - interview with Prof Mark Cook		
1 Dec 11	print	Australasian Corrosion Association	Featured profiles of Maria Forsyth, Patrick Howlett		
6 Dec 11	web	Education Sun	University of Wollongong scientific team on Indian Tour - mentions Gordon Wallace and IPRI as part of the tour		www.educationsun.com/2011/12/06/university-of-wollongong-scientific-team-on-indian-tour/
8 Dec 11	print	Times News Network, Bangalore India	Need to back academically – inclined athletes. This story featured Adam Gilchrist, the UOW ambassador. Prof Wallace and Dr Sanjeev Gambhir (ACES/IPRI) were on this promotional visit.		
8 Dec 11	print	Times of India	This story ran with a picture featuring UOW ambassador Adam Gilchrist in the foreground and UOW Profs Judy Raper and Gordon Wallace in the background along with a uow.edu.au backdrop.	Anhshuman Deb Barma	
16 Dec 11	web	UOW Media Unit	Another leap forward for nerve cell regeneration - news story on ACES ink formulation research as featured on SMALL cover		http://media.uow.edu.au/news/UOW116343.html
19 Dec 11	radio	i98 FM	ACES ink formulation research as featured on SMALL cover on their national news segment		

Appendix: Transcript from Federal Parliament 21 June 2011

SPEECH

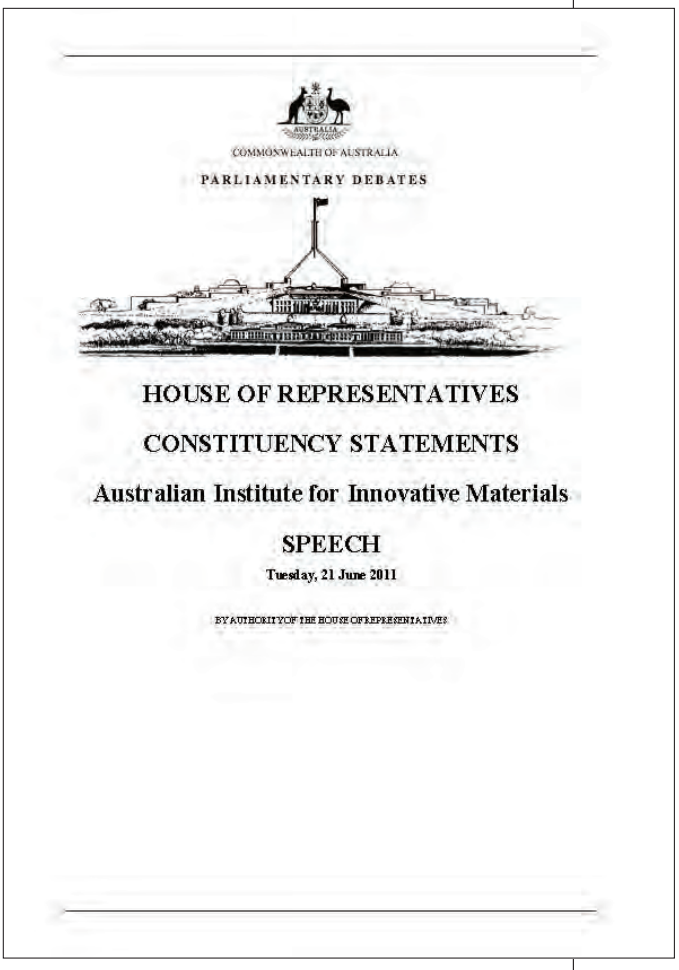
Date Tuesday, 21 June 2011 **Source** House
Page 6774 **Proof** No
Questioner **Responder**
Speaker Ms BIRD **Question No.**

(Cunningham) (NaN.NaN pm)

Ms BIRD (Cunningham) (16:28): I visited the Australian Institute for Innovative Materials facility on 9 June with Parliamentary Secretary Justine Elliot and member for Throsby Stephen Jones. The University of Wollongong, which is the facility that runs AIIM, is a recognised world leader in multifunctional materials research, and I had the opportunity to find out more about the groundbreaking research being led by Professor Gordon Wallace and Professor Dou. The research groups housed at the AIIM—the ARC Centre for Excellence for Electromaterials Science and the Institute for Superconducting and Electronic Materials—together have more than 200 researchers and postgraduate students working to tackle some of the biggest global challenges. This includes energy technology that is developing new methods of energy generation, transportation and storage, including battery technologies that will be of considerable importance to the future of electric vehicles, and building on the breakthrough research they have done. Secondly, there is health and medical bionics to advance muscle and nerve regeneration and cochlear implants and to develop wearable bionics to assist with injury prevention and rehabilitation, as well as advances in medical devices such as improved MRI systems. Thirdly, there are innovative materials and manufacturing. There is some amazing 3-D printing technology and rapid prototyping systems and there is the development of materials to help lower costs and prove the efficiency of mechanical and electrical equipment. This facility continues to grow with the support from the Gillard government. We have invested $43 million in the future of the facility to create the first materials research facility to bridge the gap between lab based research and commercial applications. The expanded facility will now be able to undertake groundbreaking research and help turn those research breakthroughs into reality. It is a state-of-the-art facility, housing internationally recognised researchers who, from their Wollongong base, have established strong collaborative research and industry partnerships that give them a global reach. It is once again an example of the Wollongong area leading the nation and the world in important research and in new technology development for the future of the nation.

The DEPUTY SPEAKER (Ms AE Burke): Order! In accordance with standing order 193 the time for constituency statements has concluded.

(Chisholm) (NaN.NaN pm)


COMMONWEALTH OF AUSTRALIA

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CONSTITUENCY STATEMENTS

Australian Institute for Innovative Materials

SPEECH

Tuesday, 21 June 2011

BY AUTHORITY OF THE HOUSE OF REPRESENTATIVES

Prizes & Awards

Prof Graeme Clark wins Florey Medal

(http://electromaterials.edu.au/news/UOW114906, http://media.uow.edu.au/news/UOW114909.html)

Prof Clark with Florey Medal Photo Courtesy Arthur Mostead

ACES Chief Investigator and co-leader of the Bionics program was awarded the CSL Florey Medal ($50 000) for his pioneering work over decades that has transformed the lives of hundreds of thousands of people worldwide and looks like leading to even more innovation.

The prestigious Florey Medal is awarded to a select few whose work follows in the tradition of penicillin pioneer Sir Howard Florey. The Australian Institute of Policy and Science has bestowed the medal on recipients every two years since 1998.

Despite restoring hearing to over 250,000 people, 76 year old Prof Clark is still working on his ground breaking innovation, with further development aiming to result in an advanced cochlear device which enables to recipient to hear music, something which to date has been problematic.

The Hon Mark Butler MP, Minister for Mental Health and Ageing, guest speaker at the Florey Medal presentation on the occasion of the Australian Medical Research Institutes' annual dinner in Canberra, praised the spirit of perseverance, even stubbornness, and sheer hard work that define excellence in medical research.

It is but another achievement for the celebrated scientist who was awarded the 2001 Senior Australian of the Year and has a portrait hanging in the National Portrait Gallery in Canberra.

Prof Clark with former Florey Medallists Prof Colin Masters (left) and Prof John Hopwood (right) at the Australian Medical Research Institute annual dinner in Canberra. Photo courtesy Arthur Mostead.

Australian Laureate Fellowships

Federal Minister for Manufacturing & Innovation Kim Carr with Prof Maria Forsyth and Prof Gordon Wallace, who were awarded their ARC Australian Laureate Fellowships on 10 August 2011.

Australian Research Council (ARC) Australian Laureate Fellowships were awarded to ACES Executive Director, Prof Gordon Wallace and Associate Director, Prof Maria Forsyth in August 2011.

Laureate Fellowships are highly prized awards given by the Commonwealth to attract world-class researchers to key positions and as incentives for them to apply their talents in Australia. Recipients are researchers of international repute who play a significant leadership and mentoring role in building Australia's competitive research capacity.

"The Australian Laureate Fellowship will enable us to continue to build a world leading Nanobionics research team here in Wollongong – covering all aspects from biomolecules to bionic devices," said Professor Wallace, "we are developing innovative approaches to bionics, including new material composition, new fabrication methods, new nano visualisation methods and innovative approaches to energy storage for bionics."

The funding will build on Professor Wallace's Federation Fellowship program and on the highly integrated activities of the ACES Bionics programs.

Prof Forsyth leads the ACES node at Deakin University, the Institute for Technology Research and Innovation. Her work has been at the forefront of developing and characterising new environmentally friendly methods to control charge transfer at reactive metal interfaces to improve corrosion resistance. Prof Forsyth aims to develop new selective transport materials that will underpin the successful development of new sustainable energy technologies and allow the greater use of renewable energy sources such as solar, wind and wave energy.

Bill Wheeler Award 2011

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

A prize of $2,000 was awarded to twenty-five year old IPRI Bionics program PhD student Amy Gelmi, for her ongoing research into characterising biomaterials using a protein measurement. By understanding the look, feel and behaviour of biomaterials made at IPRI, scientists can then determine how the materials could be used for various applications, including the creation of bionic devices to assist in regeneration of damaged nerve and muscle.

"The Bill Wheeler award gives me a fantastic opportunity to present this unique work at a conference in Paris," said Amy.

"Here the leaders in this field will be attending, giving me the chance to not only promote IPRI's bionics group but also hopefully develop new collaborations and contacts. I will also be visiting a laboratory in Ulm, Germany, where we can further investigate these biomaterials with new, exciting techniques to lead on from the work done here at IPRI."

PhD student wins Chinese Government Award

Weimin Zhang (PhD, UOW) won an award for Outstanding Self-financed Chinese Students Study Abroad by the China Scholarship Council. The award was presented at a ceremony hosted by the Chinese Consulate-General in Sydney recently.

The award was founded by the Chinese Government in 2003 with the purpose of rewarding the academic excellence of self-financed Chinese students studying overseas. Only those with outstanding performance in their PhD studies are considered by the award selection panel.

"In IPRI, I was fortunate to receive integrated training to incorporate creativity into theoretical knowledge and experimental skills which enable me to gain the capability of capturing emerging scientific phenomena," said Weimin, "I am proud of my work, and ready to move on to a new scientific area that builds on all the skills and expertise that I developed during my candidature."

ACES and IPRI provide an outstanding multi-disciplinary research environment for PhD students. Students have access to an array of facilities, equipment and expertise in the area of electromaterials that is second to none.

People's Choice Award in three minute thesis competition

Damian Kirchmajer (PhD ACES UOW) won the People's Choice Award at the University of Wollongong's Three Minute Thesis final 30 June 2011.

The nationwide 3MT competition is an exercise in communicating complicated research concepts in a compelling format to a general audience.

Damian's work involves developing a material used to grow new tissue and organs in a laboratory, which can be used to replace damaged or diseased ones in patients.

(L to R): Prof Gordon Wallace, Lexie Wheeler, Amy Gelmi (Award recipient 2011) and Prof Graeme Clark.

Left: (L to R) Consul Feng Hong, Consul Gang Bai presenting Weimin Zhang with his award for 'Outstanding Self-financed Chinese Students Study Abroad' and Consul Demin Zheng.

Prof Judy Raper presenting Damien Kirchmayer (ACES PhD, UOW) his 'Peoples Choice Award' at the 'Three Minute Thesis Final' competition in front of 130 people.

Science Foundation Ireland (SFI) - Short Term Travel Fellowship (STTF)

This fellowship was awarded in 2011 to Prof David Officer (CI ACES) to spend 3 months in Ireland at Dublin City University (DCU) from July 2012. 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.

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.

This Fellowship will represent a unique opportunity to integrate the multifunctional polymer design and synthesis capabilities developed by Prof Officer with the sensing devices and platforms developed by Prof Diamond (DCU).

Engineer Australia's Engineering Student of the Year

Chris Druitt has been named Engineer Australia's Engineering Student of the Year at an awards ceremony in Sydney.

Under the supervision of ACES Chief Investigator Gursel Alici, Chris graduated from the University of Wollongong in July with his Honours thesis entitled Intelligent Control of Tri-Layer Polypyrrole Actuators.

This work was part of an ongoing effort to improve the understanding of the mechanism of electrochemomechanical actuation, as well as improve the response characteristics and commercial viability of a new class of high force-to-weight ratio actuators manufactured in ACES.

Conference Awards

Cameron Ferris (ACES PhD UOW) was awarded a student prize, of complimentary conference registration, for his research abstract entitled 'Bio-ink for inkjet printing of living cells' for the 2nd International Conference on Medical Bionics (20 - 23 November, Philip Island), where Cameron gave an oral presentation.

Amy Gelmi (ACES PhD UOW) was awarded the best student poster award of $500 at the 2nd International Conference on Medical Bionics (20 - 23 November, Philip Island) for her poster entitled 'Probing Single Fibronectin Interactions with Conducting Polymer Electrodes using Functionalized Atomic Force Microscopy Probes'.

End-User Links

The ACES programs are aimed at not only taking fundamental knowledge to end users but engaging end users in the knowledge generation process.

The personnel

As a result of NSW State Government funding (2010), through the NSW Science Leveraging Fund, ACES has been able to appoint a part-time Director of Strategic Development (Mr Chris Gilbey), from February 2011, and a part time associate Director of Strategic Development (Dr Bridget Munro), from late May 2011.

Mr Chris Gilbey, Director of Strategic Development.

Dr Bridget Munro, Associate Director of Strategic Development

The main focus for this position was on consolidating existing and fostering new industry partnerships, so that research findings are more closely linked to commercial activities and vice versa.

Industry/End-User Interactions

Industry and community engagement are keys to sustaining ACES. The industrial engagement activities in 2010 were focussed on the development of a potential commercial opportunity in the area of water splitting.

The focus in 2011 expanded to the engagement of strategic partnerships in medical bionics.

For these plans to be realised, ACES is forming strategic collaborative agreements with industry, research institutions and leading Australian clinicians. The input from these collaborations are further developing the models to ensure a more streamlined process that will satisfy the research institutions and industry when developing and securing regulatory approval for any resulting prototype devices.

Stage 2 is then to secure the necessary funding, currently being identified from government and private sources, to develop the prototypes and then conduct the required trials to show industry the concept is strong and should be further supported.

The funding will ensure the best staff can be attracted to ACES to work with industry in these areas of growth, development and commercialisation.

The strength of this plan however, will be to ensure that basic science, the strength behind ACES, is still able to be completed to ensure capability in device design using electromaterials. When a capability is identified, the process of publication or IP disclosure is followed via the ACES agreement. The IP is also discussed with respect to a portfolio of IP and industry is engaged where possible to control the invention disclosures and ensure the IP is of use. When the IP is protected, if required, publications which have been developed in parallel to IP protection are submitted to facilitate research outcomes for ACES.

To engage with industry, ACES have regular end-users group meetings (see list at the end of this chapter) and are organised a series of industry-focused breakfast events. Further engagement with industry is anticipated through an improved website and visits both to and from other countries.

MATERIAL PROGRAM DEVELOPMENTS

The Australian National Fabrication Facility (ANFF), materials node, which is located at IPRI Wollongong, has presented commercial opportunities in materials development.

Ongoing discussions with Samsung, Sony, Securency and Sekisui may lead to the formalising of materials transfer agreements to initiate further collaborative research projects and commercialisation options, particularly in the area of graphene.

ENERGY PROGRAM DEVELOPMENTS

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 have been identified as strategic areas of research activity where innovation may be possible within ACES. These opportunities are discussed below.

Water Splitting / Hydrogen generation

The benefits that could flow from water splitting would be to focus on one specific area of activity where the addressable market is substantial, and to learn valuable skills and experience from the exercise. The target activity was to determine whether it would be possible to create a spin out company in the space. This would require capital raising and through that, enable further funded research to take place.

With this in mind Perceptric first established regular communications between Uniquest and Prof Gerhard

Swiegers (ACES/IPRI) so that key drivers were in place to enable momentum for this project.

In parallel Perceptric met with several investment bankers and venture capital professionals in Sydney to gain an understanding of the appetite for risk in the investment community in order to determine an optimum market entry point for any water splitting technology.

An initial Skills and Knowledge grant application was successfully obtained from Commercialisation Australia in early 2011 to fund the writing of a business plan, and to undertake early business development and market analysis. Initial desktop market analysis was undertaken by MBA students in the Business School at the University of Queensland. A much more rigorous analysis of the market was then undertaken, along with direct interviews with a number of C-level executives at major industrial hydrogen-using companies. Regular reports on progress and client meetings were provided to Commercialisation Australia.

As a result of the market analysis and reaching a detailed understanding of the various financial forces, together with the existing business models in place within the global hydrogen industry, a highly disruptive business model was developed that started to help inform the development and design of a device.

The next stage will be to determine whether the proposed device will be able to be built in scalable quantities necessary to deliver the level of hydrogen output that the target customers will demand. If this is possible, there are plans for a spin out company, nominally entitled AquaHydrex, and incubated at the UOW.

Based on inexpensive solar powered water splitting technology, AquaHydrex enables onsite manufacturing of hydrogen for use in industrial processes. One international PCT patent application and two Australian provisional patents have been submitted based on this technology.

The AquaHydrex business plan was selected as one of four finalists in the UQ Business School Enterprize Awards in the running to win $100,000.

The UQ Business School Enterprize Awards, which have been operating for 10 years, provide seed capital to start-up promising companies.

AquaHydrex was also named amongst 11 other outstanding innovative green technologies as a finalist (out of 70 entries) in the 2011 Australian Clean Technologies Ideas Competition (media release September 2011 Australian Clean Tech Ideas Finalist "Hydrogen Production That Doesn't Cost the Earth").

Announcing 11 finalists, Innovation Minister Senator Kim Carr said "This competition encourages developing high-tech, high-skill businesses to reduce our reliance on carbon and boost energy efficiency. The development of clean technology ideas such as those submitted to this competition will grow [clean technology] industries, creating new jobs, new products and new markets."

(http://cleantechopen.com.au/pdf/MR-534%20AUSTRALIAN%20CLEAN%20TECHNOLOGIES%20IDEAS%20COMPETITION.pdf).

All finalists were mentored by the Department of Innovation, Industry, Science and Research as well as competition partners to help make their ideas a commercial reality.

While AquaHydrex did not win either of the competitions, the prospective spin out company is now highly visible to potential investors and business partners and the next step will be to formally establish a corporate shell and to move the IP assets into that shell so that capital can be raised.

One potential company who has been interested in the technology is Orica, the largest international manufacturer of ammonium nitrate for mining. Ongoing discussions are being held in an attempt to formalise their interest and capacity to be involved in the commercialisation of water-splitting. The structure of an agreement with Orica is being developed by Michael Angliss at UniQuest with project plan support from Prof Gerry Swiegers.

Metal Air Battery Developments

Success in manufacturing metal air batteries using second generation materials can improve the rechargeable performance of the battery. As a consequence, the use of zinc, graphene and magnesium may provide some commercial opportunities, particularly following the Deakin hosted ACES Industry breakfast showcasing ACES energy storage activities. This area will be further developed in 2012.

Dye Sensitised Solar Cells and Thermo-electrochemical cells

Work is also continuing in the areas of dye sensitised solar cells and thermo-electrochemical cells with commercialisation being lead by the CRC Polymers and the CRC Automotive, respectively. A patent has also been submitted in the area of lithium batteries.

Lubricants

ACES researchers at Deakin have begun collaboration with India Oil after the signing of a memorandum of understanding (MoU) with the Indian Oil Corporation Limited (IOCL) on 17 January 2010. Prof Forsyth visited India Oil in 2011. A student visit is planned for February 2012 to further engage in the development of novel lubricants.

Large scale energy storage

During November, Dr Patrick Howlett and Dr Jim Efthimiadis met with representatives from Wannon Water, Horizon 21 Pty Ltd, DemoDAIRY, SPC Ardmona Operations Ltd and Regional Development Victoria (RDV) to discuss opportunities for projects using large-scale battery energy storage.

BIONIC PROGRAM DEVELOPMENTS

The research focus for ACES in this area is to develop wearable and implantable bionic devices using electromaterials in the key area of orthopaedics. With this focus, projects will be conducted to develop wearable biofeedback and monitoring devices able to prevent, diagnose and rehabilitate orthopaedic conditions, such as knee replacement

or osteoarthritis. Implantable devices such as drug delivery systems, bone regeneration and nerve repair will also be further developed to improve the surgical outcomes for orthopaedic patients and those in other areas of disease need, for example, epilepsy, schizophrenia and spinal cord injury. These areas have seen rapid advancements in the research domain (see research activity report) and will form part of the Bionics strategy for 2012.

ACES scientists hope to also apply their innovations into other areas but their immediate focus is on partnering with industry to solve medical problems with large addressable markets, particularly in the field of orthopaedics. A strategic plan is currently being developed in this area. Part of this strategy has been to develop collaborative agreements with international partners who are also end-users but have the capacity to assist in the manufacture of equipment or devices. These collaborative agreements are detailed below.

Korean Institute of Machinery and Materials (KIMM)

This agreement will assist in the development of new fabrication devices and processes for ACES to further our bionics program. At the same time, KIMM will be able to assist in the development of saleable machinery for medical implants (see International for further information).

Shimmer Research Ltd

This agreement will facilitate ACES development of wearable orthopaedic devices as Shimmer provide vital manufacturing knowledge and have experience in the conduct of clinical trials in other countries.

IRT and CLARITY (Dublin City University)

With an interest in presenting innovative solutions to community care to their patrons, IRT (previously named the Illawarra Retirement Trust) are a potential end-user of monitoring technologies and wish to work collaboratively with the team to develop appropriate solutions to satisfy their client needs. With their significant expertise in data collection, mining and patterning, CLARITY, complete the team to ensure our monitoring projects can be realised.

Deputy Vice-Chancellor Prof Judy Raper (L) signs the collaboration agreement with Kieran Daly (R) from Shimmer Research Ltd. Prof Gordon Wallace (R) and leading orthopaedic surgeon and collaborator Prof Peter Choong (L) are standing during the signing.

Major strategic partners for the Bionics program are now being sought together with the finalising of the plan and development of further key collaborators. To this end, face-to-face discussions have been held with Resmed, Sony and Boston Scientific to identify further potential areas of research/end-user collaboration. We are currently working with Sydney Capital Partners (SCP) to develop a business case to take to Ortho Group Pty Limited (OGL), a company that represents a closed market of 66 orthopaedic surgeons across Australia, for an innovation accelerator to develop wearable orthopaedic devices for the addressable market.

Our process of building upon our current capabilities, by expanding our strong science underpinning with rapid fabrication, integration with communication systems, and increasing our awareness of monitoring technologies and techniques will also accelerate our commercial opportunities in all levels of the bionics program.

Engagement within and beyond the walls of ACES

In 2011 ACES has also been 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. To achieve this aim ACES has hosted and participated in a number of end-user events as well as hosted some community-focused events to get the research messages out to end-users and community-focused organisations. ACES has also hosted a number of end-users as visitors and guests of the centre as well as attended meetings with potential end-users to discuss research directions. In addition, ACES has started to initiate staff training opportunities.

ACES HOSTED END-USER EVENTS IN 2011

WORKSHOP: "INTRODUCING NEW TECHNOLOGIES TO THE WORLD OF AGED CARE" (14 FEB 2011)

This workshop brought together scientists and workers from the aged care sector, telehealth and medical device sectors. The potential use of electromaterials to assist movement and active ageing was discussed as well as sensing technologies, advances in monitoring and information technology. At the culmination of this workshop, ACES researchers participated in a CRC Telehealth and Telemedicine bid. Despite not being short-listed, the CRC application provided some good networking opportunities and has lead to the development of a collaborative research project with IRT.

BIOFABRICATION SYMPOSIUM: NEW FABRICATION METHODS TO PROVIDE REAL CLINICAL SOLUTIONS (17 MAY 2011)

Co-hosted with ANFF and held within IPRI, some of Australia's leading researchers discussed the challenges faced in revolutionising medical treatments with the use of 'smart materials' (see http://electromaterials.edu.au/news/UOW101741.html).

The requirements for epilepsy detection and control and bone and muscle regeneration were presented at the symposium together with information on the advances in fabrication including 3D printing, nano printing and biofibre spinning. The merging of disciplines through advancements in nanotechnology, fabrication and bioenergy were identified as potential routes to develop the revolutionary devices required for these challenging tasks.

ACES NETWORKING BREAKFAST, SYDNEY (20 JULY 2011)

Held at the offices of NSW State & Regional Development in Martin Place, Sydney, this breakfast aimed to promote opportunities for small to medium sized enterprises in the Australian medical, automotive, defence and electronics industries to work with ACES. Over 20 senior executives attended the event which provided a briefing on nanomaterials and additive prototyping.

Delegates found out:

- How to increase their ability to innovate rapidly and become more competitive.
- Why using absolute state of the art equipment is possible, even on a tight budget.
- How working with ACES can be easy and cost effective.
- Why using AIIM P&D facility for additive fabrication should be the most logical decision they make in the new financial year.

Several of the attendees have since visited the University of Wollongong node of ACES.

Thank you to the sponsors:

NSW Trade & Investment, Regional Infrastructure & Services

ANFF

ILLAWARRA MANUFACTURING EXPO (30 AUGUST 2011)

Organised by the offices of local MPs Sharon Bird and Stephen Jones, the expo was launched by Minister of Innovation, Industry, Science and Research, Senator Kim Carr. The event highlighted a range of Government services available to the manufacturing industry, in addition to new cutting edge fabrication techniques such as those offered by ACES.

"The expo presented ACES with an opportunity to get to know our local manufacturing industry and discuss projects that can be mutually beneficial maintaining our strong sense of innovation in manufacturing," said Dr Bridget Munro, ACES Associate Director Strategic Development.

The event was a successful networking opportunity, with over 100 local business people in attendance at the AIIM facility. Many attendees sought further information about the ACES fabrication capabilities including rapid prototyping.

"To have so many local businesses in the area interested in the research programs underway at the AIIM Facility is not only a reflection on their cutting edge work but also on the fact that local researchers, in partnership with local businesses, can help set a new direction for manufacturing in the Illawarra," said AIIM Chief Operating Officer, Paul Scully.

(L to R): Prof Shi-Xu Dou (Director, ISEM), Prof Elena Pereloma (Director of the Electron Microscopy Unit), Senator Kim Carr (Minister for Innovation, Industry, Science and Research), Sharon Bird (Federal Minister for Cunningham), Deputy Vice-Chancellor Judy Raper, Stephen Jones (Member for Throsby) and Prof Gordon Wallace (Director of ACES and IPRI) at the Illawarra Manufacturing Expo.

Visitors and technology presenters at the Illawarra Manufacturing Expo.

ACES INDUSTRY ENGAGEMENT BREAKFAST FORUM (15 NOVEMBER 2011)

Deakin University hosted the ACES Industry Engagement Forum, at the Marriot Hotel in Melbourne which was a huge success, bringing together senior ACES researchers, state and federal government funding bodies and industry partners interested in energy storage, energy generation, renewables and clean technologies.

Presentations from ACES were given by Profs Gordon Wallace and Douglas MacFarlane on the research and Mr Chris Gilbey on engaging with ACES and planning for the future. Dr Bronwyn Williams, Deputy State Manager, AusIndustry, who heads up the Climate Change team in Victoria, gave an insightful overview of future federal funding opportunities in R&D.

Discussions and networking on cogeneration, solar and wind generation, photovoltaics, batteries, CO_2 carbon capture and energy storage followed.

There are a number of potential opportunities from the Melbourne breakfast as is noted in the feedback forms from attendees. The majority of these relate to the need to deliver relatively near term product and market oriented solutions. Initial communications with some of the participants is promising for projects starting in 2012.

Following feedback by attendees this hugely successful industry engagement initiative by ACES will be a precursor to further ACES-industry collaborations centred on energy storage in 2012.

ACES Participation in End-User Events in 2011

NANO TECH EXPO, TOKYO JAPAN (14-18 FEBRUARY)

In a first for the Australian and Japanese Science Media Centres a joint online briefing was held. Available simultaneously in Japanese and English, the briefing provided an update on the latest developments in medical bionics. Speakers were Prof Gordon Wallace (ACES); and the Chief Researcher and Group Leader of the Molecular Biological Systems Research Group at Nippon Telegraph and Telephone, Prof Keiichi Torimitsu.

The Australia-Japan Science Media Centre Collaboration was supported through the Australia-Japan Foundation which is part of the Commonwealth Department of Foreign Affairs and Trade.

Prof Wallace was also a keynote speaker at the event. Prof Wallace and Mr Chris Gilbey (ACES Director of Strategic Development) were part of a NSW Trade and Investment Mission with Prof Wallace's visit supported financially by the Australia-Japan Foundation. (View briefing online in English: www.ustream.tv/channel/smc-nanoe; password: smcjnano)

UCB NEUROLOGY MEETING (12 MARCH)

Prof Gordon Wallace and Prof Mark Cook presented ACES Bionics research at this meeting at the Sheraton in Sydney with over 100 delegates present.

AGING FUTURE TECHNOLOGY CONFERENCE (1 APRIL)

Mr Chris Gilbey and Dr Bridget Munro attended this 2 day Conference held at the Australian Museum, Sydney. This provided opportunity to see the latest advancements in technology for older people and to network with end-users in the aged care industry.

INNOVATION CONFERENCE (7-8 APRIL)

Mr Chris Gilbey attended a two day UniQuest conference in Queensland. This regular event is designed to help academic researchers and inventors understand the process of innovation and the UniQuest process to help identify potential investible technologies.

AUSMEDTECH CONFERENCE (MAY 2011)

Mr Chris Gilbey attended this event for new and emerging technology companies held in Sydney. The main theme that emerged was the subject of participatory health/ mhealth and the benefits of continuous monitoring of a patient, the value in improving patient outcomes in reducing uncertainty about a health problem.

CEBIT CONFERENCE (31 MAY 2011)

Mr Chris Gilbey attended the opening cocktail party. CeBit Australia has evolved as the largest and most comprehensive annual gathering of industry, government and services in Australasia, cementing it as Australia's leading ICT event. At the 2011 conference, there were more than 30 000 visitors from 38 countries, with representatives from all federal government departments and 80% of the top 200 Australian companies. In fact, 26% of attendees were at C-level (CEO, CFO, CIO/CTO, MD, GM, Business Owner); an ideal opportunity to promote the innovative research being conducted at ACES.

ENABLING ASSISTIVE TECHNOLOGIES FORESIGHT WORKSHOP (6 JUNE)

Dr Bridget Munro attended the Enabling Assistive Technologies for the Aged Foresight Workshop in Brisbane, undertaken in collaboration with Queensland Health, the Council for the Ageing (COTA), QUT Institute of Health and Biomedical Innovation (IHBI) and the Australian Academy of Technological Sciences and Engineering (ATSE) as part of the foresighting program of the Expert Forum, established under the National Enabling Technologies Strategy (NETS).

One of the key outcomes from the workshop was the identification of the most significant enabling assistive technologies for aged care in Australia, many of which are being included in the strategic plan currently being developed for Bionics at ACES (see www.aciic.org.au/system/files//f4/f22/o263//EAT%20Final%20Report.pdf for a copy of the report).

DFAT SPONSORED LUNCHEON FOR NSW CHIEF SCIENTIST AND INTERNATIONAL SCIENCE JOURNALISTS (29 JUNE 2011)

Mr Chris Gilbey attended this luncheon to discuss ACES research.

Journalists in attendance were: Mr Luc Allemand, Editor-in-Chief - La Recherche (France); Mr Martijn van Calmthout, Chief Science Editor -de Volkskrant (The Netherlands); Dr Matin Durrani, Editor - Physics World (UK) and Mr Jonathan Leake, Science Editor - The Sunday Times (UK).

INTERNATIONAL FOOTWEAR BIOMECHANICS GROUP MEETING, GERMANY (29 JUNE – 1 JULY)

Attended by all sports apparel manufacturers, attendance at this conference provided Dr Munro the opportunity to showcase research into shoes for older people and investigate new and emerging technology and strategic collaborative partners in wearable bionics.

30TH ANNIVERSARY OF AUSTRALIAN KOREAN FRIENDSHIP (1 JULY)

Mr Chris Gilbey and Dr Byung Chul Kim represented ACES at this event in Sydney together with invited guests from Korea and Australia in business and technology.

ATP INNOVATIONS (30 AUGUST)

Mr Chris Gilbey attended an event at the Australian Technology Park hosted by AusIndustry & Commercialisation

Australia, where Senator Kim Carr announced an additional $40 million in funding for Australian innovation companies. This was an opportunity to network with people from the venture capital and investment community in Sydney interested in investing in innovation.

Staff Development Programs/Training

The following staff development and training opportunities have been presented by ACES in 2011:

- The DSD, Mr Chris Gilbey, is formally mentoring the ADSD, Dr Bridget Munro.
- The DSD has been in discussion with the ACES executive about designing and running a program to increase the knowledge of the commercial process so that a greater number of research outcomes achieved through ACES can be directed towards commercialisation.
- ACES/Deakin University PhD student Tristan Simons completed Graduate Certificate in Research Commercialisation through RMIT University on 26 October.
- ACES/IPRI PhD students Willo Grosse and Cameron Ferris attended the UniQuest Research Commercialisation workshop, 1-8 April on the Gold Coast.
- ACES researchers have been developing a program for incoming HDR students to ensure they are appropriate for the institution and can achieve the outcomes of their research projects to time; which will only assist future commercial objectives.

Mr Chris Gilbey represented ACES at the Nano Tech Expo tradeshow, held in Tokyo 14-18 February 2011.

- ACES Research Director, Prof Wallace, has been working with HDR students and supervisors to formalise an exceptional ACES student experience and strong research outcomes from all. Experienced supervisors are also teamed with inexperienced supervisors to provide mentoring to the inexperienced supervisors and enable them to take a more active supervising role in the future.
- To develop the younger ACES members, the ACES executive announced Associate Program Leaders, allowing these individuals to be mentored by the Program Leader and providing them with opportunity to take on greater responsibility towards defining and managing the direction of their programs. This approach will also ensure upcoming researchers into future director's roles and career advancement opportunities for ACES members.
- A weekly seminar program has presented opportunities for all ACES staff and students to improve their communication skills as well as advance their understanding of the science being conducted by visiting research fellows and students. These seminars are a mix of research and commercial topics (for a list of talks see education section of this report).

Meetings ACES attended & Visitors ACES Hosted

MEETING WITH AUSTRALIAN AMBASSADOR IN JAPAN (17 FEBRUARY 2011)

Mr Chris Gilbey and Prof Gordon Wallace held meetings with Australian Ambassador in Japan about opportunities to enhance trade in research.

MEETINGS WITH NSW STATE AND REGIONAL DEVELOPMENT

Mr Chris Gilbey has met with representatives from NSW state and regional development office on three occasions since February 2011.

22 February: informal debrief after the Japanese Nanotech EXPO

4 March: Formal Japanese Nanotech EXPO debrief

9 March: Met with Caroline Seagrove, Dept of Premier to report on activity

16 March: Met with Paul Cheever, Chairman, Australian Institute for Innovation, discussing matters relating to ACES and innovation

13 April: Preliminary meeting with Caroline Seagrove to discuss ACES and a workshop in Sydney for ACES

31 May: Met to initiate discussions to arrange a presentation on AIIM in Sydney to Small to medium enterprise (SME's)

29 June: Attended DFAT lunch for foreign science journalists in Sydney.

21 October: Chris Gilbey and Gerry Swiegers met with Ben Smith from Dept of Innovation to discuss potential for ACES to engage with Dept of Innovation

4 November: Review of ACES Bionics research direction and update of water-splitting technology

MEETING WITH DFAT (9 MARCH)

As a follow up to the visits to Japan, Mr Chris Gilbey held discussions with DFAT and Ambassadorial staff with respect to opportunities in Japan and prior to address to Australia-Japan Foundation.

INNOVATIONXCHANGE (10 JUNE)

Mr Chris Gilbey met with Grant Kearney, ex Chairman of InnovationXChange to explore potential of relationship that could be brokered via IXC.

ADDRESS AUSTRALIA-JAPAN FOUNDATION (11 MARCH)

Mr Chris Gilbey presented on the benefits and opportunities from trade in research to the board of the Australia-Japan Foundation.

ITT COMMERCIALISATION WORKSHOP (24 MARCH)

Dr Grant Matheson attended the Sydney Business School commercialisation presentation by ITT.

SHIMMER RESEARCH, A DIVISION OF REALTIME TECHNOLOGIES (JUNE 2011)

Prof Gordon Wallace and Dr Bridget Munro visited Ireland and spoke on separate occasions with Shimmer with a view to develop collaboration for wearable bionics projects. As a result of these visits, a collaboration agreement was signed with Shimmer.

SONY R&D TOKYO (29 JUNE)

Prof Gordon Wallace visited Sony in Japan and talked about the bionics research and opportunities emanating from ACES (electromaterials.edu.au/news/UOW105383).

MILLISPOT (20 SEPTEMBER)

Prof Gerhard Swiegers, Prof Gordon Wallace and Mr Chris Gilbey met with Millispot, a venture developed by researchers at the University of Tasmania, to discuss opportunities for collaborative Bionics research.

CALTEX (20 JUNE)

Chris Gilbey and Prof Gerry Swiegers met with Julian Segal, CEO of Caltex Australia to discuss potential for water splitting technology in petrol refining.

SOLVAY (23 JUNE)

Mr Chris Gilbey and ProfGerry Swiegers met with Tony Nugent from Solvay to explore potential for onsite hydrolysis to generate hydrogen.

UCP (5 AUGUST)

Chris Gilbey met with Veronique Toulley, CEO of UCP Pharmaceutical Company specialising in neurological drugs to discuss potential for commercialisation of medical bionics technologies.

ORICA (19 MAY & 23 AUGUST)

Mr Chris Gilbey and Prof Gerry Swiegers met with Hans Zank in Wollongong to continue discussions with Orica about the development of the water splitting prototype device. A follow-up meeting was held with Hans Zank at Orica's R&D facilities in Kurri Kurri to discuss water splitting.

INDIAN DELEGATION (3-7 DECEMBER)

Led by Australian cricketer Adam Gilchrist, Prof Gordon Wallace formed part of a UOW delegation to promote ACES to businesses in India under the banner of establishing partnerships in the key area of "Future Materials". This week-long event saw Gordon meet and give presentations about ACES to eight companies every day, 30-40 companies at daily press conferences and dinners throughout Mumbai, Delhi and Bangalore, as well as present a keynote address at Bangalore Nano (www.innovationcampus.com.au/news/gilchrist-leads-scientific-team-on-indian-tour/)

Summary of End-User Engagement in 2011

This involved hosting, and talking with many industry-based visitors, many of whom were not previously in contact with ACES, including:

AT UNIVERSITY OF WOLLONGONG

FEBRUARY

- Keith Murphy, Organovo, Inc., USA
- Mark Doherty & Olivia Huettner, ASICS Oceania Pty Ltd

MARCH

- NSW Industry and Investment representatives shown around ACES/IPRI
- Kristy Wandmaker, IRT
- Shane MacLaughlin, Bluescope Steel Research
- Paul Barrett, David Israel & Michael Angliss, Uniquest
- Jim Patrick, Cochlear
- Jiangfeng Wu, DLG battery Ltd, China, met Hua Liu
- Paul Cheever, Chairman, Australian Institute for Innovation, discussing matters relating to ACES and innovation
- James Nicholson and Scott Edwards, SMR to discuss electrochromics

APRIL

- Samsung Senior Scientist
- Christoph Lungenschmied, Konarka Technologies, USA
- Gavin Telford, South Coast Surface Protection & Matt Alder, EVA Robotics
- John Devlin, chemical industry engineer and entrepreneur to discuss water splitting project

MAY

- Karl Rodrigues from CSIRO in Sydney to discuss potential for collaboration
- Denise Eaton, Austrade
- Hien Li, hydrogen gas safety engineer, to discuss participation on water splitting project
- Byung-Choi, Chang-Woo Lee, Sang-Chun Lee, KIMM, Korea to discuss printer manufacture
- John Harris (Neurovista) to discuss research opportunities in bio medicine
- Michael Ellis, SMR to discuss electrochromics

JUNE

- Hien Li, hydrogen gas safety engineer, to discuss participation on water splitting project
- Commercialisation Australia
- Paul Barrett, Uniquest
- Justine Elliot, Parliamentary Secretary for Trade
- Chris Abbott, Abbott Foundation
- James Nicholson, SMR to discuss electrochromics

JULY

- Jiangfeng Wu, DLG battery Ltd, China, met Hua Liu
- Scott Edwards, SMR to discuss electrochromics
- Greg Smith, SciVentures to discuss commercial opportunities
- Robert Bolia, Office of Naval Research Global (ONRG), Toyko Office
- Brady Butler, Weapons & Materials Research Directorate, ARL
- Larry Nagahara, National Cancer Institute, NIH
- John Boeckl, Materials & Manufacturing, AFRL
- Ali Sayir, Directorate of Aerospace, Chemistry & Materials, AFOSR
- Michael Quigley, National Broadband Network (NBN Co Ltd) to discuss collaborative research opportunities
- Prof Patricia O'Rourke, CEO of St Vincent's Melbourne; Ms Brenda Shanahan, Chair, St Vincent's Advisory Council, Melbourne and Prof Tom Kay, Director, St Vincent's Institute to discuss research infrastructure and commercial opportunities

AUGUST

- Veronique Toulley, CEO of French pharmaceutical company UCB re medical bionics
- Evan Evans, Bluescope to tour the facilities and investigate collaborative opportunities

SEPTEMBER

- Eurica Traversa, NIMS, Japan, met Hua Liu
- James Lawson, Intralink to discuss commercialisation opportunities in North Asia for ACES technologies
- Karl Rodrigues, CSIRO

OCTOBER

- David Varcoe, Head of R&D, Bluescope
- Andrew Morton, IP Manager, Bluescope
- Horace Cavallaro, Manager of Springhill plant, Bluescope
- Kirsten Lee-Archer, Business Development, Bluescope
- Brian Kelly, Head of Marketing, Bluescope
- Helen Bugg, Marketing, Bluescope
- Evan Evans, Manager of Coatings Research, Bluescope
- Chris Killmore, Manager of Cold Rolled Product, Bluescope
- Daniel Yuen (Manager of Coatings Process, Bluescope
- Robert Klees and Zoran Mitic, Bluescope to discuss 3D scanner and rapid prototyping
- John Mathieson, Acting Manager of Iron and Steel Making, BlueScope

- Anthony Lang, Technical Expert, Coatings, Bluescope
- Tahnee Lowe, Technical Expert, Bluescope
- Detlev Mueller, painted product development, Bluescope
- Troy Coyle, Manager Coated Product Development, Bluescope
- Bill Kerr, Enterprise Connect to discuss possible ways for ACES to leverage grant funding available from Enterprise Connect
- Gordon Bradbery, Lord Mayor of Wollongong, to see the facilities and hear about the projects
- Diana Rigg, DSTO for a tour of the facilities

NOVEMBER

- Stuart Anderson, Sydney Capital Partners, to discuss potential for commercialisation of orthopaedic devices
- Ian Burgess, CEO of OGL, to discuss potential for biomedical device relationship with OGL.
- Adrian Tootell, BlueScope
- Dr Thierry Seube, Business Development Manager, Solutia Performance Films
- John Dougherty, Ocean Optics in Florida
- Chuc Duc Nha, Counsellor (Education); Vu Van Toi and Chu Quang Hoa, First Secretary (Science & Technology), Embassy of Vietnam to discuss international opportunities
- Philip Walls, Hitech Materials Pty Ltd
- Ian Dagley, CRC Polymers
- Phil Aitchison, CAP-XX

DECEMBER

- Dr Mario Lafortune, Head of Innovation, Nike Golf

AT DEAKIN UNIVERSITY

FEBRUARY

- Dr. Dirk Fiedler, Principal Systems Engineer, Cochlear Ltd

MARCH

- Dr Stephen Pike, Intellectual Capital Services
- Ken Ogawa, Chief Engineer Technology Research, Honda R&D Co. Ltd, Japan
- Takehiro Yamaguchi, Honda R&D Co. Ltd, Japan

MAY

- Patrick Howlett talked on ACES research to a representative from Nippon Steel
- David Smith - Business Development Manager, ASIS Scientific
- Mark Coppola - Sales Representative, ASIS Scientific
- Mr. Neil McMahon, New Spec Pty Ltd
- Mr. James Barker Scientex
- Dr Julie Sheffield-Parker, Director, Nanospec Pty Ltd

JUNE

- Bill Sullivan, AGR FIELD OPERATIONS, Manager Maintenance Management, South Brisbane, Australia

JULY

- Dr. Wanxin Sun, Bruker (Veeco)
- Mr. Gabriel Xiourouppa - Managing Director, ASIS Scientific
- Ms. Nadine Winkelmann, Team Leader – Thermal Analysis & AutoChem Mettler-Toledo Ltd
- Grant Taylor, General Manager Couplertec Company, QLD Australia

AUGUST

- Dr. Con Litsios, Australian General Engineering
- Mr. Kevin Armstrong, Managing Director, AVT Services Pty Ltd
- Mr. Jamie Triantis, Bioscientific

SEPTEMBER

- Mr. Julian Horsley , Sales & Marketing, A&D
- Mr. Tim Smith, Sales Manager, A &D Australia

OCTOBER

- Dr.Guangling Song, Chemical Sciences and Materials Systems Lab, GM Global Research & Development, Deakin University
- Mr. Keven Beekman, Simultech Australia

NOVEMBER

Below is a list of end-user attendees at the Industry breakfast held in Melbourne on 15 November.

- Indran Pillay (Entura/HydroTasmania)
- Ashley Moore (Environmental Clean Technologies)
- Paul Scerri (Bosch Solar)
- Alan Hutchinson (Plasmatronics)
- Chris Seviloglou (Exide/Network Power)
- Jeff Castellas (Clean Technology Australia)
- Sandra Kentish & Susannah Powell (Melbourne Energy Institute)
- Kevin Thompson (Ai Group)
- Russell Moore (Australian Industrial Services)
- Mike Wilson (SPC Ardmona/Coca Cola)
- Ken van Langenberg (Dept Business Innovation, DBI)
- Kevien Beekman (Simultech)
- Kevin Armstrong (AVT Services)
- Ron Hardwick (AVT Services / VISY)
- Rosanna de Marco & Despina Anastasiou (DOW Corning Chemical)
- Con Litsios (Australian General Engineering)
- Ross Gawler (Sinclair Knight Merz / SKM MMA)
- Brett Thomas (Acciona)
- Greg Berechree (Solazone)
- Mark Nan Tie (Powercor / Citipower)

AT MONASH UNIVERSITY

JANUARY

- Ray O' Neill Business Development Manager, CSIRO Energy Transformed Flagship

MARCH

- Dr. Andreas Truckenbrodt, CEO, Automotive Fuel Cell Cooperation Corp, Canada

APRIL

- Dr Steve Pas DSTO

MAY

- Mr Michael Angliss, Uniquest
- Dr Louise Wong, Trans Tasman Investment Fund
- Mr Ricardo Signorelli, Fastcap Inc, U.S.A.-Teleconference

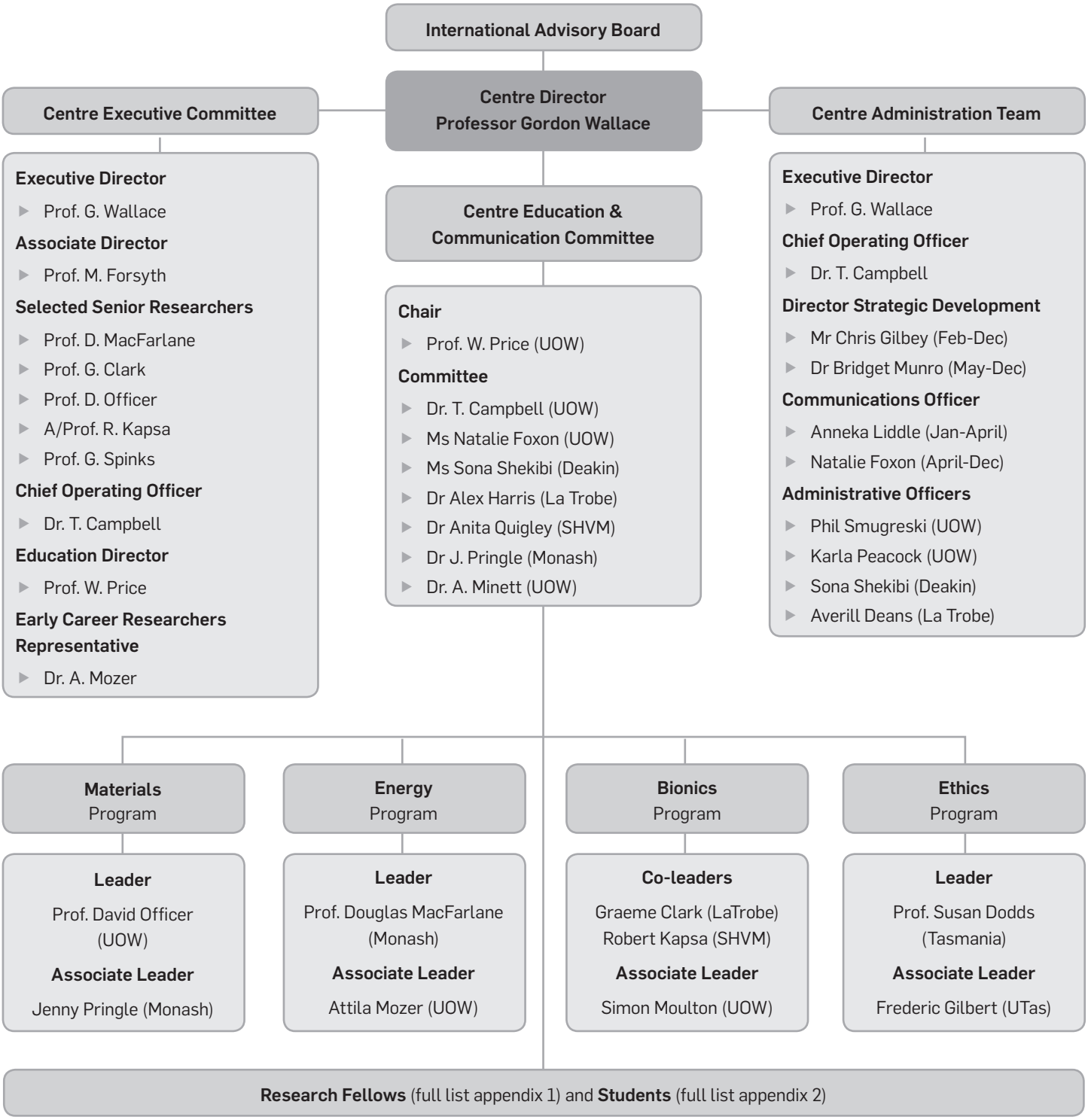
JUNE

- Mr Donato Niccarone Cytec Canada
- Mr Ricardo Signorelli, Fastcap Inc, U.S.A.

DECEMBER

- Mr Michael Angliss, Uniquest

Governance


International Advisory Board
Centre Director
Professor Gordon Wallace
Centre Executive Committee
Executive Director
Prof. G. Wallace
Associate Director
Prof. M. Forsyth
Selected Senior Researchers
Prof. D. MacFarlane
Prof. G. Clark
Prof. D. Officer
A/Prof. R. Kapsa
Prof. G. Spinks
Chief Operating Officer
Dr. T. Campbell
Education Director
Prof. W. Price
Early Career Researchers Representative
Dr. A. Mozer
Centre Education & Communication Committee
Chair
Prof. W. Price (UOW)
Committee
Dr. T. Campbell (UOW)
Ms Natalie Foxon (UOW)
Ms Sona Shekibi (Deakin)
Dr Alex Harris (La Trobe)
Dr Anita Quigley (SHVM)
Dr J. Pringle (Monash)
Dr. A. Minett (UOW)
Centre Administration Team
Executive Director
Prof. G. Wallace
Chief Operating Officer
Dr. T. Campbell
Director Strategic Development
Mr Chris Gilbey (Feb-Dec)
Dr Bridget Munro (May-Dec)
Communications Officer
Anneka Liddle (Jan-April)
Natalie Foxon (April-Dec)
Administrative Officers
Phil Smugreski (UOW)
Karla Peacock (UOW)
Sona Shekibi (Deakin)
Averill Deans (La Trobe)
Materials Program
Leader
Prof. David Officer (UOW)
Associate Leader
Jenny Pringle (Monash)
Energy Program
Leader
Prof. Douglas MacFarlane (Monash)
Associate Leader
Attila Mozer (UOW)
Bionics Program
Co-leaders
Graeme Clark (LaTrobe)
Robert Kapsa (SHVM)
Associate Leader
Simon Moulton (UOW)
Ethics Program
Leader
Prof. Susan Dodds (Tasmania)
Associate Leader
Frederic Gilbert (UTas)
Research Fellows (full list appendix 1) and Students (full list appendix 2)

The centres governance structures involve stakeholders in planning and management processes. The chart above illustrates the current governance structure and relationships.

CENTRE INTERNATIONAL ADVISORY BOARD (IAB)

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 T. Brown DVC Research La Trobe University

Prof D. Diamond CLARITY, Dublin City University, Ireland

Prof P. Nixon DVC research University of Tasmania

Prof S. Roth Korean University, Korea

Dr G. Smith SciVentures

Prof J. Raper DVC Research, UOW

Dr A. Khan Monash University

Prof R. Kaner University of California

Prof. K. Kaneto Kyushu Institute of Technology, Japan

Prof Thomas W.H. Kay St Vincent's Hospital, Melb.

Dr. I. Sare DSTO

The Centre's Advisory board, listed in the table above, 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.

At the IAB meeting held February 2011 it was agreed to expand the International Advisory Committee to include the DVC's of research from University of Tasmania, La Trobe University and Deakin University. They accepted the Chair's invitation to join the board meeting for review of ACES 2011 progress.

ACES would like to thank retiring IAB members Dr Albert Mau (CSIRO) and Prof Nagy Ogata (Chitose Institute of Science and Technology, Japan) for their contributions to ACES since its establishment. Prof Dermot Diamond (Dublin City University, Ireland) accepted the Chair's invitation to join the board meeting for review of ACES 2011 progress.

THE CENTRE EXECUTIVE

The Centre Executive met 4 times in 2011 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. 3 patents were lodged in 2011 - the intellectual property register is given in Appendix 3.

END-USER INTERACTION

In 2011 ACES End-User Technology Forums were held in the form of 2 industry breakfasts, an Illawarra Manufacturing Forum and a Bio-Manufacturing Forum. In addition several meetings were held with many industry contacts (see End-User Report).

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 2011.

For further information on the programs see Education & Training chapter and Communication & Outreach chapter.

PROGRAM LEADERS

In 2011, Prof Graeme Clarke announced his retirement from ACES effective as of 4 January 2012.

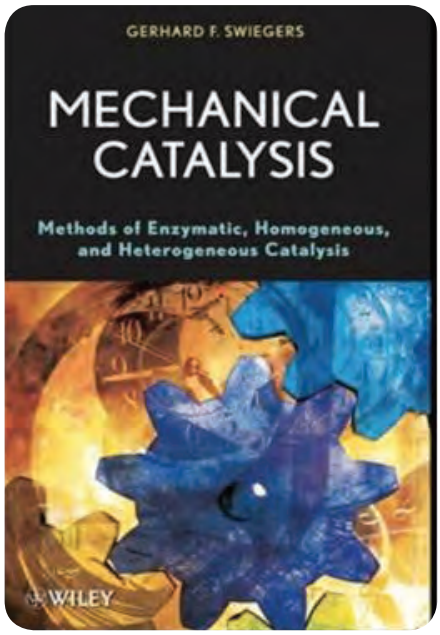
"It has been a great journey with a wonderful captain of the ship, first mate, and crew. I will miss our lively discussions and planning for the future".

Graeme was instrumental to the formation of ACES. He has been a constant source of knowledge and inspiration, providing guidance at many levels, whilst we have grown our research programs and our international presence. ACES owe him a great deal and we thank him for his efforts and support.

In 2011, ACES announced the introduction of associate program leaders. These appointments of younger career researchers into these positions are with the view to build on current ACES successes and to taking the ACES entity far beyond 2013.

Publications

In 2011, ACES membership has had two books accepted for publication; 14 book chapters either published or in press; 91 [2010-90] journal articles published (48 or 53% [in 2010 -51%] with impact factor >4; 74 or 81% [in 2010-74%] with impact factor > 2) with another 9 published as advance articles. Three journal articles were published as cover images and another on the inside cover. This exceeds the ARC target of 70 publications with 50% of journal articles in journals with an impact factor > 2. ACES members published more journal articles in higher ranked journals than in 2010.



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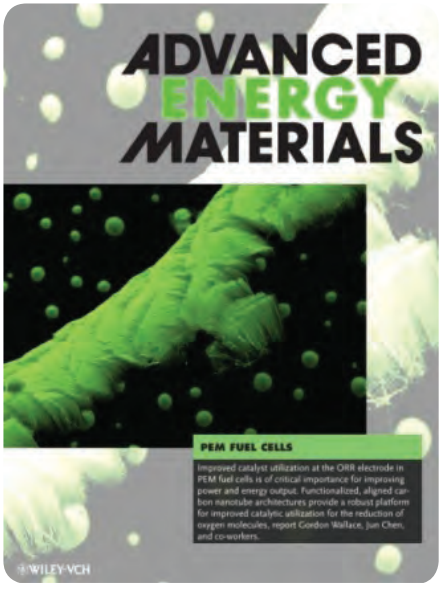

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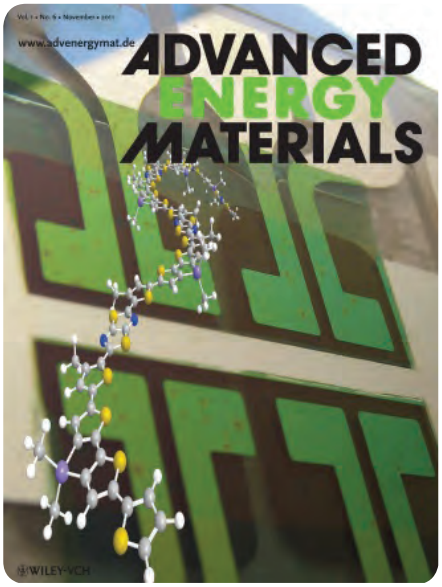

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