



ACES Newsletter

Issue 3: October 2007

Fast Read

Funding Success

ARC 2007

The ARC results are out for this year and IPRI/ACES members have had a stunning result with over \$3M research grant/infrastructure funding awarded. Monash also has a great outcome - congratulations to Dr Jenny Pringle, awarded a QEII fellowship and funds for research into *Advanced Ionic Materials for Organic Photovoltaics*.

[Read more >>>](#)

Biophotovoltaics

Professors John Madden and J. Thomas Beatty of the University of British Columbia have been awarded a CND\$450,000 National Sciences and Engineering Research Council of Canada Special Research Opportunity grant, entitled *Engineering of photosynthesis proteins and attachment to electrodes for conversion of solar energy to electrical power*, to work over the next 3 years with ACES researchers to demonstrate effective transfer of charge from bacterial reaction centres to electrodes.

Expansion of Nanobionics team

The Nanobionics team at UoW has undergone significant expansion due to the award of an ARC Federation Fellowship to Professor Wallace. A/Prof. Rob Kapsa (Cell/Molecular Biology) has joined the UoW staff, as has Dr Michael Higgins (Bio-AFM). In addition, Dr Toni Campbell (Biomaterials) and Dr Kerry Gilmore (Cell Culture) have taken up new positions to work as part of the ACES Nanobionics team. The addition of Dr David Nayagam (Neurophysiology) and Dr Chris Williams (Neurophysiology) to the Bionics team at St Vincents means that a powerful multidisciplinary team has now been established. The Nanobionics team calls on important strategic expertise and facilities in each of the other Centre programs, and we look forward to exciting progress in the areas of advanced cochlear implant electrodes, spinal cord regeneration prosthetic, and muscle regeneration in the coming months.

Science EXPOSes Ethics

Ethics workshop 5 Nov
07

Search ACES

Index to ACES Newsletter - Issue No. 3 October 2007

FAST READ

- Funding Success
- Expansion of Nanobionics Team
- Science EXPOSes Ethics
- Ethics workshop 5 November
- Engaging End Users
- ANFF node for Wollongong

PROJECT SPOTLIGHT

- Bionics
- Centre exchange

FACILITIES FOCUS

- St Vincents Hospital
- Electrochemical techniques workshop

PERSONNEL PROFILE

- David Nayagam (SVHM)
- Dr Michael Higgins (UoW)

GLOBAL ACTIVITIES

- ACES presentations at ICBN 2007, RS London, SSI-16 and COIL-3
- Endeavour Scholars from Ireland
- Research Alliances

Prof Susan Dodds, Chief Investigator of the Centre's Ethics program, will be a judge in the upcoming Science EXPOsed Nanotechnology forum. This event is run by the NSW Office of Medical & Science Research for high school science students. Prof Dodds will act as one of four judges who will comment on and judge ideas for nanotechnology inventions developed by 120 year 8 & 9 students expected to attend the workshop. More details are available on the OSMR website.

[Read more>>>](#)

ACES runs a series of education workshops for post-graduate students and ECR researchers. There is an upcoming Workshop on 5th November on Ethics and the Regulation of Risk in Nanotechnology, to which you are all invited and encouraged to attend. It is widely recognised that development of nanotechnologies and products containing nanomaterials has the potential to generate risks to health and the environment. This workshop is intended to start to come to grips with some of the issues surrounding risk and regulation and to reflect on the implications of this range of issues for the development of nanotechnology in Australia.

[Read more >>>](#)

Engaging End Users

During 2007, ACES established an End Users Committee with members from a cross section of industries where electromaterials research has an impact. The Committee reports to the ACES International Advisory Board on a range of issues relating to Centre activities, and is a valuable forum for discussing end user expectations and outcomes. ACES Executive Research Director, Prof Gordon Wallace, said it was envisaged that the Committee would help define future research paths for the ACES group that would help maximise the return to Australian End Users. The next meeting is scheduled for 22 November.

Wollongong to be ANFF Fabrication Node

ACES, with the University of Newcastle, will host the Materials Node of the Australian National Fabrication Facility (ANFF). The ANFF provides Australian researchers with state-of-art fabrication capability for nanoparticles, nanostructures, nanosensors and nanotechnological devices. It is a seven-node facility, with nodes distributed throughout Australia, drawing on existing infrastructure and expertise. Construction has commenced on the new \$28m Innovation Campus building which will house the UoW node, anticipated to be fully operational by 30 June 2008. Funding has been provided from the Federal Government's National Collaboration Research Infrastructure Strategy (NCRIS) and the NSW Government. [Read more >>>](#)



Project Spotlight

Bionics

Energy transfer from conventional electrodes to biological systems can assist in areas such as nerve regeneration, wound healing, and bone regrowth. We know that selected polymer materials can be used for mammalian cell culturing, and electrical stimuli can be used to control

CALENDAR and NEWS

EMPLOYMENT OPPORTUNITIES

PUBLICATIONS

Picture Gallery



Fifteen graduate students and researchers attended an ACES Workshop on 21st August 2007, at Monash, covering Echem techniques in



corrosion.



Professor Doug MacFarlane (centre) receiving the COIL-3 'mascot' from the COIL-2 organisers.

cell adhesion and proliferation. Our Bionics program investigates all kinds of novel materials for biological applications. [Read more>>>](#)

Centre Exchange

Integral to this multidisciplinary approach to Bionics research, Wollongong PhD student, Ms Brianna Thompson, recently spent three months at collaborators at the Bionic Ear Institute in Melbourne. During her visit, work was completed on assessing the biological response to nerve growth factors that had been released from polypyrrole. This was studied in both *in vitro* (clustering primary nerve cells derived from the inner cell mass of rat pups) and *in vivo* (implanting polypyrrole-coated cochlear implant electrodes into guinea pigs) systems with Dr. Rachael Richardson. It is anticipated that the research completed during the visit should contribute to several papers. Also during her time in Melbourne, initial work on biobattery-powered release of nerve growth factors from polypyrrole films was commenced in collaboration with Dr. Bjorn Winther-Jensen from ACES Monash node.



Facilities Focus

St Vincents Hospital Facilities

ACES Bionics program, merging traditional fields of biology and electronics, requires multi-disciplinary facilities. We need to understand the biology, modify the chemistry, and be able to fully characterise the materials. This need is well serviced by the Centre structure, with different nodes supplying equipment and an integrated training and access program for all Centre staff and students. Some of the key pieces of equipment for the Bionics program that are located at our St Vincents node in Melbourne include:

GeneWoRx and Codelink Gene Chip Microarray Expression System

Microarray analysis allows detection and measurement of gene activation in response to environmental stimuli. The Codelink 60k system that we use simultaneously measures the expression status of 60,000 gene sequences, which represents the entire known genome. The process involves exposure of cells/tissues to specific conditions (eg polymers), extracting and labelling the mRNA from the cells, and hybridising the labelled probe nucleic acid to oligonucleotide sequences representative of all of the genes in the cells and arranged in spots of 3um in diameter on a microscope slide. After development, the slide is read through a GeneWoRx slide scanner which collects the data and facilitates processing via software to establish which genes expression had been primarily involved in the cells response to the conditions imposed on the cells. This technology can be used to *ask* cells what they *think* of any particular stimulus, and to tailor environments to achieve specific molecular responses in cells. This analysis can be performed on even a single cell.

Eppendorf epMotion-5070 Automated Liquid Handling

The EP5070 liquid handler allows the rapid and error-free preparation of high throughput, high volume experiments that require the dispensation of small volumes of reagents (ul to ml). The EP5070 also facilitates the production of 300 spot arrays (on nitrocellulose) containing cloned DNA of specific genes that may be of interest in measuring or defining specific cellular phenotypic characteristics. As such, the EP5070 complements our gene expression analysis activities by providing an inexpensive way to evaluate the response (via 300 genes) of cells to contact with specific environmental factors.

Workshop on electrochemical techniques in Corrosion Research

Fifteen graduate students and researchers attended an ACES workshop on 21 August covering Echem techniques in corrosion research. Senior students led the discussion in topics covering sample and electrode preparation (metallography) to ensure accurate and reproducible results, linear polarisation resistance, cyclic potentiodynamic polarisation and microcapillary electrochemical measurements. Dr Frederic Blin (from Maunsell) and Dr Nick Birbilis (CoE for light metals) and Dr Patrick Howlett (ACES) shared their insights in modelling and interpreting EIS measurements.



Dr Joselito M. Razal (left), visited Prof. Ray H. Baughman's NanoTech Institute at the University of Texas at Dallas under an ARC Nanotechnology Network overseas travel fellowship in June 2007.

University of Wollongong



MONASH University



ST VINCENT'S
HEALTH



UTAS

Personnel Profile

Dr David Nayagam-SHVM	Dr Michael Higgins- UoW
<p><i>Qualifications</i> Bachelor of Science (Neuroscience) / Bachelor of Engineering (Electrical) (Hons) - University of Melbourne. PhD-university of Melbourne's Dept of otolaryngology in auditory electrophysiology.</p> <p>David says "I am now excited to be part of a multidisciplinary team that is attempting to communicate with brain cells as well as regenerate damaged nerve cells in the spinal cord using nanobionic technology and intelligent polymers fabricated at UoW.</p> <p>My role is to investigate the bioelectrical properties of these novel nanomaterials (such as carbon nanotubes) and help direct creation of electrodes which interface these materials with brain cells. Better neural electrodes will allow for improved performance of bionic devices such as cochlear implants and brainstem implants. I will also be making recordings from living brains and regenerated spinal nerves to test the functionality of these repaired, interfaced nerve and brain cells."</p>	<p><i>Qualifications</i> BSc (Hons) Biology- University of Melbourne. PhD Biology and Chemistry- University of Melbourne.</p> <p>Dr Higgins main area of research has focused on the application of AFM to study the nanomechanical properties of biological systems, including living cells, model lipid membranes, single ligand-receptor interactions, individual protein unfolding, fundamental surface-force interactions, as well as being involved in AFM instrument development. He now has over 10years experience with AFM in the field of Biophysics.</p> <p>He now wants to investigate cell adhesion and molecular interactions with conducting biomaterials for bionic applications, mechanical and electrical nanostimulation of single cells (e.g. sensory and muscle cells) using nanoscale AFM probes and the development of Hybrid AFM systems (e.g. combined fluorescence and atomic force microscopy). More>>></p>



Global Activities

ACES presentations at ICBN 2007, RS London, SSI-16 & COIL-3

In recent months, ACES Program leaders have delivered invited talks at a number of international conferences, covering topics such as bioengineering, solar energy & artificial synthesis, ionic liquids and solid state ionics. [Read more >>>](#)

ACES farewells Irish Endeavour Scholarship Recipients

Claire Harley and Gillian Hendy joined us in late March after both were awarded a European Endeavour Scholarship to fund a research trip to Australia for four months. Both PhD students are completing their PhD studies at the National University of Ireland, Maynooth. Claire is working on the formation of a sensor for the selective detection of dopamine and Gillian is working on a drug delivery system for the release of dopamine and other pharmaceutically important compounds. For the past four months at IPRI the Endeavour Fellows have worked under the supervision of Dr Dan Li and Dr Simon Moulton and have introduced the use of nanotechnology into their projects. This was achieved by forming nanofibres using electrospinning of biodegradable polymers. These approaches provide a new and exciting dimension to their studies to be completed in Ireland. [Read more>>>](#)

Research alliances

Hanbat University, South Korea - Prof. Jang Myoun Ko from Hanbat University recently completed a 10 month sabbatical at IPRI/ACES. Prof. Ko is an internationally recognised figure in the world of capacitor research. His team in Korea is well known for the development of new electrode materials for super capacitors. While at the Centre, Prof. Ko provided a tremendous boost to our polymer capacitor research program. Collaborative work on the use of metal oxide polymer/nanotube composites has already appeared in press (*Electrochimica Acta* 2007), other work involving the use of all polymer electrodes has been submitted for publication and our joint work on the development of flexible (recordable) all polymer capacitors is on-going. The development of new capacitor metals is critical to sustain the growth of portable autonomous devices such as mobile phones and eventually even medical bionic implants.

University of Texas Southwestern Medical- IPRI researcher, Dr Joselito M. Razal, visited Prof. Ray H. Baughman's NanoTech Institute at the University of Texas at Dallas under an ARC Nanotechnology Network overseas travel fellowship in June 2007. Dr Razal investigated ways of interfacing biomolecules into carbon nanotube architectures fabricated by dry spinning from process from CVD grown nanotube forest. The nanoscale morphology and electronic properties of these materials are attractive for studies involving the use of electrical stimulation for controlled drug release, or to promote nerve regrowth and/or muscle regeneration. Also, whilst at UTD, Dr. Razal presented at the UTD NanoTech and BioNano groups describing the results of his visit and his ongoing research in IPRI. He discussed possible strategies of developing novel materials for spinal cord regeneration research with Prof. Ray Baughman and Prof. Mario Ortega and Pedro Galvan at the University of Texas Southwestern Medical Center (UTSMC). We are currently in the process of formalising a collaborative agreement with UTSMC to develop processes for producing new spinal cord regeneration technologies. Additional funding was gained from ARC ACES (UOW) and the Robert A. Welch Foundation (UTD).



Calendar	News
3 October 2007 Closed ACES centre meeting St Vincents Hospital Melbourne.	Interested in what we are doing, and have done? Please click here for our news site .
5 November 2007 Workshop on Ethics and the Regulation of Risk in Nanotechnology.	Want to look at who graduated from IPRI in July? • July Graduation
6-7 December 2007 Workshop on Ink Jet Printing of Functional Materials.	EMPLOYMENT OPPORTUNITIES

<p>20-22 February 2008 3rd International Electromaterials Science Symposium.</p>	
<p>15-16 May 2008 3rd Australian Symposium on Ionic Liquids (ASIL-3), Clayton.</p>	<p>ACES often advertises vacancies for dynamic scientists to join our team. Please check our website for job updates.</p>
<p>22-25 June 2008 Asia-Pacific Symposium on Nanobionics.</p>	



PUBLICATIONS

Selected recent publications from our Centre are listed here under the relevant Research Program.

Electromaterials

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- Ngamna, O., Morrin, A., Killard, A.J., Moulton, S.E., Smyth, M.R., Wallace, G.G., Inkjet Printable Polyaniline Nanoformulations, *Langmuir* 2007, 23 (16), 8569-8574.
- Fabretto, M., Vaithianathan, T., Hall, C., Murphy, P., Innis, P.C., Mazurkiewicz, J., Wallace, G.G., Colouration efficiency measurements in electrochromic polymers: the importance of charge density, *Electrochemistry Communications* 2007, 9, 2032-2036.
- in het Panhuis, M., Wu, J., Ashraf, S.A., Wallace, G.G., Conducting textiles from single-walled carbon nanotubes, *Synthetic Metals* 2007, 157, 358-362.

Energy Conversion

- Tsekouras, G., Too, C.O., Wallace, G.G., Photovoltaic properties of poly(terthiophene) doped with light-harvesting dyes and photocurrent generation mechanism, *Synthetic Metals* 2007, 157, 441-447.
- Xi, B., Truong, V.-T., Mottaghitalab, V., Whitten, P.G., Spinks, G.M., Wallace, G.G., Actuation behaviour of polyaniline films and tubes prepared by the phase inversion technique, *Smart Materials and Structures* 2007, 16, 1549-1554.

Energy Storage

- Sivakkumar, S.R., Ko, J.M., Kim, D.Y., Kim, B.C., Wallace, G.G., Performance evaluation of CNT/polypyrrole/MnO₂ composite electrodes for electrochemical capacitors, *Electrochimica Acta* 2007, 52, 7377-7385.
- Chen, J., Liu, Y., Minett, A.I., Lynam, C., Wang, J., Wallace, G.G., Flexible, Aligned Carbon Nanotube/Conducting Polymer Electrodes for a Lithion-Ion Battery, *Chemistry of Materials* 2007, 19, 3595-3597.
- S.R.Sivakkumar, Wan Ju Kim, Ji-e Choi, Douglas R. MacFarlane, Maria Forsyth, Dong-Won Kim, Electrochemical performance of polyaniline nanofibres and polyaniline/multi-walled carbon nanotube composite as an electrode material for aqueous redox supercapacitors, *J of Power Sources*, 171, 1062-1068(2007).

Bionics

- Wallace, G., Spinks, G., Polymers in nanobionics, *Chemical Technology* 2007, 4 (7), T55.
- Wallace, G.G., Spinks, G., Conducting Polymers – Bridging the Bionic Interface, *Soft Matter* 2007, 3, 665-671.
- Moulton, S.E., Maugey, M., Poulin, P., Wallace, G.G., Liquid Crystal Behavior of Single-Walled Carbon Nanotubes Dispersed in Biological Hyaluronic Acid Solutions *Journal of the American Chemical Society* 2007, 129 (30), 9452-9457.

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