Australian Research Council

Nanotechnology Network

Annual Report 2008

Australian Research Council
Nanotechnology Network

ANNUAL REPORT 2008

Australian Research Council
Nanotechnology Network

MISSION STATEMENT AND OBJECTIVES

Mission Statement

The Mission statement of the Australian Research Council Nanotechnology Network is to enhance Australia's Research in Nanotechnology and related areas, by effectively promoting and drawing together collaborations in this field.

Objectives

The Nanotechnology field is one of the fastest growing areas of research and technology. The Australian Research Council Nanotechnology Network (ARCNN) is dedicated to substantially enhancing Australia's research outcomes in this important field by promoting effective collaborations, exposing researchers to alternative and complementary approaches from other fields, encouraging forums for postgraduate students and early career researchers, increasing nanotechnology infrastructure, enhancing awareness of existing infrastructure, and promoting international links. The ARCNN will achieve these goals through its dedication to bringing together all the various groups working in the field of Nanotechnology and related areas within Australia.

This innovative new network was created by four seed funding networks joining together in order to cover the broader areas and to create a larger more effective network.

The Network aims to:

1. bring together key groups working in this area to communicate, innovate, share and exploit mutual strengths and facilities to make a major impact internationally
2. identify new areas of research
3. highlight the infrastructure that is available in Australia and promote use and sharing of these facilities
4. identify infrastructure needs to strengthen research
5. leverage off and interact with other networks for mutual benefit
6. develop industry and international links
7. interact with the wider community
8. encourage postgraduate students and early career researchers to enhance their skill base and training
9. become a national resource for industry, research and educational institutions, government and policy developers

Year 4 in Review

In the beginning of 2008 ARCNN hosted ICONN (International Conference on Nanoscience and Nanotechnology), its biannual Conference. For the rest of the year the focus was on enhancing its International communications and continuing up on funding events related to Nanotechnology.

Membership of 1038, participants including 613 post graduate students and Early Career Researchers. More than 204 research groups are participating in the Network.

Over 1,467,000 Website hits

Cash Income of $ 463,445

In Kind Contributions of $ 153,603

Continued with the Development of the Nanotechnology Facilities and Capabilities Register

Hosted the International Conference of Nanoscience and Nanotechnology in February 2008

Hosted the Department of Innovation, Industry, Science, and Research (DIISR) Nanotechnology Roundtable meeting with the Hon Minister Senator Kim Carr

Hosted 2 International Distinguished Lecturer tours

Hosted 1 Special Lecture

5 Short Term Visits

1 Long Term Visit

10 Overseas Travel Fellowships

Administered the selection of students for HOPE Meeting and ANF Camp in Japan

5 Young Nanoscience Ambassador Awards

11 Events Sponsored by ARCNN

Published the first Edition of the NanoQ (Nano Quest Magazine)

Structure and Management

The Australian Research Council Nanotechnology Network is managed by a Management Committee which met 4 times during 2008. The first Board meeting for 2008 was held at the Melbourne Convention Centre at ICONN2008 on the 28th of February. Other meetings held during 2008 were at the Mawson Lakes Campus, University of South Australia, in July at the Sydney Hilton and in November at the Bio21 Institute at the University of Melbourne.
This management board represents the wider membership and is chaired by an independent chair. The committee determines the priorities for each activity and allocates the budget for the network. A Network Manager manages the day to day administrative tasks under the Guidance of the Network Convenor.

Management Committee Chair

The duties of the Chair are to chair Management committee meetings, provide advice to the Network, confirm meeting minutes for circulation to Management committee members, represent the network at important meetings and provide general guidance to the network management.

Convenor

The convenor has overall responsibility for the Network operations and for meeting ARC requirements and guidelines. Represent the network at key Nanotechnology meetings in Australia and key International network meetings. Supervise Network staff and provide overall direction to the network activities.

Management Committee Members

The management committee members participate in committee meetings. They serve on the Working Group sub committees, represent the Network and publicise network activities, organise and actively participate in the management of network activities, act as ambassadors for the Network and provide advice to the network members about network programs.

Working Groups

Committee members form into working groups that assess funding applications and other issues prior to the matter going to the full Management committee for voting.There are four working groups and their areas comprise.

Events Working Group *– evaluates all applications for sponsorship funding for Conferences, Workshops, Summer and Winter Schools and Short Courses.*

Visits Working Group *– evaluates all applications for Short and Long Term Visits and Overseas Travel Fellowships.*

Outreach Working Group *– evaluates outreach proposals such as Public Lectures, Distinguished Lecturers visits, outreach and Webpage.*

Education Working Group *– evaluates applications for student, ECR and Entrepreneur Forums and educational activities.*

The Convenor fills in if a working group member is unavailable or is one of the applicants (when there is a conflict of interest).

The Management Committee (MC) comprises of the following members, representing 6 States, students and early career researchers and chaired by an Independent chair. The MC has representatives from ANSTO, CSIRO, DSTO and industry.

The Management Committee in 2008 comprised of:

Chairman – Emeritus Professor Erich Weigold – Australian National University

Convenor- Prof Chennupati Jagadish - Australian National University

Events Working Group
Prof. Laurie Faraone –The University of Western Australia
Prof. Paul Mulvaney –The University of Melbourne
Dr Alan Wilson – Defence Science and Technology Organisation
Prof. Peter Majewski –University of South Australia
Prof Michael James –Australian Nuclear Science and Technology Organisation

Visits Working Group
Dr Adam Micolich – University of New South Wales
Prof. Deb Kane – Macquarie University
Prof Gordon Wallace – University of Wollongong
Mr Thomas Rufford - University of Queensland (From January to April 2008)
Miss Hannah Joyce – Australian National University (from April 2008)

Outreach Working Group
Dr Adam Micolich – University of New South Wales
Prof. Deb Kane – Macquarie University

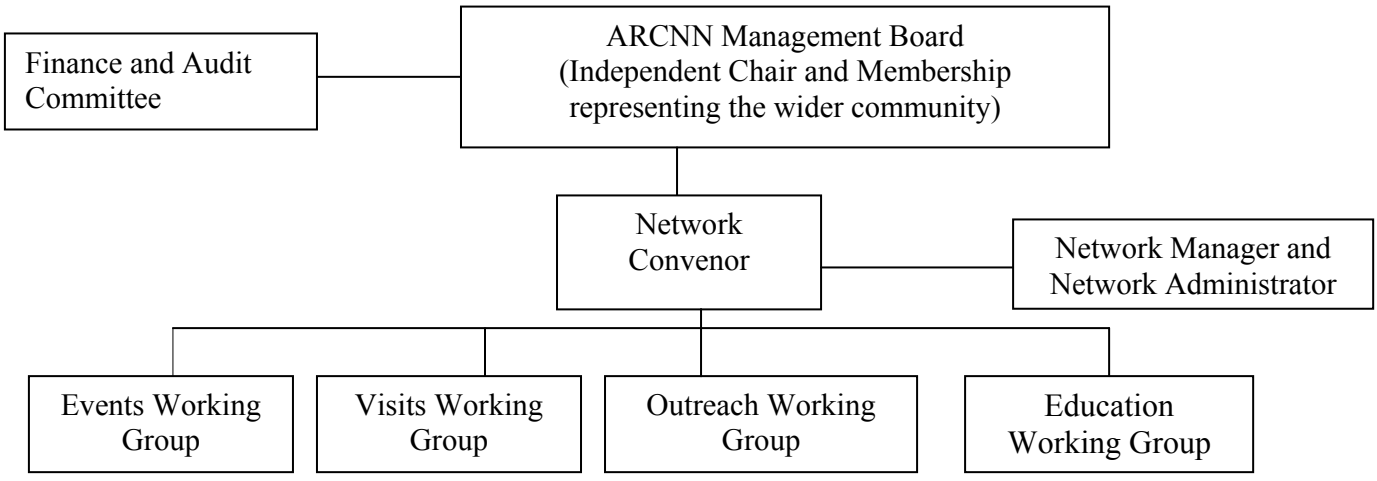
Education Working Group
Prof. Max Lu – University of Queensland
Dr Terry Turney – Commonwealth Scientific and Industrial Research Organisation

Dr Steve Duvall – Formerly from INTEL
Dr Calum Drummond – Commonwealth Scientific and Industrial Research Organisation
A/Prof Paul Wright – RMIT-University

Ms Liz Micallef – Network Manager

Ms Ilonka Krolikowska – Network Administrator

ARCNN Structure



ACTIVITIES UNDERTAKEN BY ARCNN

List of Activities funded by ARCNN

International Conference on Nanoscience and Nanotechnology (ICONN2008)
Melbourne Convention Centre 25/02/2008-29/02/2008

International Networking
Joint Aus-US Workshop - "Sustainable Nano-Manufacturing"
23/02/2008 - 24/02/2008 - **Melbourne Business School**
NanoE3-2008
22/09/2008 - 24/09/2008 - **Margaret River Resort**
Australia Japan Nanophotonics Workshop
09/12/2008 - 10/12/2008 - **ANU, Canberra**

Distinguished Lecturers
- Prof Horst Hahn from Institute for Nanotechnology and Joint Research Laboratory Nanomaterials, University of Darmstadt, Germany
  21st Feb -5th March 2008
- Prof Roberto Menozzi from the Dipartimento di Ingegneria dell'Informazione at the University of Parma, Italy.

Special Lectures organised by ARCNN
- Dr Don Eigler from IBM

Long Term Visits
- Mr Dinesh Kumar Venkatachalam (RMIT University) – visit to the Electronic Materials Engineering Department at the Australian National University

Short Term Visits
- Miss Christine Henry (Australian National University) – visit to the University of Queensland
- Miss Yimeng Yang(University of Western Australia) – visit to the University of New South Wales
- Miss E-Jen Teh (University of Western Australia) – visit to the Australian National University
- Mr Christopher Hall (Swinburne University) – visit to the Australian National University
- Mr Andrew Stephenson (University of Queensland) - visit to the University of New South Wales

Overseas Travel Fellowships
- Mr Anthony Musumeci (UQ) to visit Argonne National Labs, Chicago, USA
- Miss Glenna Drisko (Uni of Melb) visit to the National Atomic Energy Atomic Constituent Commission Center Buenos Aires, Argentina
- Dr Edith Chow (CSIRO) visit to Stanford University, USA
- Dr Diana Bowman (Monash Uni) visit to KU Leuven (KUL) Belgium
- Mr Nadim Darwish (UNSW) visit to Hokkaido University, Japan
- Miss Candace Chiu Ping Chan (UniSA) visit to University of Poitiers, FRANCE
- Mr Igor Aharonovich (UniMelb) visit to Hewlett Packard (HP), USA
- Miss Anette Tyler (UWA) visit to Virginia Tech, USA

- Mr Anbusathaiah Varatharajan (UNSW) visit to Oak Ridge National Laboratory, USA
- Mrs Shaghik Atakamarians (Uni of Adelaide) visit to RWTH Aachen University, GERMANY

Young Nanotechnology Ambassador Awards

Queensland

- Mr Anthony Musumeci (University of Queensland)
- Mr Yanan Guo (University of Queensland)

Victoria

- Mr Ashley Stephens (The University of Melbourne)
- Miss Minoo Naebe (Deakin University)
- Mr Muthukumaraswamy Pennirselvam (LaTrobe University)

Workshops and Events Sponsored by ARCNN

- **Asia Nanotech Camp**

Feb4-21 2008 Japan

- **International Program Department of Japan Society for the Promotion of Science HOPE Meeting** *24/02/2008 - 29/02/2008* – **Tsukuba, Japan**
- **Early Career Researcher and Postgraduate Student Symposium**

23/02/2008 - 24/02/2008 - **Melbourne Business School, Melbourne**

- **2008 Asia-Pacific Symposium on Nanobionics**

22/06/2008 - 26/06/2008 - **University of Wollongong**

- **International Conference on Electronic Materials2008**

28/07/2008 - 1/08/2008 – **Sydney Hilton**

- **17th International Conference on Photochemical Conversion and Solar Energy 2008**

27/07/2008 - 01/08/2008 - **Sydney, Australia**

- **1st Asian-Oceania Neutron Scattering Association**

17/08/2008 - 23/08/2008 - **Daejeon, Korea**

- **Innovations Campus (IC) Scanning Probe Microscopy and Hands-On Workshop '08**

28/08/2008 - 30/08/2008 - **University of Wollongong**

- **Workshop on Bio/Micro/Nanofluidics, Complex Flows and Rheology**

01/09/2008 - 02/09/2008 - **Monash University**

- **Nanotechnology: Science, Policy and Public Perspectives - Workshop**

21/11/2008 - **Monash University**

- **Small Matters: Microscopy and Microanalysis**

03/12/2008 - 05/12/2008 - **The University of Sydney**

Published the first Edition of the NanoQ (Nano Quest Magazine)

International Conference on Nanoscience and Nanotechnology (ICONN2008)

Melbourne Convention Centre
25/02/2008-29/02/2008

International Conference on Nanoscience and Nanotechnology (ICONN2008)
28/07/2008 - 1/08/2008 – Melbourne Convention Centre

ICONN2008 was a great success and and it attracted more than 800 delegates from around Australia and overseas. This week long conference included lectures by distinguished International and Australian researchers.

Four short courses were held on the first day and these included lectures from;
Professor Michael Gratzel from the Ecole Polytechnique in Lausanne, Switzerland, his short course was titled "Solar Cell Technology".
Professor William Ducker from the University of Melbourne, his short course was titled "Introduction to Atomic Force Microscopy: Imaging and Force Measurement".
Professor Taeghwan Hyeon Seoul National University, South Korea gave a short course on "Synthesis of Nanomaterials".
Professor Robert Lamb from the University of Melbourne gave a short course on the "Applications of the Synchrotron to Nanoscience and Technology".

This success was thanks to the hard work of the ICONN Program and ARCNN Management committees. Professor Paul Mulvaney from Melbourne University and Dr Abid Khan from Monash University were Co-Chairs of this conference and were assisted by the ICONN Program Committee.
The seven parallel symposia and the Program committee consisted of the following

Nanomaterials including Nanocrystals, Nanotubes (carbon and inorganic), Nanowires, nanomembranes

Chair:	Prof Max Lu (UQ)
Co-Chairs:	Prof Jim Williams(ANU), Prof Peter Majewski(UniSA)

Bio-Nanotechnology and Nano-Medicine

Chair:	Prof Frank Caruso(UniMelb)
Co-Chair:	Prof Gordon Wallace(UniWollongong)

Nanoelectronics, including Spintronics, Nano-Magnetics, Quantum computing, Molecular and Organic Electronics, Organic Displays, Single Ion Implantation

Chair:	Prof Michelle Simmons - (UNSW)
Co-Chairs:	Prof Lloyd Hollenberg(UniMelb), Dr Adam Micolich(UNSW), Prof Jack Singh(VictoriaUni)

Nano-Photonics, Nano-optics, Plasmonics

Chair:	Prof Min Gu (UniSwinburne)
Co-Chairs:	Prof Laurie Faraone (UWA), Prof Deb Kane(MqU)

Nano-Manufacturing, Industry Issues, Technology Transfer, Metrology, Standards

Chair:	Dr Noel Dunlop (Monash University)

Nanocomputation

Chair:	A/Prof Salvy Russo (RMIT)
Co-Chairs:	A/Prof Mike Ford (UTS), Prof Julian Gale (Curtin)

Health and Safety, Environment, Regulation, Ethical and Social Issues, Education, Training and Skills in Nanotechnology

Chair:	Prof Greg Tegart (VictoriaUni)
Co-Chairs:	Prof. Paul Wright (RMIT), Prof. Susan Dodds (UniWollongong), A/Prof. Joe Shapter (FlindersUni)

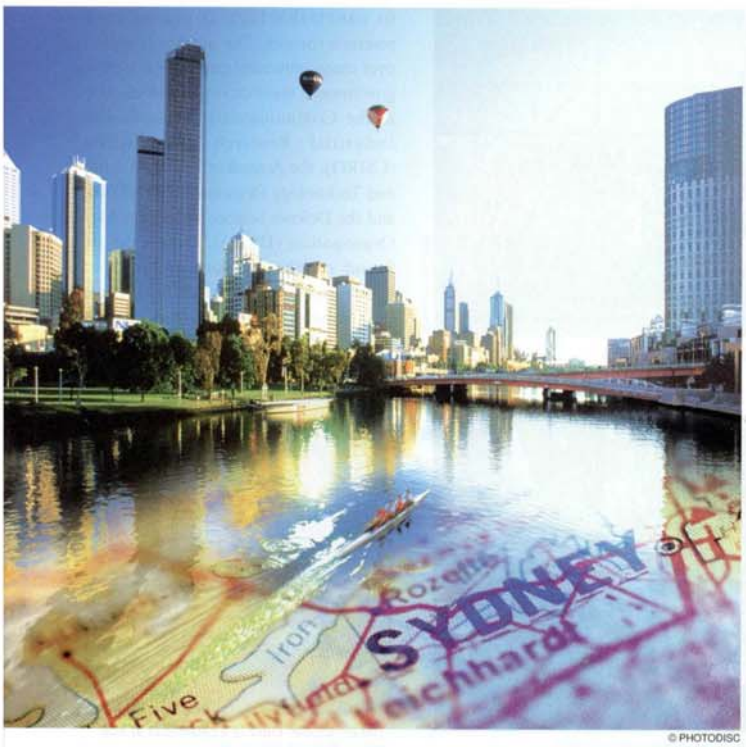
Plenary & Invited Speakers

Professor Vicki Colvin - Rice University
Dr. Don Eigler - IBM Almaden Research Center
Professor Michael Gratzel - Ecole polytechnique fédérale de Lausanne
Professor Taewghan Hyeon - Seoul National University
Professor Yicheng Lu - Rutgers University
Professor Lars Samuelson - Lund University
Professor Samuel I Stupp - Northwestern University
Dr Clayton Teague – US National Nanotechnology Coordination Office

Invited Speakers

Prof. Rob Elliman - EME - ANU
Prof. Horst Hahn - Institute for Nanotechnology, Karlsruhe Germany
Prof. Helmut Dosch - Max Planck Institute for Metals Research, Stuttgart
Prof. Horst Weller - University of Hamburg
Prof. Hui-Meng Cheng - Chinese Academy of Science
Prof. Kazunori Kataoka - University of Tokyo
A/Prof. Nick Kotov - University of Michigan
Prof. Gerhard Klimeck - Purdue University, Indiana, USA
Prof. Lieven Vandersypen - Technical University Delft, Holland
Prof. Roland Wiesendanger - Institute of Applied Physics, University of Hamburg
Prof. Lars Samuelson - Lund University, Sweden
Prof. Tanya Monro - University of Adelaide
Prof. Kobus Kuipers - University of Twente, Amsterdam
Prof. John Bowers - University of California, Santa Barbara
Prof. Jochen Feldmann - LMU, München, Germany
Dr. Jackie Fairley - Starpharma
Dr. Leo Hyde - Du Pont
Dr. Eric Isaacs - Argonne National Lab, US
Mr. Roy Rose – ITL- Innovative Technologies for Life
Dr. Sylvia Tulloch - Dyesol
Prof. Susan Sinnott - University of Florida
Dr. Marco Califano - University of Leeds
Prof. Ian Snook - RMIT University
Prof. Vicki Colvin - Rice University
Prof. Andrew Maynard - Woodrow Wilson International Centre
Dr Vicki Tutungi - CSIRO
Prof Colin Raston - UWA
Dr. O. Pfeiffer - Berlin University of Technology

IEEE Nanotechnology Magazine September 2008 – Nanotechnology in Australia



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Nanotechnology in Australia—A Network of Interactions

The ARC Nanotechnology Network looks to enhance collaboration and information exchange to benefit research productivity.

NEVILLE FLETCHER

AUSTRALIA IS A LARGE COUNTRY—greater in area than the United States—and with a population of only about 20 million people, so interactions over large distances are important. This has been recognized by the government through the Australian Research Council (ARC), which funds nearly all major research in Australia, apart from health and medical research, which has a separate funding organization. In 2004, the ARC established a set of research networks, one of which was the ARC Nanotechnology Network (ARCNN), the objective of which was to enhance collaboration and information exchange in a large variety of fields for the benefit of research productivity. The existence of ARCNN, which is administered from the Australian National University in Canberra, has made possible an overview of what is happening in the field today.

The ARCNN presently has over 1,000 members distributed across about 200 research groups, though these groups have broader interests in addition

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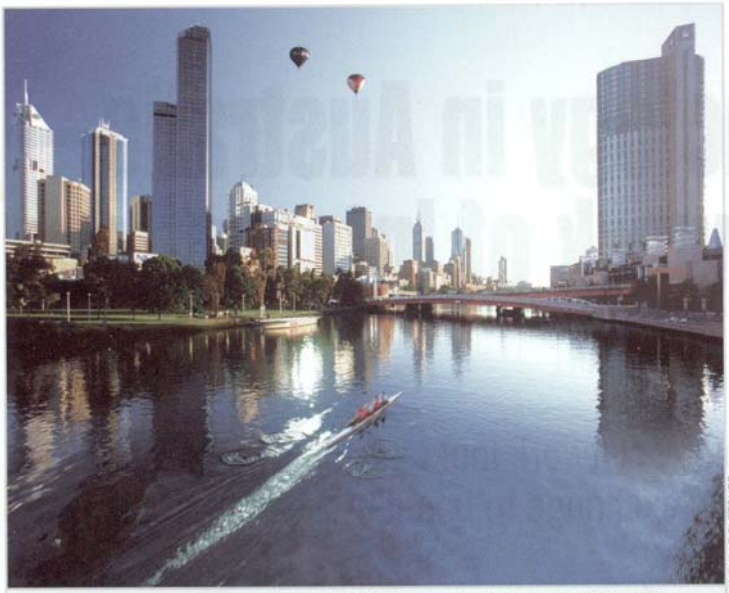
NEVILLE FLETCHER

Some of the 450 participants in ICONN2006 at the Brisbane Convention Centre.

NEVILLE FLETCHER

Some of the 850 participants in ICONN2008 at the Melbourne Convention Centre.



NEVILLE FLETCHER

The peaceful beauty of Melbourne, where ICONN2008 was held in February 2008. The Melbourne Convention Centre is also on the banks of the Yarra River.

to nanotechnology as one of their research themes. The activity is spread over many university campuses as well as government research organizations such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Nuclear Science and Technology Organisation (ANSTO), and the Defence Science and Technology Organisation (DSTO). Details can be found on the network Web site at www.ausnano.net. Research fields range from nanotubes and nanowires through functional nanomaterials, to medical

NEVILLE FLETCHER

The air-shower entry to a cleanroom at Australian National University.

applications such as imaging and drug delivery and on to nanolasers and quantum computing. Due to public concern about safety issues, there is also an organization, NanoSafe Australia, with member groups across the country, that examines and reports on the possible health risks of nanotechnologies.

There are so many of these diverse groups that it would be impossible to describe their activities adequately here, so we will focus on the many ways in which the ARCNN is enhancing the interactions between them. A major factor is by simply enabling communication. Network members can then find out about others working close to their field of interest and make arrangements for access to specialized equipment as described in the facilities register on the network Web site. In the case of graduate students and early-career researchers, the ARCNN provides travel grants to facilitate access to this

equipment. In addition to such travel within Australia, the network supplies around 12 short-term overseas travel fellowships to enable young researchers to visit special facilities or research groups in other countries. The countries visited have included the United States, England, Germany, France, Japan, Spain, and Ireland.

A more formal style of interaction takes place in the form of workshops and conferences. The ARCNN sponsors several workshops around the country each year that deal with such topics as nanoindentation, nanocomposites, and molecular modeling at the nano scale. It is also involved in sponsorship of sessions at more general conferences on materials science, but the great events are the biennial International Conference on Nanoscience and Nanotechnology (ICONN), held in Brisbane in 2006 and Melbourne in 2008, with the next in the series to be featured in Sydney in 2010. These week-long conferences include lectures by highly distinguished international scientists and local researchers and have proved popular both with Australians and many overseas visitors. ICONN2006 attracted over 450 participants and ICONN2008, which was preceded by a two-day postgraduate symposium, drew more than 850 people. A further growth in attendance is expected for ICONN2010.

ICONN2008, which was preceded by a two-day postgraduate symposium, drew more than 850 people.

Since a major role of the ARCNN is the fostering of interactions, a number of the distinguished international speakers traveled to universities in Australia

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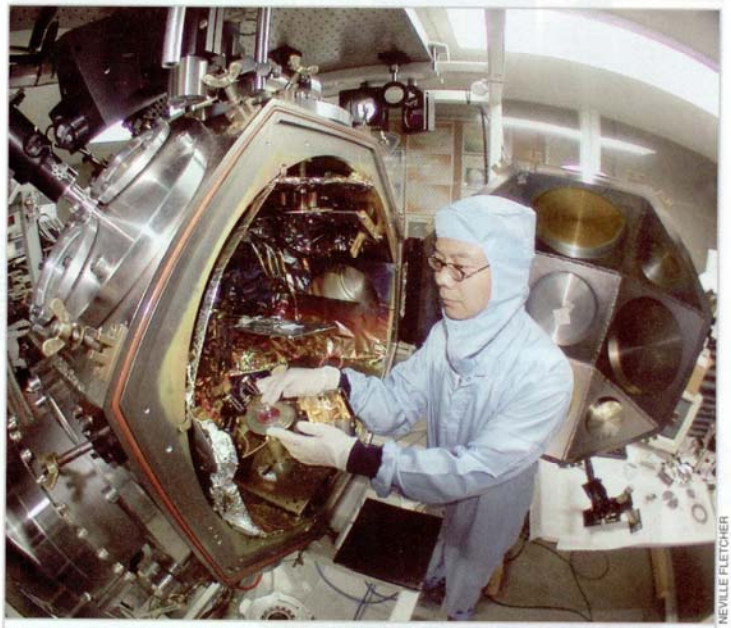
The MOCVD reactor at the Australian National University.



NEVILLE FLETCHER

A pulsed-laser deposition system at the Australian National University.

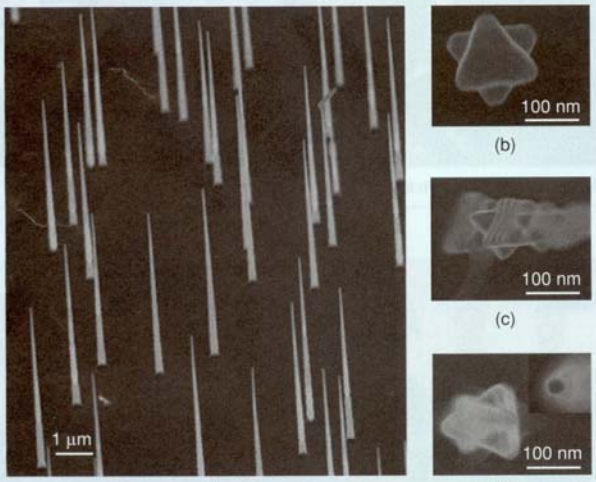
NEVILLE FLETCHER

The Management Committee of the ARC Nanotechnology Network, meeting in 2007. Along with senior representatives of major participating organizations, the Committee includes representatives of students and early-career researchers.

The network has an annual series of "Young Nanotechnology Ambassador Awards" for graduate students working in the nanotechnology field.

NEVILLE FLETCHER

Loading a wafer into the MOCVD reactor at the Australian National University.



NEVILLE FLETCHER

A nanotechnology research project. (a) Gallium arsenide nanowires, each topped by a gold droplet and growing upon a gallium arsenide substrate; (b)–(d) show top views of the cross sections of the wires.

to discuss their work and to give further lectures following each of these conferences. The network also sponsors lecture tours by several other distinguished international scientists during the year, each visiting four or more centers that are particularly relevant to their research interests. International scientists interested in making contact with Australian researchers are encouraged to join the ARCNN, for which membership is free.

It is not only distinguished international scientists who are sponsored for lecture tours. In addition, the network has an annual series of "Young Nanotechnology Ambassador Awards" for graduate students working in the nanotechnology field. The aim is that each of these ambassadors will visit a number of schools, generally in their state but sometimes as far away as the remote Aboriginal communities of the Northern Territory, and give presentations about nanotechnology. These visits have been very successful and greatly welcomed by the schools visited. The network has also sponsored a nanotechnology topic, "Nanotechnology—taking it to the people," on the immensely successful Web site "NOVA—Science in the News" (www.science.org.au/nova). It is organized by the Australian Academy of Science and aims to bring science and technology information to young people, teachers, and the general community.

While the present group of ARC networks has assured funding only to the end of 2009, there will be carryover funds to support ICONN2010, with the hope that some arrangement will be made for continuation of what has proved to be an extremely successful project. Whether that happens or not, the nanotechnology community in Australia has now been brought together to form a communicating whole and we expect great things to continue to emerge from it.

ABOUT THE AUTHOR

Neville Fletcher (neville.fletcher@anu.edu.au) is retired but still active in research. He previously served as foundation chairman of the ICONN Management Committee from 2005 to 2007.

Nanovic Nanotechnology in Australian site

Nanotechnology Education a priority at ICONN08

At ICONN08, held in Melbourne during the last week of February, 40 secondary school students from across Victoria attended the international nanotechnology conference to experience nanoscience first-hand. Each student earned their admission by submitting an essay addressing '***What is nanotechnology and what can it do for Australia?'***.

The students were given the opportunity to try hands-on nanotechnology activities including manipulation of shape memory alloys, hydrophobic effects and nanogold. They attended plenary sessions of the Conference given by world leaders in nanotechnology, including Clayton Teague of the USA National Nanotechnology Coordination Office and Don Eigler, Nobel Laureate from IBM.

Students from St Helena Secondary College presented experiments, building on the knowledge they gained through the SHINE nanotechnology elective. Andrew Barras, a St Helena student said 'I really loved today. It was fantastic to see the new applications of nanotechnology emerging. I also really enjoyed playing with the electron microscope – so simple to use'. Ashleigh Scanu, also of St Helena said 'it was really, really good. I liked that they invited high school students. We got to see stuff that is normally reserved for adults who are already in the area'.

Nanotechnology Victoria recognized the winning essay entries with a certificate and cash prize. Winners were:

- Alex Newton from Southwood Boys' Grammar School;
- Christopher Eales from Emmaus College;
- John Tellis from St John's Greek Orthodox College.
- Honourable mentions went to Andrew Barras from St Helena Secondary College, Brooke Driessen and Laura Driessen from Tintern Girls' Grammar School, Kieran Iles from St Paul's College (Altona) and Danielle Anderson from Numurkah Secondary College.

The student day was followed by a teacher professional development day attended by 40 teachers, learning about nanotechnology demonstrations and experiments and participating in the conference.

Alex Newton
Southwood Boys'
Grammar School

The Education Days were coordinated by Dr Kristin Alford from Bridge8 and Francesca Calati of La Trobe University, together with Assoc Prof Joe Shapter and Brent Banham from Flinders University, Ms Caitlin Lewis from CSIRO Education and Prof Paul Mulvaney of the University of Melbourne.

Brooke Dri Laura and Driessen,Tintern Girls Grammar School

Ingeniuty – Bridge 8

ICONN 2008

ICONN2008: Melbourne Attracts Big Names in Nano 27 February, 2008
Filed under: Awareness, Events, Learning, Nanotechnology — sarahkeenihan @ 12:27 pm
Tags: nanotech, nanovic
Sarah: The ICONN2008 conference is the hot and happening place to be this week. As well as over 700 registered Australian particpants, big international names in attendance include Clayton Teague (National Science and Technology Conference, USA), Don Eigler (IBM Amaden Research Center, USA) and Michael Gratzel (Ecole Polytechnique Federal de Lausanne, Switzerland). Lots of talks have focussed on nanoelectronics, and the use of nanotechnology to develop new methods for energy generation and storage. As an immunologist in a past life, I have been particularly interested to hear about nano-vaccine research of several Australian insitutions. Stay posted to receive more news and views from ICONN2008!
http://bridge8.wordpress.com/

ICONN2008: "That IBM Guy" 4 March, 2008
Filed under: Learning, Nanotechnology, People — sarahkeenihan @ 8:09 pm
Tags: nanotech, nanovic, public nano
Sarah: As I blogged a few days ago, one of the guests at ICONN2008 was Don Eigler, IBM fellow from IBM Almaden Research Center (USA). So who is Don? You might remember some excitement amongst physicists and molecular scientists in the late 1990s when some IBM guy managed to manipulate individual xenon atoms to spell out the word "I-B-M". That guy was Don Eigler. Don then and now works on extending human understanding of the physics of atomic-scale structures and exploring the potential of atomic-scale logic and data storage technologies. Don is remarkable not only for his capacity to dream big and make things happen for IBM, but also for his willingness to participate in the scientific process at many levels. In addition to delivering a plenary lecture at ICONN2008, Don inspired a whole new generation of scientists by chatting to teenagers and their supervisors attending the conference student and teacher nanotechnology teaching sessions. He provided simple and yet unpatronising explanations of atoms, electron microscopy and data storage amongst other topics, and willingly answered questions and posed for photos (we are such atomic celebrity junkies!). Check out the nanovic news and events pages for more on Don Eigler and the ICONN2008 student/teacher sessions later this week.
Bridge8 acknowledges the support of Nanotechnology Victoria to attend ICONN08.


ICONN 2008
International Conference on Nanoscience and Nanotechnology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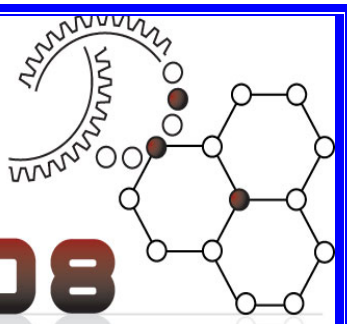

ICONN 2008

The Wiley-VCH journal ''Advanced Functional Materials'' publishes high quality papers across the spectrum of materials science but focussing on breakthrough materials research that could open up new applications and/or demonstrate new scientific phenomena. There are occasions when it is possible to focus issues of the journal on areas of high current interest, and ''nanoscale materials research'' is certainly an important area at present. It is perhaps worth reflecting how ubiquitous the field of nanomaterials has become by noting that an ISI search of the topic ''nanomaterials'' up to 1990 gives not one citation. From 1990 to 2008, there are some 5,200 papers that involve the topic of ''nanomaterials''. The case for nanoparticles is even more dramatic. Prior to 1990 there were some 130 papers on the topic of nanoparticles (all in the 1980s) but since 1990, there have been an astounding 73,000 papers published on the topic. Of course nanoparticles and nanomaterials were not discovered in 1990, and the terms nanomaterials and nanoparticle were coined in the 1980s to highlight the fact that the research was focussed on the size dependent properties of the materials. Nevertheless, these data reflect the extraordinary rise in interest in nanoscale materials and nanoparticles over the last two decades.

This particular issue of AFM provides a snapshot of some of the most active areas of current research in nanoscale functional materials. The contributions cover quite a range of materials, as well as diverse applications and functions. The common point is that the key scientific breakthroughs were announced at the International Conference on Nanoscience and Nanotechnology (ICONN) held in Melbourne in February 2008, with some 800 participants, a conference supported by the Australian Research Council and the Australian Naotechnology Network (http://www.ausnano.net)

AFM was represented at ICONN2008 by Karen Grieve, the (then) deputy editor of AFM and we are delighted that many of the keynote speakers consented to publish their resurlts as part of a special edition of AFM. We also thank AFM and Wiley-VCH for their support for the Conference and this special issue, which highlights the work of many early career researchers. As you will see this collection of papers covers a number of active areas, though it was apparent at the meeting that there is an increasing focus on nanoscale rods and wires, which can now be fabricated both by vapour deposition and through chemical synthesis in solution. These materials are being exploited for a variety of purposes.

Wang and colleagues discuss aligned titania nanotubes and their use in energy storage, while Joyce et al. explore the synthesis of high purity GaAs nanowires. They utilized gold nanoparticles formed in solution as the catalyst for steering the nucleation and growth of the wires. Gold nanorods also feature in the work of Staleva and Hartland. These authors used time resolved spectroscopy to study the vibrations of small metal nanostructures, from which they could deduce the Young's modulus of these nanoscale materials. The coherent osciliations excited by short laser purlsed provide the pathway for the dissipation of energy in metal nanorods and nanocubes. Another curious aspect of gold nanorods is the important role played by halide ions in determining the particle morphology during synthesis. Grzelczak et al. show that the tip curvature can be controlled by small amount of iodide ions. This can be exploited to switch the rod to a dumbbell shape, showing that the iodide forces gold atoms to deposit preferentially at the tips.

A completely different aspect of nanowire research is the creation of ultra-strong carbon nanotube fibres, using conventional spinning, an idea now realised by Granero et al. at the University of Wollongong. Carbon nanotubes are also finding biomedical applications due to their high strength, low toxicity and the fact they can be built into a wide range of architectures. Firkowska and colleagues find that cells can be grown directly on top of CNT scaffolds, which opens up new approaches to tissue engineering. A different approach is exemplified by the work of Bocking and coworkers , who have modified silicon surfaces to render them bicompatilbe throught selfassembly to enable them to be utilized in medical applications. This materials development is an essential step towards bioelectronics.

The key to nanowire and nanorod fabrication is anisotropic materials growth. This is still a nascent field and there is little understanding of the mechanisms that can be exploited to drive directed growth of materials. Zhang et al. show that helical silica structures can now be synthesized using achiral surfactant templating. New analytical tools are required to investigate the complex 3D morphologies produced by methods such as surfactant templating. Duke et al. describe the use of positron annihilation spectroscopy to characterize the sub-nanometre pore distribution in such nanoschale silica structures. This provides a new tool for characterizing the architecture of materials on nanometer length scales.

The development of metallic and semi-conductor nanocrystals remains a central research direction in many materials laboratories around the world. At ICONN2008, Tang et al. from Michigan presented new results on cation substitution reactions on colloidal CdTe, while Ahrenstorf and colleagues from Hamburg covered the nucleation and growth of NiPt alloy particles and demonstrated that the composition of these particles can be systematically tuned. Jasieniak and coworkers showed that core-shell semiconductor nanocrystals can be incorporated as defect layers into sol-gel based waveguides, which suggests that wet-chemical-based nanocrystal electronics may be just around the corner. Finally, we thank Professor Hyeon for his splendid Feature Article on the applications of silica-based particles to nanomedicine, one of the most prominent and fastest growing areas of materials research.

Happy reading!

Paul Mulvaney
Chair ICONN 2008
Advances Functional Materials

Exclusive Briefing: Nanotechnology on the Radar

At a landmark event for the rapidly-emerging nanotechnology industry, a select group of the nation's leading commentators and businesspeople were given a briefing on the industry and its issues high above Melbourne last on 28 February. The briefing gave them insights into the topic, and stimulated discussion on the possible futures it may provide.

The briefing of senior news editors and business leaders at the Eureka Tower on Thursday 28 February was organised by the Australian Science Media Centre as part of its program to bring science issues into the national consciousness. The Eureka Tower was chosen because the building embodies the latest in construction and information materials, including The Edge, a visual experience enabled by nanotechnology in the form of switchable glass.

The luncheon was introduced by Dr Robyn Williams, the ABC's leading science presenter, and addressed by some of the notable speakers from the international nanoscience and nanotechnology conference held in Melbourne that week. Speakers and panelists included:
Dr Andrew Maynard from the Pew Center for Emerging Nanotechnologies (US);

- Dr Peter Binks, the CEO at Nanotechnology Victoria;
- Dr Diana Bowman of the Centre for Regulatory Studies at Monash University;
- Prof Chennupati Jagadish, ARC Nanotechnology Network;
- Assoc Prof Paul Wright of Nanosafe Australia and RMIT University.

Feedback from the briefing was unanimously positive, with participants commenting on the understanding and insights they had gained on the field, and the caliber of the presentations and discussions.

The 'Nanotechnology on the Radar' briefing was sponsored by The Australian Office of Nanotechnology (DIISR) with
support from ARCNN, NanoVic
and Bridge8

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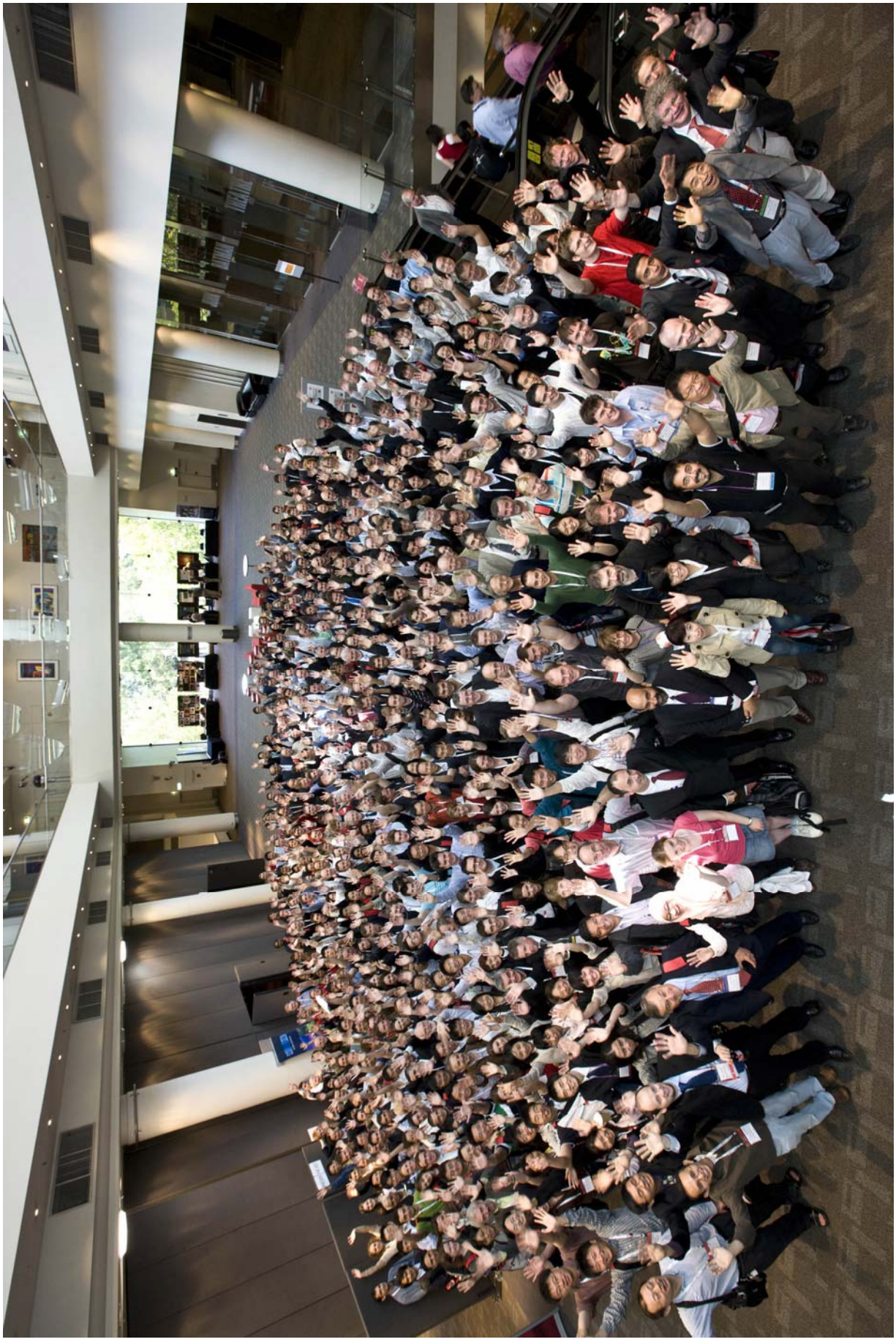
The 'Nanotechnology on the Radar' briefing was sponsored by The Australian Office of Nanotechnology (DIISR) with support from ARCNN, NanoVic and Bridge8.



INTERNATIONAL NETWORKING

INTERNATIONAL NETWORKING

Australian-US Workshop - "Sustainable Nano-Manufacturing" 23/02/2008 - 24/02/2008 - Melbourne Business School

Report on ARC-NSF Joint Workshop titled **"Sustainable Nano-manufacturing"**

Preamble: A joint workshop on Sustainable Nano-manufacturing was held on February 23rd and 25th in Melbourne. The workshop was preceded by a one-day seminar titled "Emerging Nanotechnology Issues in Energy, Water and the Environment" held at the Australian Institute for Bioengineering and Nanotechnology, The University of Queensland in Brisbane.
Invited Workshop participants were drawn from industry, government and academic institutions in Australia and the USA. Participants from New Zealand and Singapore also attended the workshop. More than sixty persons attended this workshop.

Primary Contacts:
Dr Ian Mackinnon (ARC) Dr Judy Raper (NSF)

Local Organising Committees:
Prof Chennupati Jagadish (ANU) Prof Brij Mogdil (Univ of Florida)
Prof Max Lu (Univ of Qld) Prof Glenn Schrader (Univ of Arizona)
Prof Kim Ogden (Univ of Arizona)
Secretariat:
Mrs Lisa Pope (ARC LP/EE Team)
Ms Hayley Abbott (ARC LP/EE Team)
Mrs Liz Micallef (ARC Nanotechnology Network)
Ms Donna Hannan (AIBN, University of Queensland)

Sponsors:
USA National Science Foundation, ARC Nanotechnology Network, ARC Advanced Materials Network
Australian Office of Nanotechnology, (DIISR), International Science Linkages Office, DIISR
Victorian Dept of Industry, Innovation etc, Australian Inst for BioEng&Nanotech, University ofQeensland, Australian Research Council

Seminar Format:
Opening remarks were provided by Prof Peter Gray, Director of the AIBN. The seminar series involved a further twelve presentations by leaders in their field on a wide range of topics including nanotechnology market potential, product safety and sustainability, product design and education for sustainability. Estimated attendance at this seminar series throughout the day is in excess of 65 persons including a significant number of postgraduates and post-doctoral researchers from the local area.

Workshop Format:
Plenary lectures by three leaders in their fields were provided on the Saturday evening (February 23rd) and followed immediately by a bar-b-que with ECRs who were attending an ICONN08-sponsored workshop at the same location (Melbourne Business School)
The following days involved a combination of short presentations (15minutes) on specific industry sectors
and then a series of shorter presentations (5minutes) by other participants on a wide range of "positions"
relevant to the workshop title. This format resulted in more than 50% of the participants being engaged or communicating directly to the assembled audience and thus, ensued lively discussion during the group
workshop sessions which followed. Workshop sessions were led by 2 moderators from both countries in five separate break-out groups.

These sessions followed the specific themes (a) Processing, (b) Product Design, (c) Waste Management, Utilisation and Recycling, (d) Physical and Computational Tools for Analysis and (e) Environmental, Health and Safety.

Immediate Outcomes:
On the final day, working groups confirmed the outcomes of earlier discussions and then reported back to all workshop participants. These reports were then distilled into a short PowerPoint presentation.
This distilled presentation was then used in a one-hour "report-back" session to attendees at the ICONN08 meeting. More than eighty ICONN08 attendees participated in this report-back session.A sub-committee
of Australian and USA moderators met later in the week to draft an outline of theformal report. This draft
report is currently at an early stage of development prior to circulation to awider group of workshop attendees
for comment.

Longer Term Outcomes:
A copy of the programme of events and associated powerpoint presentations used throughout the workshop period will be compiled and available *via* the ARC Website.
A formal report from this workshop is expected to be released in hard copy format in mid-2008. An additional meeting of USA and Australian organisers is scheduled for September 2008 in order tofurther develop the
living roadmap on sustainable nano-manufacturing.

Acknowledgements
Australian Department of Innovation, Industry, Science and Research (International ScienceLinkages Program and Australian Office of Nanotechnology), Victorian Department of Industry, Innovation and Regional Development, Australian Research Council Nanotechnology Network,Australian Research Network on
Advanced Materials, Australian Institute of Bioengineering and Nanotechnology, Australian Research Council and National Science Foundation (USA) are gratefully acknowledged for their support (both in-kind and financial)

Theme: Development of Technology Roadmap for Nano-Manufacturing

Saturday, 23 February 2008: The Melbourne Business School
(200 Leicester St, Carlton)
4:30pm – 6:30pm: Keynote Session
Introductory Remarks – Expected Outcomes; Workshop Co-Chairs
"The Changing Face of Nanotechnology" – Dr Mike Roco (National Science Foundation, USA)
"Nanoscience and Nanotechnology in Australia"- Prof Jim Williams (The Australian National University, Australia)
"Nanotechnology and Nano Materials – Applications and Global Market Analysis" – Dr Thomas Abraham (Innoresearch, USA)
7pm – 9:30pm: Dinner
Workshop social and BBQ dinner with young researchers and students attending the ICONN 2008 Conference.

Sunday, 24 February 2008: The Melbourne Business School
8:30am – 10:30am: Featured Presentations
Outlining the status of sustainability and other issues relevant to microelectronics, pharmaceutical products, chemical and minerals processing
Microelectronics
• "Environmental Sustainability for Nano-Manufacturing in the Semiconductor Industry" - Prof Glenn Schrader (University of Arizona, USA)
• "Consumer Electronic Products and Sustainability" - Dr Calum Drummond (CSIRO, Australia)
• "A Complete Plasma Fabricated Fuel Cell Based On Nano-Structures" - Prof Rod Boswell (The Australian National University, Australia)
Pharmaceutical
• "Nanotechnology sustainability in Australia cf Medical Device Industry" - Dr Bruce Cornell (Ambri Ltd, Australia)
• "A Framework For Impact And Risk Assessment Of Nano Inspired Products" – Dr

Susanne Smith (Australian Nuclear Science and Technology Organisation, Australia)
Chemical/Mineral Products
• “The Chemical Industry and Nanotechnology” - Dr Louis Hegedus (Arkema [retd.], USA)
• “Nano-Materials and Sustainability Metrics in Chemical and Mineral Processing” - Prof Colin Raston (University of Western Australia, Australia)
• “Critical Needs for Ensuring Safety – Nurturing innovation, protecting society” – Dr Vicki Colvin (Rice University, USA)
• “Nano-Manufacturing at the School of Advanced Manufacturing and Mechanical Engineering at Mawson Institute” - Prof Peter Majewski (Ian Wark Research Institute, Australia)

10:30am – 11am: Morning Tea

11am – 12.30pm: Featured Snapshots

Outlining factors that impact sustainability, such as Environmental Health & Safety, Success Metrics, Physical and Computational Tools, Waste Management, Education
• “Competition and Sustainable Nano-Manufacturing” - Dr Peter Talbot (Very Small Particle Company, Australia)
• “Innovate Nanotechnology for Sustainable Economy” - Dr Wenwu Zhang (General Electric Global Research Centre, USA)
• “Leveraging Nanotechnology for Business Needs” - Dr. Gavin McDonald (Kimberly-Clark Corp., USA)
• “Nano-particle Measurement and Exposure Assessment” - Prof. Rick Flagan (California Institute of Technology, USA)
• "Ensuring the Safety of Nano-materials in the Workplace" - Dr Annette Santamaria (Environ Corp., USA)
• “Risk Management – Nano-materials of Potential Novel Toxicological Concern” – Dr Andrew Bartholomaeus (Therapeutic Goods Administration, Australia)
• “Self-Assembly of Particles” - Prof Aibing Yu (The University of New South Wales, Australia)
• “Waste Management in Nanotechnology” - Prof. David Green (University of Virginia, USA)
• “Nanofabrication at IMRE” - Dr Isabel Rodriguez (Institute of Materials Research and Engineering, Singapore)
• "Low Energy Membranes" - Dr Anita Hill (CSIRO, Australia)
• “The experience of listing a nanotech company on the Australian Stock Exchange – a sustainable financing
option.” - Dr Sylvia Tulloch (Dyesol Pty. Ltd., Australia)
• “Harnessing Solar Energy for Water Treatment” - Prof Rose Amal (The University of New South Wales,
Australia)
• “Enhancing Sustainability Through Expert Cost-Effectiveness Assessment of Nano-heath Technologies” -
Dr Tom Faunce (The Australian National University, Australia)
• “Processing, Structure and Electrical Magnetic Properties C/co – Polymer Nanocomposites” – Sri Bandyopadhyay (The University of New South Wales, Australia)
• “A Biomimetic Approach to Resource Sustainability” - Dr Terry Turney (Asian Nanomaterials Pty. Ltd.,
Australia)

12.30pm – 1.30pm: Lunch

1.30pm – 3pm: Breakout Session 1

Breakout Group A: Processing
• Issues related to water, energy and materials efficient manufacturing processes
• Moderators – Prof Brij Moudgil & Dr Carla Gerbo

Breakout Group B: Product Design
• product design advances required to facilitate not only efficient production but also for economic recycling
• Moderators – Prof Glenn Schrader & Prof Abid Khan

Breakout Group C: Waste Management, Utilization and Recycling
• For example, strategies for zero water and materials discharge in nano-manufacturing

• Moderators –Dr Judy Raper & Prof Peter Majewski

Breakout Group D: Physical and Computational Tools for Analysis

• For example, sensors, modeling and simulation for reliable measurements and predictions

• Moderators – Dr Marc Ingbar & Dr Mike Sargent

Breakout Group E: Environmental Health and Safety

• For example, screening protocols at key stages during manufacturing

• Moderators – Prof Kim Ogden & Dr Andrew Bartholomaeus

3pm – 3:30pm: Afternoon Tea Break

3:30pm – 5pm: Breakout Session 2

*** Same breakout topics as the first session with new group formations.

Monday, 25 February 2008: Investment Centre, Victoria
(Level 46, 55 Collins St, Melbourne)

8:30am – 10:15am: Breakout Session 3

*** Return to formations from Breakout Session 1 and bring back to the group what was learned from other sessions.

10.15am – 10.45am: Morning Tea

10:45am – 12:30pm:

• Summary Highlights from Each Breakout Group; and

• Research Needs for Sustainable Nano-Manufacturing

12:30pm – 2pm: Lunch

2pm: Mini Tours Synchrotron and Mini Fab Labs (Positions limited)

NOTE: Due to safety requirements, all participants on the tours MUST wear enclosed shoes (NO thongs or 'peep toe' shoes allowed)

1.50pm: Meet at departure point (Sofitel hotel driveway)

2pm: PROMPTLY depart the Sofitel for the Synchrotron

2.30pm – 3.30pm: Australian Synchrotron Site Visit/Tour

3.30pm: Depart for the Mini FAB

4pm – 5.30pm: Mini FAB Site Visit/Tour

5.30pm: Depart the Mini FAB for arrival at the Melbourne, CBD

Additional Program Elements:

A. Community Report Back via ICONN Meeting: Mon 25 Feb, 4pm – 5pm
Nominated persons from the Workshop to share findings and discussion with general community participating in ICONN 2008.

B. Group Chair Recap
Informal working luncheon/dinner for Breakout Group Chairs and others on Wednesdayand Friday, - to share unique perspectives presented during ICONN 2008 and, - to prepare first draft of the report for the NSF and ARC. Prepare time table for Roadmap.

THE UNIVERSITY OF WESTERN AUSTRALIA
Achieving International Excellence

Professor Lorenzo Faraone,
BE, PhD, SMIEEE, FTSE, FAA

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9 February 2009
Professor Chennupati Jagadish
Department of Electronic Materials Engineering
Research School of Physical Sciences and Engineering
The Australian National University
Canberra ACT 0200

Dear Professor Jagadish,

RE: NanoE3-2008 Conference Report

First of all I would like to express my sincere thank you to the ARCNN Committee for supporting the NanoE3 2008 Conference. I am pleased to provide the following report.

The Conference had a total of 36 attendees and was held in Margaret River from 22 – 24 September, 2008, which included 18 invited presentations from Italy and Australia from researchers that are world-leaders in nanotechnology. In addition, an opportunity was provided for contributed presentations from 12 Australian early career researchers and PhD students. Attached is some information that details the aims of the conference and the final list of invited speakers.

By all accounts, the conference was an outstanding success, and has the potential to make a major impact on knowledge relating to nanotechnology in Australia and Italy, and make a major contribution towards enhancing research collaboration between the two countries. We have already identified a number of researchers and research organisations that will pursue future bi-lateral funding opportunities in order to formalise their research interaction.

Most of the funding support provided by the ARCNN has been committed towards assisting Postgraduate Students and Early Courier Researchers. A small portion of the support was committed to assist the Italian invited speakers to meet their travel expenses. Please find attached a break down of the funding distribution.

If you require any further information please feel free to contact me.

Yours sincerely,

L. Faraone Lorenzo (Laurie) Faraone

Professor and Head, Microelectronics Research Group
Director, WA Centre for Semiconductor Optoelectronics & Microsystems (WACSOM)
School of Electrical, Electronic & Computer Engineering, M018

NanoE3 2008
Nanotechnology for Electronics, opto-Electronics and Electro-mechanical systems
22-24 September, 2008

The aim of the bi-lateral Italian-Australian NanoE3 2008 Conference is to bring together researchers in technologies related to the semiconductor industry which has revolutionised and underpinned advanced technology, ICT and industrial innovations in the world over the past 50 years. The conference topics include semiconductor nanotechnology, materials, devices, and nanostructures, as well as theory, modelling characterisation and reliability of semiconductor nanostructure and nano-devices. These are areas in which both Italy and Australia have strong research activities, and the conference will provide a unique opportunity to establish research links between Italian and Australian participating researchers and organisations. For further information on paper submission and program, see http://nanoE3-2008.ee.uwa.edu.au

Conf. chair: Professor Lorenzo Faraone
Location: Margaret River Resort
Western Australia

Invited Speakers

From Italy	**From Australia**
Dr Livio Baldi, Numonyx, Agrate	Prof. Eric Bakker, Curtin UT
Prof Fabio Beltram, NEST, Pisa	Dr Warrick Clarke, UNSW
Prof. Massimo DeVittorio, U del Salento	Prof. John Dell, UWA
Prof. Guido Faglia, U Brescia	Prof. Andrew Dzurak, UNSW
Prof. Marco Fanciulli, CNR-INFM, Agrate	Prof. Chennupati Jagadish, ANU
Prof. Paolo Lugli, U Rome (Tor Vergata), TU Munich	Prof. David Jamieson, U Melbourne
Prof. Gaudenzio Meneghesso, U Padova	Prof. Nunzio Motta, QUT
Dr Vito Raineri, CNR-IMM, Catania	Prof. Jim Williams, ANU
Dr Nicola Sasanelli, Sc. Attaché, Italian Embassy	
PGs/ECRs	**Details**
Dr Martin KOCAN	UWA
Dr Mariusz MARTYNIUK	UWA
Mrs Jing ZHANG	UWA
Dr Martin KOCAN	UWA
Dr Mariusz MARTYNIUK	UWA
Mrs Jing ZHANG	UWA
Dr Craig BULLEN	UWA
Mr Ngwe Soe ZIN	Uni Qld
Miss Jessica VAN DONKELAAR	Uni Melb
Mr Andrea CAPASSO	Qld UT
Mr Wee Han LIM	UNSW
Mr Kuan Yen TAN	UNSW
Adj Prof. Nicola SASANELLI Italian Scientific Amabassador	Italian Embassy, Canberra

Nano E-3 2008 Participants

Australia Japan Nanophotonics Workshop
09/12/2008 - 10/12/2008 - ANU, Canberra

The Australia Japan Nanophotonics workshop was held on the 9th and 10th of December 2008. Forty delegates including Early Career Researchers and PhD students from both countries took part. The Australia Japan foundation, Australian Research Council Nanotechnology Network, The University of Tokyo, National Institute of Information and Communications Technology, Japan Science and Technology Agency and the New Energy and Industrial Technology Development Organisation provided funding for this workshop.

Prof Ohtsu from Tokyo University and Professor Jagadish from the Australian National University were instrumental in bringing about this collaborative meeting.

Some of the participants that took part in the workshop

DISTINGUISHED LECTURER TOURS

DISTINGUISHED LECTURER TOURS

The aim of the Distinguished Lecturer Program is to bring international experts in the field to Australia and to give lectures in various institutions across the country. This also allows young scientists to interact with internationally renowned scientists in the field and allow Australian researchers to be aware of state of the art research overseas. These visitors will act as Ambassadors for Australian Science internationally.

There were 2 Overseas Distinguished Lecturers invited to tour Australia and talk about their fields of research and expertise. CD Video recordings of these seminars have been distributed to members free of charge based on requests received. These CD's are very popular and we are still receiving requests for free CD's of Distinguished Lecturer seminars presented in 2005, 2006 and 2007.

Prof Horst Hahn

Horst Hahn studied Materials Science at the Universitat des Saarlandes and received his PhD from the Technishce Universtat Berlin. In 1992 he became Associate Professor of Materials Sciences at Rutges, the state university of New Jersey. From 1992 to 2004 Horst Hahn was Full Professor (C4) in the department of Materials Science at Technische Universitat Darmstadt and Head of the Thin Films Division. For three years Professor Hahn serves as Chairman of the Department. Professor Hahn is one of the co-founders os SusTech Darmstadt GmbH&Co KG, a start-up company in the area of sustainable chemistry and nanotechnology, The Company is developing products based on functionalised nanoparticulate systems. Horst Hahn is honorary Professor at the Department of Physics at the University of Hyderabad, India, Distinguished Professor of the IIT Madras, India and Guest Professor at Lanzhou University, China. Professor Hahn s a member of the DFG funded Centre for Functional Nanostructures and of the Landeskompetenznetzwerk "Functionelle Nanostruckturen" at the Universitiat Karlsurhe, His main research interests are in the areas of synthesis, characterization and functional (physical and chemical) properties of nanostructured materials in the form of thin films, nanoparticles and bulk materials.

Prof Horst Hahn in Canberra

Since April 2004 Professor Horst Hahn is Managing Director of the Institute for Nanotechnology at the Forschungszentrum Karlsruhe and Director of the Research Laboratory Nanomaterials located at the Technische Universitat Darmstadt and jointly operated by Forshungszentrum Harsuhe and Technische Universitat Darmstadt.

During his February visit to Australia he gave lectures in the topics **"Nanoscience and Nanotechnology: from basic science to applications" and** in the following cities:
Sydney, Adelaide, Perth, Melbourne and Canberra

Abstract

"Nanoscience and Nanotechnology: from basic science to applications"

The research activities at the Research Center Karlsruhe and at the University Karlsruhe in the area of nanoscience and nanotechnology are concentrated in the following fields: electron transport in nanostructures, nanomaterials, photonics and metamaterials, nanodevices and nanobiology. In these fields the researchers are closely cooperating within the Helmholtz program Key Technologies and the Center for Functional Nanostructures funded by the GermanScience Foundation. A short overview of the activities in Karlsruhe will be presented.

Besides the organizational aspects, selected examples of research results will be presented:

- Recently, the self-organized deposition of single wall carbon nanotubes (CNT) on pre-structured electrode arrays with densities exceeding 10^6 CNT/cm^2 has been demonstrated. Between each electrode pair, a single CNT is arranged by the dielectrophoretic deposition process. All CNT are electrically active which provides the base for future applications in electronics and sensors.

- The reversible change of physical, mechanical and chemical properties of metallic nanostructures has been shown for nanoporous structures and for thin films exposed to electrolytes. The tunability using an applied potential to control the change of properties is caused by the change of the electron density profile at the surface due to the electrochemical double layer formed in the electrolyte.

- Energy storage is one of the key aspects of mobility and the use of regenerative energy sources. New nanostructured chemical compounds are developed as hydrogen storage materials in close cooperation of materials scientists, chemists and physicists.

Abstract

Electronically tunable nanomaterials

The properties of materials are typically controlled in a static manner by the microstructure. This implies control of the grain size, defect concentration, structure and metastability. As long as the microstructure does not change during the use of the material, the properties of the material are fixed, or irreversible. In contrast, in semiconducting materials, properties can be tuned by the application of an external field due to the space charge regions which extend far from the interfaces. In metallic systems, this effect cannot be observed unless the dimensions of the structures are in the nanometer regime. The reason for this different behaviour is the small spatial dimension of the space charge regions due to the effective screening of the induced charges by the conduction electrons. In nanoporous metals and thin films exposed to appropriate electrolytes, it has been demonstrated that substantial changes of physical properties can be induced by the application of a potential between the nanostructured metal and a counter electrode. Examples of the changes of surface stresses and the electrical resistivity of thin Gold films and nanoporous Gold will be presented. A simple model is proposed based on the modification of the electron density distribution at the interface of the metal and the electrolyte. Effectively, the corresponding change of the effective thickness of the sample is the major cause of the observed resistivity change. Additionally, a transparent conducting oxide, ITO, in a nanoparticulate form has been prepared from a dispersion using spin coating. The observed resistivity changes, i.e. the on/off ration can be as large as 2.000, i.e. 200.000 %, between the different values of the control potential. Moreover, the device exhibits field effect transistor behavior identical to a conventional semiconductor, but in this case observed in a material with a large charge carrier density exhibiting metallic conduction behavior. Additionally, the mobility is exceeding 30 cm2/Vs. The device can be used for printable electronics and transparent electronics.

Professor Roberto Menozzi

Roberto Menozzi was born in Genova, Italy, in 1963. From 1989 to December 1990 he was with the University of Parma with scholarships from the National Research Council (CNR) and the Research Center of the Italian Telecom (CSELT).

During the years 1991-1993 he was a PhD student with the Department of Information Technology (DII) of the University of Parma.

He received a PhD degree in Information Technologies in 1994.From January 1993 to October 1998 he held an Assistant Professor position with DII, University of Parma. In November 1998 he was appointed as Associate Professor in the same department. In November 2001 he received the Tenure. On November 1, 2006 he was appointed as Full Professor.

In 2006 he was awarded a Gledden Fellowship by the University of Western Australia, and from July to December 2006 he worked with the Microelectronic Research Group, School of Electrical, Electronic and Computer Engineering, on GaN device characterization and modeling.

Prof Menozzi and Dr Hoe Tan

He is currently a committee member for the EIA-JEDEC Reliability of Compound Semiconductors (ROCS) Workshop (formerly the GaAs Reliability Workshop), and a member of the Editorial Board of Elsevier's *Microelectronics Reliability*.

R. Menozzi is a Senior Member of the IEEE and of the *Association for Research between Italy and Australasia (ARIA-WA)*. He gave lectures in the following cities Adelaide, Melbourne and Canberra on the following topic.

Abstract

GaN-NANOELECTRONICS RELIABILITY

For the last few years, GaN-based technologies have been delivering many of the promises made in their earliest development stages. As usual, when a technology moves out of the labs and into production lines, reliability becomes a major concern. GaN-based HEMTs, in particular, for example, owe most of their appeal and success to the ability to operate at higher power densities and temperatures than their competitors, i.e., under conditions that exacerbate reliability problems. These interact with nano-scale phenomena connected with the 2-dimensional electron gas (2-DEG), aggressive gate length scaling, nanometer-thin epi-layers, trap-assisted tunneling.

This paper will give an overview of the development and current status of GaN-HEMT reliability, highlighting the progress made and the challenges still to be met.

The degradation mechanisms include (but are not limited to) effects related with traps and their interaction with hot carriers, passivation, material defects, and metallization problems. Recent lifetesting data will be shown that indicate a remarkable progress in this area over the last few years.

Since reliability is often (though not always) a matter of temperature, the paper will also review the main results obtained in the field of thermal evaluation of GaN-based devices. Experimental characterization techniques include both direct (i.e. microscopy-based) and indirect (i.e., electrical) methods, each with its own merits and drawbacks. Thermal modeling (either analytical or numerical) is also a valuable complement of (if not a substitute for) experimental characterization.

SPECIAL LECTURES

Dr Don Eigler

21/02/2008 - ANU, Canberra

Dr. Don Eigler is a physicist who specializes in studying the physics of surfaces and nanometer-scale structures. In late 1989, using the liquid-helium-temperature scanning tunneling microscope that he had built, Dr. Eigler demonstrated for the first time the ability to build structures at the atomic level by spelling out "I-B-M" with individual xenon atoms.

Emeritus Prof Neville Fletcher, Dr Don Eigler and Prof Jagadish

Dr. Eigler was educated at the University of California at San Diego, where he received a bachelor's degree in physics (1975) and a doctorate in physics (1984). He was a Postdoctoral Member of the Technical Staff at AT&T Bell Laboratories for two years before joining IBM as a Research Staff Member in 1986. In 1993, Dr. Eigler was named an IBM Fellow, the highest technical honor in the corporation.

Dr. Eigler is a Fellow of the American Physical Society and of the American Association for the Advancement of Science.. In 1999, he became the first winner of the Nanoscience Prize, which he received at the Fifth International Conference on Atomically Controlled Surfaces, Interfaces, and Nanostructures

Abstract

The Quest for Spin Cascade Logic Circuits

. http://online.kitp.ucsb.edu/online/plecture/eigler/

Can we design, build and operate nanometer-scale logic circuits that perform conventional binary computation using only the spin degree of freedom? I will review progress towards this goal, highlighting the development of spin excitation spectroscopy to measure g-values, exchange energies, anisotropy energies and spin configurations of assemblies of magnetic atoms on surfaces.

LONG TERM VISITS

LONG TERM VISITS

ARCNN supports the nanotechnology community by making funding support available to **postgraduate students** and **early career researchers** (within 5 years of award of PhD degree) for travel and accommodation expenses associated with Long Term Visits to research Institutions within Australia. Up to $2,000 are provided for a maximum of three months for travel and accommodation to a location(s) within Australia.

Mr Dinesh Kumar Venkatachalam (RMIT University) – visit to the Electronic Materials Engineering Department at the Australian National University

Dinesh is a PhD student and his research interests are, Ion beam modification of materials, Self-assembly of metallic nanoclusters in semiconductors and Selective synthesis of nanowires for optoelectronic/sensing applications.

Purpose of Visit: The significant aim of this project is to develop a comprehensive model for the growth mechanism of the spiral patterns of gold nanoclusters in silicon substrates produced by Au implantation. The proposed experiments will help us gain more insights in the actual melting process involved.

Firstly, I express my sincere thanks to the ARCNN (Australian Research Council Nanotechnology Network) for supporting my long term visit to ANU. Also, I extend my thanks to Professor Robert G Elliman and his group members for their scientific inputs, technical support, enthusiasm and motivation to accomplish my research objectives. I also thank the staff and student members of EME for their help and co-operation, which allowed me to finish my experiments within the stipulated time frame.

The main purpose of this visit was to study and understand the initial growth stages of the self-assembly of gold nanoclusters in Au implanted silicon substrates using a) Rapid Thermal Annealing (RTA) b) Rutherford Backscattering Spectrometry (RBS), c) Cross-sectional Transmission Electron Microscopy (XTEM) and 4) Field Emission Scanning Electron Microscopy (FESEM). The implantation experiments were performed using both the Metal Vapour Vacuum Arc (MEVVA) ion source at ANSTO and the low energy implanter at EME, ANU. RTA experiments performed on the samples implanted using MEVVA ion source helped us to catch the birth and initial growth stages of this unique self-assembly process. For instance, Figure 1 shows the smooth transition in the surface morphology of the samples after the completion of RTA at 540^{o} C and 750^{o} C for 30s. Similar experiments were performed at temperatures above and below the Au-Si eutectic melting point to study the formation of this self-assembly process. The high resolution micrographs recorded from FESEM of the samples annealed at high temperatures revealed a new population (third generation) of gold clusters of the size ranging from 5-20 nm. These clusters were not observed in the SEM at RMIT which uses a LaB6 Filament.

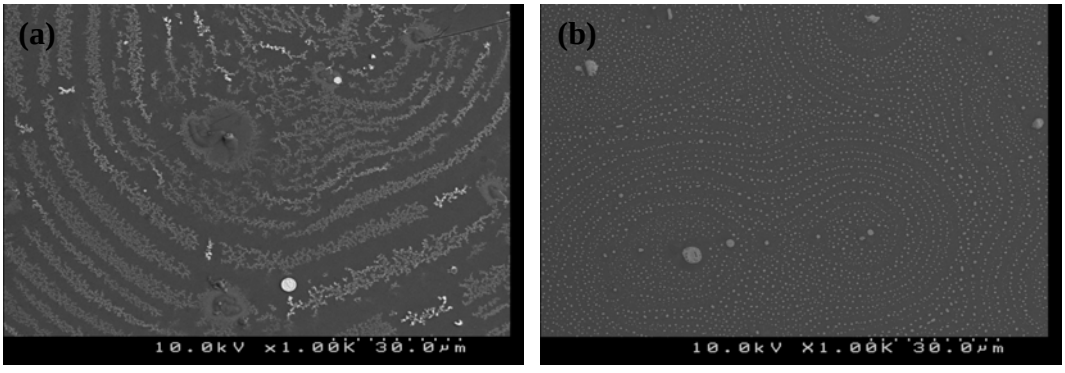


Figure 1: Scanning electron micrographs showing the surface morphology of the Au implanted silicon substrates after the completion of (a) 540 C for 30s and (b) 750 C for 30s.

The glancing angle RBS measurements recorded before and after annealing at various temperatures for very short times helped us understand the depth distribution of gold in silicon. Our preliminary XTEM investigation showed the thickness of the shallow amorphous layer and the gold distribution in the as-implanted MEVVA sample. Complete XTEM analysis is however still pending. Based on our preliminary findings to date we are planning to communicate the results from these studies to either Nature Materials or Nature Nanotechnology.
We will be extending our studies on in-situ investigation of the formation of the Au-Si self assembly process. In addition to this above mentioned investigation, we are currently designing experiments to indent the thin amorphous layer of the as-implanted substrates using the low load nanomechanical test system (Hysitron Inc.). We have performed preliminary experiments to estimate the load required to scratch the thin amorphous layer without disturbing the underlying substrate. If successful, this study will provide an opportunity to selectively control the growth of the self-assembled gold nanoclusters.

Other Projects: During this visit, experiments were performed to selectively grow silica nanowires using ion implantation as a seeding technique to seed catalyzing gold nanoclusters. Silicon (100) substrates were implanted with Au ions at different doses using the low energy implanter and subsequently annealed in a quartz tube furnace at high temperatures in Ar atmosphere. The implanted region showed dense growth of long interwoven nanowires after annealing at 1100^{o} C for 60 min. The plane view TEM analysis showed that the nanowires grow to diameters ranging from 20-100 nm. The length of the nanowires were observed to vary about 50-100 μm corresponding to an aspect ratio of up to 2500. In order to control the growth rate of the nanowires, the substrates were annealed for short time periods at the same temperature. The composition of the nanowires was measured with EDS and it was found to be close to SiO_2. The SAED patterns showed that the nanowires are amorphous in nature. However, more experiments are needed to identify the growth process of these nanowires.

In summary, this long term visit allowed further investigation on some specific aspects of this research such as
1) Understanding the initial growth stages of the self-assembled patterns
2) Role of "MEVVA macroparticles" in the formation on these patterns
3) Diffusion of gold in a-Si after rapid thermal processing
These investigations led to information to improve our understanding of the formation of these unique self-assembled gold nanoclusters. Also, it has opened up new directions of collaborative research in the areas of nanoindentation and their influence in self-assembly.

Apart from scientific learning, I particularly enjoyed the social events and dinners organized by the fellow scientists and researchers at EME.

1) **D.K. Venkatachalam**, D.K. Sood, and S.K. Bhargava, "Spiral patterns of gold nanoclusters in silicon (100) produced by metal vapour vacuum arc implantation of gold ions," ***Nanotechnology*** 19 (1), 0156051-0156058 (2008).

SHORT TERM VISITS

SHORT TERM VISITS

Funding support is also available to **postgraduate students** and **early career researchers** (within 5 years of award of PhD degree) for travel and accommodation expenses associated with Short Term Visits to research Institutions within Australia. Up to $1,000 is provided for travel and accommodation to a location(s) within Australia.

Miss Christine Henry (Australian National University) – visit to the University of Queensland.

Christine is a PhD student and her research interests are Colloid and Interface Science and Drainage of nanofilms.

Details of proposed short term visit: Two week visit to the group of Professor Anh Nguyen, BMA Chair of Minerals Processing, Division of Chemical Engineering, University of Queensland. The purpose is to carry out work that is essential to her PhD.She plans to do a series of experiments using Professor Nguyen\'s laboratory\'s Thin Film Balance to study thin films of nonaqueous electrolyte solutions in air. Some part of her PhD has been investigating ion-specific effects on bubble coalescence and thin film stability. Her work in this area to date has largely been with dynamic bubble collision experiments, and studying single liquid films is an important complementary approach. Ion-specific phenomena are relevant in any high-salt system, including biological systems and minerals processing. Different salts have significant effects on the stability of thin liquid films, and the Nguyen group has already demonstrated this in water.

I visited Professor Anh Nguyen and group at the University of Queensland, Brisbane from 7-19 September 2008. The trip was successful. I used the thin-film balance in their labs to study thin films in non-aqueous electrolyte solutions. Despite some problems with contamination, to which this technique is highly sensitive, I managed to study two different solvents, with three and two electrolytes respectively. The electrolytes were observed over a range of concentrations. We are still in the process of analysing the data, an example image of which is given in the figure below. It will certainly be helpful for my thesis, and we're considering whether the results are publishable as a stand-alone paper or in conjunction with other work. The other aim of the trip was to start a possibly long-term collaborative relationship with Professor Nguyen's group. I think this was achieved, as I worked productively with some of the students and post-docs in Brisbane, and even left them some of my solvents and electrolytes so that they can continue to explore this area. I am grateful for the contribution of the ARCNN that helped me to make this visit.

Figure. An image collected during drainage of a circular thin film between air interfaces, containing a thicker "dimple". The coloured interference fringes arise from reflection at both film surfaces and give information as to the thickness of the film. The film is approximately 0.1mm in diameter, and less than 200nm thick at its thinnest point. The solution here is formamide containing 0.20M lithium chloride.

Miss Yimeng Yang(University of Western Australia) – visit to the University of New South Wales

Yimeng is a PhD student and her research interest is Effect s of environmental exposure on the structure and properties for Si-based thin films for MEMS applications

Details of proposed short term visit: Destination: Australian National University for Atomic Force Microscopy (AFM) training. Activties to be undertaken: 1) Undertaking knowledge transfer on AFM techniques (sample preparation, colloid attachment, direct force measurement) 2) Conduct surface force characterization using AFM

REPORT ON RESEARCH EXPERIMENTAL ACTIVITY SPONSORED BY ARCNN

The Activity

Time: 28/07/2008 to 07/08/2008

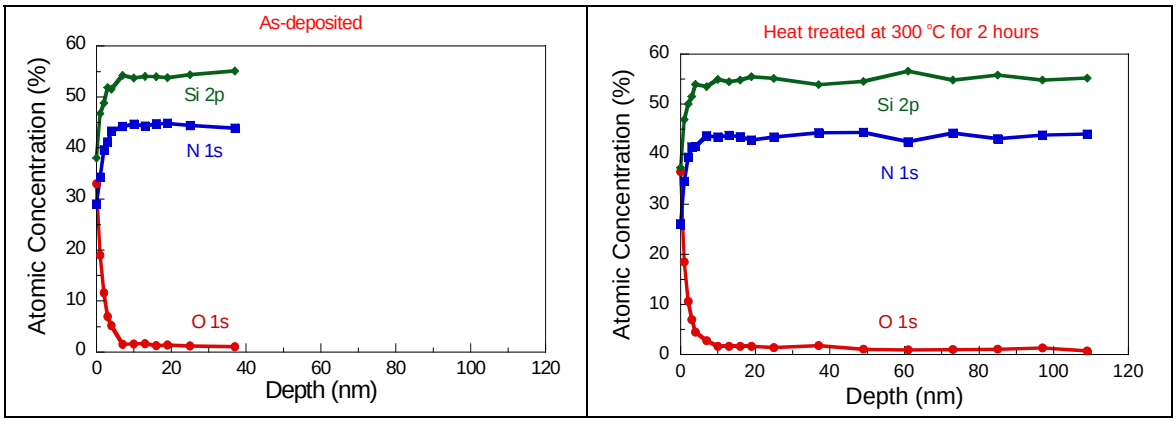
Place: Surface Analysis Laboratory
Solid State and Elemental Analysis
UNSW Analytical Centre
G61-63, Chemical Sciences Building, F10
The University of New South Wales
Sydney, NSW 2052

Contact: Dr Bill Bin Gong, b.gong@unsw.edu.au
Tel: (+61 2) 9385 4694
Fax: (+61 2) 9385 4694

Activity: X-ray photoelectron spectroscopy analysis on SiNx thin films.

The Experiment

The aim of the experiment is to quantitatively determine chemical makeup changes in PECVD SiN_x thin film, especially N loss, after low temperature annealing.
The results are shown in Figure 1.



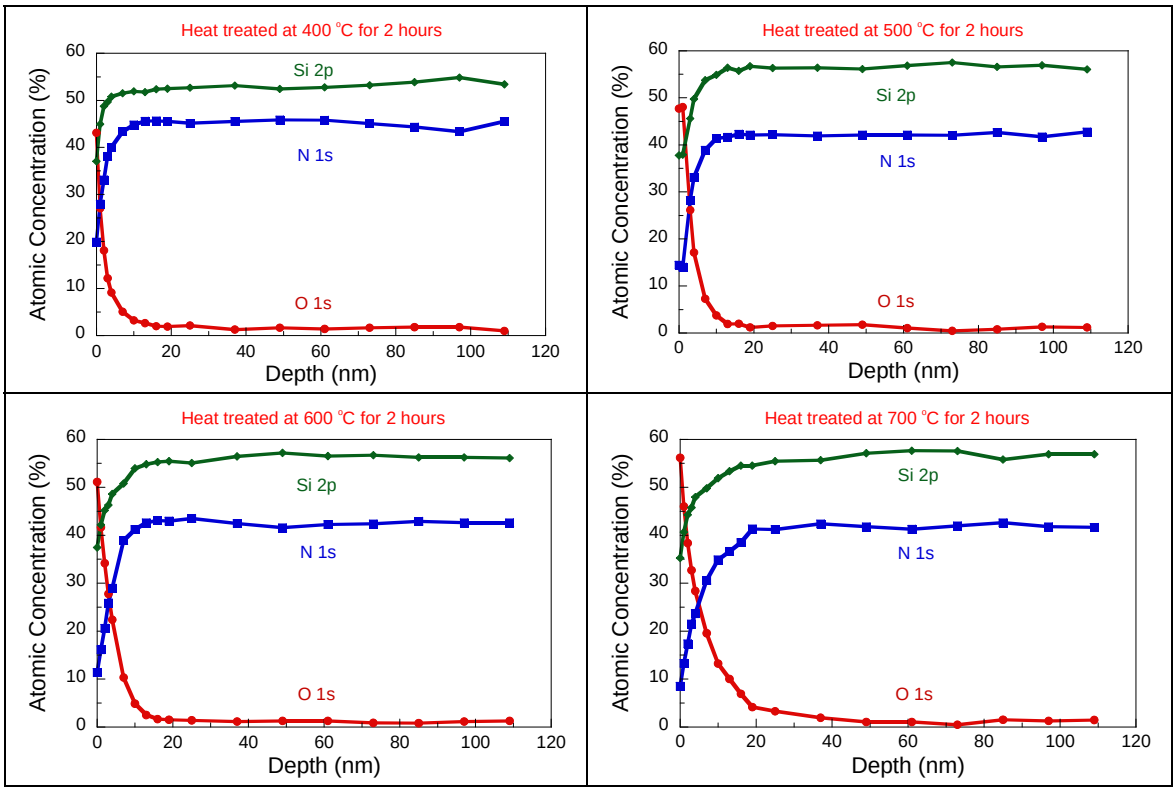


Figure 1 Depth profile for SiN_xH_y thin films annealed at elevated temperatures.

Important experimental data of chemical makeup of the films has been obtained to explain internal stress changes and potentially to verify degassing hypothesis. Besides, oxidation degree, oxidation kinetics, and element atomic ratios could also be extracted from these XPS analysis data. These findings help to build up a better understanding on effect of heating on structures and properties of SiN_xH_y thin films.

Moreover, as hydrogen is an undetectable element for XPS analysis, hydrogen element quantitative analysis is desired in farther study on verifying degassing hypothesis.

To sum up, it is a good opportunity to gain experiences and confidence in working collaboratively with other research groups.

Miss E-Jen Teh (University of Western Australia) – visit to the Australian National University

Miss E-Jen Teh will be visiting the Australian National University in 2009.

Mr Christopher Hall (Swinburne University) – visit to the Australian National University

Christopher is from Swinburne University and his Postgrad research interests are : Ultrafast spectroscopy of semiconductors. Specifically:-Coupling within asymetric double quantum wells
-Properties of gradded barrier ZnO quantum wells,-Coherence in quantum dots,

Purpose of Visit - To obtain hands on experience with semiconductor growth processes and grow an ensembly of samples for spectroscopic investigation.

Swinburne University of Technology, Hawthorn (Melbourne)
Victoria, Australia

Chris Hall
Postgraduate Student
CAOUS-Centre for Atom Optics and Ultrafast Spectroscopy
Swinburne University of Technology
Ph: 03 9214 4540

Re Report for ARCNN funded visit to ANU 1ST to 5th September 2008

Purpose of Travel

The Australian Research Council Nanotechnology Network (ARCNN) funded visit to Australian National University (ANU) was proposed for a multitude of reasons. Primarily our objective was to obtain two sets of nanostructured samples for coherence studies at Swinburne University's ultrafast spectroscopy facility, though it is obvious that if it were possible to travel to ANU to work with our collaborators and be involved with the sample growth process a range of benefits would ensue.

The structures grown at ANU were two sets of Asymmetric Double Quantum Wells (ADQW) with five samples in each set and a reference sample (Eleven samples in total). These simplified quantum systems were designed to primarily investigated two topics:

- Specifically we intend to explore coupling mechanisms which should become apparent by examining these distinctly different sample sets.
- These simplified quantum systems will then be used to test newly developed phase retrieval algorithms and new experimental procedures recently developed at the ultrafast facility at Swinburne University to further investigate work detailed in our recent publication (Davis et al, PRL 100, 227401(2008))

As these samples exhibit simplified properties, they will in fact act as a stepping stone to exploring and interpreting more complex natural quantum systems. This work is intended to be published.

Outside of merely acquiring the specific nanostructured samples there were also benefits in the form of acquired knowledge and experience. At Swinburne I do not have access to any kind of semiconductor growth apparatus, so travelling to ANU gave me physical access to this specialized equipment and allowed me to:

- Develop an understanding of the technical details involved in the MOCVD semiconductor growth process
- Experience working in a clean room
- Experience working with harmful chemicals in a monitored environment

Having experience using this equipment and having a greater understanding go of the processes involved makes me more employable as a career researcher in semiconductor spectroscopy, The research team at CAOUS has also benefited from my visit as I have transferred some of the knowledge gained from my short term visit to ANU in a seminar I prepared and presented.

Details of Visit:

My activities during my funded visit to ANU were as follows:

- Arrive at ANU Monday 1st September
- Four days were required for the growth of eleven samples with ANU's Metal Organic Chemical Vapour Deposition (MOCVD) reactor
- One day was required to characterise these samples with ANU's photoluminescence apparatus
- Depart ANU Friday 5th September

Outcome Details:

Since my return to Swinburne, I have given a technical seminar detailing the MOCVD growth process employed at ANU. On completion if current work in the ultrafast spectroscopy facility these samples will be investigated, with subsequent publications expected.

Funding:

All of the funding required for this trip was sourced from ARCNN.

Publications:

All connection to these samples will be appropriately referenced as sourced with the aid of ARCNN funding.

Mr Andrew Stephenson (University of Queensland) - visit to the University of New South Wales

Report of Outcomes from ARCNN Travel Grant: Andrew Stephenson

This grant was awarded so that I could continue my studies on metal-mixed polymers. Metal-mixed polymers are produced when a thinly deposited surface layer of metal is imbedded into the polymer via an ion beam [1]. It has been shown that this process can produce a bulk sample that has both metallic and superconducting properties [2]. Prior to the awarding of this grant I only had access to liquid nitrogen cryostats. As such all of my work to date has been limited to studying the metallic properties of these systems at temperatures above 77 K [3]. These funds provided me the opportunity to use the low temperature electrical measurement facilities in the School of Physics at the University of New South Wales. The aim of this visit was to measure the superconducting properties of these materials, and focus on determining how the superconducting properties depend on the various tuneable parameters involved in the fabrication of the materials.

I am pleased to say that the experiments undertaken at UNSW went far better than we initially hoped for. In total, 90 samples were prepared for/during this visit, which fall into three main groups: thin tin/antimony films metal-mixed with a N^+ beam; thin tin/antimony films metal-mixed with a Sn^+ beam and unimplanted tin/antimony films. Within these groups, the samples varied in films thickness and orientation relative to the substrate structure and, for the metal-mixed samples, they also varied in beam energy and dose.

The nitrogen implanted samples proved to be a great success. Having lost access to the implant facilities used to make the original samples, we have been struggling to reproduce suitable samples for further studies. These samples, implanted at the Crown Research Organisation in New Zealand are the first to show a zero-resistance superconducting state since the original samples in 2005. Furthermore, using these samples we have found new evidence suggesting that the superconductivity in these metal-mixed systems is granular in nature.

This was the first time metal-mixed samples made using a tin beam have been studied (as opposed to the nitrogen-beam processed samples investigated previously). We studied the conductivity of these samples prepared with a variety of film thicknesses and implant doses and found that we can obtain samples spanning the full range from metallic/superconducting through to strongly insulating. As part of my measurements at UNSW, I have mapped out the metal-insulator transition for this material in terms of its fabrication parameters, data which I will supplement with higher temperature measurements, above 77 K, back here at UQ.

As stated earlier all of my previous work had been done at temperatures above 77 K, with the most extensive analysis being on unimplanted samples. The measurements made on the unimplanted samples at UNSW provide an invaluable link between the results of this trip and those obtained previously.

Although only a preliminary analysis of the data has been carried out so far we are hopeful that this trip will result in up to three papers, several substantial sections in my Ph.D. thesis, and possibly one patent application related to the use of tin ion metal mixed samples for temperature measurements.

[1] E. Tavenner *et al.*, Syn, Met. **145**, 183-190 (2004)
[2] A. P. Micolich *et al.*, Appl. Phys. Lett. **87**, 155203 (2006)
[3] A. P. Stephenson *et al.*, cond-mat. arXiv:0809.4096 (2008)

OVERSEAS TRAVEL FELLOWSHIPS

OVERSEAS TRAVEL FELLOWSHIPS

Opportunities for Five to six Overseas Travel Fellowships valued at up to $5,000 each are offered every 6 months. This is a mechanism whereby Australian students and early career researchers can visit overseas laboratories to gain new skills and training in this emerging field of research. These fellowships are also offered for attending International Summer Schools of minimum one week duration, or longer.

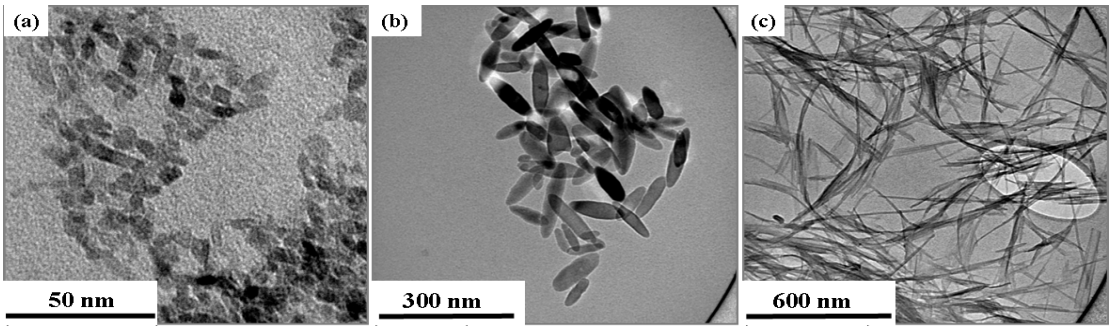
Applications are ranked and Fellowships awarded to the top 5-6 ranked applications.

Mr Anthony Musumeci (UQ) visit to Argonne National Labs, Chicago, USA

Anthony is a Postgraduate student and his research interests are materials science, nanomaterial synthesis and characterisation, radiochemistry and nanotoxicolgy.
Purpose of visit: The main aim of my PhD project is the synthesis and characterisation of tailored nanoparticles for nanotoxicological investigations. During my PhD I aim to synthesise a range of different nanoparticle libraries of varying size and charge as well as develop novel labelling methodologies to facilitate further biological studies. Currently, I have focussed on a series of industrially relevant clay nanoparticles that are of opposing charge, being Layered Double Hydroxides (LDHs, +ve charge) and hectorites (-ve charge). I plan to extend this to a neutral inorganic metal oxide (i.e. TiO2) nanoparticle series, to facilitate a full range of nanoparticle sizes and charges to be investigated. During my time at Argonne National Labs (ANL) in Chicago, I plan to develop novel labelling methodologies for both LDH and titania nanoparticle systems which will then be used in subsequent biological assays. Upon the conclusion of my time at ANL, I hope to have another journal paper ready for submission to the Journal of the American Chemical Society that will detail results obtained from the visit.
His application was supported by Dr Darren Martin from the University of Queensland and by Dr Tijana Rajh from the University of Chicago.

ARCNN Overseas travel Fellowship report
Title of project: Tailored Titania Nanoparticle libraries for Nanotoxicological Investigations.
Host organisation: Centre for Nanoscale Materials, Argonne National Labs, Chicago, USA
Time of Visit: June 8, 2008 – September 5, 2008-09-24
Funding Support: $5000 ARCNN Overseas Travel Fellowship, $5000 UQ Graduate School Research travel Grant
Research outcomes:
During the research travel many of the scientific objectives outlined prior to travel were achieved. Primarily, I was successfully able to synthesise tailored libraries of TiO_2 nanoparticles of different size and shape (i.e. TiO_2 nanotubes, nanorods and nanospheres). Experimental protocols for synthesis of each shape of nanoparticle were developed and refined. These will be used in laboratories at The University of Queensland to allow further studies concerning the biological interaction of the nanoparticles to be accessed.

Figure 1: TiO2 nanoparticles of different morphologies; (a) nanospheres, (b) nanotubes and (c) nanorods will enable further investigations into the effect of nanoparticle shape on biological interaction.



Covalent functionalisation of TiO_2 nanoparticle surface with fluorescent marker molecules and radioisotope encapsulating cage ligands was also investigated. The TiO_2 nanoparticles were first derivatised with carboxylic acid groups through adsorption of dopac (3,4-dihydroxy-phenylacetic acid) to under-coordinated TiO_2 surface sites. Linkage of marker molecules to the TiO_2 surface was performed through the EDC/NHS coupling reaction between the amine-derivatised marker molecule and carboxylic activated TiO_2 nanoparticles.

Additionally an interesting surface enhanced Raman spectroscopy (SERS) phenomenon was observed upon analysis of TiO_2-enediol ligand conjugates via Rama Spectroscopy. Detection sensitivity of absorbed enediol molecules (i.e. dopamine, dopac, salicylic acid) absorbed onto the TiO_2 nanoparticle surface was found to increase by ~1000-fold. This finding was explored further and a brief manuscript has been written and will be submitted to the Journal of the American Chemical Society (JACS).
Overall, the collaboration formed with researches from the Bionano Interfaces group at the Center for Nanoscale Materials, ANL has proven very valuable and productive. Dr Tijana Rajh has been invited to present a plenary lecture at the annual ARC Center of Excellence for Functional Nanomaterials conference on the Gold Coast, Queensland (Nov 08).

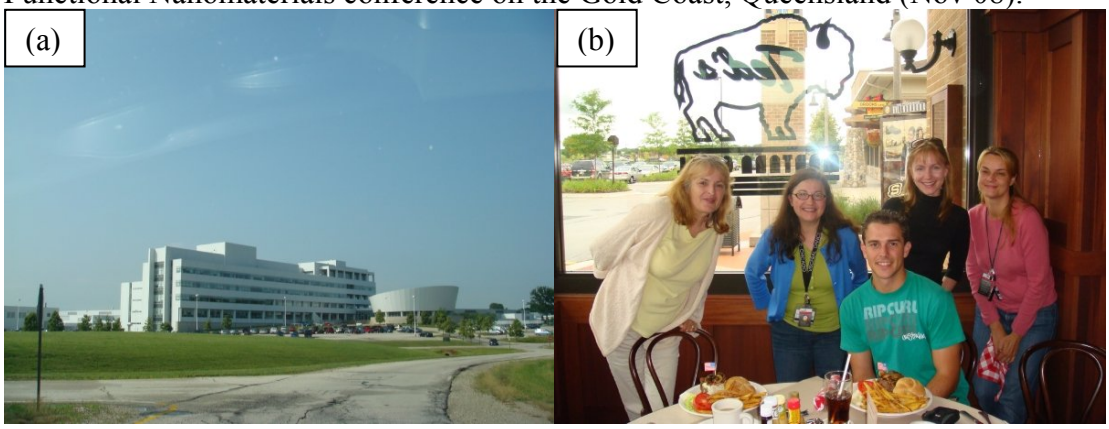


Figure 2; (a) Argonne National Labs, Chicago, (b) Nanobiointerfaces group with whom I worked.

Future Work:
Further collaboration between Dr Rajh and research groups at AIBN and the Australian Nuclear Science and Technology Organisation (ANSTO) on establishing the biological interactions of TiO_2 nanoparticles and potential biomedical applications of TiO_2-radiotracer probe conjugates has been established. I would like to take this opportunity to thank ARCNN for their generous funding towards my travels. I believe that I have benefited immensely from this trip which has undoubtedly enhanced the quality and progress of my PhD thesis.

Miss Glenna Drisko (Uni of Melb) visit to the National Atomic Energy Atomic Constituent Commission Center Buenos Aires, Argentina

Glenna is a Postgraduate student and her research interest is Template synthesis of mesoporous/macroporous materials

Purpose of visit: Environmental damage due to the presence of toxic and radiotoxic elements is of great concern. A porous metal oxide is a material capable of recovering and containing such species. As an example of cradle-to-grave methodology, these materials first act as a selective adsorbent and then, after sintering, form the permanent encasement. Alternatively, if the target metal is of commercial value, the porous metal oxides can be used to selectively adsorb and later release the species of interest. Titanium, zirconium and magnesium oxides are ideal materials for such applications because they are chemically inert, can be functionalized, are stable in extreme pH environments and are stable to radiation. The aim of this project is to synthesize metal oxides with high surface area and multi-scale porosity for use as adsorbents. The surface of the inorganic matrix is functionalized with organic polymers to tailor metal ion selectivity and increase the load capacity. These materials have a commercial value, but more importantly can be of benefit to the health of the wider community and the environment.

Nanotechnology is at the frontier of adsorbent development. It is important to have nanometer control over the pore size to balance high surface area with quick fluid diffusion through the material. In addition, nano-scale control over mesopore diameter is necessary for the incorporation of high molecular weight polymers and other macromolecules.

Glenna's application was supported by Dr Rachel Caruso from the University of Melbourne and by Associate Professor Dr. Galo Soler-Illia from the University of Buenos Aires.

ARCNN Overseas Travel Fellowship Report

Details of supervisor in Australia: Dr. Rachel A. Caruso, School of Chemistry, The University of Melbourne

Details of supervisor at host institution: Prof Galo Soler-Illia, Department of Science, University of Buenos Aires, Argentina

Project title: One-pot synthesis of hierarchically porous metal oxides through the phase separation of poly(furfurylic acid)

Period spent at host institution: 20 Aug-1 Dec, 2008

Comments about the study overseas:

The objective was to develop a one-pot synthesis of hierarchically porous metal oxides using polymer phase separation and this was achieved. Macropores (>50 nm) and mesopores (5-15 nm) were created in materials composed of silica, titania and a mixed titania zirconia.

Additionally, these materials were synthesized in bulk quantities and were monolithic, which widens the applications for which these materials may be applied. There is currently only one example in the literature of a one-pot synthesis of monolithic metal oxides with meso-macroporosity, and the authors who reported such a material commented that they had no control over the pore dimensions [Konishi, J.; Fujita, K.; Nakanishi, K.; Hirao, K. *Chem. Mater.* **2006**, *18*, 6069]. In our work, we controlled pore size by using two templates, a phase

separating polymer to create a large pore (~200 nm), and a self-assembling polymer to control the formation of the nano-sized pore (5-10 nm). Although these two polymers seemed to interact, making independent control over each pore dimension impossible, it was possible to control both large (Figure 1) and small pore volume (Figure 2).

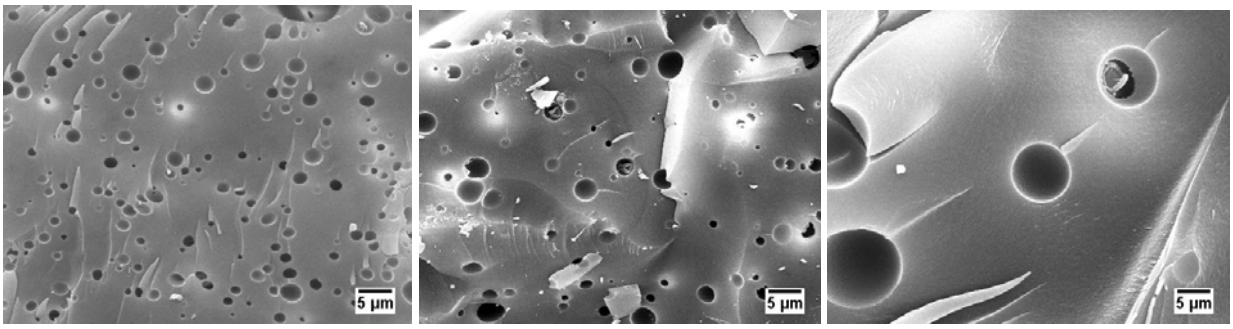


Figure 1. SEM images of the monolithic silica showing control of the macropore size by using increasing amounts of phase separating polymer, poly(furfurylic acid) in the synthesis (left to right).

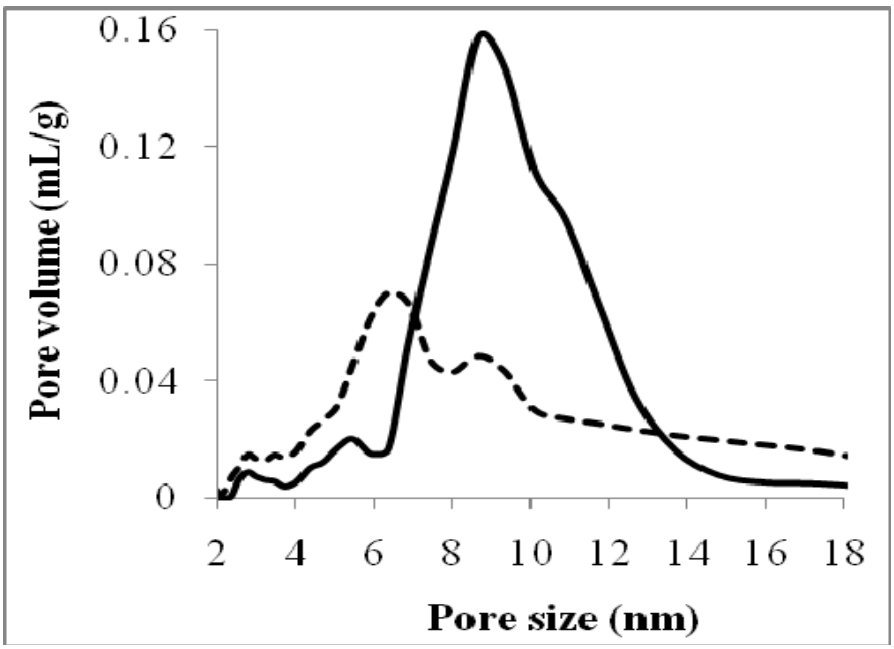


Figure 2. Pore size distribution in prepared silica, showing the effect of using different amounts of self-assembling block co-polymer in the synthesis. The dashed line refers to a small amount of block co-polymer, where the solid line is an increased quantity.

This work has furthered nanotechnology in that we were able to create nano-sized pores in the presence of inorganic sol-gel reactions and a phase separating polymer. The mesoporosity must be due to the self-assembling block co-polymer, as this porosity was not observed in the absence of the block co-polymer. Such materials could be applied to the fields of optics, catalysis, photocatalysis, separations and the controlled-release of pharmaceuticals.

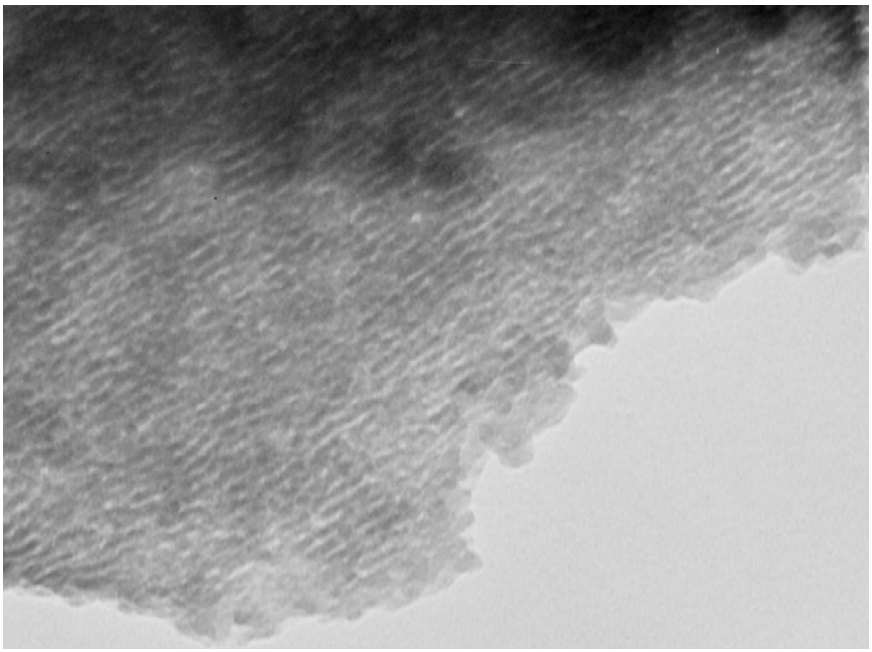


Figure 3. Transmission electron microscopy image of a silica sample, showing the mesoporosity induced by the self-assembling block co-polymer.

In the process of developing a new synthesis technique, the student learned about polymer phase separations and hybrid materials. The research was carried out between the host university and the Nuclear Center of Atomic Energy (CNEA). The student presented work which she had conducted in both Melbourne and Buenos Aires in a one-hour lecture at CNEA. A communication and a full-paper are being prepared, based on the research performed while the student was on the overseas travel fellowship.

Dr Edith Chow (CSIRO) visit to Stanford University, USA

Edith is an Early Career Researcher and her research interest is in using nanomaterials for chemical sensing applications. She is presently exploring the use of gold nanoparticle chemiresistors as sensors for organics dissolved in aqueous media

Purpose of visit: The major purpose of the proposed overseas visit is to extend CSIRO\'s capability in device fabrication and design of novel sensing materials. Nanomaterials such as metal nanoparticles and carbon nanotubes are promising candidates for chemical and biological sensing owing to their interesting electronic properties, high surface area and ease in which their surface properties can be modified. She would like to collaborate with a research group that is exploring the use of carbon nanotubes as sensing materials and develop techniques in modifying nanotubes so that they can provide high selectivity and sensitivity to the analyte of interest.

She would also like to develop a fundamental understanding of the sensing mechanism as this would allow nanotubes with integrated functionality to be designed rationally for discriminating power between certain species. In combination with the research carried out at CSIRO, this work would yield a new generation of highly sensitive chemical sensors. It would also be advantageous to work with a group that is experienced in developing nanoscale electronic devices as this would allow detection of a very small number of analyte molecules to be realised. Presently at CSIRO, our chemiresistor sensors incorporate electrodes with a 5 micron gap. If we could develop low-cost alternative approaches to lithography then this would increase the overall sensitivity of the device.

Edith's application was supported by her supervisor Dr Burkhard Raguse from CSIRO and Associate Professor Zhenan Bao from Stanford Chemical Engineering.

Report on Visit to Prof. Zhenan Bao's Research Group at Stanford University

Written by Dr Edith Chow, CSIRO Materials Science and Engineering

I visited Prof. Zhenan Bao's Macro and Nano Electronic Materials and Devices laboratory at Stanford University between June 30th and September 19th this year. Prof. Bao is a world leader in the field of organic thin film transistors and this was a great opportunity for me to see how research is conducted in a top research group. One of her research interests is on chemical and biological sensing using organic and carbon nanotube transistors. In order to detect analytes with high sensitivity and selectivity, strategies to enable operation under aqueous environments and surface functionalization of the semiconducting material are required. I was involved in the development of two different types of devices: organic transistors and carbon nanotube transistors.

Outcomes

Skills acquired

1) I learnt how to fabricate transistor devices *via* evaporation of the electrodes through a shadow mask and depositing the dielectric layer and semiconducting layer under optimum conditions

2) To provide high sensitivity devices, I learnt how to prepare nanotube transistors with high chirality control (semiconducting *vs.* conducting nanotube networks) which has been a major challenge for many researchers. The chirality could be controlled by modifying the surface with different silanes and spin-coating the nanotubes onto the substrate. This enabled nanotube devices with excellent performance.

3) I learnt how to fabricate organic transistors and provide functionality to the semiconducting layer using atomic layer deposition of alumina and self-assembly of phosphonic acid.

4) I was trained on a number of characterisation techniques including XPS, AFM, FTIR, contact angle, ellipsometry and a semiconductor analyser.

Significance of work

The work on organic transistors is the first demonstration that thin film organic transistors can operate under water without any loss in stability or delamination of the film. With this system, I proceeded to develop methods to functionalise the surface with biotin for avidin detection under low operating voltages.

The work on the carbon nanotube transistors is a demonstration that high performance devices can be fabricated by controlling the chirality of the nanotubes. To preserve the excellent electronic properties of nanotubes, non-covalent surface functionalisation methods were exploited to attach biotin to the device for biosensing. Such devices showed high specificity towards avidin.

Publications and presentations

As a result of this research, one paper on the carbon nanotube transistor sensors is currently in preparation and this work has been presented at a CSIRO Niche Manufacturing workshop. I also plan to present this work at upcoming conferences.

Dr Diana Bowman (Monash University) visit to KU Leuven (KUL) Belgium

Diana is an Early Career Researcher and her Research interest understanding the appropriateness of local and global regulatory frameworks for managing nanotechnology applications and products, the level of public engagement and associated nano-dialogue, and the influence and roles that private and civil society actors play in governing nanotechnology. Her current research activities are focused on, for example, articulating current regulatory challenges with a view to providing policy directions for government action, the adequacy of current regulatory triggers in relation to nanomaterials, and the potential role of soft law for regulating the development and commercialisation of nanotechnologies within the national and international contexts.

Purpose of visit: The primary purpose of the proposed overseas visit is to undertake collaborative research work with leading legal and regulatory scholars within the field of nanotechnology, located in the Faculty of Law, KU Leuven (KUL) Belgium. A number of other short 'side-visits' to key institutions in the UK and the US are also planned and are noted below.

The research team at KUL, led by Professor Geert van Calster, have recently commenced a three year project titled 'The Legal Case for Nanotechnology', which will assess the suitability of European Union (EU) regulatory frameworks for several classes of nanotechnology-based products. The aim of the research is to identify what, if any, regulatory gaps exist within these regimes, and develop new regulatory structures where such gaps exist. While the focus of the project is in the first instance on EU law, the intent is to conduct comparative research paying particular attention to the regulatory regimes in the United States and Australia. Other areas of interest to the project include: international governance, the role of soft law, and regulatory innovation.
Diana's application was supported by Professor Graeme Hodge from Monash University and Professor Geert Van Calster from the Katholieke Universiteit Leuven.

MONASH University

Final Report to the ARCNN Overseas Travel FellowshipDr Diana Bowman

Travel Dates: 16 May-29 June 2008

The primary purpose of my overseas visit was to undertake collaborative research work with Professor Geert van Calster and his team at the Faculty of Law, KU Leuven (KUL) Belgium, who are currentlyworking on a four year project ('The Legal Case for Nanotechnology'). The aim of their research is to identify what, if any, regulatory gaps exist within the European Union's (EU) regulatory frameworks for nano-based cosmetic products, nano-medicines, and nano-based foods and food contact materials, and develop new regulatory structures to address any indentified regulatory gaps. Their research has direct relevance to my own work, which is focused on understanding the appropriateness of Australian and comparative regulatory frameworks for managing nanotechnology applications and products, and the influence and roles that private and civil society actors play in governing nanotechnology.

A secondary objective of the overseas trip to was to engage with leading legal, scientific and industry personnel working within the field of nanotechnology, in both the EU and the US. Key individuals identified for this purpose included: Dr Qasim Chaudhry (Central Scientific Laboratory, UK), Dr Steffi Friedrichs (Nanotechnology Industries Association, UK), and Dr Andrew Maynard (Woodrow Wilson Centre forInternational Scholars, US).

The two objectives were met, and the details of the trip – including meetings, collaborations, and outcomes - may be summarised as follows:

• collaborating with Professor van Calster (KUL) on his research project. During my time at KUL, Professor van Calster and I coauthored one article, which has since been submitted to a journal and is currently under review. Other publications, building on thework that I did while at KUL, are being planned

• meeting with Professor Robert Falkner (London School of Economics), who is the project coordinator of the Regulating Nanotechnologies in the EU and US project. As a result of thismeeting I have been invited to act as an 'expert reviewer' on the groups primary report

• meeting with Dr Qasim Chaudhry (Central Science Laboratory) and Dr Anna Gergely (Mayer Brown) in relation to potential collaboration on a book chapter. As a result of this meeting I have been working with Drs Chaudhry and Gergely on a book chapter, which will examine the current regulatory arrangements for nanobased foods and food contact materials within the EU, and the potential shortfalls thereof

• meeting with Dr Steffi Friedrichs (Nanotechnology Industry Association) in regards to the development of the Responsible NanoCode and potential use of voluntary initiatives by industry soas to minimise the potential risks associated with some nanomaterials

• attending a workshop hosted by Dr Barbel Dorbeck-Jung (University of Twente) at the University of Utrecht, at which time we drafted up a proposal for a special symposia on nanotechnology regulation,which was submitted to *Regulation & Governance*. The proposal has since been accepted, and Dr Dorbeck-Jung and I will co-edit the symposia

• meetings with Dr Michael Holman (Lux Research Inc) regarding scientific, policy and regulatory developments associated with nanotechnology in the US. A key outcome of this meeting was a greater understanding of the US Environmental Protection Authority's voluntary stewardship program for nanoscale materialsand the likely broader implications thereof. Dr Holman also provided me with an update on market trends for nano-based products and applications, government and industry concerns relating to health and safety risks posed by certain nanomaterials (particularly carbon nanotubes)

• meeting with Dr Andrew Maynard (Woodrow Wilson Centre for International Scholars). The purpose of this visit was to establish a working relationship with the PEN team, gain a greater understanding of the education, policy and regulatory dimensions of the current nanotechnology debate within the US. These goals were achieved.

Outcomes/achievements associated with the trip:

The outcome of the research to date, in terms of research articles and book chapters may be summarised as follows:

1. a co-authored research paper on the regulation of nano-based cosmetics ('Flawless or Fallible? A Review of the Applicability of the European Union's Cosmetics Directive in relation to Nano- Cosmetics') has been submitted to an international peer reviewed journal and is currently under review

2. a co-authored book chapter on the regulation of nano-based foods and food contact materials within the EU is currently under development,

3. a special symposium on regulating nanotechnologies, of which I will be a co-editor of with Professor Dorbeck-Jung, has been accepted for inclusion in an international peer review journal.

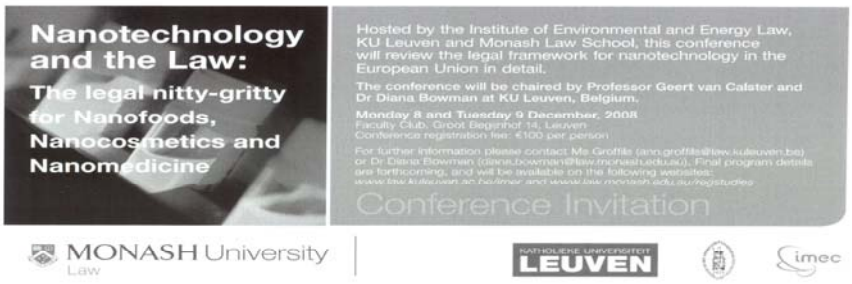
In addition to these three outputs, a number of other collaborative pieces of work are planned for the short to medium term.

I will also have the ability to provide an overview of current issues and concerns within the EU and the US to Australian nanotechnology stakeholders at a one day workshop being run by Monash University in November 2008. It is anticipated that a number of representatives from Government, academia, industry, civil society organisations will be inattendance at the workshop, and as a participant in the event, I hopeto provide attendees with insights gained as a result of my trip.

Benefits to my future research:

As a result of my collaboration with Professor van Calster at KUL, I was invited to co-chair and present a paper at an international conference being hosted by Professor van Calster at KUL in December 2008('Nanotechnology and the law: The legal nitty-gritty for nano foods, nanocosmetics and nanomedicine'). In recognition of my work on his project, the event is being advertised as a joint KUL and Monash University event. A copy of the flyer for this event is attached to this report.

Looking more generally, my collaboration with leading EU and US legal, scientific and regulatory scholars has developed my research skills in a number of ways, including providing me with a greater understanding of the EU and US's legal systems, enhancing my understanding of the potential challenges that some nanotechnologies may create for these regulatory regimes, providing me with a greater appreciation of the ways in which industry is voluntarily trying to ddress these challenges, and the subsequent implications of these developments for Australia.



Mr Nadim Darwish (UNSW) visit to Hokkaido University, Japan

Nadim will be travelling to Japan in the middle of 2009.

Miss Candace Chiu Ping Chan (UniSA) visit to University of Poitiers, France

Candace will be traveling to France in September - 2009.

Mr Igor Aharonovich (UniMelb) visit to Hewlett Packard (HP), USA

Igor is a Postgraduate student and his research interests are related to quantum optical properties of point defects in diamond. He is focusing on the fabrication and characterization of nitrogen and nickel related single photon centers in diamond and their quantum properties such as single photon emission, electromagnetic induced transparency (EIT), and quantum coherence.

Purpose of visit: The major purpose of the visit to Hewlett Packard (HP) laboratories is to study the quantum optical properties of single nitrogen vacancy (N-V) defects in diamond. The equipment available in HP laboratories is highly innovative and currently unavailable in the University of Melbourne. During his visit, they are hoping to perform quantum measurments on individual NV centers and try coupling the emitted light to an external device. Working in the same team with world leaders in quantum optics devices and technology such as Charles Santori and Ray Beausoleil of HP laboratories will greatly enhance his expertise in quantum measurements of real devices and lead towards publications in top ranked scientific journals.

His application was supported by Professor Steven Prawer and by Dr Charles Santori from the Hewlett Packer Laboratories in California.

Igor Aharonovich, School of Physics, University of Melbourne

Re: Report of my visit to Hewlett-Packard laboratories, USA

I have accomplished the visit to Hewlett-Packard (HP) laboratories, USA.

During the visit, I have been working on an optical and spectroscopic characterization of nitrogen-vacancy (N-V) centers in diamond fabricated by ion implantation and annealing. The (N-V) center is a promising candidate for quantum information processing (QIP) because it combines optical initialization and readout capabilities, milli-second electron spin coherence lifetimes. The optical characterization was done at cryogenic temperatures (T<10 K) using 532 nm excitation laser and appropriate filters to block the laser.

It was found that nitrogen implantation into CVD diamond produces the maximum increase of the total emission from an ensemble of (N-V) centers. However, this increase was associated with a broadening of the Zero Phonon Line (ZPL) of the $(N\text{-}V)^-$ center (Figure 1).

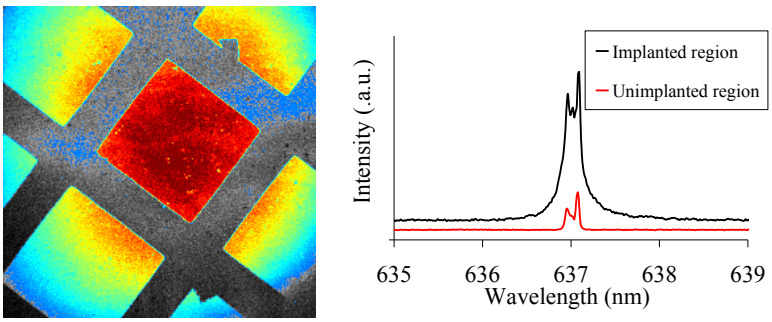


Figure 1. Left, a confocal map showing the implantation spot and a grid pattern which served as mask during the implantation. Right, PL measurement from an implanted (black curve, dose of 1×10^{12} N/cm^2, energy of 30 keV) and an unimplanted (red curve) regions of a CVD diamond. The measurement was recorded at cryogenic temperatures (T<10K)

As a next step, we found an area with the narrowest possible ZPL and performed a coherent population trapping (CPT) experiment. The CPT experiment demonstrates all optical control of the electron spin which is highly desirable for non linear optic devices based on electromagnetic induced transparency. This experiment requires three lasers: a weak 532 nm laser for re-activating the N-V center, a 637 nm laser which excites on resonance the ZPL of the N-V center and a scanning laser which will scan around the ZPL over a range of few hundreds MHz. The last two lasers originated from a single diode laser which was sent through an electro optical modulator. Figure 2 shows the results. The dip at 2.87 GHz in the spectrum indicates a CPT behavior and a rapid change in the absorption properties.

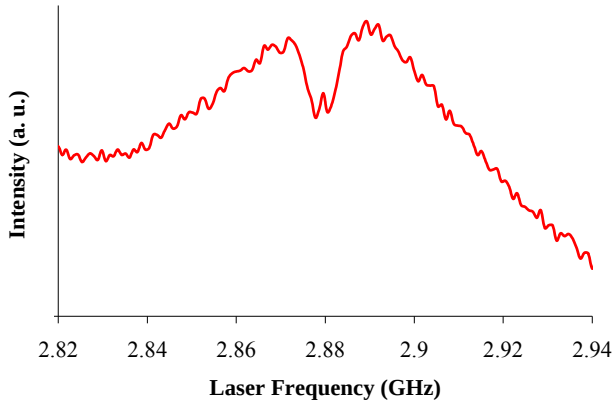


Figure 2. CPT experiment. Measured fluorescence intensity versus laser modulation frequency.

There were three main outcomes of my visit to HP laboratories. First, I have gained an important experience of performing quantum optical measurements in cryogenic temperatures and got a profound understanding of the quantum optics behind the CPT experiment. This is very important since similar experiment should be established in our group in Melbourne. Second, a publication dealing with various routes of increasing the emission from (N-V) centers is now being processed in collaboration with the HP group. Third, a solid collaboration between the two groups is now established and we are continuing to work together, especially on the nitrogen implanted samples and their advanced quantum optical characterization.

I'm very thankful to ARCNN for giving me the opportunity to visit the HP laboratories which will help to maintain a clear transfer of experimental results and conclusions required to stay in touch with the rapidly developing and exciting area of quantum information processing.

Yours Sincerely,

Igor Aharonovich PhD candidate

School of Physics, University of Melbourne, Vic, 3010, Australia

Miss Anette Tyler (UWA) visit to Virginia Tech, USA

Annette is a Postgraduate student at the University of Western Australian and her research interest is the development of magnetic nanoparticles for biomedical applications.
Purpose of visit: Physicists from The University of Western Australia (UWA) are working together with polymer chemists from Virginia Polytechnic Institute and State University to develop appropriate ferrofluids for the treatment of retinal detachment. The primary purpose of a visit to Virginia Tech will be to gain experience in the production and recovery of single-phase ferrofluids. These ferrofluids require no carrier fluid, consisting only of polymer-coated nanoparticles. When suspended in viscous media, single-phase ferrofluids behave differently from the standard, commercially available biphasic ferrofluids. Single-phase ferrofluid samples synthesised during the visit will subsequently be brought back to UWA for physical characterisation and measurements to assess suitability for use in the treatment of retinal detachment.
Annette's application was supported by Associate Professor Tim St Pierre and by Professor Judy Riffle from Virginia University.

ARCNN Overseas Travel Fellowship Report
Magnetic Fluids for the Treatment of Retinal Detachment

Annette Tyler
The University of Western Australia
Visit to Virginia Polytechnic Institute and State University
14th January – 13th February 2009

Physicists from The University of Western Australia have been working with polymer chemists from Virginia Tech on the development of biocompatible magnetic nanoparticles/polymer nanocomposites for biomedical applications. One current collaborative research project focuses on the development of ferrofluids comprised of magnetic nanoparticles for the treatment of retinal detachment. As part of my PhD project, I have designed and built an instrument capable of examining the behaviour of ferrofluid droplets in controlled magnetic fields and field gradients. This instrument will be used to study the effects of systematic variations in ferrofluid properties on ferrofluid droplet behaviour, allowing the optimisation of ferrofluid samples for the treatment of retinal detachment.

Figure 1: The Virginia Tech Campus

Virginia Tech has one of the world's leading labs on the synthesis of stabilised magnetic nanoparticles, and the only lab that can synthesise single-phase ferrofluids. The primary purpose of this visit was to gain experience in the production and recovery of single-phase ferrofluids. These ferrofluids require no carrier fluid, consisting only of polymer-coated nanoparticles. When suspended in viscous media, droplets of single-phase ferrofluids behave differently from the standard, commercially available biphasic ferrofluids. Working under the supervision of Professor Judy Riffle, I assisted in the production of a sample of single-phase ferrofluid. This sample is now ready to be physically characterised and tested using the instrument at UWA.

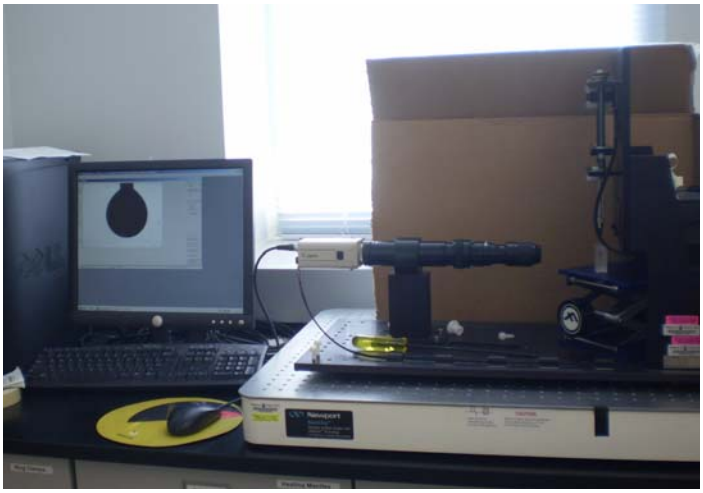


Figure 2: Instrument for Measurements of Interfacial Tension

While at Virginia Tech, I also collaborated with another PhD student (Raquel Mejia-Ariza) under the supervision of Dr Richey Davis to make measurements of the interfacial tension between ferrofluid samples and glycerol/water dilutions. Most interfacial tension measurements were of a commercially available biphasic ferrofluid sample. These measurements provided valuable data that can be used in the interpretation of results gained from the instrument I have built at UWA, as we can now compare the experimental values of interfacial tension with those predicted from measurements made using my instrument. Preliminary analysis shows good agreement between predicted and experimentally determined values of interfacial tension.

During my visit, I also met with a group of mathematicians from Virginia Tech, led by Professor Yuriko Renardy, who are interested in using the experimental data obtained using my instrument to compare with their numerical models. I provided them with data from both the commercially available ferrofluid and a Virginia Tech ferrofluid, and they are now working on numerical simulations of droplet behaviour. Preliminary simulations are providing encouraging results, and with further modelling this work should be ready for publication.

In addition to my research, as part of my visit I presented a seminar to the groups from chemistry and mathematics. It was an excellent opportunity for both groups to learn about the work being conducted at UWA in greater detail, and for me to obtain feedback from people with expertise in disciplines other than my own.

Finally, while in Blacksburg I met up with Dr. Thompson Mefford. Dr. Mefford is a PhD graduate of Virginia Tech, who worked with me on two separate visits to UWA when he was a postgraduate student. He is now an Assistant Professor at Clemson University, South Carolina. He is keen to continue his association with UWA, and is planning to send nanoparticles (and ferrofluids) produced by his group for analysis by our group at UWA.

Overall, the visit to Virginia Tech was very successful, providing me with valuable results for use in publications and my thesis, and strengthening the collaborations between our group at UWA and groups at Virginia Tech. I would like to thank the ARCNN (as well as UWA Convocation) for the financial support that made this visit possible.

Mr Anbusathaiah Varatharajan (UNSW) visit to Oak Ridge National Laboratory, USA

Anbusathaiah is a Postgraduate student at the University of New South Wales and his research interest is Advanced functional oxide thin films (Ferroelectrics and multiferroics),Scanning probe microscopy(Piezoresponse force microscope)

Purpose of visit: Multilayered ferroelectric thin films, either in the form of superlattices or systematic compositional gradients has recently been shown to have anomalous dielectric, piezoelectric and ferroelectric properties (Zhou et al., J. Appl. Phys., 96, 2004, 5706). A significant portion of the studies reported so far aim at understanding how the coupling and interaction between the layers create giant polarization values; however an effort to unravel the underpinning domain behaviour and its effects on electromechanical properties, is still lacking. In the special case of ferroelectrics that have a strong non-negligible ferroelastic self-strain associated with their phase transformation; an aspect that should be equally fascinating is that of the ferroelastic interactions between such multilayers. We have observed that a strongly tetragonal (T) ferroelectric thin film on a soft rhombohedral (R) layer, leads to an "adaptive nanodomain structure" in the T layer that is easily susceptible to external perturbation such as an external electric field. The overarching aim of this proposal is to investigate ferroelastic domain wall motion in the T layer using switching spectroscopy piezoresponse force microscopy (SS-PFM) and Vector PFM, exclusively available only at Centre for Nano Phase Materials (CNMS), Oak Ridge National Laboratory (ORNL), particularly investigating the role of texture and frequency (AC dependence) will yield specific linkages to underpinning microstructural features. His application was supported by his supervisor Dr Nagarajan Valanoor and by Dr. Sergei V. Kalinin from the Oak Ridge National Laboratory.
His application was supported by his supervisor Dr Nagarajan Valanoor and Dr Seergei V Kalinin from the Oak Ridge National Laboratory.

ARCNN Overseas Travel Award Report for the visit to Oak Ridge National Lab by Anbusathaiah Varatharajan

Investigating the local ferroelastic domain switching in bilayered ferroelectric thin films via advanced scanned probe microscopy

A. Varatharajan[1], S. Jesse[2], S. V. Kalinin[2] and N. Valanoor[1]
1. School of Materials Science & Engineering, University of New South Wales, NSW 2052 Australia.
2. Centre for Nanophase Materials Sciences, Oak Ridge National Laboratory, TN 37831 USA.

Background: Bilayered ferroelectric thin films have attracted much attention in recent years as potential applicants in high density memory devices and sensors due to their high piezoelectric and ferroelectric properties *(Zhou et al., J. Appl. Phys., 96,2004, 5706)*. These enhanced properties have been accounted for on the basis of electric field induced coupling, epitaxial strain and specific polar interactions between the interfacial layers. As most ferroelectrics have a strong non-negligible ferroelastic self-strain associated with their phase transformation, an aspect that should be equally fascinating is that of the elastic interactions between such multilayers. The interactions lead to the formation of ferroelastic domains, arranged in the form of period alternating lamellae in order to relax the excess elastic energy. (Fig 1)
In our recent work *(Anbusathaiah et al., accepted to Advanced Materials 2009)*, we demonstrate that a bi-layered heterostructure, comprised of a tetragonal (T) $PbZr_{0.3}Ti_{0.7}O_3$ film deposited on a rhombohedral (R) $PbZr_{0.7}Ti_{0.3}O_3$ film, on electrodebuffered Si substrates leads to a nanoscale ferroelastic domain arrangement that is easily susceptible to external electric field. Piezoresponse force microscopy (PFM)(Fig.1a and b) and cross-sectional transmission electron microscopy (TEM) (Fig.1g) analyses of these layered structures show complex ferroelastic domain arrangement to be present only in the Ti-rich top tetragonal layer. Thus these domains are tethered only by a soft Zr-rich R under layer and not the hard substrate. They move under the application of an external electric field leading to a giant piezoelectric coefficient (Fig.1f) of ~220 pm V^{-1}, up to 3 times larger than what is normally observed in constrained single-layered

PZT thin films. Most importantly, we find that this motion in simple thin-film geometry is reversible and repeatable with cycling application of electric field (Fig.1c-e). Such ferroelastic domain motion is very attractive for a variety of electromechanical devices.

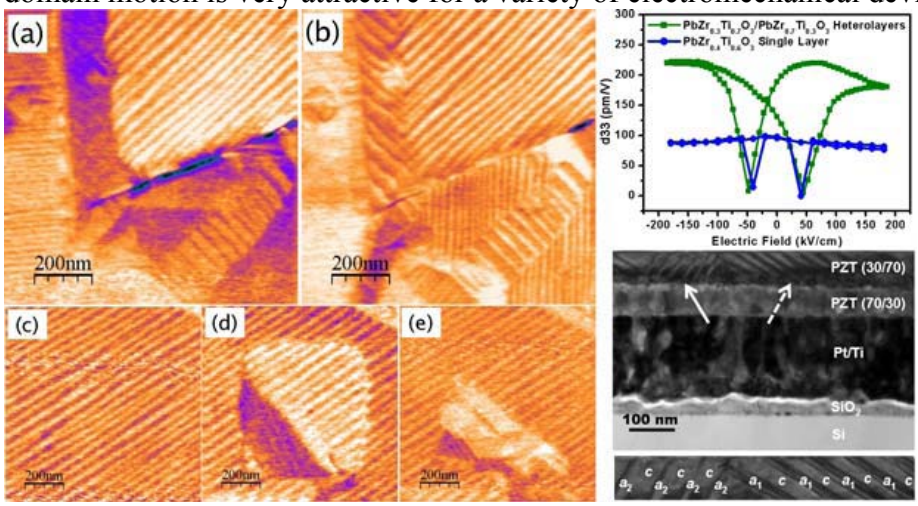


Figure 1. (a) Out-of plane PFM image of the PZT bilayer system (b) the corresponding in-plane PFM image demonstrate the ferroelastic nanodomain hierarchy. (c) Similar out-of plane PFM image at the virgin state of the domain (d) and (e) the out-of plane PFM image captured after applying -5V and +5V respectively, show the domain reversal with reconstruction. (f) Piezoelectric coefficient (d_{33}) for bilayered and single layer measured against electric field. (g) Cross sectional TEM.

The observed motion of ferroelastic domains gives rise to several scientific questions such as the role of local coercivity field, influence of electrostatic boundary conditions and the local crystalline properties that need to be answered in order to understand and hence manipulate this phenomenon. These were addressed by using two state-of-the-art scanned probe approaches- Switching spectroscopy piezoresponse force microscopy (SSPFM) and Vector PFM, which provide quantitative information on domain dynamics with both, high spatial and time resolution.

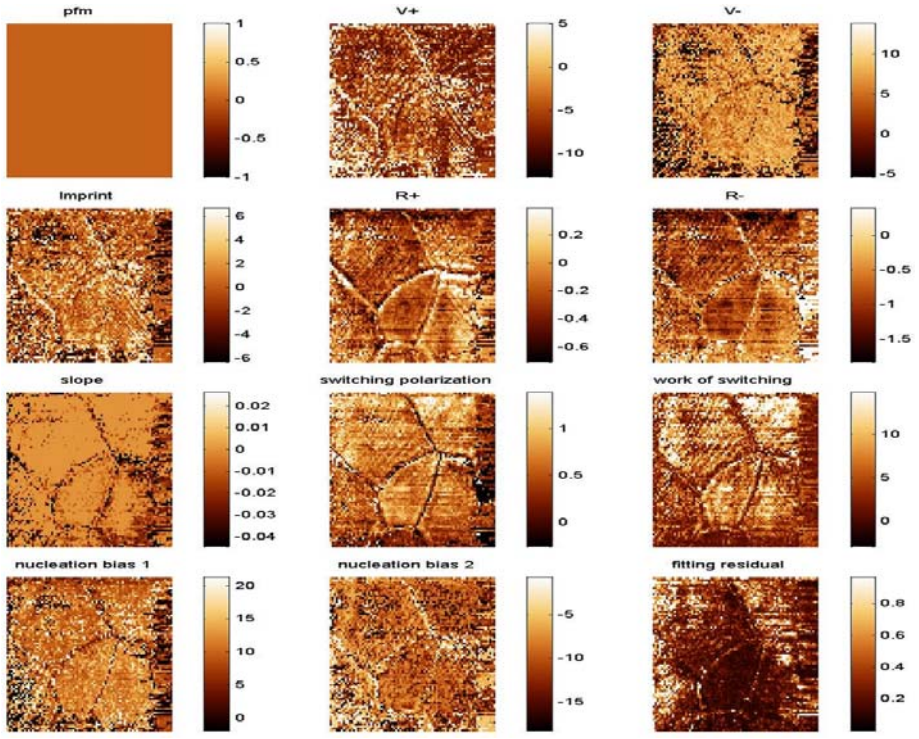


Figure 2: SSPFM parameter maps for the bilayered ferroelectric thin films

Switching spectroscopy piezoresponse force microscopy: SSPFM quantitatively addresses local domain switching characteristics of ferroelectric materials, yielding spatially resolved maps of imprint voltage, coercive bias, saturation, switchable response and nucleation bias (Jesse et al., Rev. Sci. Ins., **77**, 073702, 2006). These maps can be easily correlated with surface topography to provide spatial relationship between micro- and nanostructures and local domain switching behaviour.

Switching spectroscopy piezoresponse force microscopy: SSPFM quantitatively addresses local domain switching characteristics of ferroelectric materials, yielding spatially resolved

maps of imprint voltage, coercive bias, saturation, switchable response and nucleation bias (Jesse et al., Rev. Sci. Ins., **77**, 073702, 2006). These maps can be easily correlated with surface topography to provide spatial relationship between micro- and nanostructures and local domain switching behaviour.

Experimental details/ research tasks carried at ORNL:
1. A region like that shown in Figure 1 was scanned using a Vector PFM set up; topography, out-of
plane and in-plane piezoresponse were captured imultaneously. A local bias was then applied to the nanodomain (as in virginstate and reconstructed region) to map the local quantitative piezoelectric (d_{33})value.
2. SS-PFM measurements were performed in this same region, using the method described by Jesse et al (Rev. Sci. Ins., **77**, 073702, 2006) and then the data has been extracted using one or both of the processes described by Jesse et al (Rev. Sci. Ins., **77**, 073702, 2006) namely, statistical analysis and curve fitting to generate maps of the underlying switching properties as in Figure 2.
These maps are currently being compared to the Vector PFM images both before and after writing in order to determine what properties best predict switching behaviour and expected to yield the following significant outcomes:
Ferroelastic domain structure: Vector PFM along with texture mapping will allow us to distinguish ferroelastic domain orientation from ferroelectric domains and their correlation with grain crystallography.
Ferroelastic vs. Ferroelectric Switching: Switching bias studies in conjunction with Vector PFM allow us to classify switching as either ferroelastic (90°) or ferroelectric (180°) in connection to certain textures. Simultaneously acquired vertical and lateral loops are being analysed to establish the relationship between the onset of ferroelectric and ferroelastic switching. Further through constitutive relations between the polarization and piezoelectric strain, we are characterizing the switching properties at a much defined local region and relate this to the polarization profile of
adjacent domain structure. It is necessary to determine the reasons for these in our preliminary studies *(Anbusathaiah et al., accepted to Advanced Materials 2009)* for there are several instances where the domain structure adopts unusual arrangements (see Fig. 1e) under DC bias.

Frequency dependent domain-wall motion: One step further, SS-PFM was performed at ORNL as a function of applying a band of AC frequency, using a recently developed state-of the art Band Excitation Piezoforce Spectroscopy (BEPS) *(Jesse et al, Nanotechnology 18, 435503, 2007)* to yield "viscosity"–based quantitative data as a function of applied electric field. The data, which has been extracted using a simple harmonic oscillator (SHO) model, is expected to yield a measure of domain wall friction as well as activation energy of ferroelastic domain wall motion and hence we can determine how local textures drive the ferroelastic domain behaviour. The research outcome as a result of the applicant's ORNL visit and the analysis based on SSPFM data will be published in an international peer reviewed

Mrs Shaghik Atakaramians (Uni of Adelaide) visit to Aachen University, Germany

Shaghik is a Postgraduate student at the University of Adelaide and her Postgraduate research interest is THz subwavelength waveguides (micrometer scale) with and without air-hole features as the base of the expansion of the concept to optical fibres with nano scale sub-wavelength freatures and utilizing bio/chemo sensing in both regimes
Purpose of visit: Shaghik intends to work with Dr Michael Nagel at Institut für Halbleitertechnik at RWTH Aachen University as his research is focused on terahertz (THz) waveguides/fibres and their application in biosensing. His expertise will assist her in coupling the terahertz radiation in our recently proposed and in house manufactured porous fibers (sub-wavelength fiber with sub-wavelength features).
During her visit in Aachen, she will also acquire skills at conducting the special mode profile measurement via a near-field scanning setup. This also will support published results. It is worth mentioning that this work is essential for expanding the concept to optical sub-wavelength fiber that poses nano-scale air-holes.
Shaghik's application was supported by her supervisor Professor Derek Abbot and by Dr Michael Nagel from RWTH Aachen University.

Outcomes of ARCNN Overseas Travel Fellowship

Shaghik Atakaramians
School of Electrical and Electronic Engineering
The University of Adelaide, SA 5005, Australia

I am a PhD student conducting my research on the area of the THz spectrum in the University of Adelaide under the supervision of Prof Derek Abbott, Prof Tanya Monro, Dr. Shahraam Afshar and Dr. Bernd Fischer. I am particularly interested in THz waveguides with sub-wavelength features and porous fibres. They have potential applications in THz bio/chemo-sensing, spectroscopy, and imaging and the structure can be downscaled to reach higher frequencies in the infrared and optics regimes. My research is a joint project between two centres in the University of Adelaide, Centre of Biomedical Engineering (the leading centre in Australia for T-ray research) and Centre of Expertise in Photonics (the only centre in Australia with softglass microstructured optical fibre fabrication capability).

At the University of Adelaide, we have theoretically demonstrated that by using sub-wavelength featured fibres, microwires and porous fibres; it is possible to achieve a low loss and flattened dispersion in terahertz transmission. Moreover we have shown that asymmetrical sub-wavelength air-holes in porous fibres lead to ultrahigh birefringence that opens up the application of the porous fibres to THz polarization maintaining systems. We fabricated porous fibres with two different sub-wavelength air-hole shapes from polymer at the University of Adelaide. These fibres have diameters smaller than the operating wavelength, which makes the coupling of the field in the structure rather cumbersome. The conventional coupling methods are not sufficient to couple the field into fibres. Therefore we decided to explore this issue in collaboration with experts at RWTH Aachen University.

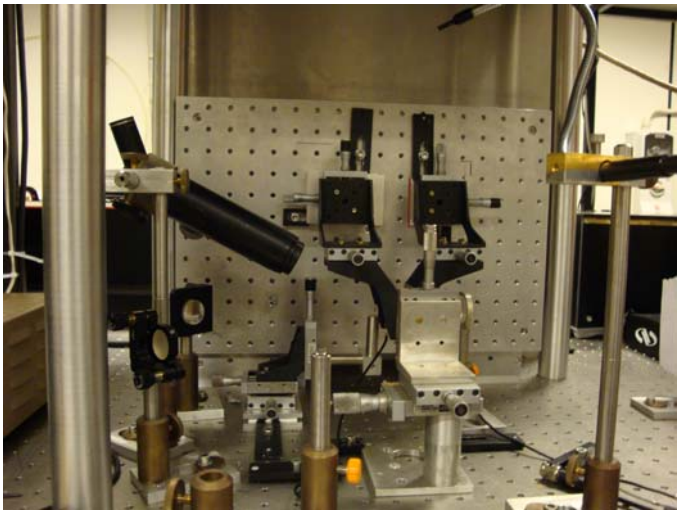
I visited the Institut für Halbleitertechnik at RWTH Aachen University in Germany for three weeks from the 12th of October to the 2nd of November 2008, to collaborate with Dr. Michael Nagel and learn from his expertise for coupling terahertz radiation into porous fibres. The ARCNN Overseas Travel Fellowship Abroad Scholarship covered my travel and accommodation cost during my stay in Aachen.

It was a very productive visit. During the first week in Aachen, I was trained to use their laboratory equipment. I prepared the fibres (cleaved them to the proper lengths). I used three different techniques available in the institute, fibre cleaver, dicing saw and razor blade. The most efficient one in terms of time and smooth fibre tip was using a razor blade. It was instructive to try different methods for cleaving, since cleaving of sub-wavelength porous fibres is non-trivial.

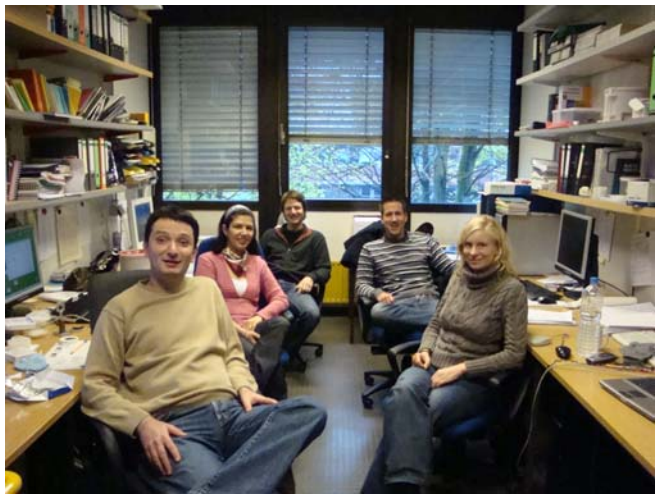
During the second week I started carrying out experiments on my fibres with the assistance of a postgraduate student. I spent days and late nights in the lab to try different ways to couple the THz filed in the fibre. We used a PCA array chip fabricated at RWTH Aachen University as a THz emitter. We found out that the best way of coupling the field inside the fibre was putting the fibre tip exactly on the antenna. The experiments for each set must be repeated for different lengths in order to calculate the absorption coefficient and refractive index later. It is worth mentioning that each experiment requires very careful alignment.

During the third week I managed to finish experiments on different fibre structures and different length. I also had a chance to work with their near-field THz spectroscopy system in order to measure the fibre's radiation pattern profile. The system was very sensitive to fibre facets. I managed to carry out two scans, which revealed the field distribution, but not the finer details.

I have been processing the scans since my return. Most of the results are verifying our theory published in Ref [1] & [2] and is promising for near-future conference and journal publications.



The waveguide experimental setup



Shaghik Atakaramians (second from left) with the PhD students at the RWTH Aachen University

References

[1] S. Atakaramians, S. Afshar V., B. M. Fischer, D. Abbott and T. Monro, "Porous fibers: a novel approach to low loss THz waveguides," *Optics Express,* Vol. 16, No. 12, June 2008, pp. 8845-8854.

[2] S. Atakaramians, S. Afshar V., B. M. Fischer, D. Abbott and T. Monro, "Low loss, low dispersion and highly birefringent terahertz porous fibers," *Optics Communications,* 282, pp. 36-38, 2008.

Mr Tor Kit Goh (Melbourne University) – visit to Nagoya University, Japan

Tor Kit is a post grad student and his area of interest is Nanotechnology, polymer chemistry, living radical polymerization (ATRP), conventional free-radical polymerization, macromolecular architecture, nanocomposites, and rheology and polymer dynamics
Purpose of visit: Molecular-level control of polymerizing processes for the development of important nanotechnologies.
To obtain knowledge on a new polymerization technique (stereospecific living radical polymerization (SLRP)) that allows facile synthesis of polymers with specific tacticity. To investigate the nano-scale interactions of these polymers that lead to self-assembly, helix formation via stereocomplexation, recognition of protein and polymer motifs, recognition of chiral molecules, and other important processes.
His application was supported by his supervisor Assoc Prof Greg Ziao and by Professor Masami Kamugaito from Nagoya University.

Molecular-level control of polymerizing processes for the development of important nanotechnologies

Final Report Goh Tor Kit

1. Project aims

Achievements:

• Acquired knowledge on a new polymerization technique (stereospecific living radical polymerization (SLRP)) that allows facile synthesis of polymers with specific tacticity.
• Synthesized and characterized novel polymeric materials, including polymers and star polymers with stereospecific configuration.
• Obtained knowledge of the state-of-the-art in polymer chemistry and related fields in Japan through seminars, conference attendance and consultation
Conferences attended; the Nagoya University – University of Michigan Joint Symposium on Supramolecular Material Science and Engineering in the 21st Century (10-11 March),the Orion 8 Mini Joint Symposium of Polymer Synthetic Research Groups in Kyoto,Osaka and Nagoya Universities (25-26 April), the 57th Society for Polymer Science Japan (SPSJ) Annual Meeting (28-30 May), the Nagoya University Global COE inChemistry Annual Symposium (11 June) and the IUPAC World Polymer Congress (MACRO) 2008 (29 June-4 July, Taiwan). I presented a poster of my work at theNagoya U. – U. of Michigan Joint Symposium, the Orion 8 symposium and MACRO
2008.
• Established a more substantial collaboration between my home and host research groups.
• Forged networks with other Japanese scientists in the same area of research.
• Learned basic Japanese language, work ethics and customs.

Future directions:
• Establishment of SLRP methodologies in my home research group.
• Evaluation of stereospecific polymers in applications such as high-density optically active coatings, stereocomplexed nano-networks, templates for asymmetric catalysis, resilient rheology regulators and other nanotechnologies.
• Investigation of nano-scale interactions of stereospecific polymers that lead to selfassembly, helix formation via stereocomplexation, recognition of protein and polymer motifs, recognition of chiral molecules, and other important processes.

2. Results

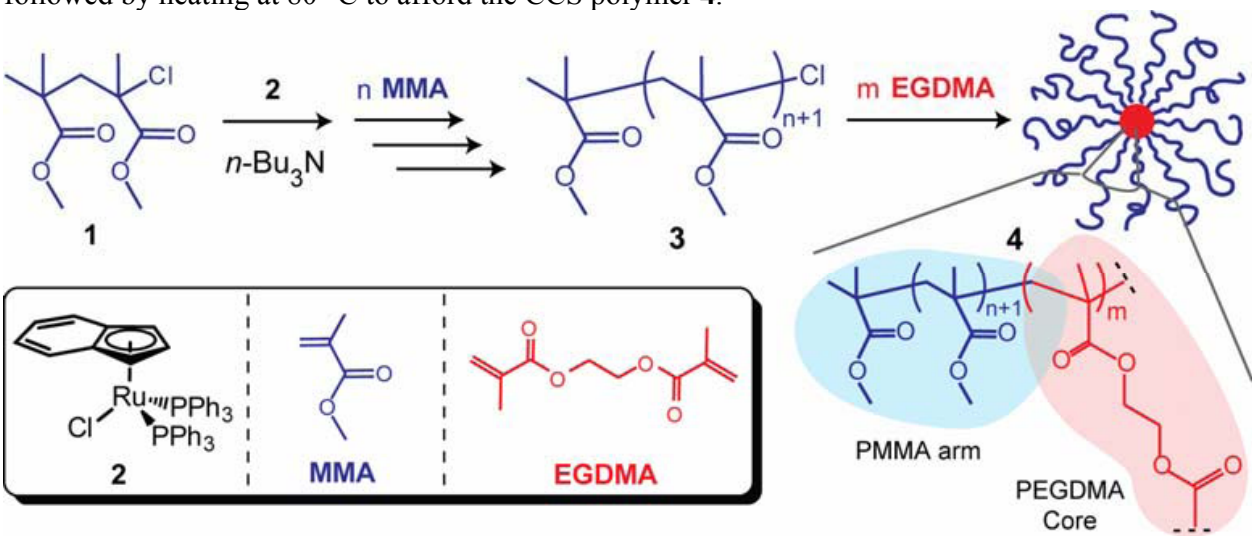
The following two sub-sections contain results and discussion of the research work carried out at my host research group in Nagoya University. These novel findings will be presented at the 30th Australasian Polymer Symposium in December 2008, pending acceptance by the symposium committee.

Two manuscripts are in preparation for submission to peer-reviewed journals and further investigation of these novel polymers at my home research group is in progress.

2.1. Towards quantitative synthesis of low polydispersity core cross-linked star polymers by Ru-catalyzed living radical polymerization

In recent years, controlled/living radical polymerization (LRP) has become an increasingly important technology for facile synthesis of macromolecules with diverse architectures. Core cross-linked star (CCS) polymers are a classical example because of their globular morphology and highly cross-linked core. Such unique characteristics make this type of polymer highly suitable for application in advanced nanotechnologies such as drug delivery and catalysis. CCS polymers can be conveniently synthesized by LRP via the two-step, "arms-first" approach (Scheme 1); however, quantitative synthesis and low polydispersities are still challenging. In this study, low polydispersity CCS polymers ($M_w/M_n < 1.16$) with varying arms sizes were synthesized in near-quantitative yields by the Ru-catalyzed LRP.

MMA was initially polymerized using the initiator **1** in the presence of the Ru catalyst **2** and tri-*n*-butyl amine in toluene at 80 °C. Typically, the polymerization was quenched at intermediate MMA conversions (< 75 %) and the macroinitiator **3** was recovered by precipitation in hexane. Secondly, the core cross-linking reaction was facilitated by the addition of macroinitiator **3** and EGDMA to a solution of **2** and tri-*n*-butyl amine in toluene, followed by heating at 80 °C to afford the CCS polymer **4**.



Scheme 2.1.1: The "arms-first" synthesis of core cross-linked star (CCS) polymers.

The core cross-linking steps of a typical CCS polymer synthesis reaction are shown in Figure 1. EGDMA was almost completely consumed within the first 24 h (>98 %). The MALLS-SEC chromatograms show that the conversion of macroinitiator **3** (M_n = 7840, M_w/M_n = 1.04) to CCS polymer **4** and almost quantitative conversion was observed after 50 h. The final star **4** (338 h, M_n = 213 kDa, M_w/M_n = 1.16, 96.5 %) possessed 22 PMMA arms. In contrast, the CCS polymers synthesized by Cu-catalyzed ATRP[1] and one-pot Ru-catalyzed[2] LRP typically achieve only *ca.* 90 % conversion for an analogous macroinitiator size with polydispersities in excess of 1.2.[1,2]

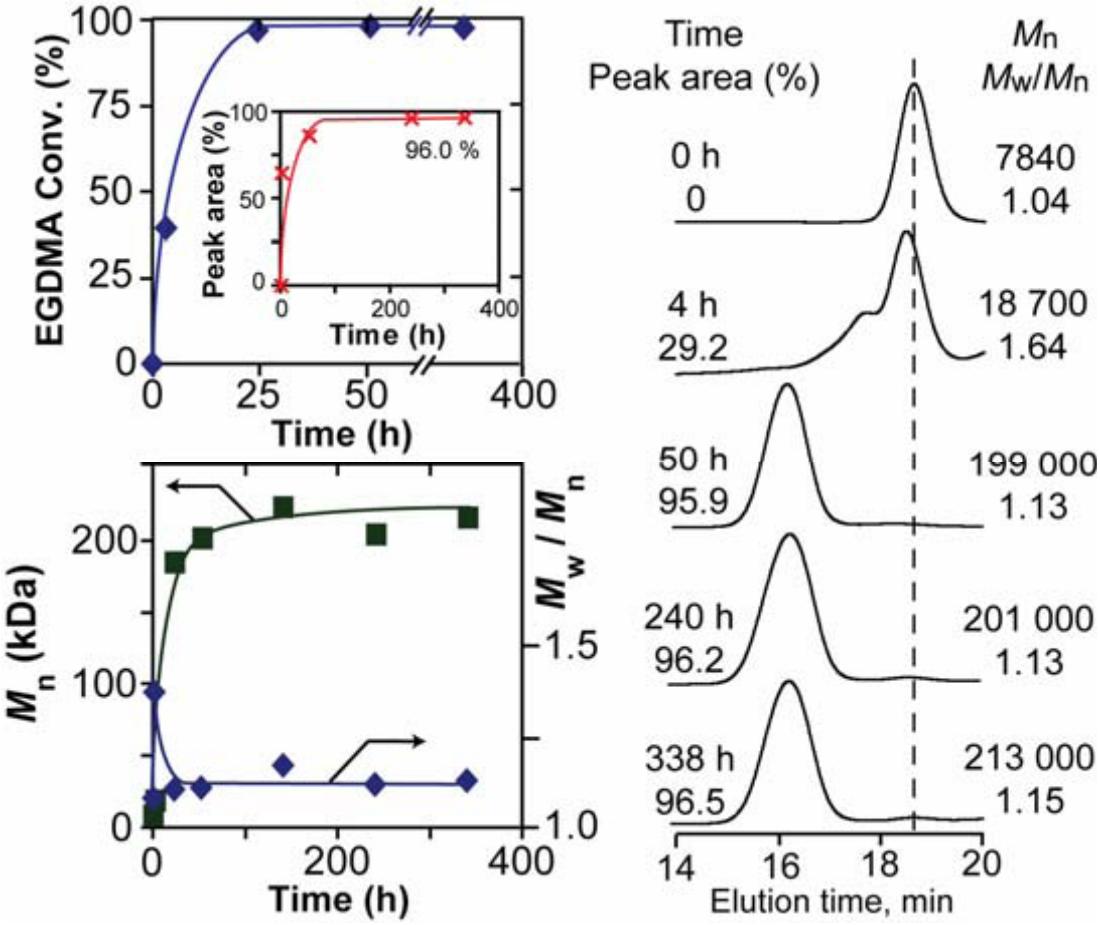


Figure 2.1.1: Core cross-linking reaction at 80 °C in toluene; [EGDMA]/[**3**]/[**2**]/[*n*-Bu3N] (mM) = 100/10/2/40.

As with all LRP techniques the conversion efficiency of macroinitiator to CCS polymer was highly dependent on the molecular weight of the macroinitiator **3** (Figure 2). High conversions were achievable for the 8 and 20 kDa macroinitiators by the Ru catalyst system (96 and 94 %, respectively) although the achievable conversion became lower as the M_n of the macroinitiator increased. Nevertheless, the narrow polydispersities of the CCS polymers were maintained (M_w/M_n < 1.16) up to high molecular weights (M_n > 2 MDa). It is proposed that the selection of the **2**/tri-*n*-butyl amine catalyst system and the highly living nature of **3** contribute to the high conversions and low polydispersities of the CCS polymers. A detailed assessment will be presented and discussed.

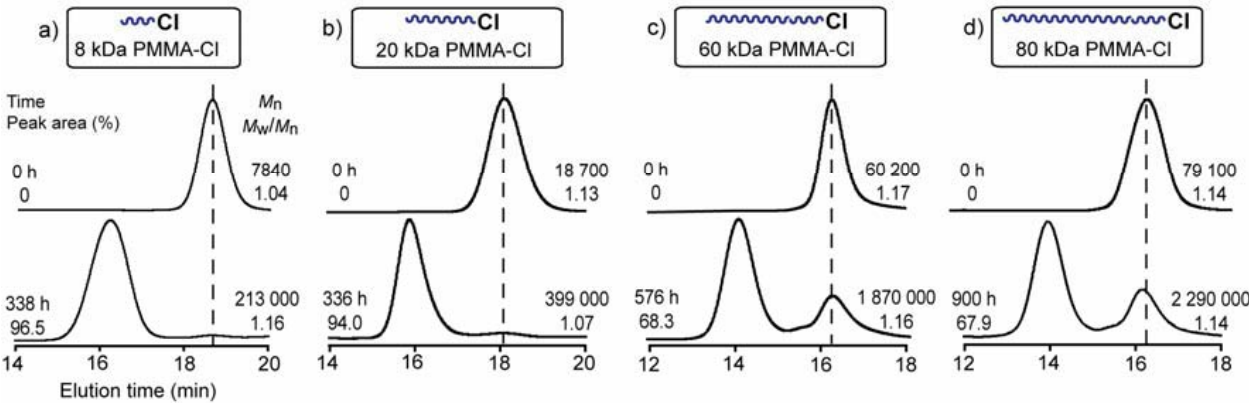
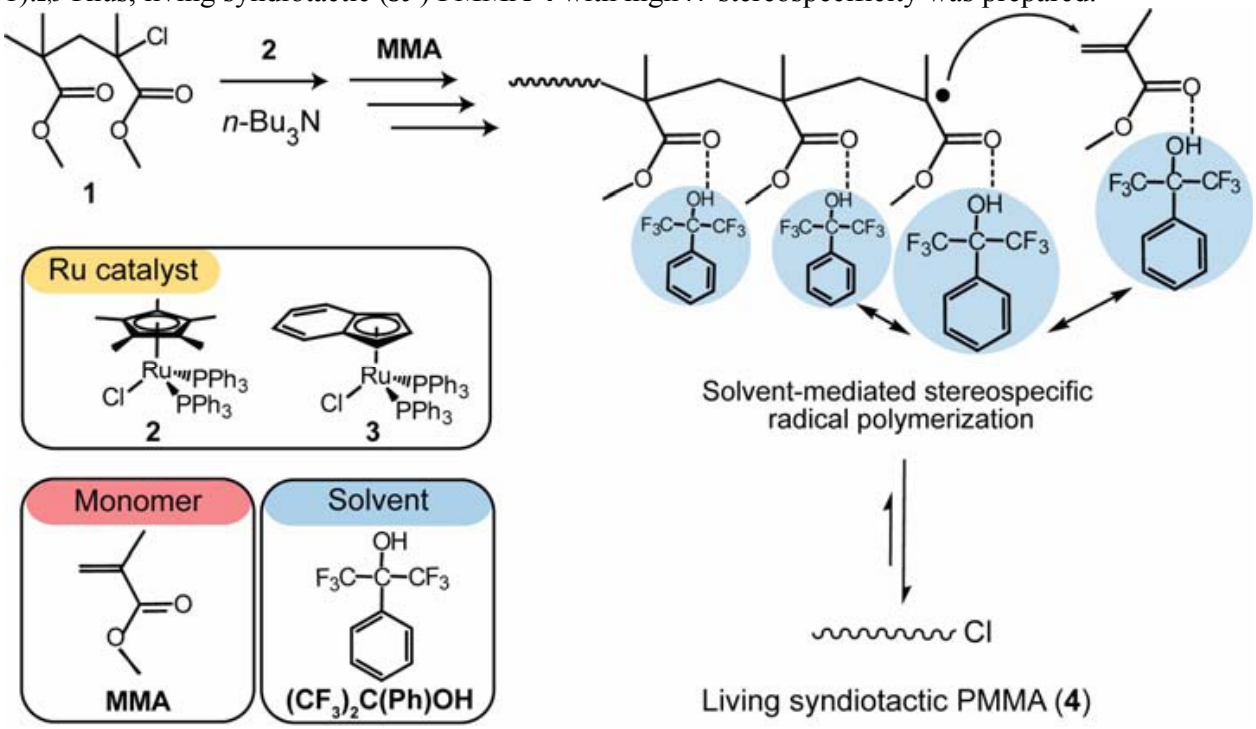


Figure 2.1.2: Conversion decreases with increasing *M*n of **3**

2.2 Stereospecific living radical polymerization for the synthesis of syndiotactic star polymers

The total control of radical polymerization is essential to creating precise and exquisite synthetic macromolecules. The control over the initiation and termination processes have been enabled by the development of controlled/living radical polymerization, which is mainly categorized into NMP,

metal-catalyzed LRP and RAFT. In addition, significant progress has recently been made in the control of stereochemistry and tacticity in radical polymerization.[1] In this study, the simultaneous control of molecular weight, tacticity and architecture via solvent-mediated stereospecific living radical polymerization (SLRP) is demonstrated. MMA was polymerized using the initiator **1** in the presence of the Ru catalyst **2** and tri-n-butyl amine in a bulky cumyl fluoroalcohol, $(CF_3)_2C(Ph)OH$, as the solvent. Hydrogen bonding between the fluoroalcohol and the carbonyl moiety of MMA leads to a bulky complex, which mediates the stereochemistry of the propagating radical (Scheme 1).[2,3] Thus, living syndiotactic (*st*-) PMMA **4** with high *rr* stereospecificity was prepared.



Scheme 2.2.1: Simultaneous control of molecular weight and tacticity via Ru-catalyzed stereospecific living radical polymerization (SLRP).

The living nature of the polymerization of MMA is illustrated in Figure 1. Shibata *et al.*[3] previously demonstrated that LRP with good stereospecificity was achieved using **2** and $(CF_3)_2C(Ph)OH$ at a reaction temperature of 0 °C. High conversions (> 95 %) were achieved without loss of catalyst activity or the living nature of the polymer, whereas narrow polydispersity was maintained ($M_w/M_n = 1.1$). The formation of highly syndiotactic PMMA was confirmed by ^{13}C NMR spectroscopic analysis of **4** ($M_n = 8710$, $M_w/M_n = 1.11$), with *rr*/*mr*/*mm* (%) = 76/21/3.

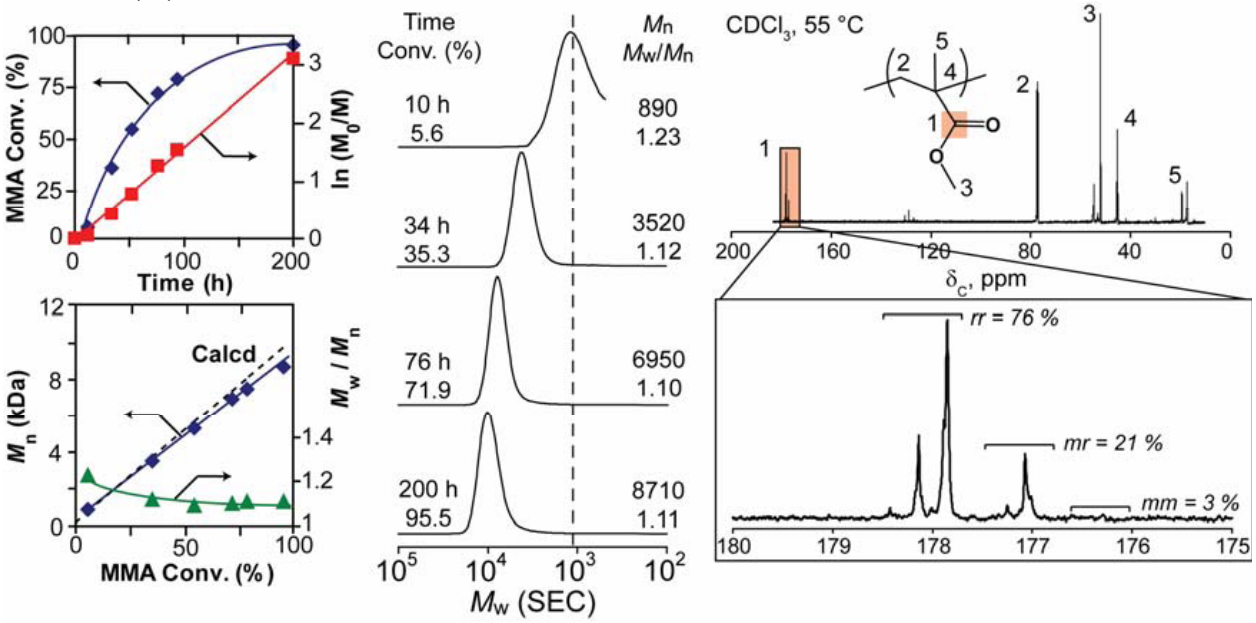


Figure 2.2.1: Polymerization of MMA at 0 °C in $(CF_3)_2C(Ph)OH$; [MMA]/[**1**]/[**2**]/[*n*-Bu_3N] (mM) = 2000/20/4/40.

The living nature of **4** was also demonstrated by the subsequent polymerization of EGDMA to yield core cross-linked star (CCS) polymers (Figure 2). The core cross-linking reaction was examined at 80 °C in toluene using the Ru catalyst **3**; almost quantitative conversion of EGDMA and **4** (> 98 % and > 94 %, respectively) was observed after 51 h. The MALLS-SEC showed that the final CCS polymer (M_n = 218 kDa, M_w/M_n = 1.56, 95.4 %) possessed 30 *st*-PMMA arms. The properties and potential applications of these novel CCS polymers will be presented and discussed.

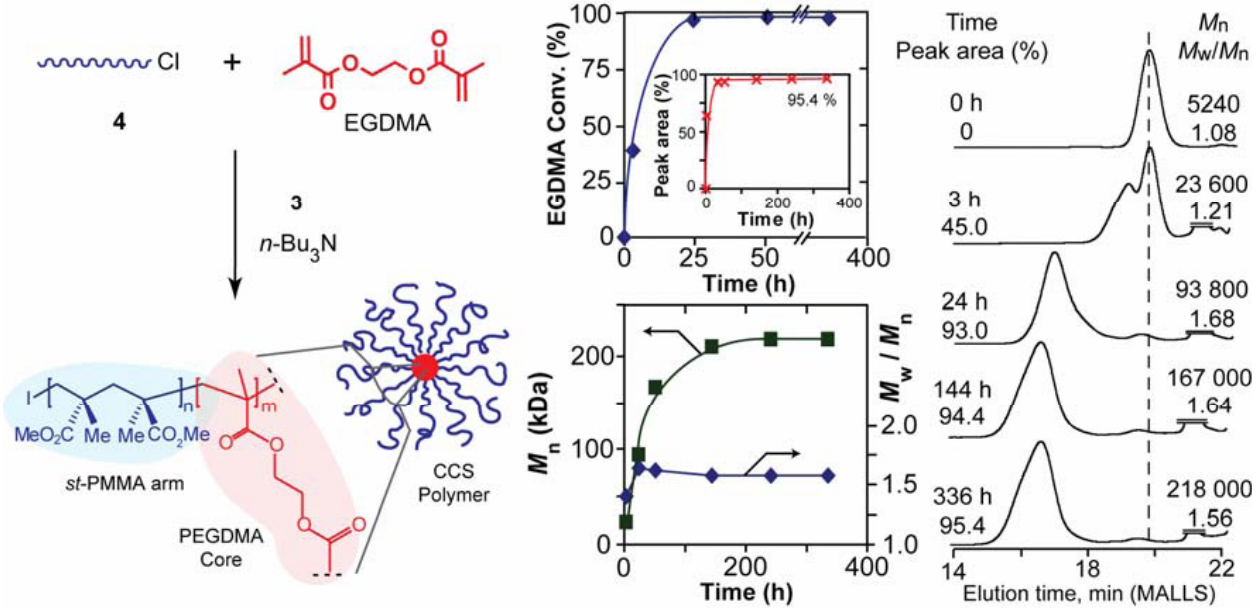


Figure 2.2.2: *st*-PMMA CCS polymer synthesised at 80 °C in toluene; [EGDMA]/[**4**]/[**3**]/[*n*-Bu$_3$N] (mM) = 100/10/2/40.

Mr Matthew Nussio (Flinders Uni) - visit to the University of Barcelona

Matthew is a post graduate student and his area of interest is Construction and Characterisation of Biomimetic Membranes for Use in Drug Binding Studies

Purpose of Visit: The aim of this project is to construct a physiologically relevant artificial phospholipid membrane and probe the dynamics of its interaction with drug molecules. The construction of these layers will be used as a testing ground to further develop a new high resolution technique based on atomic force microscopy (AFM) which has been recently developed at Flinders University. Currently this approach allows unprecedented examination of membranes and has the ability to probe the dynamics of the membranes. Potential applications will identify mechanisms by which drugs interact with membranes and how these processes are influenced by lipid composition and identifying the structural changes induced by drugs and their potential implications.

Collaborator - Professor Fausto Sanz . Activities to be undertaken during proposed visit:

(1) Phospholipid bilayer construction and characterization.

(2) Calibration of modified AFM probes in support of highly sensitive detection of surface charge.

(3)Microscopic Characterisation of Physiologically Relevant Membranes

(4)Dynamics of drug interactions

His application was supported by his supervisor Assoc Prof Joe Shapter and by Prof Fausto Sanz from the University of Barcelona.

Overseas Fellowship Report

Matthew Nussio

Dear ARCNN Network,

During the period of March until June 2008, I visited the University of Barcelona, where I worked in the group of Fausto Sanz. As a visiting researcher, I was able to access both the expertise of the research group, and a wide range of facilities available at the university. My overall experience has significantly enhanced my skills and knowledge in the area of nanomechanics of biomembranes.

Research Project

Current research in Prof. Sanz's group has used force spectroscopy to study the nanomechanical properties of supported phospholipid bilayers (SPBs). In particular, the discontinuity in the approach curves has been interpreted as the penetration of the AFM tip through the lipid bilayer, and this information has been used to create a "fingerprint" for the stability of each bilayer component.

Using this concept, the research project initially investigated the effect of the antipsychotic drug chlorpromazine (CPZ) on the stability of single component SPBs. With reference to Figure 1, the jump in the approach force-distance curve was characterised as a function of CPZ binding to liquid-disordered (L_α) DOPC SPBs. Results demonstrated a decrease in the breakthrough force of ~ 10nN indicating a huge decrease in the lateral interactions due to a less compact structure.

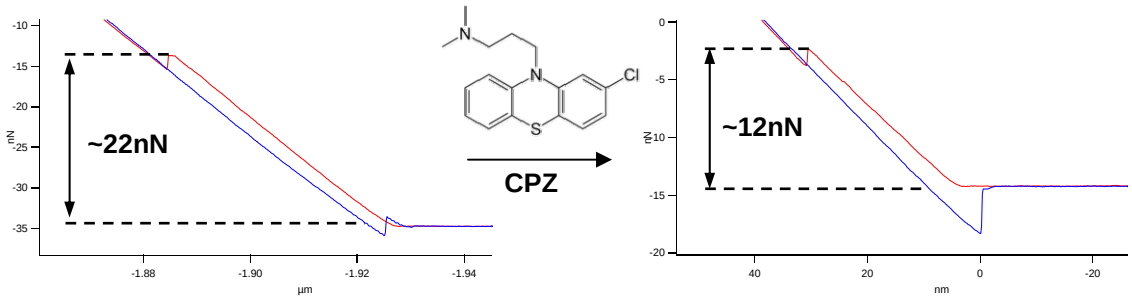


Figure 1. Breakthrough force measured for DOPC (A) prior and (B) after CPZ interaction. Buffer: 10mM HEPES 250mM NaCl pH 5.5.

Investigations utilising liquid-ordered (L_β) DPPC at room temperature, demonstrated no change in stability upon exposure of CPZ. Further experiments investigated binary mixtures combining both DPPC and DOPC, where two phases were observed (Figure 2). The two bilayer regions were determined as DPPC and DOPC rich phases by the method of force spectroscopy "fingerprinting". Upon exposure of CPZ, a change in morphology of the two component bilayer was observed. Interestingly there was also a large increase in the stability of the DOPC rich phase after exposure of CPZ (data not shown).

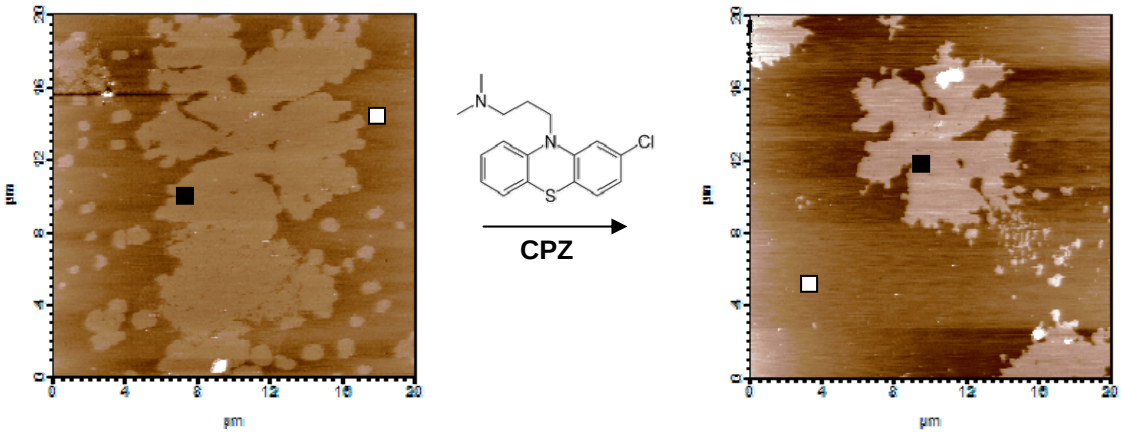


Figure 2. AFM topographic images of DPPC:DOPC (1:1) SPBs before and after exposure to 500 μM CPZ. DPPC (■) and DOPC (□) rich phases are labelled accordingly

Additional experiments performed at the University of Barcelona utilised zeta potential and single molecule fluorescence tracking. Experiments performed using single molecule fluorescence was carried out in collaboration with Prof. María García-Parajó, however only preliminary results were collected as the equipment was offline for the majority of the overseas visit. However, collaborations are still continuing and we hope to discover more information on the effect of CPZ on the translational diffusion of lipids in bilayer systems.

Dr Xiangdong Yao (Uni Queensland) – visit to the University of London (UK).

Xiangdong is an early career researcher and his research interest is Functional nanomaterials for clean energy

Purpose of visit: This project aims to investigate hydrogenation mechanism of transition-metal (such as Ni, Pd, V, or Ti) catalysed magnesium both experimentally and theroretically. This project will address the following challenges: 1) the difficulty in modeling multi-component systems that involve the synergistic interactions of Mg-X (transition metals)-H; and 2) synthesis of novel Mg nanostructures with different particle (grain) size and well-dispersed the particles from aggregation at nanoscale; and 3) preventing the Mg nanostructures from oxidation.

The specific aims of the project are:

1. To develop a modeling approach for general multi-component systems involving the synergistic interactions of Mg-X-H.
2. To synthesize Mg nanostrutures (mixed with and without nano-sized catalyst particles).
3. To understand the hydrogenation mechanism and the nanoscale effect of catalysts on hydrogenation and atomic interactions between H and metals (Mg and catalyst elements).

Dr Yao's application was supported by his supervisor Prof Max Lu and by Prof Xiao Guo from the University of London.

Final Report on ARCNN Overseas Travel Fellowship (OTF)

Xiangdong Yao

ARC Centre of Excellence for Functional Nanomaterials (ARCCFN), The University of Queensland

Aims and Background

This OTF supports Dr Xiangdong's scientific visiting and research collaboration to Prof Z. Xiao Guo's group in University College London (UCL). Prof Guo's group is focusing on the research of hydrogen storage materials and is internationally recognized in this field. Dr Yao has established links with Prof Guo through conferences etc. The aim of this visiting is to start a formal collaboration in hydrogen storage materials, especially on the catalytic effects of metallic elements on hydrogenation of Mg this time. In addition, some visitings in China and attending of the 5th International Conference on Materials and Advanced Processing (ICAMP5) have also carried out.

Timing and Activities

Sep 1-10 2008, attendance of ICAMP5 and visiting to Institute of Metal Research (IMR), China

1) Presented invited talk on ICAMP5; 2) acted as Session Chair on

Mg alloys; 3) collaboration meeting with Prof Huiming Cheng who is a long-term collaborator with Dr Yao.

Sep 11-24 2008, Research and meetings in Prof Guo's group

1)discussions with Prof Guo for further collaboration; 2) working with Prof Guo's PhD students (Ms Weina Yang and Mr Xuewen Yuan) for Mg-based materials on hydrogen storage; 3) presentation "Recent advance and future research directions on hydrogen storage" in Department of Chemistry at UCL. Among this period, Dr Yao also visited Prof Garvin's group in Nottingham University, and Prof Kevin Kendall's group in Birmingham University. Dr Yao gave seminars in both groups of these two universities to introduce the research outcomes from hydrogen storage group in ARCCFN.

Sep 25-Oct 15 2008, visitings to Jilin University, South China University of Technology and Fudan University in China

1) Presentations in these universities;
2) establishments of research collaborations with relative professors

Outcomes

1) Establishment of long-term collaboration with Prof Guo's group in UCL;
2) Good results from the collaborative research, which will lead to a journal article;
3) Presentation of our research at UQ to international community;
4) Establishment of research collaborations with international recognized researchers;
5) Reorganization of our research in hydrogen storage field by invited talks in international conference

Acknowledgments

It is greatly appreciated for the financial support through OTF by ARCNN

YOUNG NANOTECHNOLOGY AMBASSADOR AWARDS

YOUNG NANOTECHNOLOGY AMBASSADOR AWARDS

The Young Nanotechnology Ambassador Awards were set up to promote science and science education in state and territory schools. Two awards are provided per state/territory and each award is valued up to $2000.

The young nanotechnology ambassadors are required to visit a minimum of four schools (preferably at least one regional school) to inspire students about nanotechnology, and more broadly science education. It is up to the ambassadors to decide which schools they visit and to arrange these visits with the schools. The ambassadors are encouraged to present a talk which could include visual demonstrations or simple experiments, slide shows or other multimedia presentations.

The following are the Young Nanoscience Ambassadors for 2008

- **Queensland**

Mr Anthony Musumeci (University of Queensland)

Anthony is at present visiting the schools

Mr Yanan Guo (University of Queensland)

Report by Mr Yanan Guo – ARCNN Young Nanotechnology Ambassador 2008

I visited two schools in the north Queensland area on 24th Nov 2008. They were Mission Beach State School and El Arish State School, located about 200km (three hours drive south of Cairns).

I arrived in Mission Beach State School in the early morning. The principle, Mr. Robertson, allowed me the first part of the morning to interact with two year 7 classes, which comprised of around 40 students. The program I prepared for the students contained two parts. The first one was a slide show to give them an idea about science in a small nano-world. I included a substantial amount of digital micrographs of everyday things, such as fibres and fire ants. To inspire the students, I let them guess what they were, beginning with the most magnified images. This was really a fun part. Many funny answers came up. All of those images were collected from the Centre for Microscopy and Microanalysis at The University of Queensland, where I am currently a PhD student. The second part was to fold dodecahedrons to build up a 3-D crystal model by just using A4 paper. Each dodecahedron is composed of 12 parts (faces) folded from A4 paper. This required a lot of brainstorming and teamwork but was great for creating the interaction I was seeking. At last, we managed to finish 5 dodecahedrons and a lovely crystal model eventuated.

That afternoon, I started my program in El Arish State School. It is a fairly small school with 25 students from years 4 to 7 students combined into one class. I had an excellent rapport with

this class. They were very quick learners and it was a pleasure to present my talk and interact with a small class of multiple ages.

My intention is to present a talk at another two or three school visits around the south Brisbane area after Easter. Many of the schools I approached were enthusiastic for a visit from a Young Science Ambassador however due to such tight curriculums; it was not possible to complete my presentations by the close of 2008.

I think it is a great honour to be an ARCNN Young Nanotechnology Ambassador. I gained much from all my experiences, such as making contact with the schools, working around busy school schedules and preparing the best presentation I could do for each school. As a PhD student, I believe I obtained a better vision about learning through this teaching experience. And as a junior microscopist who is passionate about microscopy, the greatest highlight of my school visits was when I could see the students with mouths wide open when showing them how a fire ant looks like when magnified 150 times.

The message I have been trying to pass on to the students is simple – Nature is Beautiful, Science is Fun.

Yanan Guo

ARCNN Young Nanotechnologyy Ambassador 2008

- **Victoria**

Mr Ashley Stephens (The University of Melbourne)

Mr Ashley Stephens will be visiting the schools in April-May 2009.

Miss Minoo Naebe (Deakin University)

Minoo is visiting the schools in March 2009.

Mr Muthukumaraswamy Pennirselvam (LaTrobe University)

Muthukumaraswamy will be visiting the schools in April – May 2009.

WORKSHOPS, CONFERENCES AND EVENTS

WORKSHOPS, CONFERENCES AND EVENTS

The purpose of the workshops, Conferences and Events is to take stock of the status of the field nationally and internationally, identify emerging areas of research and exchange information and to identify opportunities for collaboration and training. A Large number of ECRs and students have been supported to attend these events.

Ministerial Roundtable on Nanotechnology - 8th July 2008
University House, Australian National University

Background

This Roundtable conference was held to provide the Hon. Senator Kim Carr, Minister for Innovation, Industry, Science and Research, with first hand knowledge about nanotechnology in Australia.

An open discussion by participants representing the research community, industry, union and civil society communities presented a full picture of nanotechnology in Australia today. It highlighted current and possible opportunities and challenges from nanotechnology and identified areas needing particular consideration in the process of developing nanotechnology policy.

Nanotechnology is considered as technology of the future with predicted revenues of multi-trillion dollars in the next 20 years. Australia has a range of activities in the field of Nanotechnology. While many exciting opportunities are envisaged for Nanotechnology, some challenges are emerging in terms of occupational health, safety, environment, regulation and life cycle issues of nanotechnology products. There is a significant interest among the public about nanotechnology and media reports are a daily occurrence in terms of the new developments in the field as well as concerns about the safety of this technology. The Minister for Innovation, Industry, Science and Research receives many requests for meetings with various nanotechnology players and it is important to have a discussion about various issues related to Nanotechnology

Outcomes

Various participants made presentations on the importance of Nanotechnology for Australia and Australian industry. Considering that Nanotechnology is predicted to generate $2.6 Trillion industry globally by 2014, Australia cannot ignore Nanotechnology and needs to invest to capture this technology for the benefit of Australia and Australian industry.

Occupational and Health effects have been discussed and need for taking precautions in dealing with free nanoparticles and nanotubes has been discussed. Need for more concrete toxicological data has been identified. Engaging with international community in learning more about OH&S issues of nanotechnology is essential. Predictive modelling of toxicity of nanoparticles and nanotubes may be beneficial as it is impossible to test all the variants of size, shape and composition of nanotubes and nanoparticles. RE-engineering of nanoparticles may be possible to reduce their toxicity. Precautions need to be taken to ensure workers are not exposed to nanoparticles and nanotubes.

Regulation is challenging for something as complex as nanotechnology which is difficult to define. However, one needs to monitor current regulations and ensure that there are no regulatory gaps. Engagement of public early is essential without which there may be public mistrust towards nanotechnology.

All the participants were given an opportunity to express their views and these were summarised in the Minutes of the meeting (enclosed).

In summary, this roundtable was found to be highly valuable to address all critical issues of importance for the development of nanotechnology. The Minister found the roundtable to be very useful in capturing views from various stake-holders.
Considering that the event gave the opportunity to address critical issues of importance for Nanotechnology, it has been suggested that it will become an annual feature taking stock of the developments so that issues of concern could be addressed.

Attendees for the Nanotechnology Roundtable

1	**Senator the Hon Kim Carr, Minister for innovation, industry, science and research**
2	**Mr. Tim Murphy, Adviser to the Sen. Kim Carr**
3	**Professor Chennupati Jagadish** **Convenor, Australian Research Council Nanotechnology Network - Australian National University**
4	**Dr. Jim Peacock, Chief Scientist, Australian Govt.**
5	**Mr Craig Pennifold** **Head, Innovation Division - Department of Innovation, Industry, Science and Research**
6	**Associate Professor Paul Wright** **Immunotoxicology, RMIT - Coordinator, NanoSafe Australia**
7	**Professor Graeme Hodge** **Director, Centre for Regulatory Studies, Monash University**
8	**Professor Brian Priestly** **Monash University, Toxicologist**
9	**Dr Maxine McCall** **Principal Research Scientist, CSIRO**
10	**Dr Simon Longstaff** **Executive Director, St James Ethics Centre**
11	**Ms. Rosie Hicks** **CEO, Australian National Fabrication Facility (ANFF)**
12	**Dr Erol Harvey** **CEO, Minifab Pty Ltd - Member, Australian Nano Business Forum (ANBF) Board**
13	**Mr. Clive Davenport** **CEO, Australian Nano Business Forum (ANBF)**
14	**Ms. Carla Gerbo** **Director, Interim CEO, Australian Nanotechnology Alliance (ANA)**
15	**Ms. Georgia Miller** **Nanotechnology Project Coordinator, Friends of the Earth (FoE) Australia**
16	**Ms. Caroline Mills, NHMRC**
17	**Dr. Ian Mackinnon, ARC**
18	**Professor Max Lu** **Professor of Nanotechnology, Australian Institute of Bioengineering and Nanotechnology (AIBN)** **Director of the ARC Centre for Functional Nanomaterials**
19	**Dr Leanna Read** **Managing Director and CEO, Tissue Growth and Repair (TGR)**
20	**Ms. Renata Musolino** **OHS Unit, Victorian Trades Hall Council and ACTU**
21	**A Representative from the Australian Office of Nanotechnology (AON)**

HOPE Meeting –24/02/2008 - 29/02/2008 – Tsukuba, Japan

International Program - Department of Japan Society for the Promotion of Science

The International Program Department of Japan Society for the Promotion of Science (JSPS) launched a new initiative called the "Strategic Program for Building an Asian Science and Technology Community." The strategic program aims to expand and strengthen the networks in S&T in the Asia-Pacific region. It called for Australian candidates to participate in the first "HOPE Meeting," to be held in Tsukuba from 24-29 February 2008. This "HOPE meeting" aims to foster talented young researchers who will shoulder the scientific future of countries in the Asia-Pacific region. JSPS will cover the participants' international airfares and local expenses during their stay in Japan. ARCNN received 30 applications of which 5 candidates were selected and forwarded to Nancy Pritchard from the Australian Academy of Science.

The following were selected:

- Miss Brianna Thompson, Wollongong University
- Miss Alica Becker, Melbourne University
- Mr Ben Flavel, Flinders University
- Mr Richard Kydd University of New South Wales
- Mr Andrew Malcolm, University of Queensland

Brief Report from Meaghan O'Brien

International Programmes – Australian Academy of Science

First HOPE Meeting-Advanced Courses on Nanoscience and Nanotechnology

The Academy was invited to nominate five graduate students to attend the First HOPE Meeting, which was organised by the Japan Society for the Promotion of Science (JSPS) and held in Tsukuba, Japan, from 24-29 February 2008. The Australian Research Council's Nanotechnology Network assisted the Academy in the selection of the five participants: Brianna Thompson of the University of Melbourne, Alisa Becker of Melbourne University, Ben Flavel of Flinders University, Richard Kydd of the University of New South Wales and Andrew Malcolm of the University of Queensland.

The aim of the HOPE Meeting was to provide an opportunity for students from the Asia-Pacific area to build networks and to engage in face-to-face exchanges with Nobel laureates and other eminent researchers working in leading -edge science. The chance to interact with these distinguished scientists was appreciated by the participants as a highlight of the event, with many noting that early researchers can often be 'left-out' of networking opportunities at major international conferences.

The participants succeeded in establishing contacts for current and future collaborations; in particular Mr Flavel established collaboration with a New Zealand participant, David Garrett, which has resulted in a draft for a publication on carbon nanotubes. Mr Flavel has also

expressed an interest in pursing a career in Japan, credited to his attendance at the HOPE Meeting.

The participants attended presentations from Nobel laureates and distinguished researchers and were encouraged to consider their roles as the future scientists in the Asia-Pacific region. A major focus of the meeting was on the decisions facing young researchers regarding their career path and whether to pursue an academic- or an industry-based path. The participants found these discussions of great value, with Mr Malcolm noting that the encouragement of 'industry-based research, not just university-based collaborations with industry, should be a priority of the Australian government', and feels this would improve and expand the career opportunities for early career researchers.

Brief Report from Richard Kydd

The first 3 days of the conference consisted of a series of talks and workshops from distinguished international researchers, including 4 Nobel Laureates (Leo Esaki, Heinrich Rohrer, Alan Heeger and Robert Laughlin). The topics discussed ranged from technical presentations into recent research, trends and future prospects for nanotechnology and more general discussion on the philosophy and techniques required to conduct effective scientific research. Renowned artist, Ikuo Hirayama, was also invited to give a presentation on the multicultural origins of Japanese society and culture. As part of the conference, the students were organized into focus groups which then gave a short presentation on a topic of their choosing.

The final day of the conference included a visit to the Advanced Institute of Science and Technology's Materials research division, where students were given an overview of synthesis methods for a new class of materials, "organic nanotubes", which are predicted to find application as a low-toxicity vehicle for targeted drug delivery. The visit also included a brief introduction to the single-walled carbon nanotube synthesis laboratory, where researchers are developing an automated high-efficiency method for producing low-cost high-purity carbon nanotubes. Participants were also given a tour of the NEC corporations R&D headquarters, where researcher Jaw-Shen Tsai presented an overview into the design and construction of the prototype microwave-addressable quantum computing device.

Ben Flavel, Andrew Malcolm, Alica Becker and Richard Kydd

A report from Miss Brianna Thompson

On 24-28th February, the first HOPE Meeting was held in Tsukuba, Japan. Brianna Thompson, a PhD student of IPRI, was chosen by the Australian Research Council Nanotechnology Network and the Australian Academy of Sciences as one of five Australian students to attend the conference. The aim of the meeting was to gather high quality research students in the field of nanoscience and nanotechnology from the Asia-Pacific region, and introduce them to Nobel Prize winners and other outstanding researchers in the field.

Throughout her visit, Brianna met and participated in discussion groups with Alan Heeger, Hideki Shirakawa (Nobel Prize winners for discovery of conducting polymers) and Sumio Iijima (who discovered carbon nanotubes), all fathers in the field of organic conducting materials. In addition, Brianna heard talks from Leo Esaki, Robert Laughlin and Heinrich Rohrer who are also Nobel Prize winners in the field of nanoscience and nanotechnology.

Tours through the facilities at the NEC Laboratories and Advanced Industrial Science and Technology in Tsukuba, as well as a demonstration of the robotic exoskeleton technology developed at Tsukuba University showcased some of the high quality research carried out in the local area.

The HOPE meeting was an excellent experience, and a wonderful opportunity to meet with other research students and enjoy tutelage from such esteemed scientists.

Thank you to the wonderful organisers.

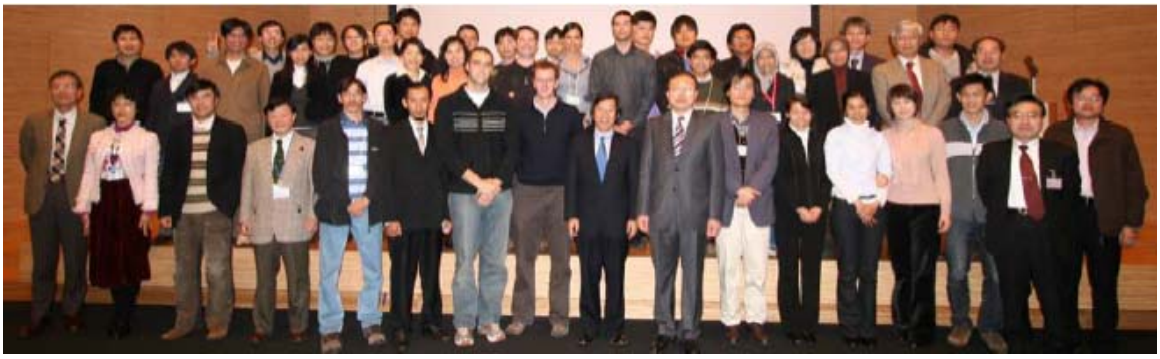
First HOPE meeting was held in Tsukuba Japan in February 2008.

Brianna gathered at the HOPE meeting with other high quality student researchers.

Brianna got to meet and talk to esteemed scientists such as the Nobel prize winners, Alan Heeger, and also with Leo Esaki.

A cultural experience all round!

Asia Nanotech Camp Initiative Feb 4-21 2008 Japan



ANF Asia Nanotech Camp Initiative delegates – Feb 4-21, 2008, Japan

Another three candidates were selected for the Asia Nano Camp organized by the Asia Nano Forum. The following two were successful

- Minoo NAEBE from Deakin University
- Martin DURISKA from Monash University

The Asia Nano Camp 2008 (ANC2008) was organized jointly by NIMS, AIST, and TIT and supported and coordinated by Asia Nano Forum. As part of the continuous effort in fostering young nanotechnology leaders in Asia, ANC2008 provided unique educational opportunities for the Asia young scientist to learn about the state of the art nanotech advancement in Japan. It is also a platform for young aspiring researchers to communicate, inspire and learn form each other.

About 50 delegates from 13 economies in Asia Pacific took part in this first-of-its-kind event. The delegates spent 17 days exploring Japan and participated in a lineup of exciting events including: nanotechnology lectures and seminars given by leaders and top researchers, NANOTECH 2008 in Tokyo (the largest nanotech show in the world), visits to Toyota plants and various state-of-the-art laboratories, as well as networking opportunities among fellow researchers and students.

On Feb. 15th 2008, representatives from each ANF network economies presented (the very first time by young scientists) overview on nanotechnology development in their own economies at "Nanotechnology Workshop for the Young Scientists" at the Nanotech 2008 in Tokyo.

Early Career Researcher and Postgraduate Student Symposium 23/02/2008 - 24/02/2008 - Melbourne Business School, Melbourne

The Australian Research Council Nanotechnology Network (ARCNN) held its Postgraduate Symposium on Nanotechnology at the Melbourne Business School on the 23rd and 24th of February 2008. This Symposium was held prior to the International Conference on Nanoscience and Nanotechnology starting on the 25th of February.

On Sunday Morning there was a group discussion on "Tips for Success after your PhD" led by the invited speakers Dr Andrew Harris and Dr Mikel Duke.

Symposium Details:

The symposium was held across one and a half days (Saturday 23 and the morning of Sunday 24th of February). A total of 22 postgraduate research students from around Australia presented talks and there were 45 attendees.

Program

The aim of the symposium was to provide a forum where postgraduate students working on nanotechnology research could present their work, meet other students and researchers, and interact with other research groups in Australia.

Symposium Chairs:

Dr Adam Micolich, University of New South Wales
Mr Thomas Rufford – University of Queensland

Delegates participating at the Symposium

The Symposium was a great success and this led to the planning of the ECR/Postgraduate symposium in February 2009 at the Australian National University.

This symposium was held Concurrently with the the Australia US “Sustainable Nano-Manufacturing Workshop at the same venue.

There was considerable joint interest between the delegates attending both meetings. There was a lot of interaction during the social breaks.

List of delegates who gave a talk at the Symposium

Deslandes	**Alec**	**Flinders University**	**Characterisation of Methane Plasma Treated Carbon Surfaces**
Duke	**Mikel**	Arizona State University	**Utilising the unique surface and structural properties of nanoporous inorganic materials for membrane desalination**
Lauw	Yansen		**NO TITLE**
Mashford	**Ben**	University of Melbourne	**Electroluminescence from Colloidal Quantum Dot Light-Emitting Devices**
Nussio	Matthew	Flinders University	**High Resolution Chemical Mapping of Biomimetic Membranes by Force Volume Imaging**
Parlevliet	**David**	**Murdoch University**	**MAPPECVD for the growth of silicon nanowires**
Puscasu	**Ruslan**	**Swinburne University of Technology**	**Computed Viscosity Kernels for Nanofluids**
Beck	**Fiona**	**Australian National University**	**Modification of Surface Plasmon Resonances in Silver Nanoparticles for Enhanced Light Absorption in Silicon Solar Cells**
Bhatta	Hemant	University of New South Wales	**Diffusion studies using the Nanoporous Structures of Diatoms**
Chan	**Yue**	University of Wollongong,	**Nano scale orbiting systems in vacuum**
Cornejo	Andrew	**University of Western Australia**	**Synthesis of Hydrogen and Chained Onion-like Carbon by the Catalytic Decomposition of Methane**
Cox	**Barry**	**University of Wollongong**	**Curvature effects for small carbon nanotubes**
Flavel	**Ben**	**Flinders University**	**Patterned Attachment of Carbon Nanotubes to Silicon**
Haberl	Bianca	Australian National University	**Characterization of Pressure-Induced Phases of Silicon by Indentation at the Nanoscale**
Mathieson	**Grant**	**Australian Nuclear Science and Technology Organisation**	**Water-splitting anodic films made from nanocrystalline precursors**
Nerush	**Igor**	**Flinders University,**	**Production of carbon nanotubes from ferrocene and liquid hydrocarbons by chemical vapor deposition**
Oliver	**David**	**The Australian National University**	**Mechanical properties of ion-implanted germanium films**
Palms	**Dennis**	University of South Australia	**Influence of Viscosity on the Dynamic Contact Angle**
Razal	**Joselito**	**University of Wollongong**	**A New Approach to Carbon Nanotube Fiber Spinning**
Vasilev	**Krasimir**	**University of South Australia**	**Nanoengineered plasma polymer films**
Wang	**Xingdong**	**The University of Melbourne**	**Synthesis and Photocatalytic Application of Porous Au/TiO2** Nano-hybrids

2008 Asia-Pacific Symposium on Nanobionics
22/06/2008 - 26/06/2008 - University of Wollongong

The Australian Research Council Centre of Excellence for Electromaterials Science (ACES)/ Intelligent Polymer Research Insititute (IPRI) node hosted the first Asia-Pacific Nanobionics Symposium from 22-25 July 2008 at the University of Wollongong's new Innovation Campus.

Vice-Chancellor Professor Gerard Sutton in his welcome said the symposium set history by being the first event held at the new campus and that the symposium represented a partnership between research, industry and commerce, which are three key aspects the innovation campus will bring together.

The CEO of the Australian Research Council, Professor Margaret Sheil, gave the opening address before the keynote address and public lecture by Professor Graeme Clark took the audience into a world where restoration of our senses is a distinct possibility. The brain is a structure that processes sensory information with vast networks of cells, connections and complex chemistry. The key to success in restoring sensing is therefore good solid science, combining new technologies and old,by many passionate Researchers prepared to collaborate across numerous disciplines. Restoration of hearing has already beenachieved, with the multi-channel Cochlear implant, employing this philosophy.

Executive Research Director of ARC Centre of Excellence for Electromaterials Science Professor Gordon Wallace with Vice-Chancellor Professor Gerard Sutton, CEO of the Australian Research Council Professor Margaret Sheil and the inventor of the Bionic Ear, Professor Graeme Clark.

World class researchers discussed how 'Nanobionics' is an area of research that could potentially bridge the gap between the traditional science areas of engineering-based Nanotechnologists and the biological-medical field of bionics. The symposium attracted over 150 delegates from the USA, China, Japan, Italy, Ireland, Korea, Singapore, France, New Zealand and all states of Australia. Several delegates from non-university sectors were also present; including Cochlear, Continence Control Systems International, eDAQ Pty Ltd, Krestal Capital, SciVentures and Nippon Telegraph and Telephone Corporation, Japan.

Key presentations included developments in electromaterials science and in particular how nanotechnology has advanced materials research, and material applications in the areas of bionics:

A paper delivered by Professor Adam Heller (The University of Texas at Austin, USA), pictured left, and outlined a roadmap to implanted biofuel cells using nanostructured electrodes and the tissue-fluid as the electrolyte for the power supply. Based on the nanostructured electrodes, a subcutaneously implantable 24 hour glucose monitor has already been commercialised.

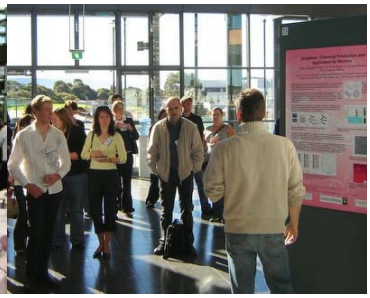
A paper delivered by Professor Mark Cook (St Vincent's Hospital Melbourne/University of Melbourne), pictured right, discussed promising new methods of polymer-based drug delivery systems direct to neural tissue in the brain that are being studied in collaboration with University of Wollongong researchers. Professor Cook is a neurologist specialising in the treatment of epilepsy which is the second commonest serious neurological disease afflicting the population.

Other papers discussed how recent advances in nanotechnology may assist recovery from the most common neurological affliction, stroke. Another focus was on spinal cord damage, where the possibilities of nerve repair using stem cell therapy and nanotechnology were described.
Also discussed were the considerations needed for using implantable bionics for restoring vision to the blind; new technologies in hand rehabilitation devices; optimising material properties and surfaces to enhance cell growth for bionics; molecular control of materials bio-interfaces; recent progress using biopolymers for nerve and muscle engineering; features, prospects and incongruous actuation of artificial muscles; photo-dynamic therapeutics based on carbon nanotubes; creation of bioinspired surfaces; new assays for measurements of DNA and proteins and the development of nanobio interfaces; wearable health monitoring; the evolution of sensing devices leading to internet sensing; advanced materials for nanomedicine using programmable assembly of DNA; and biofuel cells: the challenges and opportunities.

The symposium did not exclusively focus on the science but also emphasised the partnership between research, industry and commerce with a session dedicated to discussing the ethics of medical bionics (Professor Susan Dodds, University of Wollongong) and first-hand descriptions from industry users about the road from research to commercialisation and venture creation through to routine clinical use. This was explored in an interesting account of the cochlear electrode development by Dr Jim Patrick (Cochlear Ltd) and Dr Mike Hirshorn (Kestrel Capital).
The challenges facing commercialisation by nanotechnology research and strategies for maximising returns were detailed by Dr Greg Smith (SciVentrues).

Symposium organisers were also keen to highlight the research and impact of young researchers in the area, achieved through extensive poster sessions for post-graduate students and post-doctoral fellows. Presenters each gave 2 minute oral introductions to their poster which was well received and facilitated networking and in-depth discussion amongst delegates.





In the emerging field of nanobionics it is important to identify and involve highly-talented students. Nanotechnology scientists of the future, Nick Whiteside (3rd year), Jared Barnes (4th year), Kathika Prasad (1st year), George Stanton (2nd year), Geoffrey Pidcock (3rd year) and Cameron Ferris (4th year), all enrolled in the Bachelor of Nanotechnology [Advanced] degree at University of Wollongong, were given the opportunity to attend the symposium following the successful running of a competition where nanotechnology students gave a response to 'How nanobionics represents a new scale in the interface between the synthetic and the natural and how generally it will play a pivotal role in the future of health and medical research'. Selected responses are given below.
"Nanobionics will enable anyone to go down to the local GP, where you can plug in and have your vital signs checked immediately and fine-tuned, become being immunised for any new bad bugs through a download into your immune system and update to the latest version of smell-o-vision".
"Limbs which are lost will be replaced with biological prosthetics that connect straight up to existing muscle tissue. Using this biological-nanomaterial interface, they will be capable of every degree of freedom the original limb had, thanks to its multitude of carefully integrated artificial muscles working in symphony to reproduce the simple motions we take for granted."

"We must develop their research skills so that they can contribute to areas critical to Australia's needs. We are indeed fortunate to have UOW students of the calibre that participated in the recent nanotechnology competition," Professor Wallace said.

The networking and lively discussions continued at the symposium dinner. Professor Julie Steele (Biomechanics Laboratory, University of Wollongong), pictured left, gave an entertaining pre-dinner talk, highlighting how numerous sports injuries occur and outlining how prevention, assessment and rehabilitation could benefit by the use of wearable sensing devices.

The occasion stimulated the audience into song, dance and high spirited antics. Birthday celebrations were not forgotten either! Professor Adam Heller celebrated his 75th birthday.



The symposium concluded with Professor Gordon Wallace's closing remarks on Nanobioncs and "Where to Now"? He concurred with Professor Clark's remarks in the opening address; that the best research is done by fostering innovation and research excellence with world class facilities and synergistic collaborations and partnerships.

The event was made possible with support from the sponsors: IC central, Australian Academy of Science, Australian Research Council, NSW Office for Science & Medical Research and the Australian Research Council Nanotechnology Network who subsidised the attendance of students and early career researchers. Thank you all for your contributions to the symposium. I hope you all relaxed and enjoyed the science and social activities.

"I am back home……..for me it was, in its relevant information content and the quality of the attendees among the best I ever attended."

"…a superb conference. I learned a lot and really appreciated the truly interdisciplinary environment. I think there is a need for more like this."

"Thank you for orchestrating such a wonderful symposium and making it possible, I had a great time and look forward to the next one!"

"Thank you for your exciting meeting. It covered a wide range of research topics and wonderful speakers…..I really enjoyed."

"We enjoyed very much the time with you. Thank you so much for everything."

"Great symposium. I really enjoyed it! Liked the dancing – singing a bit odd!"

"Thank you very much to give me a chance to visit Wollongong and attend the symposium. I enjoy very much and learned much."

"Excellent conference – great facilities – wish you well in the transition to Innovation Campus."

Surname	First Name	Institution
Porazik	Kathika	University of QLD
Gu	Sophia	University of QLD
Guillaume	Le Saux	University of New South Wales
Thirunaukkarasu	P.M	University of South Australia
Quigley	Anita	Bionic Ear Institute, Melbourne
Winther-Jensen	Bjorn	Monash University
Nayagam	David	St Vincents Hospital, Melbourne
Shipham	Kylie	Bionic Ear Institute, Melbourne
Kennedy	Elizabeth	Bionic Ear Institute, Melbourne
Joshi	Tanmaya	Monash University

International Conference on Electronic Materials 2008, 28/07/2008 - 1/08/2008– Sydney Hilton

The IUMRS-ICEM 2008 (International Union of Materials Research Societies - International Conference on Electronic Materials) was held at the Sydney Convention Centre on the 28TH to the 1st of August 2008. The conference was hosted by the Australian Materials Research Society. Meeting chairman Prof. Jim Williams opened the conference and welcomed all attendees. He indicated that this was the first such IUMRS meeting in Australia and he has been looking forward to this for a while. He thanked all the conference sponsors and symposia sponsors for their support. He also mentioned that over 1150 abstracts from 51 countries had been submitted, and over 1000 presentations were scheduled. He invited everyone to enjoy the conference and Sydney.

Nobel Laureate Sir Harry Kroto and Prof.C.N.R.Rao Gabriel Crean and Kerry Doyle (r).

Next, Gabriel Crean, President of IUMRS, welcomed everyone on behalf of IUMRS and he thanked the Australian MRS for hosting the conference. He briefly described the current activities and accomplishments of IUMRS. Ms. Kerry Doyle, of the New South Wales Office of Science & Medical Research, then welcomed everyone to the conference and to Sydney. She said the conference had great potential for linking the research community in materials with local industry, which is one of the goals of her office.

Architecture in NanoSpace - Sir Harold W. Kroto (The Florida State University, and 1996 Nobel Laureate in Chemistry) kicked off the conference with a plenary presentation on Architecture in NanoSpace. At the interface of nanoscience and nanotechnology, chemistry, physics and biology come together. Complex molecules that "do things" are being made, based on understanding the clustering behavior of molecules. Kroto and others in the UK grew up tinkering with Meccano toys, experiencing the "nuts and bolts" of engineering at an early age. Such tinkering skills are now being applied to versatile fullerene structures including carbon nanotubes, buckyballs large and small, and functionalized constructions. Kroto also now spends much of his time inspiring young people around the world with the marvels of fullerenes through lectures, fullerene models, and humor.

PLENARY LECTURE: C.N.R. RAO - Alternative Routes to Multiferroics

In the Tuesday morning plenary session, Prof. C.N.R. Rao of the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India, spoke about new routes for achieving multiferroic materials, which simultaneously exhibit some form of ferromagnetism and ferroelectricity. Among the mechanisms examined for achieving multiferroics were lone-pair effects and local non-centrosymmetry. Lastly, new results on ferroelectric-ferromagnetic nanoparticles were presented. It is known that all oxide nanoparticles show some surface ferromagnetism, while $BaTiO_3$ nanoparticles are also known to be ferroelectric. As a result, these oxide nanoparticles may provide another route to multiferroic materials.

PLENARY LECTURE: SUSUMU NODA

Photonic crystals, wherein the refractive index changes periodically in 2 or 3 dimensions, is the subject of significant and extensive current research. In an outstanding plenary talk, Prof. Susumu Noda of Kyoto University, Japan, described recent results in the manipulation of photons by engineering the photonic crystal structure. In the second part, Noda discussed high-Q nanocavities which are very important for various applications including nano-lasers, photonic nano-chips, stopping or slowing light, single-photon emitters, electron-photon strong coupling devices, and biosensors.

Noda discusses his work with a section of the audience after his plenary talk

PLENARY LECTURE: MILDRED DRESSELHAUS

Potential of Nanostructured Materials for Addressing the Energy Problem

The Wednesday morning plenary session began with Mildred Dresselhaus, of the Massachusetts Institute of Technology, USA, looking at the increasing global demand for energy and strategies for meeting this demand. In the coming decades, population increases and the increased energy consumption of developing countries are expected to increase worldwide energy consumption from 13 TW in 2000 to 25-30 TW by 2050 and 40-50 TW by 2100. Dresselhaus believes that nanomaterials, with their unique properties at the nanoscale and high surface areas for catalytic behavior, are well-suited for energy applications. Dresselhaus stressed the need for investment in basic research.

CONFERENCE BANQUET

The important event of the day was the conference banquet held off-site at Luna Park. After the dinner, meeting chair Jim Williams took the opportunity to thank all the people who were involved in organizing the conference from a planning and administrative standpoint.

ICEM CONCLUDED on Friday, August 1, after a memorable week of activities and events. A special Energy Forum was the major event of the day on Thursday. An Industry Forum was held on Friday. Technical sessions continued through Friday.

ENERGY FORUM

The Energy Forum was put together as a mechanism for materials researchers to consider and discuss present and future issues relating to energy, and to come up with creative solutions. The first session was titled "Energy in Perspective" chaired by Elizabeth Fleischer. Materials research clearly has an important role to play in finding solutions, as evidenced from the presentations in the forum.

Energy forum audience

The first talk of the first session **Energy in Perspective** was given by Janette Lindesay, a climatologist with the Australian National University, on Climate Change Tipping Points. She defines tipping point as a specific threshold beyond which there could be drastic consequences to the earth's environment and human life.

This was followed by a talk by V.S. Arunachalam, Center for Study of Science, Technology and Policy (CSTEP), India, on the Global Energy Landscape. There are three major challenges in this arena, greenhouse gas emissions, depletion of economically recoverable resources and the idea of "energy for all.

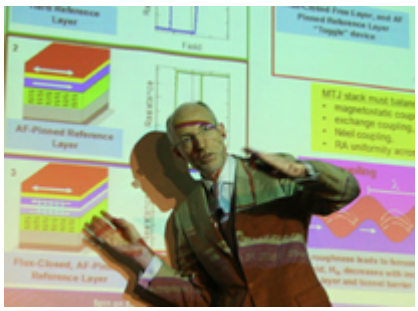
Dave Ginley of NREL, USA, rounded off the session by discussing the "True Meaning and Impact of Energy Independence". One of the consequences of higher CO_2 levels is the effect on biological systems in oceans. Ginley discussed renewable energy sources with a focus on solar energy.
In the second session of the Energy Forum, Andrew Blakers, of ANU, an overview indicated energy needs covering a world with ubiquitous, indefinitely

Australia, started with of Solar Energy. He that all of the world's could be met by very small area of the solar cells. Solar is vast, clean inexhaustible, and sustainable.

In the third session of the forum, Calum Drummond, of CSIRO, Australia, spoke about electrical energy storage technologies. The need for improved electrical storage becomes very evident when one looks at the rapid improvements in computational performance by silicon technology.
Also in session 3, Maurice Ripley, of ANSTO, Australia, described the current status of the nuclear industry and challenges facing the industry as they move towards next generation reactors. In recent years, the nuclear industry has been experiencing a renaissance. To put this in perspective, there are currently 493 operating reactors in the world, 36 being built, 93 ordered or planned, and 218 proposed.
The energy forum ended with a panel discussion covering all the issues raised in the presentations in the forum.

INDUSTRY FORUM Plenary Presentations

Gabriel Crean, of AIT, Ireland, gave a report on the Irish cconomy and landscape, the Irish Government Policy Framework for Industry, the Indigenous Industry Sector, the Global Entrepreneurship monitor (GEM), and the future challenges for Irish startups. Ireland's economic growth has outstripped that of the United States and the European Union. The Government of Ireland is very interested in the progress of Irish companies in the world market and offers a well focused series of programs that are monitored closely.



Dave Eaglesham, of First Solar, Ohio, USA, again gave a very instructive talk on what it takes to get a product to market. He recounted the history of First Solar which had an investment of $80M by John Walton (of Wal-Mart fame). After attempting to make the cadmium telluride on glass cells that comprise the photovoltaic cells, First Solar had to ask for another $80M and it is a measure of John Walton's vision that he came up with the money. Dave's message was that the dollars per watt is the main driver for his photovoltaic cells and they must reach grid parity if they are going be successful in.
Stuart Parkin of IBM Almaden, USA, talked about the new class of solid state memory that is being developed at IBM that will have the same cost as a magnetic hard-drive in a computer with no moving parts and with the speed of a flash memory but with longevity and the ability to be rewritten many times. He talked about devices that use the movement of domain wwalls to operate and he described a race-track memory that will be a 3-dimensional structre capable of storing vast amounts of data very quickly. He said that some of IBM's major customers were banks who need to manipulate vast amounts of data.

Australian Startup Case Studies

The 2nd session of the Industry Forum focused on the factors affecting five different Australian startup companies. The session began with Jose Alarco, of The Very Small Particle Company (VSPC). VSPC is focusing on the development of nanoscale $LiFePO_4$ as a cathode material for high power lithium ion batteries in the automotive market. As such, there is a very large potential market for this material. In addition, $LiFePO_4$ provides a significant safety advantage over the current $LiCoO_2$ cathode technology and is capable of higher power for rapid charging and discharging. With these advantages, VSPC is currently looking towards implementing the supply of nanoscale $LiFePO_4$ by the ton, which will involve the development and construction of new plants and business restructuring to provide more skills at the negotiating and management levels.

Karl Föger, of Ceramic Fuel Cells Limited (CFCL), discussed the development of the company from a research and development consortium to a listed company. While many challenges existed along this path, one of the primary challenges was the focusing of the research and development work into a defined market, as fuel cells are capable of a wide variety of applications. With this in mind, CFCL chose to focus on the development of solid oxide fuel cells for the home heating market and partnered with a number of utilities and boiler makers. CFCL now has a clear commercialization path, funding, product and market focus, partnerships and manufacturing strategy. However, technical challenges, such as making fuel cells cheaper and last longer, do remain.

Richard Taylor, of Mesaplexx, which develops ceramic and high temperature superconductors for microwave applications, focused more on some of the practical aspects facing a startup company. These included the potential difficulties in addressing a multi-discipline research problem and compiling a multi-discipline research team. Ensuring that researchers from disciplines ranging from materials science to mathematics to electrical engineering can communicate effectively and work together can be a significant problem. In addition, working with venture capitalists and government agencies can also be problematic, as they may have different time horizons and objectives than the company itself.

Dax Kukulj, of RPO P/L, discussed the development of their polymer waveguide technology. With the telecom boom in late 2000, the company was founded to commercialize polymer waveguide technology for telecommunications applications. However, the subsequent crash of the telecom market left little demand for their products. This inspired a move towards the application of the waveguides to the touch screen market instead.

Industry forum panel discussion

The Conference was well attended during the whole week and there were over 700 delegates attending over the week.

List of Speakers covered by the ARCNN Funding

Alexander M Grishin	Royal Institute of Technology	SE	Perspectives of ferroelectric gate SiC FETs
Peter Friedrichs	SiCED	DE	Silicon carbide diodes and transistors designed to be used in hybrid Silicon carbide - Silicon solution
Makoto Kasu	NTT Basic Research Laboratories	JP	Challenges of Diamond-based Electronic Devices
matthew peter halsall	The University of Manchester	GB	Combined Super STEM, and PL Spectroscopy of un-doped and Rare Earth doped nc-Si-rich SiOx and SiNx thin films on (100) Si
Susan Jane Angus	The University of Melbourne	AU	Quantum dots and radio-frequency single electron transistors in silicon
Martin Fuechsle	Centre for Quantum Computer Technology	AU	STM-patterned P-donor based planar Quantum Dot structures in Silicon
Federico Rosei: Quebec	INRS-EMT	CA	Alloying, self-ordering and stability of Ge/Si semiconductor nanostructures
Sven Rogge: DELFT	Delft University of Technology	NL	Addressing the charge and spin of a single dopant atom in a nano MOSFET
Jean Francois Damlencourt - CEA.	Grenoble Cedex 9, France	FR	Probing the Properties of III-Nitride-based Semiconductors for Opto- and Spintronic Device Applications from First-Principles Calculations
Yoshiro Hirayama: Tokyo	Tohoku University & ERATO Nuclear Spin Electronics Project	JP	Spin and valley degree of freedom in silicon quantum structures
Alexander M Grishin	Royal Institute of Technology	SE	Heteroepitaxial magneto-optical photonic crystals
Alfredo De Rossi	Thales Research and Technology France	FR	Membrane Photonic Crystals based on III-V semiconductors: potential for all optical switching, light matter interaction and slow light
Michal Lipson	Cornell University	US	Photonics on Chip
peter clay eklund	Penn State University		Resonant Raman Scattering from Graphene and Narrow Graphene Ribbons
Michael John Ford	Institute for Nanoscale Technology	AU	The effect of structural order and disorder on the plasmon absorption of colloidal crystals
Fu Lan	The Australian National University	AU	III-V Quantum Dot-based Optoelectronic Devices
Marek Godlewski	Institute of Physics PAS	PL	Nanoparticles doped with rare earth and transition metal ions for optoelectronic applications
Kitsuki, H (Santa Clara Univ., USA)	Santa Clara University	US	Current-carrying Capacity of Carbon Nanofiber Interconnects
Paul Mulvaney	University of Melbourne	AU	Mapping the Surface Plasmon Resonance Landscape of Gold Nanocrystals
Harold G Craighead	(Cornell Univ, uSA)		

The following students and ECR's received a prize for best paper.

Overall Conference	Poster	Sören Wohlthat	Conduction Properties of Molecules Anchored via Nitrogen to Gold Electrodes
Overall Conference	Poster	Artur Podhorodecki	New Solution for Nitrides Optoelectronics. Nanocrystalline GaN and GaN:Eu3+ Powder. Their Optical and Structural Properties
Symposium A: Wide Band Gap Materials including GaN, ZnO, SiC, Diamond	Oral	Gilberto A Umana-Membreno	Total-Dose Radiation-Induced Effects in AlGaN/GaN High Electron Mobility Transistors
Symposium B: Compound Semiconductor Materials and Devices	Oral	Zohair S Hussain	Amorphisation of Compound Semiconductors - A New Insight into Ternary Compounds
	Oral	Claudia Sarah Schnohr	Composition-Dependent Inter-Atomic Distance Distributions and Bond Angles in Ga1-xInxP Alloys Measured by Extended X-Ray Absorption Fine Structure Spectroscopy
	Poster	Gordon Keen Onn Tsen	Various Annealing Methods for Activation of Arsenic in Molecular Beam Epitaxy Grown HgCdTe
Symposium C: Silicon and Group IV Materials and Devices for Electronics and Opto-Electronics	Poster	Byron John Villis	An Angular Dependence Deep-level Transient Spectroscopy Study of He Implanted Si
	Oral	Sarah Rose McKibbin	Towards 3D Silicon Device Fabrication: The Effect of Incorporation Temperature on Activation and Encapsulation of P:Si Delta-Doped Layers
Symposium D: Nanophotonic Structures and Devices	Oral	Cameron Lesley Smith	Comparison of Microfluidic Cavities Based On Chalcogenide and Silicon Photonic Crystals
	Oral	Igor Aharonovich	Fabrication of Nickel Centers in Diamond for Quantum Optical applications
	Oral	Hannah Jane Joyce	Growth and Characterisation of High Purity Twin-Free GaAs Nanowires
Symposium E: Nanocrystals, Nanoparticles, Nanotubes and Nanowires for Electronic & Optical Applications	Oral	Xiaosheng Fang	1D ZnS Nanostructures: Controlled Growth and Field-emission Applications
	Oral	Susan Montgomery Graham	Bacterial S-Layer Templating Using Au Nanoparticles and Gene Modification
	Oral	Wei-Jung Lai	InN Nanostructure / Polymer Hybrid System for Photodetector Application
	Oral	Satyanarayan Barik	Intermixing of InAs/InP Quantum Dots Grown using Metal-Organic Chemical Vapour Deposition

17th International Conference on Photochemical Conversion and Solar Energy 27/07/2008 - 01/08/2008 - Sydney, Australia

Re: Australian Research Council Nanotechnology Network Sponsorship
The immensely successful 17th International Conference on Photochemical Conversion and Storage of Solar Energy (IPS 17) was held in Darling Harbour, Sydney on 27th July – 1st August 2008 attracting **390 participants** from all over the world. The **purpose of the IPS conference series** is to assemble a mix of eminent international researchers, academics and early career researchers to present and discuss the latest advances in photo-based technologies and concepts for sustainable energy and environmental applications. The IPS 17 ran for four full days and one half day, of which **technical program** comprised of 17 plenary lectures, 18 invited oral presentations, up to 250 poster presentations and a scientific workshop focusing on a variety of topics including solar-relevant materials, devices, systems and applications and opportunities for industries. The conference has successfully provided the Australian researchers with invaluable opportunities to demonstrate their expertise and cutting-edge research in solar energy and technology to an international audience as well as engagement with commercialization opportunities.

Key outcomes of the IPS 17:

1. Raising both national and international awareness of Australian research on photo-based technologies;
2. Providing Australian researchers with details on the latest development in international research strategies, directions and goals in the field;
3. Establishing new national and international linkages between Australian and overseas research group;
4. Expanding early career researchers knowledge-base through part-taking in various workshop themes. The high concentration of expert provided an excellent opportunity for early career researchers to increase their knowledge in the area;
5. Circulation of research efforts/findings to a broader national/international audience through journal publications and media promotion.

ARCNN sponsorship fund of AUD 10,000 was expended on supporting non-UNSW early career researcher and PhD student participants as well as on the travel and accommodation of plenary speakers:

Name	Institution	Research Topic
Early Career Researcher		
Dr Naomi A. Lewcenko	Monash University	Solar Cells
Dr Annette Louise Koo	Monash University	Photocatalysis for Water Splitting
Students		
Vincent Wing-Hei Lau	University of Sydney	Photocatalysis for Water Splitting
Tina AiTing Tan	University of Melbourne	Fundemantal in Polymer Synthesis
Dillip Kumar Panda	University of Wollongong	Solar Cells

Name	Institution	Research Topic
Plenary Speakers		
Prof. Michael Graetzel	Institute of Photonics and Interfaces EPFL	Solar Cells
Prof. Dirk M. Guldi	Universitat Erlangen-Nurenberg	Carbon Nanostructures
Prof. Mildred Dresselhaus	Massachusetts Institute of Technology	Carbon Nanostructures, Bismuth Nanowires, Low Dimensional Thermoelectricity

Acknowledgement of funding provided by ARCNN was emphasized on the conference website, final program and on the cover of proceedings (electronic and hard copy), and in all other related publicity materials. Lastly, on the behalf of the local and international organizing committees, I would like to express our deepest gratitude for the support provided by ARCNN, which has definitely contributed to the success of the IPS 17 conference.
Best regards,
Professor Rose Amal
Chair of the IPS 17

Dr Ian McKinnon opening the conference

Delegates during the Plenary lecture

1st Asian-Oceania Neutron Scattering Association
17/08/2008 - 23/08/2008 - Daejeon, Korea

The 1st AONSA Neutron Summer School held at KAIST, Korea. August 18th to 23rd, 2008.

As the first activity of the newly formed Asia-Oceania Neutron Scattering Association (AONSA), the 1st AONSA neutron summer school, co-hosted by the Korea Atomic Energy Institute (KAERI) and the Korean Neutron Beam Users Association (KNBUA), was held at the Korea Advanced Institute of Science and Technology (KAIST) in Daejeon, Republic of Korea from August 18th to 23rd. The summer school brought 44 graduate students and junior scientists in the region together. They came from such diverse set of countries as Australia, China, India, Indonesia, Japan, Korea, Malaysia and Taiwan.

Funding to support the travel expenses of five Australian graduate students was sourced from the Australian Research Council Nanotechnology Network (ARCNN) and the Australian Institute of Nuclear Science and Engineering (AINSE). The five students were selected by a panel of experts in neutron scattering, based upon their CV and a short proposal on how the school would directly benefit their postgraduate research programs. The students that attended the school were:

Ms Rachael Barnett (James Cook University)
Ms Mirjana Dimitrijev (University of Queensland)
Mr Benjamin Kent (RMIT)
Mr Jean-Pierre Veder (Curtin University of Technology)
Mr Yichao Wang (Deakin University)

The school commenced with welcoming remarks by Soon-Heung Chang, provost of KAIST and Young-Jin Kim, vice president of KAERI. The topic of the summer school was neutron small angle scattering and reflectometry and a series of lectures on basic theories, scientific applications, and data reduction and analysis methods, were delivered by leading scientists in the region, Mitsuhiro Shibayama (U. of Tokyo/ISSP), Gregory G. Warr (U. of Sydney) and Sung-Min Choi (KAIST) for SANS; Michael James (ANSTO), Naoya Torikai (KEK) and Kwanwoo Shin (Sogang U.) for neutron reflectometry, and Kye-Hong Lee and Sungil Park (KAERI) for the neutron facilities in Korea and the region. The first evening saw each student present a poster relating to their scientific research, giving experts and their fellow students the opportunity to exchange information and ideas. Students had extensive data reduction and analysis sessions throughout the week. A full program of lectures and practical sessions are attached following this report.

The 44 hard working participants not only enjoyed a week full of lectures and group projects but also had good chances to get to know each other. The planned excursion to a local tourist attraction on the third day was washed-out, but the students and staff ended up having great fun anyway at the school banquet at a local museum. Friday afternoon saw a tour to the Hanaro research reactor at the Korean Atomic Energy Institute.

At the end of the course, the participants gave presentations on what they have worked on in groups, all of which were truly excellent, and they were awarded with certificates of completion. Certificates of appreciation by the lecturers were presented to teaching assistants and secretaries for their outstanding services. Plaques of appreciation from the AONSA were presented to all the lecturers for their wonderful lectures and tremendous efforts for the school. The farewell lunch was enjoyed by all the participants.

The school, which aimed to train young neutron scientists in the region and to build friendship among them, enjoyed tremendous support from the region's neutron societies and facilities as well as support from many local organizations in Korea, and fulfilled its goal quite successfully. The organizing and program committee of the school express their gratitude to Dr. Steven Kline at NIST Center for Neutron Research for providing NIST SANS data which were used in the school. The next AONSA neutron school is planned in August 2009 in Australia.

Lecture on Neutron Reflectometry

Korean Barbecue

(Back): Prof. Greg Warr, Mr Benjamin Kent, Prof. Michael James, Prof. Mitsuhiro Shibayama, Prof. Sungmin Choi, Mr Jean-Pierre Veder, Prof. Kwanwoo Shin, Prof. Naoya Torikai. (Front) Ms Rachael Barnett, Mr Yichao Wang, Ms Mirjana Dimitrijev.

School Participants

Practical Session: Analysing Experimental Data

Innovations Campus Scanning Probe Microscopy and Hands-On Workshop '08 - 28/08/2008 - 30/08/2008 - University of Wollongong

Dr Michael Higgins & Prof. Gordon Wallace

ARC Centre of Excellence for Electromaterials Science (ACES),
Intelligent Polymer Research Institute (IPRI),
AIIM Facility, Innovation Campus,
University of Wollongong,
Squires Way, Fairy Meadow, NSW, 2519, Australia

9th February 2009

Dear ARCNN,

As organisers of the “Scanning Probe Microscopy and Hands-On Workshop’08”, we would like to sincerely thank the ARCNN for their financial support of the workshop. Without this funding, we would not have been able to host such a successful event and support the participation of top invited speakers, early career researchers, and postgraduate students. The interest in the workshop was overwhelming with over 100 attendees and feedback from the Scanning Probe and Atomic Force Microscopy community was very positive. Everyone had a thoroughly fruitful and enjoyable time, and plans are already being organized to hold a similar event this year.

Many thanks again - your support is much appreciated,

Dr Michael Higgins & Prof. Gordon Wallace.

Intelligent Polymer Research Institute University of Wollongong NSW 2522 Australia
Telephone: +61 2 4221 3127 Facsimile: + 61 2 4221 3114
www.uow.edu.au/science/research/ipri/

Dr Michael Higgins 09/02/09 ARC Centre of Excellence for Electromaterials Science Intelligent Polymer Research Institute, AIIM Facility, iC campus University of Wollongong Squires Way, Fairy Meadow, NSW 2519, Australia.

ARCNN Report on the Scanning Probe Microscopy (SPM) and Hands On Workshop'08

The Australian Research Council Centre of Excellence in Electromaterials Sciences (ACES) and the Intelligent Polymer Research Institute (IPRI) recently hosted a workshop entitled "Scanning Probe Microscopy (SPM) and Hands On Workshop'08" at the new Innovation Campus (iC), Wollongong from 28th – 30th August, 2008. The aim of the workshop was to present the latest advances in SPM research, including new approaches to SPM nanometrology, nanoscale properties of novel interfaces/nanomaterials, and design of emerging nanodevices. Importantly, the workshop provided free registration for students and early career researchers and the opportunity to meet and discuss with leaders in the SPM and nanotechnology research field. The final day of the workshop featured a free "hands-on" SPM training session for students. Altogether, the workshop generated an overwhelming response from the Australian SPM and nanotechnology community, with approximately 100 registrants making the journey to beautiful Wollongong.

In his welcome address, the executive director of ACES, Prof. Gordon Wallace, highlighted the importance of SPM in nanotechnology research and exciting opportunities that lie ahead in the field. Dr John Miles from the National Measurement Institute (NMI) commenced the workshop talks by emphasizing the importance of nanometeroloy standards and was followed by a list of world class speakers, including our international speaker, Dr Christine Kranz from Georgia Tech, USA, who gave a fascinating presentation on the nanoscale probing of biological interactions using Scanning Electrochemical AFM. The invited speaker list included:

- Prof Michelle Simmons (University of New South Wales,
- Assoc. Prof John Sader (University of Melbourne, VIC),
- Prof. Roland De Marco (Curtain University of Technology,
- Dr Hadi Zareie (University of Technology Sydney, NSW),
- Dr Vince Craig (Australian National University, ACT),
- Dr Kristen Bremmell (University of Adelaide, SA),
- Dr Mickey Huson (CSIRO Textile Division, VIC),
- Dr John Miles (National Measurement Institute, NSW),
- Dr Greg Watson (Griffith University, QLD),
- Prof. Hugh Brown (University of Wollongong, NSW),
- Dr Edith Sevick (Australian National University, ACT),
- Prof. Clive Prestidge (University of South Australia, SA),
- Dr Chris Pakes (Latrobe University, VIC),
- Assoc. Prof Joe Shapter (Flinders University, SA),
- Dr Michael Higgins (University of Wollongong, NSW)
- Dr Ray Dagastine (University of Melbourne, VIC)
- Dr Adam Mechler (Monash University, VIC)

The workshop also provided an opportunity for the leading SPM companies and their local distributors to give a short presentation to introduce themselves and promote their various instruments/products to the local SPM community. The networking and lively discussions continued at the symposium dinner, with the announcements of the winners of the image competition. The winner was Thomas Becker (Curtain University) with his image of "Hydrogel" and the runner up Jolanta Watson (Griffith University) with her image of "A Moth's Eye View". The competition was kindly sponsored by the Innovation Group (distributors for Asylum Research) with $500 awarded to the winner and $100 for the runner up.

The workshop presentations concluded with Professor Gordon Wallace's closing remarks on Atomic Force Microscopy's role in Nanobioncs research and that "the best research is done by fostering innovation and synergistic collaborations, which arise from such workshops".

The following day comprised a full-day "Hands-On" SPM training session for 12 registrants. Dr Michael Higgins and colleagues from the University of Wollongong ran the sessions using three different AFM systems. The session commenced with a presentation focusing on the basic principles of AFM and SPM operation, including spring constant calibrations, force measurements, imaging, working in liquids and many more applications. The attendees then had the opportunity to experience and learn AFM through subsequent hands-on sessions in areas such as materials and polymer applications (e.g. friction measurements, nanolithography and phase imaging) and the life sciences (e.g. DNA measurements, live cell imaging, force measurements/cell indentation and combined optical and AFM). The session provided a tremendous platform for students embarking on AFM/SPM research and an enjoyable time was had by all.

The event was made possible with support from the following sponsors: the Australian Research Council, the Australian Research Council Nanotechnology Network, the Australian Research Network for Advanced Materials, who subsidised the attendance of students and early career researchers, as well as our industry and other sponsors, including SciTech, JPK instruments, Veeco, New Spec, Asylum Research, Nucletron, The Innovation Group, ACES and IPRI. We dearly thank you for all of your contributions to the workshop and all of the attendees for taking the time to visit Wollongong. We hope you all enjoyed your stay and look forward to seeing you again at a similar event in the future.

Feedback and Comments:

"Thanks Michael for organising such a workshop, I think it has been 5 years since a similar workshop has been held and it is thoroughly worthwhile to catch up and see how others are approaching their research".

"Thanks, it made a great 3 days at the workshop".

"Thanks very much for organising what turned out to be a very interesting and stimulating workshop".

"I really enjoyed the trip to Australia, I met so many nice people and had very interesting conversations! Also, the workshop was really great, very interesting topics and great talks!

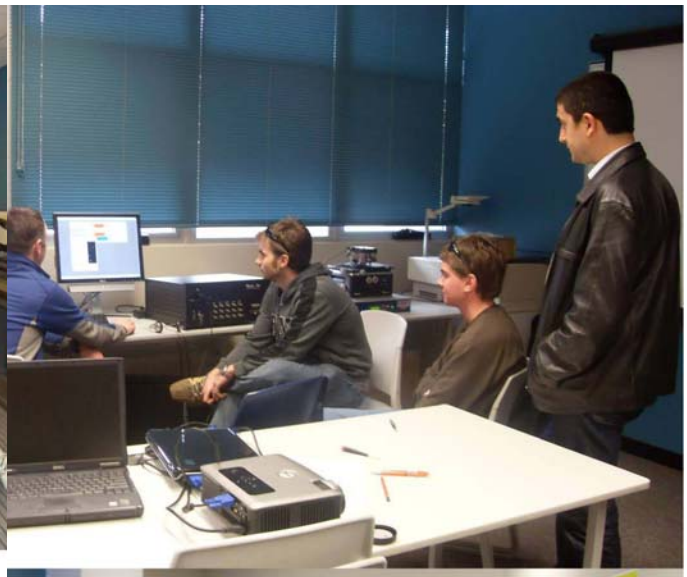
"The workshop was great."

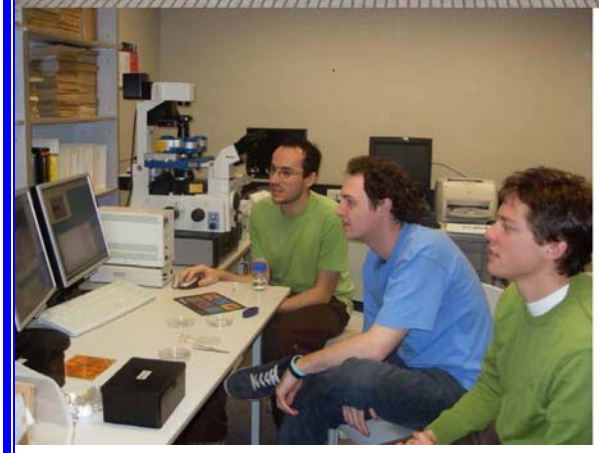
"Thank you very much for everything – the workshop was a great experience. "

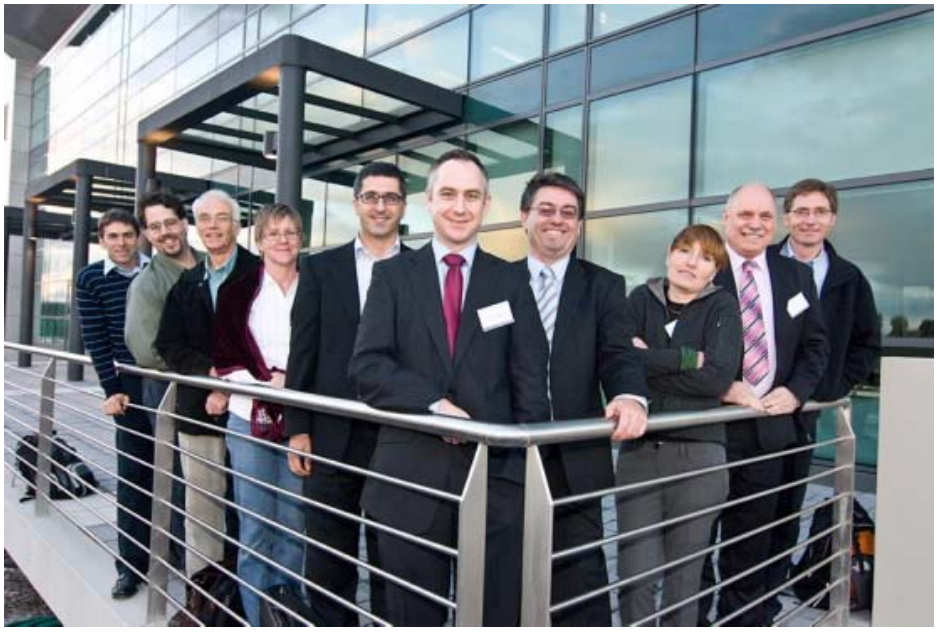
"I enjoyed Thursday very much and my student, who stayed for the workshop found it extremely useful."

Photos from the Workshop Dinner:

Photos from the Hands-On Workshop Session







Invited speakers

List of Attendees:

Name	*Institution*	*Rego Type*
Abduhakeem Al Alturki	University of Wollongong	Student/Early Career
Adam Mechler	Monash University	Invited Speaker
Adrian Gestos	University of Wollongong - ACES	Student/Early Career
Aijian Zhang	University of Wollongong - ACES	Student/Early Career
Alberto J. Granero	University of Wollongong - ACES	Student/Early Career
Andrew Ford	La Trobe University	Student/Early Career
Andrew Michael Telford	University of Sydney	Student/Early Career
Anya Yago	University of Queensland	Standard Delegate
Asa Jamting	National Measurement Institute	Standard Delegate
Ben Flavel	Flinders University	Student/Early Career
Benjamin Mueller	University of Wollongong - ACES	Student/Early Career
Bogdan Donose	Australian National Fabrication Facility	Student/Early Career
Brant Gibson	The Innovation Group	Industry
Buyung Kosasih	University of Wollongong	Standard Delegate
Caiyun Wang	University of Wollongong - ACES	Student/Early Career
Chaohua Jiang	University of Wollongong	Student/Early Career
Charles Loo Chin Moy	University of Sydney	Student/Early Career
Charles Kwet Shin	University of Sydney	Student/Early Career
Cheng Lu	University of Wollongong	Standard Delegate
Chris Gibson	Flinders University	Standard Delegate
Chris Pakes	La Trobe University	Invited Speaker
Christine Kranz	University Ulm, Germany	Invited Speaker
Clive Prestidge	University of South Australia	Invited Speaker
Con Saprounas	SciTech Pty Ltd	Industry
David Oliver	ANU Canberra	Student/Early Career
Dylan Riessen	University of Technology, Sydney	Student/Early Career
Elise Stewart	University of Wollongong - ACES	Student/Early Career
Geoff Spinks	University of Wollongong - ACES	Standard Delegate
Gordon Wallace	University of Wollongong - ACES	Standard Delegate
Grace Stevenson	University of Wollongong - ACES	Student/Early Career
Greg Tillman	University of Wollongong	Standard Delegate
Gregory Watson	Griffith University	Invited Speaker
Guillaume Michal	University of Wollongong	Student/Early Career
Hadi Zareie	University of Technology, Sydney	Invited Speaker
Hongtao Zhu	University of Wollongong	Standard Delegate
Irene Slota	CSIRO	Standard Delegate
Jan Herrmann	National Measurement Institute	Standard Delegate
Jim Efthimiadis	NewSpec Pty Ltd	Industry - $350
Joe Shapter	Flinders University	Invited Speaker
John Miles	National Measurement Institute Australia	Invited Speaker
John Sader	The University of Melbourne	Invited Speaker
Katie Levick	UNSW	Standard Delegate
Kerry Gilmore	University of Wollongong - ACES	standard Delegate
Kim Sewell	University of Queensland	Standard Delegate
Kristen Bremmell	University of Adelaide	Invited Speaker
Lauren Palmer	The University of Melbourne	Student/Early Career
Leng Nghiem	University of Wollongong	Student/Early Career
Linda Hillbrick	Deakin University	Student/Early Career
Lynn Dennany	University of Wollongong - ACES	student/Early Career
Malcolm Lawn	National Measurement Institute	Standard Delegate

Maryam Naebe	Deakin Univesity	Student/Early Career
Md Hemayet Uddin	The University of Melbourne	Standard Delegate
Miao Chew	CSIRO	Standard Delegate
Michael Coutts	University of Technology, Sydney	Student/Early Career
Michael Higgins	University of Wollongong - ACES	Student/Early Career
Michelle Simmons	UNSW	Invited Speaker
Mickey Huson	CSIRO	Invited Speaker
Oyong Novareza	University of Wollongong	Student/Early Career
Paul Hamilton-Brown	SciTech Pty Ltd	Industry
Paul Molino	University of Wollongong - ACES	Student/Early Career
Peter Sherrell	University of Wollongong - ACES	Student/Early Career
Philip Whitten	University of Wollongong - ACES	Student/Early Career
Qiang Zhu	University of Wollongong	Student/Early Career
Ray Dagastine	The University of Melbourne	Invited Speaker
Ray Johnson	University of Wollongong - ACES	Student/Early Career
Rebecca Goulter	University of Queensland	Student/Early Career
Rick Walsh	The Australian National	Student/Early Career
Robert Saunders	Nucletron Pty Ltd	Industry
Roland De Marco	Curtin University of Technology	Invited Speaker
Sahar Okhovat	University of Wollongong	Student/Early Career
Sanjeev Gambhir	University of Wollongong - ACES	Standard Delegate
Scott McGovern	University of Wollongong - ACES	Student/Early Career
Sean Lim	UNSW	Standard Delegate
Shannon Little	University of Wollongong - ACES	Student/Early Career
Stefanie Sham	The University of Melbourne	Student/Early Career
Stephen John	University of Wollongong	Student/Early Career
Suriya Ounnunkad	University of Wollongong - ACES	Student/Early Career
Tim Burgess	ANU Canberra	Student/Early Career
Toni Campbell	University of Wollongong - ACES	Standard Delegate
Tony Romero	University of Sydney	Standard Delegate
Troy Lowe	University of Wollongong - ACES	Student/Early Career
Victoria Coleman	National Measurement Institute	Student/Early Career
Vincent Craig	ANU Canberra	Invited Speaker
Weimin Zhang	University of Wollongong - ACES	Student/Early Career
Wenrong Yang	The University of Sydney	Student/Early Career
Willo Grose	University of Wollongong - ACES	Student/Early Career
Xiao Liu	University of Wollongong - ACES	Student/Early Career
Yao Han	University of Wollongong - ACES	Student/Early Career

Workshop on Bio/Micro/Nanofluidics, Complex Flows and Rheology 01/09/2008 - 02/09/2008 - Monash University

Report: Complex Fluids & Microfluidics Workshop 2008 (CFMW08)

The inaugural Complex Fluids & Microfluidics Workshop was held in Melbourne, Australia at the beginning of September 2008. The workshop constituted an informal gathering of researchers working in complex fluids and microfluidics with the primary purpose of providing a forum for cross-fertilisation of ideas on current advances and future directions in these areas. In addition, the workshop, whose programme comprised of eight plenary lectures and two panel discussion sessions to allow for the exchange of ideas amongst delegates and panel members on perspectives on future directions in both subject areas, was also aimed at providing graduate students with the opportunity to meet and listen to eight of the most prominent experts in complex fluids and microfluidics. The informal and small group setting of the workshop also provided ample opportunities for networking and discussion.

The workshop was well-attended, with over 80 participants from over 25 institutions across the world, including those as far away as China, France, Japan, Singapore, Sweden, Switzerland, Russia, Taiwan, UK and USA, as well as several researchers from industry. About half of the participants consisted of graduate students, whose registration fee was waived, made possible by kind support from the Australian Research Council Nanotechnology Network. Other sponsors of the workshop include the Monash Institute of Nanosciences, Materials & Manufacturing, the Australian Society of Rheology, the Commonwealth Scientific & Research Organisation and the Institute for Platform Technologies at RMIT University.

Following a short welcome from Professor Tam Sridhar, the Dean of Engineering at Monash University, Professor John Brady (California Institute of Technology, USA) delivered the first plenary lecture on the microrheology and microdiffusivity associated with single particle motion in colloids. Due to the disturbance in the surrounding microstructure surrounding the particle as it is pulled through the medium, a nonlinear response results in the form of an osmotic or reactive entropic force which arises to resist the particle motion. An analytical model was constructed and Brownian dynamics simulations were carried out, both of which were employed to extract information on the effective viscosity of the colloidal dispersion. This is in contrast to the inference of elastic or viscous moduli of the dispersion from measurements of the fluctuating thermal motion associated with the linear, near-equilibrium response of passive probe particles. A discussion was then provided on how the microviscosity obtained relates to conventional macroscopic rheological measurements.

This was followed by an in-depth discussion on three-dimensional foam rheology associated with random soap froth by Dr Andrew Kraynik (Sandia National Laboratories, USA). Through simulations carried out with the *Surface Evolver* software, Dr Kraynik showed how the foam structure and packing can be predicted, including the intermittent topological transition cascade that arises in the foam structure, and how their shear modulus and yield stress can be calculated. The simulation results showed remarkable agreement with the seminal experimental results by Matzke (1946) and the shear modulus measurements of Princen & Kiss (1986).

An excellent tutorial on the rheology of entangled, highly branched flexible polymers was presented by Professor Gary Leal (University of California, Santa Barbara, USA). The concept of the tube model used to describe the linear and nonlinear behaviour of linear chain polymers was systematically extended to branched polymers, from star polymers with single branch points to multiple branches and subsequently branched polymers with multiple branch points.

Conceptual issues arising in recent attempts to describe assymmetric branched polymers, with arms of differing lengths, were also elucidated in the lecture.

These fundamental concepts conveniently set up a logical framework for the subsequent lecture by Professor Eric Shaqfeh (Stanford University, USA) on the non-equilibrium dynamics associated with a single stained DNA strand in dilute and concentrated solutions. Beginning with a discussion of how the use of video fluorescence microscopy to visualize DNA chains has revolutionized the field of polymer solution rheology, Professor Shaqfeh reviewed the state of research in single DNA dynamics studies in shear flow for isolated molecules in solution, before going on to discuss a new application of single molecule microscopy involving DNA dynamics in highly entangled solutions. In order to understand the physical principles behind these measurements, the conformational dynamics were examined via molecular simulations employing a slip-link method, using multiple nonlinear, worm-like chains with different degrees of polymer entanglement and molecular weights. The simulations demonstrate that the stretching in the chain length with increasing degree of entanglement, is responsible for a nonlinear shear stress plateau. Due to molecular individualism that occur in the polymer chain dynamics, it was also shown that mean-field approximations are insufficient to describe the chain dynamics, at least those arising under experimental conditions. Finally, Professor Shaqfeh described the tumbling dynamics of the DNA through the power spectral density of fluctuations in the chain length.

Professor Justin Cooper-White (University of Queensland, Australia) offered a vibrant discussion on the elastic instabilities associated with the flow of dilute and semi-dilute polyethylene oxide solutions in a microfluidic slit contraction. This began with a review of earlier work in which the flow instability regimes from pseudo-Newtonian behaviour to steady viscoelastic flow, onset of inertial-elastic instabilities and finally the appearance and growth of vortical structures, were characterised as a function of the Reynolds and Wissenberg numbers Interestingly, geometric changes downstream of the contraction were observed to suppress the inertial-elastic instabilities upstream. The contraction length was also observed to play an important role in the fluid's viscoelastic response.

The other three speakers presented topics of a slightly different nature, adding to the flavour of the broad scope of the workshop, which was designed with a view that a variety of motifs from polymeric liquids, colloidal suspensions, physiological/biological fluids and granular materials (under the general umbrella of complex fluid systems), to fluid actuation, micro-mixing, separation, bioparticle sorting and DNA manipulation (under the general micro/nanofluidics theme), would be covered.

Professor Sriram Ramaswamy (Indian Institute of Science, Bangalore, India) brought to the table a discussion on the active hydrodynamics of colloidal particles as a framework to describe the statistical mechanics of the motion arising from collections of self-propelled living matter such as shoals of fish or filamental bacteria. This was extended to describe the instability associated with a thin-film suspension of these self-driven particles, which arises due to the coupling between the active stresses and the particle orientation with respect to the film interface.

Professor Nadine Aubry (Carnegie Mellon University, USA) described her work on electrokinetically-driven microfluidic phenomena, in particular that involving the influence of the electric-field on a single and a collection of particles suspended in a fluid medium. Electrostatic interactions between particles were observed to give rise to particle chains due to the induced dipoles arising as a consequence of the applied electric field. Experiments and numerical simulations were also presented to show how particles at the interface of two immiscible liquids assemble onto two-dimensional lattices under the application of a transverse electric field due to the combination of capillary and electrostatic interactions. Finally,

instabilities at the interface of two stratified miscible fluids in a microchannel, invoked through the application of an electric field, were discussed, with particular reference to its potential for driving efficient micro-mixing.

Numerical and asymptotic models to describe the fluid-structure interactions of biological interfaces within a physiological system were presented by Professor Oliver Jensen (University of Nottingham, UK). These were constructed to describe, for example, the squeezing and spreading of the interstitial fluid between a deformable cell and the endothelial lining of capillaries and the respiratory tract. Adhesion forces arising from the intermolecular bonds cell receptors and their ligands on the wall were modelled through springs, whose torsion provide resistance to bond tilting and breakage as the cell peels (as described by a quasi-steady travelling wave) and rolls along the wall. Cell sliding motion was also discussed through the analogue of two parallel plates whose sliding friction arises again due to the adhesion forces modelled by the springs.

As the last session of each day, a discussion forum was organized in which all the speakers who spoke during the day faced the audience and answered questions on their topics. Both the discussion sessions were lively and extended, and gave an opportunity for the speakers to carefully address issues raised by the members of the audience. Points that were discussed included the limitations of the tube model in describing deviations from equilibrium dynamics of entangled polymeric systems and the role of molecular individualism in these systems; the treatement of free volume effects due to the increased number of chain ends in branched polymers; the effect of the electric field in altering the contact angle of particles in small scale flows, and the possible effect of oscillatory electric fields; the treatment of viscous stresses and polydispersity in the modelling of foam rheology; the importance of hydrodynamic interactions in the description of the microrheology of colloidal suspensions; the role of fluorescent tags in altering the dynamics of the stained polymer; the motivations behind the use of polyethylene oxide solutions for the characterization of viscoelastic flow in microfabricated contraction geometries; the influence that the penetrability of cells to liquids would have on the deformability of biological interfaces; and the applicability of concepts from active particle hydrodynamics on a large scale such as to flocks of birds. These broad ranging discussions added significantly to the pedagogic value of the workshop to students and researchers alike.

Feedback from the participants was certainly very positive. In general, the participants found the workshop to be extremely beneficial in terms of stimulating further developments in these research areas as well as facilitating new collaborative networks. Given the encouraging response, we certainly hope that successive workshops along similar themes will be held.

Leslie Y. Yeo (Micro/Nanophysics Research Laboratory, Mechanical Engineering)

Ravi Prakash Jagadeeshan (Molecular Rheology group, Chemical Engineering)
James R. Friend (Micro/Nanophysics Research Laboratory, Mechanical Engineering)

Monash University
Clayton, VIC 3800, Australia

List of students attending the Workshop

First	Last	AFFILIATION	Amount Collected
Aisha	QI	MONASH UNIVERSITY	Student
Betty	KHANMOHAMADI	MONASH UNIVERSITY	Student
Chris	HONIG	UNIVERSITY OF MELBOURNE	Student
Daniel	LIU	MONASH UNIVERSITY	Student
Debadi	CHAKRABORTY	MONASH UNIVERSITY	Student
Edwin	BAEZ	RMIT	Student
Erwan	BERTEVAS	UNIVERSITY OF SYDNEY	Student
Fatame	REZAEI	MONASH UNIVERSITY	Student
Haiyan	LI	MONASH UNIVERSITY	Student
Katherine	HUMPHRY	HARVARD UNIVERSITY	Student
Lisa	SMITH	UNIVERSITY OF MELBOURNE	Student
Melvin	TAN	MONASH UNIVERSITY	Student
Ming	TAN	MONASH UNIVERSITY	Student
Nicholas	MILLER	RMIT	Student
Nicole	LEBO	MONASH UNIVERSITY	Student
Nikko	CHAN	UNIVERSITY OF MELBOURNE	Student
Pandurang	KULKARNI	CITY COLLEGE NEW YORK	Student
Peter	ASIMAKIS	UNIVERSITY OF MELBOURNE	Student
Quanzhi	TENG	UNIVERSITY OF WOLLONGONG	Student
Raymond	GUANG	RMIT	Student
Richie	SHILTON	MONASH UNIVERSITY	Student
Rohan	RAGHAVAN	MONASH UNIVERSITY	Student
Rudolf	SPEHAR	UNIVERSITY OF MELBOURNE	Student
Ruslan	PUSCASU	SWINBURNE UNIVERSITY OF TECHNOLOGY	Student
Sasikaran	KANDASWAMY	MONASH UNIVERSITY	Student
Stefano	OBERTI	ETH ZURICH	Student
Thanh	NGUYEN	MONASH UNIVERSITY	Student
Tri	PHAM	MONASH UNIVERSITY	Student
Tu	LE	SWINBURNE UNIVERSITY OF TECHNOLOGY	Student
Vincent	MARTINEZ	RMIT	Student
Ricky	Tjeung	MONASH UNIVERSITY	Student
Francisco	Tovar	RMIT	Student
Albert	Yel	RMIT	Student
Parithra	Prathiraja	RMIT	Student
Khashay	Khashmanesh	DEAKIN UNIVERSITY	Student

Nanotechnology: Science, Policy and Public Perspectives - Workshop 21/11/2008 - Monash University

Final Report to the ARCNN for Symposium Support - Dr Diana Bowman

On Friday 21 November 2008, the Monash University Institute for Nanosciences, Materials & Manufacture, the Monash Centre for Regulatory Studies and the Faculty of Arts School of Political and Social Inquiry held a one day symposium titled '*Nanotechnologies, Risk and Communication: Science, Policy and Public Perspectives.*'

One objective of the symposium was to examine issues associated with risk, communication, policy development and the regulation of nanotechnologies. The symposium organisers believed that an opportunity existed to advanced discussions in Australia on issues of risk, risk perceptions, and the communication of risks surrounding nanotechnologies. The structure and the scope of the symposium was therefore designed to increase scientists', policymakers', and other stakeholders' appreciation of the contributions that each sector can provide to the complex and uncertain area of risk, risk communication and policy development for nanotechnologies. It was hypothesised that such an opportunity for stakeholders to engage with and gain insights from each other would promote understanding and appreciation between these groups, which in turn will likely lead to the development of more effective public communication strategies for nanotechnologies in Australia.

While it will be difficult to determine whether this hypothesis is proven to be correct, the day was deemed to be a success by all those involved in its organisation. This is perhaps best illustrated by reference to an email that was sent by Dr Peter Binks (CEO of Nanotechnology Victoria) following the symposium:

This was one of the highest calibre forums held in Australia in this industry the last 5 years, and you succeeded in bringing together perspectives – e.g. FoE, ACTU with industry and government – that no-one else has achieved.

We were able to achieve the aim primarily due to the generous support that we received from not only the ARCNN and Monash University (the Faculty of Law, the Faculty of Arts and the Monash Institute for Nanosciences, Materials and Manufacture), but also from a range of other organisations. These included:

- Nanotechnology Victoria
- Davies Collison Cave
- Australian Nano Business Forum, and
- Future Materials.

Funding from these sponsors was used to assist in covering the operational costs associated with running the symposium, including the travel costs associated with the keynote speaker (Dr Michael Mehta from the University of Winnipeg, and catering costs).

The sponsorship money granted by the ARCNN for the event was used to cover the travel costs of two non-Monash early career researchers, and one non-Monash Masters student, each of whom has displayed a research interest in nanotechnologies. The details of the three individuals who received support from the ARCNN were:

- Dr Ben Brooks. Dr Brooks is a Senior Research Fellow in the Human Factors Group at The University of South Australia. His PhD was awarded in 2007.
- Dr Carol Richards. Dr Richards is a Post Doctoral Fellow in Sociology at the University of Queensland. Her PhD was awarded in 2007.
- Dr Kristen Alford. Dr Alford is currently enrolled in a Master of Management – Strategic Foresight.

The three recipients enjoyed the symposium, and were appreciative of the ARCNN's support which enabled them to attend. This is illustrated by reference to an email that was sent by Dr Richards to me following the symposium (attached).

On behalf of the symposium organisers, Dr Dwayne Kirk, Professor Alan Petersen and myself, as well as the three recipients of the ARCNN's support, I would like to take this opportunity to thank the ARCNN for this generous assistance. We shall all look forward to attending and participating in similar events in the future.

MONASH University

Small Matters: Microscopy and Microanalysis
03/12/2008 - 05/12/2008 - The University of Sydney

Smal l Matters: Microscopy and Microanalysis:
A commemorative symposium for the Golden Jubilee of
The Australian Key Centre for Microscopy and Microanalysis

Activity Purpose, Numbers and Outcomes

The Excellence in Microscopy Symposium was held early December last year. Things kicked off with a public lecture on the evening of Tuesday, 2 December, by the internationally respected biologist Prof. Hans Tanke, who leads the Department of Molecular Cell Biology at Leiden University in the Netherlands. A large crowd gathered to hear Hans' talk about the use of microscopy to see DNA molecules at work. His easily understandable and highly entertaining presentation explained something of the wonders of DNA, and how key developments in microscopy are helping researchers understand the way DNA and proteins work within the human body. He also provided inspiring examples of how such techniques allow doctors to accurately diagnose when the body's molecular machinery goes haywire.

The official symposium started the following morning, with a host of leading national and international speakers and eager listeners. The 100 delegates were treated to presentations that ranged from advanced materials to archaeology and from biotechnology to nanotechnology, but all shared the common theme of incorporating some form of microscopy.

The Golden Jubilee Networking Luncheon, another major event, occurred on the Thursday afternoon as the
symposium delegates moved to the University's Great Hall for the lunch and accompanying plenary lectures.
Numbers swelled as various other guests – including University dignitaries, former EMU staff and industry
representatives – joined the delegates for the event. To mark this special occasion, the unit launched its history book 50 Great Moments – Celebrating the Golden Jubilee of the University of Sydney's Electron Microscope Unit.

Following a delightful lunch, plenary lectures on both the biological and physical aspects of high-resolution
tomography were given by Prof. Wolfgang Baumeister and Dr Thomas Kelly.

Satellite events were also held around the symposium: a two-day STEM workshop with Prof. Tetsuo Oikawa from JEOL (Europe) preceded the symposium, and a three-day summit on atom-probe data reconstruction followed it. This was a wonderfully exciting time for Australia's first centralised microscopy facility and it will surely lead to new highlights in the years to come.

List of students that participated at the Symposium

Secondname	Firstname	Title	Organisation
Chen	Jiang	Mr	The University of Queensland
Chen	Zhixin	Dr	University of Wollongong
Clode	Peta	Dr	The University of Western Australia
Coleman	Victoria	Dr	Australian Government
Dippenaar	Rian	Prof.	Univesity of Wollongong
Dur	Corentin	Mr	The University of Sydney
Fok	Sandra	Ms	The University of Sydney

Franklin	Matthew	Mr	Univesity of Wollongong
Gault	Baptiste	Dr	The University of Sydney
Haley	Daniel	Mr	The University of Sydney
Jahn	Kristina	Ms	The University of Sydney
La Fontaine	Alexandre	Mr	The University of Sydney
Li	Esther (Sha)	Ms	The University of Sydney
Li	Jiehua	Mr	The University of Sydney
Liddicoat	Peter	Mr	The University of Sydney
Liu	Tao	Mr	The University of Sydney
Mahbub-Ul-Alam	Talukder	Mr	The University of Sydney
Marceau	Ross	Mr	The University of Sydney
Moody	Michael	Dr	The University of Sydney
Moy	Charles	Mr	The University of Sydney
Petersen	Tim	Dr	The University of Sydney
Powles	Rebecca	Dr	The University of Sydney
Proust	Gwenealle	Dr	The University of Sydney
Pui Ching Wo	Amy	Dr	Univesity of New South Wales
Quadir	Md. Zakaria	Dr	Univesity of New South Wales
Reade	Wendy	Ms	The University of Sydney
Shaw	Jeremy	Dr	The University of Western Australia
Stephenson	Leigh	Mr	The University of Sydney
Stevens	Frankie	Dr	The University of Sydney
Su	Susan (Ying Ying)	Ms	The University of Sydney
Tang	Feng Zai	Dr	The University of Sydney
Tsafnat	Naomi	Dr	The University of Sydney
Vinistri	Ravi	Ms	The University of Sydney
Wang	Ting Yu	Mr	The University of Sydney
Wang	Xue Feng (Steven)	Mr	The University of Sydney
Whan	Renee	Dr	The University of Sydney
Wong	Chris	Mr	The University of Sydney
Wu	Ya-Na	Ms	The University of Sydney
Xie	Kelvin	Mr	The University of Sydney
Xie	Zonghan	Dr	Edith Cowan University
Xu	Michael	Mr	Univesity of Wollongong
Yang	Wenrong	Dr	The University of Sydney
Yao	Lance	Mr	The University of Sydney
Zhang	Laichang	Dr	University of Wollongong
Zhou	Sunny	Ms	The University of Sydney

WEBSITE

NANOTECHNOLOGY FACILITIES AND CAPABILITIES REGISTER

NEWSLETTER

MEMBERSHIP

PLANNED 2009 ACTIVITIES

WEBSITE

http://www.ausnano.net

The ARCNN Website is a very popular website and as at the end of 2008 it received more that 1,560,000 hits to the site, and it is believed that a significant amount of these are from Australia, and there is also interest from a number of other countries.

A separate website page with logo below was added specially for the International Conference on Nanoscience and Nanotechnology that will be held in February 2010 and we will have an ICONN2010 logo on the site.

http://www.ausnano.net/iconn2010/

The ARCNN Website contains among other things:

- the lists of members and Research Groups affiliated with the network,
- online applications for members
- Online applications for grants
- Nanotechnology Facilities and Capabilities Register
- Reports from Young Nano Ambassadors
- Employment Opportunities
- Links to other websites and events

The website is continually being maintained and updated and there are links to various sites including various surveys, other networks and related activities.

In 2008 the website had 36186 visits from 21602 unique visitors. They viewed a total 161996 pages. Google was our largest source of traffic with the search terms "iconn" and "arcnn" driving the most traffic to the site.
The most viewed pages on the site where as follows:
* Main page
* List of members
* ICONN 2008
* List of groups

A demographic list of website hits can be found in Appendix B

NANOTECHNOLOGY FACILITIES AND CAPABILITIES REGISTER

The Nanotechnology Facilities and Capabilities Register was established at the end of 2006 and the list of registered facilities and their capabilities can be accessed on the following page http://www.ausnano.net/index.php?page=facilities
Members and visitors to the site are able to access specific nanotechnology facilities and expertise that is available across Australia.

NEWSLETTER

A newsletter which is sent to all members is another means of communication that ARCNN uses as an information management tool. The newsletter is sent out every two months and details information and events held in the field on Nanotechnology in Australia. Newsflashes are released in between newsletters to make members aware of events with a short deadline.

A copy of the 18th Edition of the ARCNN Newsletter is in Appendix C

This newsletter is not only sent to all members but also to the Friends of the ARCNN.

A list of Friends is in Appendix D

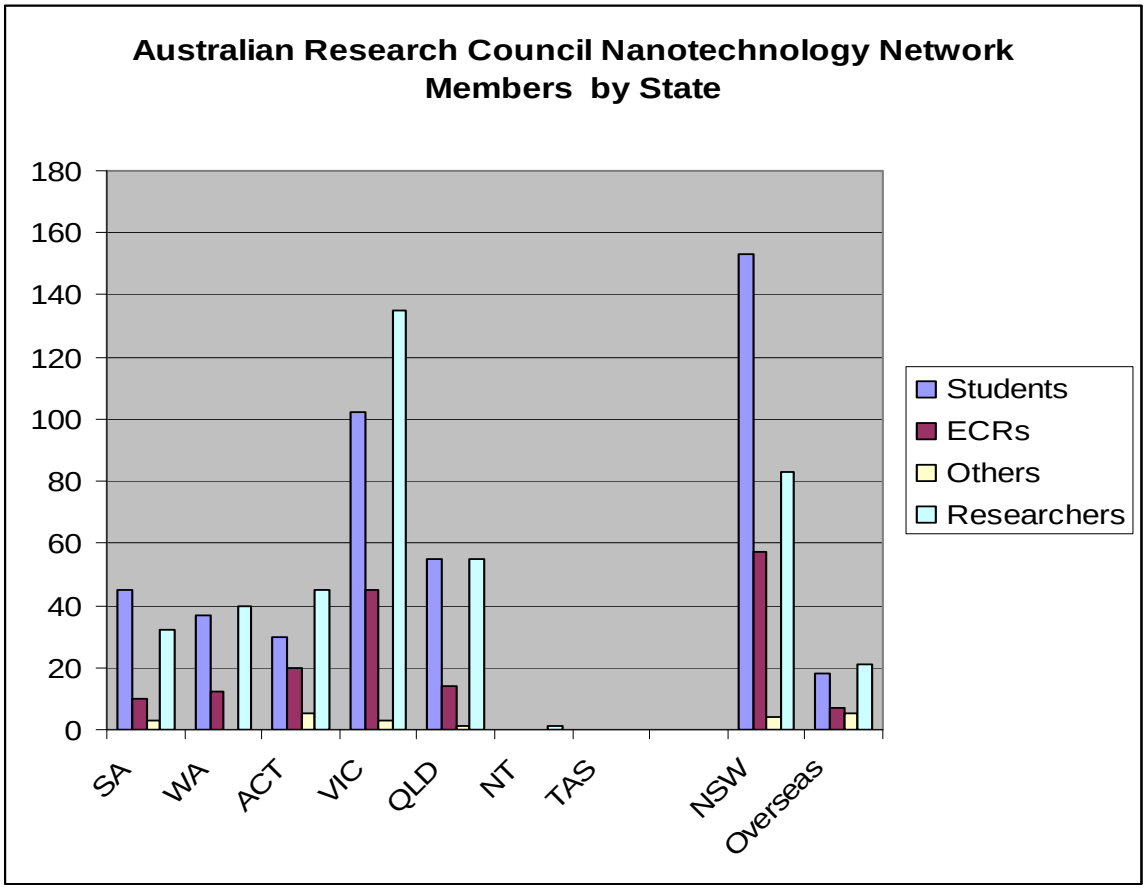
NanoQ (Nano Quest Magazine)

The purpose of this magazine is to highlight resent developments in the field of Nanotechnology in Australia and also to provide information of interest to policy makers and the public. This first issue was distributed at ICONN2008 and has also been distributed to several schools.
The name of the the Magazine is NanoQ with the Q standing for Quest. A copy of the first edition is attached.

MEMBERSHIP

The ARCNN membership consists of established researchers, Early Career Researchers, PhD students whose research field is in the area of Nanotechnology. It also consist of members from Government departments and business, for example the Australian Office of Nanotechnology and Invest Australia in the Department of Industry, Innovation Science and Research.

The following is a chart representing ARCNN members per state.



State	Students	ECRs	Others	Researchers	Total
SA	45	10	3	32	90
WA	37	12	0	40	89
ACT	30	20	5	45	100
VIC	102	45	3	135	285
QLD	55	14	1	55	125
NT	0	0	0	1	1
TAS	0	0	0	0	0
NSW	153	57	4	83	297
Overseas	18	7	5	21	51
TOTAL	440	165	21	412	1038

A list of ARCNN members per state including their affiliations can be viewed in Appendix A

PLANNED 2009 ACTIVITIES

ARCNN plans to continue funding Workshops, Conferences, Forums, encouraging and supporting participants in getting together and networking for the growth in the research of Nanotechnology in Australia.

To encourage collaborations among its members the Following Events are planned:

Following the success of ICONN 2008, the management committee has also been involved in preparing for the

- **International Conference on Nanoscience and Nanotechnology 2010(ICONN)** which will be held at the Sydney Convention Centre on the 22nd to the 26th of February 2010. **Copy of ICONN Poster is in Appendix E**

Planning is also underway for the Fourth ARCNN ECR and Post Grad Symposium

- **ARCNN Early Career Researcher and Postgraduate Student Symposium** *19/02/2008 -20/02/2008* – Australian National University ACT

There will be a continuation of the successful Overseas Travel Fellowships and Young Nanoscience Ambassador Awards.

Sponsorships for the Following Events during 2009:

- **Nanophotonics Down Under 2009: Devices and Applications** *21/06/2009* - **Melbourne Convention Centre**
- **PECS VIII - The 8th International Photonic & Electromagnetic Crystal Structures Meeting** - *05/04/2009 - 09/04/2009* **– Sydney**
- **Australian Colloid Interface Science International Conference 2009** *01/02/2009 - 05/02/2009* - **Stamford Grand, Glenelg, Adelaide, Australia**
- **MM2009 – Molecular Modelling Meeting – Mantra Legends Hotel, Gold Coast, Queensland** - *26th-29th July 2009.*

Appendix A - ARCNN Members by State

ACT

Title	Surname	First Name	Institution	Department
Dr	Arns	Christoph	ANU	Applied Mathematics
Dr	Ashrafi	Almamun	ANU	Electronic Materials Engineering
Mr	Barik	Satyanarayan	Australian National University	Research School of Physical Sciences and Engineering,Department of Electronic Materials Engineering
Professor	Boswell	Rod	Australian National University	Space Plasma and Plasma Processing group, Research School of Physical Sciences and Engineering,
Dr	Bradby	Jodie	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Brett	David	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Buda	Manuela	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Mr	Burgess	Tim	Australian National University	Department of Electronic Materials Engineering
Mr	Caillard	Amael	Australian National University	Plasma Research Laboratory
Professor	Chadderton	Lewis	Australian National University	AMPL
Dr	Charles	Christine	Australian National University	Plasma Research Laboratory, Research School of Physical Sciences and Engineering
Mr	Charnvanichborikarn	Supakit	Australian national University	EME
Dr	Chen	Ying	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Chen	Yong Jun	ANU	EME
Mr	Chen	Hua	ANU	EME
Dr	Choi	Duk Yong	ANU	LPC
Dr	Cifuentes	Marie	Australian National University	Department of Chemistry, TF
Dr	Corr	Cormac	Australian National University	PRL Research School of Physical Sciences and Engineering,
Dr	Craig	Vince	Australian National University	Department of Applied Maths, Research School of

				Physical Sciences and Engineering
Dr	Dall (Weijers)	Tessica	Australian National University	Department of Electronic Material Engineering, Research School of Physical Sciences and Engineering
Dr	de Borniol	Merbyn	ANSTO	IME
Dr	Deenapanray	Sanju	Australian National University	Department of Electronic Materials Engineering, Research School of physical Sciences and Engineering
Mr	Deshmukh	Rajeev	IP Australia	Patent Examination
Ms	Devine	Natasha	Australian National University	Optical Sciences Group
Mr	Du	Sichao	ANU	EME
Professor	Elliman	Robert	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Faunce	Thomas	ANU	College of Law and Medical School
Professor	Fletcher	Neville	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Miss	Francis	Emma	IP Australia	
Mr	Fraser	Michael	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Mr	Freeman	Darren	ANU	Laser Physics Centre
Dr	Fu	Lan	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Dr	Gao	Qiang	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Associate Professor	Gardner	Ian	Defence	Occupational and Environmental Medicine
Mr	Gareso	Paulus	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Mrs	Giulian	Raquel	ANU	Electronic Materials Engineering

Dr	Glover	Chris	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Mr	Glushenkov	Alexey	ANU	Elecromaterials Engineering
Miss	Haberl	Bianca	ANU	EME
Ms	Hackett	Suanne	Invest Australia	
Mr	Han	Ting	Australian National University	Laser Physics Centre
Miss	Hilder	Tamsyn	Australian National University	Research School of Biological Science
Mr	Howard	Shaun	Australian National University	Department of Applied Maths, Research School of Physical Sciences and Engineering,
Mr	Hsieh	Andy Shang-Yuan	ANU	EME
Ms	Hu	Julia	IP Australia	
Professor	Humphrey	Mark	Australian National University	Department of Chemistry
Mr	Hussain	Zohair	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Professor	Jagadish	Chennupati	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Mr	Johannessen	Bernt	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Mr	Jolley	Greg	ANU	EME
Miss	Joyce	Hannah	Australian National University	Department of Electronic Materials Engineering
Mr	Kang	Jung Hyun	ANU	EME
Dr	Kluth	Patrick	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineerring
Dr	Kluth	Susan	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineerring
Mr	Lakshmanasamy	Raghuveerasamy	Australian National University	Department of Electronic Materials Engineering
Dr	Li	Bill	ANU	EME

Dr	Li	Wen	ANU	Department of Electronic Materials Engineering
Dr	Li	Qing	ANU	EME
Professor	Luther-Davies	Barry	Australian National University	Department of Laser Physics Centre, Research School of Physical Sciences and Engineering,
Mr	Lysevych	Mykhaylo	Australian National University	Electronic Materials Engineering
Dr	Mackinnon	Ian	Australian Research Council	Engineering and environmental Sciences
Mr	McKerracher	Ian	Australian National University	Deaprtment of Electronic Materials Engineering
Mr	Mitchell	Jonathon	ANU	Engineering
Ms	Mokkapati	Sudha	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering.
Mr	Nawaz	Muhammad	ANU	EME
Mr	Oliver	David	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Mrs	Paiman	Suriati	ANU	EME
Dr	Pas	Steven	Australian Pesticides and Veterinary Medicines Authority	
Dr	Petravic	Mladen	Australian National University	Department of Electronic Materials and Engineering, Research School of physical Sciences and Engineering
Miss	Prasad	Amarita	ANU	Laser Physics Centre
Prof	Qin	Qinghua	ANU	Department of Engineering
Mr	Ramdutt	Devin	ANU	Space Plasma
Dr	Ridgway	Mark	Australian National University	Deaprtment of Electronic Materials Engineering, Research School of Physical Sciences and Engineering,
Mr	Rixon	Peter	Parliament of Australia	Defence & Disaster Management Reserach Analyst
Dr	Rode	Andrei	Australian National University	Department Laser Physics Centre, Research School of Physical Sciences and Engineering,
Dr	Ruan	Yinlan	Australian National University	Department of Laser Physics Centre, Research School of Physical Sciences and Engineering

Dr	Samoc	Anna	Australian National University	Department of Laser Physics Centre, Research School of Physical Sciences and Engineering
Dr	Samoc	Marek	Australian National University	Department of Laser Physics Centre, Research School of Physical Sciences and Engineering
Dr	Sheppard	Adrian	ANU	Applied Maths
Mr	Sprouster	David	ANU	Electronic Materials Engineering
Ms	Stewart	Kallista	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Talanina	Irina	IP Australia	
Dr	Tan	Hark Hoe	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Varslot	Trond	ANU	Applied Maths
Professor	Weckert	John	Australian National University	Centre for Applied Philosophy and Public Ethics
Prof	Weigold	Erich	ANU	AMPL
Mr	Wilkinson	Andrew	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Professor	Williams	James	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Wong-Leung	Jennifer	Australian National University	Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering
Dr	Xu	Wen	ANU	PRL
Mrs	Yu	Jun	ANU	EME
Dr	Zhang	Hongzhou	Australian National University	EME
Mr	Zin	Ngwe Soe	ANU	Centre for Sustainable Energy Systems, Faculty of Engineering

New South Wales

Title	Surname	First Name	Institution	Department
Mr	Allan	Jeremy	WorkCover NSW	Hazard Management Group
Professor	Amal	Rose	University of New South Wales	Chemical Engineering and Industrial Chemistry
Ms	Aminorroaya	Sima	University of Wollongong	Faculty of Engineering
Mr	Ams	Martin	Macquarie University	Department of Physics
Ms	Angus	Susan	University of New South Wales	Electrical Engineering and Telecommunications
Mr	Antiohos	Dennis	University of Wollongong	Intelligent Polymer Research Institute
Dr	Arnold	Matthew	University of Technology Sydney	Institute of Nanoscale Technology
Dr	Arrachart	Guilhem	ANSTO	Institute of Materials & Engineering Sciences
Miss	Arredondo-Arechavala	Miryam	University of New South Wales	School of Materials Science and Engineering
Ms	Arsianti	Maria	University of New South Wales	School of Chemical Sciences and Engineering
Dr	Ashraf	Syed Aziz	University of Wollongong	ARC Centre of Excellence for Electromaterials Science
Ms	Atkinson	Kaylene	University of Wollongong	Intelligent Polymer Research Institute
Ms	Bali	Rosa	University of Sydney	Department of Chemical Engineering
Dr	Bandyapadhyay	Sri	University of New South Wales	School of Materials Sciences and Engineering
Miss	Baowan	Duangkamon	University of Wollongong	School of Mathematics and Applied Statistics
Dr	Barton	Christopher	CSIRO	Industrial Physics
Mr	Bell	Laurence	UNSW	School of Physics
Miss	Bell	Jennifer	University of Sydney	School of Physics

Mr	Berger	Dan	Davies Collison Cave	
Dr	Bhatta	Hemant	University of New South Wales	School of Mechanical Engineering
Mr	Bikram	Shakya	University of Sydney	Chemical Engineering
Mr	Blaber	Martin	University of Technology, Sydney	Institute of Nanoscale Technology
Mr	Blajer	Ivan	University of Technology Sydney	Institute of Nanoscale Technology
Dr	Boecking	Till	not at UNSW	Optoelectronics Department
Mr	Breukers	Robert	University of Wollongong	Intelligent Polymer Institute
Mr	Brew	James	University of Wollongong	School of Maths and Applied Statistics
Dr	Burkhard	Raguse	CSIRO	Materials and Science Engineering
Dr	Bursill	Robert	University of New South Wales	School of Physics
Dr	Butcher	K. Scott	Macquarie University	Department of Physics
Dr	Cairney	Julie	University of Sydney	The Australian Key Centre for Microscopy and Microanalysis
Dr	Cameron	Fiona	CSIRO	Nanotechnology Centre
Dr	Campbell	Toni	University of Wollongong	ARC Centre of Excellence for Electromaterials Science IPRI
Dr	Carter	Chris	Davies Collison Cave	
Dr	Carter	Damien	The University of Sydney	School of Physics
Ms	Cassidy	Maja	University of New South Wales	School of Electrical Engineering
Miss	Causley	Jennifer	University of Wollongong	Intelligent Polymer Research Institute
Ms	Ceguerra	Anna	University of Sydney	NANO-MNRF Electron Microsope Unit
Mr	Chan	Yue	The University of wollongong	School of Mathematics and Applied Statistics

Associate Professor	Chee	Too	University of Wollongong	ARC Centre of Excellence for Electromaterials Science, Intelligent Polymer Research Institute
Mr	Chen	Patrick	Macquarie University	Department of Physics
Dr	Chen	Jun	University of Wollongong	Intelligent Polymer Research Institute
Dr	Cheng	Zhenxiang	University of Wollongong	Engineering
	Cheng	Ching-Jung	University of New South Wales	School of Materials Science and Engineering
Ms	Chew	Sau Yen	University of Wollongong	Institute for Superconducting & Electronic Materials; Faculty of Engineering
Mr	Chin	Yiing Leong	The University of Sydney	School of Chemistry
Mr	Chou	Shulei	University of Wollongong	Institute for Superconducting & Electronic Materials
Mr	Choucair	Mohammad	The University of New South Wales	Chemistry
Dr	Chow	Edith	CSIRO	Telecommunications and Industrial Physics
Mr	Ciampi	Simone	University of New South Wales	School of Chemistry
Professor	Clark	Robert	Uinversity of New South Wales	Department of Physics
Dr	Coleman	Victoria	National Measurement Institute	
Dr	Coleman	Heather	UNSW	School of Chemical Sciences and Engineering
Professor	Cortie	Michael	University of Technology Sydney	Institute for Nanoscale Technology
Mr	Cotton	Daniel	University of Newcastle	Mathematical and Physical Sciences
Ms	Court	Nadia	University of New South Wales	Centre for Quantum Computer Tech
A/Prof	Coutts	David	Macquarie University	Department of Physics
Mr	Cox	Barry	University of Wollongong	School of Mathematics and Applied Statistics, Nanomechanics Group
Dr	Cox	Grant	University of Wollongong	School of Mathematics and Applied Statistics

Dr	Cui	Xiangyuan	University of Sydney	School of Physics
Dr	Curson	Neil	University of New South Wales	School of Physics
Ms	Cutler	Jody	University of Sydney	Electron Microscope Unit
Dr	D'Alessandro	Deanna	The University of Sydney	School of Chemistry
Dr	Darwish	Tamim	ANSTO	Institute of Materials and Engineering Science
Mr	Darwish	Nadim	University of New South Wales	Chemistry
Mr	Das Arulsamy	Andrew	University of Sydney	School of Physics
A/Prof	Dastoor	Paul	University of Newcastle	Department of Physics, Faculty of Science and information Technology
Associate Professor	Dawes	Judith	Macquarie University	Department of Physics
Miss	Dechakiatkrai	Chonlada	University of Wollongong	Intelligent Polymer Research Institute
Dr	Dennany	Lynn	University of Wollongong	ARC Centre of Excellence for Electromaterials Science
Mr	Desai	Satyen	University of Wollongong	ARC Centre of Excellence for Electromaterials Science Intelligent Polymer Research Institute
Dr	Di Maio	Isabelle	University of Technology Sydney	Health Dept
Associate Professor	Dodds	Susan	University of Wollongong	School of English Literatures, Philosophy and Languages
Mr	Dore	Matthew	University of Wollongong	Intelligent Polymer Research Institute
Dr	Dowd	Annette	University of Technology Sydney	Department of Applied Physics, Faculty of Science
Mr	Duriavig	Juan Pablo	ANSTO	Bragg Institute
Associate Professor	Dzurak	Andrew	University of New South Wales	School of Electrical Engineering & Telecommunications
Mr	Edgar	Jonathan	University of Technology Sydney	Institute for Nanoscale Technology
Professor	Eggleton	Benjamin	University of Sydney	School of Physics

Mr	Ellis	Thomas	UNSW	Stride Group
Mr	Ellis	Shane	University of Wollongong	Intelligent Polymer Research Institute
Mr	Escott	Christopher	UNSW	Centre for Quantum Computer Technology
Dr	Falber	Alexander	The University of Sydney	School of Chemistry
Dr	Ferguson	Andrew	UNSW	CQCT, School of Physics
Miss	Fernades	Alanna	Macquarie University	Department of Physics
Mr	Florin	Nicholas Haley	University of Sydney	Chemical Engineering
Mr	Foley	Matthew	University of Technology, Sydney	Microstructural Analysis Unit
Associate Professor	Ford	Mike	University of Technology Sydney	Institute for Nanoscale Technology
Mr	Foroughi	Javad	University of Wollongong	Intelligent Polymer Research Institute
Dr	Friend	James	Monash University	Department of Mechanical Engineering
Mr	Fronzi	Marco	University of Sydney	Physics
Professor	Gal	Michael	University of New South Wales	Department of Physics
Mr	Gan	Wee Yong	UNSW	ARC Centre for Functional Nanomaterials
Mr	Gao	Yuan	University of Wollongong	Centre for Engineering Mechanics Faculty of Engineering
Dr	Gao	Feng	University of Wollongong	School of Engineering Physics and ISEM
Ms	Gelmi	Amy	University of Wollongong	ARC Centre of Excellence for Electromaterials Science
Mr	Gestos	Adrian	University of Wollongong	ARC Centre of Excellence for Electromaterials Science, Intelligent Polymer Research Institute
Dr	Gilmore	Kerry June	University of Wollongong	Intelligent Polymer Research Institute
Mr	Goldstein	Daniel	The University of Sydney	School of Chemistry

Associate Professor	Goldys	Ewa	Macquarie University	Department of Physics
Dr	Gooding	John	University of New South Wales	Department of Chemistry
Mr	Goon	Ian	University of New South Wales	ARC Centre of Exellence for Functional Nanomaterials
Mr	Granero	Alberto	University of Wollongong	School of Chemistry
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Ms	Mat Darus	Mazlina	The University of Western Australia	School of Mechanical Engineering
A/Prof	Lim	Lee Yong	University of Western Australia	Pharmacy School of Biomedical, Biomolecular and Chemical Sciences
Ms	Zhang	Jing	University of Western Australia	Microelectronics Research Group
Mr	Zhang	Mu	University of Western Australia	School of Mechanical Engineering
Ms	Yang	Yimeng	University of Western Australia	School of Mechanical Engineering
Mr	Parlevliet	David	Murdoch University	Physics and Energy Studies
Mr	Cankurtaran	Burak	Curtin University of Technology	Nanochemistry Research Unit
Dr	Nair	Balagopal	Curtin University of Technology	Nanochemistry Research Institute
Miss	Le	Xuan Thi	Murdoch University	Physics and Energy Studies Division of Science and Engineering
Mr	Jackson	Michael	University of Western Australia	School of Biomedical and Chemical Sciences
Mr	Sulaiman	Nadzril	The University of Western Australia	School of Electrical, Electronic and Computer Engineering
Mr	Baharin	Azlan	University of Western Australia	School of Electrical, electronic & Computer Engineering
Dr	Schuler	Leo	The University of Western Australia	School of Electrical, Electronic and Computer Engineering
Mr	Johnson	Clint	The University of Western Australia	Physiology Centre for strategic Nano-Fabrication Incorporating Toxicology
Miss	Tyler	Annette	University of Western Australia	Physics
Mr	Carroll	Matthew	University of Western Australia	School of Physics, Faculty of Life and Physical Sciences
A/Prof	St Pierre	Tim	The University of Western Australia	School of Physics
Mr	Wang	Mingliang	Mechanical School of UWA	Materials Engineering Functional Materials Lab
Mr	Abd Rahman	Mohd Amiruddin	The University of Western Australia	School of Electrical, Electronic and Computer Engineering
Dr	Bullen	Craig	The University of Western Australia	School of Biomedical, Biomolecular and Chemical

				Sciences
Dr	Leong	Yee-Kwong	The University of Western Australia	School of Mechanical Engineering
Mr	Wyndham	David	The University of Western Australia	School of Electrical, Electronic and Computer Engineering
Mr	Murdock	Adrian	Curtin University of Technology	Nanochemistry Research Institute
Mr	Evans	Cameron	University of Western Australia	Centre for strategic nano-fabrication

Northern Territory

Surname	First Name	Department	Institution	Title
Singh	Jai	School of Engineering and Logistics	Charles Darwin University,	Professor

Overseas Members

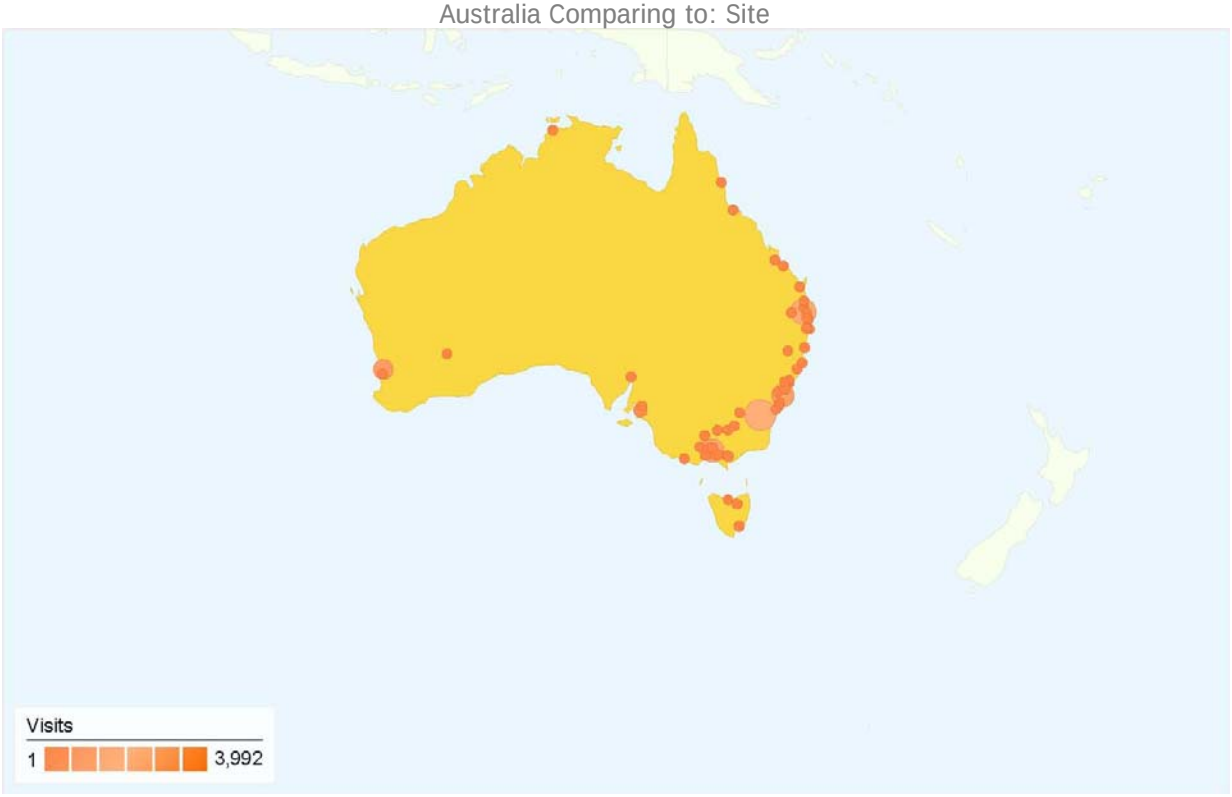
Surname	First Name	Title	Institution	Other
Alkaisi	Maan	Dr	University of Canterbury	Christchurch,NZ
Johnson	Steve	Dr	Institute of Geological & Nuclear Sciences	NZ
Kennedy	John	Dr	Rafter Research Centre	NZ
Markwitz	Andreas	Dr	Institute of Geological & Nuclear Sciences Rafter Laboratory	NZ
Starke	Kai	Dr	Freie Universitaet Berlin	Berlin
Wolter	Joachim	Professor	Eindhoven University of Technology	The Netherlands
Bakewell	David	Dr	University of Glasgow	
Barnes	Mark Campbell	Dr	Seoul National University	Korea
Blaikie	Richard	Associate Professor	University of Canterbury	New Zealand
Brault	Pascal	Professor	CNRS and Universite d'Orleans	France
Downard	Alison	Dr	University of Canterbury	New Zealand
Durbin	Steven Michael	Dr	University of Canterbury	New Zealand
Hong-Young	Chang	Professor		Korea
Pleasants	Simon	Dr	Chiba University	Japan
Rosei	Federico	Professor	University of Quebec (Montreal)	Canada
Ruda	Harry	Professor	University of Toronto	Canada
Sewell	Rob	Mr	Imperial College	London
Stern	Richard	Dr	University of Western Australia	USA
Brown	Simon	Dr	University of Canterbury	Christchurch, New Zealand
Reichel	Rene	Mr	University of Canterbury	
Ayesh	Ahmad	Mr	University of Canterbury	
Iqbal	Azhar	Dr	University of Hull	UK
Yu	Samuel S.C	Mr	University of Canterbury	New Zealand
Tan	Seng Sing	Dr	Nanyang Polytechnic	Singapore
Abdul Majeed	Abu Bakar	Prof Dr	Universiti Teknologi Mara	Malaysia
Lansley	Stuart	Dr	University of Canterbury	New Zealand
Pereira	Rosa Elizabeth Valente	Mrs	Universiti Teknologi Mara	Malaysia
Shastry	Rahul	Mr	University of Canterbury	NZ
L'Hostis	Florian	Mr	University of Canterbury	NZ
Anderson	David Philip	Mr	University of Cambridge	NZ
Golovko	Vladimir	Dr	University of Canterbury	NZ
Raineri	Vito	Dr	Italian National Council for research (CNR) Institute for Microelectronics and Microsystems (IMM)	Italy
Goldsmith	Carole	Ms	International Freelance Journalist	
Kendrick	Chito	Mr	MacDiarmid Institute for	University of Canterbury NZ

Surname	First Name	Title	Institution	Other
			Advanced Materials and Nanotechnology,	
Yusoff	Hamdan Mohamed	Mr	University of Canterbury	NZ
Mackenzie	David	Mr	University of Canterbury	MacDiarmid Institute NZ
McCarthy	David	Mr	University of Canterbury	New Zealand
Liu	Xianming	Dr	University of Canterbury	NZ
Robinson	Katie	Dr	AJ Park	Auckland, NZ
Elshayeb	Ayman	Mr	Alneelain Univerisity	From Sudan
Kruglyak	Volodymyr	Dr	University of Exeter	UK
Srinivasa Kannan	Lakshmi	Dr	SDNB Vaishnav College for Women	India
Moudgil	Brij	Dr	University of Florida	US
Buazar	Foad	Mr	Tarbiat Modares University	Iran
Raper	Judy	Dr	Missouri University of Science & Technology	US
Sarma	Shilpanjali	Ms	The Energy and Resources Institute (TERI)	India
Jackson	Howard	Prof	University of Cincinnati	US
Hendy	Shaun	Dr	Industrial Research Ltd	NZ
Ogden	Kimberly	Prof and Assoc Head	University of Arizona	US
Schrader	Glenn	Prof and Department Head	University of Arizona	US
Skandan	Ganesh	Dr	NEI Corporation	US

Appendix B – Demographic list of ARCNN Website Hits

ARCNN

Australia Comparing to: Site



Visits	Pages/Visit	Avg. Time on Site	% New Visits	Bounce Rate
16,428	4.57	00:03:15	49.67%	40.56%
% of Site Total: 45.40%	Site Avg: 4.48 (2.13%)	Site Avg: 00:03:32 (-7.80%)	Site Avg: 56.20% (-11.61%)	Site Avg: 39.53% (2.61%)

Country/Territory Detail: Jan 1, 2008 - Dec 31, 2008

Wollongong	288	5.69	00:04:33	27.08%	25.35%
(not set)	103	3.36	00:02:31	65.05%	36.89%
Geelong	98	4.24	00:03:15	58.16%	26.53%
Wollongong	68	6.00	00:04:26	51.47%	29.41%
Cranbourne	67	5.60	00:03:36	76.12%	43.28%
Newcastle	52	5.37	00:04:19	53.85%	46.15%
Hobart	49	4.22	00:01:31	77.55%	48.98%
Geelong	28	4.18	00:03:00	46.43%	32.14%
Richmond	22	7.27	00:04:23	81.82%	63.64%
Nerang	15	1.47	00:00:23	86.67%	66.67%
Central Coast	14	3.79	00:03:49	71.43%	28.57%
Townsville	11	5.91	00:03:17	54.55%	27.27%
Gold Coast	11	1.91	00:00:47	36.36%	45.45%
Cairns	8	3.62	00:04:02	75.00%	37.50%
Ballina	8	2.50	00:01:58	100.00%	37.50%
Port Augusta	7	8.29	00:03:12	28.57%	0.00%
Gawler	6	2.33	00:02:08	83.33%	50.00%
Kiama	5	4.60	00:02:02	100.00%	40.00%
Launceston	5	2.20	00:00:27	60.00%	40.00%
Townsville	5	1.00	00:00:00	60.00%	100.00%
Craigieburn	5	5.20	00:20:18	40.00%	20.00%
Toowoomba	4	1.25	00:00:02	100.00%	75.00%
Redcliffe	4	2.75	00:00:55	100.00%	50.00%
Pakenham	4	3.50	00:01:40	100.00%	50.00%
Wagga Wagga	3	1.67	00:00:09	33.33%	33.33%
Launceston	3	1.67	00:00:33	100.00%	66.67%
Victoria Point	3	2.67	00:01:29	100.00%	66.67%
Armidale	3	1.33	00:00:30	100.00%	66.67%
Melton	3	3.33	00:00:56	66.67%	33.33%
Palmerston	3	1.00	00:00:00	66.67%	100.00%
Darwin	3	3.00	00:00:33	100.00%	33.33%
Ballarat	3	1.00	00:00:00	100.00%	100.00%
Bendigo	3	1.00	00:00:00	66.67%	100.00%
Cairns	2	1.00	00:00:00	100.00%	100.00%
Toowoomba	2	2.50	00:00:07	100.00%	50.00%
Wangaratta	2	1.00	00:00:00	50.00%	100.00%
Canberra	2,199	5.63	00:04:41	26.74%	36.06%
Brisbane	1,619	4.62	00:02:33	55.28%	43.67%
Melbourne	1,404	3.77	00:02:17	65.74%	52.28%
Sydney	1,286	3.47	00:02:09	70.84%	47.59%
Perth	993	4.19	00:02:42	47.83%	41.29%
Adelaide	889	4.34	00:03:02	41.96%	36.45%
Adelaide	368	4.25	00:02:30	65.49%	54.08%

Nowra	2	1.50	00:00:14	100.00%	50.00%
Ballarat	2	4.50	00:14:02	50.00%	0.00%
Victoria Point	2	9.00	00:13:53	100.00%	50.00%
Lismore	2	1.50	00:00:13	100.00%	50.00%
Warrnambool	2	1.00	00:00:00	100.00%	100.00%
Albury	2	2.00	00:00:31	50.00%	50.00%
Kwinana	2	1.00	00:00:00	100.00%	100.00%
Nerang	2	1.00	00:00:00	100.00%	100.00%
Shepparton	1	8.00	00:08:22	100.00%	0.00%
Nowra	1	5.00	00:01:30	100.00%	0.00%
Gladstone	1	1.00	00:00:00	100.00%	100.00%
Moe	1	2.00	00:03:28	100.00%	0.00%
Kalgoorlie	1	1.00	00:00:00	100.00%	100.00%
Bendigo	1	1.00	00:00:00	100.00%	100.00%
Taree	1	1.00	00:00:00	100.00%	100.00%
Port Macquarie	1	1.00	00:00:00	100.00%	100.00%
Raymond Terrace	1	1.00	00:00:00	100.00%	100.00%
Maryborough	1	1.00	00:00:00	100.00%	100.00%
Rockhampton	1	30.00	00:07:05	100.00%	0.00%
Melton	1	3.00	00:00:15	0.00%	0.00%
Craigieburn	1	3.00	00:00:32	0.00%	0.00%
Albury	1	1.00	00:00:00	100.00%	100.00%
Shepparton	1	8.00	00:01:51	100.00%	0.00%
Cessnock	1	1.00	00:00:00	100.00%	100.00%
Warrnambool	1	7.00	00:02:04	100.00%	0.00%
Moe	1	1.00	00:00:00	100.00%	100.00%
Maroochydore	1	1.00	00:00:00	100.00%	100.00%
Coffs Harbour	1	1.00	00:00:00	100.00%	100.00%
Devonport	1	1.00	00:00:00	100.00%	100.00%
Rockhampton	1	3.00	00:00:39	100.00%	0.00%
Coffs Harbour	1	6.00	00:16:21	100.00%	0.00%
Maroochydore	1	7.00	00:02:02	100.00%	0.00%
Morwell	1	13.00	00:05:28	100.00%	0.00%

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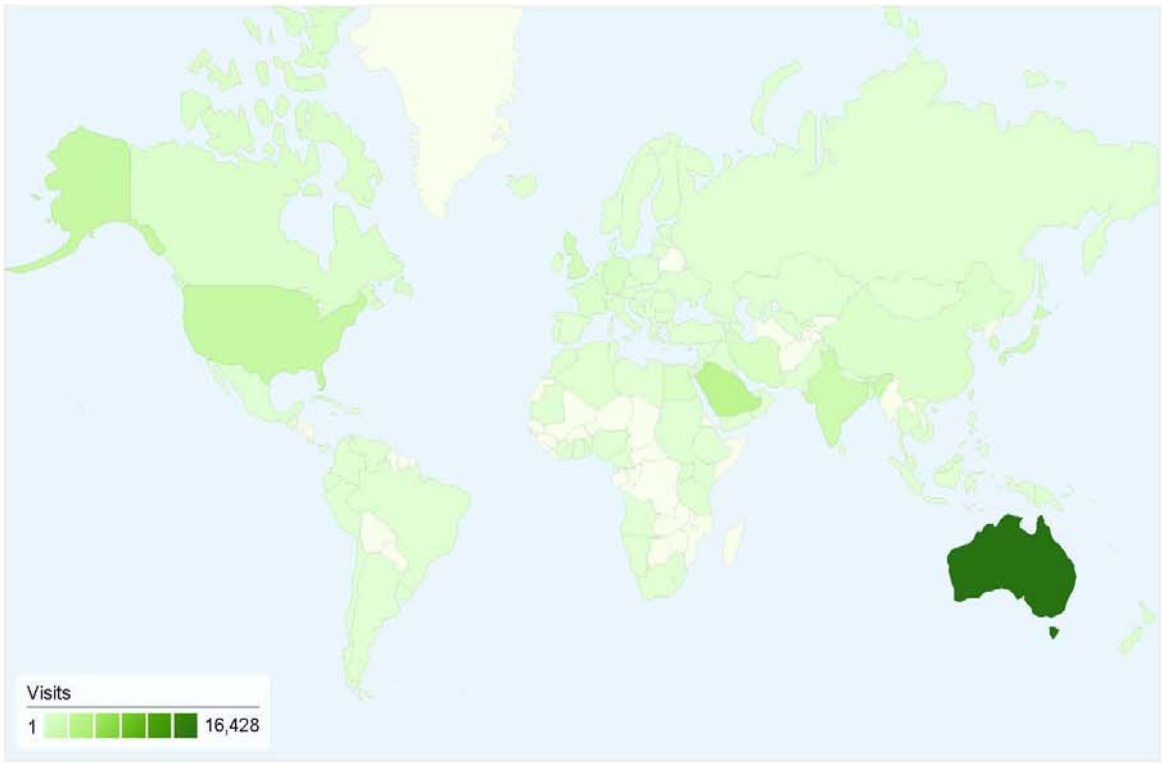
ARCNN
Map Overlay

Jan 1, 2008 - Dec 31, 2008
Comparing to: Site



36,186 visits came from 128 countries/territories

Site Usage

Visits	Pages/Visit	Avg. Time on Site	% New Visits	Bounce Rate
36,186 % of Site Total: 100.00%	4.48 Site Avg: 4.48 (0.00%)	00:03:32 Site Avg: 00:03:32 (0.00%)	56.37% Site Avg: 56.20% (0.30%)	39.53% Site Avg: 39.53% (0.00%)

Country/Territory	Visits	Pages/Visit	Avg. Time on Site	% New Visits	Bounce Rate
Australia	16,428	4.57	00:03:15	49.67%	40.56%
Saudi Arabia	3,296	5.03	00:05:36	36.35%	26.49%
United States	2,355	3.49	00:02:02	82.38%	51.68%
India	1,831	6.37	00:05:25	71.22%	38.18%
United Kingdom	1,322	3.92	00:03:04	60.21%	36.38%
Japan	1,209	3.71	00:02:46	39.45%	34.24%
South Korea	869	3.65	00:03:11	55.58%	36.48%
Germany	803	4.01	00:02:20	65.88%	38.48%
Iran	730	5.62	00:05:33	55.89%	32.88%
Egypt	556	5.70	00:07:28	43.35%	19.60%

China	512	5.11	00:04:49	61.91%	37.50%
Canada	477	3.14	00:01:43	75.26%	50.94%
Singapore	440	5.19	00:04:23	68.18%	35.68%
France	428	4.69	00:02:46	85.28%	49.53%
Malaysia	375	4.42	00:04:29	58.40%	36.53%
Taiwan	341	4.16	00:03:27	54.55%	43.70%
New Zealand	289	3.71	00:02:11	72.32%	37.72%
Italy	258	3.21	00:01:51	75.58%	46.90%
Netherlands	203	3.54	00:02:25	74.88%	44.83%
Mexico	192	2.06	00:00:59	90.62%	68.23%
Thailand	184	2.83	00:02:39	65.76%	47.83%
Algeria	176	4.30	00:04:47	31.82%	15.34%
Spain	145	4.50	00:02:55	76.55%	48.97%
Switzerland	143	2.69	00:01:13	88.81%	45.45%
Sweden	140	3.05	00:01:27	67.86%	46.43%
Russia	132	3.31	00:02:58	75.76%	52.27%
United Arab Emirates	108	4.57	00:04:37	55.56%	27.78%
Brazil	104	1.95	00:01:26	85.58%	61.54%
Belgium	102	3.16	00:02:46	76.47%	47.06%
Turkey	102	3.01	00:02:06	84.31%	60.78%
Denmark	93	3.63	00:01:37	72.04%	35.48%
Ireland	86	3.44	00:01:42	86.05%	44.19%
Finland	82	3.15	00:02:06	80.49%	51.22%
Portugal	82	5.05	00:04:37	54.88%	32.93%
Pakistan	77	6.19	00:06:26	85.71%	24.68%
Bahrain	75	3.67	00:04:03	50.67%	22.67%
Hong Kong	75	2.92	00:01:36	74.67%	52.00%
Poland	74	2.57	00:01:44	82.43%	52.70%
(not set)	73	5.36	00:05:54	67.12%	34.25%
Austria	64	2.95	00:02:07	76.56%	45.31%
Romania	58	3.33	00:02:04	77.59%	50.00%
Israel	55	2.95	00:02:39	96.36%	63.64%
Kuwait	55	5.84	00:03:58	63.64%	25.45%
Czech Republic	54	3.44	00:02:12	85.19%	61.11%
Norway	47	2.49	00:00:35	53.19%	38.30%
Indonesia	46	3.17	00:03:05	91.30%	45.65%

Vietnam	45	13.73	00:04:14	80.00%	64.44%
Philippines	38	2.55	00:01:00	94.74%	65.79%
Morocco	38	5.95	00:04:20	21.05%	7.89%
South Africa	36	4.42	00:03:36	80.56%	55.56%
Yemen	35	4.57	00:04:11	31.43%	11.43%
Tunisia	33	4.15	00:04:16	30.30%	27.27%
Oman	32	5.41	00:05:54	59.38%	31.25%
Ivory Coast	27	6.37	00:03:15	77.78%	59.26%
Greece	27	3.33	00:02:05	92.59%	37.04%
Nigeria	27	14.89	00:12:21	85.19%	51.85%
Jordan	26	6.12	00:06:08	73.08%	11.54%
Ukraine	25	2.76	00:03:47	100.00%	44.00%
Colombia	25	2.20	00:01:33	80.00%	72.00%
Bangladesh	24	8.29	00:09:10	87.50%	50.00%
Argentina	23	2.61	00:02:36	91.30%	69.57%
Venezuela	22	3.18	00:02:15	90.91%	40.91%
Hungary	19	2.47	00:00:26	84.21%	52.63%
Bulgaria	18	4.56	00:02:06	72.22%	27.78%
Sudan	17	2.18	00:01:55	94.12%	70.59%
Sri Lanka	17	4.12	00:03:03	100.00%	29.41%
Lithuania	16	1.81	00:00:41	100.00%	62.50%
Ghana	14	2.00	00:01:25	71.43%	71.43%
Lebanon	14	2.86	00:03:29	57.14%	35.71%
Croatia	13	3.77	00:01:47	100.00%	23.08%
Qatar	12	3.00	00:01:01	66.67%	50.00%
Chile	12	3.75	00:02:15	91.67%	50.00%
Cuba	10	2.80	00:03:21	60.00%	40.00%
Mauritius	9	1.33	00:00:44	44.44%	77.78%
Serbia	9	2.11	00:00:16	88.89%	77.78%
Slovenia	9	2.67	00:01:19	88.89%	66.67%
Puerto Rico	9	2.44	00:01:37	88.89%	44.44%
Slovakia	9	3.78	00:03:59	88.89%	66.67%
Liechtenstein	8	2.38	00:01:28	62.50%	75.00%
Kenya	8	2.75	00:03:49	75.00%	25.00%
Palestinian Territory	7	10.43	00:04:39	100.00%	28.57%
Peru	7	3.86	00:01:59	85.71%	42.86%

Estonia	7	2.43	00:02:02	100.00%	42.86%
Uzbekistan	6	2.67	00:06:05	33.33%	66.67%
Luxembourg	6	3.33	00:01:12	83.33%	66.67%
Bosnia and Herzegovina	6	2.50	00:00:57	83.33%	66.67%
Nepal	5	2.80	00:01:13	100.00%	60.00%
Libya	5	7.80	00:12:35	80.00%	20.00%
Syria	4	3.75	00:06:42	100.00%	0.00%
Latvia	4	1.00	00:00:00	100.00%	100.00%
Georgia	4	4.75	00:03:30	75.00%	0.00%
Togo	4	1.75	00:04:24	75.00%	50.00%
Cyprus	4	2.00	00:00:37	100.00%	75.00%
Guatemala	4	3.00	00:01:19	100.00%	25.00%
Benin	4	1.00	00:00:00	75.00%	100.00%
Moldova	3	3.33	00:01:27	100.00%	33.33%
Armenia	3	5.33	00:05:05	100.00%	0.00%
Macedonia	3	1.67	00:01:17	66.67%	33.33%
Cameroon	3	2.33	00:00:48	66.67%	66.67%
Cambodia	3	1.00	00:00:00	100.00%	100.00%
Kazakhstan	3	1.67	00:00:59	100.00%	66.67%
Uganda	3	1.67	00:00:32	100.00%	66.67%
Malta	2	2.50	00:01:47	50.00%	0.00%
Fiji	2	2.00	00:00:25	100.00%	50.00%
Jamaica	2	1.00	00:00:00	100.00%	100.00%
Costa Rica	2	1.50	00:00:16	100.00%	50.00%
Ethiopia	2	1.50	00:00:20	100.00%	50.00%
Iceland	2	4.50	00:02:10	100.00%	0.00%
Uruguay	2	1.00	00:00:00	100.00%	100.00%
Dominican Republic	2	5.00	00:04:27	100.00%	0.00%
Ecuador	2	1.00	00:00:00	100.00%	100.00%
Serbia and Montenegro	2	1.00	00:00:00	100.00%	100.00%
Azerbaijan	1	4.00	00:15:25	100.00%	0.00%
Mauritania	1	1.00	00:00:00	100.00%	100.00%
Tanzania	1	2.00	00:00:53	100.00%	0.00%
Angola	1	1.00	00:00:00	100.00%	100.00%
Solomon Islands	1	1.00	00:00:00	100.00%	100.00%
Brunei	1	1.00	00:00:00	100.00%	100.00%

Mongolia	1	1.00	00:00:00	100.00%	100.00%
Barbados	1	1.00	00:00:00	100.00%	100.00%
Bhutan	1	7.00	00:04:35	100.00%	0.00%
Gambia	1	2.00	00:05:32	100.00%	0.00%
Trinidad and Tobago	1	1.00	00:00:00	100.00%	100.00%
Iraq	1	1.00	00:00:00	100.00%	100.00%
Namibia	1	3.00	00:02:11	100.00%	0.00%
Bahamas	1	7.00	00:04:43	100.00%	0.00%
Panama	1	7.00	00:11:13	100.00%	0.00%
Papua New Guinea	1	1.00	00:00:00	100.00%	100.00%
					1 - 128 of 128

Appendix C - ARCNN News, Edition 18, December 2008

ARCNN News. Edition 18, December 2008

Australian Research Council Nanotechnology Network

Welcome

Dear Members and Friends

Welcome to the eighteenth edition of the ARCNN News.

Preparations for ICONN 2010 are now underway. It will be held in Sydney at the Sydney Convention Centre on the 22nd to the 26th February 2010. ICONN 2010 will be chaired by Dr. Calum Drummond and co-chaired by Dr. Cathy Foley and Professor Michelle Simmons.

We recently held the Australia Japan Nanophotonics Workshop on December 9th-10th at The Australian National University, Canberra. Thank you to everyone for your contribution in making the workshop a successful one. Details and pictures of the workshop can be found in this newsletter and on the website.

The second edition of the NanoQ magazine is now available. The magazine will be available for download on the website or alternatively contact us for any copies.

We encourage Postgraduate student and ECR members to participate in the next ARCNN PhD and ECR Symposium which will be held at the Research School of Physics and Engineering at the Australian National University on the 19th and 20th of February.

Best wishes to you all for the festive and holiday season and a Happy New Year 2009.

Look forward to your active participation in the Network activities for 2009.

C Jagadish, Convenor

Australian Research Council Nanotechnology Network

Update profiles, address changes etc

Please remember to advise address and email changes so that the ARCNN member database is kept up to date. Your current details can be checked on your online profile at http://www.ausnano.net/index.php?page=profiles.

If you have not submitted an online profile, we would encourage you to do so as this provides a valuable resource for researchers seeking collaboration with people who have experience or expertise in a particular nanotechnology area. A search facility is provided on the Members Profiles webpage. Researchers looking to fill postdoc positions may also use the member database to locate students with research interests and experience in particular fields.

ARCNN ECR/Postgraduate Student Symposium

The next ARCNN ECR/Postgraduate student Symposium will be held at the Research School of Physics and Engineering at the Australian National University. The dates of the Symposium are the 19th and 20th of February. The aim of this symposium is to provide a forum where ECRs and Postgraduates students working on nanotechnology research can present their work, meet other researchers and students and interact with other research groups in Australia.

ECRs and PhD students wishing to present a talk should email their abstract by arcnn@ausnano.net by the 22nd of December. Further information can be found at http://www.ausnano.net/index.php?page=events&event=104

ARCNN Nanoforum

The ARCNN nanoforum (http://forum.ausnano.net.au/) is now fully online and ready for use. It is intended to serve as a bulletin/discussion board for the nanotechnology community in Australia, so if you'd like to post notices there (e.g., positions open, confs/workshops, events, questions, discussion points, etc), please feel free to do so. You will need to register first, which you can do by clicking the register link at the top left corner of the website. When registering could you please ensure that your username is reflective of your actual name (e.g, surname, firstname_surname or something similar), so that people can identify who is making postings. Adam Micolich is the current moderator for this forum, if you have problems, questions or suggestions for topics to be posted to the forum site, feel free to email him at mico@phys.unsw.edu.au

ARCNN Awards and Deadlines - 2009

ARCNN Overseas Travel Fellowships

Deadline for the 1st round of next year's Overseas Travel Fellowships is the **31st February 2009**. More information can be found at http://www.ausnano.net/content/overseas_travel

ARCNN Long and Short Term Visits

The ARCNN offers Long term and Short term funding for visits within Australia to successful applicants throughout the year. Further information about any of the funding available can be found at: http://www.ausnano.net/content/funding_and_sponsorship

Australian Research Council Nanotechnology Network

Nanophotonics Down Under 2009: Devices and Applications

21 June 2009
Held at: Melbourne Convention Centre, Victoria
Details: http://www.smonp2009.com/

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International Conference on Nanoscience and Nanotechnology (ICONN 2010)

22nd-26th February 2010
Held at: Sydney Convention Centre
Chair: Dr Calum Drummond, CSIRO
Co-Chairs: Dr Cathy Foley and Prof Michelle Simmons, UNSW

Other Upcoming Nano events

The Nanowerk website lists all the International Nano events that you will ever need to know about: http://www.nanowerk.com/phpscripts/n_events.php

Nanotechnology Facilities Database

ARCNN has added a Nanotechnology Research Facilities and Capabilities database onto our site. The aim of this database is to be a first access site to all the Nanotechnology Infrastructure facilities and capabilities available to nanotechnology researchers. All group leaders who are interested in adding their facilities onto the ARCNN site are asked to add facilities/equipment/Infrastructure. NCRIS people have been using the Network web page to get information about activities in various institutions in the country.

ANFF Oficial Opening

The Australian National Fabrication Facility was officially opened by Senator the Hon Kim Carr, the Minister for Innovation, Industry, Science and Research. The launch has taken place on October the 17th 2008, at the Shine Dome in Canberra.

The contact for the ANFF is Rosie Hicks.

See the website for more details: http://anff.org.au/

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Australian Office of Nanotechnology Tenders

The AON currently has a request for tender offers to conduct a Literature review on the social impact of Nanotechnology. More information is available at: www.tenders.gov.au

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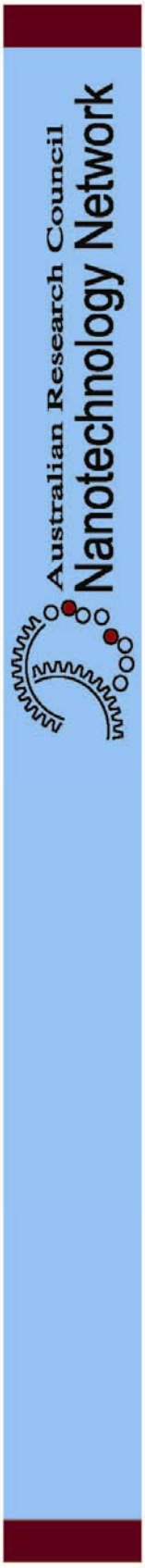
ATSE Project Report Launch

On the 12th of September 2008, Senator the Hon Kim Carr launched the ATSE Project Report titled Energy and Nanotechnologies: Strategy for Australia's future.

The report can be accessed from the ATSE website: http://www.atse.org.au/index.php?sectionid=128



ARCNN Admin Contacts

Network Manager: Ms Liz Micallef

Tel: 02 6125 5952

Network Administrator: Ms Ilonka Krolikowska

Tel: 02 6125 2495

Or email Liz and Ilonka: arcnn@ausnano.net

Fax: 02 6125 3915

For further information on ARCNN events, contact Liz or Ilonka, or go to: www.ausnano.net

Appendix D - List of ARCNN Friends

ARCNN Friends as at 31/12/2008

Surname	First Name	Department
Tegart	Alistair	Standards Australia
Oldfield	Anthony	ACT Govt
Paterson	Chris	DITR
Atkinson	David	DEH
Gallagher	David	DITR
Willcocks	Deborah	NICNAS
Pianca	Dennis	ACT government
Hall	David	Treasury
Papadakis	Elim	Australian Research Council
Keogh	Geoff	ACT Govt
Harvey	Graham	NICNAS
Barber	Greg	Health
Koerbin	Gus	ACT Govt
Ahmet	Halil	work cover Vic Govt
Dyne	Heather	DEST
Morris	Howard	DEWR
Copeland	Ian	Health
Gardner	Ian	Defence
Somina	Irina	ARC
Niall	Jane	IIRD Vic Govt
Thomas	Janet	Defence
Gardiner	Jennifer	DITR
Miles	John	National Measurement Institute
Moore	Joslin	DEST
Emslie	Kerry	National Measurement Institute
Gale	Kevin	DEH
Hodgman	Laurie	DEH
Davies	Les	Health
Meisel	Linda	DEH
Ribeiro	Luiz	National Health and Medical Research Council
Thomas	Mandy	ARC
Gredley	Matthew	Aus Industry
Lindsay	Megan	Dept of Environment and Heritage
Claessens	Michael	AusIndustry
Faiz	Mohammed	Workcover NSW Govt
Buckley	Nick	ACT government
Mewett	Osman	Bureau of Rural Sciences
Ross Matthews	Paul Mohan	AusIndustry DFAT
Haynes	Peter	DEWR
McInnes	Peter	DEH
Holgate	Robert	ACT Government
Keir	Roland	Defence
Brooke	Shelley	Invest Australian
Utick	Stephen	DEST
Walker	Stephen	ARC
Zaluzny	Stephen	NICNAS

Rothnie	Tony	DEST
Swan	Verity	DEST
Creaser	Wayne	DEWR
Schnaufer	Andrea	UTS
Hicks Devignes	Anne Marie	ANU
Innes	Brian	Advance Nanotechnology
Laing	Chris	University of Melbourne
Denny	Chris	ANU
Ford	D	University of Queensland
Salt	David	ANU
Rathjen	Deborah	Bionomics
Read	Leanna	TGR Bionomics

Appendix E – ICONN 2010 Poster

ICONN 2010

www.ausnano.net/iconn2010

The 2010 International Conference on Nanoscience and Nanotechnology (ICONN 2010) will bring together the Australian and International community working in the field of nanoscale science and technology to discuss new and exciting advances in the field. ICONN will cover nanostructure growth, synthesis, fabrication, characterisation, device design, modelling, testing and applications.

UNSW

CSIRO

Australian Research Council Nanotechnology Network