Australian Nanotechnology Network

Annual Report 2013

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ANNUAL REPORT 2013

Australian Nanotechnology Network

MISSION STATEMENT AND OBJECTIVES

Mission Statement

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

This innovative 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 Australian Research Council funding came to an end in 2010. ANN received funding from the Department of Innovation, Industry, Science and Research towards the continuation of network operations until the end of 2013.

The following institutions are also contributing to the funding of the network operations which will be continuing.

Australian National University, CSIRO, DSTO, Deakin University, Flinders University, Griffith University, LaTrobe University, Monash University, Queensland University of Technology, RMIT, University of Melbourne, University of Newcastle, University of New South Wales, University of Queensland,University of South Australia, University of Sydney, University of Technology Sydney, University of Western Australia, University of Wollongong

Objectives

The Nanotechnology field is one of the fastest growing areas of research and technology. The Australian Nanotechnology Network (formerly 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 ANN 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.

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

2013 in Review

The work in 2013 was focused on enhancing the funding of programs and events related to Nanotechnology around the country.

Membership of 1450, participants including 800 post graduate students and Early Career Researchers. More than 265 research groups are participating in the Network.

Over 5,600,000 Website hits

Held the ANN Early Career Researcher Workshop

3 Young Nano Ambassador Awards

1 Long Term Visit

2 Short Term Visits

12 Overseas Travel Fellowships

14 Events Sponsored by ANN

Published the 5th Issue of the NanoQ (Nano Quest Magazine)

Structure and Management

The Australian Nanotechnology Network is managed by a Management Committee which met twice during 2013. The meetings were held in February at the Research School of Physics and Engineering, Australian National University and in June at the Adelaide Convention Centre.

This management committee 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. The current chair is Professor Erich Weigold.

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. The network Convenor is Professor Chennupati Jagadish.

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 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.

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 Tan Truong	**Defence Science and Technology Organisation**
Prof. Peter Majewski	**University of South Australia**
Prof Michael James	**Australian Nuclear Science and Technology Organisation**
Prof Ian Gentle	**University of Queensland**

Visits Working Group

Dr Adam Micolich	**University of New South Wales**
Prof. Deb Kane	**Macquarie University**
Prof Gordon Wallace	**University of Wollongong**

Outreach Working Group

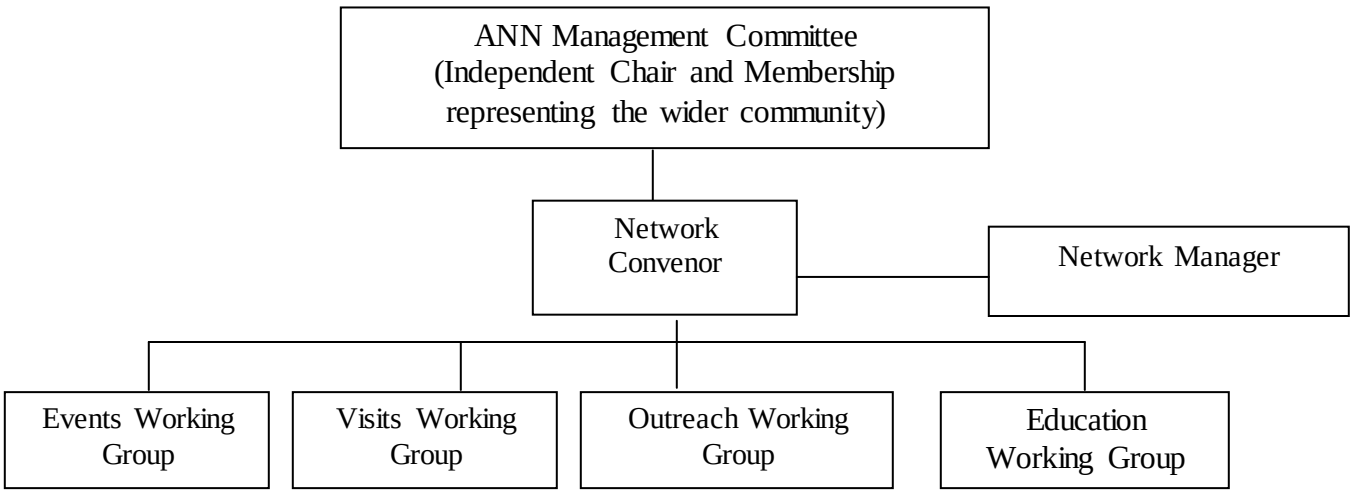
Dr Adam Micolich	**University of New South Wales**
Prof. Deb Kane	**Macquarie University**
Mr Jaret Lee	**Australian National University**

Education Working Group

Prof. Max Lu	**University of Queensland**
Dr Terry Turney	**Micronisers Pty Ltd and Monash University**

Dr Steve Duvall	**Silanna Ltd**
Dr Calum Drummond	**Commonwealth Scientific and Industrial Research Organisation**
A/Prof Paul Wright	**RMIT-University, convenor of NanoSafe Australia**
Ms Liz Micallef	**Network Manager**

ANN Structure



ACTIVITIES UNDERTAKEN BY ANN

List of Activities funded / organized by ANN

- ANN Early Career Researcher Workshop – Flinders University - July 2013

Young Nanotechnology Ambassadors program

- Western Australia - Mr Tristan Clemons, Biomedical, Biomolecular and Chemical Sciences at the University of Western Australia
- Queensland - Mr Amirali Popat from the Australian Institute for Bioengineering and Nanotechnology University of Queensland
- South Australia -Mr Jakob Andersson from the Chemical and Physical Sciences at Flinders University

Long Term Visits

- Mr Cathal O'Connell from the University of Wollongong visit to the University of Melbourne for a period of 3 months

Short Term Visits

- Dr Stephanie Pace from the Mawson Institute at the University of South Australia visit to the University of Sydney
- Chamanei Hettiarachchige from Queensland University of Technology visit to Monash University and Melbourne Centre for Nanotechnology.

Overseas Travel Fellowships

- Mr Dominic Ho from the University of Western Australia visit to Stanford University, USA
- Mr Damon Carrad from the University of New South Wales visit to Lund University in Sweden for a period of eight weeks.
- Miss. Nian Jiang from the Australian National University visit to the University of Cincinnati, USA for a period of five weeks.
- Mr Michael Challenor from the University of Western Australia visit to the Institut Europeen de Chimie et Biologie in Bordeaux France for a period of 3 months.
- Dr. Alessandro Rossi from the University of New South Wales visit to Aalto University in Helsinki, Finland for a period of 4 weeks.

- Mr Peter Felfer from the University of Sydney visit to Harvard University, USA, for a period of twenty eight days.
- Miss. Katherine Moore from Flinders University visit to the Karlsruhe Institute of Nanotechnology in Germany for a period of three months.
- for Mr Mark Edmonds from La Trobe University visit to the Max-Lab Synchrotron in Lund, Sweden for a period of 3 weeks.
- Mr Behnam Akhavan from the University of South Australia visit to the Max Planck Institute for Polymer Research, Mainz, Germany for a period of 16 weeks.
- Miss Suzy Streatfield from the Australian National University visit to Rennes University in France and Wroclaw University of Technology in Poland for a period of one year.
- Miss Georgia Miller from the University of New South Wales visit to Harvard University, USA for a period of 4 months.
- Dr Ryo Sekine from the University of South Australia visit to Trinity College at Oxford, U.K for a period of eight weeks.
- Mr Thomas Keevers from the University of New South Wales visit to the University of Warwick, U.K, for a period of three months.

Asia Nano Camp

Participants sent to the 6th Asia Nanotech Camp (ANC) 2013 which took place on the 1-10th October 2013 in Serpong, China.

Work on NanoQuest magazine to enhance public awareness of Nanotechnology

Workshops and Events Sponsored by ANN

- ACIS 2013 - The Biennial Australian Colloid and Interface Symposium held in Noosa, Queensland on the 3-7th February 2013
- 4th International NanoMedicine Conference held at the Intercontinental Hotel, Sydney, on the 1-3July 2013.
- 34th Australiasian Polymer Symposium (34 APS) held at the Darwin Convention Centre on the 7-10th July 2013.
- 4th International Conference on Smart Materials and Nanotechnology in Engineering (SMN 2013) held at the Gold Coast on the 10-12th July 2013.
- ANN Early Career Workshop held at Flinders University on the 25-26th July 2013.
- NanoS-E3 2013 International Workshop & School on Nanotechnology held at Airlie Beach, Queensland on the 15-20th September 2013.
- 4th Asia Pacific Symposium on Nanobionics held at the University of Melbourne, Law School on the 14-15th November 2013.
- OZCarbon2013 held at Graduate House, University of Melbourne on the 1-3rd December 2013.
- ANN Nanotechnology Bookwriting Project held at Macquarie University on the 4-10th December 2013.
- Australia New Zealand Conference on Optics and Photonics held at Freemantle on the 8-11th December 2013.

ANN Early Career Workshop held at Flinders University on the 25-26th July 2013.

On July 25 and 26 July the Centre for NanoScale Science and Technology (CNST) hosted the 2013 Australian Nanotechnology Network (ANN) Early Career Researcher Symposium.

The aim of this symposium was to provide a forum for early career researchers (ECRs) and postgraduate students working on nanotechnology research to present their work, and to meet and interact with other researchers and students from Australia.

Dr Ingo Köper, a Research Leader from the CNST was the Symposium Chair and organised the event along with the Symposium Convenor, Professor Chennupati Jagadish from Australian National University.

The Symposium attracted over 60 researchers Australia wide working in the field of Nanotechnology, from biotactical engineering to organic photovoltaic devices. The program consisted of 20 contributed talks, a poster session, a career building session and plenty of networking opportunities including a conference dinner in Glenelg.

The presentations were given by Australian ECRs and postgraduate students, along with keynote addresses given by more senior speakers.

Keynote speakers - Professor Thomas Nann (University of South Australia right), Professor David Lewis (Flinders), Dr Chiara Neto (University of Sydney, above left) and **Professor Sally McArthur** (Swinburne University, above right).

The symposium was concluded with a prize giving presentation for the two best contributed talks from Chris Elbadawi (University of Technology, Sydney) with his talk on *Localized fabrication of pure platinum nanostructures* and Karan Gulati (University of Adelaide) for his talk entitled, *Healing traumatised bones: perspectives of nano-engineered drug-releasing implants*.

The two best posters were awarded to Jin Jau Liau (University of South Australia) for the poster *Liposomes in double emulsion system for controlled release oral vaccine delivery* and Sam Turner (Australian National University) for the poster *Wavelength Scale Dielectric Diffraction Gratings for LightTrapping in InGaAs/GaAs Quantum Well Solar Cells*.

Overall the symposium was a great success and an ideal opportunity for Flinders to host external researchers and inspire collaboration.

List of PhD students and ECRs

Mr	Hussein N	Ahmadabadi	School of Electrical and Computer Engineering	RMIT
Mr	Behnam	Akhavan	Mawson Institute	University of South Australia
Mr	Faisal Khalid	Alotaibi	School of Chemical and Physical Sciences	Flinders University
Mr	Akash	Bachhuka	Mawson Institute	University of South Australia
Mr	Achal	Bhatt	Ian Wark Research Institute	University of South Australia
Mr	Klaus	Boldt	School of Chemistry and Bio21	University of Melbourne
Mr	Simon	Bou	Centre for Nanoscale Science	Flinders University
Miss	Siobhan	Bradley	Ian Wark Research Institute	University of South Australia
Mr	Alex	Cavallaro	School of Engineering	University of South Australia
Mr	Lijue	Chen	Institute for Frontier Materials	Deakin University
Mr	Laurent Lee	Cheong Lem	Department of Physics and Advanced Materials	University of Technology, Sydney
Miss	Melissa	Dewi	Ian Wark Research Institute	University of South Australia
Mr	Chris	Elbadawi	School of Physics and Advanced Materials	University of Technology, Sydney
Dr	Drew	Evans	Mawson Institute	University of South Australia
Mr	Bonnie	Fadi	Department of Physics and Advanced Materials	University of Technology, Sydney
Mrs	Chunfang	Feng	Institute for Frontier Materials	Deakin University
Dr	Becky	Fuller	School of Chemistry and Biochemistry	University of Western Australia
Ms	Qian	Gao	Department of Electronic Materials Engineering	Australian National University
Mr	Karan	Gulati	School of Chemical Engineering	University of Adelaide
Mr	Philipp	Gutruf	School of Electrical and Computer Engineering	RMIT
Dr	Zhao Jun	Han	Materials Science and Engineering	CSIRO NSW
Mr	Christopher	Hassam	Centre for Nanoscale Science	Flinders University
Mr	Shahram	Hazrati	Centre for Nanoscale Science	Flinders University
Miss	Juanita	Hughes	Science and Engineering	Queensland University of Technology

Mr	Ehsan	Jazaeri	Institute for Frontier Materials	Deakin University
Mr	Minsu	Jung	School of Chemical Engineering	University of New South Wales
Miss	Maryam	Khaksar	Mawson Institute	University of South Australia
Mr	Lachlan	Larsen	School of Chemical and Physical Sciences	Flinders University
Mr	Yongzhen	Li	Institute for Frontier Materials	Deakin University
Ms	Jin Jau	Liau	Ian Wark Research Institute	University of South Australia
Dr	Charlene	Lobo	Physics and Advanced Materials	University of Technology, Sydney
Mr	Tom	Macdonald	Ian Wark Research Institute	University of South Australia
Mr	Yatin Jadavji	Mange	Ian Wark Research Institute	University of South Australia
Mr	Daniel	Mangos	Centre for Nanoscale Science	Flinders University
Mr	Aiden	Martin	Department of Physics and Advanced Materials	University of Technology, Sydney
Dr	Peter	Metaxas	School of Physics	University of Western Australia
Mr	Thomas	Michl	Ian Wark Research Institute	University of South Australia
Mrs	Alaa	Munshi	School of Chemistry and Biochemistry	University of Western Australia
Dr	Divina Angela	Navarro	Land and Water	CSIRO
Mr	Samuel	Ogden	School of Chemical and Physical Sciences	Flinders University
Mr	Afaq Habib	Piracha	School of Physics	University of Melbourne
Mrs	Yasmin	Rokhsana	Ian Wark Research Institute	University of South Australia
Ms	Natalya	Schmerl	School of Chemical and Physical Sciences	Flinders University
Dr	Ryo	Sekine	Centre for Environmental Risk Assesment and Remediation	University of South Australia
Mr	Shayan	Seyedin	Intelligent Polymer Research Institute	University of Wollongong
Mr	Charan M	Sha	School of Electrical and Computer Engineering	RMIT
Mr	Toby	Shanley	School of Physics and Advanced Materials	University of Technology, Sydney
Miss	Xiaodong	She	Institute for Frontier Materials	Deakin University
Mr	Alexander	Sibley	Centre for Environmental Risk Assesment and Remediation	University of South Australia

Miss	Shima	Taheri	School of Engineering	University of South Australia
Dr	Pejman	Talemi	Mawson Institute	University of South Australia
Dr	Vanessa	Thompson	School of Chemical and Physical Sciences	Flinders University
Mr	Daniel	Tune	School of Chemical and Physical Sciences	Flinders University
Mr	Sam	Turner	Department of Electronic Materials Engineering,	Australian National University
Dr	Leonora	Velleman	Institute for Frontier Materials	Deakin University
Mr	Zhigang	Xie	Institute for Frontier Materials	Deakin University
Mrs	Roya	Yadollahi	Mawson Institute	University of South Australia
Mr	Zhifeng	Yi	Institute for Frontier Materials	Deakin University
Dr	Chun-Yang	Yin	Chemical and Analytical Sciences	Murdoch University
Mr	Xiaoming	Yuan	Department of Electronic Materials Engineering	Australian National University
Mrs	Thilaga	Yuvuraj	Ian Wark Research Institute	University of South Australia

Delegates at the workshop

YOUNG NANO 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 2013

Western Australia -Mr Tristan Clemons, Biomedical, Biomolecular and Chemical Sciences at the University of Western Australia

Award – Tristan Clemons
Nanotechnology Roadshow to the Mid-West of Western Australia

Introduction

Unfortunately, scientists have a bad standing amongst school students with the traditional stereotypical scientist with white coat, glasses and a microscope seeming to hold true. This stereotypical view students have is likely to have been contributed to by a range of factors, with some of the major ones being the poor public image of science amongst secondary students, a lack of understanding about jobs available in science within Australia and that science is at times a difficult subject to understand. The major aim of my visits to Geraldton in the mid west of Western Australia was to discredit these misconceptions and present the truth about a career in science and especially nanotechnology as exciting and interesting with many benefits and opportunities both here in Australia and abroad. During my visit I was fortunate enough to be involved in the Mid West Youth Science Forum (MWYSF), and pay visit to the four major high schools in the area addressing an estimated 300 students over the 3 days.

This report will outline some of the hands on activities I produced and utilized while visiting the schools as well as at the MWYSF. This visit and the developed resources were only made possible by the gracious support from the Australian Nanotechnology Network (ANN) and the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) through, the ANN Student Ambassador Award.

My aim was to develop hands on nano related resources and demonstrations which students were able to use and discover the wonders of the nanoscale. This was achieved by setting up a range of small stations where the students received a short introduction (from the station's

information sheet or from me directly depending on time) describing the technology followed by instructions on what was happening and how to carry out the demonstrations.

Resources developed with the ANN funding showing the 5 different nanorelated stations with which the students could carry out hands on demonstrations at during the visit.

The stations included the following topics:

- Hydrophobic and Hydrophilic surfaces - students looked at the characteristics of water droplets on glass compared to Teflon coated glass and then compared this to how water interacted on ordinary cotton compared to that modified with a hydrophobic nano coating. Thanks must be to NanoTex® for their support and generous donation of the modified fabric samples (http://www.nano-tex.com/index.html).

- Magnetics and Ferrofluids – Students here were able to see how ferrofluids interacted in a magnetic field and compared this to samples of larger iron particles in water to see the stark differences nanoparticle size can have on how particles interact with a magnetic field.

Students from Nagle Catholic College exploring how ferrofluids interact with a magnetic field.

- Nano imaging with Quantum Dots and Gold Nanoparticles – This station consisted of a range of CdTe quantum dots with different emission characteristics as well as gold nanoparticles of varying sizes to show students that particles of the nanoscale can interact very differently with light. Students enjoyed using light to excite the quantum dots and learning about the process's behind their emission.
- Surface Area to Volume and Shape Memory Alloys – This station allowed students to investigate how altering the surface area of steel can dramatically change its reactive properties in a Bunsen flame. Students were also introduced and were able to investigate the exciting transformations and memory capabilities of some Nitinol shape memory alloy samples kindly donated by Assoc/Prof. Yinong Liu from the School of Mechanical Engineering, University of Western Australia.

- Nano ethics – Nano ethics was the final station students visited and this was an area where some background and opposing views surrounding nanotechnology research were proposed. Students were able to discuss important issues surrounding policy making, and regulation of research going forward.

The above workstations coupled with short informative videos from the NanoYou series (http://nanoyou.eu/) narrated by Stephen Fry made up the resource component of the visits. The University of Western Australia kindly donated a suite of pens, highlighters, rulers and pads which I was able to use as spot prizes during my visits for the students. The reason behind structuring my activities in this way was to ensure students were introduced to a range of nanotechnology applications, in a fun and interesting way which I felt was achieved by the small groups and hands on activities. Furthermore I developed a 'how to' guide and accompanying lesson plans to ensure that others from within my research group could also use these resources with their own outreach activities in an attempt to broaden the reach of the developed resources beyond the single visit to the mid west. This way the ANN and DIISRTE funded project will have long lasting effects beyond the completion of my PhD with others able to easily integrate further activities into the resource kit.

Discussing my research with year 10 students at the Mid West Youth Science Forum

Demonstrating the hydrophobic nature of the Nano-Tex fabric to students at Strathalbyn Christian College

Mid West Youth Science Forum (MWYSF) 26th June 2013

The MWYSF was a fantastic initiative which had year 10 students from all over the region come together for a

day of science lectures, displays, activities and small groups to gain abetter understanding of the possibilities a career in science can afford.

My role at this event was to conduct a display on nanoscience, which allowed students to get hands on and learn the difference between hydrophilic and hydrophobic surfaces, as well as gain an insight into my own pathway to university and my current research on multifunctional nanoparticles for drug delivery. A great event to kick starts the beginning of the mid-west nano-roadshow. An article directly related to my research and involvement in the MWYSF was recently published online (5th July, 2013) on the Science Network of Western Australia's website (http://www.snwa.net.au) entitled 'Students consider small scale benefits at Mid West forum,' where in the first 5 days of being online the article had over 3000 hits.

School Visits 27th and 28th June 2013.

Four schools were visited over a two day period in and around the city of Geraldton, Western Australia. I felt it was important to ensure regional students were given the opportunity to see these resources and this was the main driving factor for deciding to drive the four and a half hours from Perth to be able to conduct these visits. Presentations were given to mainly science extension year 10 students as well as some year 11 and year 12 classes focusing on the chemistry and biological applications of my research.

Students gathering around for a quick photo after my visit to Geraldton Senior College

The visits were well received by both students and teachers alike. Jim Plunkett, a science teacher at Nagle Catholic College, said "It is great for the kids from regional areas to have a chance to listen to and be given further nsight into further studies at uni." He also cited "the combination of hands on experience with supporting information" as being "really good" at keeping the students engaged and interested throughout the session.

Similarly Keith Roffman, Head of Science at Strathalbyn Christian College, said that "the whole thing was well constructed and delivered in a great time frame, holding the student's

attention." These comments were echoed by all involved and I really felt a sense of appreciation from the teachers as they often feel left out of such events and visitors being so far from the Perth metropolitan area.

Finally I would like to thank again the ANN and DIISRTE for the funding support provided to allow me to undertake these visits and I encourage other PhD students and early career researchers to apply for this award as it is a great opportunity to practice presentation skills but also to highlight some of the exciting research occurring in our field of nanotechnology to the students whom one day may be in the laboratories alongside us.

Details of the schools visited during the mid-west nano roadshow 2013

Thursday 27th June 2013
Geraldton Grammar School
Nagle Catholic College
Friday 28th June 2013.
Geraldton Senior College
Strathalbyn Christian College
15 Cedar Crescent Strathalbyn WA 6530
http://www.scc.wa.edu.au

A student from Nagle Catholic College investigates the fluorescent capabilities of some quantum dot samples.

Queensland - Mr Amirali Popat from the Australian `Institute for Bioengineering and Nanotechnology University of Queensland

Amirali will be visiting the schools in 2014

South Australia - Mr Jakob Andersson from the Chemical and Physical Sciences at Flinders University

Jakob will be visiting the schools in 2014

LONG TERM VISITS

LONG TERM VISITS

ANN 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 Cathal O'Connell from the University of Wollongong visit to the University of Melbourne for a period of 3 months

Project title: "Towards Single Nanocrystal Devices: Nanoparticle Manipulation by Atomic Force Microscopy"

Date of visit: 1st June -31st August 2013 (3 months)

Visiting Researcher: Cathal O'Connell

ARC Centre of Excellence for Electromaterials Science, Intelligent Polymer Research Institute, Innovation Campus, University of Wollongong, NSW 2522

Host: Prof Paul Mulvaney

Nanoscience Laboratory, School of Chemistry, Bio 21 Institute, University of Melbourne, Parkville, VIC 3010

Project aim: To develop a protocol for three-dimensional manipulation (i.e. pick-up and place) of individual nanoparticles using atomic force microscopy (AFM).

Key Outcomes of Visit:

Experimental results

1. A strategy was developed for the AFM manipulation of Au nanoparticles in two dimensions by lateral pushing.
    - Capability to arrange Au NPs (15nm) in arbitrary patterns on Si/SiO_2.

- Recording of the lateral force signal allows for quantification of tribological properties of nanoparticle-substrate system (see Figure 1).

2. Several novel switching mechanisms were investigated towards three dimensional (pick-and-place) manipulation of 15 nm Au NPs. These included:
    - Electrostatic force through charged particles
    - Electrostatic force through applied bias between tip and particle.
    - DNA-hybridisation through complementary AFM tip and nanoparticle functionalization
3. Nanoparticle pick-up was achieved using applied bias, however the subsequent placement of the nanoparticle on the surface had a low success rate.
    - Quantification of the adhesion forces at play is necessary.
4. AFM force maps were generated to quantify tip-nanoparticle and tip-substrate adhesion (Figure 2).
    - This demonstrated the capability to quantify change in adhesion properties vs applied bias.
    - The experiment requires switchable adhesion between two situations (1) tip-NP adhesion stronger than NP-substrate adhesion and (2) NP-substrate adhesion stronger than tip-substrate adhesion
    - Tip-NP adhesion strength could be controlled, however no current method for quantifying NP-substrate adhesion.

<u>Training/Collaboration</u>

5. A PhD student, Jianing Liu, was trained in advanced AFM techniques (Lateral Force Microscopy, Electric Force Microscopy, Kelvin Probe Force Microscopy).
    - Jianing's project will use two dimensional manipulation to study nanoparticle tribology.
6. A seminar was given to members of the Nanoscience Laboratory on the use of AFM as a lithography tool.
    - Each member of the group was consulted with to discuss how AFM measurements could benefit their individual projects.

Instrumentation

7. The thermal stability of the AFM system was improved to resolve issue of drift in piezo-scanners.
    - Crucial to enable registry with nanometre precision.
    - Thermal drift decreased from +/-1.5°C/day to 0.15°C/day.

Conclusions and Future Work:

- Jianing Liu will continue the project at the Nanoscience Laboratory by using 2D particle pushing as a means to study nanoscale tribology.
- AFM is an effective tool for quantifying adhesion properties between the tip and the nanoparticle. However, information about the nanoparticle-substrate interface is also required.
- Nanotribology information gleaned from 2D particle pushing may fill in the gaps, yielding information on NP-substrate interface and allowing a hierarchy of switchable forces to be established.

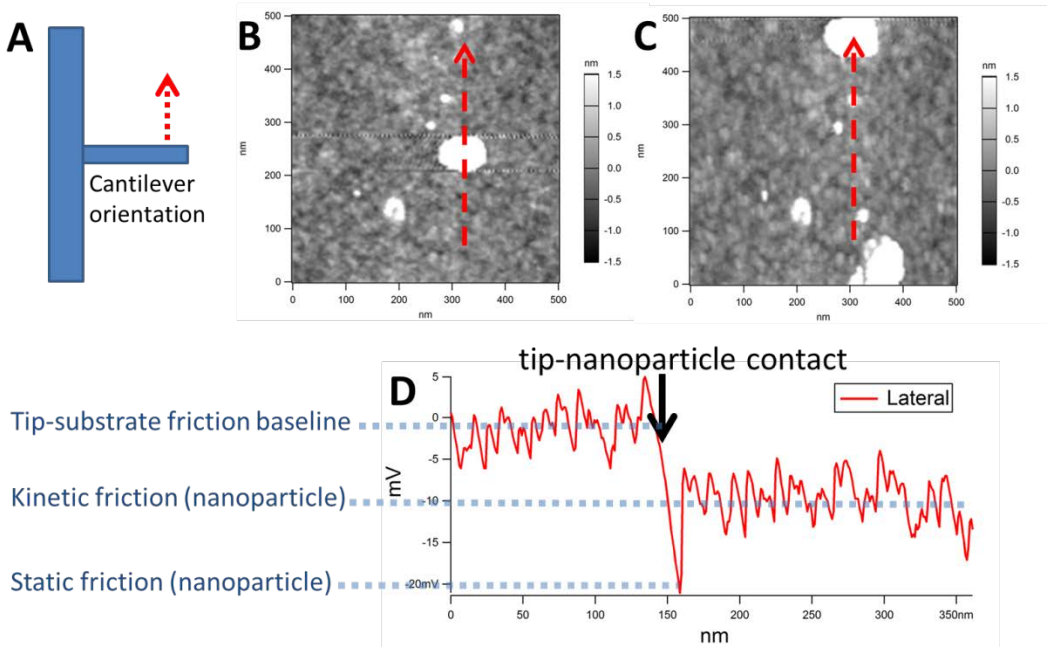


Figure 1: Monitoring lateral deflection during nanoparticle manipulation by atomic force microscopy. (A) Illustration of the orientation of the AFM cantilever with respect to direction of the push (top-down view). (B) AFM topography image of the nanoparticle before manipulation. The tip trajectory during manipulation is shown (red dashed line). (C) AFM topography image of the nanoparticle after manipulation. The particle has been pushed approximately 200nm in the direction of the push. (D) The lateral deflection (i.e.torsional

bending) of the cantilever during the manipulation event can be used to extract tribological information about the nanoparticle-substrate system. The y-axis represents the lateral deflection, while the x-axis is the distance moved by the tip during the manipulation.

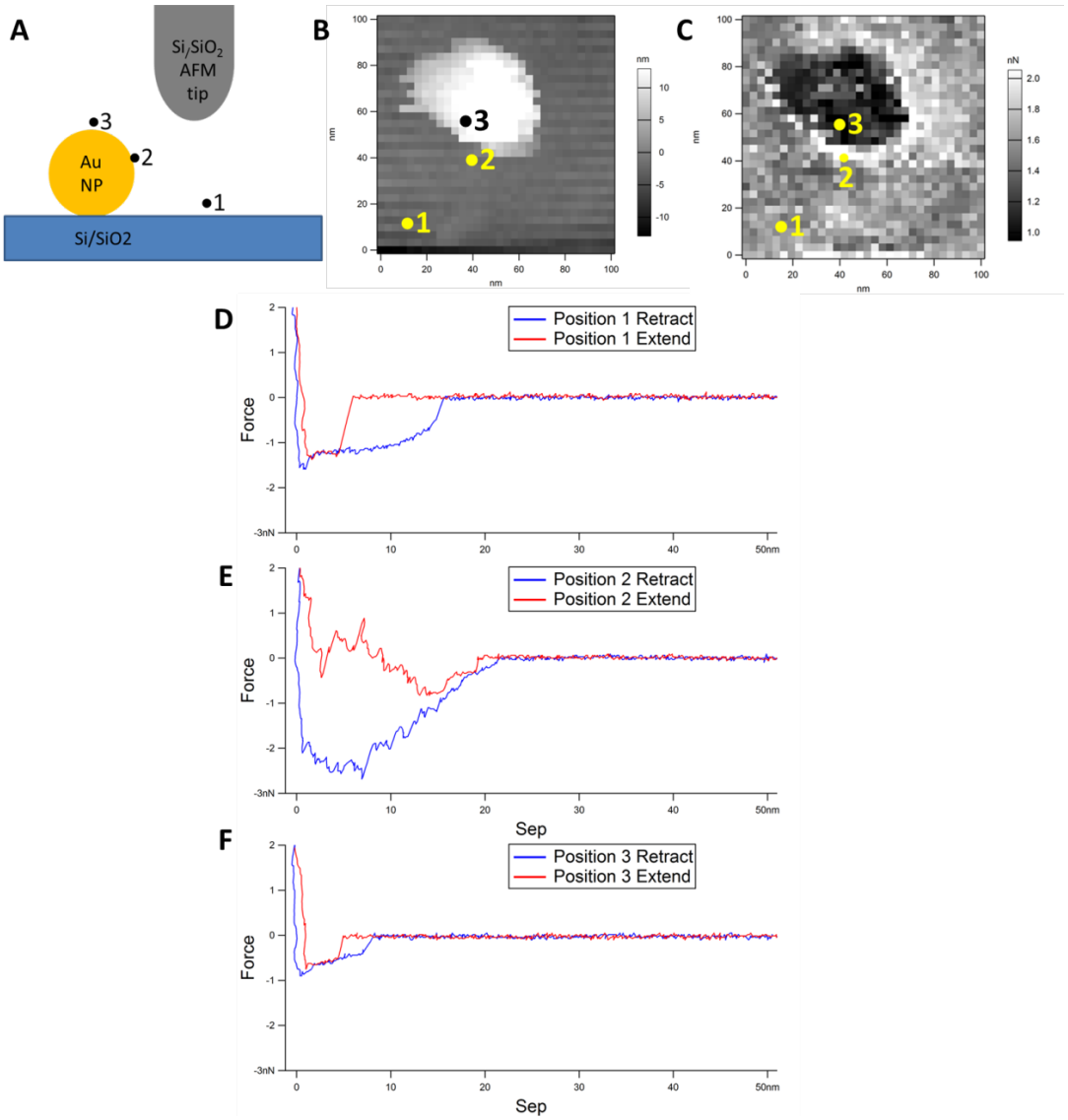


Figure 2: AFM force maps used to characterize the adhesion forces between the AFM tip and the nanoparticle. (A) Schematic of the experiment. In force-mapping, the adhesion force between tip and substrate is measured for hundreds of positions over a 100x 100 nm area. Three positions are labeled (1) on the substrate far from the nanoparticle, (2) on the substrate very close to the particle, (3) on the nanoparticle. (B) The height image generated from the force map. This shows the position of the nanoparticle. (C) Map of adhesion force. Lighter pixels indicate higher force. Tip-nanoparticle adhesion is lower than tip-substrate adhesion. The white pixels surrounding the nanoparticle may indicate the location of a capillary meniscus. (D-F) The individual force curves generated at positions 1, 2 and 3 respectively.

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.

Dr Stephanie Pace from the Mawson Institute at the University of South Australia visit to the University of Sydney

This report describes the scientific outcomes of my short term visit to the University of Sydney, in the Key Centre for Polymer & Colloids group under the direction of the Prof. Sebastien Perrier.

INTRODUCTION

Chronic wounds are an important and costly medical issue, imposing considerable pain, reduced mobility and decreased quality of life. Wounds that do not heal within three months are considered chronic. During the healing process, the wound can be exposed to some bacteria, causing change in wound metabolism and change of pH in the wound fluid. [1]
The objective of my postdoc project at the Mawson Institute was to develop porous silicon-based photonic sensors to be incorporated into existing wound dressing for the detection of small changes in pH, which are indicative bacterial infection and changes in wound metabolism. For this project, hybrid organic/inorganic materials were generated. One of those materials was a hybrid of poroussilicon (pSi) and pH-responsive polymers such as poly(acrylic acid). We were limited to a small range of polymers at the Mawson Institute and were interested in a polymer that would act as abarrier to prevent the water to penetrate inside the porous matrix at neutral pH. As the pH would decrease, the polymer would become hydrophilic, thus opening up the pores of the porous layer, and enabling water penetration. The water penetration will result in a conspicuous wavelength shift of the porous silicon reflector, giving an optical signal visible to the unaided eye. This would constitute a faster diagnostic of the wound to practitioners and nurses.

pSi is an attractive candidate to use as a sensor because its porosity, pore size and surface area can be tuned by adjusting the electrochemical conditions to produce nanostructure with photonic features such as resonant microcavities and rugate filters.[2] As a pH-responsive polymer that could fulfil the above criteria, poly(2-diethylaminoethyl acrylate) (PDEAEA) was chosen since the group of Prof. Perrier has extensive experience with this particular polymer and its synthesis. The PDEAEA displays pH-responsive properties: the pendant amine groups are deprotonated at pH > pKa and the polymer is hydrophobic, but when the pH decreases, the polymer is quaternised and become hydrophilic. Deprotonation of the tertiary amine pendant groups of the DEAEA unit causes the PDEAEA to change its conformation from highly extended chain to a random coil. [3]
During the visit in the Key Centre for Polymer & Colloids group, the PDEAEA was synthesized by

reversible addition fragmentation chain transfer (RAFT) polymerization and characterized, before being immobilized on the external surface of the pSi.

EXPERIMENTAL RESULTS

Materials

2-diethylaminoethyl acrylate (DEAEA) was obtained from Aldrich. The inhibitor was removed from DEAEA by passing the monomer 2 times over an inhibitor removal column. 2,2'-Azobisisobutyronitrile (AIBN; Aldrich) was recrystallised from ethanol. L. 2-Propanoic acid butyl trithiocarbonate (PABTC) was supplied by Dulux, Australia. Toluene and tetrahydrofuran (THF) were of AR grade and were used as received.

pSi preparation

pSi single films were prepared from single-crystal p-type silicon (boron doped, 0.0005-0.0011 Ω cmresistivity, <100> orientation) at a modulated current density with a sine wave (between 11.36 and 28.4 mA cm-2, 21 s periodicity) for 477 s in a 1:1 (48%) aqueous hydrofluoric acid ethanol solution, to produce a rugate filter. This nanostructure acts as a filter, reflecting the light at a precise wavelength that can be easily tuned. After etching, the samples were thermally oxidised at 600°C for 1h in order to render the film stable in aqueous medium.[4, 5]

Polymerization and characterization

RAFT polymerization was used to synthesis the PDEAEA after a published procedure (Figure 1 a).'[3] PABTC (0.037 g, 0.155 mmol) was placed in a round bottom flask and AIBN (0.0051 g, 0.031 mmol) was added to it. To this mixture DEAEA (4 g, 23.359 mmol) and the toluene (1.33 g, 14.433 mmol) were added. The solution was homogenized by shaking at 0°C and deoxygenated by bubbling nitrogen through it for 20 min. The solution was placed in an oil bath at 65°C and polymerized for 24 hours.

After polymerization the residual monomer and solvent was removed by precipitating the polymer in acetone.

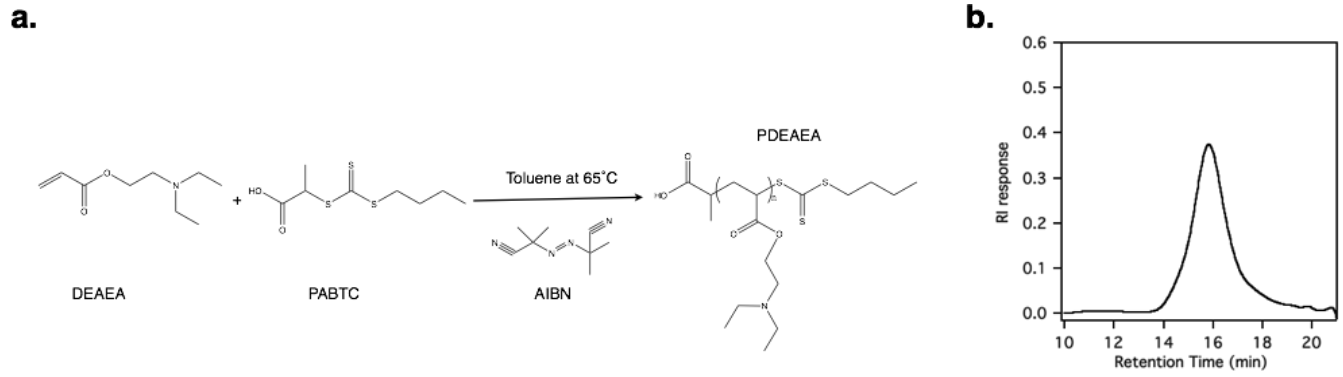


Figure 1 : a. RAFT synthesis of DEAEA polymer . **b.** GPC trace of PDEAEA

The polymer was dried under vacuum overnight. After reaction, a monomer conversion of 75 % was calculated by 1H Nuclear Magnetic Resonance (NMR), performing on a 200 MHz Bruker spectrometer. The molecular weight distributions of the PDEAEA (polydispersity 1.7) was

determined by gel permeation chromatographic (GPC) analysis using tetrahydrofuran (THF) as an eluent (40°C, 1.0 mL/ min). Molecular weight of 4 379 g/mol was obtained by GPC. A typical GPC trace for the PDEAE is represented in the figure 1b.

Color change assay for the hybrid material pSi-PDEAEA in acidic and neutral conditions

After reaction, the polymer was deposed on the external surface of the pSi by spin coating, in a manner that the polymer acts as a barrier to prevent the water to ingress into the porous matrix. PDEAEA was dissolved in toluene (40 mg/ml), and was spin-cast in the pSi film at 3000 rpm for 1min. Three depositions were done on the same sample in order to generate a thick layer of polymer. The samples were placed under vacuum for 12 hours, in order to evaporate the solvent remaining in the surface.

The new material pSi-PDEAEA was then exposed to water at different pH (pH 3 and pH 7), in order to measure the penetration of the water inside the porous matrix over the time (Figure 2). Figure 2 a. represents the change of color over the time, after adding a drop of water (3 µl) at pH 3 and pH 7 on the surfaces of the oxidized pSi (control) and the pSi-PDEAEA. Figure 2b. shows the evolution of the color green (580 nm) on the samples in presence of the water. The intensity of the signal drops very quickly for the control sample exposed to water for both pH, a decrease of 40 % is observed after 2 sec, in these conditions. The intensity of the signal drops of 40 % after 20 sec for the pSi-PDEAEA samples after been exposed to the water. Simultaneously, an increase of the intensity of the color red (615 nm) on the samples exposed to the water is observed (Figure 2c). The signal increases of 50 % in less than 5 sec for the control at pH 3 and pH 7. For the pSi-PDEAEA sample, an increase of the signal of 20 % in 20 sec and of 10 % in 20 sec is observed in presence of water at pH 3 and at pH7, respectively.

The penetration of the water inside the porous matrix causes the change of color of the surface. In the case of the pSi-DEAEA sample, the polymer acts as a barrier, the pore are filled up with air (nair=1), the sample looks green. At pH 7, the polymer coated on the surface is hydrophobic, the water (nwater=1.33) penetrated very slowly inside the porous matrix until the surface looks red. The refractive index inside the porous matrix has changed, inducing a change of color of the surface. At pH 3, the pH conditions are below the pKa value of the PDEAEA, the polymer will become **Figure 1 : a.** RAFT synthesis of DEAEA polymer . **b.** GPC trace of PDEAEA
hydrophilic because of the quaternisation of the amine group. In this condition the polymer will change conformation, loosing the opening of the pores. Indeed, the water penetration is faster that the one observed at pH 7. For the control, the color red appears instantaneously after the deposition of the water, in the two conditions of pH, this observation confirms the role the polymer as a barrier.

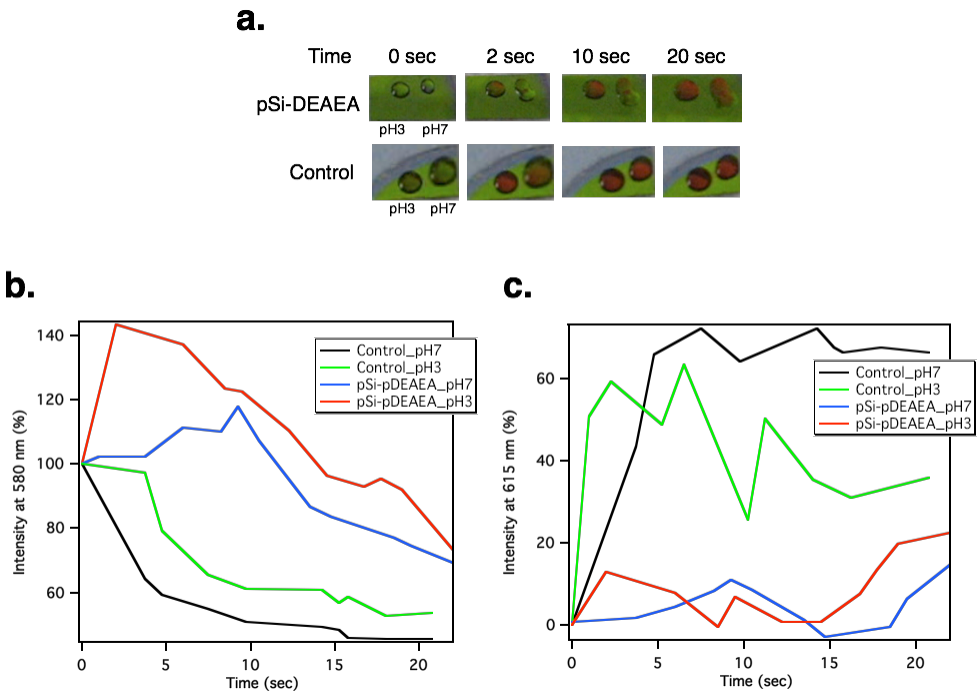


Figure 2 : Characterization of the color change after adding a drop of 3 µL of the water at pH 3 or pH 7 on the control (oxidized pSi) and the pSi-PDEAEA surfaces. **c.** Images of the samples (control and pSI-PDEAEA) exposed to the water at different pH. **b.** Intensity of the color (580 nm) over the time for the aera exposed to the water at pH 3 and pH 7, for the control and the pSi-DEAEA. **c.** Intensity of the color (615 nm) over the time for the aera exposed the water at pH 3 and pH 7, for the control and the pSi-DEAEA.

CONCLUSIONS

A new hybrid material composed of a pSi rugate filter and a PDEAEA has been generated. After characterization of the PDEAEA synthesized by RAFT polymerization, it was spin-coated in the porous layer. Some preliminary results were presented here. The role of the PDEAEA, as a barrier depending of the pH condition was demonstrated. Slow penetration of the water in the pSi- PDEAEA, correlated with a change of color of the sample. The conditions of deposition of the PDEAEA on the pSi can be improved in order to have a impermeable barrier on the top of the surface at pH 7. Moreover, the interferometric reflectance spectroscopy can be used to investigate the water infiltration in the pSi-PDEAEA surface, when the samples were exposed to a buffer solution at different pH. This work will be the object of a manuscript for an high impact factor article.

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Mrs Chamanei Hettiarachchige from Queensland University of Technology visit to Monash University and Melbourne Centre for Nanotechnology

Student name: Chamanei Sandamali Hettiarachchige
Institute: Queensland University of Technology From: 26th May 2013 – 21st June 2013

Acknowledgement

I would first like to acknowledge my husband for his love and encouragement. Acknowledgement should be extended to my supervisor Dr. Kristy Vernon for her endless support and guidance and Dr. Alison Funston for her full support she gave me during the visit to Monash University.

I would also like to thank Dr. Fatima Eftekhari and Dr. Matteo Altissimo for their help throughout the fabrication process undertaken at Melbourne Centre for Nanofabrication.

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Last but not least, I would like to thanks Patrycja Ballard and Wenming Tong for their support during my stay at Monash University.

Abstract

There are several structural designs which can be used in plasmon waveguiding such as gap, V-groove, stripe, nanowire and wedge. In this project only stripe waveguide structures will be considered as they are simpler to fabricate and the plasmons supported by these waveguides have a moderate propagation capability. Ultimately, single emitter Quantum Dots will be used as emitters in near vicinity of plasmon waveguides to study the interactions between Quantum dots and plasmons.

Introduction

A plasmon is a coherent oscillation of light interacting with conduction electrons of a metal [1]. As the conventional optics is limited by diffraction, plasmons are ideal candidates for focusing light into nano scale vicinity surpassing diffraction limit, thus increasing the field [1]. Plasmon waveguides are proposed to use in sensors and circuits to achieve more compact devices [2].

Purpose

In order to use plasmons for complex tasks, there should be a way of controlling the plasmon propagation. This research ultimately focuses on making a plasmonic switch using a Quantum dot. To create this switch we will need to study the interactions between QD and plasmons.

Importance and Significance

To develop all optical circuit, the circuit should contain a method to propagate light around the circuit, a method to couple light efficiently in to the circuit and active components to control the propagation of plasmons inside the circuit. The purpose of this PhD project is to develop plasmon waveguides which can propagate plasmons with active components to control the propagation.

Scope

There are several structural designs which can be used in plasmon waveguiding such as gap, V-grove, stripe, nanowire and wedge. In this project only stripe waveguide structures will be considered as they are simpler to fabricate and have a moderate propagation capability. Ultimately, single emitter Quantum Dots will be used as emitters in near vicinity of plasmon waveguides and I will study the interactions between Quantum dots and plasmons. Excitation methods will include SNOM, end-fire excitation and grating coupling.

Discussion

2.1 Literature Review

Rapid development in technology yields faster and compact integrated devices. However, the size of the electronic components is approaching a fundamental limit. Due to the quantum effect which arises from the size reduction of the electronic component, an alternative method is needed in order to overcome the challenge. Optics is a good solution but the conventional optics is limited in application in nanoscale due to the diffraction limit. As an example, optical fibre has the minimum size ~$\lambda/2n$ where λ is the wavelength of light and n is the refractive index of the medium. For most photonic circuitry, light should be confined and routed into a volume far beneath the diffraction limit. Plasmonics enables the control of light in the nanoscale. Plasmonics is a promising solution for the above problem.

Nanoplasmonics is the study of optical phenomena in nanoscale at a metal surface. With an approximation, electrons of the metal surf freely and driven by external light E- field, they are displaced periodically with respect to the lattice ions [1, 3, 4]. This displacement creates opposite charges at opposite surfaces leading to an attractive restoring force [1, 4, 5]. This creates an electron oscillator, which is called a surface plasmon (SP). Frequency of the SP is determined by restoring force and effective mass of the electrons [1, 4, 5]. Therefore SPs are localized collective oscillations of electron density. So, electromagnetic waves can couple to these oscillations and be guided as Surface Plasmon (SPs) which propagate at metal-dielectric interfaces or can be excited locally depending on the geometry.

Asymmetric stripe waveguide (dielectric medium above and below the stripe is different) supports highly localised mode and leaky modes which radiate into the high index dielectric medium. Lower order plasmon modes exhibit high loss due to its tight evanescent field confinement inside the metal. In order to get a suitable propagation distance with high confinement of field, it is possible to use a higher order mode confined to the lower index interface well away from the interior of the metal.

In order to excite the plasmon, the wave vector of the light travelling in the adjacent medium should match the wave vector of the plasmon. Plasmon can be excited using free space illumination with a suitable mechanism to match the wavevectors. It is theoretically and experimentally shown that an excited quantum emitter can decay in to plasmon mode when it is in near proximity of a plasmon waveguide. This is very useful when it comes to controlling the propagation of plasmon through the circuit.

2.2 Experiment

Here we used end-fire excitation, SNOM and grating coupling. With end fire excitation, an oil-immersion microscope objective with high numerical aperture brought into contact with glass

substrate with an index matching oil. A highly focused optical beam sends through the objective. High numerical aperture of the objective ensures a large angular spread of the focused laser beam. This includes angles greater than the critical angle of total internal reflection at the glass-air interface.
With the SNOM, the subwavelength aperture size of the tip ensures the light ensuing through the tip consists of wide range of wavevectors enabling to match the wavevectors of the plasmons.
Stripes were milled using Focused Ion Beam lithography. A large area was milled out leaving the stripe in the middle ensuring there was enough distance between the stripe edge and the edge of the milled out area.

2.3 Method

First, grating periods for fundamental mode with wavevector 2.01x 10^7 m^{-1} (before spin coating PMMA) was calculated. After adding PMMA, grating periods required for fundamental mode (k=2.29x 10^7 m^{-1}) and second order mode (1.67x 10^7 m^{-1}) were calculated. Then, glass slides were cleaned inside Class 10 clean room using Acetone, IPA and distilled water. After that, 2 nm Ge layer was evaporated using e-beam evaporator. Again, on top of that, 100 nm Ag layer was evaporated. After that, stripes were milled using Focused Ion Beam lithography. Then, the stripes were excited using SNOM, end-fire excitation and grating coupling methods and were tested for waveguiding. Finally, 175 nm PMMA layer was spincoated on the substrate and tested using inverted microscope excited via grating coupling.

2.4 Results and Analysis

Grating periods were calculated for the fundamental mode
Stripes milled using FIB:

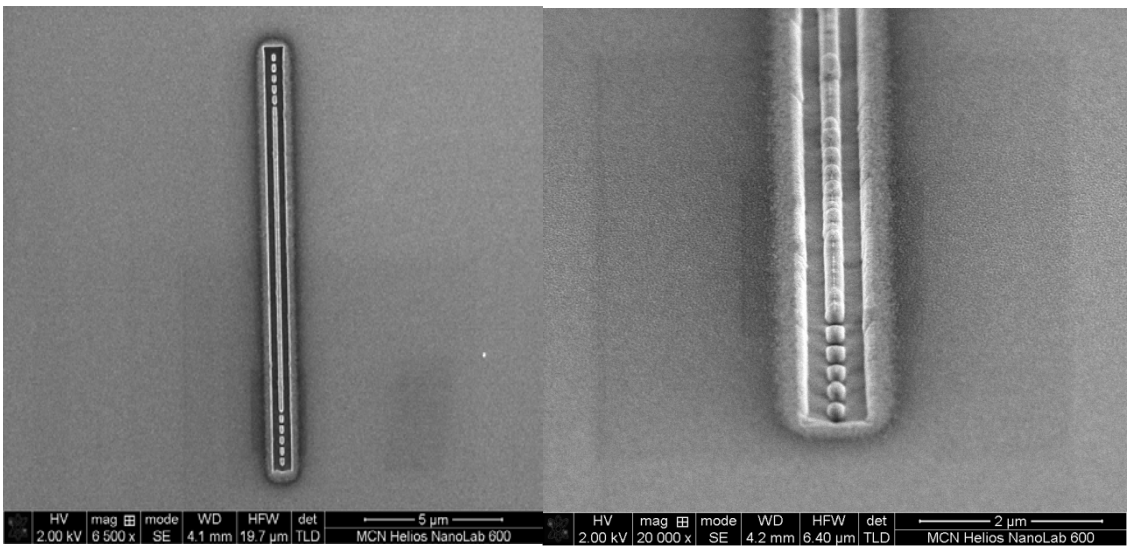

Figure 3. a) 100 nm x 10 µm x 150 nm stripe waveguide (before milling out the large area) with 280 nm grating period b) 52° tilted image of the same stripe

SNOM couldn't excite the plasmons. The milled stripes were too high so that SNOM tip couldn't go over the stripe to scan. Needed to adjust FIB parameters to reduce the milling depth, to get smooth edges and preserve the quality of the grating structure.

Endfire excitation set up:

Chemically synthesized nanowires were excited using the endfire excitation set up at Monash and observed for waveguiding.

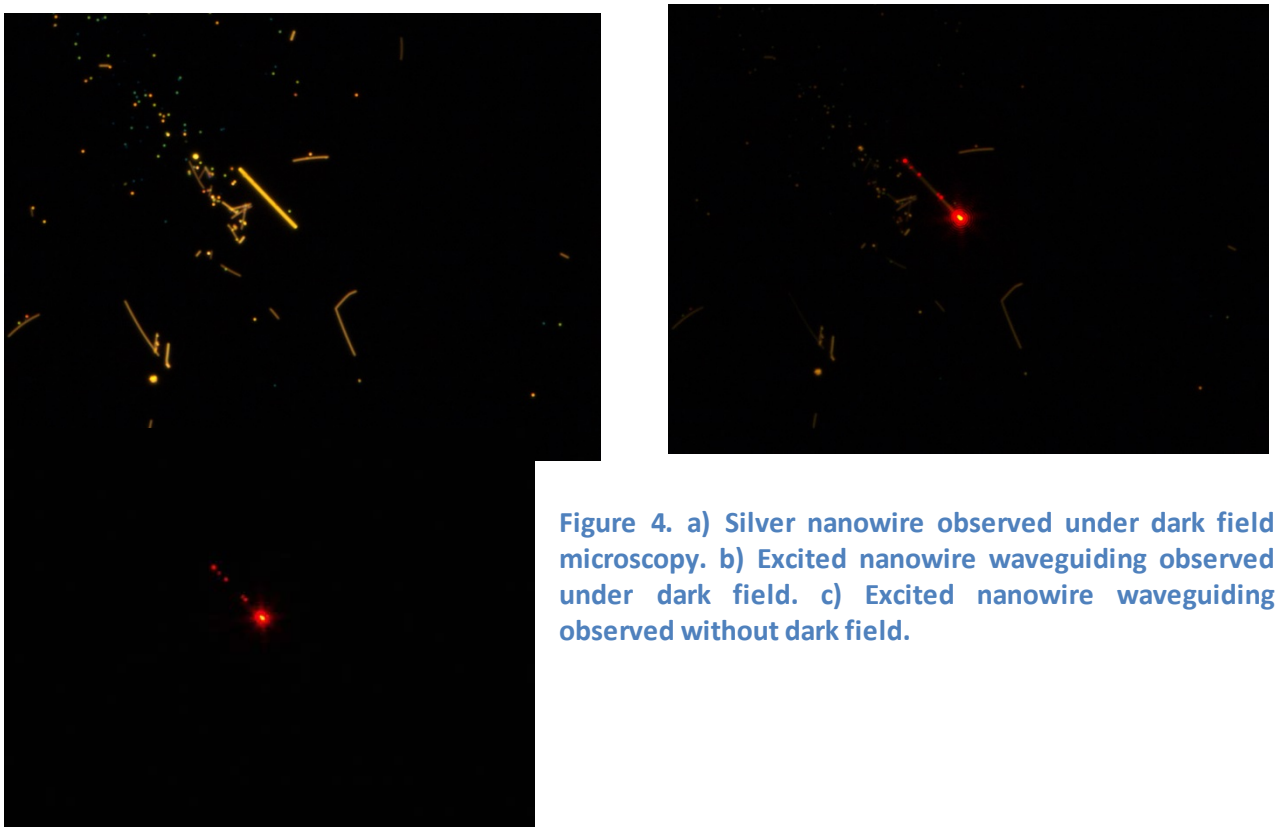

Figure 4. a) Silver nanowire observed under dark field microscopy. b) Excited nanowire waveguiding observed under dark field. c) Excited nanowire waveguiding observed without dark field.

Conclusion

It is possible to make stripe waveguides using Focused Ion Beam Lithography with carefully determined milling parameters. SNOM cannot scan properly if the stripe height is around 400 nm. After learning of Monash University end fire set up, I'm confident enough to produce the same set up at QUT. Through many discussions, I learnt a lot about dark field microscopy, SNOM, and Focused Ion Beam lithography. I had the first time experience with class 10 clean room at MCN.

With all the knowledge I gain, I hope to continue this research at QUT aiming for a journal publication.

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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 Dominic Ho from the University of Western Australia visit to Stanford University, USA

The purpose of this report is to detail the outcomes of ANN Overseas Travel fellowship visit (July 2013 – September 2013) to Stanford University's Stanford Partnership for Spinal Cord Injury and Repair laboratory as part of an ongoing collaboration with A/Prof Giles Plant.
The main aim of the visit was to develop a technique to differentiate stem cells using nanoparticles which had been developed in our lab at UWA. These involved first learning to culture and maintain the stem cell followed by determining their biocompatibility with our multifunctional nanoparticles and developing a new technique to differentiate the stem cell into desired cell types.

Research Outcomes

The majority of research aims were achieve Learning to culture and maintain the mouse neural stem cells(mNCSs) was achieved within the first few weeks, This was followed by toxicity assays on the mNSCs involving clinically relevant concentrations of our nanoparticle formulations, Results demonstrated that the 2 particle types had no toxic effect on the stem cell profanation, Fluorescence microscopy also confirmed the cellular uptake of up one particle type which the second had showed unexpected potential to adhere to the cell membrane and would be left for further investigation. The next step was to develop the differentiation, This was to be done by magnetizing the neurospheres with nanoparticle followed by magnetically "pulling" the spheres onto an electrically conducting surface for stimulation, Though we were able to demonstrate the feasibility of magnetically controlling the floating neurospheres, we were not able to differentiate them. It was found that the neurospheres were proliferating at a rate which made it difficult to monitor any differentiation 2 days after commencing the experiment. Though we were unable to complete this aspect of the study before the end of the fellowship we have identified aspects of the study which can be changed to attain a working differentiation technique. With the expertise gained from the fellowship, we plan to continue the study back in Australia.

Research Benefits

The overseas research travel fellowship allowed me to benefit from the one on one mentoring from our collaborator (A/Prof Giles Plant). In addition, the new skills and techniques I learnt at Stanford have allowed me to generate new data which is not only beneficial to my thesis but also to my development as a scientist, Furthermore the visit has also allowed me to gain an insight in the work ethic and approach toward research foreign institutions follow. This insight is invaluable as I will soon be looking to apply for post-doctoral positions and may influence any decisions I make in the future.

Mr Damon Carrad from the University of New South Wales visit to Lund University in Sweden.

Damon Carrad. Outcomes of travel to Lund, Sweden.
7/9/2013 – 1/11/2013

During my visit to Sweden, I worked on two projects related to the electrical and thermoelectric properties of semiconductor nanowire devices. These devices were enhanced by the incorporation of nano-scale patterned polymer electrolyte 'wrap-gates', which were developed by myself and my research group earlier this year, before my trip. The operation of nanowire transistor devices is governed largely by metal gates at the surface of the nanowire. Applying a bias to these gates alters the electron density, current, and many other device properties. The most effective geometry for the gate is one that wraps around the circumference of the nanowire, but these are tricky to fabricate using traditional a traditional 'metal-oxide' approach. Our development was to pattern a polymer electrolyte on the nano-scale and apply this to nanowire transistors. Polymer electrolytes generally consist of a salt e.g. $LiClO_4$ in a polymer matrix. The salt dissociates into e.g. Li^+ and ClO_4^- ions, which can move within the polymer matrix in response to an external bias applied to a connected metal electrode many microns away. The ions are attracted/repelled from the metal electrode, and transfer that charge to the surface of the nanowire. This provides the same effect as a metal wrap-gate, but the fabrication is much simpler; hence we have moved much of our focus to this new material. The paper related to this work has been recently published in NanoLetters (IF = 13.025) [1].

The first project I worked on was to investigate the electric and thermoelectric properties of polymer-electrolyte gated nanowires. This project began earlier in the year when Sofia Fahlvik-Svensson from Lund University visited UNSW. Together, we fabricated InAs nanowire devices with a polymer electrolyte gate. The polymer electrolyte formed quantum dot-like states within the nanowire at temperatures of less than 1 K. At UNSW, we carried out the electrical and thermoelectrical measurements for this project. We continued working together in Lund on analysis of the data and began work on a paper, which we intend to submit to NanoLetters.

The second project I worked on in Lund was to develop a nanowire-based, tunable p-n junction incorporating a polymer electrolyte gate. The behaviour of p-n junctions is largely determined by the density of electrons and holes, (n and p, respectively) on either side of the junction. In traditional devices, n and p are determined by the density of dopant impurities, which is fixed for each device; dopants cannot be removed once they are introduced. An alternative route is

to induce electrons and holes electrostatically by gating. Here, n and p vary with the bias applied to the gates, and the result is a device with fully tunable behaviour.

Tunable p-n junctions based on InP nanowires have been developed by Dr Kristian Storm and Gustav Nyland at Lund University [2]. However, one disadvantage to using metal gates to define n and p is that there is a limit to how close two oppositely biased metal gates can be before they electrically short (typically around 50 – 100 nm). This prohibits having the abrupt junctions that are possible using impurity doping. One solution is to use a polymer electrolyte for one of the gates. The advantage here is that the ions do not leave the polymer, so if the polymer electrolyte overlaps an adjacent metal gate (e.g. the other gate in our tunable p-n junction), the two will not electrically short.

At Lund, I worked with Dr Kristian Storm on the development and fabrication of these devices. In doing so, I learned new techniques, e.g. atomic layer deposition and ellipsometry, and was exposed to different ways of conducting techniques I was already used to, e.g. electron microscopy, and electron beam lithography. It also presented me with the challenge of taking established techniques at UNSW and adapting them to a different environment. Together, Kristian and I fabricated many working devices, which I have brought back to UNSW for characterisation and testing. We also developed ideas for more complicated tunable devices that could replicate CMOS technology on a single nanowire.

Beyond the scientific outcomes, the trip to Lund was an invaluable to meet and work with many new colleagues from different groups within the department, from masters students to professors, and experience difference approaches to science. The fact that the ANN Overseas Travel Grant had taken me to Europe also gave me the opportunity undertake an ARC-funded trip to give an oral presentation at the ICON2013 conference in Annecy, France – a major international conference.

[1] D.J. Carrad et al NanoLetters, 14,
94 -100 (2014)
[2] K. Storm et al AIP Conference Proceedings, 1399, 279-280 (2011

Miss. Nian Jiang from the Australian National University visit to the University of Cincinnati.

TEMPERATURE-DEPENDENCE PHOTOLUMINESCENCE STUDY ON GAAS/ALGAAS QUANTUM WELL TUBE NANOWIRES

My visit of ~ 8 weeks (22nd March – 20th May, 2013) to Unite States of America is sponsored by the Australian Nanotechnology Network Overseas Travel Fellowship. This visit mainly took place in Nano Materials Physics Group in Department of Physics in University of Cincinnati. This group equips with custom-built state-of-art high spatial resolution spectroscopy systems on which I carried out my experiments. The group leaders, Prof. Leigh M. Smith and Prof. Howard Jackson, have more than 30 years of experience in optical spectroscopy of semiconductors. During the visit, a series of experiments on single nanowire spectroscopy, including low temperature photoluminescence (PL), PL excitation (PLE), and temperature dependence PL together with spatial PL mapping were carried out. A large amount of experimental data has been collected and numerous discussions have been held among group members. The results of this visit helped to understand the effects of growth parameters and crystal structure on the optical performance of nanowires and to optimize the growth parameters to develop high quality nanowires for future optoelectronic devices. Apart from the research visit, I also attended the MRS Spring Meeting in San Francisco and gave an oral presentation during the first week of April.

Figure 1. With the Nano Materials Physics group in University of Cincinnati.

I am very grateful to Australian Nanotechnology Network for the financial support for this trip.

Base on the results on this trip, a few papers are under progress.

Background and Premise for the research visit

With reduced dimension and outstanding material properties, III-V heterostructure semiconductor nanowires hold outstanding potential as key component for future nanoscale optoelectronic devices. The complex heterostructures and well-defined interfaces lead to new and/or enhanced optical and electronic properties compared with bulk material. The heterostructure nanowires also allow the fundamental investigation of quantum confinement phenomena. However, the electronic properties -- i.e., carrier mobility and lifetime—of GaAs nanowires are largely limited by high surface-to-volume ratio and high surface recombination velocity (SRV). During the first two years of my PhD, I have optimised the Au-catalysed growth of GaAs/AlGaAs core-shell nanowires using metal organic vapour deposition (MOCVD). The free GaAs surface is replaced by GaAs/AlGaAs heterointerface in the core-shell nanowires and the upper limit of the recombination velocity at the heterointerface was reduced to 600 cm/s compared with ~ 10^6 cm/s of SRV at the free GaAs surface. Based on these results, GaAs/AlGaAs quantum well tube (QWT) nanowires were grown. Structural characterisation shows high quality crystal structures without defect and the thickness of QWT is well controlled. Initial optical measurements of these nanowires have been carried out at both low temperature and room temperature. Results shine special interests in optical properties with high spatial resolution at low temperature. The differences between the QWT emission at low temperature and that at room temperature require temperature dependence measurements. Also, these high quality nanowires provide an excellent opportunity to explore the semiconductor physics at low dimension and quantum physics.

The main purpose of this research visit was to complete the optical properties characterisation of QWT nanowires in terms of both spatial and temporal scale on a high spatial resolution optical spectroscopy.

Outline of methods and experiments

A pulsed laser with tunable wavelength was used to generate white light via the optic fiber and the excitation wavelength was chosen by a slit. The details of experiment setup are shown in Figure 2. Solid immersion lens (SIL) was used to increase the spatial resolution. Barbinet was used to set the polarization of excitation laser for polarization measurement. An extra lens was added to the optic pathway to disperse the laser beam to excite the whole wire for PL mapping. Nanowires were first transfer to Si substrate or SIL and put into cryostage which was cooled by liquid helium to carry out both low PL and temperature dependence PL measurements. The structure of cryostage is shown in Figure 3. The nanowires were aligned in a way that is parallel to the slit before spectrometer for PL mapping by rotating the copper chip. Metal indium was used to improve thermal contact between SIL and the copper chip and the Si wafer with nanowires were attached to the copper clamp by Ag paste. The movement of stage was controlled by auto-cube on both x- and y- direction. PL spectra were obtained at 10 K for the whole set of QWT nanowires (as listed in Table 1) with different QWT growth time and

temperature dependence PL measurements were carried out on nanowires with QWT growth time from 15 s to 1 min 14 s.

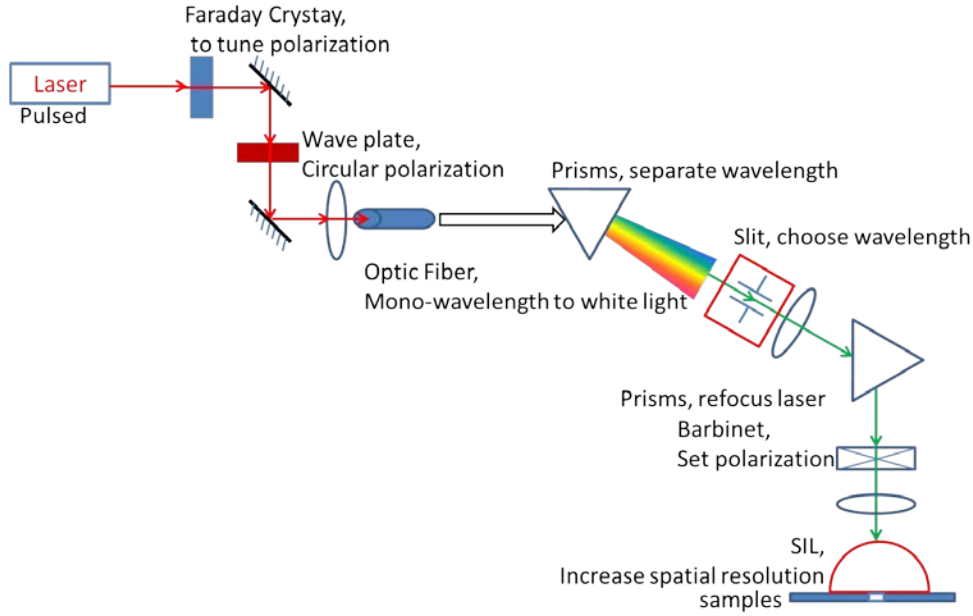

Figure 2. The schematic diagram of the spectroscopy setup.

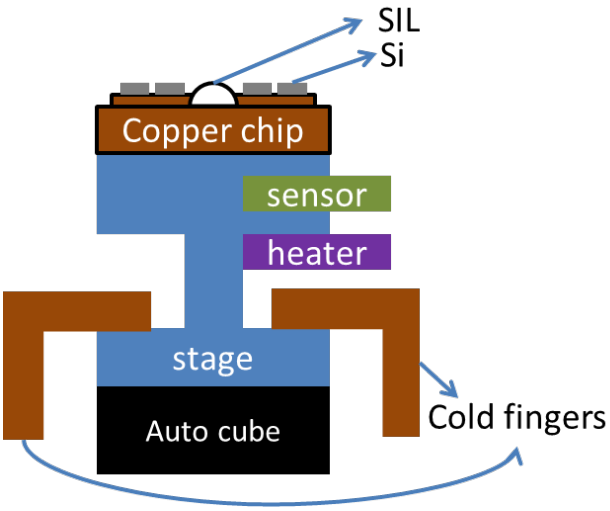

Figure 3. The schematic of cryostage.

Summary of select results from the visit

1. A PL peak around 820 nm was observed for all QWT nanowires at 10 K. This peak is mainly from GaAs core. PL emission at shorter wavelength was observed, which is contributed to GaAs QWT. The blue shift of emission is due to quantum confinement as the thickness of QWT is smaller than the Bohr radius of the exciton in GaAs. When the QWT growth time is reduced, the QWT emission peaks shift towards short wavelength. Based on the PL spectra at 10 K, the thicknesses of QWT were calculated out (listed in Table 1). Thess results are consistent with the QWT thicknesses measured directly from cross-sectional transmission electron microscopy (TEM) images.

2. PL spectra measured at 10 K reveal broad emission wavelength range with multiple peaks, as shown in Figure 4. The sharp lines in the PL spectra indicate the existence of localised states in the QWT.
3. Obvious red shift was observed for the emission from both the GaAs core and GaAs QWT when the temperature rose, due to the expansion of the lattice (Figure 5).
4. The analysis of polarisation measurements indicates that the QWT is polarised in the direction parallel to the growth axis of the nanowire (Figure 6).

Conclusion

This optical characterisation of heterostructure nanowires is an essential part of my Ph.D. project and the large amount of data collected during this research trip complements the characterisation of this set of QWT nanowire samples, which enables me to finalise the results for publication. The details revealed by the high resolution PL carried out at 10 K shine special interests into the ultrathin QWT nanowires which offer a unique opportunity to investigate the quantum confinement phenomena. Discussions with Prof. Leigh M. Smith, Prof. Howard Jackson and their group members helped me to enhance my understanding of semiconductor physics at low dimensions. Also, I have gained a precious experience of overseas research and extended my international collaborative skills, which is very helpful for my research career in the future.

Table 1. The list of samples. The thicknesses of QWT were calculated regarding to the centre of the QWT emission. The failure of the calculation of the QWT thickness of sample AX11-456 is due to the limitation of spectroscopy system.

Growth	QWT growth time	Thickness of QWT (PL results)
AX11-456	5 min	-
AX12-008	3 min	8.2 nm
AX12-009	2 min	5~6 nm
AX12-115	1min 14s	3.9 nm
AX12-369	36 s	2.5 nm
AX12-594	15 s	1.4 nm

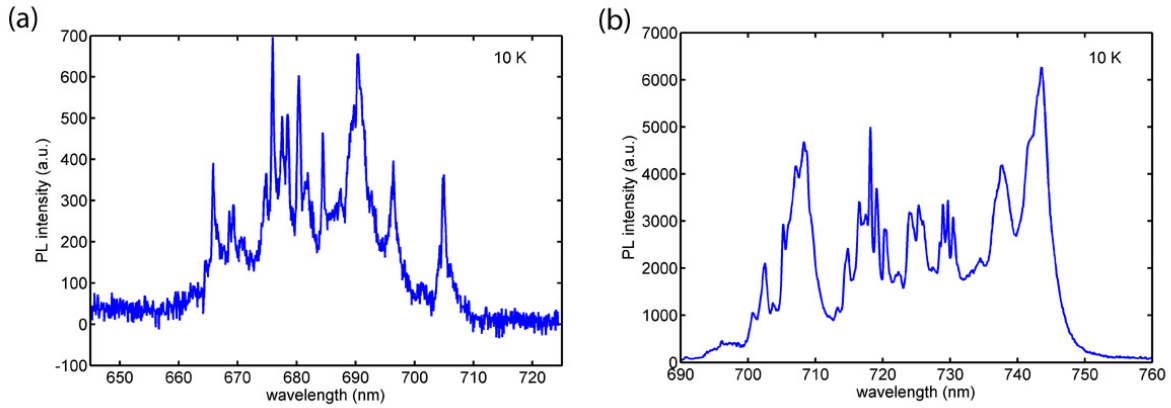

Figure 4. PL spectra at 10 K from (a) sample AX12-369 with 36 s QWT growth time and (b) sample AX12-115 with 1 min 14 s QWT growth time, both showing broad PL spectra with multiple peaks.

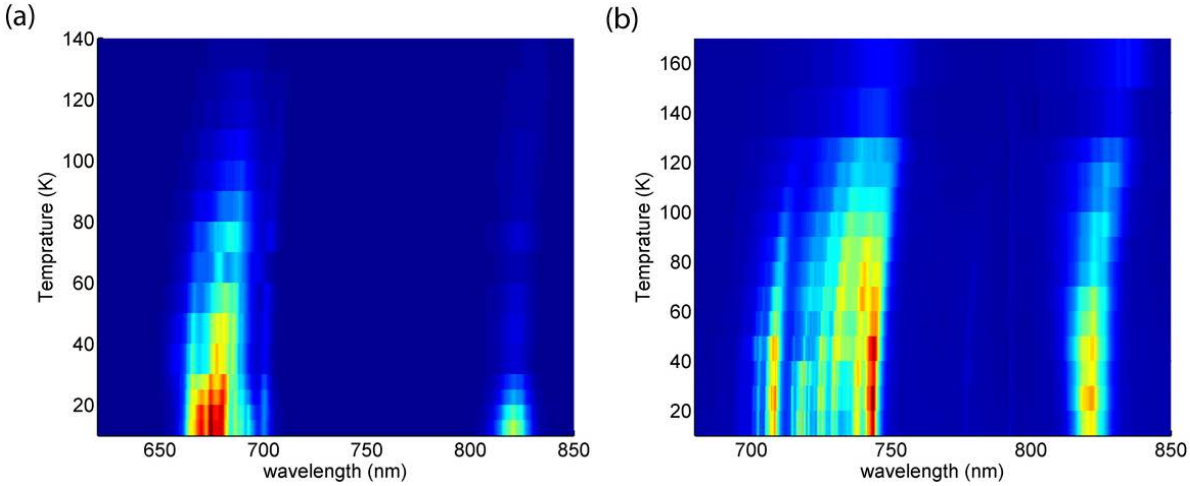

Figure 5. Temperature dependence PL from (a) sample AX12-369 with 36 s QWT growth time and (b) sample AX12-115 with 1 min 14 s QWT growth time. The emission around 820 nm is from GaAs core while the emission at shorter wavelength is from GaAs QWT. A red shift is observed for both the core and the QWT emission.

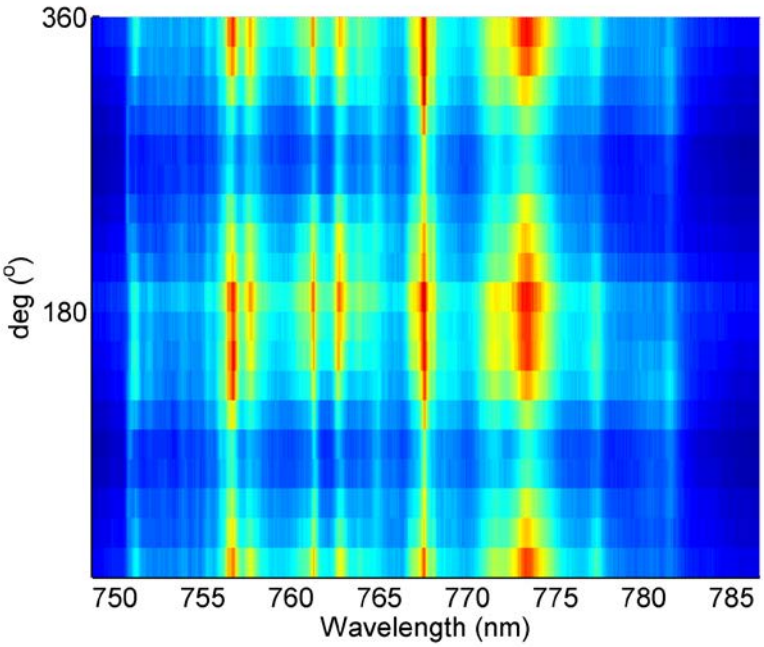

Figure 6. Polarisation measurement of the emission from QWT at 10 K. Most of the peaks show the polarisation parallel to the growth axis of the nanowire.

Mr Michael Challenor from the University of Western Australia visit to the Institut Europeen de Chimie et Biologie in Bordeaux France

The purpose of this report is to briefly detail the outcomes of an ANN overseas Travel Fellowship visit (June 2013 –July 2013) to the Unusual Nucleic Acids laboratory within the Institut Européen du Chimie et Biologie as part of an ongoing collaboration with Professor Jean-Louise Mergny.

Research Visit Aims

The main aim of the visit was to study the binding properties of different polymeric ligands with nucleic acids. The polymeric ligands, developed within our lab at the University of Western Australia are used to coat the surface of our nanoparticles as part of a larger investigation to develop nouvelle polymeric transfection agents. This involved familiarising myself with the highly sensitive isothermal titration calorimetry techniques in order to further understanding of the way the polymeric ligands of interest interact with nucleic acids.

Research Outcomes

The majority of the research aims were achieved. In particular, learning to troubleshoot the isothermal titration calorimetry equipment was performed within the first week. During the visit, binding studies were performed using a GAPDH double stranded siRNA sequence under different types of buffers. The buffers utilised were HEPES mixed with salt. We found that by varying the salt concentration, we could achieve different titration curves. It was determined from this that salt concentration within the buffer plays a big role in affecting the manner with which nucleic acids bind the the polymeric ligands. With the assistance and expertise provided by the Mergny lab, I was able to effectively analyse the nucleic acid interaction with the polycationic polymer polyethylenimine.

The results showed exothermic binding events with increasing titration of the nucleic acid with the polymer. Though we were unable to complete properly analyse interaction of the PEG polymer and the PEG-PEI copolymers before the end of the fellowship, we are continuing with the international collaboration via correspondence. With the expertise gained from the fellowship, we plan to continue the study back in Australia.

Research Benefits

The overseas research travel fellowship allowed me to benefit from the one on one mentoring provided by Associate Professor Anne Bourdoncle and the scientific perspective of Professor Jean- Louise Mergny. In addition, working in a nucleic acid laboratory was a completely different experience to my background in chemistry laboratories and the visit exposed me to a different environment and provided me with a new set of skills and techniques which allows me to procure data beneficial to my thesis but also to my development as a scientist. Furthermore, the visit has also allowed me to gain an insight in the work ethic and approach towards research foreign institutions follow. This insight is invaluable as I will soon be looking to apply for post-doctoral positions and may influence my future decisions.

Dr. Alessandro Rossi from the University of New South Wales visit to Aalto University in Helsinki, Finland.

Travel dates: 4th October 2013 – 2nd December 2013

Purpose of the visit:

The primary aim of this visit was to use the high-accuracy cryogenic platforms at Aalto University to carry out experiments on silicon-based single-electron pumps fabricated at the NSW node of the Australian National Nanofabrication Facility. Furthermore, working in close collaboration with scientists expert in the field of quantum metrology from Aalto University and MIKES, I acquired the competences which allowed me to establish an analogous metrological measurement setup at UNSW.

Background:

During the last three decades, the ac Josephson Effect and the quantum Hall effect have provided stable reference standards linked to fundamental physical constants for the units of voltage and resistance, respectively. However, despite intensive research, at present there is no equivalent metrological standard for the electrical current, which can be defined in terms of fundamental constants (such as the elementary charge) to acceptable accuracy (better than 10^{-8}). A redefined ampere could be realised by using a quantised electron pump, a device which transfers single charges in a controlled and accurate way. In these systems, the transport current is the result of an integer number of electrons pumped between source and drain for each cycle of an ac input signal. The overall goal of this project is the development of a new electrical current standard by using silicon-based electron pump devices.

Research findings:

The experimental work performed during the visit has allowed us to achieve record performance in terms of pumping accuracy for silicon-based systems. In particular, we have demonstrated single- electron pumping through a silicon quantum dot with sinusoidal drive.

We have exploited the design flexibility of our nano-pump to the fullest by controlling the electrostatic confinement of the dot via purposely engineered gate electrodes. The excellent cryogenic systems in place at Aalto University have been crucial to demonstrate that the theoretical pumping errors can be significantly reduced, the loss of quantization due to non-adiabatic excitations can be largely suppressed and the experimental uncertainty at 0.5 GHz is better than 30 parts per million. The latter result is by 2 orders of magnitude better than what it has been previously achieved in other silicon-based electron pumps.

Visit outcomes:

The visit has been overall extremely successful and productive. The demonstrated operation of an accurate source of electrical current with record performances for silicon systems is expected to have a major impact. In fact, these findings have been recently published* in *Nano Letters*, one of the most highly regarded peer-reviewed journals in the field of nanotechnology. This has now positioned UNSW as among the very few Universities worldwide able to compete with the most prestigious metrology institutions towards the definition of a novel standard for the electrical current.

Furthermore, these results have been accepted as oral contribution and poster presentation at two international conferences, namely the Conference on Precision Electromagnetic Measurements 2014 and the Silicon Nanoelectronic Workshop 2014.

This visit has also provided an opportunity to develop professional contacts with scientists from the Finnish Metrology Institute (MIKES), as well as from the Low Temperature Lab and QCD Lab at Aalto University. During the time spent in Europe, I was also invited to give a seminar at Cambridge University for the Hitachi Seminar Series.

*A. Rossi *et al.* An accurate single-electron pump based on a highly tunable silicon quantum dot, *Nano Letters* **2014**,
DOI:10.1021/nl500927q

Mr Peter Felfer from the University of Sydney visit to Harvard University, USA.

Report ANN overseas travel fellowship, Peter Felfer

Thanks to an overseas travel fellowship of the Australian Nanotechnology Network, I was able to visit the Center for Nanoscale Systems at Harvard University in the period from Aug 11 to Sept. 10, as a guest of Dr. Henning Galinski in the group of Prof. Federico Capasso, one of the co-inventors of the laser. The purpose of the visit was the further advancement of atom probe tomography of nanoparticles. Atom probe tomography is an atomic resolution microscopy / mass spectrometry method that is an ideal tool for the analysis of nanomaterials such as nanoparticles, nanorods or nanowires, if the problemof sample preparation can be solved. Unlike in the case of conventional materials, the analysis of nanomaterials in the atom probe also demands the use of nanofabrication techniques for sample preparation

At the deposition equipment with Dr. Andrew Magyar (left), senior atom probe scientist and Dr. Henning Galinski (right).

While this was occupying most of the time, my host Henning Galinski and David Bell, the director of CNS organised for me to give a one-hour seminar on atom probe tomography in Harvard's summer lecture series on nanotechnology in the first week of my stay. Since CNS only recently inaugurated their own atom probe, this seminar was intended to interest new people in using the tool and communicating the capabilities and possible uses. The significant interest

of around 70 participants from both Harvard and the Massachusetts Institute of Technology (MIT), that co-owns the centre, is a great testament for the amount of attention that atom probe is getting in the materials community. This seminar kick-started a discussion among many CNS users about the potential use of atom probe for their work and within the following month, I started to get involved in a variety of projects including work on atomic layer deposition, quantum cascade lasers and solar cells. Some of these collaborations still last until today.

The travel fellowship also allowed me to visit two more top tier institutions on the US east coast, The University of Pennsylvania in Philadelphia and John's Hopkins University in Baltimore to give lectures on my work. The visit to UPenn was of special interest, since the university is currently commissioning a nanotechnology centre that is very similar to the Australian Institute for Nanotechnology, which is currently being built on the grounds of Sydney University.

In the duration of my visit, we managed to fabricate over twenty different sets of samples in two different nanoparticle systems and with three different thin films acting as the matrix. This gave us completely new insights into the requirements of the sample preparation process and as a result, Sydney University decided to invest into deposition equipment so that similar experiments can be carried out in house.

This will give Australian researchers, hopefully including members of the ANN the possibility to analyse their nanomaterials on a single atom, sub-nm scale.

The results of this visit are currently submitted to the Erwin Mueller Young Scientist competition of the International Field Emission Society, which will be held in Stuttgart, Germany in September this year. They will subsequently appear as an article in Ultramicroscopy, one of the highest impact journals in the field of microscopy.

Best regards, Peter Felfer.

Miss. Katherine Moore from Flinders University visit to the Karlsruhe Institute of Nanotechnology in Germany.

Dates of overseas stay: 19 July 2013-20 October 2013

Host Institute: Karlsruhe Institute of Technology, Institute ofNanotechnology

Host Supervisor: Dr Benjamin Flavel

Aims of working trip:

The aim of my trip to Germany was to produce a DNA biosensor based on carbon nanotube transistor architecture. Carbon nanotubes have very high chemical stability, high surface area and are very sensitive to the presence of surface adsorbates. The proposed project was to fabricate this structure using ion beam lithography, atomic layer deposition and electrophoretic deposition. Then to use the proven reversible interaction of single stranded DNA (ss-DNA) with sp^2 hybridised carbon surfaces to indicate the presence of certain DNAstrands.

Outcomes of the working trip:

During the first month of my stay I worked closely with Simone Dehm, the technician for the Krupke research group, who specialised in nanolithography techniques. We were aiming to produce a patterned metal substrate with carbon nanotubes deposited between the electrodes and to then coat the surface with an insulating material. Then using ion beam lithography, we planned to open a window over the carbon nanotubes, enabling electrical transport measurements through the tube to be taken while exposing the nanotube to different chemical environments. This structure is very complex and we encountered many problems finding suitable etchants which didn't degrade the carbon nanotubes. As this structure was taking a long time to produce, I moved on to different areas of research while the technician optimised the fabrication process. In my last week at KIT the structure was ready for testing with DNA however there was no more time to work on this project. I am currently seeking financial support for another trip next year to complete this research.

The project I began working on as a secondary experiment, was to take as-prepared samples of double walled carbon nanotubes (DWCNTs) and sort them from single walled impurities using a technique known for sorting SWCNTs by chirality (1), gel column chromatography. The motivation behind this research is that DWCNTs have gained increased attention of late due to their unique ability to yield 'molecular wire' structures with a conducting inner core surrounded by an insulating barrier. Hence being able to separate DWCNTs from a sample containing SW impurities is an important processing method. To date my PhD has focused on the advantageous of using DWCNTs for electrochemical electrode surfaces and so this project was on great interest to me and would fit my thesis (2-4).

Currently the research group of Hersam (5, 6) has lead the field of DWCNT separation and has

been able to separate small diameter (2 nm diameter) DWCNTs form SW using density gradient ultracentrifugation (DGU), yielding very pure solutions of each. While Hersam has proven this process works, the techniques involved and the cost of the equipment makes the process very difficult to scale up and is only available to select groups in the world. The advantage of gel column chromatography is that it can be easily scaled up, doesn't require expensive DGU medium and centrifuge, and can be conducted with simple glassware in any laboratory. Dr Benjamin Flavel, my supervisor at KIT, is a world leading expert on sorting of SWCNTs by chirality using this method and with his expertise and equipment, we had successfully separated the DWCNTs within a week. Using characterisation such as Raman and UV Vis, as well as techniques unavailable to me at my home institute such as UV Vis monitored centrifugation and photoluminescence, we determined that our separated DWCNTs were as good as those reported in Nature in 2009 by Hersam's group using DGU. We believe these results to be of significance in the field of DWCNTs and I am currently preparing this paper for submission to ACS Nano.

During the remaining time in Germany I also collaborated with Dr Flavel on his research, producing a paper which was submitted to ACS Nano yesterday about the chirality sorting of SWCNTs using a commercial gel permeation chromatography system. As a result of producing highly pure chirality sorted SWCNTs in this research, the tubes were tested using a cutting edge photocurrent measurement technique, yielding another paper, in which I will be a co-author.

In summary, the original project I travelled to Germany to conduct was delayed due to several complications in the nanofabrication process. I am currently seeking funding to return and continue working on the proposed project. Instead, I used my time to complete research which will form a chapter in my thesis and produce a high quality publication. I also worked on two collaborative projects, which will also lead to publications.

I wish to thank the ANN for funding my overseas tip. The experience I gained working in a world class research institute is invaluable and the work I conducted there will undoubtedly improve the quality of my thesis.

1. Flavel, B. S.; Kappes, M. M.; Krupke, R.; Hennrich, F., Separation of Single-Walled Carbon Nanotubes by 1-Dodecanol-Mediated Size-Exclusion Chromatography. ACS Nano 2013, 7 (4), 3557-3564.

2. Moore, K. E.; Flavel, B. S.; Ellis, A. V.; Shapter, J. G., Comparison of double-walled with single-walled carbon nanotube electrodes by electrochemistry. Carbon 2011, 49 (8), 2639-2647.

3. Moore, K. E.; Flavel, B. S.; Shearer, C. J.; Ellis, A. V.; Shapter, J. G., Electrochemistry of polystyrene intercalated ve1tically aligned single- and double-walled carbon nanotubes on gold electrodes. Electrochemisfly Communications 2011, 13 (11), 1190-1193.

4. Moore, K. E.; Flavel, B. S.; Yu, J.; Abell, A. D.; Shapter, J. G., Increased redox-active peptide loading on carbon nanotube electrodes. Elecfl•ochimica Acta 2013, 89 (0), 206-211.

5. Green, A. A.; Hersam, M. C., Processing and properties of highly enriched double-wall carbon nanotubes. Nat Nano 2009,4 (1), 64-70.

6. Green, A. A.; Hersam, M. C., Properties and Application of Double-Walled Carbon Nanotubes Sorted by Outer-Wall Electronic Type. ACS Nano 2011,5 (2), 1459-1467.

Mr Mark Edmonds from La Trobe University visit to the Max-Lab Synchrotron in Lund, Sweden.

The outcomes of this award are as follows:

- Mark Edmonds visiting the Max-Lab Synchrotron in Lund, Sweden with Assoc. Prof. Justin Wells for the period of 30 September 2013 to 14 October 2013.
- The visit aimed to conduct a collaborative project with Assoc. Prof. Wells to study the spin-orbit coupling mechanism at the surface of diamond.
- The measurements were performed on the I3 beamline at Max-Lab Synchrotron, which is a spin-resolved ARPES beamline.
- Measurements of the band dispersion at the surface of hydrogen-terminated diamond were performed as a function of coverage of the strong electron acceptor molybdenum trioxide, MoO_3.
- MoO_3 was chosen as an acceptor molecule, as it can successfully induce large hole sheet densities in the diamond well in excess of 10^{13} cm^{-2} and is stable under prolonged exposure to synchrotron radiation.
- These measurements were performed in order to observe the band-splitting as a result of the strong spin-orbit coupling (measured previously in low temperature magneto-transport measurements) to determine the dominant spin-orbit coupling mechanism.

Unfortunately, no conclusive results were obtained from the beamtime with a brief outline of reasons as follows:

1. MoO_3 has a high sublimation temperature of 520^{O}C, and the home-built evaporator that was used in this experiment did not reliably deposit molecules onto the diamond surface.
2. No accurate calibration of MoO_3 coverage was possible due to the low photon energy of the I3 beamline, this prevented access to the molybdenum core levels in XPS.
3. The lack of a working quartz crystal monitor in the chamber to determine deposition rate, meant deposition was not performed in a controlled way.

- However, even with these problems, interesting features in the band dispersion appeared as MoO_3 was deposited onto the diamond surface as illustrated in Figure 1 below. The most interesting and perhaps puzzling is the appearance of a feature with an almost "graphene-like" dispersion.
- An additional beamtime scheduled for the second half of the year has been successfully applied for at Aarhus Synchrotron, Denmark to further investigate the features in Figure 1 and the predicted band-splitting.
- The advantages of this beamline are; a wider photon energy range and lower sample temperature. This will allow for a more comprehensive set of measurements of the band splitting (including XPS core levels), with better energy resolution.
- Furthermore, this beamline has a dedicated sample preparation chamber which will allow Edmonds to bring along a commercial effusion cell that he has considerable experience with

in the deposition of molecules including MoO_3, rather than having to rely on a home-built cell.

- The visit provided a great opportunity for networking and learning new experimental techniques. This is evidenced by a beamtime at the Australian Synchrotron that Wells and Edmonds collaborated together on. This work is currently being written into a paper on the doping profile of delta-doped phosphorus in Silicon, and is attached.
- Furthermore, as a demonstration to the ongoing nature of the collaboration the two beamtime applications submitted to Aarhus Synchrotron, Denmark are attached. Both these applications were successful and ranked highly in the review round.
- A funding application to the Australian Synchrotron, under the International Synchrotron Access Program (ISAP) has been submitted to fund this ongoing research.

I should like to take this opportunity to formally thank the ANN for selecting me for this award and for providing the funding that has facilitated the beginning of a new research collaboration that will hopefully lead to a number of research publications in the future.

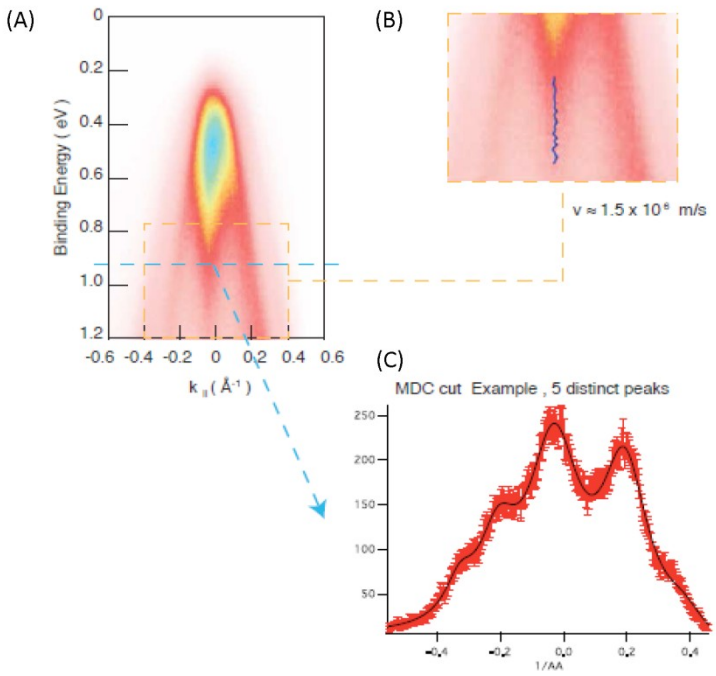

Figure 1. (A) Band dispersion of hydrogen-terminated diamond with MoO_3 deposited onto the surface. (B) Blow-up of the "graphene-like" state that appears after MoO_3 deposition and the extracted Fermi velocity. (C) Momentum distribution curve taken at a binding energy of -0.95 eV below the Fermi level, clearly highlighting 5 distinct peaks.

Mr Sean O'Keefe from RMIT University visit to University College, Dublin, Ireland.

Sean will be taking up the Overseas Travel Fellowship in 2014

Mr Behnam Akhavan from the University of South Australia visit to the Max Planck Institute for Polymer Research, Mainz.

Mr Behnam Akhavan will be taking up his Overseas Fellowship in 2014

Miss Suzy Streatfield from the Australian National University visit to Rennes University in France and Wroclaw University of Technology in Poland for a period of one year

Miss Streatfield's visit will be finishing in February 2015

Miss Georgia Miller from the University of New South Wales visit to Harvard University, USA.

Miss Miller's visit will be finishing in June 2014

Dr Ryo Sekine from the University of South Australia visit to Trinity College at Oxford, U.K.

Dr Ryo Sekine will be travelling in 2014

Mr Thomas Keevers from the University of New South Wales visit to the University of Warwick, U.K.

Mr Thomas Keevers will be travelling in 2014

Asia Nano Forum -Asia Nano Camp 2013- China

Asia Nanotech Camp is a program initiated by Asia Nano Forum (ANF) as a platform for young nanotechnology researchers to learn about the state of the art and nanotechnology advancement in ANF network economies. It provides unique educational opportunities for these young researchers to communicate, network, and collaborate with one another.

For the past five years, the Asia Nano Camp was held in Japan (2008), Taiwan (2009), Singapore / Malaysia (2010), Korea (2011) and China (2012).

The program includes technical lectures by experts in various areas of nanotechnology, industry seminars, visits to universities and research institutes, as well as networking/ social activities. The participants are also requested to share their research activities, work on group assignments and present their findings at the workshop.

ANN has provided return economy class airfare to the awardees for the 6th Asia Nano Camp. The Asian organizing committee provided local hospitality including accommodation, meals, local transportation, and social activities.

The following three young scientists (PhD students and ECRs) from Australia have been selected and have participated in the 6th Asia Nano Camp which was held in Serpong, China on the 1-10th October 2013.

The theme of this year's camp was "Responsible Development of Nanotechnology Products Enabling Sustainability". The program included attending LIPI International Nanotechnology Symposium and present technical posters, lectures by experts in various areas, workshops, as well as networking/social activities.

The participants have also been requested to share their research achievements, activities, work on group assignments and present their findings.

The Australian Nanotechnology Network provided return economy class airfare by direct route to Serpong, China and the host organization provided local hospitality including accommodation, meals, local transportation, and social activities.

The awardees were:

- Dr Liang Zhou from the University of Queensland
- Dr Dawei Su from the University of Wollongong
- Mr Jiangbo Zhao from Macquarie University

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.

ACIS 2013 - The Biennial Australian Colloid and Interface Symposium held in Noosa, Queensland on the 3-7th February 2013

Thank you for the financial support. The funding of $5000 from ANN was used to assist 14 Australian Students in attending the conference

Details of the conference

ACIS 2013 was held at the Outrigger Little Hastings Street Resort & Spa, Noosa Queensland, from 3 to 7 February 2013.

The conference programme offered four days of stimulating and thought provoking sessions and showcasing speakers in the Nanoscience field of Colloids and Interfaces.

The conference commenced with registration at 3.00pm on Sunday 3 February, and the Welcome Mixer was held at the Noosa Heads Surf Club that evening. The 2013 ACIS sessions commenced on Monday 4 February at 8.30am. The programme format consisted of plenary & concurrent sessions, trade displays, a poster session and social functions. Sponsorship of $5000 was received from the Australian Nanotechnology Network.These funds were used to support the attendance of Australian PhD students at the meeting through a discounted registration fee.

Participants

Confirmed delegates by State (or Country I not from Australia)

State (Country if not Australia)	No. of Delegates	Percentage
ACT	9	4.92%
NSW	31	16.94%
QLD	10	5.46%
SA	34	18.58%
VIC	52	28.42%
WA	1	0.55%
BAHRAIN	1	0.55%
CANADA	3	1.64%
CHINA	2	1.09%
FRANCE	2	1.09%
GERMANY	8	4.37%
INDIA	1	0.55%
JAPAN	2	1.09%
KUWAIT	1	0.55%
NETHERLANDS	1	0.55%
NEW ZEALAND	5	2.73%
POLAND	1	0.55%

SAUDI ARABIA	1	0.55%
SINGAPORE	1	0.55%
SOUTH KOREA	1	0.55%
SWEDEN	4	2.19%
SWITZERLAND	2	1.09%
TAIWAN	1	0.55%
UNITED KINGDOM	4	2.19%
USA	5	2.73%
	183*	

*35 Delegates were Students (ACT 4, NSW 5, Queensland 2, 11 South Australia, 11 Victoria, 1 Overseas (New Zealand)

ACIS 2013 Sponsors

Gold Sponsors

Bursary Sponsors

Expenditure of ANN funds

The ANN funds were used to subsidise the registration costs of the following students
Vivianne Deniz Australian National University
Manuel Ghezi University of Sydney
Terence Hartnett University of Melbourne
Robert Hayes University of Newcastle (winner of the conference poster prize)
Paul Joyce University of South Australia
Stephanie Phan Monash University
Nichola Selway The University of Queensland
Alison Sham Australian National University
Heather Shewan University of Queensland
Jacob Smith University of Newcastle
James Sweeney University of Newcastle
Kristian Tangso Monash University
Rick Walsh Australian National University
Joshua Willott University of Newcastle

Poster Prize Sponsor

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Conference Exhibitors

ATA SCIENTIFIC

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Scitech imaging specialists

BRUKER

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The Sponsors were featured on the website and in the conference programme and booklet as above.

4th International NanoMedicine Conference held at the Intercontinental Hotel, Sydney, on the 1-3July 2013.

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The Australian Centre for NanoMedicine (ACN), based at the University of New South Wales (UNSW) was successful in attaining a grant of $5000 from the Australian Nanotechnology Network (ANN) towards the *4th International NanoMedicine Conference*, held between1-3 July 2013 at the Sydney InterContinental Hotel.

NSW Minister for Health and Minister for Medical Research The Hon Jillian Skinner MP opened the conference

ACN was officially established as a research centre at UNSW on 20th July 2011 under the co-directorship of Professor Tom Davis, Professor Justin Gooding and Professor Maria Kavallaris. ACN is a multi-disciplinary research centre incorporating researchers from UNSWs Faculties of Engineering, Science and Medicine. ACN has two key aims, first and foremost as a research centre dedicated to finding solutions to provide a better way of life for those in our population afflicted with hard to treat diseases; and second to work with a diversity of stakeholder groups to communicate research findings and be an Australian hub for nanomedicine discussion and commentary.

Both of these aims are central to ACN hosting the *4th International NanoMedicine Conference* from July 1-3 2013 at Sydney's InterContinental Hotel. 220 attendees representing 23 countries attended the conference. Plenary speakers during the three day event included Prof Heather Maynard (UCLA USA), Prof John Mattick (Garvan Institute of Medical Research Australia), Dr Scott McNeil (Nanotechnology Characterization Laboratory USA), Prof Xiaohu Gao (University of Washington USA), and Prof Maria Vicent (PrincipeFelipe Research Centre Spain)

The five plenary speakers were joined by a further 39 invited speakers. The conference also saw a further 55 oral presentations and 21 posters. The conference was opened by the NSW Minister for Health and Minister for Medical Research, the Hon Jillian Skinner MP and the UNSW Vice President and Deputy Vice Chancellor (Reseaerch), Professor Les Field.

Themes of the conference included:

- Drug Delivery
- Bioactive Materials
- Diagnostic Technologies
- Translational Nanomedicine
- Diagnostics
- Polymer conjugates
- Toxicology
- Therapeutic Applications

For the third consecutive year it was ACNs pleasure to bring together the top minds in a discipline that crosses boards incorporating medicine, chemistry, and engineering and truly represents the adage of “bench to bedside”, but just as importantly “bedside to bench”.

Through the funding provided by ANN, ACN was able to provide assistance to the following ECRs and PhDs. As can be seen from the list below, funding was provided to assist 17 people representing four institutions.

Nathan	Boase	University of Queensland	Development of a Multimodal Hyperbranched Polymer Imaging Agent
Tristan	Clemons	University of Western Australia	Breast and colon cancer tumour regression through the delivery of c-Myc shRNA conjugated to multifunctional polymeric nanoparticles
Jacob	Coffey	Australian Institute of Bioengineering and Nanotechnology/UQ	Wearable micro-projection array skin patches for minimally invasive and selective biomarker capture from skin
Priyanka	Dey	Queensland University of Technology	Ex-vivo detection of Hyperbranched Polymer mediated SERS-barcoded Gold NP Assemblies in animal tissue
Jessica	Gibbons	Deakin University	Polymeric nanoparticles encapsulated with bovine lactoferrin targeting EGFR-positive breast cancer
Juanita	Hughes	Queensland University of Technology	Ultra-trace Detection of Diagnostically Important Biomarkers using Functionalised-Surface Enhanced Raman Spectroscopy (SERS)
Fransiska	Krismastuti	University of South	Study on The Fluorescence Enhancement in Porous Silicon Resonant Microcavities:

		Australia	Application in Matrix Metalloproteinase Detection
Tushar	Kumeria	The University of Adelaide	Graphene oxide - diatomaceous earth hybrid as a drug microcarrier for poorly water soluble drugs
Tu	Le	CSIRO	Amphiphilic Nanoparticles for Drug Delivery: A Modeling Approach
Rohimah	Mohamud	Monash University	PS50G nanoparticles altered $TNFR2^{+}Foxp3^{+}$ regulatory T cells in the lung and ameliorate allergic asthma in a mouse model
Gysell	Mortimer	University of Queensland	Nanoclay Particles Bind Albumin and Induce Protein Unfolding Recognised by Class A Scavenger Receptors
David	Pattinson	Qld Institute of Medical Research	Chimeric virus-like particles induce cellular and humoral immune responses and reduce *Plasmodium* parasite burden
Abel	Santos	The University of Adelaide	Optimisation and Comparison between interferometric and photoluminescent optical biosensors based on nanoporous anodic alumina
Jayanth	Shankaranarayanan	Deakin University	EpCAM targeted chitosan nanoparticles loaded with therapeutic anti-survivin proteins: promising stem cell targeted nanotheraphy for prostate cancer
Je Lin	Sieow	Monash University	Delivery of inert polystyrene nanoparticles downregulates key allergic inflammation signalling pathways and alters immunoregulatory cell proportions in the lung
Nicolin	Tirtaatmadja	University of Queensland	Size dependant toxicity of layered silicate nanoparticles
Jing	Zhang	University of Queensland	Comparison of solvent casting and supercritical carbon dioxide loading on the release of compounds from polyurethane films

1. **Broader benefit to the Australian nanotechnology community**

There is a global unmet need to cure and prevent diseases for which we currently lack efficient treatments and which cause suffering and a shortened life expectancy. The ageing population, the high expectations for improved life quality and the changing lifestyle also call for improved, more efficient and affordable healthcare.

NanoMedicine, the application of nanotechnology in health care, offers numerous promising possibilities to significant improve medical diagnosis and therapy, ultimately leading to higher standards of living. Furthermore, nanomedicine is an important strategic issue for sustainable competitiveness in Australia. The global competition in the field is very strong and the strategic importance of nanomedicine is being increasingly recognised by industry and government around the world.

Australia is facing strategic challenges in the field of health due to issues such as an ageing population, negative environmental effects on personal health and a demand for improved personal healthcare

Healthcare expenditures presently account for 10% of gross domestic product (GDP) in industrialised countries and are expected to grow at an average of 6% pa in the future. Nanomedicine offers numerous promising possibilities to significantly improve medical diagnosis and therapy and the field thus has a large potential for developing public welfare and economic growth. There is a large industrial enthusiasm for nanomedicine, with the US National Science Foundation has estimated that by 2015 half of the world's pharmaceutical industry products will be made with nanotechnology, and that the contribution of products incorporating nanotechnology to the global economy will be around $1 trillion.

So to the question, has nanomedicine impacted human health? The answer is yes. High profile groups like the UK based Macmillan Cancer Support reported "a dramatic increase in the median cancer survival times over the past 40 years. Coupling nanotechnology drug delivery (NDD) methods with improvements in diagnostic, we can expect that much more progress will be made in the next 10 years than in the previous 40."

2. **Size of Event - anticipated number of attendees ; anticipated number of international attendees**

The conference attracted some 220 attendees representing 23 countries. The five plenary speakers were joined by a further 47 invited. The conference also saw 23 oral presentations and over 50 posters.

3. **Quality of plenary speakers**

Five plenary speakers led the program these being:

- Prof Heather Maynard (UCLA USA)
- Prof John Mattick (Garvan Institute of Medical Research Australia)
- Dr Scott McNeil (Nanotechnology Characterization Laboratory USA)
- Prof Xiaohu Gao (University of Washington USA)
- Prof Maria Vicent (PrincipeFelipe Research Centre Spain)

- **Branding of ANN during the conference**
  - ***Logo and acknowledgement on overhead slides before/after session***
  - ***Verbal acknowledgement of ANN as a sponsor***

- ***Acknowledgement during opening and closing ceremonies***
  - At the conference opening, officiated by ACNs Prof Justin Gooding, the following was stated while ANNs logo was on screen "*to the Australian Nanotechnology Network we thank them for their assistance in providing support to Early Career Researchers".*
  - At the Closing address, Professor Maria Kavallaris (ACN) acknowledged all sponsors including ANN.

- ***ANNs logo and 100 word description in Conference program***
  - The following words, contact details and logo appeared in the conference program

Australian Nanotechnology Network **Australian Nanotechnology Network** **www.ausnano.net** Ms Liz Micallef Network Manager Phone: (02) 6125 5952 ann@ausnano.net	**The Australian Nanotechnology Network (ANN - Formerly ARCNN)**'s mission to enhance Australia's Research in Nanotechnology and related areas, by effectively promoting and drawing together collaborations in this field. The Nanotechnology field is one of the fastest growing areas of research and technology. ANN is dedicated to 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. ANN 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.

- ***Acknowledgement with the ANN logo and preferred ANN URL link on Event website***
  - ANNs logo with connection to webpage can be viewed at http://www.oznanomed.org/index.php?option=com_content&view=article&id=52&Itemid=58

- ***Acknowledgement with ANN logo in marketing activities (national and international) in the lead up to and during the conference***

- ***Acknowledgement with ANN logo on any sponsor slides displayed over the duration***
  - All sponsors logo was included on a "sponsors power point" slide that was on a continuous loop before and after all sessions.

Prof Maria Kavallaris **Prof Justin Gooding**

Conference Co- Chairs – International NanoMedicine Conference

34th Australiasian Polymer Symposium (34 APS) held at the Darwin Convention Centre on the 7-10th July 2013.

The 34th Australasian Polymer Symposium was held in Darwin, Northern Territory, Australia from July 7th – 10th, 2013. The meeting was attended by 250 delegates, which included 70 student delegates, and saw over 250 oral and 60 poster presentations. The meeting was structured into a number of themes which included: Advanced Polymeric Materials and their Characterisation, Polymers in Health and Medicine, Applications of Polymers for Electronics and Energy, Bio and Natural Polymers and the Environment, The Latest Developments in Polymer Synthesis, and Polymers in Industry and Translational Research. The scientific program was led by plenary lectures from six internationally outstanding scientists: Professors Cameron Alexander (University of Nottingham), Anna Balazs (University of Pittsburgh), Kristi Anseth (University of Colorado), Maria Forsyth (Deakin University) Axel Müller (Universität Bayreuth) and Mitsuo Sawamoto (Kyoto University) and each of the themes was supported by twenty-three equally outstanding keynotes speakers from across Asia, Europe, America and Australasia and six 'emerging talent' speakers from Australia and NZ. Moreover, there was great opportunity for contributed presentation (both oral and poster) from the student delegates at the meeting.

Darwin Convention Centre
Northern Territory
7–10 July 2013
www.34aps.org.au

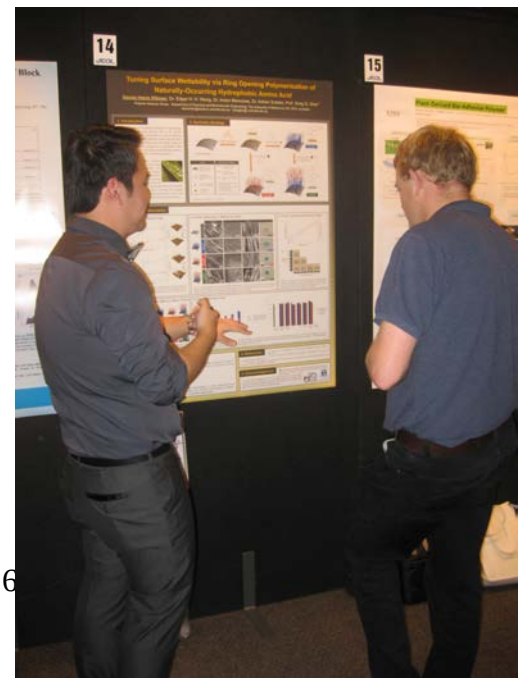
The roles of the nano-structure within polymers or polymeric hybrid materials is a burgeoning field in the polymer community and as such a large number of the presentation at this meeting were devoted to the characterisation, understanding, control and application of polymeric nanomaterials and/or nanostructures. Some inspiring examples of were provided in the plenaries of Professors Balazs; nano-scale structure and dynamics in polymeric gels and Müller; who provided a *tour de force* of the fabrication of polymeric nanostructures through engineered self-assembly along with some fantastic electron microscopy of these structure. However, these are but two examples and numerous others were presented throughout the meeting by the plenaries, keynotes, invited and contributed speakers. In addition to the scientific program, there were a number of events (e.g. evening mixers and student events) which provided excellent opportunities for networking of the delegates. Importantly these also provided opportunities for our younger delegates (students and early career researchers) to interact with both our esteemed guests and with each other.

The Australian Nanotechnology Network (ANN) contributed to the success of this meeting through the sponsorship which saw 17 ANN

members' students receive a $300 subsidy toward their conference expenses. The names and affiliations of these students are provided below. Moreover, 34APS saw the inclusion of a day long symposium dedicated to the role of polymers and polymeric nanostructures in both Industry and Translational Research, which included keynote lectures form Leo Hyde (Dupont, Australia), Derek Irvine (University of Nottingham) and Chris Such (Dulux, Australia; recipient of the Bruce Guise Industrial Polymer Technology Award). The ANN further contributed to the success of this special symposium through the sponsorship of $1000 which was used to fund a mixer prior to the symposium.

Both 34APS, and the industrial symposium within the meeting, were a great success, and the support of the ANN is greatly acknowledged.

Name	Affiliation
Alexandra Rodriguez	Australian National University
Martin van Koeverden	University of Melbourne
Damian Kirchmajer	University of Wollongong
Alison Maniego	University of Western Sydney
Joel Thevarajah	University of Western Sydney
Danielle Lynne Taylor	University of Western Sydney
Roshan Bharath Vasani	University of South Australia
Natalie Holmes	University of Newcastle
Simon Bou	Flinders University
Jing Yang Quek	University of New South Wales
Thomas Michl	University of South Australia
Rajkamal Balu	University of South Australia
Toen Castle	Australian National University
Zohreh Abdollahi Banouei	University of Sydney
Jasmin Whittaker	University of South Australia
Priyanka Dey	Queensland University of Technology
Yiming Ma	University of Queensland



4th International Conference on Smart Materials and Nanotechnology in Engineering (SMN 2013) held at the Gold Coast on the 10-12th July 2013.

Introduction:

Recently, the design of a new material with a multi-functional capability has become a key research focus in all materials science and engineering discipline. A "smart material" is one having a structure at the nano-structural level that responds in a particular and controlled way to influences upon it. These range from magnetically-changed materials, to "memory" molecules that return to their original form, to materials that generate an electric charge when pressed, twisted, or warped. In some extent, a structure made by this material or more than one type of this material incorporated with an appropriated sensor system has been well defined as a “smart structure”, that can be used for the implementation of a damage and performance detection strategy for aerospace, civil and mechanical engineering and other applications. Since the last decade, an increasing interest in the development of miniaturized structures and systems, particularly on micro and nano electromechanical systems (MEMs and NEMs), and integrated biosensor systems has evolved a new page in the area of smart materials and nanotechnology. The scope of this conference is mainly focused on smart materials and structure, and nanotechnology for different engineering applications ranging from nano-structural and biosensor systems to large scale structures, like smart wind turbine technology and solar energy systems for space vehicles.

Scope of the Conference:

Sensors and actuators
Fibre-optic sensor technology
Multifunctional materials
Nano-structural composites
Bio-inspired materials and structures
Adaptive materials and structures
Structural health monitoring
Mechanics and modelling
Applications

USQ Deputy Vice Chancellor (Research & Innovation) Professor Mark Harvey officially opens the 4th International Conference on Smart Materials and Nanotechnolog.

Attendance and Presentations

The conference was another success in its series after the inaugural conference in Harbin China. There were more than 120 attendees from many countries over the world including, UK, China, India, Sri Lanka, Brazil, US, Singapore, Malaysia, Pakistan, Bangladesh, United States of America and there were 71, oral and 10 poster presentations. The presentations were carried out in three parallel sessions. Three best student papers were selected. The proceedings were published in SPIE Vol. 8793. Further the extended versions of selected materials were published in the journal of Multifunctional Composites and Journal of Smart and Nano Materials.

Key note Speaker, Professor Robin Batterham, Kernot Professor of Engineering, The University of Melbourne

Participants at the conference welcome drinks. (from left: Professor Priyan Mendis (U Melb, Dr. Gayan Kahandawa , Mrs. Indunil Jayathillake (USQ), Mr. Joshua Pearuil (USQ), Associate Professor Karu Karunasena (USQ), Dr. Jayantha Epaarachchi (Chairman SMN 2013, USQ).

A performance of traditional Australian Dancers at SMN2013 Gala Dinner(Performed by Jellurgal Aboriginal Cultural Centre, Kalwun Development Corporation, QLD, Australia.

ANN Financial Support Distribution

Name	University	Status
Dr. Dahua Shou	The University of Sydney	ECR
Mr. Navid Bavi	ANU	Post Grad Student
Miss. Noushin Nasiri-Varg	ANU	Post Grad Student
Mr. Sherif Gouda Ismaeil	University of South Australia	Post Grad Student
Mr. Nasser Saber	University of South Australia	Post Grad Student
Mrs. Maduwanthi Rupasinghe	The University of Melbourne	Post Grad Student
Mrs Quynh Nguyen	The University of Melbourne	Post Grad Student
Dr. Shen Hin Lim	UNSW	ECR
Dr. Ann Lee	UNSW	ECR
**Dr. Gayan Kahandawa	Former USQ	ECR
**Dr. Sindy M L Lau	Former USQ	ECR

NanoS-E3 2013 International Workshop & School on Nanotechnology held at Airlie Beach, Queensland on the 15-20th September 2013.

The 4th NanoS-E3 International Workshop and School brought together nanotechnology specialists to advance knowledge and research, focusing on sensors, electronics, energy and the environment. The three day workshop has been preceded by a twoday school for PhD and masters students. The event took place at the Coral Sea Resort, located at Airlie Beach in the Whitsundays.

The rapidly growing field of nanoscale science iswidely recognised as a critical component of the world's future economy. New advances are predicted to transform a wide range of scientific and engineering disciplines. This initiative, in partnership with the Italian and Australian governments built on existing nanotechnology networks and fostered new collaborations. In 2013, the workshop has welcomed scientists from France, Germany, Japan, Canada and the USA.

Participant numbers:

- Delegates: 31 - Keynote speakers: 7 - Students: 24

CHAIRS

- A/Prof Nunzio Motta, Queensland University of Technology (QUT), Brisbane Australia
- Prof John Bell, Queensland University of Technology (QUT),Brisbane Australia
- Prof Giorgio Sberveglieri,Universita' Degli Studi di Brescia, Brescia Italy

ORGANISING COMMITTEE

- Prof OscarMoze ,Embassy of Italy, Canberra
- Prof Federico Rosei, EMT---INRS Universite 'du Quebec, Montreal Canada
- Dr Francesca Iacopi , Griffith University, Brisbane
- Dr Giuseppe Carlo Tettamanzi, The University of New South Wales (UNSW), Sydney
- Dr Giordano Scappucci, TheUniversityof New South Wales (W), Sydney Australia
- A/Prof Eric Waclawik, Queensland University of Technology (QUT), Brisbane Australia
- Dr Mahnaz Shafiei, Queensland University of Technology (QUT),Brisbane Australia
- A/Prof Yuan Tong Gu, Queensland University of Technology (QUT), Brisbane Australia

Advisory Committee

- Prof Guido Faglia, Universita' Degli Studi Di Brescia, Brescia, Italy
- Prof Maurizio De Crescenzi, Universita'Degli Studi Di Roma"TorVergata", Roma Italy
- Prof Federico Rosei,EMT---INRS Universite' du Quebec, Montreal Canada
- Prof Chennupat Jagadish, Australia national University (ANU),Canberra Australia
- Prof David Jamieson,The University of Melbourne, Melbourne Australia
- Prof Michelle Simmons, The University of New South Wales (UNSW), Sydney Australia
- Prof Wojtek Wlodarski, Royal Melbourne Institute of Technology RMIT), Melbourne

SPONSORS

In addition to ANN sponsorship the event was sponsored as well by
: Embassy of Italy, I stitute for Future rvironments (QUT), University of Brescia, TSI.

SCHOOL

The two days school, attended by 24 students coming from several universities in Australia and Overseas, was a very successful introduction to physics and chemistry of new materials and Nanostructures, ranging from self-assembly of organic molecules to use of carbon nanotubes in Solarcells and fuel cells, down to the fascinating quantum computing realm.

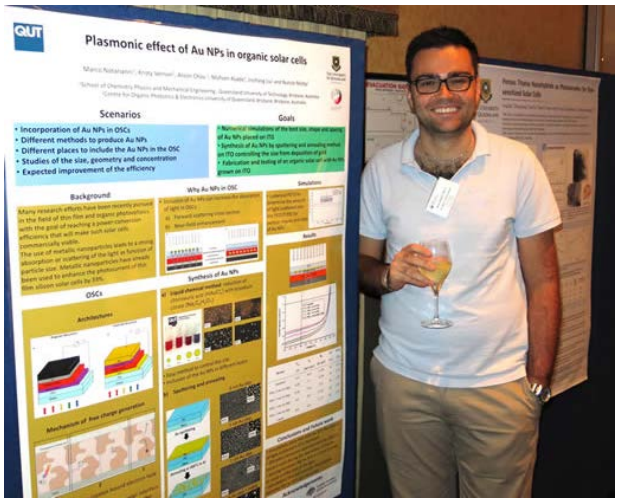
SCHOOL LECTURERS

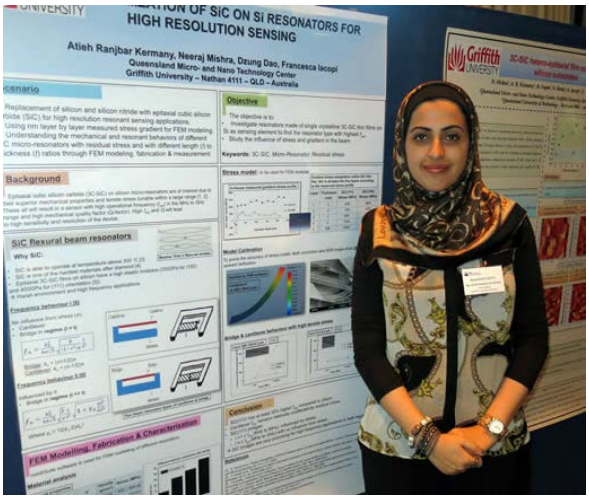
Name	**Topic**	**Affiliation**
Carlo Mariani	Electronic and Magnetic Properties of Organic Molecules on Surfaces	Università di Roma La Sapienza, Italy
Michael James	Characterisation of Nanoscale Films and Molecular Surfaces by Neutron and X---ray reflectometry	Australian Synchrotron, Melbourne
Wojtek Wlodarski	Nanomaterials Based Optical Gas And Vapour Sensors	RMIT, Melbourne
Nunzio Motta	Graphene: Structure and Properties of a Unique 2D Material	QUT, Brisbane
John Bell	Nanotechnology for Solar Energy	QUT, Brisbane
Simon Ringer	Microscopy – the Key Tool for	The University of Sydney

	Nanoscience	
Lloyd Hollenberg	Quantum Computing in Silicon: Basics to Architectures	University of Melbourne
Michelle Simmons	Building a Practical Quantum Computer	University of New South Wales, Sydney
Chennupati Jagadish	Semiconductor Nanostructures: Growth and Properties	ANU,Canberra
Joe Shapter	Characterisation of Photovoltaic Devices	Flinders University, Adelaide

POSTER SESSION

At the end of school, a poster session allowed the students to present thei rown work.
As the poster session continued in a welcome cocktail and barbecue starting the workshop,
All participants to the workshops attended the poster session.
A prize of AU$200 and an award certificate for the best poster were granted to the PhDstudent:





Mr Marco Notarianni from QUT and Atieh Ranjbar Kermany from Griffith University

LIST OF STUDENTS FUNDED BY ANN

No.	Title	Name	Institution
1	Mr	Carlo Piloto	QUT
2	Mr	Yang Bai	UQ
3	Mr	Lachlan Larsen	Flinders University
4	Mr	Neeraj Mishra	Griffith
5	Dr	Jerry Yu	University of Hong Kong
6	Ms	Bharati Gupta	QUT
7	Ms	Atieh Ranjbar Kermany	Griffith
8	Mr	Marco Notarianni	QUT
9	Mr	Arixin Bo	QUT
10	Mr	Ye Wei	QUT

11	Ms	Suchitra Waruni de Silva	QUT
12	Mr	Gabriele de Boo	UNSW
13	Mr	Joost van der Hijden	UNSW
14	Mr	Fabricio Borghi	Uni of Sydney/CSIRO
15	Ms	Chee Ling Tong	Flinders University
16	Mr	Michael Stuiber	University of Melbourne
17	Mr	Tim Burgess	ANU
18	Mr	Anirudh Sharma	Flinders University
19	Ms	Natalya Schmerl	Flinders University
20	Mr	Anushan Kulendran	QUT
21	Mr	Dhruv Saxena	ANU
22	Dr	Haifei Zhan	QUT
23	Dr	Dean Hu	QUT
24	Mr	Kang Xia	QUT

Average funding support per student: 208$.The ANN funding has been used to reduc ethe Registration fee of the students to 350$

WORKSHOP

The three days workshop focused on the following topics:
Semiconductors, Photonicdevices, Quantumdevices, Graphene/carbon nanotubes, Nanomaterials, Sensors, Solar Energy, Environmental materials

KEYNOTE SPEAKERS

David Jamieson	Ion Implanted Donor Atoms with Nuclear and Electron Spin Readout: Engineering Multi-Atom Devices	University of Melbourne
Sven Rogge	Dopant Atom in Silicon Sees the Light	UNSW
Isabelle Berbezier Federico Rosei	Ge/Si Nanostructures Exploring Molecular Assembly At Surfaces	CNRS INRS
Enrico Traversa	Materials for Therapy: Antioxidant Properties of Cerium Oxide Nanoparticles	Kaust
Guido Faglia	Oxide Nanowires for Opto-electronics And Energy Harvesting	University of Brescia
Paul Dastoor	Solar Paint: A New Paradigm in Organic Photovoltaics	University of Newcastle

The Presentations were all at the highest level, creating the opportunity for animate discussions And debates, with followed up during the free time.

CONFERENCE OUTCOME

It is difficult to evaluate now the networking outcome of the event, asnetworking activities will Require a few months to producef ruits, however the interaction has been very effective, thanks to the many opportunities offered during the common meals and free time.
I have been informed of PostDoc positions in Australia and overseas offered by some of the Lecturers or invited speakers to the PhD students.

OZCarbon2013 held at Graduate House, University of Melbourne on the 1-3rd December 2013.

Executive Summary

OzCarbon2013, the second of the annual meetings of the Australian Carbon Society, was a resounding success, with more than 80 delegates attending from across theengineering and science disciplines, as well as industry. Crucially, we saw a significantrise in the number of delegates from the physics community. The two day event saw 30 oral and 50 poster presentations, many of which were concerned with nanotechnology. The ANN sponsorship was used to support the attendance of 16 PhDstudents and 5 ECRs from universities out-with the Melbourne area. The delegates receiving this support and the organisers are extremely grateful for this support.

Background

The OzCarbon meetings are the annual meetings of the Australian Carbon Society (AusCS). OzCarbon2013, which was held in Melbourne, was the second of these meetings, the first being held in 2012 in Adelaide. This year it will return to Adelaide as a symposium within the RACI's triennial Congress, and it is due to be held in Sydney and Brisbane in 2014 and 2015 respectively.

The Australian Carbon Society, which incorporates the RACI's Carbon Division, was formally constituted in early 2013 following the successful inaugural OzCarbon meeting in 2012. It is now composed of around 150 members drawn from a wide range of disciplines, including various engineering disciplines, physics and chemistry, and materials science. There is also industry members. This field is dominated by nanotechnology as indicated by analysis of the book of abstracts (see wordcluster analysis at the end of this report).

The ANN has supported both OzCarbon meetings. These funds have been essential to ensuring a very strong PhD representation at the meetings; feedback from the students and their supervisors indicates that this meeting is a very welcome forum for them to present their work in and learn about the latest work in the field. The funds this year also supported the attendance of the ECRs who gave orals; once again, the feedback from them on the conference has been very positive.

Overview of OzCarbon2013

The OzCarbon2013 meeting was hosted by the Melbourne Materials Institute (MMI) of The University of Melbourne, and held in Graduate House of the University between Sunday 1 December and Tuesday 3 December 2013. The Organizing Committee was composed of Prof. Steven Prawer (MMI, Melbourne), who was Chair, Dr. Igor Aharonovich (Physics, UTS), Prof. Mark Biggs (Chemical Engineering, Adelaide) assisted by Ms. Lilian Tan (MMI, Melbourne). These academics were joined by Prof. Joe Shapter (Chemistry, Flinders) and Dr. Irene Suarez-Martinez (Nanotechnology, Curtin) to form the Technical Committee.

The meeting was attended by more than 80 delegates, including more than 30 PhD students and around the same number of ECRs, with the remainder being senior academic staff and industry delegates. The vast majority of the delegates were based in Australia, but there was also an international presence from the UK and China. The delegates were drawn from across engineering, the sciences and, interestingly, even the legal profession (in the context of safety

of nanomaterials). Importantly, this year we saw a major contribution from the physics community, which represents an important development both for the OzCarbon meetings and the Society.

The full program and the book of abstracts is attached to this report. The program was presented in a single stream composed of invited plenaries (2 of) and keynotes (6 of), invited contributions (2 of) and invited forums (4 of). The latter, which were an innovation in the OzCarbon2013 program, were 40 minute long sessions in which an expert first presented a 20 minute introductory talk before the floor was opened for discussion. These were particularly successful in opening up areas to non-experts, which we felt important given the diversity of disciplines present at the meeting. In addition to the various invited talks, there were 16 other lectures and nearly 50 posters, and a LIEF Workshop, which was led by Prof. John Bell (QUT) and Prof. Mark Biggs, who were both recent members of the ARC College of Experts and, in the case of the former, a member of the ARC LIEF Panel from 2011-2013.

The contributions made by ECRs and PhD students were judged as part of two competitions that lead to the award of four prizes: winner and runner-up in the best poster competition; and winner and runner-up in the best non-invited oral presentation. The standard of both the oral and poster presentations was truly outstanding, making the task of the judges very difficult indeed.

The recipients of the prizes were (each was awarded an engraved certificate and $500 cash, although this was split two ways for the oral runner-up prize):

- Winner of the Best Non-invited Oral Presentation by an ECR was Dr. Yun Hau Ng (UNSW).
- Runner-up to the Best Non-invited Oral Presentation by an ECR was split two ways between Ms. Kasturi Vimalanathan (Flinders) and Dr. Luke Sweetman (Wollongong).
- Winner of the Best Poster by an ECR was Dr. Barbara A. Fairchild (Physics, Melbourne).
- Runner-up of the Best Poster by an ECR was Ms. Masturina Kracica (RMIT).

The standard of the contributions to the meeting was outstanding. This combined with the breadth and depth of the delegates made the meeting particularly vibrant, with all talks and the poster sessions being well attended (see photos below for example) and with plenty of discussion and debate ensuing.

The Invited Forum of Dr David Simpson (Melbourne) on use of nanodiamonds in supercapacitors

(One of the invited industry speakers (Dr. Phillip Aitchison, CAP-XX) speaking on his company's nanoporous carbon-based supercapacitors.

Report on use of funds from ANN

The $5,000 sponsorship from the ANN, which the organisers are extremely grateful for, was used to fund the registration costs of all 16 PhD students that attended from out-with the Melbourne area (a further 7 were sponsored by the organisers), and all the non-Melbourne based ECRs who gave oral presentations. The full details of the recipients are attached below. The sponsorship was acknowledged on all the literature associated with the meeting, as well as the website, which is at www.ozcarbon2013.net. The website will be kept live for a number of years to help raise the profile of the conference series.

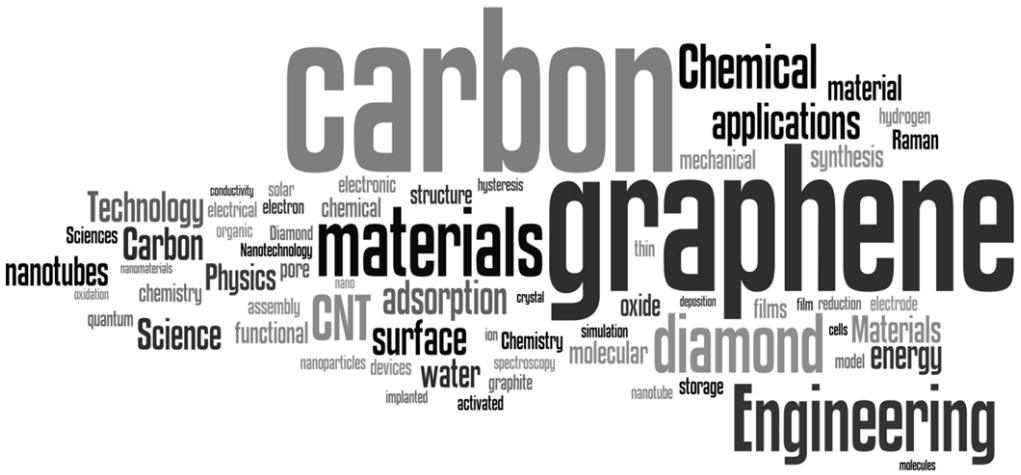
Recipients of ANN sponsorship

Title First name Last name Institution

Mr Khris Fair UTS , Mrs Shervin Kabiri Adelaide
Mr Daniel Tune, Mr Shujun Wang Griffiths
Mr Meisam Kiamahalleh Adelaide , Mr Sui Boon Liaw Curtin
Miss Fahimeh Mehrpouya Wollongong , Ms Van Nguyen UQ
Mr Taiwo Odedairo UQ , Mr Poomiwat Phadungbut UQ
Miss Alison Sham ANU , Miss Kasturi Vimalanathan Flinders
Mr Shuai Wang Curtin, Mr Kuang-Hsu Wu UQ
Mr Qingcong Zeng UQ , Ms Yonghong Zeng UQ
Dr Igor Aharonovich , Dr Javad Foroughi Wollongong
Dr Luke Sweetman Wollongong, Dr Yun Hau Ng UNSW
Dr Da Wei Wang UQ

Wordcluster analysis

Below is shown the output from a wordcluster analysis of the book of abstracts with non-technical.and every-day words removed. This shows that whilst the newest carbon allotrope, graphene, was a major subject of discussion at the meeting, CNTs also continue to receive good coverage. Nanodiamonds also saw a major outing in the meeting due to the increase in number of physicists attending the meeting. Overall, the word ‘nano’ was mentioned 235 time in the book of abstracts.



ANN Nanotechnology Bookwriting Project held at Macquarie University on the 4-10th December 2013.

ANN Nanotechnology Bookwriting Project was held in the department of Physics and Astronomy at Macquarie University on the 4-10th December 2013.

Staff and Participants		
Staff	**University/Organisation**	**Role**
Deb Kane	Macquarie University	Editor, Physics
Adam Micolich	UNSW	Editor, Physics
Peter Roger	Macquarie University	Editor, Linguistics
Adam Joyce	Macquarie University	Professional Officer, Physics
Iwan Kelaiah	Macquarie University	Tutor, Blender

The following are the chapter titles and the authors

Participant	University	Chapter Topic
Nano biosensors		
Gino Putrino biosensors	PhD, UWA	MEMS micro-cantilever, fabricated over diffraction grating
Anna Podolska	ECR, UWA	AlGaN/GaN transistor based chemical and biological sensor
Nano-based Advanced materials		
Bernard Mostert	ECR, UQ	Melanin as a multi-functional substrate and electronic substrate
Yang Bai	PhD, UQ	Design of new photoanode materials for low cost efficient solar cell application
Fundamental science of nano-fibres and nano- particles		
Fehmida Kanodarwala	ECR, UNSW	Colourful world of quantum dots
Dahua Shou	ECR, University of Sydney	Transport behaviour in nanoscale fibrous media
Nano-particles for nanomedicine		
Tristan Clemons	PhD submitted, UWA	Nanoparticles in modern medicine – drug delivery
Tianyu Yang	PhD, UQ	Yolk shell structured NPs for nanomedicine applications

Program

Wednesday 4th December

7.00-9.00 am	Continental Breakfast at DLC
9.30 am	Welcome & Mutual Introduction
10.00 am	Presentations on writing quality and impact
11.00 am	Morning tea
11.20 am	Checking Format of draft chapter before circulation, Assimilating resources on writing quality
12.00 pm	Physics Colloquium by Prof Toth, UTS for those who want to attend
1.00 pm	Lunch at DLC
2.00 pm	Mindmaps etc.
2.30 pm	Starting work on giving feedback on the writing of the two chapters assigned to each participant (Appendix A)
4.00 pm	Afternoon tea
4.20 pm	Continuing work on giving feedback on the writing of the two chapters assigned to each participant
5.30pm	Return to DLC
5.30- 7.00 pm	Dinner at DLC
~7.00 pm	Campus familiarisation walk

Thursday 5th December

7.00-9.00 am	Breakfast at DLC (hot breakfast from 7.45 am)
9.30 am	Presentations on collaboration, copyright and authorship
10.15 am	Continuing work on giving feedback on the writing of the two chapters assigned to each participant
11.00 am	Morning tea
11.20 am	Continuing work on giving feedback on the writing of the two chapters assigned to each participant and starting permissions process.
1.00 pm	Lunch at DLC
2.00 pm	Blender, Dr Iwan Kelaiah Starting to plan two-page colour insert on your chapter
4.00 pm	Afternoon tea
4.20 pm	Blender and continuing work on writing feedback on the writing of the two chapters assigned to each participant
5.30pm	Return to DLC
6.00- 6.30 pm	Dinner at DLC

Friday 6th December

7.00-9.00 am	Continental Breakfast at DLC
9.30 am	Main Feedback discussion session.
11.00 am	Morning tea
11.20 am	Feedback discussion session continuing as needed. Start acting on feedback. Continue using Blender.
1.00 pm	Lunch at DLC

2.00 pm Acting on feedback. Continue using Blender. Continue critically appraising writing content, format and detail.
4.00 pm Afternoon tea
4.20 pm Blender and continuing work on responding to feedback on your writing, and replanning aspects of your chapter based on assimilation of ideas and suggestions. Progress copyright permissions.
5.30pm Return to DLC
5.30- 7.00 pm Dinner at DLC
7.30 pm Outing to the Ranch?

Saturday 7th December
8.00-11.0 am Breakfast/Brunch at DLC
Morning Free time (But using some of the time to further advance colour insert, writing and permissions is encouraged. Collaboration in this is encouraged).

11.00 am-1.00pm Lunch at DLC
Afternoon Free time (But using some of the time to further advance colour insert, writing and permissions is encouraged. Collaboration in this is encouraged).
~4.00 pm Leave to travel to city for Workshop Dinner

Sunday 8th December
8.00-9.30 am Breakfast/Brunch at DLC
Morning Free time (but using some of the time to further advance colour insert, writing and permissions is encouraged. Collaboration in this is encouraged).
11.00am-1.00pm Lunch at DLC
Afternoon Free time (but using some of the time to further advance colour insert, writing and permissions is encouraged. Collaboration in this is encouraged)
5.30-7.00pm Dinner at DLC
Monday 9th December
7.00-9.00 am Breakfast at DLC
9.30 am Continued work on Blender (with Iwan's assistance). Continuing work on responding to feedback on your writing, and replanning aspects of your chapter based on assimilation of ideas and suggestions. Progress copyright permissions.
11.00 am Morning tea
11.20 am Workshop work
1.00 pm Lunch at DLC
2.00 pm Workshop work Acting on feedback. Continue using Blender. Continue critically appraising writing content, format and detail.
4.00 pm Afternoon tea
4.20 pm Workshop work
5.30pm Return to DLC
6.00- 6.30 pm Dinner at DLC
7.30 pm Outing to the Ranch/ game evening/Bowling

Tuesday 10th December

7.00-9.00 am Breakfast at DLC (hot breakfast from 7.45 am)
9.30 am Presentation of colour graphics and vote for front cover.
11.00 am Morning tea

11.20 am Workshop work
1.00 pm Lunch at DLC
2.00pm Closing session and discussion
3.00 pm Close of the workshop

Appendix A – Editor and Reader Assignments

Participant	Chapter Topic	"Editors"	Readers/Discussants
Nano biosensors			
Gino Putrino	MEMS micro-cantilever, fabricated over diffraction grating biosensors	Deb	Anna ,Dahua
Anna Podolska	AlGaN/GaN transistor based chemical and biological sensor	Deb Peter	Gino, Fehmida
Nano-based Advanced materials			
Bernard Mostert	Melanin as a multi-functional substrate and electronic substrate	Adam	Yang, Tristan
Yang Bai	Design of new photoanode materials for low cost efficient solar cell application	Adam	Bernard ,Tianyu Yang
Fundamental science of nano-fibres and nano-particles			
Fehmida Kanodarwala	Colourful world of quantum dots	Adam	Dahua, Anna
Dahua Shou	Transport behaviour in nanoscale fibrous media	Adam Peter	Fehmida, Gino
Nano-particles for nanomedicine			
Tristan Clemons	Nanoparticles in modern medicine – drug delivery	Deb Peter	Tianyu Yang, Bernard
Tianyu Yang	Yolk shell structured NPs for nanomedicine applications	Deb Peter	Tristan, Yang Bai

Australia New Zealand Conference on Optics and Photonics held at Freemantle on the 8-11th December 2013.

ANZCOP 2013 Conference Chair's Report

The Australia and New Zealand Conference on Optics and Photonics was held in Perth, Western Australia, at the conference venue in the City of Fremantle, where the Swan River meets the Indian Ocean. The 2013 meeting was a fresh take on a more than 30-year tradition of such meetings in Australia and New Zealand. The conference incorporated the Australian Optical Society Annual Meeting, the Australian Conference on Optics, Lasers and Spectroscopy and the Australian Conference on Optical Fibre Technology. It will also included a satellite meeting on Rogue Waves and Extreme Events, a field closely associated with Nonlinear Optics.

The objective of the conference was to bring a large community of scientists and engineers closer together than ever before. While focussed on the Australian and New Zealand scientific communities, the meeting has always been strongly international and featured many international delegates. The OSA and SPIE presidents traditionally presents invited papers – 2013 was no exception, with the past plenary speakers including Nobel Laureates and those who have gone on to become so. The 2013 Speakers did not disappoint.

ANZCOP 2013 featured four streams:

1. Atom, quantum and nonlinear optics, and optical spectroscopy
2. Optical materials and devices, including lasers, meta-materials, plasmonics, and nanophotonics
3. Optical sensors and imaging, including microscopy
4. Optical communications and photonic systems

Re-launching the conference under a new and united name affords the opportunity to revisit the formats and themes of our meeting, to make them fresh and relevant to the present interdisciplinary world of science and engineering in which we find ourselves. The efforts to build bridges between our specialisations and make new horizons accessible were much appreciated with delegates encouraged engage outside of their immediate specialty.

There were 286 delegates including exhibitors attending this conference.

Conference Committees

Executive Management Committee

David Sampson (University of Western Australia), Chair Ann Roberts (University of Melbourne) Ken Baldwin (Australian National University) Simon Fleming (University of Sydney) John Harvey (University of Auckland) Mirerva Holmes (Engineers Australia) Thas Nirmalathas (University of Melbourne) Audra Young (EECW Pty Ltd)

Technical Programme Committee

Michael Withford, Chair (Macquarie University) Robert McLaughlin (University of Western Australia), Co-chair Cather Simpson (University of Auckland), Co-chair

Plenary Speakers: Rainer Blatt (University of Innsbruck) Miles Padgett (University of Glasgow) Bruce J. Tromberg (University of California)

SPIE and OSA speakers Philip Bucksbaum (Stanford University) and H Philip Stahl (NASA)

Invited Speakers: Stream 1: Andrew Truscott (ANU) and Dana Anderson (Colorado) Stream 2: Ann Roberts (Melb) Stream 3: Richard Blaike (Otago) and Jas Sanghera (US NRL) Stream 4: Jagadish Chennupati (ANU) and Leif Oxenlowe (DTU) **Tutorial Speakers:** Howard Carmichael - Quantum Science (University of Auckland) Peter Schultz - Optical Fibres (Peter Schultz Consulting) Ben Eggleton - Nonlinear Optics (University of Sydney) Tanya Monro - Advanced Sensing (University of Adelaide) Brian Wilson - Optical Biophysics (University of Toronto) Michael Ireland - Astrophotonics (Macquarie University

OSA prize (best student poster): Nicolas Riesen, ANU

Wanda Henry Prize (student talk): Stine Højer Møller Larsen, DTU Fotonik

A limited number of bursaries were available to support the attendance of student members of the Australian Nanotechnology Network.

The bursaries were available for: **1. Early-career researchers (less than 5 years post PhD) - $400 towards registration 2. Students - waiver of registration costs**

List of bursary winners

Name	Affiliation
Liming Liu	The University of New South Wales, Canberra/ Also at the Joint group: Electronic Materials Engineering, Australian National University
Annemarie Nadort	PhD student at Macquarie University, NSW
Ekaterina Ivukina(Grebenik),	PhD student, Physics and Astronomy Department, Macquarie University, NSW
Izabela Spaleniak	MQ Photonics Research Centre, Department of Physics and Astronomy, Macquarie University
Hong Kang	Centre for Micro-Photonics, Swinburne University of Technology
Withawat Withayachumnankul	ARC Postdoctoral Research Fellow, The University of Adelaide, Adelaide, SA, Australia
Igor Aharonovich	Sydney University of Technology
Alessandro Tuniz	Institute of Photonics and Optical Science, School of Physics, University of Sydney

Sponsors and Exhibitors

WEBSITE

NANOTECHNOLOGY FACILITIES AND CAPABILITIES REGISTER

NEWSLETTER

MEMBERSHIP

NanoQ Magazine

PLANNED 2014 ACTIVITIES

WEBSITE

http://www.ausnano.net

The ANN Website is a very popular website and as at the end of 2013 it received more that 5,600,000 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.

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.

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 ANN uses as an information management tool. The newsletter is sent out every six 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.

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.

The fifth issue of Nano Quest was published in May and featured articles on

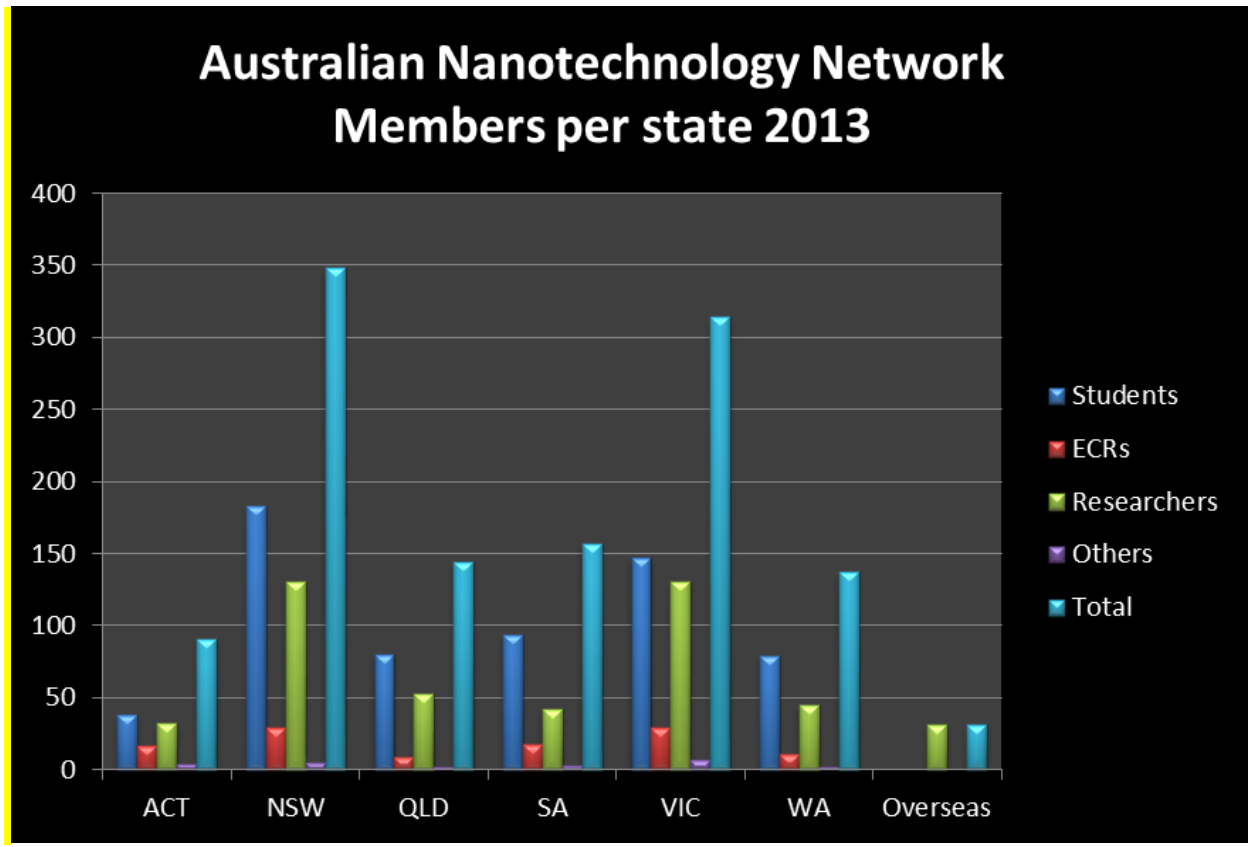
- Insect Silk spins a new story
- Tiny capsules have big potential
- The transition project
- VIEWS for studying nano-scale
- Nanoconnect- prviding a bridge between industry and university

These issues are distributed to several schools.Copies can be accessed on the ANN website.

MEMBERSHIP

The ANN membership consists of established researchers, Early Career Researchers, PhD students whose research field is in the area of Nanotechnology. It also consists of members from Government departments and business.

The following is a chart representing ANN members per state for 2013.



State	Students	ECRs	Researchers	Others	Total
ACT	38	17	32	4	91
NSW	183	29	131	5	348
QLD	80	9	53	2	144
SA	94	18	42	3	157
VIC	147	29	131	7	314
WA	79	11	45	2	137
Overseas			31		31
TOTAL	**621**	**113**	**465**	**23**	**1222**

PLANNED 2014 ACTIVITIES

The Australian Nanotechnology Network (ANN) 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.

The management committee has also been involved in preparing for the

- **International Conference on Nanoscience and Nanotechnology 2014(ICONN)** which will be held at the Adelaide Convention Centre during 2th - 6th of February 2014 which is shaping up to be as outstanding as the previous four conferences. This will be co-located with the the 23rd Australian Conference on Microscopy and Microanalysis (ACMM 23)

There will be a continuation of the successful Overseas Travel Fellowships, Short and Long Term visits and Young Nanoscience Ambassador Awards.

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

Molecular Modelling 2014: From Biomolecules to Materials
31/07/2014 - 02/08/2014 - **Lamington National Park, Gold Coast**

ANN Early Career Workshop
10/07/2014 - 11/07/2014 - **Guthrie Theatre, University of Technology, Sydney**

NanoBio Australia 2014
06/07/2014 - 10/07/2014 - **THe University of Queensland**

5th International Nanomedicine Conference
30/06/2014 - 02/07/2014 - **Coogee, Sydney, Australia**

International Conference on Nanoscience and Nanotechnology (ICONN2014)
02/02/2014 - 06/02/2014 - **Adelaide Convention Centre, Adelaide**

Advanced Nanomaterials Workshop

30/01/2014 - 31/01/2014 - **University of Melbourne**

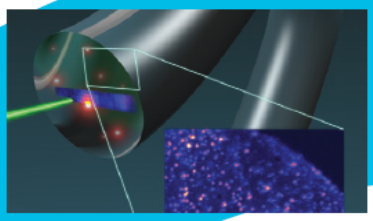
3rd Biennial Conference of the Combined Australian Materials Societies CAMS2014
26/11/2014 - 28/11/2014 - **University of Sydney**

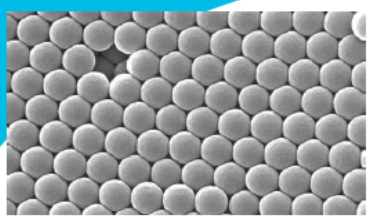
ACMM23 ICONN2014

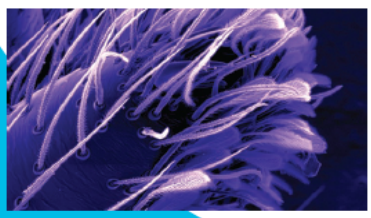
2-6 FEBRUARY 2014 ADELAIDE SOUTH AUSTRALIA

ACMM23
23rd Australian Conference on Microscopy and Microanalysis

ICONN2014
2014 International Conference on Nanoscience and Nanotechnology







Invitation to attend

The Australian Microscopy and Microanalysis Society, together with the Australian Nanotechnology Network, are pleased to present the 23rd Australian Conference on Microscopy and Microanalysis (ACMM23) and the International Conference on Nanoscience and Nanotechnology (ICONN 2014), to be jointly held at the Adelaide Convention Centre, South Australia, from February 2-6 2014.

Including dynamic invited speakers, an extensive scientific program, workshops, exciting joint social events and a major exhibition component, these conferences are not to be missed. The organising committee looks forward to welcoming delegates to Adelaide to experience the conference and all that this vibrant city has to offer.

Tanya Monro, Chair, ICONN Organising Committee and Angus Netting, Chair, ACMM Organising Committee.

Key Dates
- Call for Abstracts Open: 31st August 2013
- Submission of Abstract Deadline: 30th September 2013
- Notification to Authors: 31st October 2013
- Early-bird registration deadline: 15th November 2013

Conference Themes
- Correlative light and electron microscopy
- Advances in In-vivo imaging
- Microscopy in cellular biology
- Advances in Analytical Transmission Electron Microscopy
- Quantitative Electron Probe Microanalysis
- Laser Ablation ICPMS and EPMA
- Nanobiotechnology
- Nanoelectronics
- Nanophotonics
- Computational Nanotechnology
- Nanotechnology for Energy and the Environment
- Nanomanufacturing
- Nanocharacterization

Confirmed Plenary Speakers
- Professor Masakazu Aono - National Institute for Material Sciences, Japan
- Professor Dr. Wolfgang Baumeister - Max-Planck-Institute of Biochemistry, Germany
- Professor Jeremy Baumberg - University of Cambridge, UK
- Professor Federico Capasso - Harvard University, USA
- Professor Charles M. Leiber - Harvard University, USA
- Professor Michael Strano – MIT, USA

All Occasions Management
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conference@aomevents.com
www.acmm23iconn2014.com.au

Australian Nanotechnology Network