

Section 1

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President's Report

Although each succeeding year inevitably seems busier than its predecessor, 2008 was undoubtedly a high point for AINSE, and accordingly a very active year for its Secretariat and Executive. During 2008, AINSE celebrated its 50th Anniversary with the formal launch of its documented history¹, a project conceived by our immediate Past President, Emeritus Professor Brian O'Connor, and seen to completion by him. The latter stages of the project were indeed hectic, as our Executive Secretary cajoled anecdotes from and challenged the memories of the volume's many contributors, right up to the printing deadline. The launch, on the evening of 11 December, in a function centre near Sydney airport, following the AINSE Council Meeting, represented an assembly of AINSE supporters, councillors and collaborators spanning five decades. We were delighted by Professor Mary O'Kane's perceptive reading of the history, and her supportive comments in her launch address. The following day provided another highlight with 18 AINSE Scholars (PhD students and Research Fellows) providing a seminar series demonstrating the breadth and depth of their research. Dr Ziggy Switkowski, Chairman of the ANSTO Board and an AINSE alumnus, provided a thought-provoking opening presentation. Most of the photos on this page and the next were taken at the launch of the History.



AINSE President Professor Allan Chivas (left) and Chair of ANSTO Dr Ziggy Switkowski

Throughout 2008, the close co-operation of Council, the Executive Committee, and particularly the efforts of the Executive Secretary, led to the successful transfer of AINSE from an incorporated association to a company limited by guarantee. This change in status is a requirement of the NSW Office of Fair Trading resulting from AINSE's assets, annual income and expenditure exceeding \$500,000.

AINSE is enthusiastic about the new OPAL-based neutron scattering facilities, which started with Wombat and Echidna being commissioned in late 2008. A further 7 instruments are planned for commissioning 2009. In the first two funding rounds, AINSE researchers were allocated 374 days out of a total of 582 days (64.3%). ANSTO researchers accounted for 18.7% and others, mostly from foreign researchers, accounted for 17.0%.



Left to right: E/Professor Ian Polmear, Dr Henk Heijnis, E/Professor Peter Parsons, Dr Ron Cooper, Mr Bill Palmer OBE, Dr Chris Howard. This group was photographed at the 50th Anniversary just after Henk received his Honorary Fellowship. Polmear, Parsons and Cooper are Past Presidents, and Palmer was the first AINSE Executive Officer.

¹ O'Connor B H, Chivas A R, Mather D W, Studdert J D C, and Binnie A E. 2008. AINSE, An Institute for Research and Training Excellence in Nuclear Science. The First 50 Years. Australian Institute of Nuclear Science and Engineering. 159pp. ISBN 978-0-9758434-5-1.

The AINSE Fellowship program has now recruited its third annual cohort, by welcoming Dr Lizhong He (University of Queensland) and Dr Helen McGregor (University of Wollongong) to work with their own university's and ANSTO teams. Helen is the first fellow to be appointed in the area of high-resolution climate records. They join our existing four Fellows, Dr Darren Goossens (Australian National University), Dr Daniel Riley (University of Melbourne), Dr Moeava Tehei (University of Wollongong), and Dr Duncan McGillivray (University of Auckland). AINSE is most grateful to Emeritus Professor Don Napper (University of Sydney) who chaired the Fellowships Selection Committee during the past three years, and welcomes Professor John White (Australian National University) who will fill the same role from 2009. The Research Fellowships Scheme will now be included on the Australian Competitive Grants Register, as are AINSE Research Awards.

Further recognition of excellence during the year includes the award of the initial John Ferris Memorial Fellowship, to support PhD studies in the area of environmental research, to Mr Jamie Howarth of Otago University. His topic is 'Radiocarbon contamination in lacustrine sediments: understanding the process and developing a reliable dating strategy'. An AINSE Honorary Fellowship was awarded to Dr Henk Hejnis from ANSTO, for his collaborative research with many AINSE colleagues and research students over the past 15 years in the area of radioactive dating and tracing.

I have pleasure in acknowledging the close working relationship provided by key ANSTO personnel, particularly Dr Ian Smith, CEO, and Dr George Collins, Chief of Research, both of whom left that organisation during 2008, and were strong supporters of AINSE. Our Vice President, Professor Bruce King (University of Newcastle), dealt with important issues on several occasions when I was overseas on fieldwork, and for which I am most grateful. Finally, I close in acknowledging the dedicated and effective work of Dr Dennis Mather and the Secretariat staff of AINSE, in dealing smoothly with another year. AINSE is most fortunate to have such professional resources.

Professor Allan R. Chivas
President, AINSE



Jamie Howarth (left) of Otago University receiving his notification of award from AINSE Executive Secretary Dennis Mather



Left to right, E/Professor Brian O'Connor (immediate Past President), Mr Bill Palmer OBE, and Dr Anna Binnie



Dr Henk Hejnis receiving his Honorary Fellowship from Professor Mary O'Kane, NSW Chief Scientist and Scientific Engineer



AINSE Executive Secretary Dennis Mather and E/Professor Harry Messel. Professor Messel was the catalyst for the formation of AINSE.

Executive Secretary's Report

This year was a watershed one for AINSE, with the launch of the Institution's 50-year history, a restructure into a company limited by guarantee, and the establishment of a Trust.

This is the final annual report for The Australian Institute of Nuclear Science and Engineering Inc. A new company, called AINSE Ltd, commenced trading on 1 January 2009 and AINSE Inc is to be wound up. Negotiation with our 41 members was not without its challenges but the successful outcome is testament to the continuing support for AINSE from the university and research sector. In parallel with this restructure, AINSE also established a Trust with the aim of sourcing donations to fund scholarships and fellowships. A generous donation from the family of the late Dr John Ferris to support environmental research spurred AINSE to establish a Trust Fund. Dr Roger Gammon also provided a generous donation in December. Donors are acknowledged on our web site.

AINSE ran two major conferences: the Seventh AINSE/ANBUG Neutron Science Symposium; and the Fourth AINSE Quaternary Dating Workshop. The Second Neutron School was a success and the year's activities reached a climax in December with the celebration of AINSE's 50th anniversary. These included the launch of The History of AINSE by the newly appointed NSW Chief Scientist and Scientific Engineer Professor Mary O'Kane, and a seminar at which AINSE scholars outlined their research activities. In her address, Professor O'Kane succinctly reminded past and present AINSE collaborators of how AINSE has had a positive impact on the lives of so many members of the Australasian scientific community.

AINSE provided travel support for contributors at a number of conferences, workshops, and experiments overseas. A summary can be found on pages 18 and 19 in Section 1 of this report.

During the year some research activities were deferred because of technical problems at the OPAL reactor. AINSE provided travel support to a number of researchers and their students who had secured instrument time on overseas neutron scattering facilities but who were unable to secure Access to Major Research Facilities funding.

The first experiments by university researchers on the new OPAL neutron scattering instruments commenced towards the end of the year. Those experiments used two instruments: Wombat, the high-intensity powder diffractometer; and Echidna, the high-resolution powder diffractometer. AINSE has agreed to a protocol for travel and accommodation support, and for novice user support, for researchers who gain access to the OPAL neutron scattering instruments. Eight neutron scattering research projects received funding in 2008, and many more are planned for 2009.

Dr Matthew Hole (ANU), who has led the Australian ITER forum for a number of years, was appointed by the Director General of the IAEA, Dr Mohamed El Baradei, to the International Fusion Research Council (IFRC). The function of the IFRC is to advise the IAEA on its controlled nuclear fusion research program, and promote international cooperation in this field. The last Australian appointed to the IFRC was previous AINSE President Professor Max Brennan AO FAA, who served as Chairman of the IFRC from 1987 to 1995.

Face-to-face contact with researchers at member universities, with an emphasis on evaluations of and discussion on continuing and new areas of research, is an essential feature of the duties of the Executive Secretary of AINSE. To this end, during the year I visited 15 campuses in Australia and New Zealand as part of my objective of visiting each member university within a two year timeframe.



AINSE continues its important function as a peak body, acting on behalf of its member organisations in applying for external grants. In addition to our continuing LIEF Grant for access to ISIS, our application for a high-throughput neutron spectrometer for the study of atomic and molecular motion, costed at \$1,043,694 and requesting \$533,694 from the ARC, was successful. It was supported by AINSE and ANSTO along with 10 research groups from 9 members.

Council and Committees

I am grateful for the enthusiasm and generosity of all those who contributed to the various committees and to Council throughout the year. Their considerable input is critical to the onward development of the Institute. In the period: ANSTO's Ian Smith and George Collins were replaced by Ron Weiner;

The University of Adelaide's Gerald Laurence was replaced by John Carver;

The Australian National University's John White was replaced by Keith Fifield;

University of Ballarat's Stafford McKnight was replaced by Peter Gell;

University of Canterbury's Steven Durbin was replaced by Greg Russell;

Curtin University of Technology's Brian O'Connor was replaced by Craig Buckley;

University of Otago's Glen Summerhayes was replaced by Gary Wilson.

Finances

In 2008, operating revenue of \$3,472,636 was made up of \$2,778,172 from membership fees, \$392,250 from external grants, \$245,340 from interest, and \$56,874 from other sources, see figure 1. In line with practice, membership subscriptions are reviewed on an annual basis to determine AINSE support for each university. On average, for the period 2006 to 2008 inclusive, universities received research and training benefits amounting to 2.85 times their subscriptions, reflecting the continuing problems with access to neutron scattering and x-ray instruments which made it impossible to support some awards in accordance with their original budgets.

AINSE's operating expenses in 2008 were \$3,154,565, leaving a surplus for the year of \$318,071. The majority of AINSE funds are used to facilitate access and travel to Lucas Heights for university researchers (\$1,179,514), PGRAs (\$442,871), and Research Fellows (\$439,262), see figure 2.

The Financial Statements for the calendar year 2008 in Section 2 of this report were prepared by ANSTO Finance and audited by Mr David Aston of Escott Aston and Co.

Awards and postgraduate research awards

A total of 136 Awards were funded in 2008, and another 96 were carried over from previous years. Figure 3 shows the distribution of 2008 AINSE Awards by specialist area. Research highlights in each of the specialist areas are given below on pages 6 to 15. Progress reports for each of the projects can be found on our web site. Of the 136 Awards, 117 or 86% were conducted in collaboration with ANSTO research staff. First-time award holders in 2008 represented 18% of the cohort, this includes four students who applied for neutron beam time through the Bragg Institute. My thanks go to the Councillors who continue to work on attracting new applicants.

In 2008, 15 of the 66 AINSE postgraduate research award holders received an award for the first time and 13 doctoral theses were received. A further 37 theses where students conducted experiments under a research award in the name of their supervisor are recorded in the publications list. The AINSE postgraduate research award holders accessed the facilities for a total of 597 days. In addition, another 69 students gained access to the facilities via awards held by their supervisors, for a total of 837 days. The numbers of students and total number of days access to facilities is less than in previous years primarily because of the lack of neutron scattering facilities at ANSTO for much of the year.

In the period, we recorded 454 publications, of which 199 are articles in refereed journals, 176 are conference papers, 23 are books or chapters of books, and 57 theses. Details of publications can be found in Section 2 of this report.

Acknowledgements

It has been a pleasure to work with AINSE President, Professor Allan Chivas of the University of Wollongong. I thank Dr Ian Smith, CEO of ANSTO to May, and Dr Ron Cameron, acting CEO of ANSTO since May 2008, who have provided practical advice throughout the year and supported AINSE in numerous ways. Dr George Collins, Chief of Research, left ANSTO in September to take up a new position as CEO of the CAST CRC. George has been a great supporter of AINSE over many years and will be a significant loss to the organisation.

I am grateful for the dedication and support of the President and other members of the Executive Committee who share the responsibility of running the Institute with me. I also extend my thanks to all those from the universities and ANSTO for their help and advice throughout the year. There are far too many to name individually.

In the AINSE Secretariat, Gillian Blackburn, Nerissa Phillips, Sandy O'Connor, Rhiannon Still and John Studdert have continued to maintain the long-standing reputation of a friendly, supportive and effective secretariat.

Dr Dennis Mather
Executive Secretary

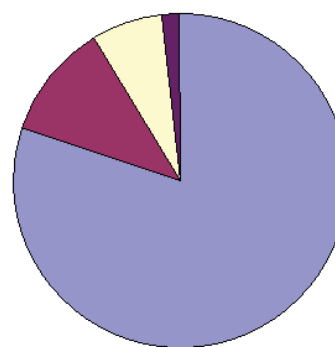


Figure 1 Operating Revenue

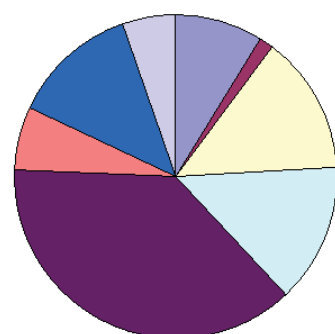


Figure 2 Operating Expenses

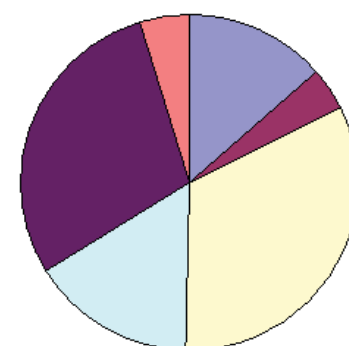


Figure 3 Awards Expenditure by Specialist Area

Research Highlights

Archaeology and Geosciences

Ostrich eggshells suggest early occupation

The transition from the Middle to Later Stone Age (MSA/LSA) is the final major cultural transition within the southern African Stone Age sequence. However, many of the key archaeological sites within the region remain poorly dated and good climate records have not been obtained. The aim of this AINSE supported project is to provide a dating framework for relating climatic and environmental change occurring at one of the sites along the Ghaap Escarpment, Northern Cape in South Africa, to occupation of this semi-arid environment zone by late Pleistocene and Holocene hunter-gatherers.

Dr Andy Herries of the University of New South Wales and Dr Ed Hodge at ANSTO carried out fieldwork at the Ghaap Escarpment late in 2006 to retrieve a variety of samples for radiocarbon dating including ostrich eggshell, charcoal and tufa. The dating of the samples, using the ANSTO radiocarbon facility, performed two key functions. Firstly, different types of material were dated and compared to each other to check suitability for dating. Secondly, samples were dated to provide an archaeological and palaeoenvironmental context.

Radiocarbon dates older than 25,000 years, on pieces of ostrich eggshell, found in association with LSA artefacts, suggest that the Malony's Kloof site has the oldest evidence for LSA occupation along the Ghaap Escarpment and perhaps also for South Africa as a whole. Radiocarbon dates on tufa flows imply there have been a series of temporally distinct wet phases at the site including immediately prior to the last glacial maximum, as well as during the deglacial and late-glacial periods.

On the riverbanks

The Liverpool Plains, near Tamworth, northern New South Wales, while one of Australia's richest agricultural regions is faced with increasing pressure on its land and water from coal mining and feed lots. This research, conducted by Dr Robert Haworth of the University of New England and Dr Geraldine Jacobsen at ANSTO, set out to measure disturbance in channel bank sediment over the past few thousand years, and especially the 200 years since farming commenced, in order to begin to quantify the occurrence and extent of serious channel collapse and flood plain disruption over time.

At the site, ¹⁴C dating has indicated that over one metre of fine topsoil had been deposited sometime in the last 200 years, whereas the metre of newly exposed bank sediment below this had taken 2500 years to accumulate. The age of giant red gums growing in and on the creek banks gave a surprisingly young age of 100 to 150 years. These trees, as well as adjacent undisturbed telegraph poles known to date from around 1880, suggested that the creek channel was not much older than 150 years. It was concluded that the metre of modern silt had apparently been deposited fairly rapidly sometime in the early 19th century, possibly following the environmental shock from the first introduction of sheep and cattle, and that the stream channel had only established its present course following this. In the last 10 years, however, as development pressures have increased on the plains, the river banks appear to have entered a new phase of accelerated erosion, threatening infrastructure and vegetation that has been in place for most of the last 150 years.



Fieldwork at the Ghaap Escarpment, Northern Cape in South Africa



Recently exposed bank sediments at Colly Plains Crossing, Borambil Creek, Quirindi

North Stradbroke Island – an ideal location for investigation

Improved knowledge of landscape change for the last 50,000 years in the subtropics of eastern Australia is crucial to increasing our understanding of the broader effects of environmental processes, such as climate change and human impact for the Australian continent. This region forms a significant transitional and overlap zone between tropical northern and temperate southern Australia. North Stradbroke Island, situated 30 km from Brisbane, is an ideal location for the investigation of subtropical landscape change for this time period. PhD student Lynda Petherick, Dr Patrick Moss and Dr Hamish McGowan of The University of Queensland have investigated a number of sites across the island using pollen, charcoal and loss-on-ignition analysis of sediment cores. One site in particular, Tortoise Lagoon, has provided a high-resolution picture of subtropical environmental change for the last 40,000 years. Initial findings suggest high climate variability for the region, with several periods of drought, alternating with wetter conditions observed throughout the record. Furthermore, there is a strong indication of the impact of European settlement on the island's environment with the presence of pine pollen, increase in eucalypt pollen and an unprecedented alteration in burning regimes recorded at the top of the sediment core.



Tortoise Lagoon, North Stradbroke Island

Old growth moss forests in Antarctica

Antarctica is the coldest and driest continent on Earth. These harsh conditions reduce the growth rates of Antarctic plants to a minimum. The Antarctic climate is now changing, with rapid warming over the Antarctic Peninsula, increased strength of the circumpolar westerlies and increased UV-B radiation under the Austral ozone hole. However, to date, no-one had measured changes in the growth rate of Antarctic plants over this period of environmental change.

In collaboration with Drs Quan Hua and David Fink of ANSTO, Dr Laurence Clarke (now at Flinders University) and Associate Professor Sharon Robinson of the University of Wollongong, using AMS radiocarbon dating techniques have shown that some Antarctic moss plants have been growing continuously since before the 1960s peak in atmospheric carbon-14 due to nuclear testing (the bomb pulse), and are thus more than 50 years old. Average growth rates are extremely slow, commonly less than a millimetre per year. The sensitivity of this technique means that for the first time we can begin to correlate growth rates with changes in the Antarctic environment.

Growth rates correlated positively with temperature and ozone depth, but negatively with wind speed. Changes in stable carbon isotope ratio ($\delta^{13}\text{C}$) over the length of the moss shoots suggest the effects of temperature and wind speed are at least, in part, due to their influence on water availability. Warmer temperatures lead to faster growth due to increased melt, but increased wind speeds which have already been observed at coastal Antarctic sites seem to be drying out these plant communities and may lead to a major loss of regional biodiversity.

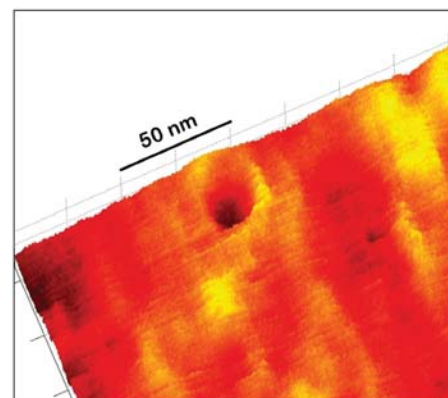


Summer on the Antarctic Peninsula

Reconstructing complex geological processes

To increase our understanding of complex geological processes, PhD student Fabian Kohlmann with Associate Professor Barry Kohn and Professor Andrew Gleadow of the University of Melbourne, in collaboration with Dr Rainer Siegele at ANSTO, have used the ANTARES Tandem accelerator at ANSTO to study the effect of the impact of swift, heavy iodide ions over a range of energies on different mineral surfaces. Using Atomic Force Microscopy (AFM), which has the unique ability to image the surfaces of minerals down to the nanoscale, the impact sites have been used as proxies to advance our fundamental knowledge of the structure of spontaneous ^{238}U fission tracks in their latent state.

Knowledge of the detailed structure of fission tracks in this state, prior to chemical etching, is critical for assessing mineral lattice response resulting from energy imparted by ion implantation. This study has shown that the diameter of impact structures increases with decreasing ion energy. The implication is that the strained mineral lattice along an ion track will be more readily etched and, therefore, slow ions etch wider, but result in shorter channels. Etching is a key requirement to reveal visually the products of fission within suitable uranium-bearing minerals in order to carry out fission track thermochronology (FTT). FTT is one of the best-established radiometric dating methods available for reconstructing complex geological processes in time and space, in the upper Earth's crust.



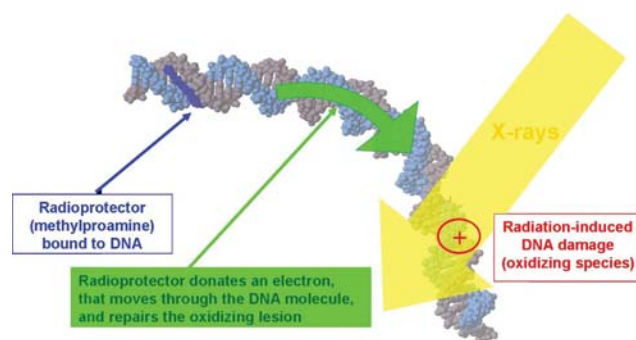
AFM image of an impact crater from an iodide ion on muscovite

Research Highlights

Biomedical Science and Biotechnology

Saving normal tissue from damage

Methylproamine is the lead compound of a new class of radioprotectors being developed at the Peter MacCallum Cancer Centre in Melbourne, for use in cancer radiotherapy. Topical radioprotectors can be applied to normal tissues “at risk” by being in the radiation beam used to treat patient tumours. Such normal tissues can include the oral mucosa, rectal mucosa, esophageal mucosa and skin. In many radiotherapy settings, normal tissue damage limits the radiation dose that can be prescribed for treatment, so that the optimum radiation dose cannot be given to the tumour. In addition, there are other potential applications for new radioprotectors that extend beyond the oncology arena, involving both planned and unplanned radiation exposures. Dr Roger Martin’s project is now at the stage of lead optimisation, and methylproamine analogues are being designed, synthesised and evaluated, in collaboration with Associate Professor Jonathan White at the University of Melbourne School of Chemistry.



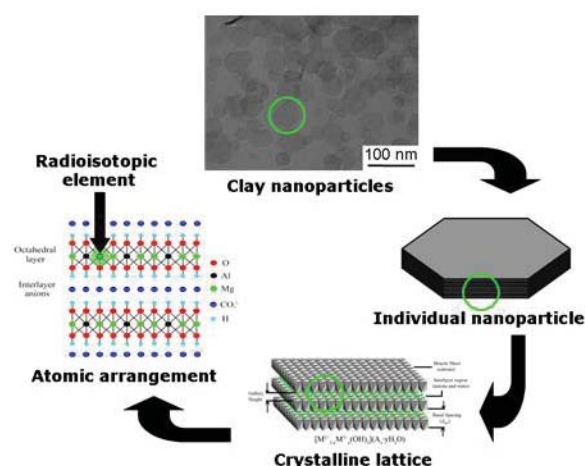
Meanwhile an AINSE-funded project, involving pulse radiolysis studies at the University of Auckland Facility, in collaboration with Associate Professor Bob Anderson, has revealed information about the mechanism of action of methylproamine. Time-resolved spectrophotometry enables monitoring of the kinetics of oxidation of the DNA-bound ligand, following a pulse of radiation to initiate a radical reaction to damage DNA. The transient, radiation-induced, oxidising species on DNA is reduced by the DNA-bound ligand, by electron donation from the ligand to the lesion such that methylproamine can now be considered as a DNA-binding anti-oxidant. These studies are continuing, using new methylproamine analogues, with a range of redox properties.

Biological interactions of industrially relevant nanomaterials

While the sustainability of many existing and emerging nanotechnologies is dependent on understanding and managing the short and long term effects that nanoparticles have on our communities, these new nanomaterials are appearing faster than scientists are able to evaluate their impact on humans and the environment.

Associate Professor Darren Martin of the University of Queensland and Dr Suzanne Smith, at ANSTO, with their research teams, have been working together to develop methodologies to radiolabel a series of industrially relevant nanoparticles. Radiolabelling nanoparticles offers unprecedented sensitivity in comparison to other labelling techniques, and it will allow them to track and monitor their distribution in biological systems. Supported in part by AINSE, this collaboration has developed methods to radiolabel a range of synthetic clay nanoparticles with radioisotopes such as ^{57}Co and ^{67}Ga , and study their stability at biologically relevant pH. Both these isotopes can be used for imaging with a SPECT camera. Having established stable labelling conditions, future work will involve *in vitro* and *in vivo* studies to examine the uptake of these particles in algae and their biodistribution in animal models.

These studies are expected to enhance our understanding of the interaction of nanomaterials in biological systems and also assist in the development of the next generation of nanomaterials used for drug and gene delivery, as well as polymer nanocomposites for use in biomedical implant components.



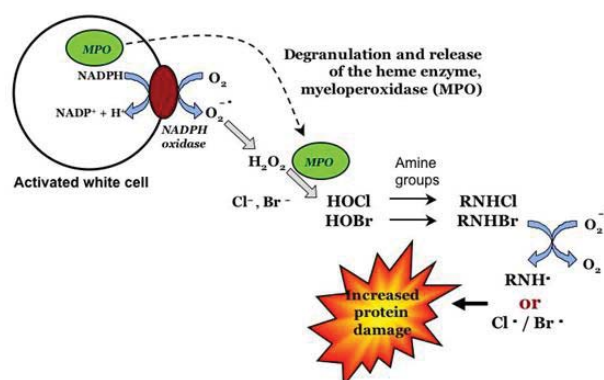
Schematic diagram of clay nanoparticles exemplifying how radiolabelling involves substitution of single atoms into the nanoparticle structure

Human inflammatory disease investigation

Professor Michael Davies and Dr David Pattison of the Heart Research Institute and the University of Sydney, are working with Dr Bob Anderson of the University of Auckland to assess the rate constants of reactions which can generate damaging free radicals.

Hypochlorous acid (HOCl, a major component of household bleach) and hypobromous acid (HOBr) are potent oxidants generated by the human immune system using the heme enzymes myeloperoxidase and eosinophil peroxidase. These oxidants exhibit potent antibacterial properties, but can also cause damage to host tissue. This damage has been linked to a wide range of human inflammatory diseases including heart disease, some cancers, arthritis, and asthma. Reaction with amines yields relatively stable chloramines (RNHCl) and bromamines (RNHBr). These chloramines and bromamines can undergo one electron reduction by metal ions to yield free radicals that may exacerbate biological damage. While it is known that chloramines/bromamines and superoxide are generated simultaneously during inflammation, the significance of their interactions *in vivo* cannot be assessed until the rate constants for these processes are known. This project aims to determine whether superoxide radicals react with chloramines and bromamines and to determine absolute rate constants for these reactions using the pulse radiolysis facilities at the University of Auckland in collaboration with Dr Bob Anderson.

Pulse radiolysis data acquired in this project suggest that RNHCl and RNHBr species are readily reduced by electrons and superoxide radicals to yield nitrogen-centred radicals and chloride/bromide ions, or alternatively (in the case of the bromo species) to bromine atoms and the amide/imide anion. These additional radicals may enhance biological damage at sites of inflammation.



Pathway from generation of myeloperoxidase to free radicals

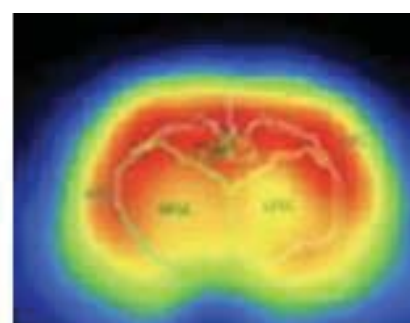
Improving the quantification of small animal brain PET

The collaboration between Dr Damian Myers and Professor Terence O'Brien of the Royal Melbourne Hospital and the University of Melbourne, Professor Rodney Hicks of the Peter MacCallum Cancer Institute, and Drs Marie-Claude Gregoire and Andrew Katsifis of the Radiopharmaceutical Research Institute, ANSTO, have developed a methodology to quantify GABA_A/central benzodiazepine receptor (GABA_A/cBZR) density and affinity in the living rat brain during epileptogenesis using Positron Emission Tomography (PET).

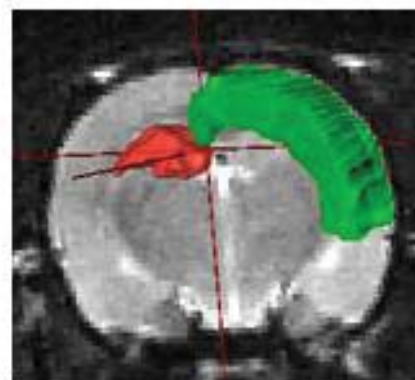
The prevalence of epilepsy is estimated at 5 to 10 persons per 1000. It can occur following an initial insult (head trauma, stroke, status epilepticus, or a genetic deficit) and, after a variable latent or silent period, continues on to the onset of spontaneous recurrent seizures. Epileptogenesis refers to the process of molecular and cellular changes that occur in the brain during the development of epilepsy, converting a previously normal brain into an epileptic one. These neurobiological processes which result in the development of epilepsy are not well understood and currently there is no available therapy to halt or retard the development or progression of the condition.

The development of effective treatments for epilepsy relies on understanding these epileptogenic processes, but they are very difficult to study in humans, so animal models play a significant role in the study of these processes by allowing the investigation of all stages of the disease - baseline, developing and chronic epileptic states. The GABA_A/cBZR, particularly in the hippocampus, has been shown to be part of the development of epilepsy and can be studied *in vivo* with PET and [¹⁸F]FMZ, a radiotracer specific to GABA_A/cBZR. Because anatomical changes occurring in parts of the brain during the epileptogenic process can influence the PET data, this research needed to take into account these morphological changes in the functional results assessed by the PET. Healthy and epileptic rats (with temporal lobe epilepsy) were imaged with PET and [¹⁸F]FMZ. T2 (transverse relaxation) magnetic resonance imaging (MRI) was also performed so that the brain structures could be outlined and used for correcting the PET signal.

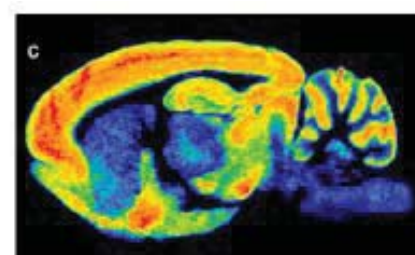
Initially a rat brain atlas containing 25 regions-of-interest was defined. Subsequently, variability within structures, like the hippocampus, were assessed for each rat, and finally, compensation was made for the low spatial resolution of the PET (~3mm for the Mosaic saPET) and the restored receptor density levels in the PET data were directly comparable with autoradiography results (spatial resolution ~0.5mm).



Coronal slice PET and segmented structures



3D view of hippocampal and cortical structures on MRI



Sagittal slice autoradiography

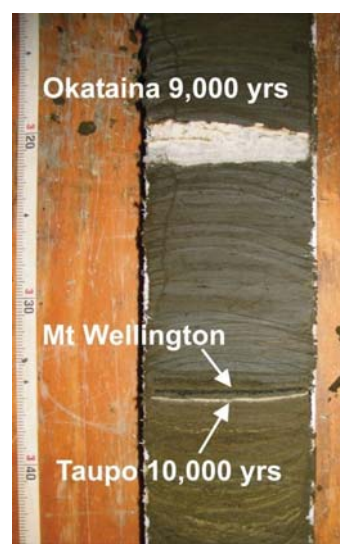
Research Highlights

Environmental Science

Basaltic eruptions

Terrestrial basaltic volcanic fields comprise tens to hundreds of short-lived volcanoes spread over wide areas. While eruption recurrence rates are between 1 eruption every 1000 to 10,000 years, the spread of human infrastructure into basaltic volcanic fields necessitates a better understanding of future hazards. For example, Mexico City, and Auckland, are large metropolitan areas built on basaltic volcanic fields which have been active during the last 10,000 years.

To gain a better understanding of the frequency of volcanism in the Auckland Volcanic Field, Dr Phil Shane and Dr Paul Augustinus of the University of Auckland have been studying cores of sediment drilled from ancient lakes within volcanic craters. The sediments represent an excellent archive of volcanic ash fall-out from both local basaltic volcanoes in Auckland and distant andesite and rhyolite volcanoes, some 220-270 km to the south. With the aid of radiocarbon ages, determined at ANSTO through collaboration with Dr Geraldine Jacobsen, and geochemical fingerprinting of volcanic ash to identify the source volcano, an inventory of over 100 volcanic eruptions has been documented. Twenty-four basalt eruptions from the Auckland Volcanic Field over the last 80,000 years represent an average frequency of one per 3,500 years. Recurrence times between eruptions varies from about 500 years to 20,000 years with no long term trend. However, a major 'flare-up' in explosive eruptions occurred about 32,000 years ago, demonstrating the difficulties of assessing the likelihood of future activity.

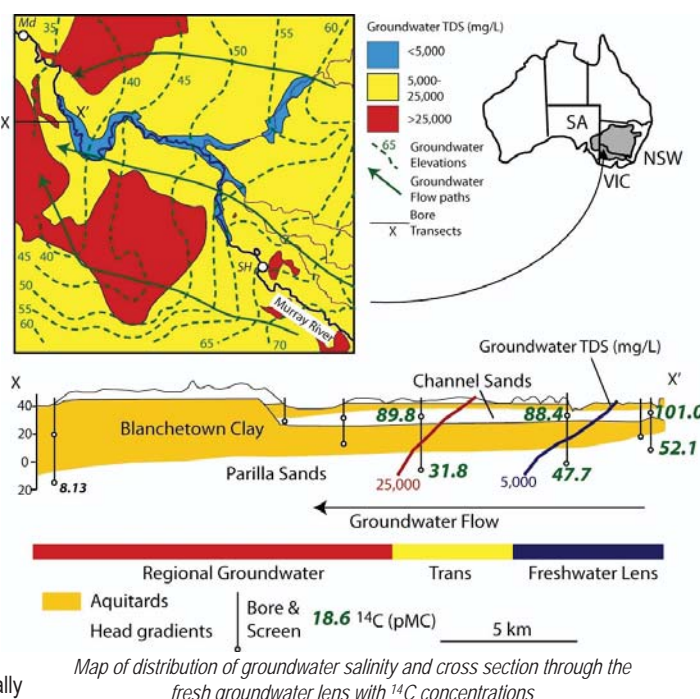


Three volcanic ash layers with a sediment core. The dated ash layers from Okataina and Taupo volcanoes provide a means to date a previously undated Auckland basalt ash layer from Mt Wellington volcano

Fresh groundwater under the Murray River

Groundwater in the Murray Basin of northern Australia is generally saline, with Total Dissolved Solids (TDS) up to 50,000 mg/L, except around the Murray River and its major tributaries where lenses of fresh groundwater (TDS <5,000 mg/L) up to 5 km wide and up to 80 m deep exist. Radiocarbon and tritium dating carried out at ANSTO together with physical hydrogeology and stable isotopes have allowed Professor Ian Cartwright and Honours students Phil Matheson and Nikki Eldridge from Monash University, together with ANSTO research scientists Drs Robert Chisari and Simon Varley, to understand the processes that form these lenses.

Radiocarbon ages in the fresh groundwater from under the river are modern, but as the distance from the river increases so does the age of the fresh water. At the edge of the lenses it is up to 10,000 years old, suggesting that the groundwater is recharged from the river and then flows laterally into the regional groundwater system. High tritium concentrations close to the river are consistent with this conclusion. The data show that fresh groundwater lenses are being formed today and result from leakage from the Murray River when river levels are high. When river levels drop, as has happened in the current drought, the lenses shrink, and, if river levels were to remain low, these precious fresh groundwater resources will eventually disappear.



Exceedingly slow nutrient accumulation in wilderness

The landscapes of the Tasmanian Wilderness World Heritage Area are characterised by a vegetation mosaic of treeless buttongrass moorlands, eucalypt forests and rainforests (see photo). There has been much debate about the dynamics of the abrupt boundaries between these vegetation types, which are thought to be controlled by complex interactions between fire, vegetation and soils. Have the moorland-rainforest boundaries shifted during the Holocene or have they been relatively stable?

Using a methodology developed in the grassland-forest ecosystems of northern Tasmania, Professor David Bowman and PhD candidate Sam Wood, both of the University of Tasmania, and in collaboration with Dr Quan Hua of the Institute for Environmental Research at ANSTO, used the ratio of stable carbon isotopes ^{13}C and ^{12}C in soil organic matter (called delta carbon-13 or $\delta^{13}\text{C}$) and radiocarbon dating of soil profiles across two rainforest-forest-moorland boundaries, to see if Holocene boundary shifts could be detected. Their study revealed that this method has little utility in this particular landscape because the $\delta^{13}\text{C}$ signatures between the vegetation communities are not significantly different. However, radiocarbon dating of the organic soil profiles, coupled with nutrient budgets has provided evidence of differential nutrient and carbon accumulation rates under the three vegetation communities. Preliminary results indicate that accumulation of nitrogen, phosphorus and carbon in highly organic moorland soils may be exceedingly slow compared to the high turnover soil systems of the rainforest. This underlying edaphic control has profound implications for the idea of rapid succession between vegetation types as proposed for the region.



Abrupt boundaries in the vegetation mosaic, South West Tasmania Tasmania

Carbon-14 bomb pulse in young speleothems – a chronological tool

Speleothems (cave deposits such as stalagmites, stalactites and flowstone) are used to interpret past climates by analysing the geochemical signals recorded along their growth axes. Drs Janece McDonald, Russell Drysdale and others of the University of Newcastle, together with other collaborators from the University of Melbourne are investigating a drought history for the Sydney Basin over the last 1,000 years using trace element and stable isotope variability in stalagmites as palaeohydrological proxies. The stalagmites were collected from Wombeyan Caves, about 200 km south west of Sydney, and within the Sydney water catchment area. Determining the frequency of wet/dry cycles beyond the instrumental record is becoming increasingly significant for hydrological modelling and water management into the future. A robust chronology is vital so that wet/dry cycles can be placed into a definite time-scale.

Collaboration with Drs Quan Hua and David Fink, both of the Institute for Environmental Research at ANSTO, and using high-precision accelerator mass spectrometry ^{14}C analysis on small sub-samples provides detailed bomb-pulse profiles on these stalagmites. The resulting data enables assignment of chronologies since about 1950, inverse modelling of the ^{14}C uptake by the stalagmite and an estimation of growth rates during modern times. Chronologies have been assigned to two stalagmites growing for the past 100 years and have allowed the linking of wet periods, for example during high inflow to Warragamba Dam, to variability in hydrological proxies such as magnesium, phosphorus, yttrium and oxygen isotopes. The ability to assign calendar years and the comparison of the geochemistry to the instrumental record has validated the use of these geochemical species as robust palaeohydrological proxies at this site. Work is now progressing on the interpretation of these proxies in fossil stalagmites to extend the hydrological record well beyond the instrumental archives.



Dr Janece McDonald is collecting drip waters for geochemical analyses from the Wollondilly Cave, Wombeyan Caves Karst Conservation Reserve

Research Highlights

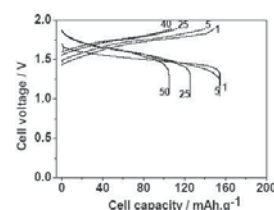
Materials – Properties and Engineering

Safer, lighter and cheaper batteries for electric vehicles

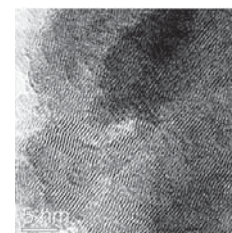
The availability of a light-weight, low-cost rechargeable battery is a critical bottleneck in the development of affordable electric vehicles (EV). Nickel-metal hydride technology is currently used in hybrid vehicles. However, for EV applications, cost and weight are serious limitations. Rechargeable lithium ion batteries using non-aqueous electrolytes power today's portable electronics. However, scaling up this technology for EV applications is challenging, due to the reactivity of the electrode materials with the non-aqueous electrolytes. Recently, Dr Manickam Minakshi of Murdoch University working with ANSTO scientists demonstrated that a rechargeable cell could be produced using aqueous electrolytes – which are inherently much safer. The prototype battery uses a MnO_2 cathode, a Zn anode and an aqueous LiOH electrolyte.

Drs David Mitchell, Melody Carter and Kathryn Prince from ANSTO, performed a range of analyses including electron microscopy, x-ray diffraction and secondary ion mass spectrometry measurements. These confirmed that the electrode reaction of MnO_2 in this electrolyte is lithium insertion (Li^+) rather than the usual protonation (H^+). Lithium is intercalated in the MnO_2 lattice forming Li_xMnO_2 during cell discharge. Lattice imaging and diffraction of the Li_xMnO_2 cathode showed a high degree of crystallinity. The lithium insertion/extraction into MnO_2 is found to be reversible (rechargeable) over many tens of cycles. With further optimisation, this technology could power electric vehicles of the future.

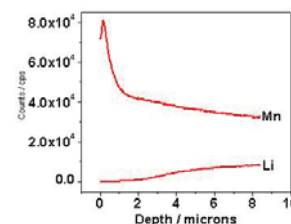
Multiple discharge-charge behaviour of MnO_2 cathode with Zn as an anode using lithium hydroxide as an electrolyte. Cycle numbers are indicated in the figure.



High resolution TEM of discharged MnO_2



Secondary Ion Mass Spectrometry (SIMS) depth profile results of discharged MnO_2

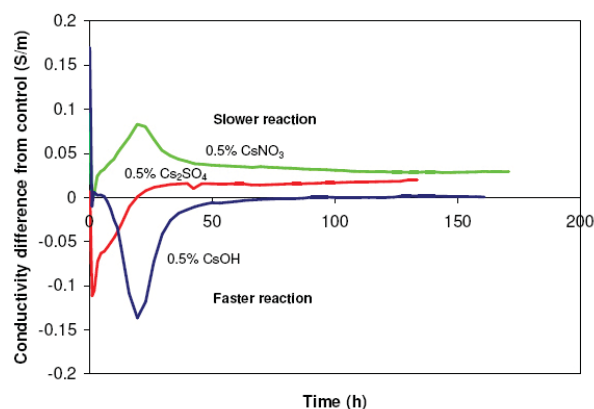


Immobilising nuclear waste in geopolymers

The use of geopolymeric materials in treatment of radioactive wastes has been receiving increasing attention recently, particularly with regard to caesium- and strontium-bearing waste streams. Caesium is particularly difficult to immobilise in Portland cement, which is one of the most widely used materials in this area.

Collaboration between Dr John Provis and Professor Jannie van Deventer of the University of Melbourne and colleagues Dr Phil Walls, Dr Dan Perera and Dr Lou Vance in ANSTO's Institute of Materials Engineering has led to the development of a new understanding of the roles played by immobilised salts in geopolymers. Impedance spectroscopy was used to monitor the progress of the geopolymer formation reaction in control samples, and in samples containing different concentrations of various caesium and strontium salts. These data showed that much of the effect on geopolymer structure that has been attributed to the immobilised waste species is in fact due to the counterion, not the caesium or strontium cations.

Changes in the final geopolymer pore structure with different salts were also observed, and could be correlated with previous observations relating to immobilisation efficiency. This research advances the development of geopolymers for the immobilisation of low- and intermediate-level nuclear wastes.



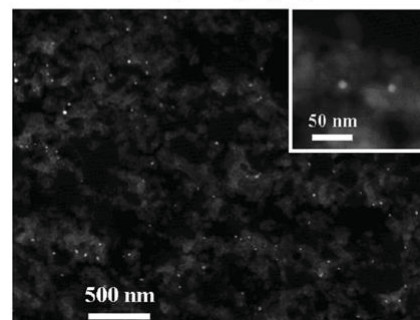
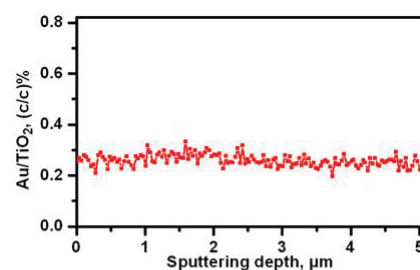
The progress of the geopolymer formation reaction in samples containing caesium and strontium salts

Precious metal nanoparticles for environmental remediation

The use of titanium dioxide (TiO_2) as a photocatalyst is a promising solution to addressing increasing environmental pollution, including purifying polluted air and the clean-up of contaminated water. However, TiO_2 has intrinsic limitations, chiefly the high recombination of around 90% of the photon excited electrons and holes, which is the primary source of the photocatalytic activity.

To improve the photocatalytic activity of TiO_2 , post-graduate student Xingdong Wang and her supervisor, Dr Rachel Caruso, of the University of Melbourne have established an advanced material using a preparation technique that deposits a noble metal (such as gold, silver, platinum or palladium) within the TiO_2 structure. This defers recombination of the electron and hole, improving the photodegradation efficiency. Further, the introduction of a controlled porous structure enhances accessibility to the degradation surface compared with bulk TiO_2 . The resultant materials have demonstrated enhanced photocatalytic activity, with photodegradation of up to 60% of the pollutant after 1 hour of UV-irradiation.

The major challenge is identifying the noble metal nanoparticles distributed in the material as a function of material depth and metal content in the final TiO_2 structure, as they are crucial parameters that influence photocatalytic performance. Through collaboration with ANSTO researchers, Dr Kathryn Prince and Armand Atanacio, dynamic Secondary Ion Mass Spectrometry (SIMS) has allowed the noble metal content to be determined at the parts per million level, at varying depths of the porous materials. In addition, Dr David Mitchell assisted with a novel plasmon analysis technique which examined the location of the metal particles in the porous matrix. Using these two techniques, the materials properties could be correlated to the photocatalytic activity allowing for further advances in the functional materials being synthesised.



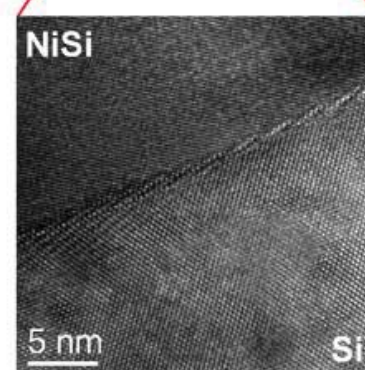
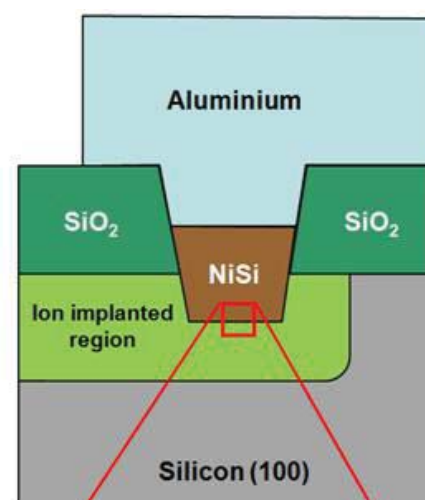
Representative SIMS plot of the Au content vs depth (top), and the TEM images (bottom) showed the Au nanoparticles (bright spots) homogeneously distributed in the Au/TiO₂ composite

Communication with nanostructures

Advances in nanotechnology have created the need for an efficient means of communication of electrical signals to nanostructures, which can be addressed using low-resistance contacts. In order to study and estimate the resistance of such contacts or the resistance posed by the interface(s) in such contacts, accurate test structures and evaluation techniques need to be used. To cater to silicon-based nanotechnology devices and to adhere to the requirements of CMOS technology, the use of silicides, as thin films about 100-250 nm thick, in such contacts was investigated.

This research was conceived by Dr Anthony Holland and Associate Professor Geoffrey Reeves of the Microelectronics and Materials Technology Centre of RMIT University. The synthesis of materials and fabrication of test structures and devices was carried out by RMIT University doctoral students, Ms Madhu Bhaskaran and Mr Sharath Sriram. AINSE support for this project, from 2006 through to 2008, enabled valuable collaboration with ANSTO researchers. The expertise of Dr Ken Short on synthesis of silicides and x-ray diffraction, Dr David Mitchell on transmission electron microscopy, Dr Peter Evans on ion beam analysis and implantation of silicon dopants, and Armand Atanacio with SIMS analysis to determine stoichiometric uniformity and dopant distribution, led to new ground-breaking results on silicide thin films, resulting in numerous journal articles.

The outcomes of this research include the synthesis of highly stoichiometric silicide thin films (of both titanium and nickel), with the desired abrupt silicide-silicon interfaces. Such synthesis enabled the use of micro-fabricated test structures, in combination with finite element modelling, to develop techniques for accurate estimation of the inherent properties of electrical contact interfaces. The combination of these outcomes resulted in the experimental demonstration of the lowest values of measured specific contact resistance values for metal-silicide and silicide-doped silicon ohmic contacts.



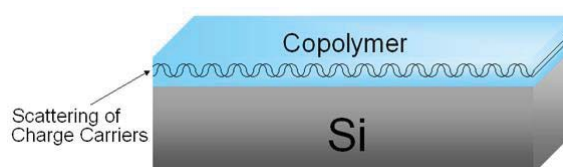
A schematic representation of the cross-section of a micro-fabricated test structure. A high resolution transmission electron micrograph (HRTEM) of the nickel silicide to silicon (NiSi-Si) interface is also shown.

Research Highlights

Materials – Structures and Dynamics

Quantum confinement effects tuning electrochemical devices

Serendipity at its finest! When the De Marco ion sensor research group at Curtin University of Technology started its ARC and AINSE supported electrochemical sensor research in 2006, it had little idea that it would stumble across an innovative and significant research finding that has the potential to revolutionise the way electrochemical sensors are utilised. Whilst preparing high integrity, ultrathin films for investigation using neutron and electrochemical techniques, De Marco and his team discovered that nanometre-thick films yielded an abrupt increase in sensor resistivity in the same way that quantum dots display an elevation in electrical resistivity below the quantum length for scattering of the charge carriers in the nano-sized conductor via quantum confinement. De Marco and his team corroborated this unique phenomenon with over a dozen film thicknesses in a complementary AINSE study in 2008 in collaboration with Dr Andrew Nelson of the ANSTO's Bragg Institute. Ultimately, the De Marco research group aims to utilize this new concept in a novel gas sensor technology platform whereby an ultrathin polymer film comprising molecular recognition sites, for example molecular templates or molecular receptors, will be used to create a truly selective gas sensor that will swell and change its electrical resistivity while interacting with the gas analyte in the region of quantum confinement.

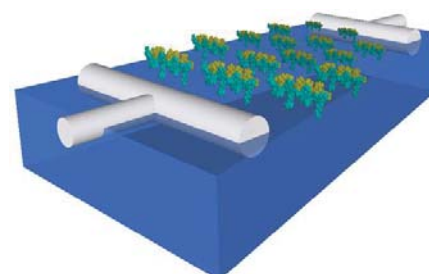


A cartoon depicting how quantum confinement leads to scattering of charge carriers in a molecularly thin copolymer sensing film giving rise to an increase in the bulk resistivity of the confined film

Triggered switching of peptide ensembles at soft interfaces

Soft interfaces occur where water, air or oil meet. Stabilising these interfaces with proteins or surfactants leads to products such as ice cream, pharmaceuticals, personal care foams and agrochemicals. On the other hand, destabilising these interfaces is necessary for processes involving foam control and oil-water separation. Recently a new technology based on peptide surfactants, which act like proteins as well as surfactants, has been developed at The University of Queensland by Professor Anton Middelberg, Dr Annette Dexter and AINSE Research Fellow Dr Lizhong He, and involving four Australian PhD students, Mirjana Dimitrijevic, Andrew Malcolm, Yong Ding and Sagheer Onaizi. The technology, called Pepfactants®, aids the formation of stable emulsions and foams, and their destabilisation with a pH trigger. Using neutron reflectometry coupled with advanced molecular deuteration, the researchers aimed to elucidate the structure and dynamics of these novel interfacial materials.

The team in collaboration with colleagues at Oxford University and the Rutherford Appleton Laboratories created partially-deuterated peptides and fully deuterated surfactants which were then analysed by neutron reflectometry. During three visits to ISIS, two peptide films were fully characterised and their response to common chemical surfactants was determined. One peptide creates monolayered films by folding into an α -helix, similar to logs floating on water, in both the stable and unstable states. Only the interconnection of the peptide units differed in stable and unstable states. In the stable state, reflectometry revealed that the peptides created a molecularly thin interfacial film that nevertheless had the mechanical modulus of collagen. The results, recently published in *Journal of the Royal Society, Interface and Langmuir*, point the way to better peptide surfactant designs, and raise important fundamental questions about electrostatic effects at interfaces and, in particular, the nature of cooperative interactions between peptides and chemical surfactants.

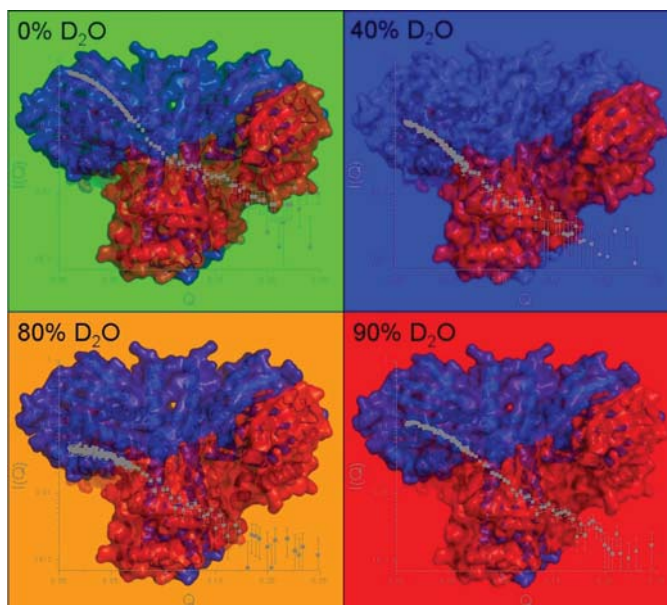


Surfactant-like peptides arrayed at an interface interconnect to create a molecularly thin (~15Å) film that has the mechanical properties of collagen

New strategies to combat antibiotic resistance

With the increasing prevalence of antibiotic resistance in bacteria, the need to explore new strategies to combat infection has never been greater. A potential new drug exists in the histidine kinases - a class of enzyme responsible for the regulation of many bacterial processes including replication, metabolism, virulence, and even antibiotic resistance. Since histidine kinases are not found in mammals, understanding their inhibition may lead to novel therapeutic antimicrobial compounds. To that end, AINSE postgraduate research scholar David Jacques, Professor Jill Trehwella, their team at the University of Sydney, and Drs William Hamilton, Tracey Hanley, and Anthony Duff of ANSTO's Bragg Institute, have been studying the histidine kinase KinA from *Bacillus subtilis* - a non-pathogenic soil-dwelling bacterium closely related to the infamous *Bacillus anthracis* responsible for anthrax. In *B. subtilis*, KinA is responsible for spore development. This process is stringently regulated, and the organism has developed two histidine kinase inhibitor proteins, Sda and Kipl, to ensure that spores are not produced under unfavourable conditions.

By labelling the inhibitor with deuterium, and forming the enzyme-inhibitor complex with unlabelled KinA, it has been possible to probe the mechanism of inhibition by small-angle neutron scattering with contrast variation (see figure). The results show that the organism has evolved inhibitors to target the so-called 'stalk' region of KinA resulting in an allosteric mechanism of inhibition. It is hoped that this result will facilitate the development of synthetic compounds to inhibit histidine kinases across many bacterial pathogens.



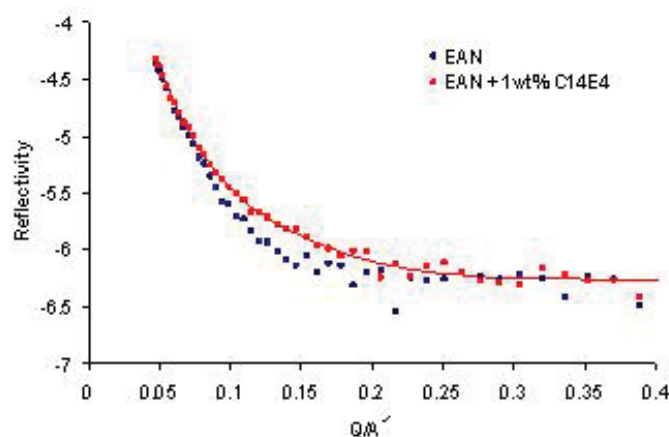
Small-angle neutron scattering on KinA₂-²D₂Kipl. As the D₂O content of the solvent is varied, the contribution of each component to the scattering data changes. At 40% D₂O KinA is effectively invisible, while at 90% D₂O Kipl disappears.

Unusual and tunable liquids

Ionic liquids (ILs) are attracting considerable research interest due to their unusual and tunable physical properties. The often negligible vapour pressure of ILs makes them viable replacements for organic solvents in gas-liquid adsorption, catalysis, and gas separation, while their wide electrochemical window and thermal stability make them suitable conductive media for solar cells and other electrochemical devices. Interfacial chemistry is critical in all these applications yet remains largely unexplored, particularly in terms of modifying interfacial properties via the adsorption of surface active molecules.

Initial experiments conducted by Dr Rob Atkin and PhD student Deborah Wakeham of the University of Newcastle, with the assistance of Dr Andrew Nelson of the Bragg Institute, ANSTO, used x-ray reflectometry to study the structure of the ethylammonium nitrate (EAN) liquid/air interface, and the structure of adsorbed non-ionic surfactant at this interface. Subsequent neutron reflectometry experiments on the same systems were completed at ISIS by Atkin, Wakeham and Professor Greg Warr of the University of Sydney, supported by Access to Major Research Facilities funding. Sum frequency spectroscopy experiments were then undertaken in collaboration with Professor Mark Rutland and PhD student Petru Niga at KTH, Stockholm, Sweden, who is supported by an ARC Linkage International Grant (LX0776612).

Preliminary data analysis has revealed that, for the pure IL, EAN molecules are ordered at the air interface with the ethyl moiety orientated towards the air to minimise surface energy. When surfactant is added, it adsorbs at the surface and displaces the EA⁺. Increasing the surfactant tailgroup length from C₁₂ to C₁₆ for 1.0wt% does not affect the thickness of the tailgroup layer, suggesting that the tilt angle of the alkyl chain relative to the surface must vary, and calculation reveals that the tailgroup layer becomes more densely packed as the chain length increases.



The change in neutron reflectivity profiles after the addition of tetraethylene glycol tetradecyl ether (C₁₄E₄) surfactant to EAN. The alkyl chain layer is between 12.1 – 12.5 Å thick with air penetration of 20 – 30 vol%. The headgroup layer has a thickness of 6.8 – 7.0 Å which is 25 vol% EAN.

AINSE Winter School 2008

Saturday 5 July – Wednesday 9 July 2008

The School continues to be a most valuable AINSE activity for the promotion of research opportunities at ANSTO to prospective research students. One student is selected by the AINSE councillor at each of the 39 member universities.

Despite the dominance of students with chemistry majors there was a variety of disciplines represented, see the table on page 17.

The experiments and lectures, which cover a wide range of disciplines and scientific techniques, are designed to broaden the scientific outlook of the students. Team work and socialising are other important aspects of the Winter School experience for students.

The AINSE postgraduate scholars, Benjamin Kent (RMIT), Iona Flett (ANU), Ashley Natt (ADE), Joel Pedro (TAS), and Amy Ziebell (WOL), made a very important contribution to the Winter School as demonstrators for the experiments, mentors and role models, and through the presentations on their research. They are warmly welcomed by the students and the Winter School and AINSE are very grateful for their commitment to the School.

Special Speakers

Dr Michael Colella of the Institute for Materials Engineering, ANSTO, spoke on forensic exploitation of radiological/nuclear incidents.

Dr Joel Gilmore, of the University of Queensland, once again gave his entertaining and informative presentation entitled How a Nuclear Reactor Works. Both presentations were received with enthusiasm.



Winter School 2008, the entire group

The number of students studying chemistry was far greater than in previous years. The gender ratio was 14 females to 25 males. This year the following students attended the Winter School.

Students

Name	Uni	Name	Uni
Nicholas Ballam	UNE	Daniel Langley	LAT
Sarah Ann Best	MEL	Andrew Larkin	MUR
William Brant	SYD	Nyathon Mai	BAL
Josh Brown	MAC	Stacey Murphy	VIC
Andrew Burgess	ANU	Jayden Nicholl	DEA
Thomas Carruthers	GRI	Aaron William O'Meara	UWS
Alicia Cavan	CAN	Laura Rayner	ACU
Daniel Clarke	ECU	Alisha Rohrlach	FLI
Mathew Creese	TAS	Benn Scrivenor	SWI
Karl Davy	QLD	Jenny Spence	USQ
Daniel Farrugia	WOL	Henry Pratt	QUT
Alexander William Franklin-Smith	AKL	Dimitra Thomas	USA
Ashley Freeman	CSU	Simon Turner	SCU
Bakul Gupta	NSW	Anna Voss	CQU
Robert Hayes	NCT	Danica Maree Vress	CBR
Luke Heames	CDU	Daniel Weber	JAM
Alexander Holman	CUR	Claire Weekley	ADE
Raphael Horvath	OTA	Wenjie Kester Wong	RMI
Alexandra Howie	UWA	Shaun Yeoh	UTS
Mark Hughes	MON		



Dr Danielle Meyrick, Convenor of the Winter School 2008

Discipline	No
Chemistry	16
Physics	9
Nanotechnology	3
Forensic Science	2
Environmental Science	2
Engineering	2
Biotechnology	2
Biomedical Sciences	2
Biological Sciences	2
Biochemistry	2
Mechanical Engineering	1
Mathematics	1
Geology	1
Chemical Engineering	1
Biochemistry,	1
Applied Mathematics	1
Sum	48

The total number of students shown in the sum of disciplines exceeds 39 because 9 students were doing a double discipline major and each of these has been tallied.



Daniel Weber and Mark Hughes - one of them has the solution

Thanks

The Convenor of the 2008 Winter School, Dr Danielle Meyrick and the Executive Secretary of AINSE record their gratitude and that of the students to the Board, the Executive Director and the staff of ANSTO for their generous contribution to the School. They thank the many ANSTO staff who gave so generously of their time and talents in making the School a success.

It is appropriate to record a special thank you to Dr Margaret Elcombe who retired from ANSTO's Bragg Institute in late 2008 and has, therefore run her last experiment for the Winter School. Margaret has organised an experiment every year since the very first Winter School and her dynamism and talent has been an inspiration for many of the students.

2008 Conferences & Workshops

AINSE conferences play a major part in the information exchange process for scientific and technological information, providing a forum for debate and an opportunity for young researchers to present their work. Participants from member organisations are assisted with travel and accommodation support and receive a discount on registration fees.

AINSE supported participants from member universities presenting at the Plasma Science and NUPP Conferences held in conjunction with the AIP National Congress in Adelaide 30 November to 5 December.

AANSS 2008: 7th AINSE/ANBUG Neutron Science Symposium

8 – 10 December 2008, AINSE, Lucas Heights

The goals of AANSS 2008 were:

- to highlight the capabilities of the new OPAL neutron beam facility at Lucas Heights, both at the date of the Symposium and in the near future;
- to present some of the best recent results in Australian and international neutron scattering science;
- to promote graduate student research activities;
- to engage local researchers, especially students, in the possibilities and practice of neutron scattering methods;
- to highlight the complementarity of neutron and x-ray scattering, particularly synchrotron x-ray scattering.

Of the 70 participants 35 were from ANSTO, 33 were from member universities, and two were from other organisations. There were 13 students. The oral program included 35 presentations and these were supplemented by 19 posters.

AINSE is grateful for the financial support from ARNAM and MMSN.

ANSTO - AINSE Neutron School

21 – 26 July, AINSE/ANSTO, Lucas Heights

This School was attended by 21 PhD students and post doctoral researchers from member universities, three from CSIRO, one from Argentina, and five from Taiwan. The participants were among the first external scientists using the OPAL neutron-beam instrumentation.

AINSE provided travel and accommodation support for 21 of the delegates who came from member universities.

4th Australian Aerosol Workshop

16 – 18 July AINSE, Lucas Heights

The topics covered by the workshop included: industrial aerosols, bushfire aerosols, source characterisation, biogenic aerosols, remote sensing and instrumentation and many more. The program included presentations by students, academics and industry professionals from ANSTO and CSIRO.

The workshop had 42 participants: 22 from AINSE member universities; seven from ANSTO and 13 from other organisations. There were 19 oral and three poster presentations.

4th AINSE Quaternary Dating Workshop

26 – 27 March, AINSE, Lucas Heights

This series of workshops is designed to showcase dating methods and new developments in instrumental techniques. The target audience is research students and young career researchers.

The workshop was attended by 84 delegates: 67 from AINSE member universities, 13 from ANSTO and four from other organisations. There were 12 oral presentations and 36 posters. Laboratory tours were organised at ANSTO and University of Wollongong facilities.

Australian Rainfall Records, beyond the instrumental record

23 January, AINSE, Lucas Heights

This workshop was a showcase of the current stage of research and the future potential of speleothem-rainfall records for water resources, government, cave management and conservation bodies.

The workshop was attended by 69 delegates from AINSE member universities, ANSTO and non AINSE members.

International Conference Travel Scholarships

These scholarships are available to students and post doctoral fellows from AINSE member universities who wish to present their AINSE supported research at an international meeting. Three international travel scholarships were awarded during the year to the following students.

In addition four students and one lecturer were provided with travel support to attend the first AONSA Summer School on SANS and Reflectometry in Daejeon, Korea.

Finally, since the neutron scattering instruments at ANSTO were unavailable during most of 2008, consideration was given to ten people who gained beam time at major overseas facilities but had not been able to secure Access to Major Facilities funding.

Student	UNI	Conference	Amount
David Langley	SYD	NIST	\$6000
Moeava Tehei	WOL	NIST	\$1554
Duncan McGillivray	AKL	ISIS	\$10,000
Tilo Soehnel	AKL	ISIS & NIST	\$10,000
Jitendra Mata	ANU	ISIS	\$5000
Neeraj Sharma	SYD	ISIS	\$2016
Alan Burt	GRI	ISIS	\$4681
Matthew Crossley	GRI	ISIS	\$4681
Peter Yaron	ANU	ISIS	\$5000
Chris Ling, SYD	ILL	ISIS	\$5418
Neeraj Sharma	ILL	ISIS	\$5,317
Jean-Pierre Veder	CUR	AONSA Summer School in KOREA	\$1746
Rachael Barnett	JAM	AONSA Summer School in KOREA	\$1746
Ben Kent	RMI	AONSA Summer School in KOREA	\$1746
Yichao Wang	DEA	AONSA Summer School in KOREA	\$1746
Mirjana Dimitrijevic	QLD	AONSA Summer School in KOREA	\$2359
Greg Warr	SYD	AONSA Summer School in KOREA	\$1941
Mitra Safavi	WOL	2008 IEEE NSS MIC Conference GERMANY	\$900
Amy Ziebell	WOL	2008 EPSM Conference in NZ	\$900
Krystyna Saunders	TAS	Euroclimate Spring School	\$900

For more information about International Travel Scholarships see our web site www.ainse.edu.au.