Section 1

Contents

President's Report

The simple statement that the Australian Institute of Nuclear Science and Engineering (AINSE) made considerable progress during 2012 is testament to the impact AINSE has on the activities of its members. We judge progress by looking back at our achievements, and for the AINSE family these remain outstanding. However, a hallmark of all successful institutions is their ability to predict and adapt to changing circumstances and in 2012 AINSE has seen a number of significant changes. We should all look forward to these changes since they bring new opportunities that are designed to strengthen AINSE.

2012 saw the appointment of Dr Frank Bruhn as Managing Director following the retirement of Dr Dennis Mather as well as the appointment of two independent directors, and a restructuring of the research awards program. The diversity of AINSE is critical - AINSE's membership comprises 42 Australian and New Zealand universities plus four research establishments (ANSTO, CSIRO, GNS Science and the Australian Synchrotron). Each member has its own expectations from AINSE but we all share the common goal of enabling high quality research. During 2012 we were advised of over 200 peer reviewed publications which resulted from AINSE supported projects. This work was performed by the holders of more than 200 current research awards, students and research fellows in collaboration with a large number of ANSTO scientists.

Research needs people, and AINSE plays a major role in the training of the next generation of researchers in nuclear science and engineering. This is achieved through a succession of schemes - the Winter School for senior undergraduates, the honours scholarship scheme for final year undergraduates, the Postgraduate Research Awards (PGRA) program for postgraduate researchers followed by the AINSE Postgraduate Fellowships for high quality researchers undertaking postdoctoral research and culminating in the AINSE research Awards. AINSE also provides bursaries to assist students in presenting their work at international meetings and for members to access ISIS. In 2012 AINSE also supported students to attend the Asia-Oceania Neutron Scattering School that was held in Beijing.

The 2012 Winter School received excellent reviews from participants, thanks to the dedication of presenters and the excellent stewardship of Professor Tom Millar. We were fortunate to have the Chief Scientist for Australia Professor Ian Chubb and the 2012 Young Australian of the Year Marita Cheng address the School participants. It was pleasing to see graduates of previous winter schools returning to AINSE, as PGRA or Honours scholarship holders or as researchers. The contribution of students to much of the research supported by AINSE is critical and the PGRA students play a pivotal role. We awarded 10 Honours scholarships in 2012 and had 20 new PGRA scholars join the 71 continuing students. The AINSE office received 5 theses from PGRA students. The quality of the research sponsored by these programs is no more evident than in the work of Dr Kateryna Bazaka from James Cook University who was awarded the AINSE Gold Medal for excellence in postgraduate research in 2012.

In 2012 AINSE appointed its 12th Research Fellow Dr Neeraj Sharma (a former PGRA holder) who took up his fellowship at the University of New South Wales. The fellowship will allow Dr Sharma to continue his battery research that is reliant on the neutron scattering facilities at the OPAL reactor. Dr Sharma has been awarded the Royal Australian Chemistry Institute 2013 Nyholm Youth Lecturer.

Other fellows continue to excel with Dr Popelka-Filcoff (Flinders University) being named the South Australian Tall Poppy of the Year (2012), as the top early-career researcher in the state.

These activities cost money and all AINSE members have been operating under strained financial circumstances. The efficiency dividends imposed on ANSTO have forced that organisation to cap its membership fee and changes to ARC funding opportunities lead to AINSE running an unsustainable deficit in 2012. The Executive is working to eliminate the deficit and a consequence of this is a decision not to offer any more Research Fellowships. Likewise AINSE is no longer in a position to facilitate access to the UK neutron facility, ISIS.

At the other end of the spectrum it was my great pleasure to present Professor Len Lindoy with an AINSE Honorary Fellowship in 2012. Len has the distinction of having served as a councillor for two member institutions as well as being an excellent scientist and a great leader for AINSE.

There are many other people to also thank for their efforts on behalf of AINSE. I start with Jorden Lickiss, who has elected to return to full time study, for her service to AINSE and, obviously, Dennis Mather who has (finally) retired. I acknowledge the effort of the AINSE secretariat, Michelle Durant, Nerissa Phillips and Sandy O'Connor, who are the face of AINSE and each has done an excellent job in 2012.

I would like to recognise the efforts of the executive – Professor Bruce King, Professor Lee Astheimer, Professor John Dodson, Professor Lyndon Edwards, Dr Rob Robinson, Dr Peter Coldrey, Ms Roslyn Hatton and Dr Frank Bruhn; I at least owe a great debt to them!

I note the passing of Gerald Laurence who received his first AINSE Research Grant in 1961! AINSE was fortunate to be one of Gerald's passions and his contributions were enormous. Vale.

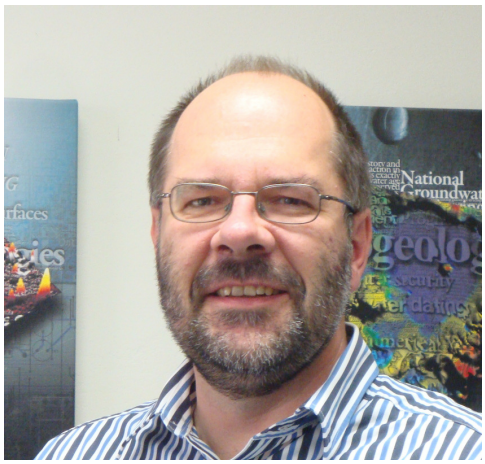
Finally I started by noting that progress can only be measured by looking back. But as scientists we know we can project where we will be in the future. In the short term the research AINSE supports will continue to flourish and new areas will develop as a consequence of the new accelerators and neutron beam instruments at ANSTO. These new facilities will drive increased demand for access and resources. AINSE exists for the members and I look forward to continuing to work with each of the councillors as we strive to satisfy these demands.

Brendan Kennedy

AINSE President

AINSE President Professor Brendan Kennedy presenting Dr Kateryna Bazaka with her Gold Medal after the presentations for the AINSE Council and Specialist Committees in May 2012.

Managing Director's Report



The year 2012 was a year of transition, with Dennis Mather at the helm until June and me taking over command of the ship in the second half of the year.

AINSE has continued to provide significant benefits to all its members, as outlined in the President's report. The impressive breadth of scientific research supported by AINSE is demonstrated in the Research Highlights on the following pages. One additional and important aspect of statistics is the fact that in 2012 AINSE students gained access to ANSTO and other AINSE supported facilities for more than 1245 days, to be trained in conducting their experiments and using these unique facilities as a platform for scientific collaboration. While the publications resulting from these collaborations are an important measure of performance we will need to expand our focus on other measures to demonstrate AINSE's relevance to the Australasian science community. Many activities conducted under the auspices of AINSE provide the basis for more substantial and often multilateral research programmes, such as ARC or Marsden grants. The impact of AINSE's activities in this context must be quantified and more explicitly demonstrated.

AINSE Funding Schemes

We have started to introduce some changes to our funding schemes. From now on, AINSE will call for research award proposals every six months instead of once a year. At the same time we will discontinue the concept of "provisional" research awards, so projects are either approved or declined. These changes will provide more certainty and financial transparency for all involved. Researchers will definitely know whether they are successful and if not have another chance to submit a revised proposal in the following round after only six months. For the AINSE secretariat, this will provide increased certainty and transparency on its financial position throughout the financial year.

AINSE Winter School

As in previous years, the AINSE Winter School continues to be one of the highlights in the AINSE calendar. It is the nursery of nuclear science and scientists in Australia and New Zealand. Its purpose is to enable undergraduate students to participate in experiments at Lucas Heights, utilising some of ANSTO's facilities, with the aim to encourage them to take an interest in nuclear science and engineering and to learn how to apply these in their future research. Equally important as the scientific programme is the social programme which includes speakers to encourage discussion not just on scientific issues but also on how science and technology might impact on current social issues and vice versa. In 2012, AINSE was proud to present two high-profile guest speakers, Professor Ian Chubb, Chief Scientist for Australia, and Marita Cheng, Young Australian of the Year.

AINSE Strategic Plan

At the time of publication of this report, the AINSE Board will have held a strategy meeting as part of a rigorous strategic planning process in 2013, during which we will review how AINSE has delivered on its goals over the past five years and, importantly, set the course for AINSE moving into the future by re-defining its vision and mission. This will determine

what difference AINSE will be able to make in a changing environment and how its activities will contribute to outcomes of importance to Australasia. In planning for AINSE's future, we are drawing on the expertise and experience of a wide range of AINSE stakeholders within universities, businesses and government. From 2013 onwards, we will give our Annual Reports a new format to closely align with the key elements of our Strategic Plan and report on progress on an annual basis.

Finances

In 2012, AINSE's operating revenue was $3,839,461, which included membership contributions of $3,208,075. Membership subscriptions are reviewed each year based on the benefits accrued for each member over the previous three years. AINSE's operating expenses in 2012 were $4,556,593, which left a deficit for the year of $717,132.

Although AINSE has continued to provide significant benefits to all its member organisations, it has made a significant financial loss in 2012. Clearly, such levels of deficit do not provide a sustainable future scenario for AINSE. The above changes to our research awards system will provide considerably more transparency and robustness to our financial reporting. In contrast to previous years, our budget for 2013 is very close to break-even, which will allow us to honour our commitments and use our reserves more strategically.

Personal and acknowledgements

Having been part of the AINSE family as Councillor for GNS Science since 2005, I am delighted to now be able to contribute to AINSE in a very different role. Facilitating stimulating and financially viable research collaborations has always been a focus of my activities in my previous position, and I am excited that I will be able to expand these interests within an organisation which has a strong tradition and exciting prospects for the future.

I am extremely grateful for the support I have received from the AINSE Board, AINSE staff, my previous employer GNS Science, as well as my predecessor Dr Dennis Mather. They have all shown considerable flexibility during the first half of 2012 when personal reasons forced me to delay my formal commencement as Managing Director.

Frank Bruhn

Managing Director

Four generations of leadership: All four AINSE Scientific Secretaries and Managing Directors meet on the occasion of Dr Dennis Mather's retirement function. From left: Roger Gammon 1988 -1998, Frank Bruhn (from 2012), Dennis Mather (1998-2012), Bill Palmer (1960-1988).

Research Highlights

Archaeology and Geosciences

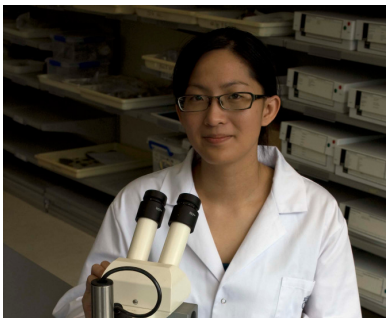
The signature of identity: Obsidian exchange in late Lapita society of the Western Pacific as an indicator for regional breakdown and the beginnings of local identity

Identifying and quantifying where the obsdian found in archaeological sites originated from is important in analysing ancient trade and exchange patterns and modelling the social and economic nature of prehistoric societies from the western Pacific. In this study, PIXE-PIGME was used to characterise and source obsidian found from sites on the island of Watom, East New Britain, Papua New Guinea, dated from 3,000 to 1600 years ago. This period of time is crucial in understanding changes to Lapita society and its subsequent transformation. To model chronological differences in source selection 89 flakes of obsidian were sourced from the sites of Kainapirina (SAC), Vunaburigai (SAB), Vunavaung (SDI) and Vunatambun (SDI) which were excavated by Dr Dimitri Anson on Watom in 2008-09. Any shift of the relative proportion of the major obsidian sources are taken as indicators of changing exchange relationship and changing "social distance" between Lapita communities.

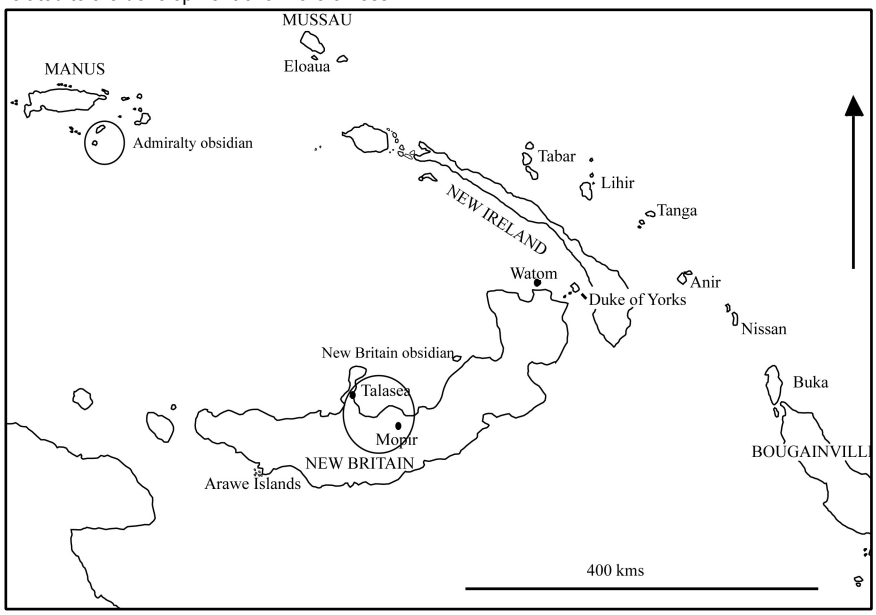
The overall results confirms the regional pattern of obsidian source selections where the West New Britain obsidian sources round Talasea were the predominant utilised sources at Watom throughout the sequence, with the relative proportion of them increasing over time. In comparison, obsidian from the Admiralty Islands composed only a small, although in some sites significant portion of the assemblage. Of importance is identification of obsidian at SDI layer 4 from the Mopir source which had been covered and made inaccessible by the devastating volcanic eruption of nearby Mt Witori dated to 3400 years ago. The re-emergence of Mopir obsidian informs us of opening of social ties with exchange partners to the west and its increase over time may be related to the development of a more or less down the line exchange pattern. To sum up, the intra-site study of the chronological differences in obsidian source selections at Watom are providing new insights to the understanding of local Lapita sequences and its successors.

Professor Summerhayes is an expert on the archaeology of New Guinea and has been working with AINSE in solving archaeological problems for the last 30 years. He is currently based in the Department of Anthropology & Archaeology at the University of Otago. Ms Elaine Chen is a student of Prof Summerhayes at Otago and has just submitted her MA dissertation on the obsidian from Watom. Dr Dimitri Anson, a Visiting Fellow at Otago, undertook excavations at Watom over a twenty five year period.

Professor Summerhayes working with the locals.



Ms Elaine Chen analysing results.



Map of the Research Area in Papua New Guinea.

Characterisation of Australian Aboriginal ochre

Dr Rachel Popelka-Filcoff (photograph courtesy of Ashton Claridge of Flinders University).

Ochre (an iron-oxide based natural mineral pigment) is a significant Australian Aboriginal cultural material in both the past and present. In some cases, people would travel great distances to obtain and exhange the material but many of these exchange routes are lost to time.

In order to reconstruct the routes, the "trace elemental fingerprint" of known ochre sources across the continent must be determined to establish the trace chemical variation within and between ochre sites. Neutron activation analysis using the k_0-method of standardization (k_0-NAA), as implemented by the Neutron Activation Group at the OPAL research reactor, provides reproducible and accurate data for 40+ elements over a wide concentration range for ochre samples. In addition, data from particle induced X-ray emission (PIXE) provides additional elements such as Pb. Through multivariate statistical analysis, ochre sources with distinct geological and geochemical histories can be identified uniquely by their trace elemental patterns.

The comprehensive elemental analysis of Australian ochre combined with statistical analysis characterises the trace geochemistry of Australian ochre and demonstrates the significance of NAA and PIXE for cultural heritage analysis. This database will allow future studies into the reconstruction of trade routes of archaeological samples for this culturally significant indigenous material.

This first comprehensive multi-elemental characterisation of Australian ochre is part of a larger collaborative project that includes Dr Rachel Popelka-Filcoff, Associate Professors Claire Lenehan and Jamie Quinton from Flinders University; Professor Allan Pring, Dr Philip Jones and Dr Keryn Walshe from the South Australian Museum; and Mr Andrew Durham from Artlab Australia. ANSTO collaborators are Dr John Bennett, Leader of the Neutron Activation Group in Nuclear Operations, and Mr Ed Stelcer, Accelerator Beamline Scientist at the Institute of Environmental Research. Dr Rachel Popelka-Filcoff is a current AINSE Research Fellow and was recently named the South Australian Tall Poppy of the Year (2012), as the top early-career researcher in the state.

Tundzha Regional Archaeological Project 2009-2011

The Tundzha Regional Archaeological Project was a three-year multidisciplinary landscape archaeology project (2009-2011), which aimed to document the diachronic development of archaeological cultures in their environmental context in the Tundzha River watershed in Central and South Eastern Bulgaria.

Over three years and five field seasons, we undertook large-scale pedestrian surface survey and satellite remote sensing, as well as test excavations at selected sites. We also conducted extensive paleoenvironmental and geological sampling.

The archaeological and paleoenvironmental data produced by the project address questions about the introduction of agriculture to Europe, which seems to avoid the most direct route from Anatolia. Investigations headed by Dr Connor have shown that during Neolithic periods the interior East Balkans suffered from persistent aridity, which presented a constraint on early farming in inland Thrace. The palaeoecological data also indicates a significant environmental transformation in the second millennium BC, possibly the result of changes from intensive to extensive agropastoral regimes. Surface survey has shed light on the origins and evolution of Thracian society during the first millennium BC, casting doubt on the widely-held view that complex, state-level societies emerged prior to the Roman conquest. Chronological investigations have also revealed discrepancies in dates between dates based on ceramic typologies and C14 sequences. Finally, our survey and environmental data provide a fuller picture of the settlement archaeology, contextualising the spectacular Thracian burial mounds found around major Odrysian centres such as Seuthopolis and Kabyle.

Shawn Ross busy digging in the field.

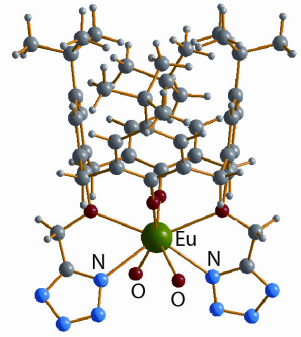
TRAP marks a major collaborative venture. Led by the University of New South Wales (Australia), partners included the University of the Algarve (Portugal), the University of Michigan (USA), the American Research Center in Sofia (Bulgaria), Sofia University St Kliment Ohridski (Bulgaria), the Yambol Historical Museum (Bulgaria), the Kazanluk Museum (Bulgaria), and the Archaeological Institute and Museum at the Bulgarian Academy of Sciences. About a hundred students and volunteers from a variety of disciplines took part in the field school that accompanied the project. The project was funded by: the Institute for the Study of Aegean Prehistory, the GeoEye Foundation; the America for Bulgaria Foundation, the Australian Institute of Nuclear Science and Engineering, and Australian Research Council Linkage Projects Funding Scheme LP0989901. The AINSE grant provided critical C14 dates for the Straldzha environmental samples underpinning our QSR paper.

Research Highlights

Biomedical Science and Biotechnology

Synthesis and complexation studies of Lutetium-177 and Gallium-68 calix[4]arene complexes and their application in therapeutic medicine and diagnostics

The radiolabeling of biomolecules with radiometals has tremendous utility in the diagnosis and treatment of many diseases including various forms of cancer. Biomolecules such as proteins, peptides and monoclonal antibodies often display high affinity for receptors that are overexpressed on tumor cell surfaces. By attaching a positron emitting radiometal - such as Gallium-68 - a physician can diagnose and develop a treatment plan for a cancer patient. Alternatively, by attaching a beta emitting radiometal such as Lutetium-177, the physician can selectively kill tumor cells in an effort to cure the patient. Given the significant potential of radiometals in medicine, the discovery of new ligands for complexing radiometals is extremely important. This is due to an ongoing need for improvements of in vivo stability, radiometal selectivity, conditions for radiolabeling and decreasing radiation doses to patients. We have designed and synthesised several different ligand systems based around the calix[4]arene scaffold. The ligands contain tetrazolyl moieties in their lower rim to allow formation of stable coordination complexes. The tetrazole functional groups were also chosen as they are bio-isosteres of carboxylic acids and have been reported to possess increased metabolic stability. Initial radiolabelling experiments proved successful but indicated that further modification of the ligand system would be required in order to achieve the very high in vivo stabilities required for an imaging or therapeutic agent. In addition to this work, we also investigated the fundamental chemistry and photophysics of the lanthanoid complexes. This allowed us to exploit the hypersensitive emission bands of lanthanoid ions, which gave vital information on the nature of the coordination sphere of the metal centre under simulated physiological conditions. This preliminary investigation is demonstrating how electronic spectroscopy is a valuable tool that can be used to advance the area of radiometals and help mitigate the risks associated with the manual handling of radioactive complexes.



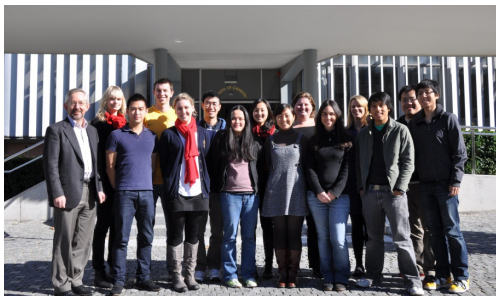
The investigation is led by Dr Max Massi and Professor Mark Odgen at Curtin University, with the experimental work carried out as part of Daniel D'Alessio's PhD studies at Curtin University. The team is undertaking the work in collaboration with Dr Ivan Greguric, Dr Ben Fraser, Dr Nigel Lengkeek and Ms Anwen Krause-Heuer at ANSTO LifeSciences.

Modifying physical and chemical properties of platinum anti-cancer complexes to enhance tumour penetration

STIM and PIXE mapping were investigated as techniques for the characterisation of multi-cellular spheroids, which are 3D *in vitro* tumour models, and the determination of platinum bio-distribution within spheroids treated with anti-cancer platinum complexes. The use of STIM mapping revealed that the density of spheroids was the highest in the outer cell layers of the spheroids and lowest in the deeper central regions, analogous to the presence of necrotic regions distal to nutrient sources in *in vivo* tumours. The use of PIXE elemental mapping revealed that a large proportion of the lighter elements including Cl, S, P and K, were present within the central regions of the spheroids, consistent with the necrotic region serving as a reservoir for a range of chemicals, including thiol-containing waste products. Maps of platinum-treated spheroids revealed that highest levels of platinum were present within the necrotic region of the spheroids, suggesting that platinum agents can penetrate reasonably well into spheroids.

The results from these studies helped to establish spheroids as suitable *in vitro* tumour models that have important tumour micro-environments, an important finding for future drug response studies. Additionally, the use of PIXE in these studies gave insights into the bio-distribution of the platinum agents within the tumour models, aiding drug design.

This work was carried out by Jenny Zhang as part of her PhD research under the supervision of Professor Trevor Hambley, and can be found in the publication: Zhang *et al.,* The use of spectroscopic imaging and mapping techniques in the characterisation and study of DLD-1 cell spheroid tumour models, Integrated Biology 2012;4(9): 1072-80. Professor Hambley's research group (right) focuses on the design of more effective anti-cancer treatment by the exploitation of unique tumour microenvironments, and frequently makes use of the spheroid tumour model.

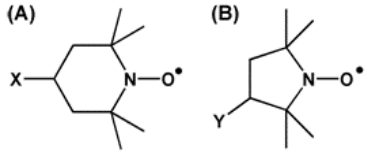


Professor Hambley's team in front of the School of Chemistry.

Repairing damaged proteins with radical antioxidants

Radical-mediated protein damage occurs during radiation-exposure, aging and some human diseases (e.g. cataracts, heart disease). The resulting protein radicals can propagate damage to a range of cellular components, and such uncontrolled radical reactions are detrimental to biological systems. Dr David Pattison and Professor Michael Davies (both University of Sydney) have undertaken collaborative research with Associate. Professor Bob Anderson (University of Auckland) to investigate whether these protein radicals can be effectively repaired by stable nitroxide radicals (RR'NO•; see Scheme) to prevent further biological damage from occurring.

They have shown using pulse radiolysis instrumentation (University of Auckland) that a range of peptide- and protein-derived tyrosine and tryptophan radicals react rapidly with TEMPO, with rate constants almost as high as those for endogenous antioxidants such as ascorbate and urate.

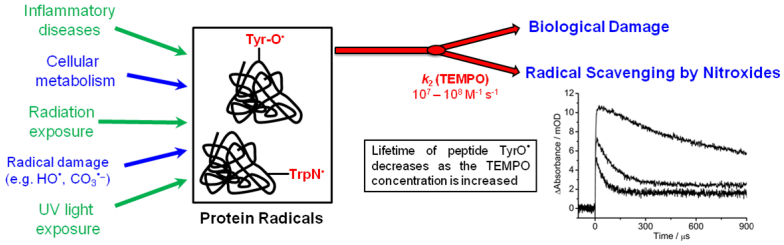


Scheme: Structures of the nitroxides used: **(A)** TEMPO (X = H) and other TEMPO derivatives with X = -OH, $-COO^-$, $-NH_3^+$, =O; **(B)** PROXYL species with Y = $-COO^-$, $-CONH_2$.

This work has recently been published: Free Radic. Biol. Med., 2012, 53, 1664-1674. Further studies assessed whether derivatisation of the TEMPO structure (see Scheme) affects their ability to scavenge protein radicals. For the majority of the nitroxide derivatives investigated there was little effect on the reactivity with protein radicals.

The accrued data demonstrate that stable nitroxide radicals are efficient antioxidants against protein radicals, a property that may contribute to their observed beneficial effects in animal and human supplementation studies. These include important clinical applications such as radioprotection agents and anticancer agents, as well as an ability to reduce hypertension and prevent obesity.

Furthermore, as added substituents have little kinetic impact on their radical-scavenging efficacy, targeting of these nitroxides to particular intracellular locations may be possible by judicious derivatisation of the nitroxides, thereby generating targeted protein antioxidants for further therapeutic interventions.



Disinfestation of Calypso mango using irradiation

Calypso mango is a relatively new Australian cultivar. It is high yielding with highly desirable organoleptic fruit attributes for consumers. However, fruit lenticel discolouration (LD) is a key quality issue for the mango industry, including with the Calypso cultivar. The incidence and severity of LD seemingly varies widely with the season, the production site, and fruit maturity. The pre-harvest causes of variability in susceptibility are not yet understood for this economically and aesthetically important physiological disorder. Fruit irradiation for fruit fly control is the preferred post-harvest method of mango disinfestation for several important export markets. Unfortunately, LD is markedly aggravated by irradiation. The resultant fruit skin damage restricts the commercial utility of this otherwise desirable disinfestation method.

To identify specific pre-harvest factors affecting fruit LD after irradiation, field trials were established in 2010 at five commercial farms in major mango production areas in the NT and QLD. Pre-harvest data are being recorded on weather conditions, tree flowering and flushing patterns, canopy area, and tree yield. Post-harvest data on the fruit maturity parameters of dry matter and flesh colour and on fruit quality during ripening following irradiation treatment (350 Gy) at the Lucas Heights ANSTO facility are also being collected. LD will be correlated to the pre- and postharvest data sets gathered across seaons. Anatomical differences between healthy and damaged lenticels are also being examined by light and electron microscopy.

Over the last two seasons and across all farms, LD was consistently more severe on the irradiated ripe Calypso mango fruit than on the non-irradiated control fruit. Large variation in LD was recorded across farms and among trees at each farm. Compared to the control fruit, the irradiated fruit took 2 to 4 days longer to reach the full yellow ripe stage, resulting in softer fruit at ripe. Data are being collated and comprehensive statistical analyses will be applied on the full final data sets to identify the key factors associated with LD following irradiation. The research will provide baseline information that enables the mango industry to more effectively address this critically important quality issue.

The LD project with ANSTO (Justin Davies; Connie Banos) involves researchers from Q-DAFF (Peter Hofman; Roberto Marques) as well as from UQ (PhD student Mr Minh Nguyen; Daryl Joyce).

Non-irradiated ripe Calypso mango.

Irradiated ripe Calypso mango.

Research Highlights

Environmental Science

Carbonate sediment age, distribution and reef island accretion indicated by age and taphonomic studies of benthic foraminifera

The main scientific objectives of this study were to 1) date individual reef sediment components from four cores from a reef island in the far northern Great Barrier Reef to reconstruct the evolution of island growth; and 2) Investigate the temporal links between reef sediment production and island deposition using a single-grain ^{14}C dating technique applied to large benthic foraminifera (LBF). LBF are the most dominant component of reef sediments across Raine Island and the adjacent reef flat, and an important sediment component of reefs and reef islands globally.

Large benthic foraminifera.

During 2010 and 2011 Mr John Dawson and Dr Quan Hua prepared, hydrolysed and graphitised a total of 69 samples including 9 extracted from a coral core (used to calibrate ages of the LBF that were younger than the onset of bomb radiocarbon (1950AD). All samples were dated using Accelerator Mass Spectrometry dating at ANSTO. The researchers have since produced the most recent calibration curve for the far northern GBR extending previous data by a further 15 years (1995-2010), which was not only critical for this project but extremely helpful to other researchers conducting radiocarbon dating in this region.

This project has revealed exciting results that are important to managing the sustainability of reef islands through some of the predicted negative impacts of climate change over the next century. The researchers found that most samples from the reef were remarkably young indicating rapid transport or breakdown and a strong temporal link between the production of LBF on the reef and their deposition on the island. Consequences are near-immediate island erosion to any diminished sediment supply, which is a strong possibility under current climate change predictions.

This project was a joint collaboration between James Cook University (JCU) and the radiocarbon dating laboratories at the Australian Nuclear Science and Technology Organisation (ANSTO). Principal investigator is Mr John Dawson (PhD candidate at JCU) with collaborators Dr Quan Hua (ANSTO) and Dr Scott Smithers (Associate Professor.Geography, JCU).

Lake response to natural and cultural impacts at the landscape scale in western Uganda

There is an increasing need to integrate a range of long-term records to provide a comprehensive environmental understanding of human-environment and spatial-temporal interactions within a landscape. This approach to understanding modern landscape change in a palaeolimnological framework is important when developing management strategies for ecosystems in regions most susceptible to future changes.

For this research, diatom records from two Ugandan crater lakes, (pristine Lake Kyogo and heavily impacted Lake Nyamogusingiri), spanning the last 50-150 years, were used to compare the palaeolimnological records of environmental change to establish the potential impact of humans on the record of climate history contained within the lake sediments. The research was undertaken by Dr Keely Mills (Centre for Environmental Management, University of Ballarat) and Dr David Ryves (Centre for Hydrological and Ecosystem Science, Loughborough University) in collaboration with ANSTO's Dr Atun Zawadzki and involved the analysis of changes in the diatom assemblages in two sediment cores and ^{210}Pb radiometric dating.

The results show that even near-pristine lakes in protected areas of western Uganda demonstrate a significant shift in water quality, as inferred from the diatom assemblages, over the last 25-50 years. This switch is coincident with an increase in the delivery of catchment-derived sediments. A similar response is seen across a number of other lakes in the area, and suggests that a regional driver is responsible for the observed recent changes, perhaps related to the onset of significant human activity, overprinted on known regional (wet vs dry) climatic fluctuations.

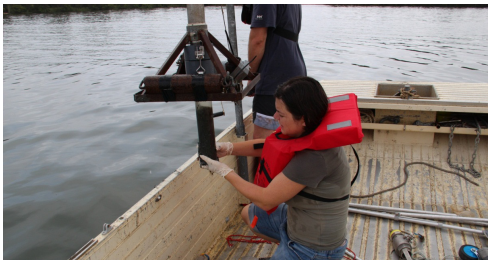
Lake in western Uganda.

Pb-210 radiometric dating in sediment of three marine lakes receiving metal inputs from coal-fired power stations in Australia

In New South Wales, estuarine lakes receiving inputs from coal fired power plants have been shown to contain elevated metal concentrations which may be degrading aquatic ecosystems. This is potentially a major problem considering coal-power stations currently supply 49% of Australia's electricity, with energy supply from coal fired power stations projected to increase to 57% by 2040.

This project aims to investigate the history of trace metal contamination in sediments of Lake Macquarie, Lake Budgewoi and Lake Illawarra in order to evaluate the metal contamination profile of estuarine lakes receiving inputs from coal-fired power stations.

The geochronology of sediment cores showed an increase of Se concentration in the 60s for Lake Macquarie and Lake Budgewoi, corresponding to the start of power stations activities. Selenium concentrations decreased from the 70s, corresponding to the improved ash handling procedures established by the power stations in these 2 lakes.



Collection of sediment core in Lake Macquarie.

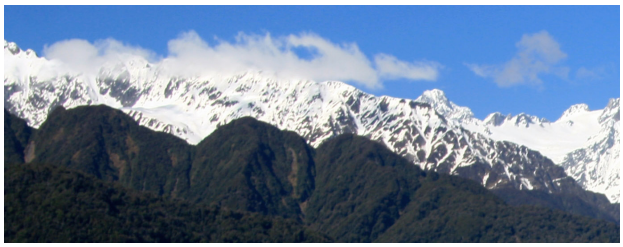
The plot of Se concentration against the age of the sediment in the core collected in Lake Illawarra shows an increase of Se concentration in the 60s which corresponds to the start of Tallawarra Power stations activity. The time of closing the power station also correlates with the time at which Se concentrations decreased in the lake.

These results show that mitigation measures taken by the power stations to improve ash handling procedures has been effective in reducing selenium inputs and should be considered at other power stations to minimize selenium contamination in Australian water systems.

This project is part of Larissa Schneider's PhD thesis in Environmental Chemistry at the University of Canberra. Larissa is being supervised by Professor Bill Maher from the University of Canberra and Jaimie Potts from the Department of Environment and Heritage NSW.

Lake sediments record cycles of sediment flux driven by large earthquakes on the Alpine fault, New Zealand

In mountain environments large earthquakes are important drivers of erosion because they trigger extensive landsliding. Such earthquake-induced landsliding represents a considerable hazard to society and infrastructure. Despite this hazard the magnitude and duration of enhanced landsliding triggered by large earthquakes remains poorly understood because the long recurrence times of these events frequently precludes direct observation of landscape responses. Our research developed a new approach for addressing this issue by using lake sediments to reconstruct the duration and magnitude of the landscape response to earthquakes on the Alpine fault, New Zealand.



Southern Alps from Lake Mapourika.

We investigated the sedimentary basins of two lakes, Paringa and Mapourika, which are situated adjacent to the central segment of the Alpine fault and have small catchments that drain the range front of the Southern Alps, making them ideally placed to record the impacts of past Alpine fault earthquakes. The sediments of the lakes contain a repeating sequence of deposits that record Alpine Fault earthquakes and the landscape response to them. Combining the sedimentary records with high precision chronology developed by radiocarbon dating numerous leaf macrofossils allowed the magnitude and duration of sediment flux driven by earthquake-induced landsliding to be quantified. The data show that an elevated sediment flux from catchments adjacent to the Alpine fault persists for approximately five decades following each of the last four great (Mw8) earthquakes. We conclude that Alpine fault earthquakes are one of the most important drivers of erosion in the Southern Alps and that the response to these events represents considerable delayed hazard that persists long after an earthquake.

The research was led by Dr Jamie Howarth, with support from Professor Sean Fitzsimons and Professor Richard Norris, at the University of Otago, and involved close collaboration with Dr Geraldine Jacobsen from ANSTO. Sediment coring and core characterisation were conducted by the University of Otago team, while the radiocarbon dating was conducted at ANSTO. The support we received from AINSE for the radiocarbon dating component of the research was essential in developing the high-precision chronology that underpins the success of the study.

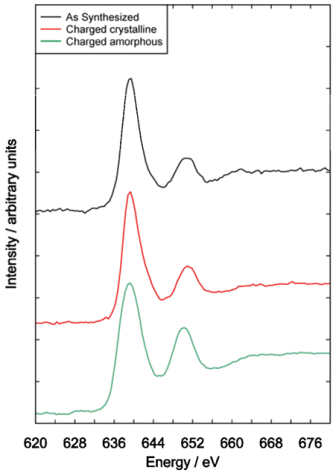
Dr Jamie Howarth with the corer used to sample lake sediment.

Research Highlights

Materials – Properties and Engineering

Li_2MnSiO_4 electrodes for Lithium ion Batteries

Today, lithium-ion batteries dominate the battery market for portable electronic devices. Current cathode materials do not, however, meet the cost, safety, energy density and cycle-life requirements for new large-scale applications like electric vehicle batteries and stationary storage batteries for solar and wind power. Lithium transition metal orthosilicates like Li_2MnSiO_4 are attractive alternative cathodes as they consist of non-toxic, abundant natural elements and offer high theoretical capacities of more than 300 mAhg-1. The use of Li_2MnSiO_4 is limited by its multiple structural forms, low electronic conductivity and its tendency for structural collapse when lithium is extracted electrochemically.

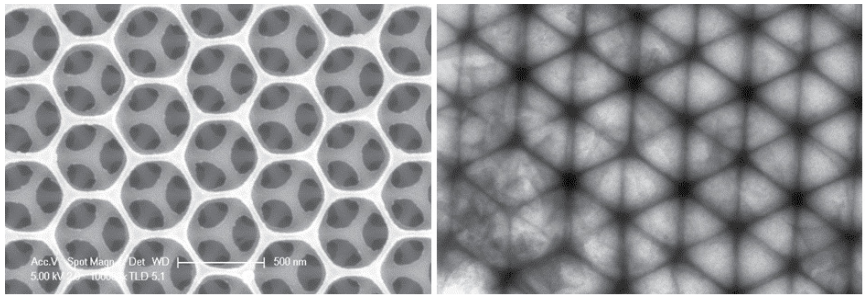


In this project Dr Rosalind Gummow and Professor Yinghe He and student Juliana Donovan from James Cook University, in collaboration with Dr Greg Lumpkin and Dr Mark Blackford from ANSTO prepared various single-phase Li_2MnSiO_4 and substituted materials. In collaboration with Dr Neeraj Sharma (AINSE postdoctoral Fellow at UNSW) and Dr Vanessa Peterson of ANSTO both neutron diffraction and synchrotron x-ray diffraction were used to characterize the structure of the materials in detail.

SAED results for the orthorhombic *Pmnb* form of Li_2MnSiO_4 showed that there is a non-uniform loss of crystallinity in particles of charged cathode material; some particles retained their crystallinity and others became almost completely amorphous. Mn L-edge EELS data further showed that the oxidation state of the Mn cations in the amorphous particles was significantly higher than that in the crystalline particles. This implies a non-uniform Li extraction in the electrode. Secondly, changes in the O K-edge EELS spectra showed that there were significant changes in the oxygen environment in the charged amorphous and crystalline particles compared to the starting material. This may be interpreted as meaning that there is some O compensation for lithium loss. This study is an important step towards understanding the loss of discharge capacity that is observed when these cathodes are cycled repeatedly in lithium cells and may lead to modified materials with improved cycling stability.

EELS spectra of the Mn $L_{2,3}$ edges of the (a) as-synthesized Pmnb form of Li_2MnSiO_4 material and (b) crystalline and (c) amorphous charged particles. The energy axis is shifted so that the Mn L_3 edges are aligned and the peaks are normalized to the maximum height of the L_3 peak and offset vertically for clarity.

High resolution TEM characterization of novel 3-dimensionally ordered macroporous (3DOM) carbon electrode materials



SEM (left) and TEM (right) images of a 3DOM carbon prepared at the University of Auckland.

Porous carbon materials find widespread use as adsorbents for organic compounds, as catalyst supports and as electrode materials. Recently, there has been interest in the development of porous carbons with well-defined microporosity (pore diameter < 2 nm), mesoporosity (pore diameter 2-50 nm) and macroporosity (pore diameter > 50 nm). The colloidal crystal template technique is a simple synthetic route for fabricating carbons with pore diameters over several different length scales. The Waterhouse group at the University of Auckland have successfully used the colloidal crystal template technique to prepare 3-dimensionally ordered macroporous (3DOM) carbons with inherent microporosity and tuneable macroporosity. On account of their 3DOM structure, these materials possess photonic band gaps at visible wavelengths and angle-dependent structure colour just like the gemstone opal. The high surface area (800-1100 $m^2\ g^{-1}$) and optical properties of the 3DOM carbons are currently being exploited in the development of thin film optical sensors, glucose monitoring devices and fuel cell systems. High-resolution TEM studies, supported by AINSE funding, were invaluable in establishing the best synthetic approach towards 3DOM carbons.

Multi-functional structured composite scintillation materials for neutron detection

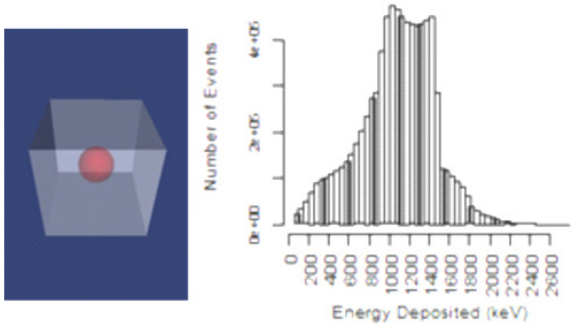
Thermal neutron detection is an important process in national security, science and industry. Currently, neutron detection is performed through the use of gaseous proportional counters utilising Helium-3 (^{3}He) as the neutron converter. ^{3}He has established itself in the industry as the 'gold standard', with high neutron detection efficiency and excellent gamma-ray discrimination properties. However ^{3}He is in short supply with increasing demand, creating a genuine need for replacement materials.

The aim of the project was to address this problem through the computational modelling of alternative composite neutron detection materials. Composite detectors consist of; 1) a neutron converting component to convert neutrons into charged particles, and 2) a detection medium of either semiconductor or scintillator material which can directly detect the energy depositions of the charged particles.

Utilising materials selection charts, different scintillation materials were mapped to maximise key properties crucial to the performance of a detector system. KI, NaI, CaF_2 and KYP_2O_7 were identified as the optimal materials for a converter-scintillator composite. Silicon was the obvious choice for a converter-semiconductor composite structure. ^{10}Boron was identified as the optimum neutron converting material. Different composite designs were considered, namely cylindrical, sandwich and spherical geometries for the neutron converter material within the detection medium. GEANT4 based Monte Carlo simulations were performed to assess the characteristics of each of these geometries. The analysis undertaken revealed that the spherical geometry of ^{10}B with a diameter of 4 µm, and spacing of 2-3 µm was optimal in achieving the best neutron detection efficiency with acceptable gamma-ray discrimination for most applications under consideration.

Making several assumptions of charge collection efficiency within silicon, the required thickness of a ^{10}B repeating sphere composite detector was calculated. It was found a 2 mm detector of this design could in theory detect up to 90% of incident neutrons. This investigation highlighted that a ^{10}B repeating sphere structure is a viable composite neutron detector for potential replacement of ^{3}He technology.

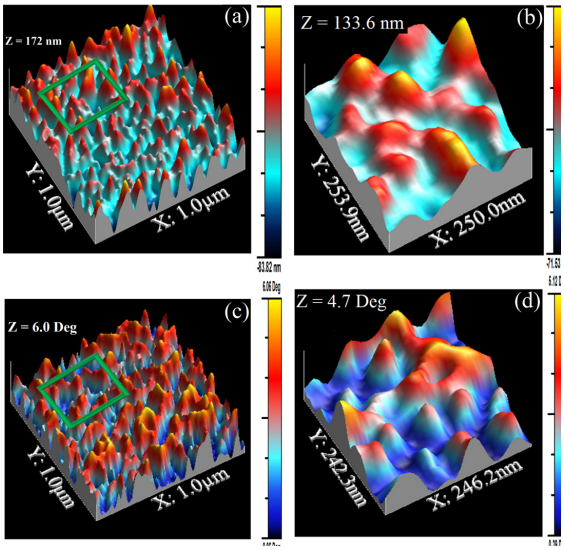
The project was developed as a collaboration between Dr John Daniels at UNSW and Dr Mark Reinhard of ANSTO. This work shown here was the final year project of UNSW Materials Science and Engineering Honours student Steven Pert who was assisted at ANSTO by Dr Dale Prokopovich. Since graduation Steven has taken a position with Rio Tinto based in Brisbane.



Simulated spherical model and associated detection energy spectra for 3 µm spheres.

Carbon nanostructured arrays with tunable charge transport

Arrayed electron sources, particularly the cold electron emitters utilizing field emission have shown great potential for a range of device applications such as flat display panels, lighting elements and field emission electron guns that produce coherent electron beams. Field emission with aligned carbon nanotubes has been demonstrated; alternatively stable robust carbon nanostructures embedded within polymer matrix could provide such behaviour. Electrically active carbon nanostructured arrays confined within aromatic polymer media were produced by high energy ion beam irradiation. Here, conductive nanotracks are separated by surrounding polymer which also undergoes structural modification exhibiting different dielectric behaviour able to influence electron transport along the tracks. Electron microscopy shows these tracks are graphitic 3-5 nm carbon clusters with basal planes preferentially orientated along the ion path.



The charge distribution and surface potential at ion entry points can provide further understanding of the dielectric nature of these heterostructures enabling control of charge transport in new device applications. Electrostatic force microscopy (EFM) is strongly influenced by the surface conductivity of nanostructured arrays providing improved definition of electrical structures compared to conventional topographic AFM. EFM scan discriminated the polymer surface features providing more realistic images of the carbon nanotracks.

Electrical conductivity along the track is also governed by the electronic structure of the carbon clusters which can be altered by doping. Doped carbon nanostructures are of current interest for their unique electronic properties (magneto- transport, enhanced field emission and energy storage). While theoretical studies report on the doped carbon nanostructures, formation of well defined doped nanostructures is still a challenge. A novel method is being developed where the doping strategy is separated from nanostructure formation to allow design and synthesis of doped carbon clusters formed during irradiation. This work is being carried out by Professor. David Mainwaring and Dr Pandiyan Murugaraj (RMIT) with Dr Rainer Siegele (ANSTO).

3-D image of irradiated PI film surface (fluence $6x10^{10}$ ions/ cm^2): (a) and (b) height scan from tapping mode; (c) and (d) phase shift scan in EFM mode.

Research Highlights

Materials – Structures and Dynamics

Investigation of antimicrobial protein-membrane interactions

The antimicrobial protein (AMP) amoebapore-A is a broad-spectrum bacteriacide produced from *Entamoeba histolytic* and is hypothesised to be a pore-forming protein. The membrane binding activity of APA-1 is postulated to be regulated by a pH-dependent dimerisation event which aggregates into pore structures within the membrane bilayer (Figure 1 and Figure 2A). However, detailed mechanism of this process remains unclear. Characterisation of the amoebapore-A-membrane interactions will aid in our efforts to enable development of new classes of therapeutic anti-infective agents based on AMPs as natural sources.

Quartz crystal microbalance with energy dissipation and neutron reflectometry were used to characterise the interactions of amoebapore-A with model bilayers. Nine different membrane models mimicking eukaryotic and prokaryotic bilayers on surfaces were chosen. Changes in the lipid bilayer architecture upon addition of amoebapore-A were analysed. The results showed that amoebapore-A bound favorably to membranes containing negatively charged phosphatidylglycerol, supporting the hypothesis that positive electrostatic regions on amoebapore-A are essential for the initial recognition of a negatively charged membrane. Moreover, amoebapore-A bound more effectively to loosely deposited phospholipids and bilayers with defects, and the membrane interaction was found to be reversible. Amoebapore-A was capable of removing thick lipid deposits that had not formed stable bilayers, suggesting that amoebapore-A can facilitate the shedding of lipid material (Figure 2B).

This research has been undertaken by doctoral student Gloria Xun with her supervisors Dr Andrew Dingley and Dr Duncan McGillivray from the University of Auckland, New Zealand, and Professor Michael James and Dr Anton LeBrun from ANSTO, Australia.

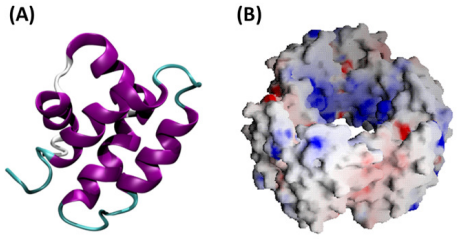


Figure 1: (A) The solution structure of monomeric amoebapore-A solved by NMR spectroscopy at pH 3.0. (B) Surface electrostatic potential of the hypothesised pore structure. Positively charged surface regions are in blue and negatively charged surface regions are coloured red.

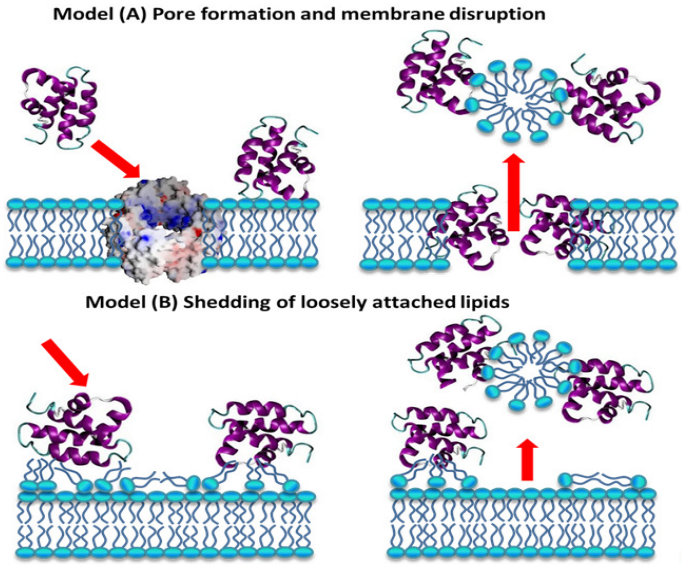


Figure 2: Model (A): it is postulated that amoebapore-A dimerise, binds to membrane, and forms pores structure in the membrane. Changing pH or protein concentration can lead to pore disruption and dissociation of amoebapore-A from the membrane; Model (B): it is postulated that amoebapore-A binds efficiently to loosely packed phospholipids and facilitates shedding of lipid material.

Use of nanotechnology in the design and manufacture of nanoscale materials

Dr Kateryna Bazaka in the laboratory.

The use of nanotechnology in the design and manufacture of nanoscale materials is rapidly increasing, with applications that span from electronics across renewable energy areas, and biomedical devices. Novel polymers are attracting significant attention for they promise to provide a low−cost high−performance alternative to existing materials and enable the development of new technologies. Under supervision of Associate Professor Mohan Jacob, James Cook University PhD student Kateryna Bazaka developed a range of new low-cost environmentally-friendly polymer materials for applications in areas of organic (flexible) electronics, optics, and biomaterials. The environmentally-conscious focus of this project is reflected in the choice of the monomer and fabrication technique: terpinen-4-ol is a major constituent of Australian grown *Melaleuca alternifolia* (tea tree) oil and plasma polymerisation requires minimal use of harmful chemicals and produces no hazardous by-products.

In collaboration with ANSTO's Dr Michael James and Dr Suzanne Smith, the chemical and structural properties of the newly developed materials as a function of fabrication conditions were investigated. Polymers deposited under low power conditions allow for retention if desirable functionality of the essential oil within the solid thin film. In collaboration with Professor Ivanova from Swinburne University, the polymers were demonstrated to retard bacterial colonisation. As such, the polymer has great potential for low-cost encapsulation of existing medical implantable devices to minimise implant-associated infections and enhance tissue integration. Under high power conditions, deposited polymers exhibited promising optoelectronic properties. In collaboration with Professor Iwamoto from Tokyo Tech, a highly desirable hole transport electron blocking electrical property of polymer films was demonstrated, a characteristic that can be effectively utilised in many emerging organic electronic devices. Only very few materials show this property, and therefore there is a strong potential to further expand this research towards enhancement of the efficiency of organic electronic devices and development of biocompatible electronic devices.

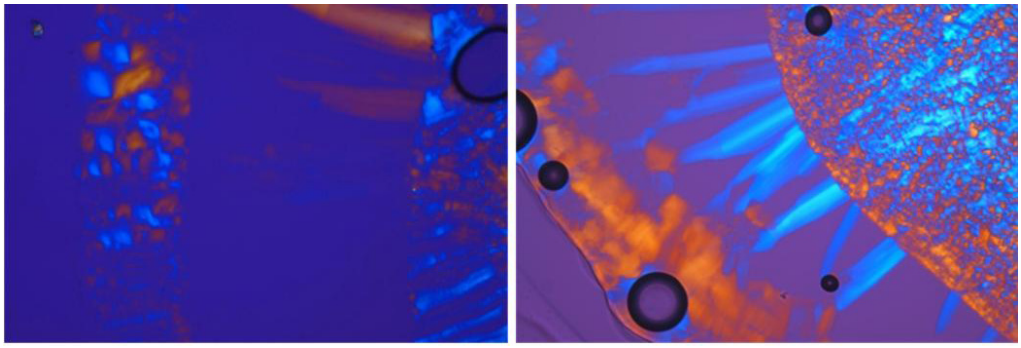
Self-assembly of cationic surfactants with hydrolyzable counterions

In order to understand how micelles and lyotropic liquid crystals might be used to create novel nanoporous forms of biominerals, we have investigated how carbonate, phosphate and oxalate anions influence the self-assembly of cationic surfactants. These are more strongly hydrated than typical halides, and their hydrolysis state depends on pH. SANS reveals that all such alkyltrimethylammonium surfactants form small micelles that remain spherical even in the presence of added electrolyte.[1] At higher concentrations, synchrotron SAXS reveals the formation of the rare 3D hexagonally closest-packed spheres phase ($P6_3/mmc$) at compositions adjacent to the *Pm3n* cubic phase.

Prolate micelles were found in analogous double-chained didodecyldimethylammonium carbonate and phosphate. Their dimensions depend on surfactant concentration, and on counterion type and hydrolysis state; that is, micelles whose dimensions respond to pH changes through their counterion. Polarising optical microscopy (Figure 1) shows (and SAXS confirms) the presence of both disordered and tetragonally-ordered mesh phases, but only in DDA_2HPO_4, whereas all counterions yielded a lamellar phase.

Hydrolysable counterions have so far been under-exploited in directing amphiphile self-assembly. This work highlights their potential to control the structure of surfactant aggregates in solution, and establishes the conditions under which novel mesoporous biominerals might be created.

Dr Connie K Liu acknowledges receipt of an Australian Postgraduate Award and an AINSE PGRA Scholarship. This work was undertaken at the University of Sydney with Professor Greg Warr and Dr Paul FitzGerald, and with the support of Dr Bill Hamilton and Dr Katy Wood at ANSTO. Thanks also to Dr Nigel Kirby at the SAXS/WAXS beamline at the Australian Synchrotron, Victoria, Australia, and Dr Paul Butler at the NIST Centre for Neutron Research, Gaithersburg, MD.



Polarising optical microscopy images (20×) of the birefringent regions in the concentration gradient formed between water and DDA_2HPO_4 showing intermediate phase textures.

(1) Liu, CK and Warr, GG. Resiliently spherical micelles of alkyltrimethylammonium surfactants with multivalent, hydrolyzable counterions. Langmuir, 28 (30), 11007-11016, 2012.

AINSE Winter School 2012

Saturday 30 June to Wednesday 4 July 2012

The Winter 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 42 member universities. The experiments and lectures cover a wide range of disciplines and scientific techniques and are designed to broaden the scientific outlook of the students. Working in teams and socialising are also important parts of the Winter School experience.

AINSE postgraduate Scholars Sarah Hobgen, Vijay Bhatia, Jayde Livingstone, Gregory Hall, Shaun Haskey, provided the students with a presentation on their research projects on the Tuesday evening, and made a very important contribution to the School as demonstrators and role models. They were warmly welcomed by the students and the Winter School Committee and AINSE are grateful for their commitment to the School.

Professor Ian Chubb, Chief Scientist for Australia spoke to the students about the importance of science and engineering and the benefits of a science or engineering career. Professor Chubb presented his vision on how the students, as future scientists, can better inform the public to contribute to important societal outcomes and ensure the continual success of their own studies.

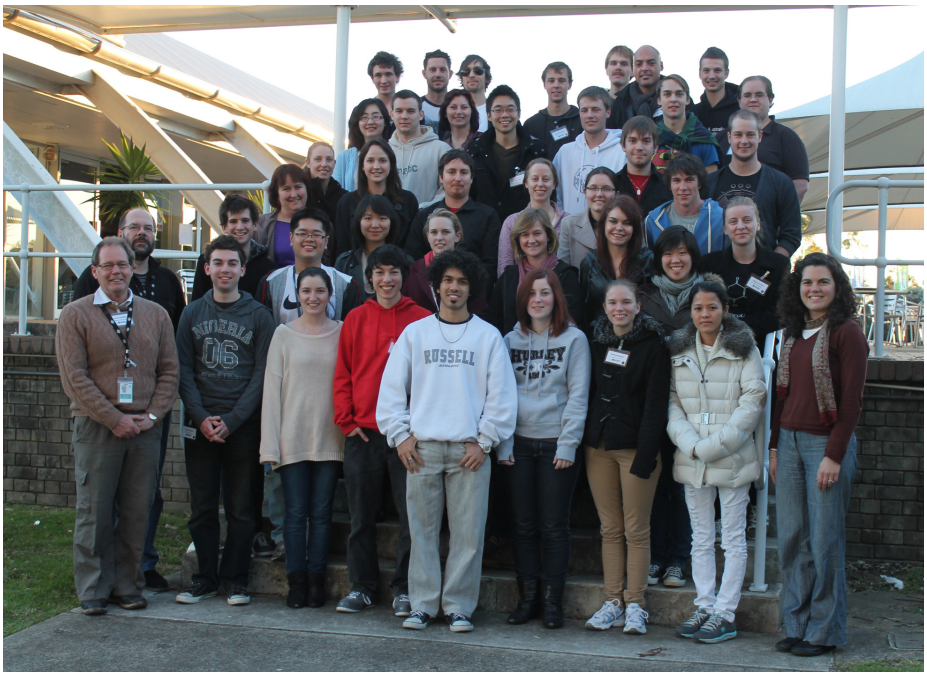
The students also heard a presentation given by Marita Cheng, Young Australian of the Year. Marita talked about how she became interested in engineering and founded Robogals. Robogals is an organisation that actively works to increase the number of young women pursuing engineering in their tertiary studies and careers.

Winter School Convenor Professor Thomas Millar.

The students attended five experimental sessions; Measuring structure with neutrons at temperature and pressure (Bragg Institute), Radiation Damage Effects (Institute of Materials and Engineering), Rutherford backscattering (RBS) and Proton-Induced Gama-ray Emission (Institute of Environmental Research), Radiation Safety (Safety Environmental and Radiological Assurance) and Use of Natural Radioactivity in Environmental Studies (Institute of Environmental Research).

The students were also given the opportunity to discuss ideas for an honours project through the AINSE Research Roundup. ANSTO research scientists attended with a poster describing the science that can be done on their instruments. The students circulated and discussed their experiments with the relevant ANSTO research scientist. The aim of the Roundup was to provide a focus for each student and to encourage them to do an honours project which utilises one of ANSTO's facilities. This was a beneficial event which the students thoroughly enjoyed.

ANSTO Contact Scientist Dr Gordon Thorogood discussing honours projects with student Tania Griffiths.



The 2012 Winter School Group Shot with Dr Frank Bruhn (AINSE Managing Director), Prof Thomas Millar (Convenor), Dr Rachel Popelka-Filcoff (AINSE Research Fellow).

Left to right: special guest speaker Professor Ian Chubb, Chief Scientist for Australia with Winter School Convenor Professor Thomas Millar and AINSE Managing Director Dr Frank Bruhn.

Thanks

The Convenor of the 2012 Winter School and the Managing Director of AINSE record their gratitude to the rest of the organising committee, to the postgraduate students and the staff, CEO and Board of ANSTO for their generous contribution to the School. They thank the ANSTO staff who gave so much of their time and talents in making the school a success.

Student	
Juelian Siow	ACU
Chun Yi Aaron Oo	ADE
Jane Leung	AKL
Zalesh Myers	ANU
Paulo Silva	BAL
James McKay	CAN
Corey Goodwin	CBR
Kelly Munro	CDU
Sarah Young	CQU
Kalam Ciantar	CUR
Rebecca Collins	ECU
Nathan O'Brien	FLI
Waylon Nielsen	GRI
Dominic Torrisi	JAM
Julia Kirschbaum	LAT
Katherine Berthon	MAC
Hugh Elder	MEL
Yi-Wen Lao	MON
Tina Berry	MUR
Ross Wood	NCT
Courtney Ames	NSW
Stephanie Florin	QLD
Jesse Allen	QUT
Tania Griffiths	RMI
Aaron Walker	SCU
Jaimys Arnott	SWI
Zixin Huang	SYD
Sarah Stace	UNE
Jessica Mackintosh	USA
Hollie Stevenson	USC
Gabrielle Sévigny	USQ
Daniel King	UTS
Jacob Ross	UWA
Grace Blackwell	UWS
Ngan Thanh Thi Pham	VIC
Shane Rooyakkers	VUW
Christopher Lockley	WAI
Peter Monaghan	WOL

2012 Conferences & Workshops

AINSE conferences play a major part in the exchange of scientific and technological information, providing a forum for debate and an opportunity for young researchers to present their work. In 2012, AINSE hosted the following conferences:

Radiation 2012

15–17 February 2012, Lucas Heights

The Radiation conference brings together many scientific disciplines. In the tradition of the Radiation Conference, all aspects of the radiation techniques and the applications were discussed. Papers were supported by poster and oral presentations. The conference gathered together the radiation communities under the theme 'Radioprotection: Past, Present and Future'. Along with organising the conference, AINSE provided 20 students with funding.

ANSTO Breakfast

18 July 2011, Lucas Heights

AINSE hosted a breakfast for ANSTO staff with links to scientific education and training. This event started with breakfast to show AINSE's gratitude to ANSTO staff for all their help and contributions to AINSE and was then followed by presentations on AINSE's role and activities to help give a better understanding of how AINSE works. This breakfast was attended by 41 ANSTO staff members.

12th South Pacific Environmental Radioactivity Association Conference

16-19 October 2012, Lucas Heights

The SPERA Conference was attended by those interested in the release of radionuclides from nuclear power plants into the environment following the earthquake and tsunami in Japan. Other focus areas included Environmental Radioactivity in the Atmosphere, NORM & TENORM, Radioecology, Radioactive Contaminant Transport, Isotopes in Water Resources, Instrumentation and Radiochemistry, Isotopes in Sedimentation and Erosion, Nuclear Forensics, Radioactivity Impact Assessment, Marine Radioecology & Radioactivity. The event attracted 64 participants from 18 different organisations.

10th AINSE-ANBUG Neutron Scattering Symposium

7-9 December 2012, Lucas Heights

The AANSS meeting is the annual coming together of all researchers, across a broad range of disciplines and techniques, who are involved in neutron scattering in Australia. The conference is especially geared towards presentations from students and ECRs, who are strongly encouraged to report results from projects that have been funded by AINSE and/or have made use of the facilities at ANSTO. Along with organising the conference, AINSE provided 23 students with bursaries.

Other Conference Support

In addition to these events, participants from member organisations are assisted with travel and accommodation to attend a number of other AINSE approved conferences such as:

Current State and Future of Neutron Stress Diffractometers

10-12 January 2012, Sydney

3 students, 3 organisations SWI, MEL, MON

Workshop of Second Guide Hall for OPAL-Next Phase of Expansion at the OPAL Reactor

16-18 April 2012, Sydney

17 students, 12 organisations AKL, ANU, CSIRO, CUR, MEL, MON, NSW, QLD, RMI, SYN, TAS, UWA

10th Spring Meeting of the International Society of Electrochemistry (ISE2012)
16-19 April 2012, Perth
31 students, 7 organisations LAT, MON, NCT, NSW, RMI, USC, WOL

Synchrotron and Neutron New Users Symposium 2012
9 July 2012, Australian Synchrotron
23 students, 12 organisations ADE, AKL, ANU, CUR, DEA, MUR, NSW, SCU, SWI, SYD, USA, WOL

Texture Analysis with MTEX
30 July – 3 August 2012, Lucas Heights, Australia
3 students, 3 organisations WOL, UWA, OTA

7th International Sample Environment at Neutron Scattering Facilities Workshop
17-20 September 2012, Amora Hotel Sydney
2 students, 2 organisations AKL, GRI

20th International Workshop on Electron Cyclotron Resonance Ion Sources (ECRIS 2012)
25-28 September 2012, Sydney
1 student ANU

5th AONSA Neutron School
23-28 October 2012, Beijing, China
2 students, 2 organisations WOL, SYD

Powder Diffraction at Australia's Synchrotron and OPAL Facilities: Experiment Planning to Data Analysis
12-14 November 2012, Lucas Heights
18 students, 10 organisations ADE, AKL, ANU, CSI, DEA, GRI, MEL, MON, NSW, UWA

XV. International Conference on Small-Angle Scattering (SAS2012)
18-23 November 2012, Sydney
6 students, 5 organsations ANU, CAN, MEL, MON, QLD

ACAS School for Accelerator Physics
26 November-3 December 2012, Melbourne
3 students, 3 organisations

Structure and Dynamics of Condensed Matter by Scattering Methods; Past Present and Future, JWW Symposium
25-28 November 2012, Hunter Valley
2 Buses to transport students from the airport to Hunter Valley

Bragg Institute IAT meetings
AINSE supported one IAT Instrument Advisory Team meeting. This meeting provides technical and user advice to ANSTO's Bragg Institute on new instrument development.

Bragg Institute PAC meetings
AINSE supported two PAC Program Advisory Committee meetings. These meetings provide recommendations to the Head of the Bragg Institute concerning the allocation of beam time. The committee examines not only scientific merits but also technical and safety aspects of a beam-time request.

University of Sydney students experimental sessions at the Bragg Institute
AINSE provided travel support for University of Sydney students to come to ANSTO to do a measurement at OPAL using one of the powder machines.

24 April 2012	12 Students	$422.40
25 May 2012	12 Students	$422.40
31 August 2012	8 Students	$380.00

International Conference Travel and ISIS support Scholarships

These scholarships usually provide up to $900 as a travel and accommodation subsidy for students and post-doctoral fellows from AINSE member universities who wish to present their AINSE supported research at an international meeting. Support of $5,000 has been provided as well for AINSE supported members' researchers to access ISIS.
Details are provided in the following table.

Awardee	UNI	Conference/Facility	Amount
Joshua Dean	LAT	The Goldschmidt Conference, Montreal	$900
Melinda Waterman	WOL	APECS workshop, Sopot, Poland	$900
Nellie Hobley	NCT	The 4th International Conference: EUROSOIL 2012, Bari, Italy	$900
Stephen Holt	ANS	ISIS Experiment	$5,000
Stephen Holt	ANS	ISIS Experiment	$5,000
Brendan Kennedy	SYD	ISIS Experiment	$5,000
Chris Ling	SYD	ISIS Experiment	$5,000
Siegbert Schmid	SYD	ISIS Experiment	$5,000
Ian Gentle	QLD	ISIS Experiment	$5,000