OPAL news

While the OPAL Reactor continued to perform very well during the period April to June 2012, with an overall reliability of 91% relative to the published schedule, OPAL’s cold neutron source has not operated since 8th March, due to ongoing reliability issues. As a consequence, we will are unlikely to see cold neutrons again before April 2013, and both QUOKKA and PLATYPUS have been withdrawn from the current proposal round that closes on September 15th. We are therefore attempting to secure beam time for our SANS and reflectometry users at other leading overseas neutron sources.

Having said this, our 5 thermal-neutron instruments used 93% of the available beam time for user experiments, in the last quarter. In addition, the Australian nuclear regulator, ARPANSA, recently approved ANSTO’s request to implement a flexible fuel management strategy. This will allow OPAL to operate to a fixed calendar schedule, improving schedule predictability for our neutron users.

Around the instruments

Kowari (strain scanner)

In April, we diffracted neutrons from the largest sample so far at OPAL: a 630 kg section of natural-gas pipeline section with circumferential weld from TWI Ltd, in Cambridge, England. The total mass of the pipe and its support frame exceeded 850 kg. As far as we are aware, this is possibly the largest neutron diffraction sample ever, anywhere in the world.

Strains were scanned using our KOWARI strain scanner in all three principal directions in and around the weld. No extra cuts were made in the piece, which was cantilevered from the sample stage, in order to place the weld at the centre of rotation of KOWARI. Loading of the sample on KOWARI was only possible due to the removable collimators which could be reinstalled onto the instrument once the sample position was fixed.

The project is led by Elvin Eren from TWI, and the idea is to investigate the variability of mechanical properties along the circumference of such girth welds.

Helium-3 Polarisation Station

Our new Helium-3 Polarising Station arrived in May and has been installed into its final position above the bunker in the neutron guide hall. This is a joint project between ANSTO and the Institut Laue Langevin in Grenoble, France, to bring neutron polarisers and analysis to 6 of the neutron scattering instruments at OPAL in the following order: WOMBAT, TAIPAN, SIKA, QUOKKA, PLATYPUS and PELICAN. With this capability, the instruments can use polarised neutrons for magnetism research. The commissioning of the equipment on the neutron-scattering instruments will begin in September 2012. This project is led by Hal Lee.

Platypus (neutron reflectometer)

The first polarisation-analysis publication from OPAL has been accepted for publication in Physical Review B. The work, performed on our PLATYPUS neutron reflectometer, results from a collaboration involving the Universities of
The researchers investigated a haematite-Fe₂O₃/Permalloy Ni₈₀Fe₂₀ bilayer film where the antiferromagnetic layer consisted of small haematite grains in the 2-16 nm range. A pronounced exchange bias effect was found to occur in this material, evident in a shifted magnetic hysteresis loop and unusual magnetic reversal mechanism.

Polarised neutron reflectometry was used to place an upper limit on the concentration and length scale of a layer of uncompensated moments at the antiferromagnetic interface, and was consistent with an induced magnetic region at the antiferromagnetic interface of 0.5 - 1.0 μB per Fe within a depth of 1 - 2 nm. The field dependence of the neutron spin-flip signal and spin asymmetry was analysed in the biased state, and the first and second magnetic reversal were found to occur by asymmetric mechanisms. For the fully-trained Permalloy loop, reversal occurred symmetrically at both coercive fields by an in-plane spin rotation of ferromagnetic domains.

**National Deuteration Facility** (bio-deuteration)

The second user-article published incorporating biomass produced at the National Deuteration Facility, and the first in which such material has been investigated using SANS has been published in the *Proceedings of the National Academy of Science*. Contributing to the study of neuronal signalling, the article: “Low resolution solution structures of Munc18:Syntaxin complexes indicate an open bonding mode driven by the Syntaxin N-peptide” incorporates small-angle neutron scattering data obtained at the Institut Laue Langevin in Grenoble, France and is the result of a collaboration between researchers at the University of Queensland and ANSTO. Had OPAL’s cold neutron source been operating more reliably, this work would have been done exclusively on QUOKKA.

**Koala (Laue Diffractometer)**

Two Laue diffraction images of the same crystal of piroxicam monohydrate at 22 K obtained first upon cooling and after 8 hours in the identical orientation.

In a paper published in *ChemPhysChem*, the remarkable reformation of a single-crystal which split into several fragments on cooling to 22 K is reported. The study is the first publication from a collaboration between ANSTO and the University of Durham, UK. The study seeks a
better understanding the various crystalline forms in which pharmacologically active compounds can be obtained and demonstrates the sensitivity of Laue diffraction to crystal quality and changes in mosaicity.

The images shown are the diffraction patterns for a crystal of piroxicam monohydrate, the active ingredient in the non-steroidal anti-inflammatory drug **Feldene™** when it was first cooled, and an image recorded for the identical sample in the same orientation after remaining at 22 K for 8 hours. Diffraction spots appearing in the later image are clearly apparent as clusters of spots in the first image, illustrating the formation of crystal domains that contract separately from each other due to strong hydrogen-bonded chains present in the monohydrate. These interactions also account for the irregular and hysteretic thermal contraction of the unit cell.

**Chris Garvey (soft condensed-matter)**

Scientists have explained the evolutionary history of haemoglobin using what might seem an unlikely array of samples. (Credit: ILL)

Researchers from ANSTO, Institut Laue-Langevin (ILL), Aachen University of Applied Sciences (FH Aachen), the Centre National de la Recherche Scientifique (CNRS) in Paris and FRMII in Germany have found a mechanism by which haemoglobin molecules are adapted to body temperature, by studying haemoglobin from different species of animals. This work is published in *J. R. Soc. Interface*.

The flexibility and stiffness of haemoglobins from three endotherms with different body temperatures (platypus, domestic chicken, and human) and an ectotherm (salt-water crocodile), were measured by incoherent elastic neutron scattering (ILL & FRM-II), while the specific amino-acid sequences that determined these properties were elucidated by complementary coarse-grained computer simulations. We also showed that changes in the conformational dynamics of the molecule occurred at the exact body temperature of each endotherm. The implication is that, at the body temperature, the protein becomes more flexible, allowing an easier pathway for gas molecules such as oxygen to diffuse in and out of the haemoglobin structure. In the case of the salt-water crocodile, little change in haemoglobin flexibility with temperature was observed.

The findings, which explain how evolution has optimised the vital job haemoglobin carries out, within different species, could prove particularly interesting to biological, bioengineering and biomedical research on red blood cells.

**Announcements**

The 2013-1 Proposal Round is now open for beam time between February and June 2013 and access to all 5 thermal-neutron-beam instruments. Proposals should be submitted online by **15 September 2012** via [https://neutron.ansto.gov.au](https://neutron.ansto.gov.au).

**2012 AINSE/ANBUG Neutron Scattering Symposium (AANSS 2012), 7-9 November 2012**

The 2012 AINSE/ANBUG Neutron Scattering Symposium (AANSS 2012) will be held at AINSE, Lucas Heights, on 7-9 November 2012.

This 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 other early-career researchers, who are strongly encouraged to report results from AINSE-funded projects and/or that have made use of the facilities at ANSTO.
The meeting will involve a mixture of invited talks and short presentations from the submitted abstracts. There will also be an informal poster session and ample opportunities for networking in a social environment. Academics are strongly encouraged to support this affordable local event and to encourage their students to attend and present. AINSE offers travel and accommodation for presenting students. The deadline for submission of a one page abstract is 20 August and for ‘early bird’ registrations is 28 September.

For more information, abstract submission and registrations please visit http://ainse.edu.au/events2/AANSS


The “Structure and Dynamics of Condensed Matter by Scattering Methods; Past Present and Future - John White Celebratory Symposium” is a satellite meeting to the SAS2012 conference. The meeting is being held in celebration of Professor John White’s 75th birthday, 25-28 November 2012 at the Mercure Resort Hunter Valley Gardens. The focus of the meeting will be the impact of scattering methods upon our understanding of the structure and dynamics of condensed matter systems, ranging from colloid and surfactant self-assembly, protein films, emulsions to intercalation compounds and beyond. Contributions will cover current work and look to future prospects - considering where scattering methods will enable new science through the development of instrumentation and sources internationally. There will also be a reflection on the development of this broad and dynamic field of research.

The preliminary programme, registration form and other information are available here. The deadline for Early Bird Registrations is 17 August 2012. For more information, please contact Cherylie Thorn: cherylie.thorn@ansto.gov.au.

New Faces

Arrivals

Tim D’Adam has recently joined the Bragg Institute as a Professional Officer, working on our polarised ³He system. He has a BSc in Nanotechnology from University of Technology Sydney and experience working with vacuum and pressure instrumentation.

Sanjoo Paddea is a PhD student from the Open University, in the UK, and joins us for 3 months working on residual stresses in power-plant components. Sanjoo is working with Dr Anna Paradowska (Bragg Institute) and Dr Michael Drew (Institute of Materials Engineering).

Robin Ouallet joins the Sample-Environment team for a 4-month internship. He is in the penultimate year of his engineering degree at the École des Mines de Douai, in France.