Australian Synchrotron

LIGHTSPEED October 2010

TOP STORIES

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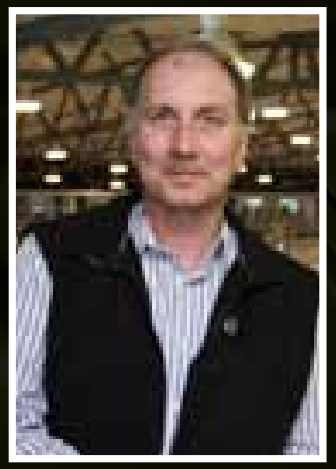
From the Acting Director



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Background image: Close-up of linear accelerator at the Australian Synchrotron

IN THIS ISSUE

From the Acting Director - Users play a vital role

At the Australian Synchrotron, our aim is to be a world-class facility supporting a wide base of users undertaking leading-edge scientific research. Our User Meeting in November 2010 is an excellent opportunity for existing and potential users to improve their knowledge of synchrotron techniques as well as share their expertise.

Development of the scientific program for the User Meeting is progressing well with confirmation of several eminent international and national guest speakers, including Dr Ulrich Schade (THz microspectroscopy expert, BESSY), Dr David Parsons (Adelaide Cystic Fibrosis Gene Therapy Group) and Associate Professor Matthew Wilce (Wilce Structural Biology Laboratory, Monash University). If you haven't already submitted your abstract, you'll have to be quick - the deadline for abstracts is 14 October 2010. An early bird registration discount is available until 31 October.

The Australian Synchrotron also supports many smaller meetings that enable users to learn more about synchrotron science and provide a venue for sharing their experiences. At a recent cultural heritage conservation workshop, synchrotron staff explained how our facilities can assist materials conservation projects, and users presented examples of synchrotron applications involving such diverse materials as ancient Egyptian jewellery, Aboriginal ochres, Mayan paint and plaster samples from the Honduras, 19th century historic documents and 20th century artworks.

We also support our user community through ongoing development of Australian Synchrotron capabilities and facilities; for example, construction has commenced on the next phase of the planned extension and upgrading of the imaging and medical beamline. Full beamtime will be available in 2011, with clinical research commencing in 2012. Another important user infrastructure program is the construction of the 50-room user accommodation block and other user facilities with a planned completion date in late 2011.

Discussions are currently underway with the state and federal governments about the introduction of the next set of beamlines that will help to satisfy the future demands of our user community.

The past year has seen us reach some key milestones in our development and the release of our 2010 Annual Report is an excellent opportunity to reflect on these achievements. I'm proud to say that the Australian Synchrotron is steadily moving closer to reaching its full potential, as evidenced by a significant increase in scientific publications arising from work undertaken here by users and staff. The publication of over 100 scientific papers so far this year has exceeded our expectations and is in keeping with overseas benchmarks. As our development plans unfold we will continue to provide facilities that enhance our region's strong scientific performance.

Significant contributions by Australian Synchrotron staff and users helped to ensure the great success of our 2010 Open Day on 15 August, with attendance almost doubling that of previous years. This was an important opportunity to highlight the work of users and show the Australian public the value of the work undertaken here. The response from attendees was overwhelmingly positive and we thank the many users and synchrotron staff members who volunteered their time to help on the day.

George Borg

Chief Operating Officer, Australian Synchrotron

Up to speed: Richard Farnsworth

This month our short interview features Richard Farnsworth, head of information technology and computing at the Australian Synchrotron. The synchrotron's longest-serving employee, Richard will leave the Australian Synchrotron in October 2010, and his contributions to the facility will be missed!

How long have you been with the Australian Synchrotron?

I joined the Australian Synchrotron Project (ASP) run by Major Projects Victoria (MPV) in April 2003 as lead control systems engineer. I was interviewed by Alan Jackson (ASP Technical Director), Garry Seaborne (ASP Project Director) and James Cain (Head of MPV). As a local, I was able to start before all the other technical specialists, who were not locals. Both Alan and Garry have since retired and James Cain was not part of the synchrotron project, which makes me the longest-serving ASP employee at about seven-and-a-half years. Staff from ANSTO and the Australian Synchrotron Research Project also worked on the ASP, but were not directly employed by ASP.

What have you learnt about synchrotron scientists as a result of working here?

Synchrotron scientists are the biggest bunch of ratbags out! More seriously, the beamline scientists and accelerator scientists here are among the most talented in their fields, and I am honoured to have personally worked alongside them. They are very individualistic and highly motivated and each believes passionately that their chosen speciality is of great importance.

What will you miss most about the Australian Synchrotron?

This place has been a tight-knit team working together towards a common goal. The genuine closeness of the early days, the sense of achievement in getting the machines working, the enormous technical interest in the work itself and community support – both in my profession and the wider community – are all unique things that I doubt I will ever see again.

What will you miss least about the Australian Synchrotron?

Some of the more frustrating challenges encountered in getting a facility of this type operational; resources are often more limited than one would like to see. It's also true that while the synchrotron has achieved so much so quickly, it's a bit like a precocious teenager who hasn't yet developed the maturity to match his or her technical accomplishments.

What are you going to do next?

I'm going to head up the accelerator controls team at the Advanced Photon Source (the APS) in Chicago.

Australian Synchrotron Open Day 2010

Shine a bright light on an object and you can see it more clearly. Shine intensely bright synchrotron light and you can see objects in astonishing detail, right down to the smallest atoms!
The light created at the Australian Synchrotron is about a million times brighter than the sun. This brilliant light can be used to assemble tiny machines that would fit into the eye of a needle, to improve cancer detection, to develop new drugs to fight malaria and to improve mining processes. From human cells to paintings and fossils the work done at the Australian Synchrotron is helping to build a brighter future for all Australians.
This is your chance to come and see one of Australia's most exciting scientific facilities and see how synchrotron science can make life better for everyone.
We will offer tours, activities for kids, photography competitions and even the first on line opportunity to see this unique facility. Come and see us for yourself...

Australian Synchrotron Open Day on Sunday 15 August 2010
10.00 a.m. – 4.00 p.m.
800 Blackburn Road, Clayton (Car park entry off Wellington Road only)
Entry is free but bookings are essential – click here to go to booking page.
Any enquiries, please email Melissa Moyle at openday@synchrotron.org.au

This event is hosted as part of National Science Week.
The Australian Synchrotron: turning bright ideas into brilliant outcomes

Beamtime applications October 2010

Beamtime submissions for round 2011/1 (January-May 2011) closed on 6 October.

Key dates for beamtime submissions are listed on the synchrotron website at:
http://www.synchrotron.org.au/index.php/features/applying-for-beamtime/2010-proposals-schedule

If you would like to discuss your ideas for future beamline proposals with the beamline scientists at the Australian Synchrotron, please allow plenty of time.

For more information about applying for beamtime at the Australian Synchrotron, contact the User Office:

user.office@synchrotron.org.au

Synchrotron reveals details of artist's cover-up

The details of a hidden self-portrait by celebrated Australian painter Arthur Streeton have been revealed in a new collaboration between art and science. The joint investigation will encourage further use of synchrotron techniques for studying artists' materials and methods, assisting art restorers, and providing new evidence in cases where the identity of an artist is unclear.

Now owned by Streeton's grandson, Oliver Streeton, the work in question was painted on a prepared canvas but later covered over with white lead paint by the artist. Towards the end of his career, Streeton often painted over earlier canvases and re-used them. In this case the canvas was not re-used, but instead remained in the artist's studio where it gradually accumulated layers of dust and even the occasional cat paw print. The hidden self-portrait was visible as a faint image behind the white paint, but the details were impossible to distinguish.

"We think this painting could have been a practice run for another self-portrait, which now belongs to the Art Gallery of New South Wales' says David Thurrowgood, a senior conservator at the National Gallery of Victoria. "When Streeton finished the other one, he probably decided there was no need to keep the earlier version."

David Thurrowgood and Deborah Lau (CSIRO) used the x-ray fluorescence microprobe (XFM) beamline at the Australian Synchrotron in early 2010 to examine the Streeton work, with permission from Oliver Streeton. Synchrotron techniques are well-suited to examining works of art because they are non-destructive and can rapidly provide detailed information on the chemical composition of different constituents. Researchers can use the XFM beamline to scan across an entire canvas section by section, collecting detailed chemical information as they go. The beamline can also provide a 'fingerprint' of the elements that are present in different pigments.

"We're developing new methods of analysis, and we chose to examine this work because it presented some major challenges," David said. "It's basically a series of similar pigment colours sandwiched between two layers of white lead paint."

Most current examination methods involve taking small cross-sections, which damages the artwork. Laboratory x-ray techniques don't require cross-sections, but are unsuitable in this case because lead strongly absorbs x-rays, swamping the signals from other, lighter elements. At the synchrotron, the detrimental characteristics of

Image: David Thurrowgood (NGV) and Deborah Lau (CSIRO) position a painted-over Streeton self-portrait for analysis on the XFM beamline at the Australian Synchrotron. Behind them, Daryl Howard (AS) checks the alignment of the x-ray microprobe.

lead are minimised with judicious choice of the incident monochromatic beam energy, allowing researchers to focus on the x-ray fluorescence of the other elements in the painting.

David and Deborah had previously studied the painting using x-radiography and infrared reflectance techniques, but the synchrotron XFM beamline offered much higher spatial resolution.

"This project is very much a work in progress," David says, "But the results so far are very encouraging in terms of our developing a new technique to assist possible future investigations of artworks in our collection."

Mismatches work for organ transplants

Australian Synchrotron user Julia Archbold is the winner of the 2010 Victorian Premier's Award for Health and Medical Research. Photo: MNHS Multimedia Services, Monash University

The winner of the 2010 Victorian Premier's Award for Health and Medical Research is an Australian Synchrotron user whose work is helping to provide new insights into organ transplant rejection.

Julia Archbold received the $16 000 award for her PhD research on the role of immune system proteins in organ transplantation, which she conducted under the supervision of Professor Jamie Rossjohn in the Monash University School of Biomedical Sciences.

Julia's research helps explain why patients' bodies may reject transplants of donor-recipient matched organs. She discovered that the three-dimensional structures of immune proteins called major histocompatibility complex (MHC) molecules, along with their corresponding T-cell receptors, can be used to help predict whether organ rejection will occur.

MHC molecules and T-cell receptors play important roles in enabling our bodies to recognise whether particular proteins belong to us or whether they are foreign and should therefore be attacked by our immune systems. In simple terms, the MHC molecules present the proteins for assessment by the T-cell receptors, which can call in the rest of the immune system if required.

Each person's T-cell receptors are educated to interact with certain MHC molecules. If the MHC molecules in the donor organ have a different structure from the recipient's MHC molecules, the recipient's T-cell receptors can't recognise them and won't mount an immune response to destroy the transplanted tissue.

Although this work is still in the preliminary stages, it could eventually lead to the development of a structural database of MHC molecules, which could be combined with existing tissue typing strategies to identify suitable donor-recipient 'mismatches' for organ transplantation. Around 1700 Australians are currently waiting for donor organs.

Julia used the Australian Synchrotron macromolecular crystallography beamlines MX1 and MX2 for her x-ray crystallography studies and collaborated with researchers from the University of Melbourne and Queensland Institute of Medical Research during her PhD. Julia is currently in Auckland, NZ undertaking a postdoctoral position in Ted Baker's laboratory at Auckland University. She has a National Health and Medical Research Council overseas training fellowship and will return to Australia in 2012.

The sun and its wind

Bruce King (RHS) and Michael Gladys from the University of Newcastle in NSW recently brought their solar wind samples to the Australian Synchrotron

Australian researchers are helping NASA to obtain new information on the evolution of our solar system, with the help of a specialised experimental setup at the Australian Synchrotron.

It might sound like a sci-fi fantasy concept, but the solar wind is simply a stream of charged particles, mainly ionised hydrogen atoms, that flow outwards from the sun, travelling at around 500 kilometres a second.

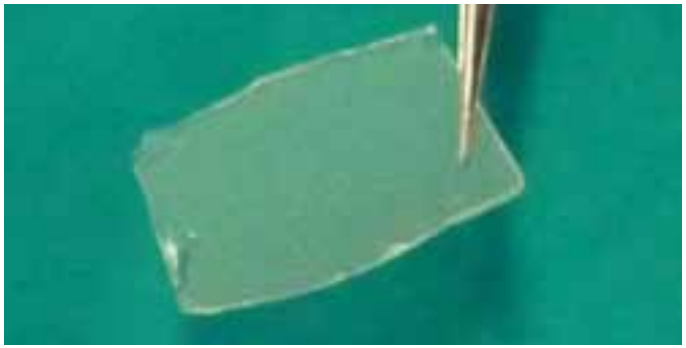
Knowing more about the composition of the solar wind will improve our knowledge of how the solar system was formed. Scientific evidence suggests that the outer layer of the sun has not changed much since it was formed about 4.6 billion years ago, and its composition is closely related to that of the solar wind. Comparing the composition of the solar wind with what we know about the composition of planetary systems should provide new information on the evolution of our solar system and its planets.

The NASA Genesis spacecraft was launched in August 2001 and orbited the sun, collecting solar wind atoms travelling at such high speeds that they became buried below the surface of specially designed silicon, diamond and sapphire wafers. One of the mission's key goals was to use these samples to measure the fluence of the solar wind, i.e. the number of particles that flow through a given cross-sectional area. However, terrestrial contamination caused when the spacecraft crashed on re-entry in 2004 has created additional challenges for researchers.

In August 2010, Bruce King and Michael Gladys from the University of Newcastle brought sapphire solar wind samples that had flown on the Genesis spacecraft to the Australian Synchrotron for specialised x-ray absorption spectroscopy (XAS) studies.

Bruce and Michael worked with Chris Glover on the XAS beamline to establish a new setup for collecting reflectance rather than absorption data. Using a technique called total reflection x-ray fluorescence (TXRF) to determine the surface concentrations of impurities on the Genesis wafer samples, they hoped to distinguish solar wind impurities - present in the near-surface region at concentrations well below one part per million - from terrestrial contamination.

The initial TXRF results obtained at the XAS beamline showed the clear benefit of the synchrotron source compared to a laboratory-based instrument. For example, contaminants that were invisible after a two-hour lab-based TXRF measurement were clearly resolved into This



11 x 6 millimetre sapphire wafer travelled 32 million kilometres on the Genesis spacecraft. Photo courtesy of Bruce King.

the different metal components after a few seconds of synchrotron TXRF measurement. This can be attributed to sample setup and greater photon flux, as well as the ability to readily tune the incident photon energy.

The researchers chose to use the XAS beamline at the Australian Synchrotron because of its ability to accept different experimental setups. The second experimental hutch at the XAS beamline contains no fixed experimental setups, enabling users to devise a new experiment and providing the time and space needed to construct it.

Chris says the experimental setup used for the Genesis samples is analogous to grazing incidence x-ray absorption spectroscopy.

"The work with the Genesis samples has got us half-way to realising grazing incidence x-ray absorption spectroscopy for XAS users," Chris told Lightspeed. "We had to set up a lot of stages to finely align the samples, and then deal with the very small background of iron from contamination from scattered x-rays in the hutch. This was quite a challenge, as there's a lot of steel around the beamline! The experience has given us ideas about how to improve sample alignment and deal with iron contamination in the future."

New tools for preserving the past

Synchrotron techniques are assisting the preservation of historical documents, works of art, buildings and other physical objects that embody much of what we know about our past and that of ancient civilisations.

However, these physical objects are often fragile and require careful handling to ensure their continued preservation. Australian researchers and conservators are increasingly using synchrotron techniques to analyse and help preserve historical and cultural heritage materials from around the world.

In September 2010, conservators from across Australia attended a workshop at the Australian Synchrotron to learn more about synchrotron science for cultural heritage materials. The workshop was organised by Deborah Lau from CSIRO Materials Science and Engineering and supported by the Australian Synchrotron and the Australian Institute for the Conservation of Cultural Materials (AICCM).

After hearing from synchrotron scientists about the scope and applications of relevant synchrotron techniques, participants were presented with case studies from conservators and researchers who are currently using synchrotron techniques in their work with cultural heritage materials.

Read on for a summary of the workshop presentations, which are also available in more detail on the AICCM website (see link below).

Techniques

Infrared microspectroscopy expert Ljiljana Puskar emphasised how the advantages of the bright synchrotron IR source, such as fast data acquisition, improved signal-to-noise ratios and enhanced lateral resolution, can benefit work in materials conservation. She offered examples of work from the IR microspectroscopy beamline, including the identification of minor components such as pigments present in low concentrations. This information would be lost using conventional laboratory IR sources and is only possible using a synchrotron source.

Chris Glover, who heads the x-ray absorption spectroscopy (XAS) beamline at the Australian Synchrotron, explained the value of the techniques available on XAS beamline.

Ljiljana Puskar (RHS) explains the advantages of using a synchrotron IR source.

Daryl Howard from the x-ray fluorescence microprobe (XFM) beamline team told participants about recent work on a self-portrait by Arthur Streeton (discussed subsequently in more detail by David Thurrowgood). For conservation work, the XFM beamline offers spatial resolution between 1 and 100 microns. The beamline's new detector, the Maia-384 detector, collects data much faster and minimises potential radiation damage. A new sample stage that can scan objects as large as 600 x 300 mm will be available early in 2011.

The imaging and medical beamline, which is currently being upgraded, will offer non-destructive, low-dose, high contrast-resolution 2-D and 3-D (computed tomography) imaging. Synchrotron scientist Chris Hall noted that the beamline's 33 frames per second and 50-micrometre resolution are significantly better than MRI scanning techniques.

New tools for preserving the past (cont.)

Powder diffraction beamline head Kia Wallwork told participants that x-ray powder diffraction (PD) is an important tool for characterising materials that consist of many tiny crystals, such as mineral samples, artists' pigments and Aboriginal ochres. Although laboratory x-ray sources are good for routine work, synchrotron PD provides higher intensity x-rays, much better peak resolution and faster data collection, in addition to a much larger selection of means for mounting unusual samples.

Applications

Maria Kubik from the Art Gallery of Western Australia has surveyed Aboriginal red ochres from sites around Australia. Red ochre was extensively traded across the continent. Maria has produced an ochre atlas for the National Museum of Australia and is interested in using synchrotron techniques to obtain maximum information from tiny samples, and potentially also for analysing ochres in Aboriginal artworks.

David Hay and Deborah Lau from CSIRO use a range of synchrotron and laboratory x-ray techniques. David noted that while traditional laboratory-based XRD and XRF techniques are well-established in the art conservation world, the benefits of synchrotron (over laboratory) sources have led to an upsurge in applications over the last few years. In particular, the high flux levels and tunability of synchrotron radiation sources allow mapping experiments to be performed in real time over relatively large areas of, for example, paintings or artefacts. This can be done using spot sizes measured in micrometres (microns) or smaller. XRD mapping reveals the detail of crystalline phase distributions, XRF mapping shows the distribution of specific elements, and XAS carried out at specific points provides information on the forms of those elements, e.g. oxidation states.

Alana Treasure from the University of Canberra and the Australian War Memorial is using a synchrotron technique called micro-FTIR spectroscopy to examine how iron gall inks are degrading historic documents on parchment. The work complements international studies of iron gall ink damage on paper. Alana follows the extent of the degradation by looking at changes in the IR spectrum peaks that correspond to protein amide groups. She also reported on work being done by Rosemary Goodall from the Queensland University of Technology, who is using similar techniques to look at Aboriginal rock art from Queensland and paint and plaster samples from Mayan buildings in the Honduras.

Melina Glasson and Nicola Tse from the University of Melbourne's Centre for Cultural Materials Conservation discussed their use of synchrotron techniques to examine and characterise twentieth century painting materials and their degradation in humid environments. A particular challenge is the need to develop methods to enable soft materials to be thinly sliced in a microtome prior to analysis by synchrotron IR spectroscopy.

David Thurrowgood from the National Gallery of Victoria told the workshop about his work in collaboration with Deborah Lau (CSIRO) and Daryl Howard (Australian Synchrotron). They are developing synchrotron techniques for obtaining maps of the distribution of different elements in paintings. Knowing which elements are present and where provides valuable information on which pigments have been used, assisting studies of authenticity, composition and restoration. Recent work has centred on a self-portrait of Arthur Streeton that was subsequently painted over by the artist. David commented on the safety aspects of using synchrotron techniques on artworks, noting that the XFM beamline hutch temperature and relative humidity during data collection were better than most galleries, and that a system capable of detecting surface temperature changes due to a 10-second finger touch did not detect any thermal change on the surface of the Streeton self-portrait while it was on the synchrotron beamline.

Mark Eccleston and Peter Kappen from La Trobe University were unable to attend the workshop in person because they were in Hamburg using a German synchrotron to complement their Australian Synchrotron work examining ancient Egyptian faience. Instead they provided a pre-recorded presentation, in which Mark explained his studies of the faience and manufacturing industries of Amarna, which was the pharaoh Akhenaten's royal capital for a period of just 25 years around 1350 BC. A quartz-based ceramic material with a vitrified blue-green surface glaze, faience was used for jewellery and decorative items such as the shabti figurines found in many Egyptian tombs. Mark is using synchrotron powder diffraction and x-ray absorption spectroscopy to investigate the materials and methods used to make faience.

More information on the workshop presentations will be made available on the AICCM website at http://www.aiccm.org.au/

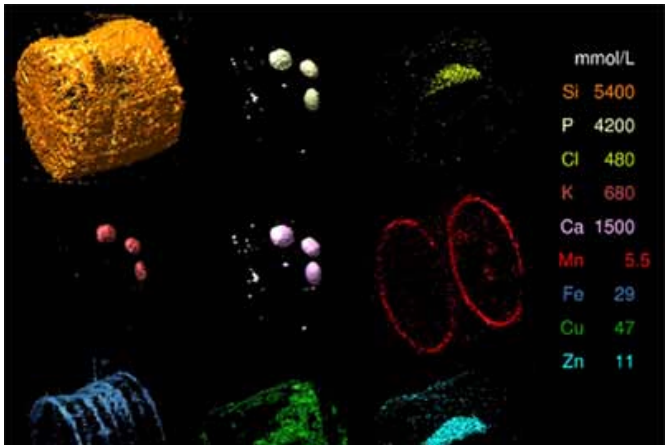
Synchrotron technique goes high-definition 3D

Accurate knowledge about the distribution of transition metals such as calcium, iron, manganese and zinc could help resolve key medical, biological and environmental questions such as how much atmospheric carbon dioxide could be sequestered within the deep waters of the earth's oceans.

Martin de Jonge from the Australian Synchrotron and his local and US collaborators recently announced a significant improvement in elemental imaging that will provide unprecedented detail of the three-dimensional distribution of elements in a wide range of sample types. Called x-ray fluorescence tomography, the technique creates three-dimensional x-ray fluorescence 'maps'.

X-ray fluorescence microscopy is a proven technique for obtaining valuable elemental, structural and chemical information. The Australian Synchrotron's x-ray fluorescence microprobe (XFM) can resolve details as small as around one-thousandth the diameter of a typical human hair. It can also detect various elements at much lower concentrations than laboratory-based techniques such as proton-induced x-ray emission.

The technique is often used to produce two-dimensional maps by projection imaging – much the same as you might obtain for a broken arm. In this kind of imaging, all of the parts are cast as a shadow onto the film, essentially flattening out the patient or object. While useful, this imaging mode loses the three-dimensional nature of the object, and with it goes much valuable information. Tomography is a technique that can be used to infer the 3-D distributions from 2-D projection images; when the doctor uses this it is called C-T or a CAT scan. Martin and co-workers have developed the techniques of three-dimensional computed tomography and



applied them to the problems of fluorescence imaging. In particular, they have improved the resolution of the measurement to below 400 nanometres. Their measurements were taken at the APS in July 2008, over 32 hours of beamtime.

Martin and his colleagues used the new technique to produce 3-D x-ray fluorescence images of a freshwater diatom. In addition to the detail they obtained for known structures inside the diatom, the researchers made some surprising new findings about iron and manganese distribution in association with silicon at submicron length scales. These preliminary findings appear to suggest that iron and manganese may play a role in silica deposition.

In addition to these developments at the APS, Martin and the team at the XFM beamline are developing the techniques of x-ray fluorescence tomography at the Australian Synchrotron. The technique has been tested using the Kirkpatrick-Baez microprobe and the Maia detector, and has achieved an estimated 3-D resolution of around two micrometres. Current upgrades to the XFM scanning stages will improve scanning performance for 2-D and 3-D work, and will make this one of the world's premier facilities for micrometre fluorescence studies.

'Definition' refers to the number of pixels used to represent an image. Previous implementations of fluorescence tomography have been limited to low-definition by data acquisition times. The present work increases the resolution by a factor of 10 and the definition by a factor of greater than 1000 over previous work. Martin says that such measurements will become routine in the near future with present trends in data acquisition and detector sensitivity.

The collaborators reported their work in the Proceedings of the National Academy of Sciences: Martin D. de Jonge, Christian Holzner, Stephen B. Baines, Benjamin S. Twining, Konstantin Ignatyev, Julia Diaz, Daryl L. Howard, Daniel Legnini, Antonino Miceli, Ian McNulty, Chris J. Jacobsen, and Stefan Vogt, 2010, Quantitative 3D elemental microtomography of Cyclotella meneghiniana at 400-nm resolution, PNAS vol 107 no.36, 15676-15680

Image: These images are 3D renderings of elemental distributions in a freshwater diatom (Cyclotella meneghiniana).
Isosurface concentrations used for the display are indicated in mmol/L. Clear correspondences between P (phosphorus), K (potassium), and Ca (calcium) are observed in the organelles, with a small amount of Mn (manganese) apparent. The Si (silicon) frustules and the Fe (iron) and Mn (manganese) rings are striking; and the cytoplasmic pillar (running along the axis of the diatom) contains mainly Cl (chlorine), Cu (copper), Zn (zinc), and S (sulphur - not shown). As with the concentration thresholds shown here, total elemental content spans three orders of magnitude, ranging from 8 µg for Si (silicon) to 2 ng for Mn (manganese). From PNAS 107, 15676-15680, with permission.

Synchrotrons in the news

Praise for crystallography team

According to Australian Life Scientist magazine: "Australia now boasts one of the most advanced synchrotrons in the world. The third-generation Australian Synchrotron in Melbourne is transforming proteomics, and the high-impact research papers are flowing."

http://www.lifescientist.com.au/article/363376/feature_australian_synchrotron_transforms_proteomics/?fp=4&fpid=3

Under extreme pressure

About 2900 kilometres under our feet, at around 4000°C and more than 1.4 times atmospheric pressure, the Earth's mantle mixes with the Earth's molten iron core. Using synchrotron x-ray diffraction and diamond anvil cells at the ESRF, geophysicists have re-created these conditions and applied them to tiny mineral samples to verify the possibility that the Earth's mantle is partially fused in this mysterious zone.

http://www.esrf.eu/news/general/when-the-earth-mantle-finds-its-core/

Black holes in outer space

The largest x-ray telescope ever built will be launched into space in 2021 to provide new information about black holes and the origin of the universe. Called the International X-ray Observatory, the telescope will follow preliminary studies by another international mission to be launched in 2013. The silicon wafers that will form the surface of the IXO mirror for detecting cosmic x-radiation from black holes are being tested at the BESSY II synchrotron in Germany.

http://www.ptb.de/en/aktuelles/archiv/presseinfos/pi2010/pitext/pi100916.html

AIDS drug could also combat herpes virus

A drug developed for treating AIDS may also be effective against the herpes virus, scientists from the Institute for Research in Biomedicine (IRB Barcelona) have found. The researchers used a test-tube protein assay, a high-performance protein expression technique and the ESRF in Grenoble to obtain their findings.

http://www.irbbarcelona.org/index.php/en/news/irb-news/scientific/a-drug-against-aids-could-be-effective-against-the-herpesvirus

Close to the bone

Detailed three-dimensional images of fragile bone structures can now be collected using a novel nano-tomography method developed by researchers using the Swiss Light Source. The team tested the technique on a mouse bone fragment just 25 micrometres across, narrower than a human hair. Their first nano-computed tomography (nano-CT) images appeared in Nature on 23 September 2010.

http://portal.mytum.de/pressestelle/pressemitteilungen/news_article.2010-09-17.2179735000

http://www.nature.com/nature/journal/v467/n7314/full/nature09419.html

Measuring the risk

A method for determining how much of the arsenic in mine tailings might actually be absorbed by people who come into contact with the tailings has been developed by Canadian researchers using the National Synchrotron Light Source. Their bio-accessibility test involves a simulated digestive system complete with mock gastrointestinal fluids.

http://www.nsls.bnl.gov/newsroom/science/2010/09-422.asp?eid=102010&sid=2

Towards lead-free electronics

Synchrotron techniques have revealed that a new synthetic material has the potential to replace lead-based ceramics in electronic devices such as inkjet printers, digital cameras, hospital ultrasound scanners and diesel fuel injectors. Concerns about the disposal of lead-based materials are driving the search for alternatives.

http://www.leeds.ac.uk/news/article/903/a_step_towards_lead-free_electronics

Thesis medal dates extended

The eligibility dates for the Australian Synchrotron Thesis Medal 2010 have been extended to cover the period from 1 July 2008 to 30 June 2010 (instead of only the 12 months to 30 June 2010). This will allow applications from people who had a PhD awarded or conferred between 1 July 2008 and 30 June 2009. The award was not offered in 2009.

The new deadline for applications is Monday 18 October 2010.

The Australian Synchrotron Thesis Medal recognises excellence in the area of synchrotron science amongst postgraduate students in the completion of their PhD studies. Applications are invited from PhD graduates whose thesis includes research undertaken at the Australian Synchrotron or the Australian National Beamline Facility (ANBF) or whose work was undertaken under the auspices of the Australian Synchrotron Research Program (ASRP). Applicants must have completed their PhD while enrolled at an Australian or New Zealand University.

Click here for further information.

Victoria Fellowship for synchrotron user

Australian Synchrotron user Matthew Hill, from CSIRO's Materials Science and Engineering division, is one of six early-career researchers to receive a Victoria Fellowship 2010 from the Victorian Government.

Matthew received the fellowship in recognition of his work with metal organic frameworks (MOFs), which exhibit exceptional room temperature storage of hydrogen and methane gaseous fuels. A promising technology for carbon capture, MOFs have the potential to make a major contribution to reducing emissions from power generation in Victoria.

Matthew's fellowship will enable him to work with a top chemical engineering group at the University of Minnesota, USA, to further develop these MOFs.

Click here for more about Matthew and MOFs at the Australian Synchrotron

Engineers measure ring shrinkage

When the synchrotron was built, its concrete floors were carefully poured to ensure a flat, stable surface. This is critical to the production and alignment of the synchrotron x-ray and infrared light beams that are generated in the storage ring and must then travel down the length of the beamlines to reach the specialised equipment used for research experiments.

Under the supervision of senior engineer Jonathan McKinlay, synchrotron technicians Jason Wirthensohn, Alan Easdon, Trent Smith, Craig Hodgson, Robert Grubb and Robert Rostan have just finished painstakingly surveying 324 network points on the technical floor that houses the beamlines and in the heart of the synchrotron building: the storage ring, booster ring and linear accelerator.

The network re-survey is conducted every 18-24 months to find out by how much the synchrotron floor has shifted and whether this might affect the position of any equipment inside the synchrotron light source – in particular the alignment of the synchrotron beams.

The synchrotron's accelerator physicists can adjust the controls on the electron beam to accommodate gradual changes of the order of several millimetres in the position of the powerful magnets that control the movement of the electron beam inside the storage and booster rings. However, ensuring that the equipment inside the synchrotron light source is as close to possible to its ideal positioning helps to achieve optimum performance. The network survey also helps to ensure that new equipment can be installed with the required accuracy.

The survey process involves placing a spherical metal ball at each network point, and using a laser tracker to very accurately measure the precise position of a mirror inside the sphere. Heights are measured using a yardstick with a unique barcode at every point along its length. The survey can detect changes of the order of just 30 micrometres, or one-quarter the thickness of a standard piece of copy paper, in the position of a seven-tonne storage-ring magnet. The information is recorded in a database of coordinates for every single network point.

For the record, the 0.6 mm shrinkage in storage ring diameter noted between 2008 and 2010 was accommodated by a realignment of the storage ring in which all the magnets and girders were moved back to their nominal positions, or as close to this as practically possible.

Alan Easdon prepares to measure another set of network points at the Australian Synchrotron

Engineers recently re-measured the precise position of 324 network points like this one

Synchrotron staff volunteer day

Hardy synchrotron employees braved the August mud and cold to participate in 'Target 25000', a project to revegetate bushfire-affected areas. In addition to planting 500 trees at the Chum Creek Wildlife Reserve, staff erected a kangaroo shelter, restored fences, built paths, cleaned animal shelters and had a lot of fun in the process. The synchrotron encourages staff to devote one day's paid work-time to volunteer activities each year.

http://www.wildlifeconnections.org.au/organisations/Shelters/VIC_ChumCreek/index.htm

Australia to host XRM 2014

The Australian Synchrotron, CSIRO, the ARC Centre of Excellence for Coherent X-ray Scattering and La Trobe University have won their collective bid to host the 12th international conference on x-ray microscopy: XRM 2014.

The 10th XRM conference was held in **Chicago in August 2010**. The 11th XRM conference will be held in Shanghai in 2012.

Events diary

Synchrotron-related events in Australia and overseas. Read more

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http://www.synchrotron.org.au/index.php/about-us/working-at-the-synchrotron/employment-opportunities

Staff list

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