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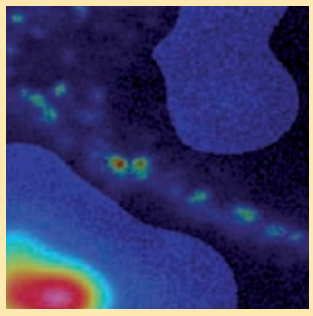
AUSTRALIAN MICROSCOPY & MICROANALYSIS RESEARCH FACILITY



FOCUS

Minister Carr launches flagship ion probe

AMMRF @ UWA

On 28 August, Senator the Hon. Kim Carr, Minister for Innovation, Industry, Science and Research, launched an internationally unique facility at the AMMRF's University of Western Australia (UWA) node. UWA is the only institution in the world to house both a Cameca IMS 1280 large-geometry ion probe and a Cameca NanoSIMS 50. The IMS 1280 ion probe was delivered late last year, following an arduous journey from the Cameca factory in Paris. With its commissioning in April, the Centre for Microscopy, Characterisation and Analysis (CMCA) significantly improved its already world-class capabilities.

In front of an assembled crowd of 100 invited guests Senator Carr and UWA Vice-Chancellor Prof. Alan Robson unveiled a ceremonial plaque to commemorate the occasion. Senator Carr then cut a ribbon to officially open the new facility. Prof. Robson said the Cameca IMS 1280 would enable the university to extend beyond its existing record of scientific achievement to reach new levels of international excellence for the benefit of the whole community.

The ion probes perform secondary-ion mass spectrometry (SIMS), and work by bombarding samples with a high-energy ion beam and analysing the near-surface atoms that are ejected from the sample.

The new IMS 1280 instrument is optimised for high-precision elemental and isotopic ratios, in-situ, from areas as small as a few micrometres. This is particularly useful for measuring isotope ratios in minerals to determine where they formed and how they have been affected by mantle or crustal processes. World-leading researchers are already lining up to use the new facility. Some of the projects being developed at this early stage include exploring early life on Earth, detecting microscopic signatures indicative of new ore deposits, and mapping the migration patterns of extinct mammals based on the chemical signatures hidden in their fossilised teeth.

The launch of this top-of-the-range instrument, and its significance for Australian research excellence, was picked up and reported by a wide range of media. It was featured on the Channel 10 evening news, with a story on the IMS 1280 research capability and comments from Assist/Profs John Cliff and Matt Kilburn. In the ensuing weeks its capabilities were also brought to the fore in innovation and business publications including the innovation website and magazine *Fast Thinking*, the *Australian Mining Review* and the *Australian R&D Review*, along with the *UWA Western Australian Business News* supplement. The September issue of the *Australian Microscopy and Microanalysis Newsletter* also featured the IMS 1280 in its cover story.

There is bound to be much interest in, and activity around, this instrument from academia and industry alike and its impact on research should be considerable. ■

The Minister for Innovation, Industry, Science and Research, Senator, the Hon. Kim Carr interviewed by Channel Ten during the official launch of the new flagship instrument.

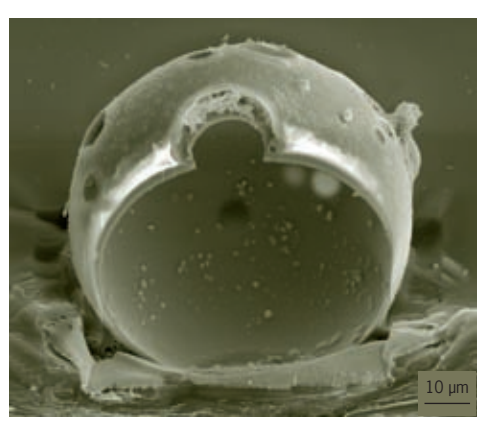
RESEARCH

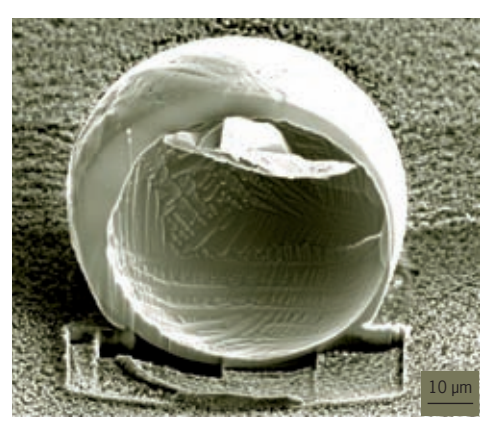
FIBing – firearms or fireworks?

AMMRF @ SARF

The forensic detection and identification of gunshot residue (GSR) particles on suspects, victims and objects provide evidence in criminal investigations. GSR particles are routinely analysed by scanning electron microscopy, and energy-dispersive X-ray spectroscopy to detect the constituent elements.

Originally, the composition of all GSR was consistent and unique; however, more recently, new formulations have started to be used, complicating forensics considerably. It is now far more likely that small particles similar to GSR could be present on suspects from other less-suspicious sources such as brakes linings, fireworks and welding. Ivan Sarvas from Forensic Science South Australia and colleagues from around the country and from the USA are investigating the internal structure and composition of a variety of these particles using the focused ion beam at the AMMRF at the University of Adelaide to slice the particles in half to look inside. GSR is formed at extremely high temperatures and pressures and also cools extremely fast, leaving telltale signs in the particles' internal structure. It shows an amorphous structure throughout, but a particle from a sparkler was crystalline. The detection of these differences is the first step to a clearer resolution of evidence involving GSR, and more wide-ranging work is continuing. ■





GOVERNANCE

Meeting the National Research Infrastructure Council

From left to right: Prof. John Drennan, John Ryan, Julia Evans, Prof. Paul Munroe and Dr Miles Apperley.

During September Mr John Ryan, Chair of the newly formed National Research Infrastructure Council (NRIC) and Ms Julia Evans, General Manager of the Research Infrastructure Branch, Science and Infrastructure Division, at the Department of Innovation, Industry, Science and Research (DIISR) visited the AMMRF at the University of Sydney.

Both visitors are taking up the reigns in their new roles, and were keen to gain an insight into the structure and operation of the AMMRF and to become familiar with an NCRIS facility 'at work'. The visit also provided an opportunity for Mr Ryan to meet with senior AMMRF staff and outline the role and operation of NRIC, which has replaced the NCRIS committee.

The AMMRF Scientific Director Prof. John Drennan, Technical Director Prof. Paul Munroe and General Manger Dr Miles Apperley were on hand to explain all things AMMRF and guide Mr Ryan and Ms Evans on a tour of the Sydney node, which included the flagship local electrode atom probe suite along with the rest of the instruments and people that comprise a busy multi-user facility. This important combination of instruments, and people with expertise in running them, was emphasised as a critical element in infrastructure funding, which would enable us to continue delivering world-class research outcomes in the future. ■

LAB NEWS

Fidel Castro, Jr. visits to talk science

AMMRF @ USYD

On 20 October 2009, Dr Fidel Castro Díaz-Balart, Scientific Advisor of the State Council of Cuba, visited the University of Sydney as part of a visit by a Cuban delegation, coordinated by the Commonwealth Government's Department of Innovation, Industry, Science and Research. Dr Castro is the eldest son of Fidel Castro, the former prime minister and later president of Cuba. He and the rest of the Cuban delegation were here to examine Australia's research in the fields of biotechnology, nanotechnology, and nuclear science, looking for opportunities for collaboration and exchange of ideas. As part of his visit, Dr Castro visited the Australian Key Centre for Microscopy and Microanalysis and was particularly interested to learn about the innovative collaborative structure of the AMMRF and to see the facilities and the research done within one of its nodes. He was fascinated by the detailed tour of the some of the unit's major instruments and laboratories, led by the AMMRF CEO, Prof. Simon Ringer, and was keen to meet the students and staff doing the work.

Dr Castro has an extensive scientific and research background. He received a masters degree in nuclear physics and a PhD in physical-mathematical sciences from Russian institutions during the 1970s, and did post-doctoral research in nuclear-power generation in Moscow. In later years, he also undertook a masters degree in strategic planning and higher management and he was awarded a doctor of sciences in 2000. Dr Castro has received several prizes and distinctions during his career and has more than 150 scientific publications and 10 books. ■

ITUAG in the USA

Several members of the AMMRF International Technical and User Advisory Group (ITUAG) gathered together for the Microscopy and Microanalysis 2009 conference in Richmond, Virginia. This opportunity was seized and a meeting of the ITUAG convened. Members met key AMMRF staff and were briefed on AMMRF operations and performance. The AMMRF Scientific Director, Prof. John Drennan lead a discussion on what future trends and emerging technologies will impact on microscopy and microanalysis in the future. ■

RESEARCH

A boost for research

With the recent grants announcements made by the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) for next year, researchers across the country were finally released from long months of suspense. Among the pleasantly surprised applicants were a number of the AMMRF's academics and researchers who collectively received nearly $7.5 million in research funds. This represents 12 grants: six Discovery Projects, two Linkage Projects and one Future Fellowship from the ARC, and three NHMRC Project Grants.

The scope of research funded by these grants is understandably broad, yet focussed towards major national or global challenges. For example, one project will seek to exploit and improve plant's natural defences to increase their resistance to insect attack, while another will create advanced materials and technologies that will underpin Australia's future water resources. Still another will develop a high-resolution optical imaging technique that will allow clinicians to 'see' the mechanical properties of tissue and so diagnose diseased areas.

While these projects and grants contribute primarily to the local research at the nodes, they also support the AMMRF's service of the wider user community. This support has also undoubtedly helped many of our users to gain success in their grant applications.

Outcomes from the ARC's Linkage Infrastructure, Equipment and Facilities (LIEF) scheme, which helps the AMMRF provide new instruments each year, will be made known during November as the current edition goes to print. ■

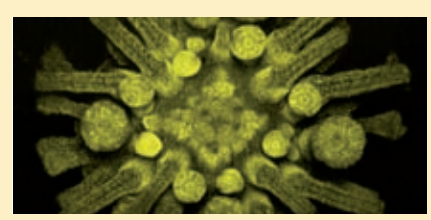
EXECUTIVE DIRECTOR'S COLUMN

As we approach the end of the year we can start to catch our breath after a very busy and eventful period. A highlight that you can read about in the cover story was the opening of the Cameca IMS 1280 ion probe at the Centre for Microscopy, Characterisation and Analysis at the University of Western Australia by Senator, the Hon. Kim Carr, Minister for Innovation, Industry Science and Research. We have all followed the progress of this high-specification instrument as it was constructed in Paris, flew into Adelaide, was trucked across the Nullarbor Plain and finally came to rest alongside its sister instrument the NanoSIMS 50. Its official launch by the minister in August was a great opportunity for us to press home the AMMRF message of accessible high-end instrumentation plus expertise and its importance for Australian research. Senator Carr was very engaged with the opportunities offered by the new instrumentation, and indeed by the whole AMMRF, and talked enthusiastically with the media on its benefits.

Within his department, the NCRIS team has recently been evaluating the effectiveness of their programs. The analysis covered the economic angle, and the impact on research outcomes. Of course we regularly report on all aspects of our operation to both the commonwealth and state governments but this was different and extremely important for us. Forty-four questions on how we work within the framework and demonstrations of how the program adds value to Australian research. We were determined to contribute an appropriately comprehensive and considered response and while it took considerable time and input to pull it all together, I think it was in the end, a worthy, if somewhat lengthy, response. We have subsequently also taken part in two sets of interviews, one with the economic consultants and another with the scientific panel to provide further in depth information.

Finally, as it is the season of celebration, I think we can justifiably add our many AMMRF successes into the celebratory pot. As you will see in the 2009 Profile that accompanies the News, these are numerous, from exciting research outcomes and industry partnerships to the satisfaction felt by so many of our users on a daily basis. Please celebrate these successes with us and have an enjoyable and rejuvenating festive season. ■

Regards,
Simon Ringer, Executive Director & CEO



RESEARCH

Detecting drug resistance in malaria parasites

AMMRF @ UWA

Rapid detection of drug resistance in malaria parasites is important in selecting the right treatment for those suffering from this life-threatening disease. In a collaborative project between Stephan Karl and Rina Wong, PhD students at the University of Western Australia (UWA), under the supervision of Prof. Tim St Pierre from the Department of Physics and Prof. Timothy Davis from the Department of Medicine and Pharmacology respectively, a new and rapid method to measure drug resistance in *Plasmodium falciparum*, is being developed.

P. falciparum is a causative agent of human malaria and the parasites grow inside red blood cells where they replicate every 48 hours. Over this time the parasites synthesise DNA inside the red blood cells, which otherwise don't contain any DNA. As the parasites mature, the DNA content increases and can be detected by the binding of inexpensive DNA-specific fluorescent dyes. By using flow cytometry it is possible to measure the DNA content of the red blood cells based on the fluorescence. If the parasites are grown with inhibiting drug concentrations, the DNA synthesis will be delayed or halted, and this too, can be detected.

The flow-cytometry facilities at the Centre for Microscopy, Characterisation and Analysis at the UWA, have allowed the team to develop their assay. It needs very few cells and very little reagent, making it highly cost effective, around only 10% of the cost of other commonly used assays. It is also very time efficient, with a high-throughput flow cytometer being able to process a 96-well plate in about 20 minutes. Furthermore, due to its sensitivity, detection time is halved requiring only a 24-hour incubation with the drug while most other assays rely on an incubation time of 48 hours.

Although flow cytometry is still largely unavailable in malaria endemic regions, if made available, this method could be used to test very small sample volumes of blood, such as obtainable by a finger prick (in contrast to collection of venous blood), allowing large scale, cross sectional studies on *P. falciparum* drug resistance using in-vitro techniques without causing excessive discomfort to the affected people. ■

LINKED LABS

New director

Prof. Brent McInnes has been appointed as Director of the John De Laeter Center for Mass Spectrometry at Curtin University, a Linked Laboratory of the AMMRF. He holds joint appointments as research professor at Curtin University and chief research scientist at CSIRO Earth Sciences and Resources Engineering Division. Educated in Canada and trained at the California Institute of Technology, he is the author of many articles on geology and geochemistry, including publications in *Nature* and *Science*. He is the recipient of the 2003 CSIRO Chairman's Gold Medal for Research Excellence for work in the area of marine geology, and won the 2007 CSIRO National Service from Science Award. An Australian-American Fulbright Professional Business/Industry Fellowship in 2007 supported him as a visiting scientist at the NASA Goddard Space Flight Center. ■

PC4 lab – work kicks off

Construction has begun on the physical containment level four (PC4) space at CSIRO's Australian Animal Health Laboratory (AAHL) in Geelong. Due for completion in late 2010, the new PC4 space will incorporate the AAHL Biosecurity Microscopy Facility (AMBF), a Linked Laboratory of the AMMRF. Researchers will be able to work with the most hazardous human and animal pathogens within the new facility.

The new PC4 space is being established within AAHL's existing high biocontainment facility, making its construction complicated. As one of the world's most sophisticated laboratories for the safe handling and containment of infectious organisms, everything leaving the AAHL biocontainment area has to be treated in some way. Air is filtered, sewage is heat-treated, solid waste is incinerated and scientists must take a personal shower.

Construction Project Manager, Mr Allan Kershaw, explains that part of the existing biocontainment space was sectioned off, including the associated air handling and sewage treatment systems. "Then the area was decontaminated and opened up to the outside world, providing our construction workers with relatively easy access," he said.

Once the construction works are complete, the area will be sealed off again, rejoining the AAHL microbiologically secure airtight 'box'. The new PC4 facility will be one of Australia's largest, available at a subsidised rate for Australian publicly funded research organisations. ■

Left to right: Andrew Munro, Department of Innovation, Industry Science and Research (DIISR), AAHL Director Martyn Jeggo and Allan Kershaw, NCRIS Construction Project Manager, inspect the works.

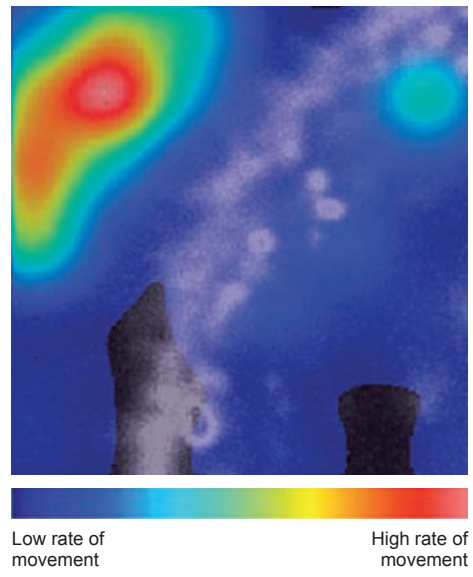
TECHNOLOGY

What is raster image correlation spectroscopy?

The rate of movement of individual molecules in live cells can be measured using fluorescently-labelled forms of the molecules of interest. However measuring molecular movement in live cells with high spatial and temporal resolution as well as high sensitivity poses significant challenges. Earlier this year Dr Jennifer Clarke and Yvette DeGraaf from Flinders Microscopy (part of SARF) spent three weeks at the Laboratory for Fluorescence Dynamics (LFD) at the University of California, Irvine, where techniques based on image correlation spectroscopy are being developed by Prof. Enrico Gratton and Dr Michelle Digman.

Raster image correlation spectroscopy (RICS) exploits the time-related information that exists in sequential laser-scanned images to correlate fluorescence intensity fluctuations over time on a pixel-by-pixel basis. Data from fluctuations in fluorescence intensity can be analysed as a function of time and space by autocorrelation mathematics to reveal information on diffusion, binding, flow and the state of molecular aggregation. RICS is able to provide highly detailed positional and time-resolved data on the movement of the labelled molecules in the microsecond to second range with single molecule sensitivity. Importantly, RICS can reveal fast molecular movement by filtering out the slower bulk cell movement, which is invaluable as many cellular components are constantly in motion. Furthermore, RICS software has been designed to be suitable for use on data from most commercially available confocal laser scanning microscopes.

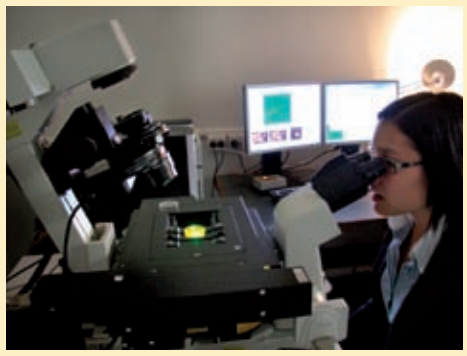
The image shows the average intensity of a labelled protein in grayscale (the white dots indicating a concentration at the cell membrane and within vesicles) overlaid on a colour-coded image of the rate of movement of the same protein. The data is assembled from 100 raster-scanned image frames. ■



IN BRIEF

Flagship engineers, Assist/Profs John Cliff and Matt Kilburn from the Centre for Microscopy, Characterisation and Analysis at UWA, recently visited Vienna for a **Consultants Group Meeting at the International Atomic Energy Agency (IAEA)**. The IAEA monitors global nuclear activity as part of the Nuclear Non-Proliferation Treaty. One important task involves determining the degree of ^{235}U enrichment in particles recovered in countries suspected of having illicit weapons programs. Detecting a single particle of uranium in a swipe containing millions of minute dust particles is like looking for a needle in a haystack, but it's relatively straight forward for the flagship Cameca IMS 1280 ion probe. Automated software locates individual particles and then measures the isotopes of uranium. UWA is currently exploring the possibility of becoming part of the IAEA's network of analytical laboratories, using the ion probe to perform analyses that may have profound implications for nuclear security. ■

The UNSW node has a new environmental scanning probe microscope configured for observation and nano-characterisation of inorganic and device materials.



The JEOL JSPM 5400 MkII eAFM, has a range of atomic force imaging modes that may be operated in ambient and high-vacuum conditions during imaging. Modes include contact, intermittent contact and non-contact topography, current imaging, piezo-response force microscopy and magnetic force microscopy. A cold stage is available for low temperature experiments. ■

Two new instruments have been installed at the UWA node. The new Nikon A1 confocal microscope (left) offers four excitation laser lines, a spectral detector and a TIRF capability. The spectral detector allows distinction between fluorophores with similar emission spectra, such as GFP and YFP. TIRF allows detection of fluorophores at the interface with a coverslip and the examination of features on, or very near, the cell surface. The Nikon's incubation chamber is already being used to perform time-lapse experiments on human egg maturation.

The BD Influx high-speed micro cell sorter (right) is able to resolve and sort small objects from less than 0.5 µm up to 25 µm. This allows sub-cellular particles such as organelles and chromosomes, or microorganisms such as bacteria and parasites, to be resulting in high purity and excellent recovery. Very rapid sorting of large numbers of particles or cells, combined with high yield, allows the isolation of previously undetectable, very rare populations of cells. Dr Kathy Heel and Tracey Lee-Pullen from the CMCA will be visiting the USA early in December for further training. ■

STAFF NEWS

The University of New South Wales

In September, **Dr Warren McKenzie** joined the Electron Microscope Unit as a research associate. He has already begun playing an active role, providing advisory, analytical and technical support to researchers from the materials and physical sciences. Warren is well acknowledged for utilising modern electron microscope facilities in resourceful ways. Before joining UNSW he played key roles in managing and modernising a full-scale electron microcopy facility in Trinity College Dublin, Ireland. Warren has BSc and PhD degrees in materials science and a MCom degree in finance from UNSW. ■

The University of Western Australia

Alynka Youngman has recently joined the Centre for Microscopy, Characterisation and Analysis as Centre Manager. Although fairly new to the university sector she has a diverse background, having worked with Wesfarmers, a family antique business and the NGO World Vision Australia in roles that have included investor relations, operations management, personal assistant, project manager and an IT-based business analyst. Having relocated from Melbourne, Alynka spent the last six months as executive assistant to the Dean of the Faculty of Engineering, Computing and Mathematics and has been finding her way around the workings of the university. ■

COMMUNITY

Node Director shares his knowledge in Malaysia

AMMRF @ UNSW

It is always gratifying when our expertise is recognised on the international stage and this is the case for Prof. Paul Munroe who has been appointed as a Visiting Professor at the University of Malaya. Invited by his counterpart within the university, Prof. Haseeb, he recently visited Malaysia and gave a two-day workshop entitled 'Introduction to Nanometric Characterisation of Materials by Transmission Electron Microscopy'. Around 30 people eagerly attended the course, mostly postgraduate students from the University of Malaya, but also students from other institutes in Kuala Lumpur. The course covered all elements of transmission electron microscopy, including specimen preparation, theories of image contrast and microchemical analysis. It was enthusiastically received by all the participants, especially as Prof. Munroe took the time to personally meet with some 15 research students to discuss their thesis work in detail, providing individually tailored, expert advice in microscopy and microstructural analysis. The visit has also resulted in one of the students coming to do some electron microscopy at the University of New South Wales. ■

Prof. Paul Munroe (on left) and students of the two-day workshop 'Introduction to Nanometric Characterisation of Materials by Transmission Electron Microscopy' in Kuala Lumpur.

RESEARCH

Congratulations Professor Jin Zou

AMMRF @ UQ

We congratulate **Prof. Jin Zou**, a reader at the AMMRF at the University of Queensland, who has won one of the prestigious ARC Future Fellowships. It will allow Prof. Zou to investigate the role of catalysts in the growth of nanowires, through detailed nano-characterisation.

In general, nanowire growth is mediated by nano-sized metallic catalysts, which are necessary, but can significantly complicate the growth process. The new knowledge developed from this project will have a significant impact on the future design and manufacture of practically useful nanowire-based nanodevices.

A number of AMMRF users around the country have also won Future Fellowships and will be making the most of the microscopy facilities available to them. ■

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