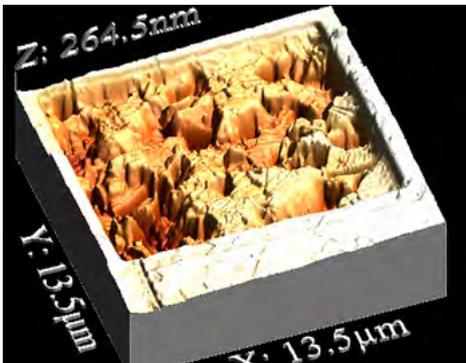




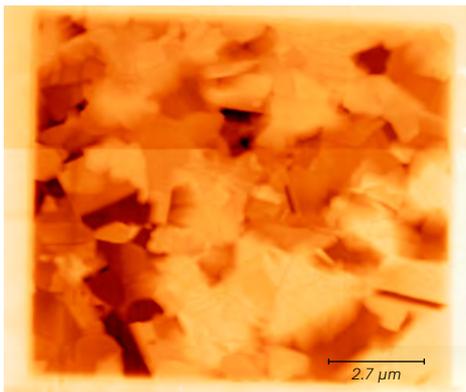
IN THIS ISSUE

- 01 A WORD FROM THE LAB MANAGER
- 03 MEET YOUR TECHNICAL TEAM
- 06 TKD IN THE SEM
- 07 INCREDIBLE INNER SPACE AT CUSTOMS HOUSE
- 08 WHAT'S ON
HELP US TO HELP YOU

FEATURED MICROGRAPHS



Atomic force microscopy images of a copper surface after FIB milling. It is the same dataset displayed in 2D and 3D. The data was captured on the PicoSPM and is part of a study into the analysis of grain crystal orientation on ion sputtering yield. Images by Steve Moody.



A WORD FROM THE LAB MANAGER

BY ELLIE KABLE

As a University core research facility we provide high-quality, value-added services to the University research agenda. In this issue we take a closer look at the technical team that enables your research endeavours and the superb capabilities on offer here at Sydney Microscopy & Microanalysis.

What a busy year it has been here at SMM! We've enjoyed seeing new and familiar faces in our hallways and on our microscopes. While we have gone through some organisational changes in the past year, the technical team remains a cohesive unit, extremely qualified in microscopy and microanalysis. We are in this team because we love enabling other people's research and developing the skills of new waves of microscopists.



For me, one of the greatest rewards from my work is to see a user I've trained become a confident scientist. It's great to enable someone to answer the question they set out to and realise research possibilities they could not have imagined before. It is fabulous to be invited to their talks and be sent copies of their papers and posters.

Training users is a virtuous cycle, because as we train we are also learning, which helps the next generation of users. One-to-one training and service means our staff tends to form unique relationships with users. This sometimes leaves users feeling they can't solve their problems with anyone else in the team.

I would like to take this opportunity to remind you to make use of our Duty Microscopist (DM) service. There is always a DM on duty during normal business hours (9am to 5pm, Monday to Friday). Once you achieve Category 2 access, your first point of contact if you have any problems should be the DM. The DM will either solve your problem or find help for you the fastest. Our DM service is available to ensure you are using the microscope productively for the whole of your session.

Thank you to the researchers who participated in our annual user satisfaction survey earlier this year. Your feedback is important and helps us to continuously improve our services. However, please don't wait until this survey comes out if you have any ideas or observations about how we can improve. You can email me at eleanor.kable@sydney.edu.au or feel free to come and chat about any aspects of the SMM operation and especially about your achievements that we have made possible with our technical assistance and microscopes. My door is always open to you.

As SMM's Lab Manager it is my responsibility to manage each of the laboratories in our centre and to develop training for staff and users. I provide operational and strategic support to our Director, Prof. Simon Ringer and am particularly involved in the integration of lab activities at Sydney and at other Australian Microscopy & Microanalysis Research Facility (AMMRF) nodes.

One of my personal achievements this year was the introduction of the Confocal Microscopy MyScope unit (ammrf.org.au/myscope/). This has been developed in conjunction with my AMMRF colleagues. Here at Sydney University we have been incorporating the SEM and Confocal module as pre hands on training as well as undergraduate courses. All the MyScope modules are great online learning tools and your feedback is greatly appreciated as we continuously upgrade them.

For me, one of the greatest rewards from my work is to see a user I've trained become a confident scientist.

My original background was in medical research. I fell in love with microscopy when I had a stint in the US in a biophysics lab and contributed to the first multi-photon paper.



On returning to Australia I worked for four years in the Pharmacy department on heart research and then joined the ACMM as a light/optical specialist. I've been Lab Manager here for 10 years now, while continuing to be involved in training and collaborating with a small number of projects when time permits. While still enjoying teaching users about basic light and confocal microscopy, I like to learn new advanced techniques and the multiphoton microscope is my favourite.

Solving complex 'structure-function' problems often requires multiple modes of microscopy. Our superb capabilities coupled with the diverse range of technical expertise of our staff are here to help you answer your research questions. I hope you enjoy getting to know the people I'm very proud to work with in the Meet Your Technical Team story starting on page 3.

We look forward to seeing you in our hallways and to serving your research agendas on our microscopes in 2014 and beyond!

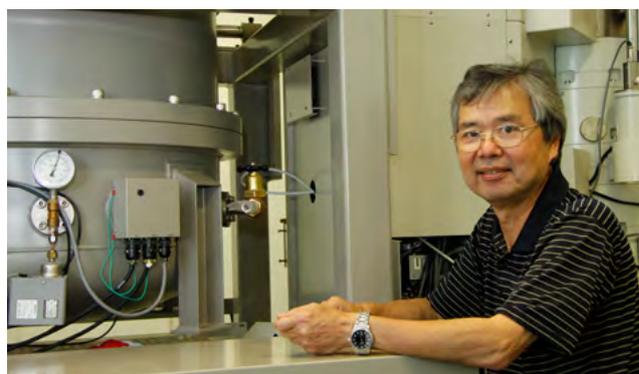
MEET YOUR TECHNICAL TEAM

Take advantage of SMM research services – our interdisciplinary team has the skills to translate instrument capability into outcomes for researchers. As you develop new research proposals, we encourage you to contact us to explore our superb capabilities for imaging & analysis using light, lasers, X-rays, electrons and ion-optical systems. Meet the team and learn how they can play an enabling role in your research endeavours.

TOSHI ARAKAWA, INSTRUMENTATION SPECIALIST

Toshi's years of experience in the field of service for microscopes is an invaluable asset to the SMM team. He minimises instrument down time and maximises their effectiveness for user experiments.

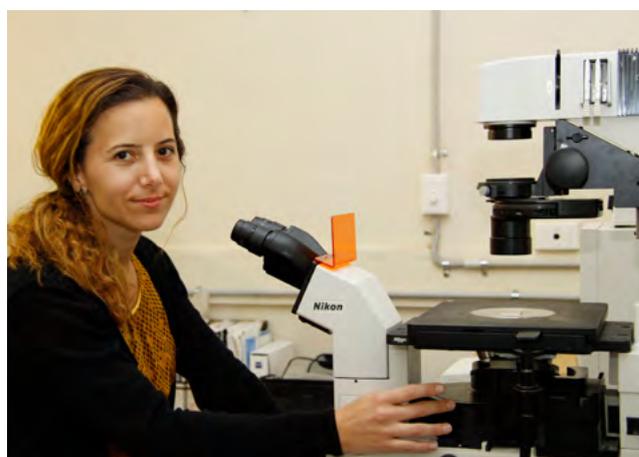
In my area: *"Keeping SMM's diverse range of state-of-the-art instruments in top operating condition is a rewarding challenge. It's particularly satisfying when we achieve a standard of performance from our instruments that is higher than the manufacturer's performance expectations."*



SHERIN CHIKHANI, BIOLOGICAL TECHNIQUES

After completing a Bachelor of Science Degree with a Masters in Molecular Genetics, Sherin worked as a research assistant at Sydney University for four years. She was involved in investigating the role of ascorbate in transferring iron uptake in cancer cells and researched the iron-regulated metastasis suppressor gene in tumor progression. We welcomed Sherin to our team as a general microscopist in March this year.

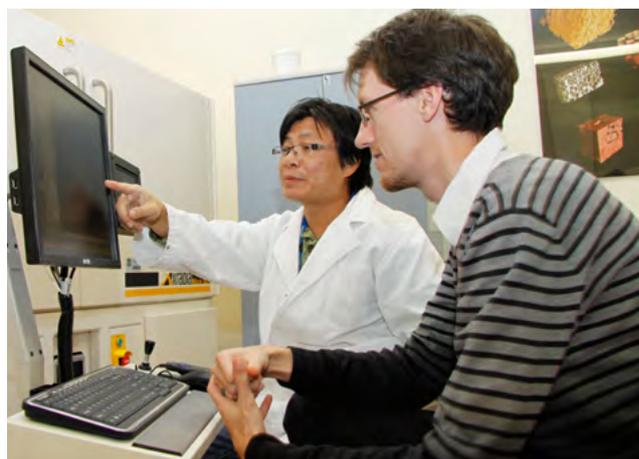
In my area: *"The superb capabilities offered at our facility attract many different kinds of research. It's really exciting for me to be involved in such a diverse range of projects, from material engineers looking at cell adhesion on scaffolds, to chemists making spheroids, to biologists trying to find a cure for cancer."*



MATTHEW FOLEY, X-RAY & IMAGE ANALYSIS

Matt (on the right in the photo) has a PhD in materials characterisation, with a strong electron microscopy research component and extensive experience with X-ray diffraction. Matt's great at working with researchers to develop in-depth methodologies to extract data from their images.

In my area: *"There's lots of exciting developments at the moment. The Xradia NanoXCT, which gives us the ability to perform high resolution 3D imaging in a non-destructive manner, is back up and running. In initial user experiments it delivered promising results with images down to ~50nm feature sizes across a sample. New computers and software packages for 3D visualization have also arrived, giving us top of the range XRD and 3D image analysis opportunities."*



NAVEENA GOKOOLPARSADH, BIOLOGICAL SPECIMEN PREPARATION

In addition to a Bachelor of Science degree in Medical Microbiology & Immunology, Naveena has a Masters in Microscopy & Microanalysis. She has worked at Prince of Wales Hospital Anatomical Pathology department, where she developed many skills in histology. She also worked as a Research Officer at the Australian National University's Centre for Advanced Microscopy before joining the SMM team in 2011. She provides training and support in biological specimen preparation for electron microscopy.

In my area: *"Over the years I have developed expertise in dealing with a wide range of biological specimens including cultured cells, bacteria, plant and animal tissue. I seek to optimise existing protocols in the preparation of each biological specimen in order to obtain reliable and informative results for users. Besides chemical methods of preparation, I've been exploring cryo methods, including high-pressure freezing, freeze substitution and cryo-sectioning, with promising results."*



HONGWEI LIU, TRANSMISSION ELECTRON MICROSCOPY (TEM)

Hongwei brings his expertise in materials science and engineering to the SMM team, enabling research in the areas of:

- crystallography of phase transformations
- nanocomposite structures & crystal growth
- 3D tomography and Cryo-TEM
- in-situ TEM techniques using heating (up to 1000°C)
- deformation and electrical conductivity measurement

In my area: *"SMM is a perfect platform to extend my microscopy and nanoscopy abilities across a broad range of materials. Our centre currently runs seven TEMs which serve biological, chemical, physical, geological and metallurgical research fields. I enjoy developing novel TEM solutions for researchers at all stages of their experiments."*



STEVEN MOODY, SCANNING ELECTRON MICROSCOPY (SEM), FOCUSED ION BEAM (FIB),

Steve supports researchers in FIB-based sample preparation, SEM, atomic force and scanning tunneling microscopy. His studies focused on nanotechnology which translates into a predominantly physics background, with additional knowledge in chemistry, biology and materials. Over eight years working with SEMs has given Steve great depth of knowledge in many techniques with a wide range of specimens to optimise the research outcomes of users.

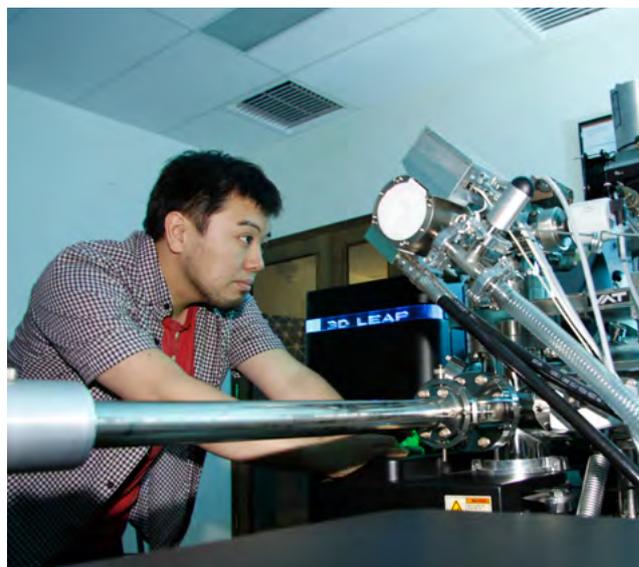
In my area: *"In addition to training researchers in FIB based and atom probe tomography preparation, I am currently working towards adding electron beam lithography to our array of available techniques in 2014 and am also looking into the possibility of adding cathodoluminescence to the mix. Stay tuned..."*



TAKANORI SATO, ATOM PROBE

As a mechanical engineer and materials scientist, Takanori brings great expertise in metallurgy, especially light alloys and deformation to the SMM technical team. He has worked with a variety of electron microscopy techniques here and in his previous roles at the University of Canterbury and with Fuji Heavy Industries. He is responsible for the two CAMECA LEAP atom probes and is the best person to contact for atom probe microscopy and transmission electron microscopy special holder techniques.

In my area: *“Research in atom probe microscopy has expanded from traditional metallurgy to other creative applications in functional materials and this has increased usage across our systems. The UV laser atom probe which was installed a year ago is now booked out every day and generating excellent research output. The older Dingo LEAP system is now back in service after a recent repair.”*



ADAM SIKORSKI, MATERIALS SPECIMEN PREPARATION

Adam's Masters Degree in Material Engineering coupled with over 30 years' experience in sample preparation can help you to prepare even the most difficult samples for TEM and SEM study. His extensive expertise in tripod polishing, ion beam and electro polishing techniques makes him the best person to consult when you need to prepare any metal or semi conductive samples for a SEM or TEM.

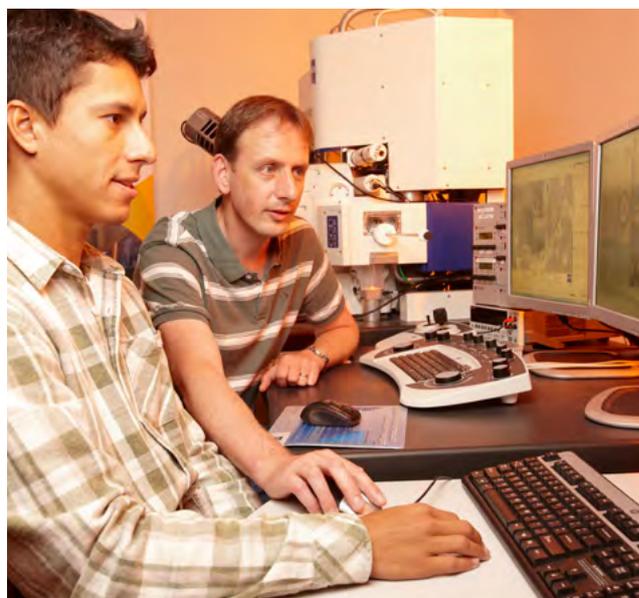
In my area: *“In the Materials Spec. Prep. Lab I continue to support users with a range of equipment to cut, polish, make epoxy blocks and thin samples. Good preparation is critical to optimise the results users achieve from their SEM and TEM beam time.”*



PATRICK TRIMBY, SCANNING ELECTRON MICROSCOPY (SEM) & MICROANALYSIS

While Pat's original background is in the geological sciences, he also worked extensively with materials scientists during a decade of commercial electron microscopy work before joining the SMM team in 2010. Since then he has enjoyed a continued education in the application of SEM to the life sciences – long may that continue!

In my area: *“It's an exciting time to be looking after the SEMs at Sydney Microscopy & Microanalysis. Our Zeiss Ultra is as busy as ever, not least due to the success of the upgraded EBSD/EDS system installed in 2012. The good news for users battling for time on this instrument is that we have installed a new, top of the range EDS system on our Zeiss EVO, complete with automated particle detection software. We're also purchasing a new FEG-SEM equipped with an in-situ 3D microtome system, due to be installed in mid 2014. In addition, we recently welcomed back our EDS system on the Hitachi S4500, giving that instrument further analytical capability. Lots to look forward to here!*



COMING SOON! LIGHT & OPTICAL MICROSCOPIST

We are currently in the process of employing a fabulous new light and optical specialist who will be introduced to you soon. This new microscopist will be able to keep our team and users at the cutting edge of this technology.

For staff contact details visit sydney.edu.au/acmm/about/staff

TKD IN THE SEM

Dr Patrick Trimby takes electron backscatter diffraction down to the nanoscale with transmission Kikuchi diffraction in the scanning electron microscope.

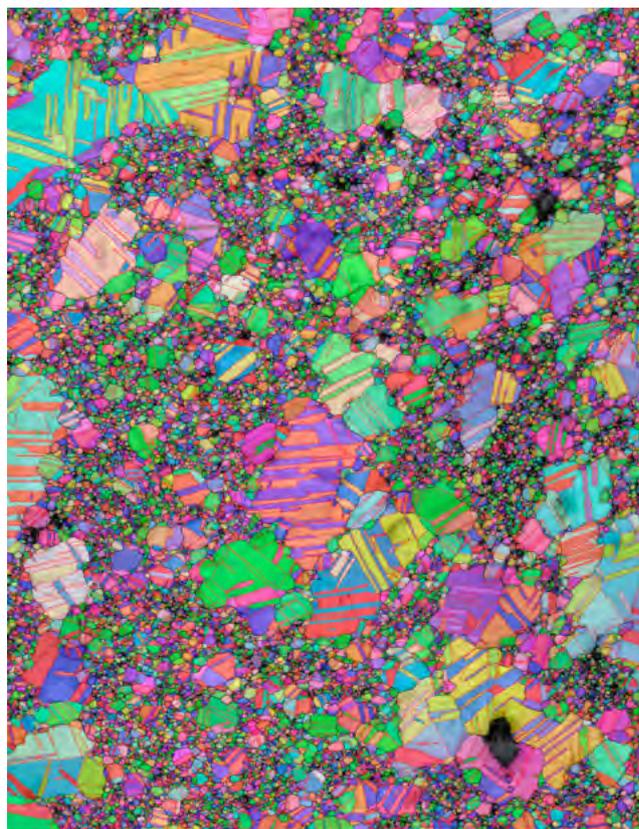
Electron backscattered diffraction (EBSD) has, for many years, been the technique of choice for the rapid characterisation of microstructure and microtexture in the scanning electron microscope (SEM). However, the ongoing push into the truly nanoscale world has left EBSD struggling: it has become harder to resolve features of interest as grain sizes dip into the realms of a few hundred or even a few tens of nanometres. Work published last year by researchers at the National Institute of Standards and Technology in the United States showed how a conventional EBSD system in the SEM could be used to measure diffraction patterns from electron-transparent TEM samples, with resolutions below the ten-nanometre level. They called this transmission-EBSD.

Based on this work, Pat Trimby, SEM Manager, developed a practical technique for nanoscale characterisation, adapting transmission-EBSD to enable automated orientation mapping of nanostructured materials in the SEM. These advances were published in the September 2012 edition of *Ultramicroscopy*, and have resulted in a more accurate name for the technique, namely transmission Kikuchi diffraction in the SEM (SEM-TKD).

With SEM-TKD the sample is kept horizontal at a short working distance in the SEM. The diffraction pattern is projected from the lower surface of the electron transparent region and collected using a standard EBSD detector. The short acquisition times (typically 10-25ms), enable orientation mapping of over 100 μm^2 with measurement spacing in the 2-20nm range.

This approach has been successfully taken up by technical staff and researchers here at SMM and is being routinely used to characterise a wide range of very fine-grained nanomaterials at high speed and with sub-10nm spatial resolution. This technique is has resulted in six publications from SMM staff and users. The most recent paper accepted in *Acta Materiala* shows how SEM-TKD can be applied to a range of different deformed materials.

Early applications of SEM-TKD have focused on aluminium alloys deformed using high pressure torsion (HPT), in conjunction with researchers at the University of Sydney's School of Aerospace, Mechanical & Mechatronic Engineering. This work was published in *Materials Science and Engineering A* (Tugcu et al., 2012). Further work has primarily looked at the analysis of samples that have been



An orientation map collected using transmission Kikuchi diffraction in the SEM (SEM-TKD) showing nanocrystalline structures in copper films. The horizontal field width is 6.6 μm . Saritha Samudrala, University of Sydney.

deformed at room temperature: the extreme density of dislocations coupled with the ultrafine grain size renders conventional EBSD analyses almost impossible, yet SEM-TKD has enabled detailed characterisation of these samples at a scale previously only achieved using TEM.

Exceptional results are also being produced in international collaborative research. Saritha Samudrala, working with A/Prof. Julie Cairney and researchers in the United States, is using the technique to study the structures in nanocrystalline copper films used in micro-electro-mechanical systems. These metals have been designed with a mixture of large and small grains for strength and flexibility. SEM-TKD is used to analyse the crystal structures and changes that occur during use. The ability to glean crystal orientation information from grains less than 20nm is unprecedented and this image is an outstanding example of the technique.

Additional benefits of the technique are the ability to simultaneously measure the chemistry, using energy dispersive X-ray spectroscopy, and capture a high-quality dark-field image by using forescatter detectors mounted on the EBSD detector.

If you want to find out more about how SEM-TKD can enable your research endeavours contact Pat Trimby at patrick.trimby@sydney.edu.au

INCREDIBLE INNER SPACE AT CUSTOMS HOUSE

Prof. Mary O’Kane, NSW Chief Scientist and Engineer enthusiastically opened a newly-enhanced version of the exhibition on 24 July in Sydney.

The Australian Microscopy & Microanalysis Research Facility’s touring exhibition, Incredible Inner Space, was recently on display in Sydney. Seven movies set in a 20-metre-long backlit wall with illustrations and six laser-etched crystal sculptures of flagship atom probe datasets augmented the original 28 prints. These additions to the Sydney season of the show highlighted ACMM-based research and the increasingly three-dimensional nature of modern microscopy.

The exhibition occupied the gallery and atrium on the ground floor of the magnificent Customs House building at Circular Quay. It is a freely accessible public thoroughfare, also housing a library and a restaurant. This ensures that the exhibition reached a broad cross section of the Australian public. 108,322 people visited the venue while the exhibition was on. The public response to Incredible Inner Space at Customs House was very positive. The Wollongong Science Centre & Planetarium is hosting the exhibition from 1st December.



HELP US TO HELP YOU

Where microscopy enables your research endeavours, we're counting on you to acknowledge the role our facilities and expertise played in your work.

Acknowledgements demonstrate that investments in equipment and people have led to important outcomes. Your publications, presentations and posters are a vital part of the business case for ongoing funding of the ACMM and SMM. Here is a sample of correct acknowledgement.



"The authors acknowledge the facilities, and the scientific and technical assistance, of the Australian Microscopy & Microanalysis Research Facility at the Australian Centre for Microscopy & Microanalysis, at the University of Sydney."

You can easily access this text anytime on this link:
ammrf.org.au/access/acknowledge-us

WHAT'S ON

SYDNEY TO HOST FOCUS ON MICROSCOPY 2014 (FOM2014)

From Sunday April 13 to Wednesday April 16, 2014, FOM will be hosted at the University of Sydney. This international microscopy conference is the next in a series of unique interdisciplinary meetings on advanced multidimensional light microscopy and image processing. An exciting program of workshops, presentations and posters is planned. For further details on this AMMRF-sponsored event please visit the FOM website: focusonmicroscopy.org



SUMMER HOLIDAY SHUTDOWN

The last day for using the instruments will be Monday 16 December 2013. We will re-open for business on Monday 6 January 2014.

ACMM23/ICONN 2014

The 23rd Australian Conference on Microscopy & Microanalysis (ACMM23) will be held jointly with the International Conference on Nanoscience & Nanotechnology (ICONN 2014) at the Adelaide Convention Centre, South Australia, 2-6 February 2014.

The AMMRF is sponsoring the Best Micrograph Competition at the conference so check out the website below for image specifications and bring prints of your best images to the conference for the chance to win a cash prize.
aomevents.com/ACMMICONN

POSTER COMPETITION - WIN AN IPAD MINI! DEADLINE 29/11

We are looking for great posters to display in the Madsen building. If you've attended a conference this year bring your poster to Room 234 to be in the running to win this great prize.

Posters will be accepted until Friday 06 December, 2013. The winner will be announced at our SMM Christmas party on Thursday 12 December, 2013. What are you waiting for?

COME TO OUR FAMOUS CHRISTMAS PARTY!

1.00pm, Thursday 12 December 2013
Room 238, Madsen Building (F09)
RSVP by 5 December to our email address below.

SYDNEY
MICROSCOPY &
MICROANALYSIS

T +61 2 9351 2351
F +61 2 9351 7682
E acmm.info@sydney.edu.au
sydney.edu.au/acmm

Issue No. 02 2013
Editor: Linda Cassimatis
E linda.cassimatis@sydney.edu.au



THE UNIVERSITY OF
SYDNEY