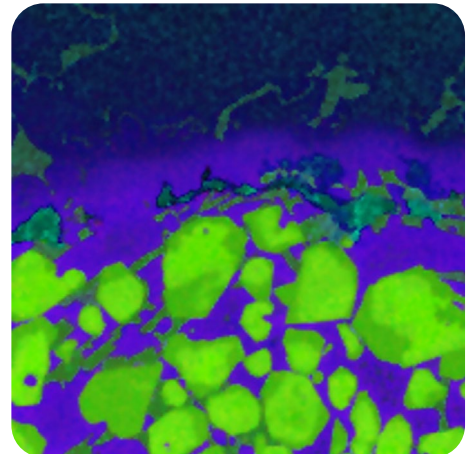
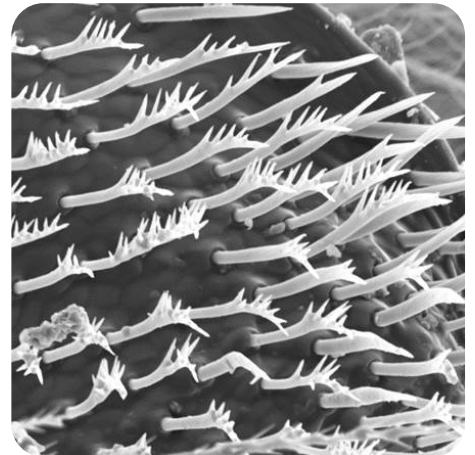
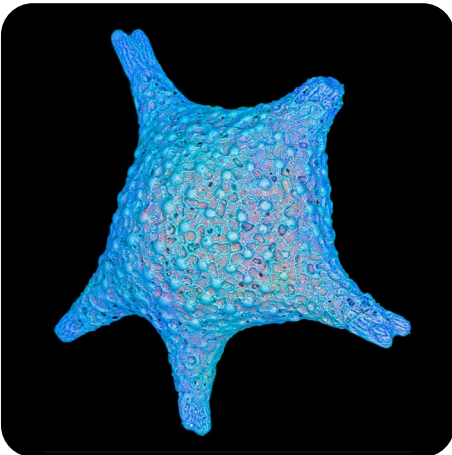
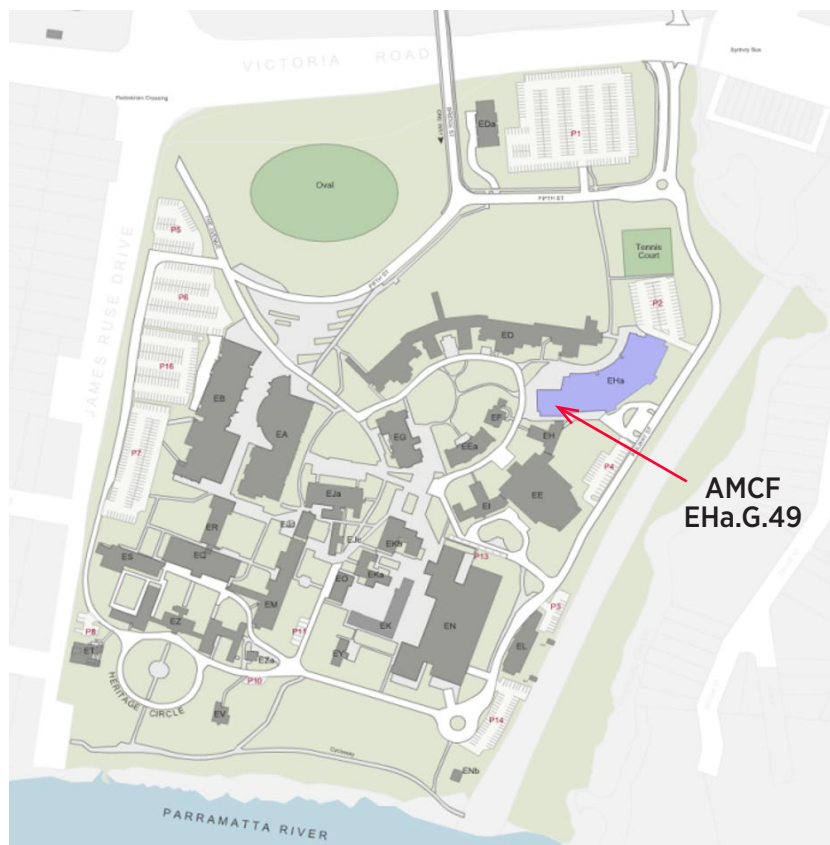




AMCF

Advanced Materials Characterisation Facility



Address

Western Sydney University,
Advanced Materials Characterisation Facility (AMCF),
Parramatta South Campus,
Building EHa G.49,
Victoria Road, Rydalmere NSW 2116

Front Cover Images

Left to right from the top:

- Moss found on a path at Parramatta campus.
- Crystals of an iron coordination complex.
- A flower's stigma.
- A piece of coral sand.
- Dandelion pollen.
- Hairs on a European honey bee's wing joint.
- Wattle pollen.
- The surface of a furry leaf sample.
- An X-ray map of a metal alloy sample.

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12th Edition Newsletter, September 2024

Editors: Laurel George, Daniel Fanna
and Richard Wuhler.

The AMCF is a part of:

**Research Infrastructure
Research Services**

Office of the Senior Deputy Vice-Chancellor and Vice-President (Research, Enterprise and Global)



FROM THE FACILITY RESEARCH MANAGER

It has been a busy year so far!

Since the last newsletter, we have grown with two new technologies; a Single Crystal X-Ray Diffractometer (SC-XRD), and a new generation of micro-CTs. Further to this, we are now collaborating with NewSpec-Hitachi on their STEM outreach program to bring electron microscopes to schools in NSW. NewSpec-Hitachi have provided a benchtop Hitachi SEM which can be taken to schools. This is a fantastic initiative.

The AMCF staff have been busy operating a variety of instrumentation with the many facility users; facilitating a number of courses, workshops and masterclasses offered during the year; providing tours for our international visitors and groups, while organising and facilitating instrument maintenance and software upgrades.

The interest generated in XRD analysis of materials from WSU researchers and industry clients since running the two multi-day workshops last year on Bruker's XRD processing softwares "EVA" and "TOPAS" has kept AMCF staff busy training new users on XRD phase identification and quantification.

The latter half of this year will continue to be busy as we plan to run various introductory lunchtime workshops on the use of instruments and masterclasses on specialised instrumentation and techniques. Currently, we are running smaller group training. As always, we are happy to show anyone our facility. Do not hesitate to contact us for a walk through of our labs.

Dr Richard Wuhrer
Facility Research Manager, AMCF
September 2024

RECENT ACTIVITIES

Visitors to the AMCF Visitors

The AMCF has welcomed a number of visitors and tour groups so far this year who have been interested in our instrumentation and research capabilities. Besides microscopy and microanalysis, the AMCF is extensively involved with x-ray diffraction (XRD), thermal analysis (TGA, DSC and TMA) and vibrational spectroscopy (Raman and FTIR). Some of our visitors have included:

- Steve Milanoski and Stephan Wagner (Western Parkland City Authority, WPCA).
- Tony Tang (Our Lady of Mercy College, OLMC).
- Nester Zaluzec (University of Chicago/Argonne National Laboratory).
- John Teague (WSU's Industry Partnership advisor, Factory of the Future) and a group of partners,
- WSU's WHS team.
- Teachers from Richmond Agricultural College.

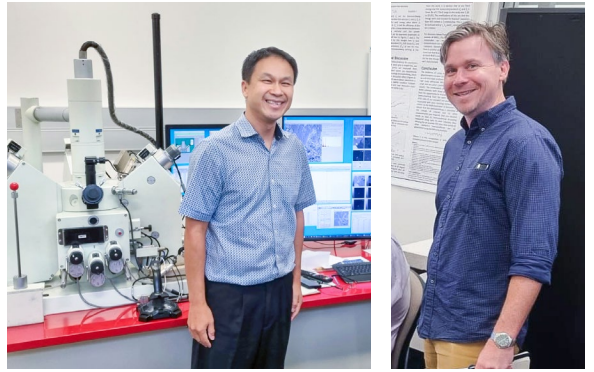
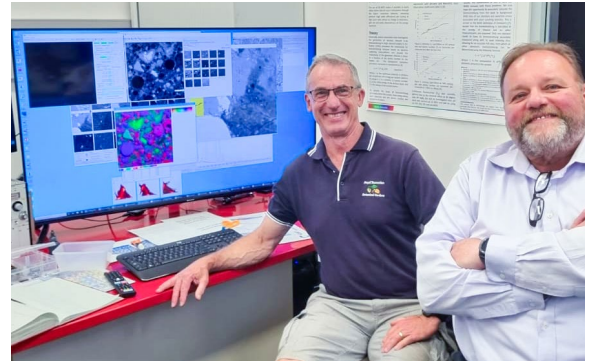
Materials Workshop

In May, the AMCF welcomed students completing the subject "Materials Selection and Design" as part of their Bachelor of Engineering program. Organised by the Associate Dean (Learning and Teaching), and co-ordinator Assoc. Prof. Leigh Sheppard. The AMCF provided a lecture and workshop on material properties, analysis instrumentation, and how material characterisation can contribute to materials selection in various industrial settings.

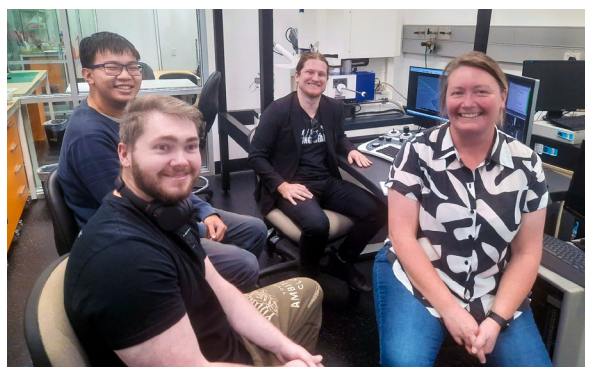
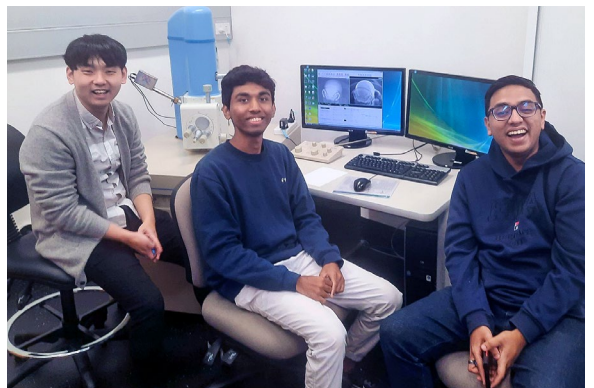
Students were given the opportunity to rotate between different scanning electron microscopes and get hands on experience imaging and undertaking elemental analysis of different material types. The opportunity to access highly advanced instrumentation was something students highly appreciated, as can be seen in their feedback.

"I just wanted to say thank you for organising our session at the AMC facility. It was really cool trying out the electron microscopes as well meeting the passionate team behind it. It made me feel like a kid excited about science all over again. I definitely think that if possible, such sessions should be incorporated into this subject in the future. I'm sure the students will find it valuable (and fun!)."

Engineering students having fun while getting some hands-on experience with the AMCF's Scanning Electron Microscopes (SEMs).



Clockwise: Stephan Wagner with Ric, Steve Milanoski and Tony Tang



AMAS Symposium Success

AMCF staff kicked off the year with an opportunity to attend and present at the 16th biennial Australian Microbeam Analysis Society's (AMAS) Symposium in February, the first in-person event since covid lockdowns, and boy, was it worth it! These events give staff a chance to attend advanced instrumentation workshops, network with other facility staff and researchers from both Australia and overseas, learn new techniques and tour labs at other universities. All of this benefits our AMCF users as we apply this to our own instrumentation and link our researchers into the networks we are making. Presentations and workshops made at the conference included:

- "Improving the Wavelength Dispersive Spectrometer (WDS) with a Silicon Drift Detector (SDD) – Opening up New Possibilities", Dr Richard Wuhrer.
- "In-situ X-ray Diffraction and X-Ray Mapping Studies on Ordinary Portland Cement Hydration", Dr Daniel Fanna
- "Correlative micro-CT and X-ray mapping of eucalyptus leaves", Dr Laurel George
- "EM Maintenance Workshop", Dr Richard Wuhrer

To top the week off, good friend of the AMCF, Ken Moran and our own AMCF Facility Research Manager, Richard Wuhrer received the AMAS Australian Science award for outstanding contribution to the science and advancement of microbeam analysis, beating out nominations from all over the country. Ric also recieved an AMAS service award.



Clockwise: Ric and Ken receiving their AMAS Australian Science award for outstanding contribution to the science and advancement of microbeam analysis, Ric's EM Maintenance workshop run during the symposium, the moment Ric realised he had won, and the AMCF team at the AMASXVI Symposium composing of Daniel Fanna, Ric Wuhrer, Laurel George, Ken Moran and AMCF ex-staff Tim Murphy.

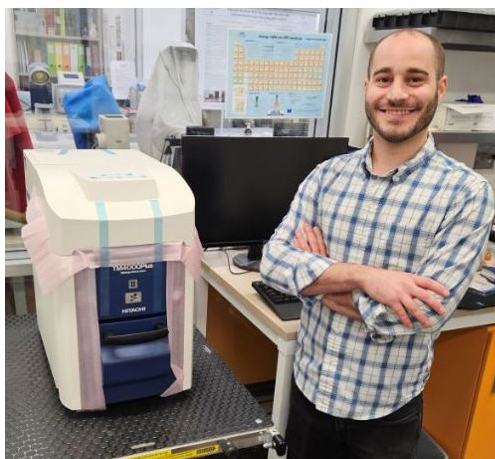
"Ken Moran and Ric Wuhrer have been nominated for the AMAS Scientific Award for their research in developing and applying microbeam analysis techniques. Their recent research has focused on the incorporation of silicon drift detectors as an X-ray detector in wavelength dispersive spectrometers (SDD-WDS) of electron microprobes (EPMA) This has led to more accurate quantification and X-ray mapping.

Ken and Ric are on over 50 papers together, covering both the fundamental physics of instrumentation and their application to a large array of sample types, from biomaterials and insects, to concretes, composite and steels to name a few. Their research highlights the challenges and pushes the boundaries of what can be achieved in microanalysis, such as their work with Xray mapping and scatter diagrams, low voltage imaging and microanalysis, spectral analysis with multiple detectors and what will be required in the next generation of microanalysis instrumentation."

Relaunching the NewSpec Inspire program in NSW

It is an absolute pleasure to announce that the NewSpec Inspire initiative has been relaunched in NSW with the assistance of the AMCF after a four-year break. The Inspire program is a STEM outreach experience for schools where students get hands on experience with a Scanning Electron Microscope (SEM). Take a look at some of the amazing images taken by primary and high school students so far, shown opposite.

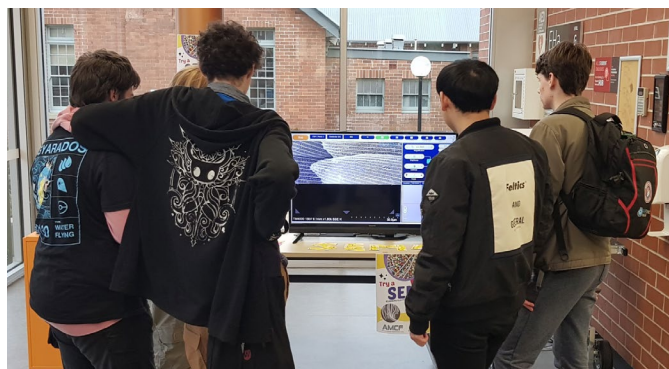
The program trains school teachers on how to operate an SEM. Once trained, NewSpec Inspire staff drop a Hitachi TM4000 benchtop SEM off to the school and allow the teachers and students to incorporate it in their curriculum, or simply get kids excited about STEM. The program has been highly successful in South Australia, Victoria and Queensland with over 65000 school students engaged! When this instrument isn't out inspiring the next generation (see opposite for the awesome images taken by local school students), it will be available for AMCF users to use. If you would like to know more about this initiative please reach out to the team at NewSpec (outreach@newspec.com.au) or talk to the AMCF.



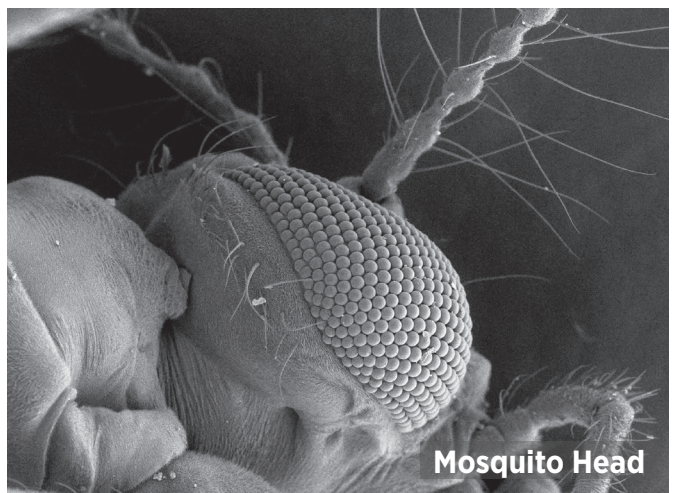
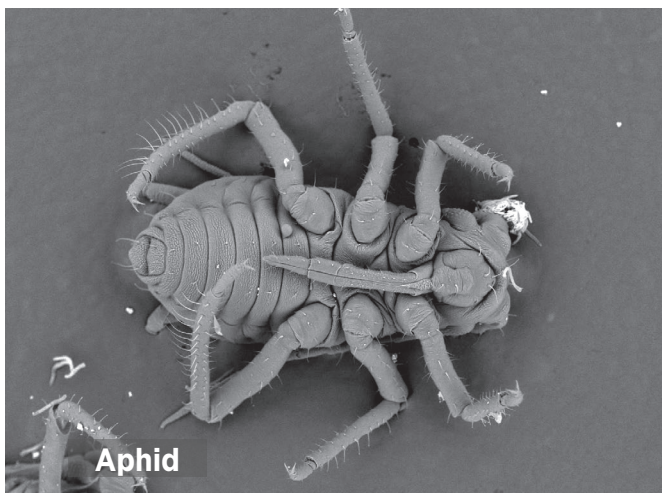
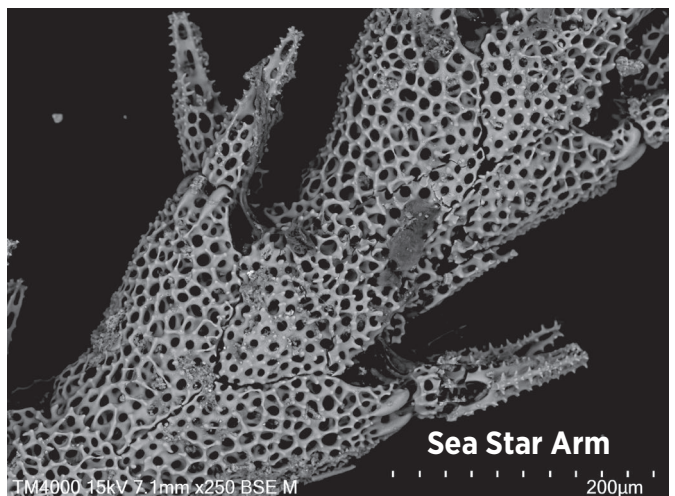
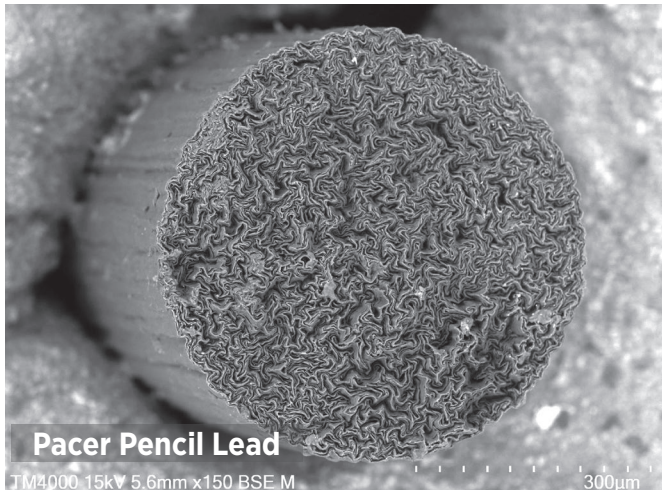
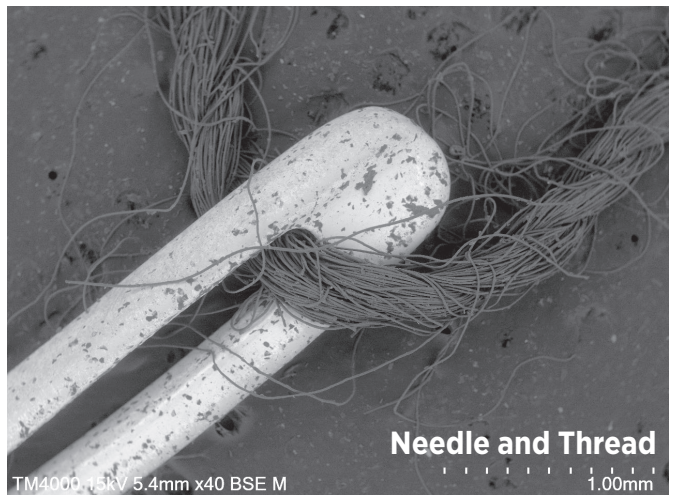
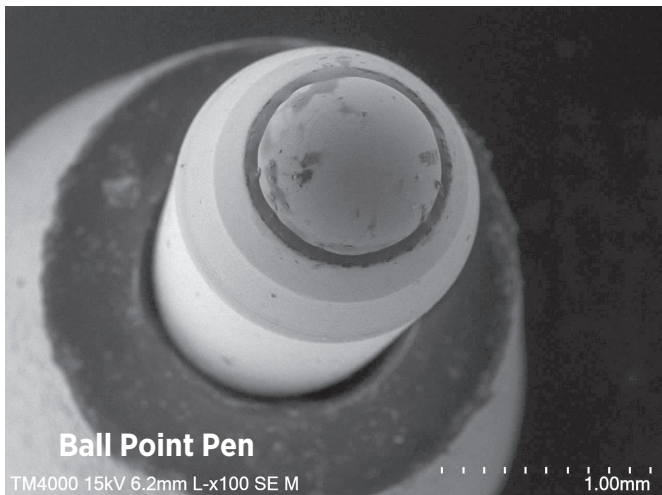
Dr Daniel Fanna with the TM4000 during installation at the AMCF (left) and training teachers at a NSW high school.

WSU Open Day

This year, for WSU Open Day 2024, the AMCF set up a stand, inviting community members passing through the Parramatta South Science building to have a go at operating an SEM. The star of the show, the Hitachi TM4000 (on a school break) was setup with a multitude of samples, giving community members and prospective WSU students a chance to look at all sorts of interesting samples like bugs, textiles and even the fibres of a facemask.



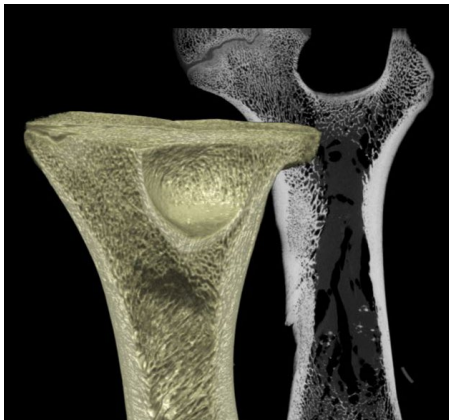
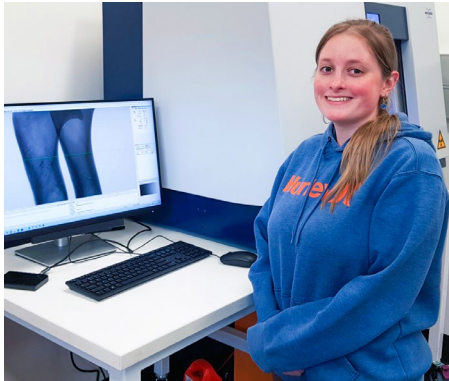
Some eager potential students imaging butterfly wings (top), and AMCF intern Hyun set up and ready for visitors with the TM4000 on WSU open day (bottom).



SEM images taken by High School and Primary students on the Hitachi TM4000 benchtop SEM as part of the NewSpec Inspire initiative.

RESEARCHERS AT THE AMCF

Natasha Robinson
School of Science (Forensics)



RESEARCH

Natasha is currently completing her Masters degree in Forensic Science. Her research involves following changes in the structure and chemistry of bones (in this case pig bones) as they decompose. Natasha is interested in seeing if any differences can be distinguished across samples with different post-mortem intervals (i.e. time since death).

IMPACT

A precise time since death is of utmost importance for forensic examinations and their ability to determine when a homicide occurred. The potential use of new analytical technique to improve the accuracy of post-mortem interval estimations will therefore have a positive impact for homicide investigations.

SUPERVISORS

Dr Hayley Green and Dr Jason Reynolds.

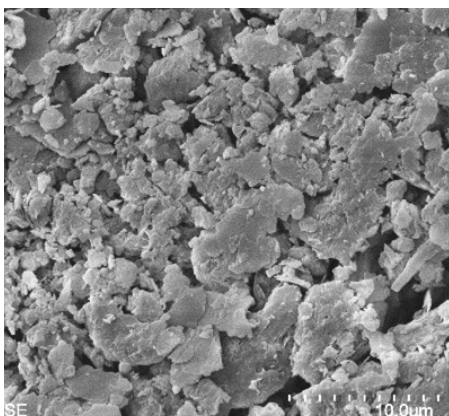
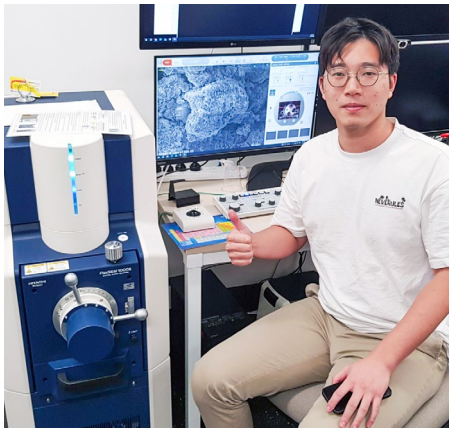
INSTRUMENTS

Natasha has been using the AMCF's:

SEM/EDS: To observe any differences in structural and elemental composition across the bone samples.

Micro-CT: To observe any differences in the bone surface and thickness in samples of different post-mortem interval.

Mengyuan Zhu
School of Engineering, Design and Built Environment



RESEARCH

Mengyuan Zhu is a PhD candidate with the School of Engineering, Design and Built Environment (SoEDBE) at WSU. His research focuses on the development of novel soil binders, designed to effectively stabilise expansive soil, in comparison to traditional lime stabilisers. Mengyuan aims to create a new low-calcium, low-temperature, and low carbon footprint alkali-activated binder using un-calcinated clay-rich precursors.

IMPACT

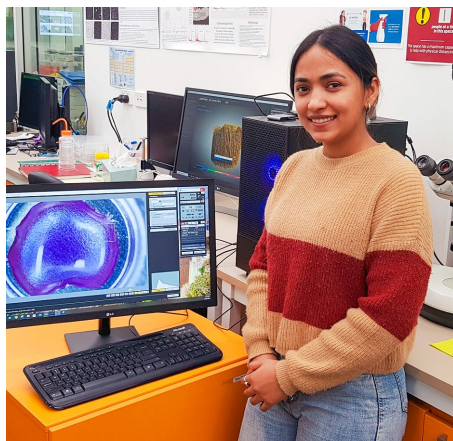
The significance of this study lies in addressing critical research gaps in the field of expansive soil stabilisation. Mengyuan aims to advance the understanding and implementation of sustainable soil stabilisation strategies. In doing so, he can help to create innovative environmentally friendly binders, derived from un-calcinated natural precursors reacted with alkaline reagents.

SUPERVISORS

Prof. Chin Leo, A/Prof. Qinghua Zeng, Prof. Samanthika Liyanapathirana and Dr Pan Hu.

INSTRUMENTS

In Mengyuan's research, microstructural and mineralogical changes in all samples were analysed using **SEM/EDS**, and **XRD**.



RESEARCH

Basanti is currently completing her Master of Science. Her research project is focused on polycarbonate agricultural films, and how they age over time. When placed over greenhouses, these pigmented films can shift the light spectrum of natural light to one that encourages more plant growth. By studying changes in the films as they age, Basanti is hoping to figure out ways to improve their performance.

IMPACT

Information on film performance, durability, and aging will benefit a wide range of stakeholders, from farmers to researchers. Insights will contribute to the broader goals of sustainable and efficient agriculture, food security and environmental conservation.

SUPERVISOR

Dr Richard Thomas.

INSTRUMENTS

Basanti has made great use of the AMCF's capabilities using:

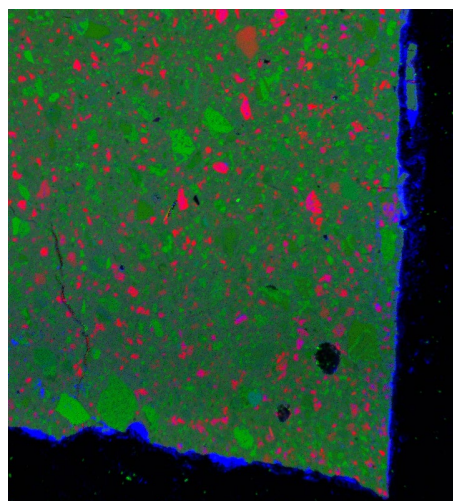
SEM/EDS: To analyse film structure and chemical composition.

FTIR/Raman: To analyse the chemical structure and composition.

XRD: To monitor the crystallinity of the films

TGA/DSC: To monitor thermal properties of the films and identify any changes due to aging.

Optical Microscopy: To inspect film surfaces.



RESEARCH

Matheus Duarte is a PhD student with the School of Engineering, Design and Built Environment (SoEDBE), focusing on CO₂ capture using an adsorbent made from waste. Among the many forms of carbon emissions control, solid adsorbents are a promising solution. Currently their production costs are often too high and complex, resulting in a significant carbon footprint that undermines their original purpose. Matheus' research involves the physical and chemical modifications aluminosilicate which are synthesized from Australian mine waste to create a cost-effective solid adsorbent.

IMPACT

In recent years, record-breaking atmospheric CO₂ concentrations have been documented, along with rising global temperatures. Consequently, extreme weather events have occurred across all continents, with an estimated cost of trillions of US dollars per year by 2050. Matheus's research aims to not only provide a way of reducing atmospheric CO₂, but also reduce mine waste by transforming it into a valuable product.

SUPERVISORS

Dr. Mariam Darestani and Prof. Richard Yang

INSTRUMENTS

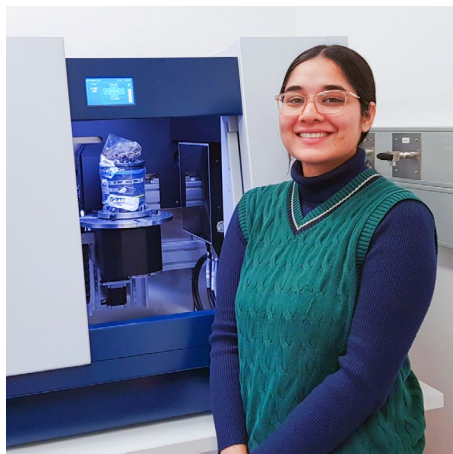
Matheus has been using the AMCF's:

ASAP2020: to track the **BET surface area** of the samples.

TGA: to see the sample mass gain as CO₂ binds to the surface.

Evolved Gas FTIR: to detect the functional groups are introduced to the minerals surface.

Tasmeen
School of Science (Horticulture)



RESEARCH

Tasmeen is researching non-destructive methods for examining plant structures for her Masters in Agricultural and Greenhouse Horticulture. Her main focus has been on the use of micro X-ray Computed Tomography (micro-CT) and the associated modelling software to analyse strawberry and blueberry plant growth stages and fruit structures. She is also looking at the effects new fertilisers can have on plants root systems.

IMPACT

A more detailed understanding of how plants work and respond to different fertilisers could allow farmers to make more informed decisions when selecting fertilisers for their crops. Utilising the appropriate fertiliser not only yields economic benefits for farmers, but also aids in mitigating environmental degradation resulting from the excessive use of nitrogen-based fertilisers.

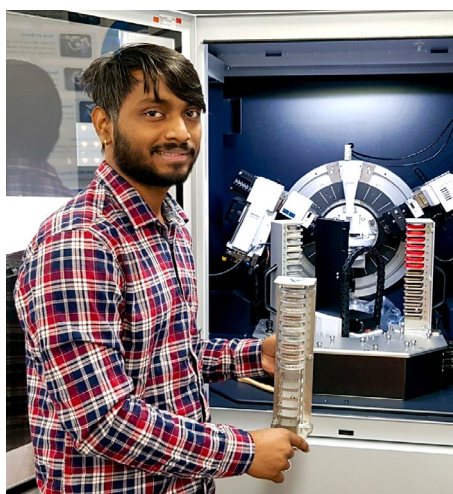
SUPERVISOR

Dr. Richard Thomas.

INSTRUMENTS

Tasmeen has been using the AMCF's brand new **Bruker Skyscan 1273 and 1272 micro-CTs**. She has been using **Bruker's NRecon** software to reconstruct 2D projections, and **ORS Dragonfly** to create 3D models of plant structures.

Reena Sanjay Krishna
Centre for Infrastructure Engineering (CIE)



RESEARCH

Krishna is a PhD student who has been working on the utilisation of different waste and local clay varieties in Australia. His goal is to use these clays to develop economical limestone-calcined clay cement (LC3) which aids in carbon mineralisation and hence reduces concrete carbon emissions. His studies include the assessment and characterisation of different clays based on their dehydroxylation temperature, mineral content and chemical profile, to understand why some clays react better with cement and others do not.

IMPACT

By replacing cement with economical reactive clays, the cement content in concrete is reduced, helping to reduce costs and carbon emissions associated with the construction industry. His work therefore aligns with global sustainability goals, offering a pathway to more economical and environmentally friendly construction practices.

SUPERVISORS

Dr. Cheng (Jason) Jiang and Prof. Zhong Tao.

INSTRUMENTS

Krishna has been using the AMCF's:

XRF: To analyse the chemical composition.

SEM/EDS: To capture sample imaging and elemental analysis.

XRD: To find the mineral composition and crystalline phases.

ASAP2020: To assess the nanopores and specific surface area.

TGA/DSC: To confirm the dehydroxylation temperatures.

RESEARCH FOCUS

Jim Sharpe and John Rankin

Mechanical Engineer, Jim Sharpe, began his career working in construction, before finding work in mining conveyor and skip systems. In the 1990's Jim commenced working with WSU's Prof. Peter Williams, helping to take geology students and classes on trips to mine sites such as Cobar. Eventually, Jim completed his Master of Science degree at WSU with Pete.

Industrial Chemist, John Rankin has always had a love of chemistry, and started out in the paint industry. Eventually John started transferring his knowledge of minerals in paint, to those found in the ground. Having had a grandfather who was a tin miner, and spending time gold fossicking when he was young, a strong interest in mineralogy was meant to be!

Together they are affectionately known to the AMCF staff and users as "Dad's Army". Having met through mineralogical societies, Jim and John now spend part of their retirement giving back. They have been using the AMCF facility to identify minerals held in Museum collections such as the Australian, Victorian and South Australian museums. At the same time they are helping fellow budding geologists and university students learn about mineral identification and analysis techniques.

Museum mineral collections can be vast and can include samples over 100 years old. Samples may not have enough information included with them when donated or may have been incorrectly labelled. Museum staff may not have the experience to undertake mineral identification or the resources to do so.

Jim and John having been using X-ray diffraction (XRD) at the AMCF to help identify and verify samples from various collections, with a particular interest in minerals containing copper or bismuth. They can then inform others of their findings, and educate staff, geologists and our own WSU students on what minerals and artifacts to examine during analysis.

Jim and John are an absolute wealth of knowledge, not only for their mineralogical work, but also their past experiences in various industries. WSU students (and AMCF staff) who get to have a chat with them value their expertise. We are very lucky to have them in our facility.



Jim Sharpe (left) and John Rankin (right) with the AMCF's XRD



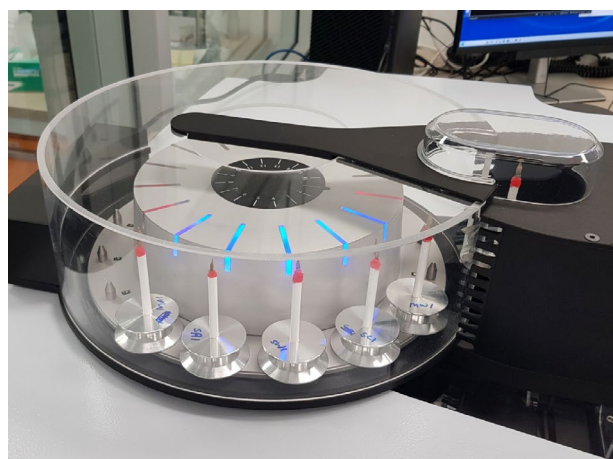
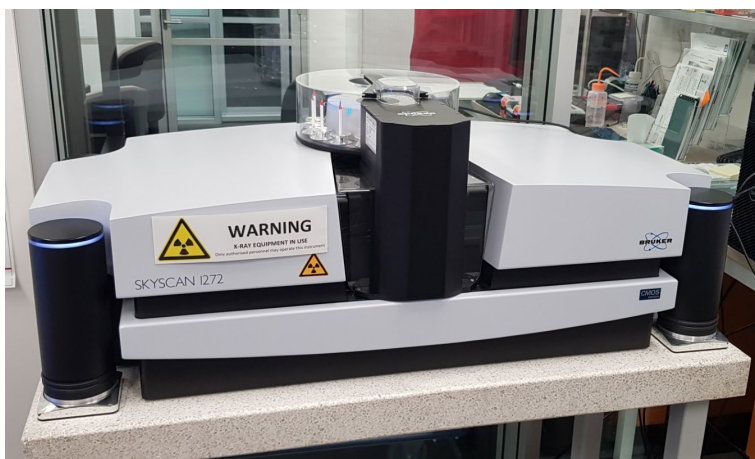
A backscatter SEM image of a mineral (top), where the different greys seen show that different elements or phases must be present. Two minerals found at Elsmore NSW, including yellow Koechlinite (middle) and a silvery-grey Molybdenite crystal (bottom)

INSTRUMENT NEWS

X-ray Vision - New micro-CTs now online

Regular AMCF newsletter readers might remember the mentioning of two upcoming Bruker Skyscan X-ray Micro Computer Tomography (Micro-CT) instruments in our last newsletter. It's with great joy that we can now announce that both the 1272 and 1273 MicroCTs are installed and available for our users. These instruments replace a 20-year-old aged MicroCT, which until recently, was highly sought after.

Our 1273 was installed at the end of 2023 and has since been running a range of samples including whole pot plants to observe root-growth, carbon fiber panels, concrete, sea urchins, industrial parts and much more. More recently, in the last couple of months we had the 1272 installed and setup. Since then, we have been using this instrument for higher resolution scans of plant materials such as tomato flowers and grass leaves, as well as cementitious materials.



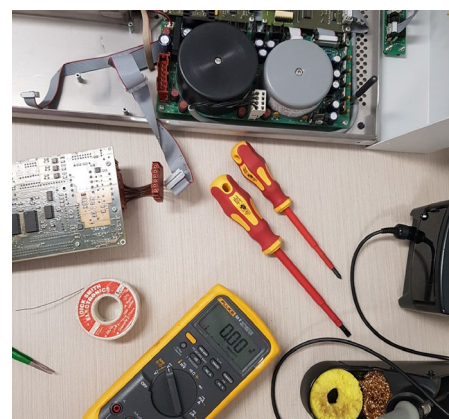
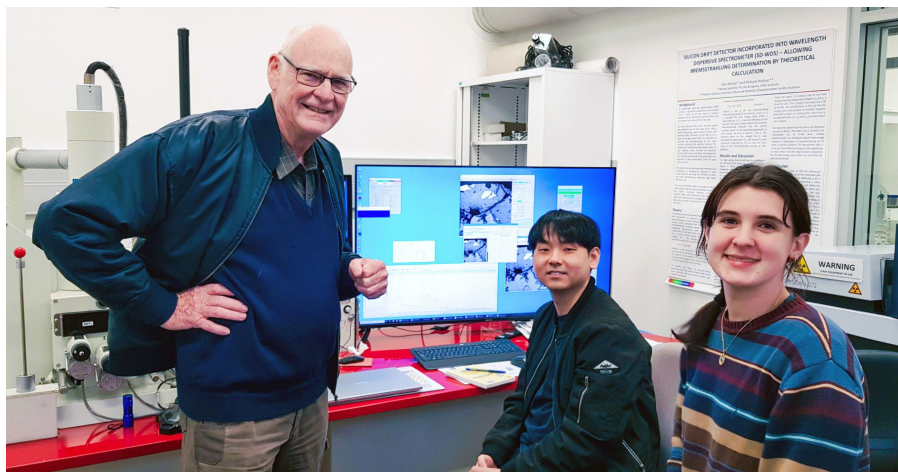
The new Bruker SkyScan 1272 micr-CT (left), with 16 sample autosampler (shown right).

Maintenance Extravaganza!

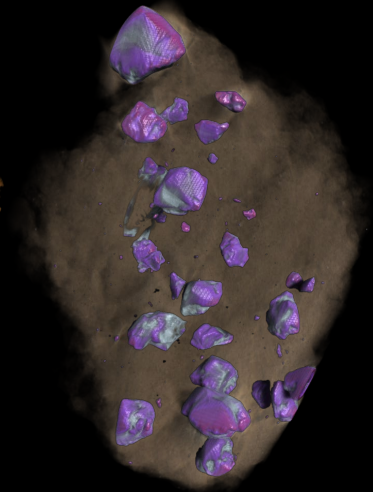
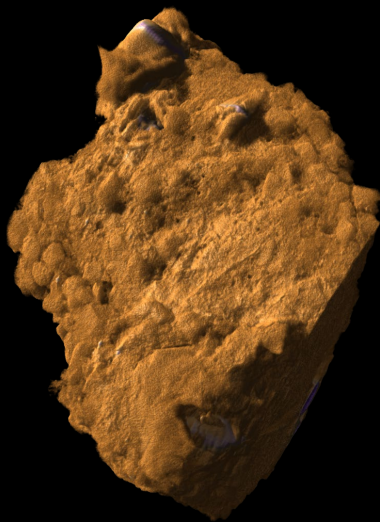
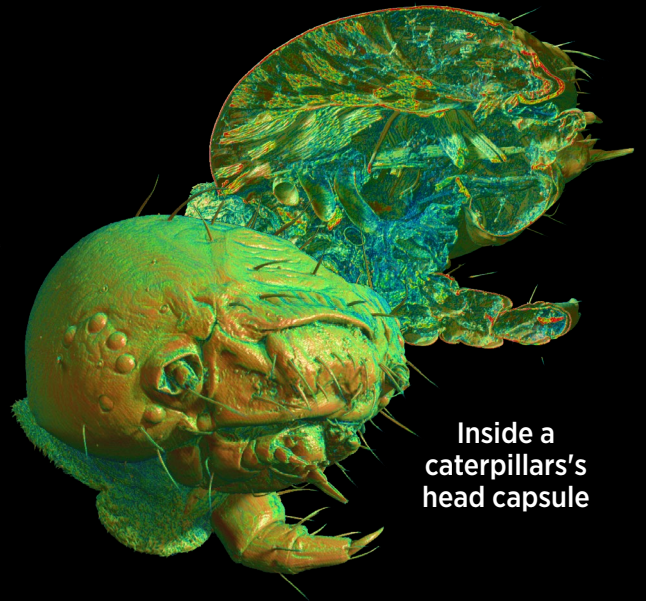
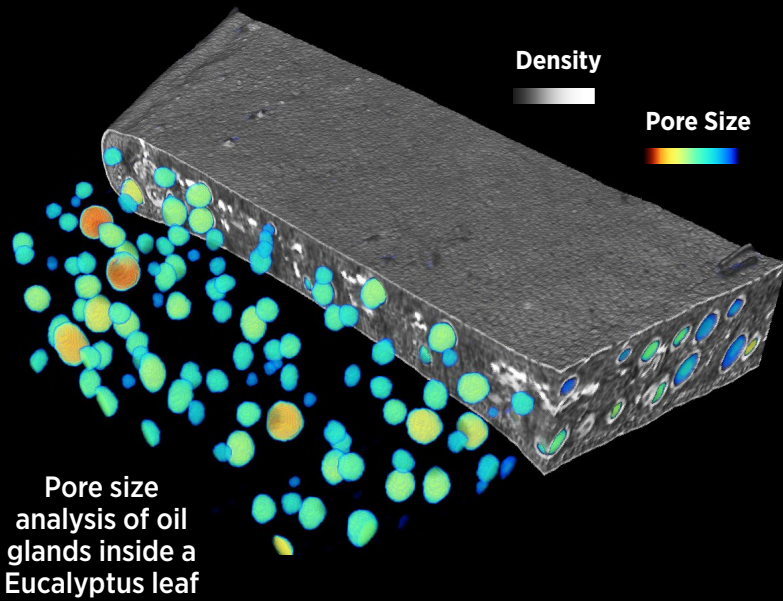
The AMCF have been busy this year completing maintenance of our instrumentation.

One of the benefits for students coming through the AMCF is the opportunity to see what is inside our instruments when maintenance is taking place. This allows students to get a better understanding of how our systems work and the fundamental science behind them. For our more advanced users, we are happy to provide training in this area.

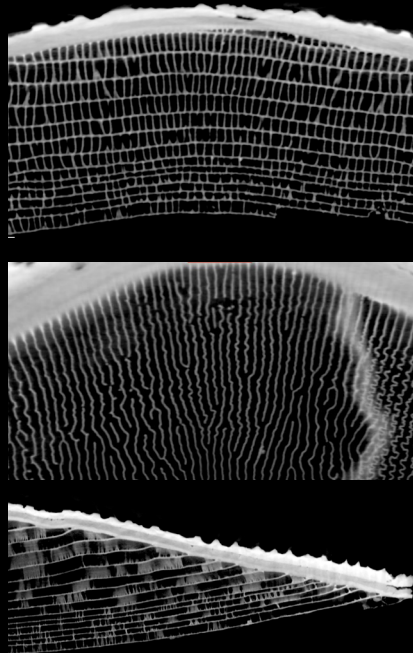
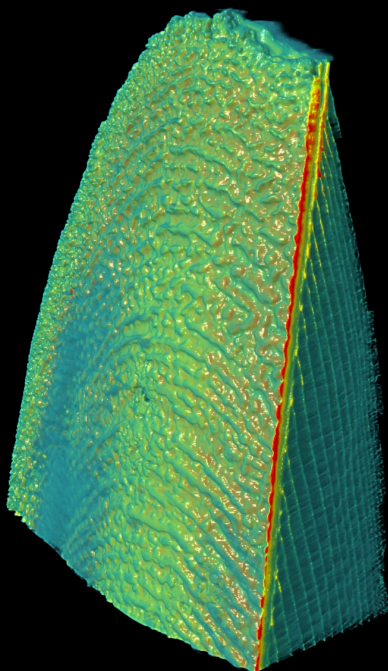
Ken Moran (top left) providing maintenance training for Hyun and Eleanor on the Jeol 8600 Probe, and Laurel (bottom left) carrying our maintenance on some of our diaphragm pumps.



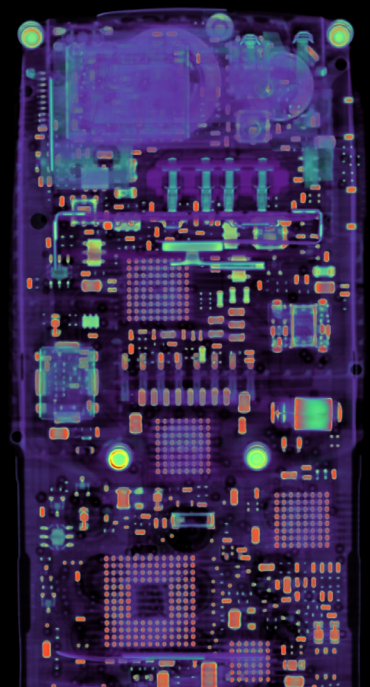
Micro-CT allows us to look inside a sample without having to cut it open.



Hidden minerals inside a rock sample



Revealing the complicated fine structure inside cuttlefish bone



Checking connections inside a Nokia mobile phone

RECENT PUBLICATIONS

1. Abden, M.J., Tam, V.W., Afroze, J. D. and Le, K.N. (2024). "Energy efficient sustainable concrete for multifunctional applications" *Construction and Building Materials*, 418, pg135213.
2. Ahmad, F., Rawat, S., Yang, R. C., Zhang, L., Guo, Y., Fanna, D. J. and Zhang, Y. X. (2024). "Effect of hybrid fibres on mechanical behaviour of magnesium oxychloride cement-based composites". *Construction and Building Materials*, 424, pg135937.
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UPCOMING EVENTS



2024 Combined Student Seminar

Call for student presentations

Do you live for analysis?

Spend your time thinking about electron, X-ray or neutron beams?

Want to see what other researchers are working on?

We invite student researchers (undergrad, Honours, Masters and PhD) from all disciplines to present results where any electron, X-ray and neutron analytical techniques have been applied in their research. All interested are also welcome to come and join us.

Presentations will be 10 minutes in length, with time for questions after.

Food and drinks provided after for networking with other students, researchers and industry professionals.

When: Thursday October 17th, 10am-1pm
followed by a networking lunch

Where: UNSW, June Griffith Building (F10), G37

Registration: Free! Register on Eventbrite

(www.eventbrite.com.au/o/amas-axaa-nsw-86288842133)

!! Cash prizes for best talks !!

Abstract Submission: Submit abstracts to L.george@westernsydney.edu.au

One page abstracts should include details of the analysis techniques used and be no more than 250 words (images allowed). Please include a letter of support from your university supervisor.

Submissions Close at 5pm Monday September 30th 2024.

Notification of acceptance will be by Friday October 4th 2024.



The 13th Asia Pacific Microscopy Congress

2-7 February 2025



Asia Pacific's Largest Event Dedicated to Microscopy, Microanalysis and Imaging

The 13th Asia Pacific Microscopy Congress 2025 (APMC13) will bring the world of scientific imaging and microanalysis together in Australia's New World city - Brisbane.

Embedded in Asian & Australian Indigenous Culture and Tradition, the Committee of Asia Pacific Societies for Microscopy (CAPSM) will present the 13th Asia Pacific Microscopy Congress (APMC13) to establish a balanced programme of light, ion and electron microscopy and imaging spectroscopy in physical, material and life sciences. Microscopists, scientist, manufacturers, and suppliers will come together to share new instrumentations, techniques, workflows, applications, and technologies.

Welcome

The Australian Microscopy and Microanalysis Society (AMMS) is honoured to host APMC13 in Brisbane, Australia from February 2nd to 7th in 2025. APMC13 will be an in-person event, bringing together colleagues across the life and physical sciences, engineering, and instrumentation to work towards new visions and goals in microscopy. We take pride in putting together a strong program for the conference based on advances in electron, X-ray and light microscopy and microscopy-enabled research in the life and physical sciences. The conference will include oral and poster presentation sessions, trade show and workshops, pre- and post-conference workshops, and social events.

Key Dates

Conference Dates	Registration Open	Super Early Bird Registrations Close	Oral Abstract Submission Close	Poster Abstract Submission Close	Early Bird Registrations Close
2 -7 February 2025	1st July 2024	13th September 2024	2nd November 2024	2nd November 2024	13th November 2024

FIJI/ImageJ Workshop with Cameron Nowell, Monash University

1-2 October 2024 - 9am-5pm

Charles Perkin Centre Hub Building (D17), Level 1, Dry Lab 1.4
University of Sydney



Topics include (but are not limited to):

- Image Analysis Fundamentals
- Simple Analysis, Cell Counting, Segmentation, 3D and Making Movies
- Scratch Wound Assay Analysis
- Image Stitching and Alignment
- Skeletonisation for Bacterial Length and Mitochondria Networks
- Writing Macros
- Batch Processing

LMA Members: \$150 (join AMMS/LMA at <https://microscopy.org.au>)

General: \$200

Students: \$175