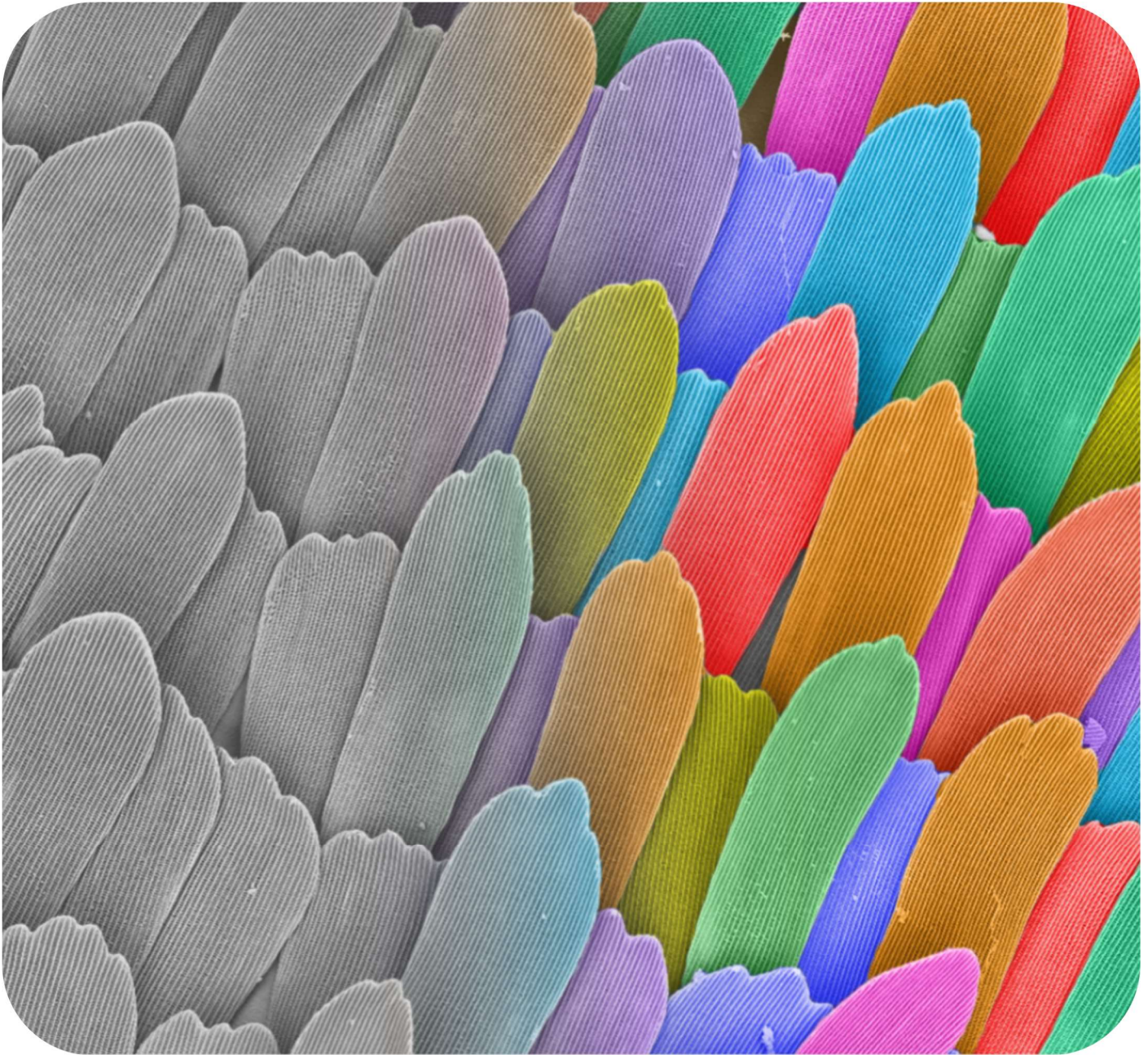


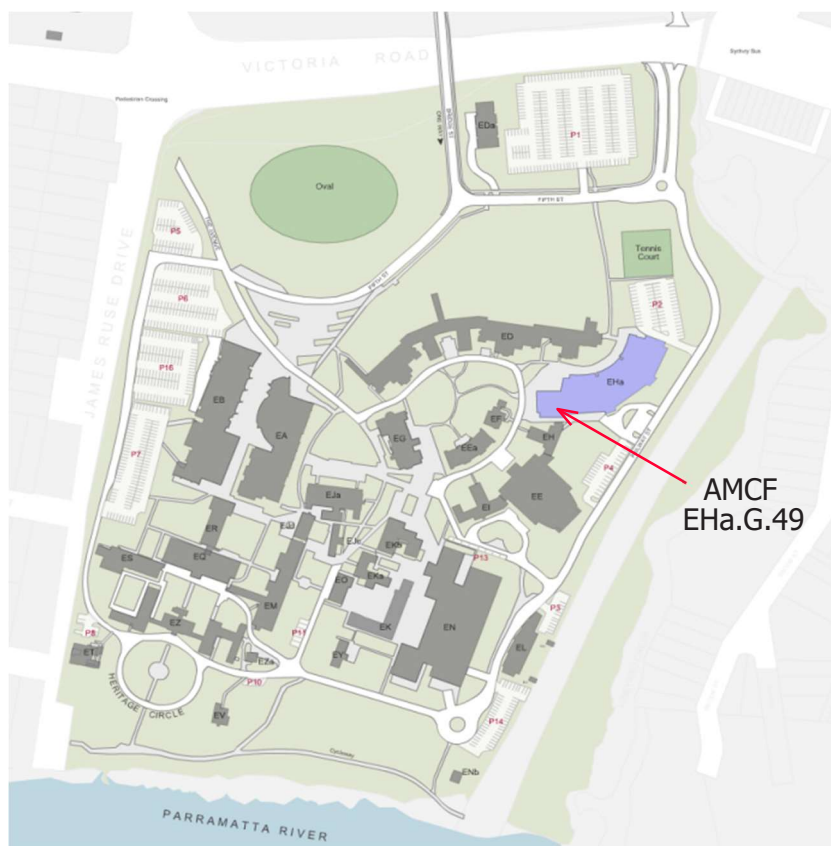
WESTERN SYDNEY
UNIVERSITY



AMCF

Advanced Materials Characterisation Facility

Newsletter: December 2024



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Front Cover Image:
A false coloured backscattered electron micrograph of a butterfly wing taken by Dr Daniel Fanna on a Hitachi TM4000 scanning electron microscope, which is taken to schools.

Dr Laurel George
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Back Cover Image:
A series of X-ray maps collected by Dr Richard Wuhrer on a Jeol 7001F FEGSEM of a liquid phase sintered composite of iron/chromium carbide in a predominantly nickel matrix produced by Huggett Materials for potential use in wear resistant products for the mining industry. The three elements shown are Fe, Cr and Si with colour channels rotated.

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14th Edition Newsletter, December 2024
 Editors: Daniel J. Fanna, Hyunsung Min, Laurel George and Richard Wuhrer

The AMCF is a part of:
 Research Infrastructure
 Office of the Senior Deputy Vice-Chancellor (Research, Enterprise and Global)



FROM THE FACILITY RESEARCH MANAGER

Another year has passed. I cannot believe that I am writing the December 2024 note, as it only seems like yesterday I did it for 2023. What a year! On reflection, many things have happened in the last year; and we are now only a couple weeks from Christmas and New Year celebrations.

The AMCF initially attracted researchers and academics from many different disciplines to utilise the AMCF instrumentation. Over the last 6 months, we have seen a rapid increase in the number of HDR's requiring access and training with, of course all results required by yesterday. This is great to see. The facility already has several dozen bookings for January and February 2025.

As highlighted in the newsletter, this year has been filled with numerous events that have made the time fly by. At the start of the year, we welcomed the installation of two state-of-the-art Bruker micro-CT systems: the Bruker 1272 and 1273. This instrumentation allows us to scan a large range of different samples of varying sizes. In August 2025, extensive training from Bruker occurred and we were very lucky to have Dr Valérie Vancauwenberghe from Bruker Belgium run courses and demonstrations for a week. The micro-CT's have proven to be very popular with users/clients and AMCF staff have been kept busy training new AMCF users on collection, processing of results and interpretation of results.

We are fortunate to have Hyunsung Min on board as our new Technical Officer. He has proven very valuable and received a "Local Achievement Reward" last week from Research Services in recognition of his contribution.

The New Year will be busy as we plan to run various introductory workshops on our instruments. The first course/workshop is set for February/March 2025 with Netzsch on thermal analysis. Further information will be sent out in the New Year.

As always, we are happy to show anyone our facility. Please do not hesitate to contact us for a walk through of our lab.

The AMC Facility will be closed for the Christmas to New Year period from Wednesday 18th of December 2024 (12pm) until Tuesday 7th of January 2025. No usage of instrumentation and/or bookings will be possible due to the closure. Instruments will either be shut down or placed in standby mode during this period. All instruments should be up and running again by Monday the 6th of January 2025 with first bookings allowed from 7th of January 2025.

On a final note, I would like to wish everyone a Merry Christmas and Happy New Year. I look forward to seeing everyone in the New Year.

Dr Richard Wuhrer
Facility Research Manager
December 2024

RECENT ACTIVITIES

AMAS/AXAA student event

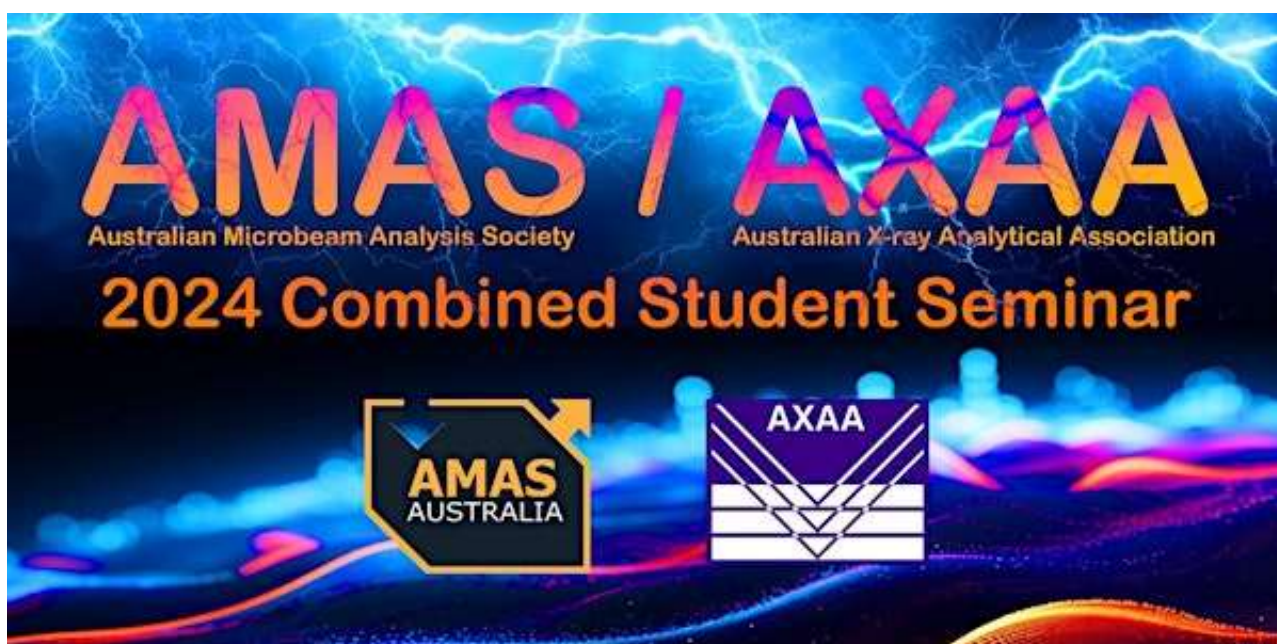
On October 17, the NSW branches of the Australian Microbeam Analysis Society (AMAS) and the Australian X-ray Analytical Association (AXAA) joined forces to host the long-awaited AMAS/AXAA combined student seminar. The seminar was held at UNSW and was co-organised by WSU AMCF staff members Dr Daniel Fanna and Dr Laurel George, and UNSW MWAC staff members Dr Ruoming Tian and Dr Karen Privat. This event marked the first-ever joint seminar between the two societies and was a much-anticipated return of NSW student-focused seminars, the last of which had been an AXAA-only event held in 2019 at ANSTO. The student-seminar was a great success and provided a valuable opportunity for students to reconnect, collaborate, and engage with both societies and their peers.

The morning session featured 18 student presentations, attracting an enthusiastic audience of more than 60 attendees. A diverse range of research covered various topics, many of which utilised techniques supported by both AMAS and AXAA. Presentations spanned subjects such as material analysis of archaeological artefacts, ligands, diodes, clays, expansive soils, steels, tomato flowers, batteries, perovskites, and software optimization for micro-CT and XRD analysis. It was inspiring to see how students are applying advanced analytical methods to address complex research challenges.

At the conclusion of the seminar, prizes were awarded to the top presenters. **Marcus Miljak** from UNSW/CSIRO claimed first place with his talk on "Implementation of X-Ray Powder Diffraction in Geant4," earning a gift card, a 3D-printed trophy, and, of course, this year's prestigious "Bragg-ing" rights.

The event wrapped up with a networking session over a delicious pizza lunch, where students and staff from various universities had the chance to exchange ideas and discuss their research.

We would like to express our heartfelt thanks to our sponsors for their generous support: **Do the Science** (first-place prize and lunch), **Zeiss** (second- and third-place prizes and morning tea), in addition to the backing from AMAS, AXAA, WSU, and UNSW. These events would not be possible without the collaboration and support of the wider scientific community. A special thanks is extended to our student presenters, whose outstanding research and high-quality presentations made the seminar an unforgettable success. We look forward to continuing these events in the future and further expanding the AMAS and AXAA student communities.





Top, Group photos of event attendees, Middle left to right, prize winners, 1st - Marcus Miljak (UNSW/CSIRO), 2nd - Mia Brennan (USyd) and 3rd - Kayla Lord (UNSW). Bottom left, the event underway with our first presenter, and bottom right the 3D printed trophies.

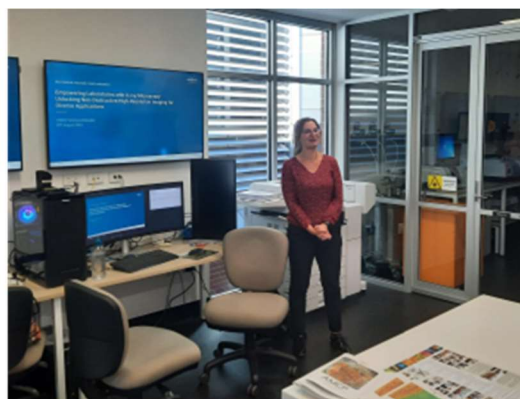
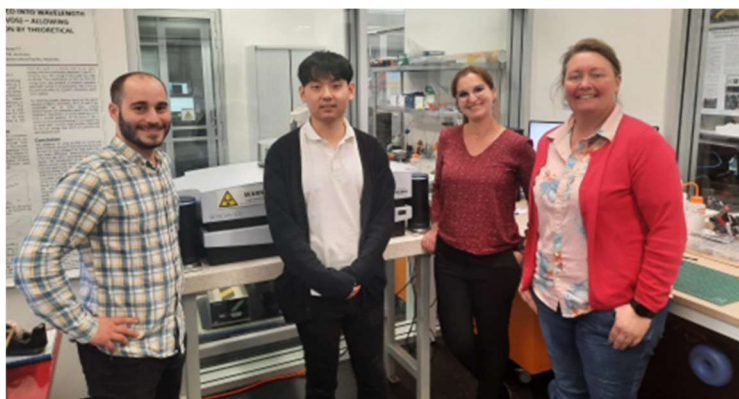
Bruker Micro-CT training and seminar

As many of our regular readers and lab visitors will already know, we've recently expanded our capabilities with the addition of two new Bruker Skyscan micro-CT instruments. The first, a 1273 model, arrived at the end of 2023, followed by the delivery of our second system, a 1272, earlier this year. As part of the purchase, we arranged for specialised hands-on training for AMCF staff, led by a Bruker micro-CT expert from Belgium. After taking some time to familiarise ourselves with the instruments, we were thrilled to finally lock in the training session for August.

We were delighted to welcome Dr Valérie Vancauwenberghe from Bruker Skyscan in Belgium to our lab, where she provided comprehensive, hands-on training for both micro-CT systems and Bruker's suite of micro-CT processing software. The training was exceptional, and thanks to Valérie's expertise, AMCF staff are now fully equipped to handle a wide range of samples and analysis conditions to meet the needs of our users.

In addition to the training, Valérie also treated us to a fascinating half-day seminar, where she shared some of the incredible applications of micro-CT technology. The seminar was a resounding success, drawing a packed room of attendees, including WSU users, external clients, and staff from other universities.

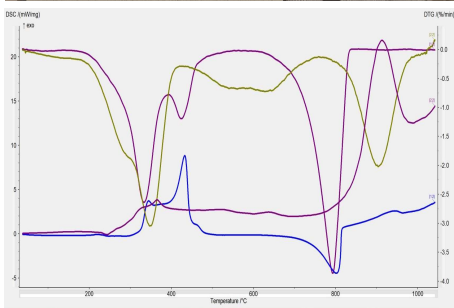
We thank Valérie for taking the time to share her expertise with us—and for making the event so engaging. We're all feeling ready to tackle new challenges with our Bruker systems!



Top left, AMCF staff with Valérie being trained on our 1272 micro-CT. Top right Valérie giving her seminar on micro-CT. Bottom. Seminar attendees stunned by the sheer breath of what micro-CT can do.

RESEARCHERS AT THE AMCF

Touha Nazrun
School of Engineering, Design and Built Environment



RESEARCH

Touha is a MPhil candidate with the School of Engineering, Design and Built Environment (SoEDBE) at WSU. Her research focuses on the development of low-cost high fire protective intumescent coating for sustainable onsite and offsite building materials. Her aim is to create low-cost and high-performance coating which can make any building material fireproof.

IMPACT

The significance of the study focuses on developing a low-cost, high-performance intumescent coatings that saves lives and protects structures by offering effective fire resistance for any building material. Affordable and versatile, this coating enhances safety across industries, reduces fire risks, and supports resilient infrastructure worldwide.

SUPERVISORS

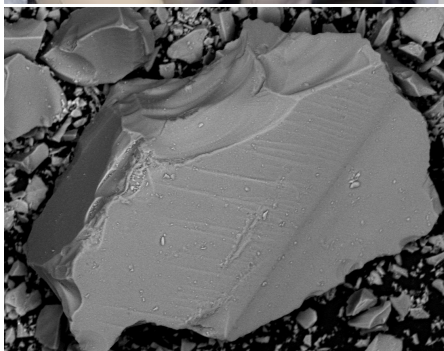
Dr Kamrul Hassan and Prof. Swapan Saha.

INSTRUMENTS

Touha has been using AMCF's:

- SEM-EDS: For coating sample imaging and elemental analysis
- FTIR: To analyse functional groups present in the coating
- XRD: To find crystalline phases present in the coating
- TGA/DSC: To observe thermal behaviour of the coating

Kayode Jolayemi
School of Engineering, Design and Built Environment



RESEARCH

Kayode is a Master of Research student carrying out his research in the School of Engineering, Design and Built Environment (SoEDBE). His research is in the field of geotechnical engineering focusing on mitigating swelling in an expansive soil using geopolymerisation. Kayode aims to achieve this by using waste materials to foster more sustainable environment.

IMPACT

The research would provide a geopolymerisation solution to reduce swelling in such expansive soil by using innovative and environmental-friendly sustainable raw materials. Solid knowledge on the right proportion of mix to produce workable geopolymer gel would also be provided.

SUPERVISORS

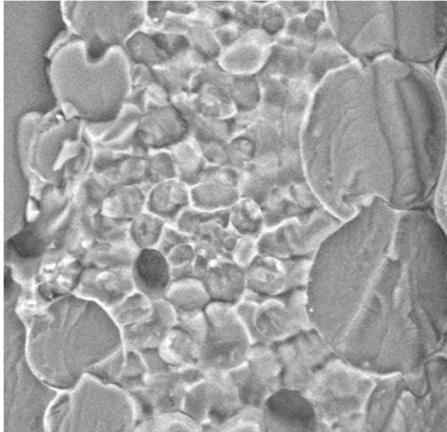
Prof. Samantha Liyanapathirana, Prof. Chin Leo, and Dr Pan Hu

INSTRUMENTS

Kayode has been using AMCF's:

- SEM-EDS: For sample imaging and elemental analysis
- FTIR: To analyse functional groups present in the geopolymer
- XRD: To identify crystalline phases and observe amorphous geopolymer regions
- TGA/DSC: To observe thermal behaviour of the geopolymer

Sarah Fletcher
Hawkesbury Institute for the Environment



RESEARCH

Sarah Fletcher is a Doctor of Philosophy candidate working with the Sharwood lab at the Hawkesbury Institute for the Environment. Sarah's main project involves overexpressing a Sorghum PEPC enzyme in Setaria viridis to improve CO₂ assimilation rates in leaves. Sarah is also exploring the Kranz anatomy of Setaria around the world to see if there are any anatomical differences in species with higher photosynthetic performance.

IMPACT

This project will help us to understand if the PEPC enzyme is a suitable target for bio-engineering and could lead to higher yield production in millet species. This research will also help us understand if high photosynthetic performance seen in certain Setaria species is due to leaf anatomy, or enzyme kinetics.

SUPERVISORS

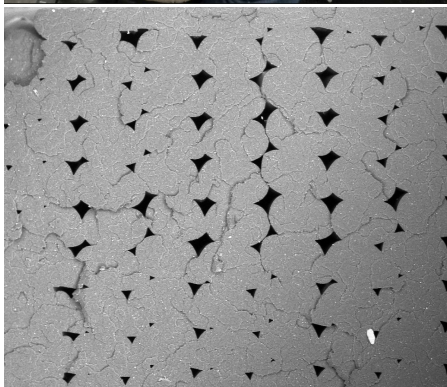
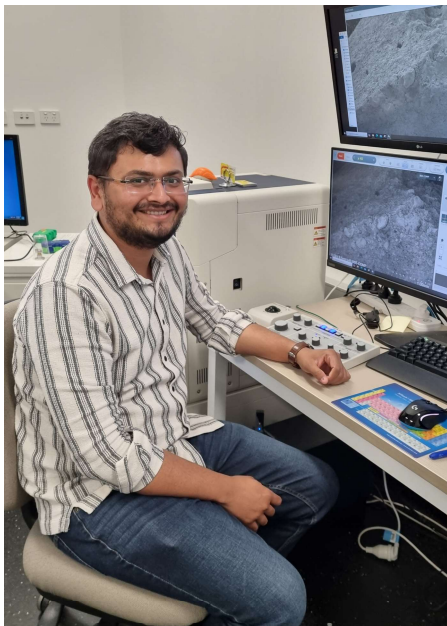
Dr Robert Sharwood, Dr Demi Sargent and Prof. Oula Ghannoum

INSTRUMENTS

Sarah has been using AMCF's:

- Hitachi SEM-EDS: For sample imaging and elemental analysis
- Zeiss FEGSEM: For high-resolution STEM imaging
- Ultramicrotome: To prepare samples for STEM imaging

Tusharbai Gajjar
School of Engineering, Design and Built Environment



RESEARCH

Tusharbai is a PhD student who has been working on Fused Filament Fabrication (FFF), and 3D printing of thermoplastic and fibre reinforced thermoplastic composites. His goal is to improve the material properties of 3D-printed parts using a modified FFF 3D printing technology. His studies include the optimisation of key printing parameters through experimental investigations, analysing interlayer bonding behaviour, and minimising void formation defects in 3D-printed samples.

IMPACT

By utilising modified FFF technology for 3D printing, material properties are improved by optimising void formation compared to commercial FFF technology, for both thermoplastic and fibre-reinforced composite materials.

SUPERVISORS

Prof. Sarah Zhang and Prof. Richard Yang

INSTRUMENTS

Tusharbai has been using the AMCF's:

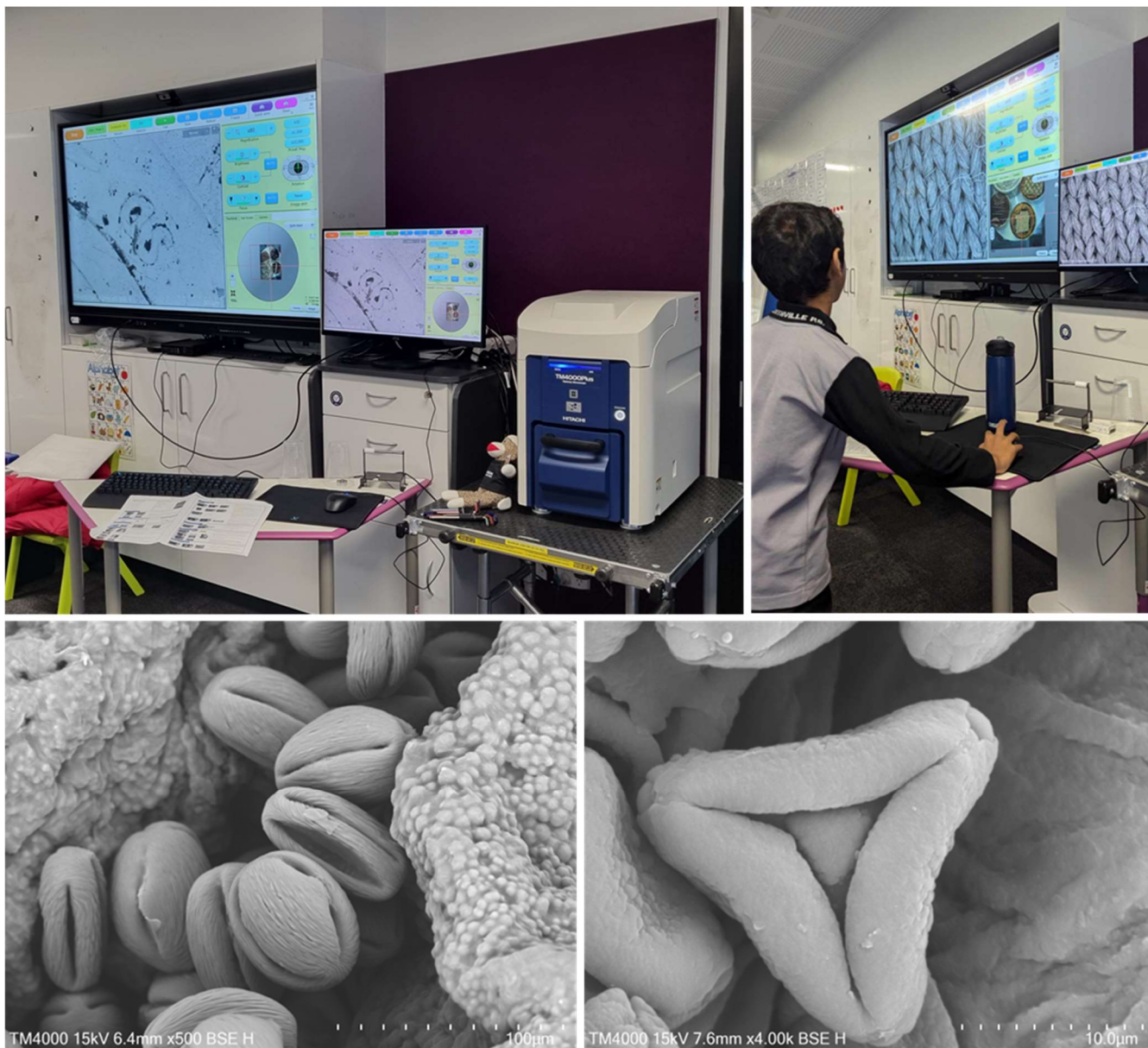
- SEM/EDS: For sample imaging and elemental analysis
- TGA/DSC: Thermal stability and mass loss behaviour of 3D printed samples
- Optical Microscope: To analysis surface property of 3D printed samples

INSTRUMENT NEWS

An Inspire Update

In our last newsletter, we announced that Dr Daniel Fanna and the AMCF are teaming up with NewSpec Hitachi to relaunch their Inspire program in NSW. The Inspire program is a fantastic STEM initiative that engages school students by bringing a benchtop Hitachi TM4000 scanning electron microscope (SEM) into their school for a week or two, to let the students explore materials and life sciences under the scope. We are absolutely thrilled to announce that so far, the program has been off to a great start, visiting schools in Gosford, Foster, the Northern Beaches and, of course, in our backyard of Western Sydney. 2025 is shaping up to be an even bigger year and we are looking forward to continue working with this great STEM outreach program.

If you know any schools interested in hiring the TM4000 SEM, please reach out to the team at the AMCF or directly with the NewSpec Inspire program at Outreach@newspec.com.au.



Clockwise from top Left: The TM4000 setup at Wentworthville Public School (WPS) ready to engage year 2 students, a WPS student taking some images, pollen from two different flower species captured by WPS students.



RECENT PUBLICATIONS

1. Ahmad, F., Rawat, S., Yang, R. C., Zhang, L., Guo, Y., Fanna, D. J., & Zhang, Y. X. (2024). Effect of hybrid fibres on mechanical behaviour of magnesium oxychloride cement-based composites. *Construction and Building Materials*, 424, 135937. Elsevier.
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3. Camus, P., Moran, K., Matthews, M., & Wuhrer, R. (2024). Shortcomings in low-energy X-ray quantification using proportional counters in WDS. Oxford University Press US.
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6. Fanna, D. J., George, L., Moran, K., & Wuhrer, R. (2024). Investigation of ordinary Portland cement hydration mechanisms utilizing X-ray mapping, in situ X-ray diffraction, and in situ micro-CT. Oxford University Press US.
7. George, L., Fanna, D. J., Lindsay, S., Min, H., Hinwood, T., & Wuhrer, R. (2024). To stain or not to stain: Micro-CT analysis of eucalyptus leaves. Oxford University Press US.
8. Howard-Smith, K. J., Wallis, M. J., Flood, J. P., Min, H., Tadros, J. C., Tian, R., Bhadbhade, M. M., Marjo, C. E., & Li, F. (2024). Conformational investigations on three large dinuclear triple helicates by single crystal X-ray diffraction. *Journal of Inclusion Phenomena and Macrocyclic Chemistry*, 104(5), 199–207. Springer Netherlands Dordrecht.
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11. Malkawi, S., Hagare, D., & Maheshwari, B. (2024). Phosphorus recovery from hydroponics waste solutions and its economic potential. Available at SSRN, 4690514.
12. Montroni, D., Sarmiento, E., Zhao, R., Dasika, P. S., Connolly, J. M., Wuhrer, R., Zhang, Y., Zhernenkov, M., Wang, T., & Ramirez-Santana, B. P. (2024). The multiphasic teeth of *Chiton articulatus*, an abrasion-resistant and self-sharpening tool for hard algae collection. *Advanced Functional Materials*, 2401658. Wiley Online Library.
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14. Nguyen, P. Q. K., Zohdi, N., Zhang, Y. X., Zhang, Z., & Yang, R. (2024). Study on material behaviours of additively manufactured high-impact polystyrene using artificial neural networks. *Progress in Additive Manufacturing*, Jan-18. Springer.
15. Premathilaka, K. K. W., Liyanapathirana, D. S., Leo, C. J., & Hu, P. (2024). Novel recycled waste glass-based material with geopolymerisation. *International Conference on Transportation Geotechnics*, 87–95. Springer.
16. Rao, J., Hagare, D., & Tao, Z. (2024). Upcycling of end-of-life vehicle plastics as a replacement for natural fine aggregate in concrete. *Resources, Conservation & Recycling Advances*, 21, 200210. Elsevier.
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19. Rawat, S., Zhang, Y. X., & Lee, C. K. (2024). Effect of specimen size and shape on the compressive performance of high-strength engineered cementitious composites at elevated temperatures. *Innovative Infrastructure Solutions*, 9(8), 317. Springer.
20. Summers, P. K., Wuhrer, R., & McDonagh, A. M. (2024). Electrically conductive gold films formed by sintering of gold nanoparticles at room temperature initiated by ozone. *Journal of Nanoparticle Research*, 26(5), 97. Springer.
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22. Uddin, M. M. N., Bekmukhametova, A., Antony, A., Barman, S. K., Houang, J., Wu, M. J., Hook, J. M., George, L., Wuhrer, R., & Mawad, D. (2024). Encapsulated rose bengal enhances the photodynamic treatment of triple-negative breast cancer cells. *Molecules*, 29(2), 546. MDPI.
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26. Zhang, K., Wallis, M. J., Craze, A. R., Hayami, S., Min, H., Fanna, D. J., Bhadbhade, M. M., Tian, R., Marjo, C. E., & Lindoy, L. F. (2024). Spin crossover of an Fe(II) mononuclear complex induced by intermolecular factors involving chloride and solvent ordering. *Dalton Transactions*. Royal Society of Chemistry.
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UPCOMING EVENTS

13th Asia Pacific Microscopy Congress (APMC13)

The 13th Asia Pacific Microscopy Congress (APMC13) will be hosted in Brisbane in February 2025.



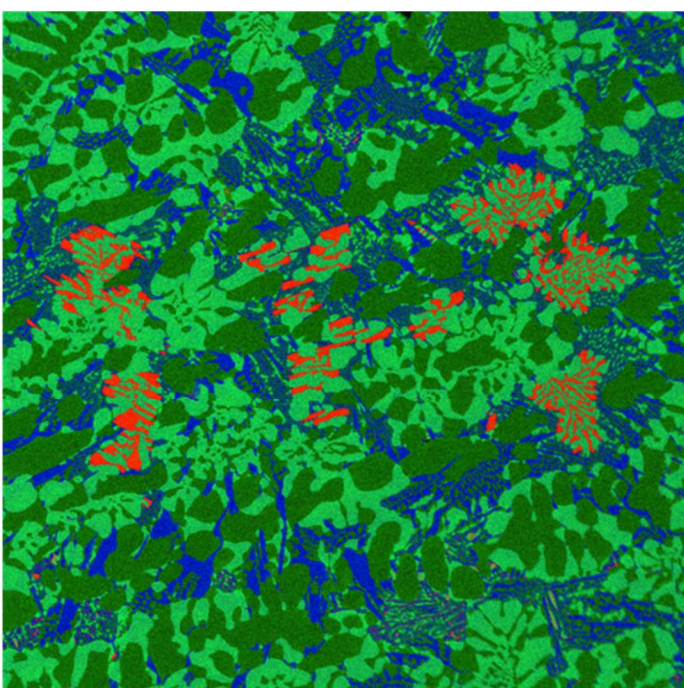
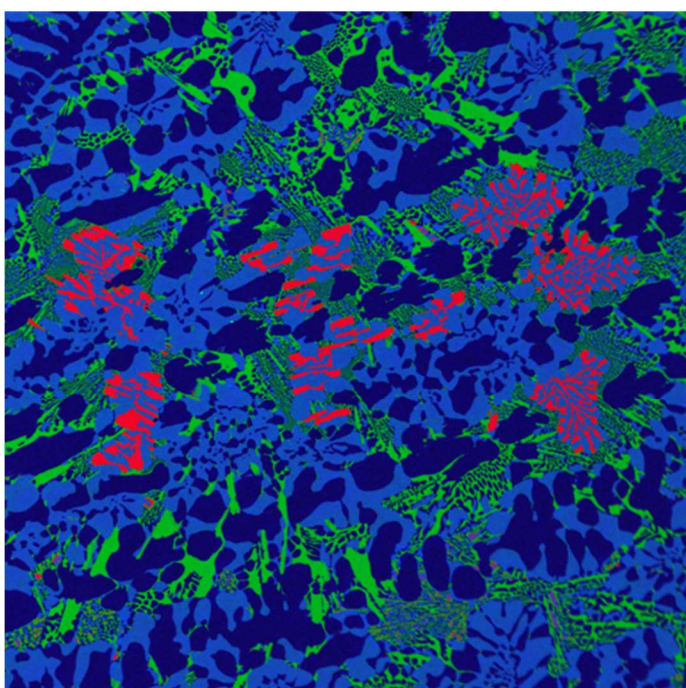
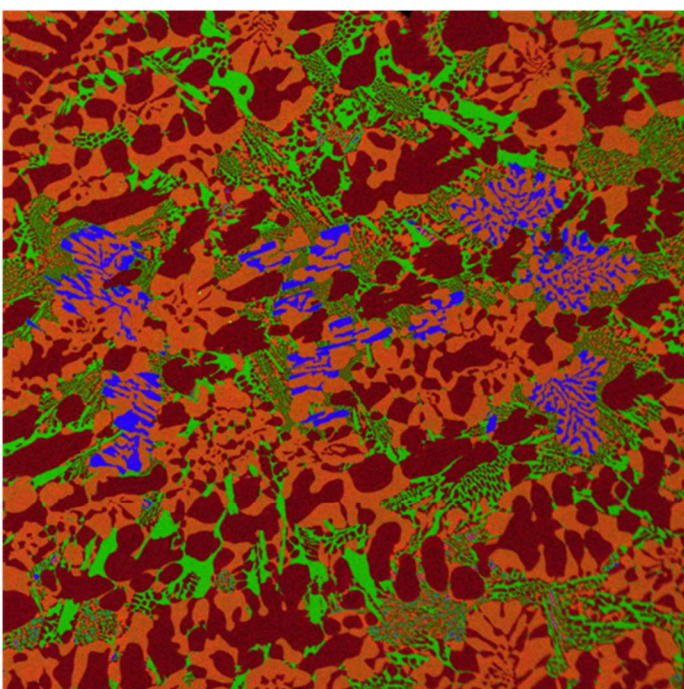
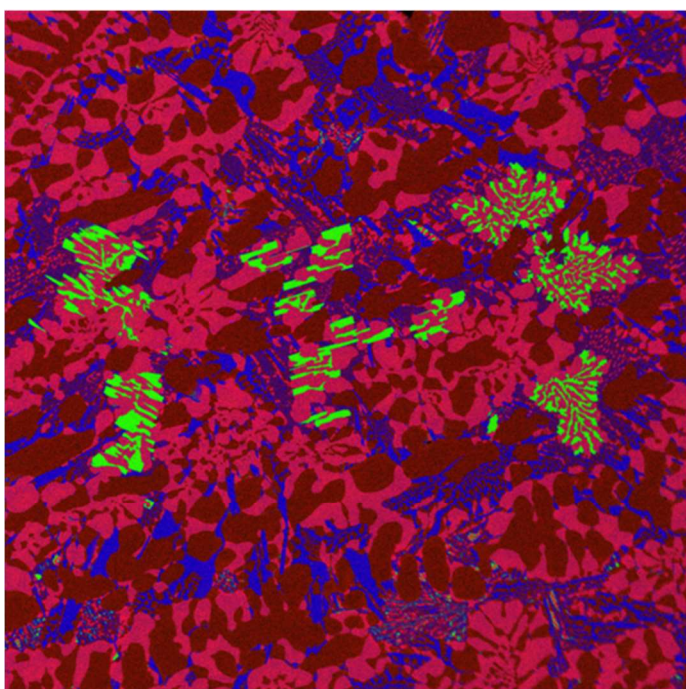
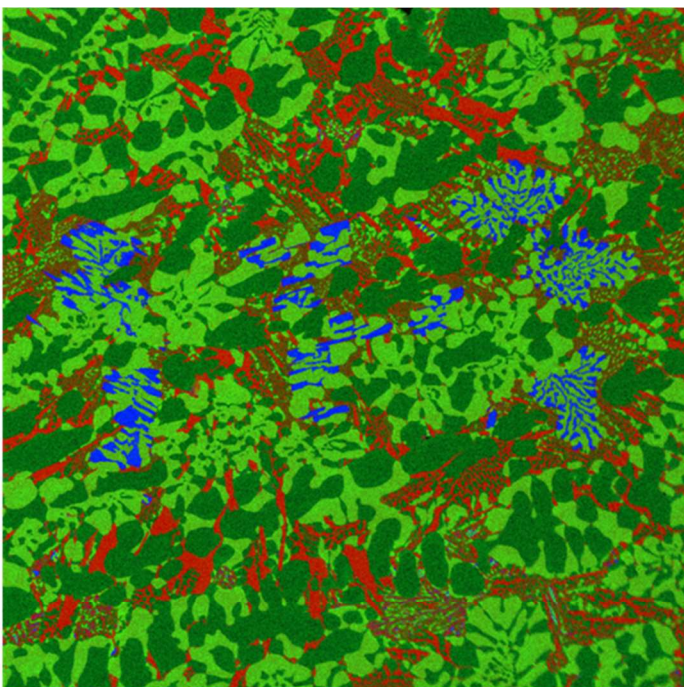
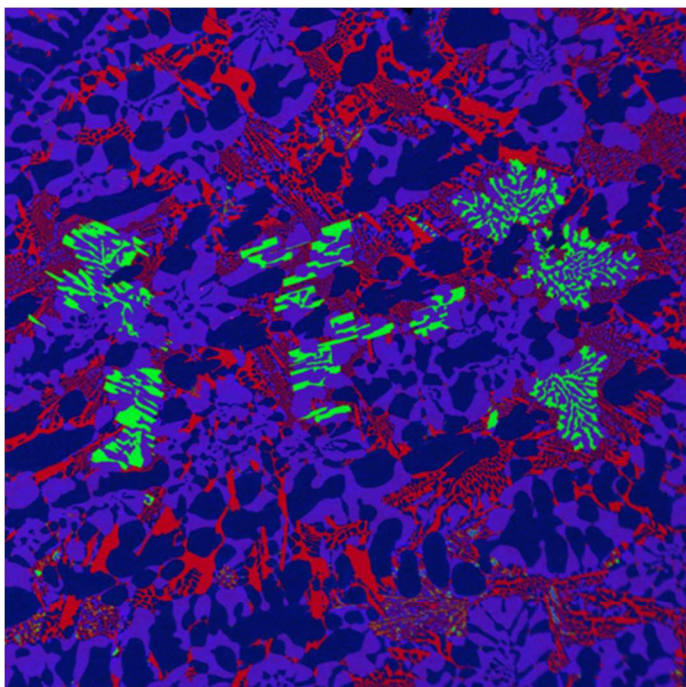
IMPORTANT DATES

Christmas/New Year Closures

The AMC Facility will be closed for the mandatory Christmas to New Year leave period, from Wednesday 18th December until Monday 6th of January with some instruments available from Tuesday the 7th of January 2025. Instruments will either be shut down or placed in standby mode during this period, therefore cannot be used/booked.

- Wednesday 18th December 2024: Last day AMCF labs are open for regular use.
- Monday 6th January 2025: Instrumentation start-up and checks.
- Tuesday 7th January 2025: AMCF labs open again for regular use.





AMCF