



THE UNIVERSITY OF  
**SYDNEY**

Core Research  
Facilities

**Enabling research  
excellence**



A person wearing a red lab coat and white gloves is using a pipette to transfer liquid into a multi-well plate. The background is a blurred laboratory setting with a computer monitor and other equipment.

“We will invest in major new capabilities for our core research facilities that will provide our researchers with the infrastructure, tools and technical support to pursue research excellence.”



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# Enabling research excellence

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“World-class infrastructure, user-centric processes and the skills, talents and passions of a professional team dedicated to supporting the research ambitions of the institution and our partners—this is the essence of Sydney's core research facilities.”

# Director's welcome

## Professor Simon Ringer

Director, Core Research Facilities



At the University of Sydney, our research is driven by the pursuit of excellence. The University's unprecedented focus on research and research infrastructure is transforming our capacity to drive both fundamental and translational research for the benefit of Australia and the world.

The continuing development of our core research facilities is an integral part of this strategy. Our research facilities are intimately linked to our search for solutions to the

most significant contemporary challenges in climate, health, food, water, energy, communications, transport, manufacturing, construction and national security.

The facilities bring together world-class instrumentation, outstanding people and excellent user-focused processes. They provide staff and students from the University and our partners around the world with an exceptional basis on which to achieve research excellence.

The facilities are designed for use by academic teams in the physical, medical, life and engineering sciences and throughout the humanities and social sciences.

They serve as a focal point for collaborations and partnerships with researchers from these diverse disciplines tackling frontier research questions.

If you or your research team could benefit from the facilities at Sydney, I encourage you to make contact to discuss the possibilities.

## Our research services



### Project development

Our specialist technical staff are on hand to help design your research project from the ground up, ensuring you get the most from our facilities.



### Instrument training

Through comprehensive one-on-one training, you will acquire the skills to operate the full range of instruments required by your research.



### Regulatory compliance

You will be guided through the necessary safety, ethics and building access protocols tailored to your project's scope.



### Lab support

Our staff are a constant presence in each of our facilities, and are available at any time to provide hands-on technical assistance.



### Data analysis and visualisation

We have vast capabilities and expertise for advising and supporting you in analysing, visualising and publishing your research data.



### Contract research and testing

We have a strong track record of providing high-quality research and testing services for clients, and can accommodate small and large scale projects.



### Assistance with grant preparation

Up-to-date facility access information is an important part of any grant application. We can assist you with this during the grant-writing process.



### Assisted access to national research facilities

With our established networks of research partners, we can assist you in accessing specialist research facilities throughout Australia.



### Guidance on advanced computing

Through consultation, training courses or one-on-one support, we can help you with all your HPC, VRD and research data needs.

Major partner research organisations:



# Access your research facilities



## Consultation

Our staff will work with you to put together a viable project design, taking into account factors such as experimental scope, instrument requirements, and budget.



## Activation

We will assist you in registering your project in our online Facility Access System, and will guide you through any regulatory approvals necessary.



## Induction

We will organise a bespoke training program specific to your needs, giving you autonomous access to our facilities to complete your project.



## Supervision

Our specialist staff will be onsite to provide any technical assistance you require.

## User Access Scheme

The Core Research Facilities User Access Scheme has been developed to invest in and drive research excellence across the University by providing small grants to support user access to the facilities.

These grants are aimed at supporting important research that would significantly benefit from use of the core research facilities, as well as supporting preliminary, supplementary or additional research related to funded research projects, to best leverage the outcomes from awarded grants.

Interested in applying for a grant? Find out how:

– [sydney.edu.au/research/facilities/user-access-scheme](https://sydney.edu.au/research/facilities/user-access-scheme)

## Facts and figures

8

openly available specialist facilities

80+

onsite experts providing guidance and research services

400+

instruments available for users

# Research and Prototype Foundry

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ELION  
Made in 10

The Research and Prototype Foundry, based at the Sydney Nanoscience Hub, offers instruments for the fabrication of devices and structures with features on the micro and nanoscale, with specialised processes allowing users to prototype new optical chips, electronic devices and new quantum science and technology devices.

Our goal is to provide ready access to state-of-the-art tools for micro and nano fabrication (lithography, etching, deposition and metrology) backed up by a team of expert process engineers.

#### More information

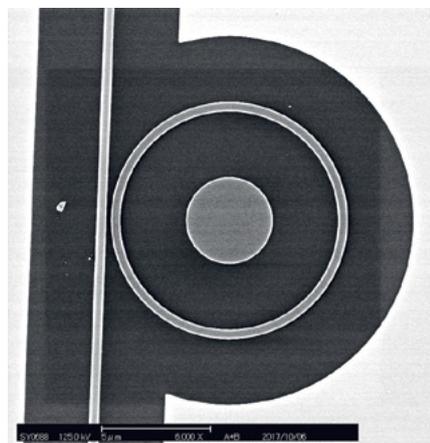
– [sydney.edu.au/research-and-prototype-foundry](http://sydney.edu.au/research-and-prototype-foundry)

### Our capabilities

- ASML PAS 5500/100 i-Line stepper
- SVG 88 track system
- Oxford ICP reactive ion etcher
- Atomic layer deposition
- DWL 66+ laser mask writer
- Elionix electron beam lithography
- Atomic force microscopy
- Brewer spin coater
- Brewer developer
- MLA 100 Maskless aligner
- Spin dryer
- Wet benches
- Focused ion beam scanning electron microscopy
- PM 5 probe station
- Leica stereo zoom microscopy
- Olympus stereo zoom microscopy
- DekTak stylus profilometer
- ISO Class 5 cleanroom.

### Research in action ►

This image shows an optical ring resonator device for high frequency signal processing. This was produced by a photonics researcher, using several different capabilities within the Research and Prototype Foundry cleanroom. The Foundry is capable of printing details less than 10nm wide using one of the most powerful electron-beam lithography instruments in the Southern Hemisphere.



# Sydney Analytical

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Sydney Analytical is the University's core research facility dedicated to materials, chemical and biological analysis. Our instruments are operated in four principle clusters: vibrational spectroscopy, x-ray techniques, magnetic resonance, and drug discovery.

We provide instruments and services to researchers from across the spectrum of life and physical sciences, engineering, and beyond.

#### More information

– [sydney.edu.au/sydney-analytical](https://sydney.edu.au/sydney-analytical)

## Our capabilities

- Vibrational spectroscopy: Raman, infrared and near-infrared spectrometers, offering 2-D and 3-D mapping at resolutions down to nanometres with AFM/spectrometer techniques.
- X-ray diffraction (single-crystal and powder X-ray) and X-ray scattering.
- X-ray spectroscopy: XPS and UPS mapping (30  $\mu\text{m}$ ) and depth profiling, XRF
- Portable spectrometers: Raman, infrared and XRF
- Specialist capability in the characterisation of cultural heritage materials.
- Controlled sample environments, including temperature, pressure and battery cells.
- Support for early-stage drug discovery: protein production and characterisation, protein X-ray crystallography, fragment-based drug discovery, and cyclic peptide screening.
- Magnetic resonance: NMR spectrometers from 300 to 800 MHz and EPR.

## Research in action ►

Portable vibrational spectroscopic techniques are being used for the identification of faded pigments on a 2500-year-old coffin believed to belong to the woman Mer-Neith-it-es. The coffin was donated to the University in 1860 by Sir Charles Nicholson.

Image courtesy of the Nicholson Museum (NMR.29.1-2)





# Sydney Cytometry

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Jointly operated by the University of Sydney and the Centenary Institute, Sydney Cytometry provides access to cytometry and cell-sorting techniques for researchers both internal and external to the University. We are committed to the development and transfer of expertise in quantitative cell science to answer questions in cell biology and biomedical research, applied clinical research and trials, and the diagnosis of cancer and other health disorders.

#### More information

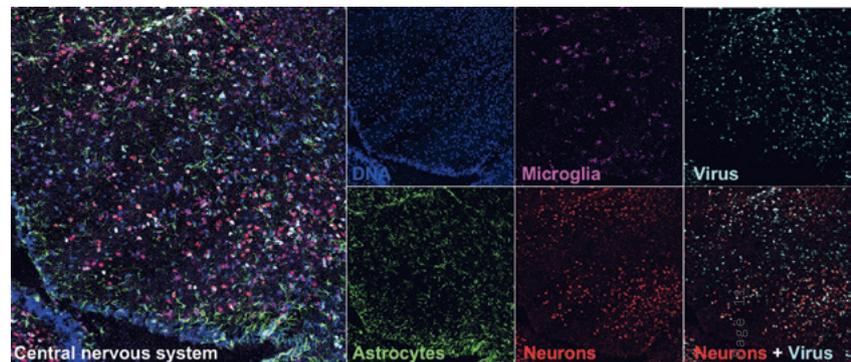
– [sydneycytometry.org.au](http://sydneycytometry.org.au)

#### Research in action ►

Our imaging mass cytometer is helping us understand how the immune system responds to viral infection by simultaneously measuring 40 cellular or viral protein targets on tissue sections of the central nervous system. In this example, we are tracking the spread of virus throughout the central nervous system as well as investigating the response of immune cells, such as the brain-resident microglia.

#### Our capabilities

- Cell analysis by fluorescence-based flow cytometry. The facility provides a range of instruments from basic 3-laser, 10-parameter cytometers to a unique custom-built instrument with 10-lasers and 30-parameters and one of the first next-generation spectral flow cytometers
- Cell and tissue analysis by imaging flow cytometry and high-content bio imaging
- Cell and tissue analysis by mass cytometry, including the Southern Hemisphere's first imaging mass cytometer that enables the simultaneous localisation of up to 45 different molecules at microscopic resolution
- Cell sorting via automated magnetic separation or high-throughput droplet-based cell sorting of multiple populations at speeds up to 30,000 cells per second. In addition, the Centenary Institute has a cell sorter within a PC3-facility, enabling the sorting of highly biohazardous samples.



# Sydney Imaging

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Offering world-class imaging capabilities and technical expertise, Sydney Imaging is a unique facility for research and education in the field of biomedical science. We operate a diverse range of preclinical and clinical imaging modalities, and a world-class hybrid theatre providing the capability for translational research along with training and development of specialised and complex surgical skills.

#### More information

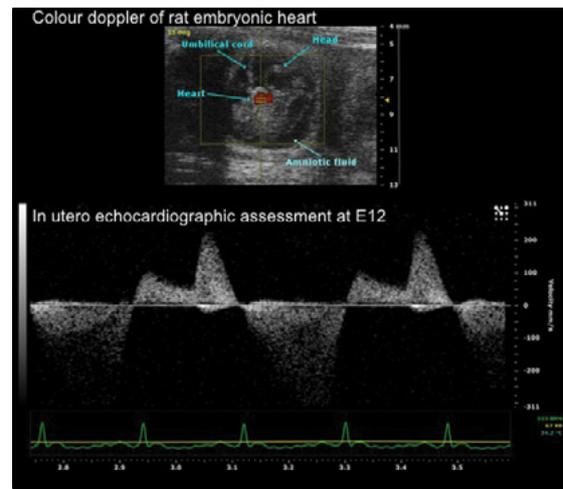
- [sydney.edu.au/sydney-imaging](http://sydney.edu.au/sydney-imaging)

#### Research in action ►

Non-invasive real-time *in utero* high-frequency ultrasound imaging of a rat embryo at gestational day E12 for echocardiographic assessment with colour doppler. This modality allows researchers to perform longitudinal cardiac assessment from embryonic gestation to adulthood including heart muscle thickness, haemodynamic assessment as well as oxygenation/haemoglobin saturation of different regions of the heart when combined with photoacoustic imaging.

#### Our capabilities

- MRI (preclinical): 3T, 7T
- MRI (clinical): 3T (I-MED Radiology)
- PET/MRI (preclinical): 3T
- Body composition EchoMRI
- Optical bioluminescence and fluorescence imaging
- High-frequency ultrasound
- Photoacoustic imaging
- 3D microCT
- 2D x-ray with DXA camera
- Hybrid operating theatre
- Artis Pheno C-arm: x-ray, fluoroscopy and CT
- Specialist clinical ultrasound (including TOE echocardiography)
- Kuka LBR Med Surgical Robot
- PET/CT and PET/SPECT/CT (preclinical) – (ANSTO)
- Small Animal Radiation Research Platform – (Kolling).



# Sydney Informatics Hub

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The Sydney Informatics Hub works with and supports the research community by providing comprehensive research data services, leveraging staff expertise and capabilities in high performance computing, data analytics, bioinformatics, and research data management, statistics and strategy.

#### More information

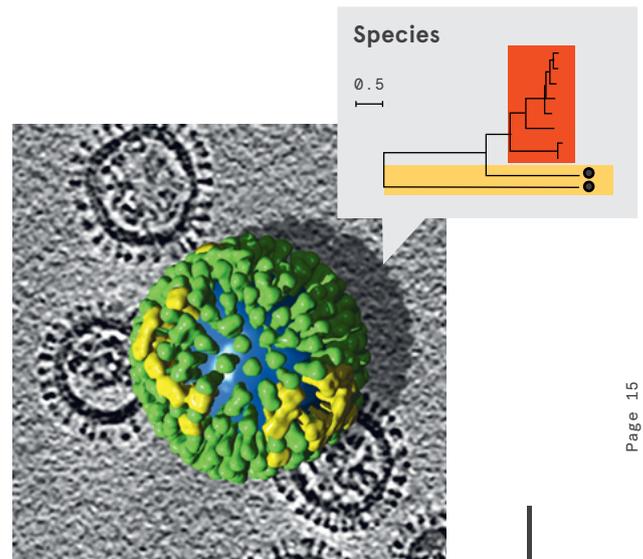
- [sydney.edu.au/informatics-hub](https://sydney.edu.au/informatics-hub)

## Our capabilities

- Expert data consultancy and training
- Software development and application support
- Digital research tool support, consultancy and training (Redcap, eNotebook, Research Data Store (RDS), Dropbox, GitHub, Cloudstor)
- Data analytics/science, visualisation, image processing and publishing support and training
- Bioinformatics support and software (CLC Genomics Workbench and Server, Ingenuity Pathways Analysis)
- Statistical consulting and support (e.g. experimental design, optimal statistical analyses, training)
- HPC (Artemis, Pawsey, NCI), Argus Virtual Research Desktop and cloud computing support
- Research data planning, collection, storage, sharing, and security
- Advise on data and computing infrastructure policy and strategy.

## Research in action ▶

By processing high-throughput sequencing data on the Artemis High Performance Computing cluster, researchers were able to find 214 RNA viruses in frogs, fish and reptiles that have never been seen before. It shows RNA viruses are many millions of years old and have existed with and evolved alongside the first vertebrates. These findings contribute to our understanding of disease-causing viruses. The research was published in *Nature*, 2018.



# Sydney Mass Spectrometry

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Sydney Mass Spectrometry supports research with global impact through a portfolio of 20 mass spectrometers for proteomics, glycomics, metabolomics, lipidomics, and mass spectrometry imaging applications.

We partner with research groups both internal and external to the University to answer questions in biomedical research, plant biology, applied animal and human clinical research, neuroscience and many other areas.

#### More information

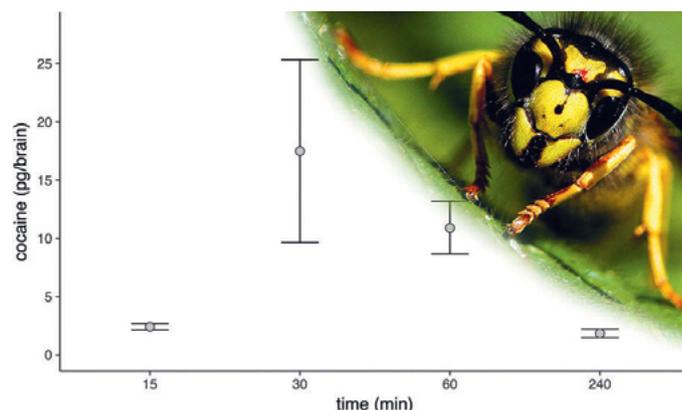
– [sydney.edu.au/mass-spectrometry](https://sydney.edu.au/mass-spectrometry)

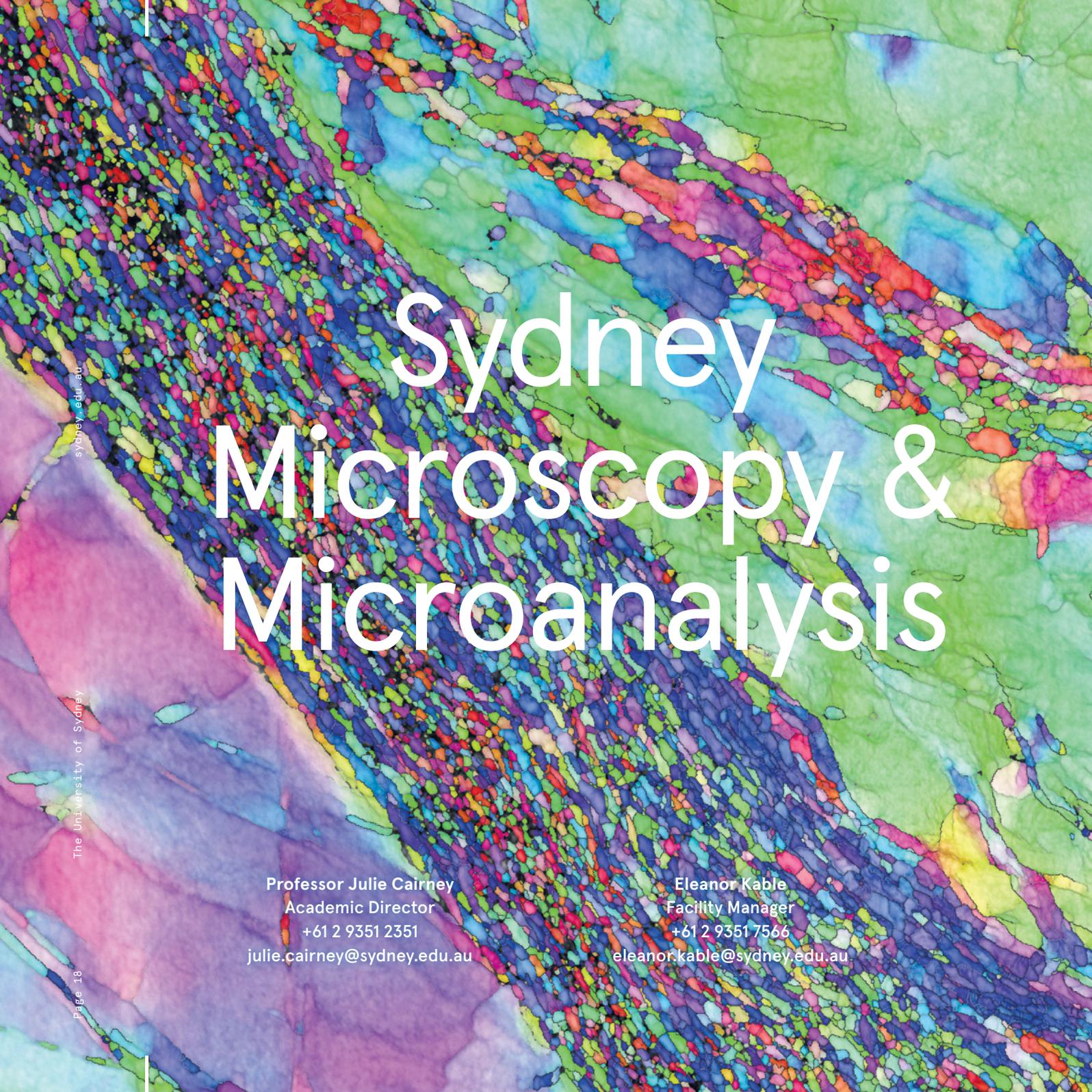
#### Research in action ►

The concentration of cocaine in the brains of honey bees was directly measured using a QTRAP mass spectrometer. Why? Honey bees are a well-established model for behavioural studies, and the research group were able to show that cocaine may act by directly altering DNA methylation. Their observations could shed light on why cocaine has such an enduring impact on behaviour.

#### Our capabilities

- We have several orbitrap platforms (HFX, 480, Eclipse) and 6600 Triple ToFs dedicated to discovery proteomics, including phosphoproteomics
- Glycomics using an Orbitrap Fusion with ETD
- Targeted metabolomics and lipidomics on two QTRAPs or two TSQ Altis QQQs
- Multiple discovery metabolomics/lipidomics platforms including Q Exactive HFX, Synapt G2 Si, Fusion
- Mass spectrometry imaging via MALDI (UltrafleXtreme TOF-TOF) or DESI (Synapt G2 Si)
- A Lumos (with ETD, UVPD, 1M) for cross-linking interactomics analysis and other applications
- Bioinformatics suite equipped with over 6 high-performance data-processing workstations and a wide range of analysis packages





# Sydney Microscopy & Microanalysis

sydney.edu.au

The University of Sydney

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One of the largest and most comprehensive facilities of its kind in the world, Sydney Microscopy & Microanalysis enables insights into how materials work – at the scale of living cells, tissue, molecules, crystals and even individual atoms.

The facility offers access to specialist staff, instruments and training to enable research into physical and biological structures across a variety of lengths and time scales. This expertise extends from specimen preparation to data capture and data analysis, and can be used across multiple disciplines.

#### More information

- [sydney.edu.au/research/facilities/sydney-microscopy-and-microanalysis](http://sydney.edu.au/research/facilities/sydney-microscopy-and-microanalysis)

#### Research in action ►

Our facilities support research into both inorganic and biological structures such as the examples pictured on the right.

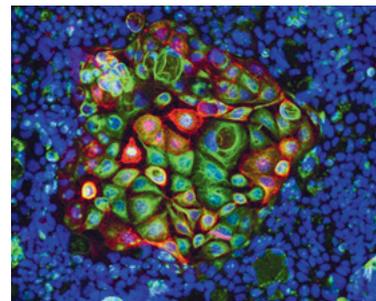
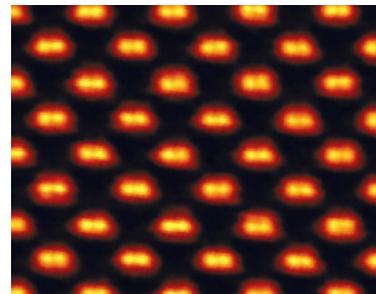
Top: Aberration-corrected scanning transmission electron micrograph of GaN imaged along the [211] zone axis, demonstrating

spatial resolution better than 0.6 Ångström, recorded on the new double-corrected FEI Themis-Z microscope operated with monochromator excited at 300 kV.

Below: Confocal micrograph of colorectal cancer cells at the micrometre scale.

#### Our capabilities

- Atom probe tomography
- Transmission electron microscopy
- Scanning probe microscopy
- Scanning electron microscopy
- X-ray microscopy
- Light and laser microscopy
- Super-resolution microscopy
- Correlative light and electron microscopy
- Cryo electron microscopy
- Expert specimen preparation
- Image visualisation.



# Sydney Manufacturing Hub

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Additive manufacturing of advanced metals, ceramics and polymers, materials processing facilities, materials testing platforms and world-class expertise are the essence of the Sydney Manufacturing Hub. Geared to support R&D on the design and development of new materials, manufacturing processes and integration, this unique, research-focused manufacturing facility enables concept-to-production capabilities in the areas of health, defence, transport, oil & gas, mining and construction. Facilitating researcher-industry interfaces is a specialty.

#### More information

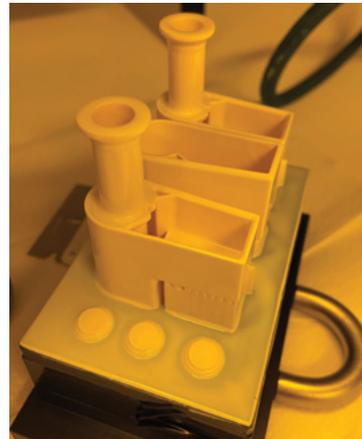
- [sydney.edu.au/sydney-manufacturing-hub](http://sydney.edu.au/sydney-manufacturing-hub)

#### Research in action

The Cerafab 7500 3D ceramic printer at Sydney Manufacturing Hub was used to manufacture a bionic eye-lid implant for the BLINC project which aims to restore blinking in patients with facial paralysis. The inability to blink presents a unique problem, as blinking is required to lubricate the eye, without which the eye can dry out and be damaged, ultimately leading to blindness. Ceramic printing of Aluminium Oxide was selected for its biocompatibility and non-magnetic properties. Ceramics are normally difficult to work with in R&D, however leveraging 3D printing allows for a much higher degree of flexibility and agility in design.

#### Our capabilities

- 3D printing: a digitally enhanced alternative to traditional 'subtractive' manufacturing
- Printing materials, including:
  - Metals (Stainless Steel, Al, Ni, Ti, based and other alloys)
  - Ceramics (Al<sub>2</sub>O<sub>3</sub>, SiN, ZrO<sub>2</sub> etc)
  - Polymers (PLA, ABS, PETG, Nylon)
- Printing Technologies:
  - Vat Polymerisation
  - Electron Beam Melting
  - Direct Metal Laser Melting
  - Fuse Deposition Modeling
  - Heat treatment:
  - Programable inert/active atmosphere furnaces, Oil and Salt Baths, Ovens
  - Metal melting/casting
- Design:
  - ANSYS software package
  - Computer Aided Design (CAD) systems
- Finishing, Metrology and Testing:
  - Precision Electro-discharge Machine cutting
  - Surface profiling
    - LiDAR
  - Mechanical testing
    - Nanoindentor
  - State-of-the-art mechanical testing



# Our locations

Forest Lodge

 **Kolling Institute**  
(Royal North Shore Hospital,  
St Leonards)

Parramatta Road



sydney.edu.au



 **Charles Perkins Centre**

 **Centenary Institute**



 **School of Chemistry**

 **Sydney Nanoscience Hub**



 **Madsen Building**



 **Brain and Mind Centre**  
(94-100 Mallett Street)



**Royal Prince  
Alfred Hospital**

## Camperdown Campus

Camperdown

 **Merewether  
Building**



## Darlington Campus

Carillon Avenue

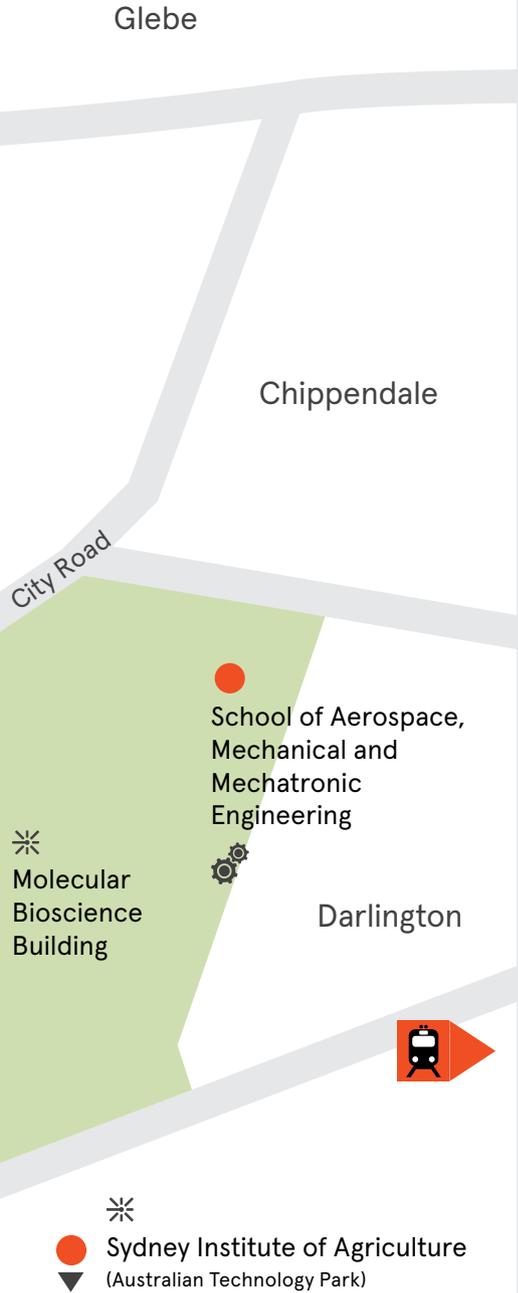
Missenden Road

Newtown



The University of Sydney

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## Locations of our facilities



### Research and Prototype Foundry

Sydney Nanoscience Hub



### Sydney Analytical

Madsen Building  
Molecular Bioscience Building  
School of Chemistry  
Sydney Institute of Agriculture  
Sydney Nanoscience Hub



### Sydney Cytometry

Centenary Institute  
Charles Perkins Centre



### Sydney Imaging

Brain and Mind Centre  
Charles Perkins Centre  
Kolling Institute



### Sydney Informatics Hub

Merewether Building



### Sydney Mass Spectrometry

Charles Perkins Centre  
Kolling Institute



### Sydney Microscopy and Microanalysis

Brain and Mind Centre  
Charles Perkins Centre  
Madsen Building  
Sydney Nanoscience Hub



### Sydney Manufacturing Hub

School of Aerospace, Mechanical  
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