



## Core Research Facilities Research Highlights



The University of Sydney's Camperdown campus sits on the lands of the Gadigal people with campuses, teaching and research facilities on the lands of the Gamaraygal, Dharug, Wangal, Darkinyung, Burramadagal, Dharawal, Gandangara, Gamilaraay, Barkindji, Bundjalung, Wiradjuri, Ngunawal, Gurend Gureng and Gagadju peoples. We recognise and pay respect to the Elders and communities of these lands, past present and emerging, who for thousands of years have shared and exchanged knowledges across innumerable generations, for the benefit of all.



THE UNIVERSITY OF  
SYDNEY

# Core Research Facilities Research Highlights

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# A NOTE FROM THE DIRECTOR

In 2016 the University embarked on an ambitious strategic initiative to establish a world-class research infrastructure platform for our researchers and research partners.

The Core Research Facilities have quickly become an integral part of the University's commitment to delivering research excellence. They serve as a focal point for bringing researchers together to tackle frontier research questions using advanced methodologies and research workflows.

Over the last five years, we have brought eight research facilities into operation. Research excellence in support of the University's research strategy will remain the key focus of our facilities. With an already impressive userbase of more than 3000 researchers and commercial users and supporting over 400 individual pieces of equipment with approximately 120 highly skilled technical staff supporting the day to day running of the facilities, we look forward to working with our academic stakeholders to ensure that this superb resource is leveraged appropriately and effectively towards the University's mission.



Professor Simon Ringer  
Director, Core Research Facilities

“The Core Research Facilities program has brought together exceptional research infrastructure and made it easily accessible. Our researchers think of these facilities as a straightforward extension of their school or faculty, their research centre, or their particular institute. Whether they be global primes, or local start-ups, our industry partners tell us that these facilities add competitive advantage. So, from ‘Archaeology’ through to ‘Zoology’—Sydney’s core research facilities have been highly effective at building research capacity that enables both a fundamental and a translational research pipeline.”

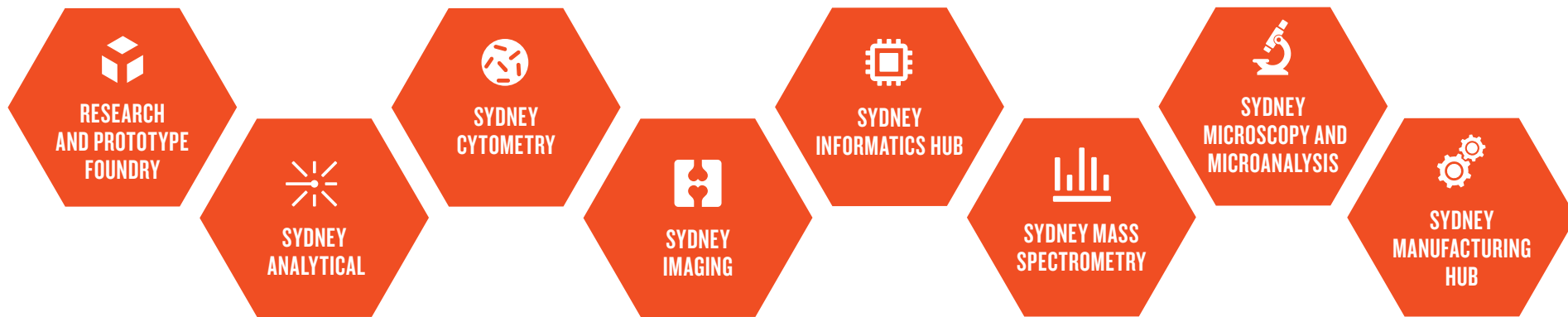


Laurent Rivory  
Pro-Vice-Chancellor (Research)

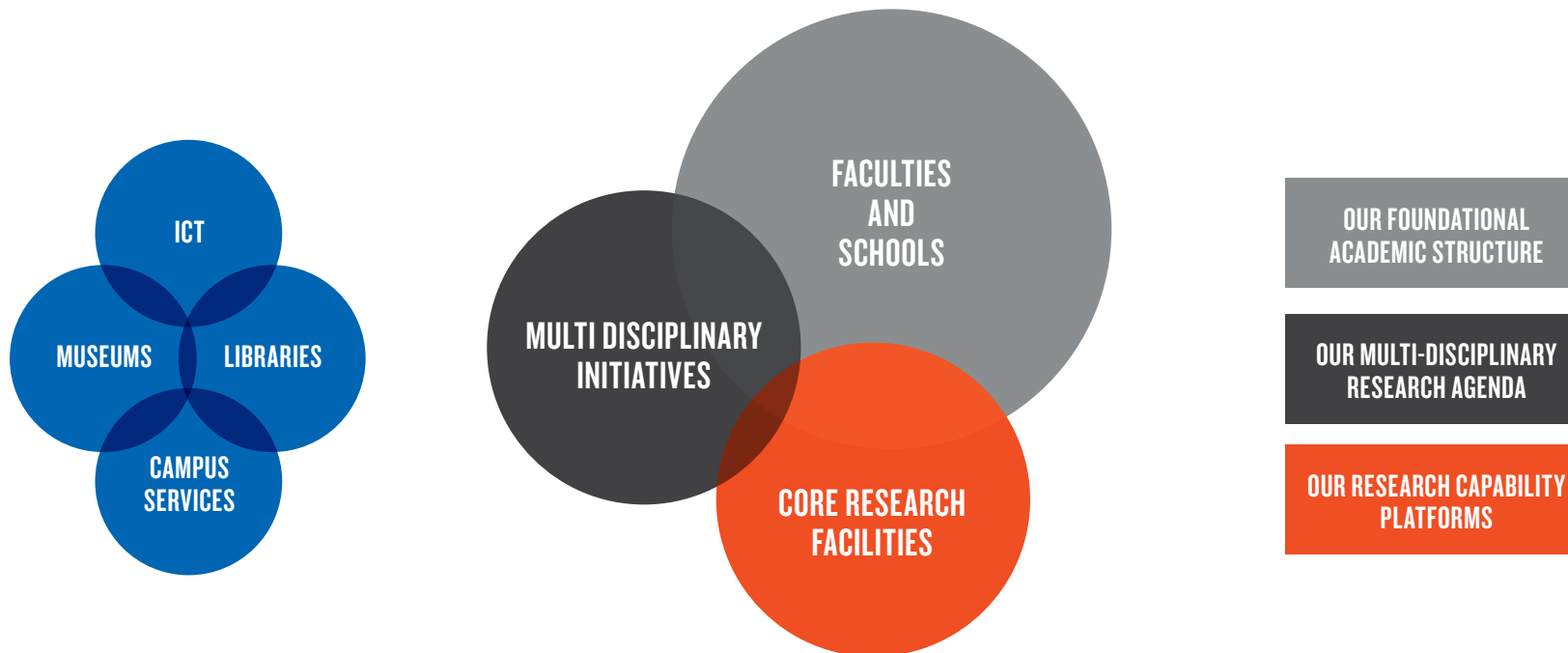
# WHAT WE DO

The Core Research Facilities at the University of Sydney provide access to high-end research infrastructure and support a range of research services that enable researchers to tackle challenging research questions and undertake complex research workflows. These centralised, shared facilities serve all faculties and are focal points for multidisciplinary research activity. They bring together researchers from diverse disciplines and provide an efficient and effective means to better manage and sustain the high-end research infrastructure that underpins research excellence.

## CORE RESEARCH FACILITIES

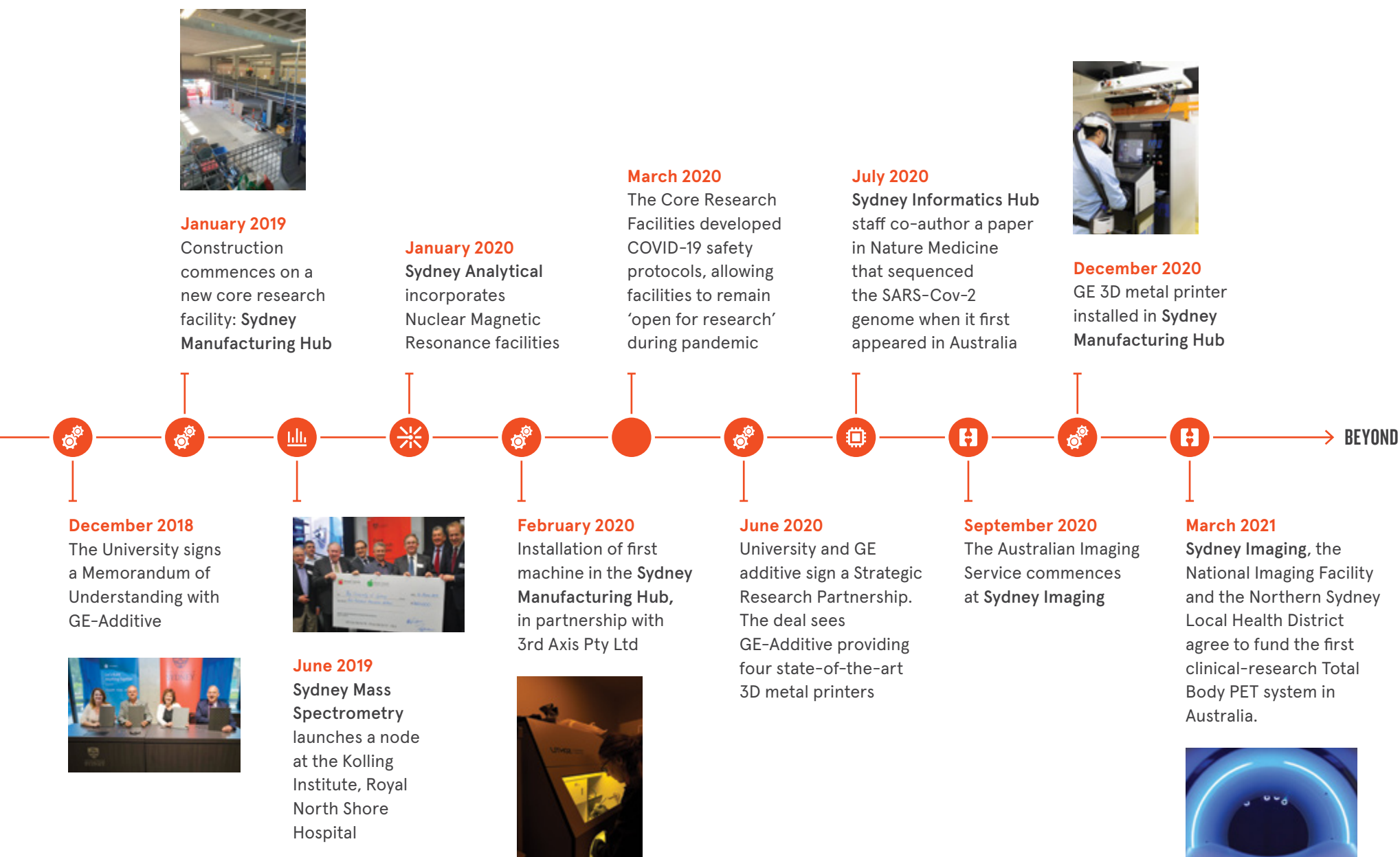


## UNIVERSITY MODEL FOR SUPPORTING RESEARCH



# OUR JOURNEY SO FAR





# CORE RESEARCH FACILITIES BY NUMBERS



8

facilities



468

instruments



**886,000+**

hours of  
equipment use



**3,700+**

projects



**3,400+**

users of  
the facilities



**120**

staff



**55**

industry  
clients

### Core Research Facilities users come from



**28%**

Faculty of  
Science



**28%**

Faculty of  
Medicine  
and Health



**15%**

Faculty of  
Engineering



**15%**

MDIs, MRIs  
and other  
University  
affiliates



**23%**

of the  
University's  
publication  
output



**83%**

of total  
University grants  
awarded



**52%**

of the University  
Research Block  
Grant income

# COLLABORATIONS

The CRF collaborates with researchers, industry partners  
and government networks and initiatives.





Raman spectroscopic analysis of pigments from a medieval palimpsest manuscript (Add. Ms. 411) held in the Rare Books and Special Collections of The University of Sydney Library.

# NATIONAL RESEARCH PRIORITIES

The Core Research Facilities have enabled a diverse range of excellent research over the past five years. Here we present a selection of research projects which support national research priorities, including the rapid response to COVID-19.

## Legend: Core Research Facilities

-  Research and Prototype Foundry
-  Sydney Analytical
-  Sydney Cytometry
-  Sydney Imaging
-  Sydney Informatics Hub
-  Sydney Mass Spectrometry
-  Sydney Microscopy and Microanalysis
-  Sydney Manufacturing Hub



## Food

-  Converting biowaste from Jackfruit into battery cells
-  Discovery of biomarker that allows for better selection of cattle for management of feedlots
-  Understanding the effect of cryo-preservation on ram spermatozoa to inform sheep farming practice
-  Discovery of a new mechanism for salt tolerance in wild Australian rice species *Oryza australiensis*



## Soil and water

-  Predicting soil properties using deep learning techniques
-  Analysis of microplastics and nanoplastics in the food chain
-  Paving the way for graphene-based antifouling membranes for water treatment applications



## Transport

-  Comparison of untreated and laser cleaned granite surfaces on the Sydney Harbour Bridge and other bridges
-  MetroScan: a transport and planning system that allows for mapping of passenger and freight activity



## Energy

-  Understanding how sulphur affects catalysis in fuel cells
-  Development of highly efficient, flexible and rechargeable batteries
-  Development of charge sensing qubits



## Resources

-  Observation of hydrogen trapping at dislocations, grain boundaries and precipitates
-  Combining sensor and observational data for mineral exploration
-  Predicting formation of deep-sea polymetallic nodules/ore deposits



## Cyber security



Support of a multi-year collaboration with Microsoft on projects related to quantum



## Advanced manufacturing



Development of carbon nanotubes onto carbon fibre creates a fibrous film with superior strength, flexibility and performance



Robotic glasses with movement sensors to identify and avoid hazards



Strengthening via spinodal decomposition in a new ultralight magnesium alloy



## Environmental change



Mapping the oceanographic changes to the Great Barrier Reef for the last 126,000 years



Analysing prey behaviour while escaping a predator (fish)



Anatomical 3D modelling of leaves



## Health



Metabolic effects of moderate vs high intensity interval training (in mice)



Branch-chained amino acid in diet impacts health and lifespan



Immune cell populations define response to certain metastatic melanoma treatments



Fragment based drug discovery (FBDD) finds potential new class of antibiotics



Understanding the role of thrombin inhibitors in ticks paves the way for anti-thrombotic drug development



Identifying risk factors for severity of patient response to influenza infection



Protein PKC 3 acts on adipose tissue—not on the liver directly, to cause insulin resistance



Effects of parvovirus can cause spontaneous nephropathy and kidney fibrosis



## COVID-19



Sequencing of the COVID-19 genome from NSW cluster



Understanding how and why a massive immune response to COVID-19 can cause organ failure



New technique to insert cardiac device at the bedside for critically ill patients



Modelling how social distancing reduces transmission and control of COVID-19 in Australia



Clinical trial using immune-modulatory particles to reduce the inflammatory immune response in COVID-19 patients



Developing a biomarker that helps predict how a patient will respond to COVID-19



Design and manufacture of adaptors that turn a 3M respirator into a HME filter

# CORE RESEARCH FACILITIES SUPPORTING UN SUSTAINABILITY GOALS



“Sustainable Development Goals provide a global language for political action and policy reform. Universities can and need to contribute to these discussions... They promote a culture of co-design and collaboration between Governments, industry, universities and civil society in tackling these challenges. They promote innovation, not for the sake of innovation itself, but for the public good.”



**Professor Duncan Ivison**  
Deputy Vice-Chancellor (Research)



# RESEARCH AND PROTOTYPE FOUNDRY

The Research and Prototype Foundry (RPF) is a nanofabrication facility which offers instruments and specialist expertise for the fabrication of devices and structures with critical features on the micro and nanoscale. Users run specialised processes to make devices and prototype new ideas.



## Find out more

- [sydney.edu.au/research/facilities/research-and-prototype-foundry](https://sydney.edu.au/research/facilities/research-and-prototype-foundry)

## New nano device lights the way for quantum development

Using light for information processing is increasingly important for both the fidelity and speed of communications. However, efficiently miniaturising devices so that they can manipulate and concentrate light at the nanoscale remains a formidable challenge for both researchers and industrialists.

Utilising the world-leading capability at the **Research and Prototype Foundry**, the Sydney Nano Institute's Dr. Alessandro Tuniz (School of Physics, Faculty of Science) has created a hybrid waveguide device that could potentially solve this problem. The device rotates and then focuses light to an incredibly fine point – all within a monolithic chip.

This process is normally achieved through separate components, but in Dr Tuniz's solution, each module has been integrated within a single chip using widely available fabrication processes and standard materials. This makes industrial scalability plausible and this is a future direction. This device was built in the **Research and Prototype Foundry** cleanroom, utilising specialised electron beam lithography equipment and an atomic force microscope.

In developing his device, Dr Tuniz has built a bridge between industry-standard silicon photonic systems and metal-based waveguides, which concentrate light in areas that are 100 times smaller while retaining efficiency.

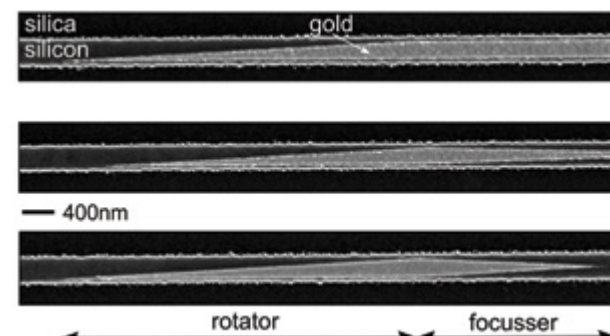


The new device has the potential to be used in quantum information systems, nano-spectroscopy, nano-scale detectors, and atomic scale sensing.

### User access scheme success

Dr Tuniz received a Core Research Facilities *User Access Scheme* grant in 2018 to enable his initial access to the **Research and Prototype Foundry** to support his proof-of-concept work. This preliminary work ultimately led to Dr Tuniz's successful 2020 Australian Research Council, Discovery Early Career Researcher Award application.

The outcomes and implications of his device were published in *Nature Communications*.



Scanning electron micrograph (top view) of silicon on insulator waveguides post processed with hybrid plasmonic waveguide circuits

## Using microchips to understand heart disease



Heart disease affects 1.2 million Australians every year and is the number one cause of deaths worldwide. Dr Lining Arnold Ju (School of Biomedical Engineering, Faculty of Engineering and Heart Research Institute) and his research team have been seeking to better understand blood clotting in heart disease through microfluidics and nano health – an emerging capability within the **Research and Prototype Foundry**.

### One cell at a time

Dr Ju, with the support of **Research and Prototype Foundry** staff, built a microfluidic chip that was able to simulate the narrowing of blood vessels – a key cause of blood clots. This allowed Dr Ju's team to directly observe the mechanical forces that influence blood clotting on a molecular level.

Published in *Nature Materials*, the research was able to describe mechanically driven platelet activation and why that causes platelets to aggregate and cause clots.

**This research could inform the design of efficient anti-thrombotic approaches that reduce biomechanical blood clotting.**

Beginning as a small project funded via the Core Research Facilities *User Access Scheme*, Dr Ju's promising research into the biomechanical properties of clotting has been formally recognised via an Australian Research Council Discovery Early Career Researcher Award (2019), a Tall Poppy Award (2020) and being placed as a finalist in the Eureka Prize (2020).

Dr Ju and his research team are taking their research to the next level, continuing to work with **Research and Prototype Foundry** to make microfluidic chips to examine biomechanical regulation of blood cells for both healthy and diabetic patients.



## Galaxy search

Looking for new galaxies far, far away has taken a leap forward thanks to recent innovations in telescope design. One of these innovations is “Hector” – a new dark-time instrument that will be incorporated into the Anglo-Australian Telescope (AAT) and will enable scientists to survey up to 15,000 galaxies!

### Who is Hector?

Hector is comprised of 21 hexabundles – optical fibre imaging devices where the fibres have been modified and fused together in a hexagonal shape using a specially developed technique that enables more light to pass through. The hexabundles that are so integral to Hector were designed and constructed by Associate Professor Julia Bryant (School of Physics, Faculty of Science) and her research team, leveraging the expertise of the **Research and Prototype Foundry** staff.

The research team, including Rebecca Brown and Adeline Haobing Wang (both School of Physics, Faculty of Science), collaborated with the **Research and Prototype Foundry** staff to develop a process for modifying commercial optical fibres using chemical etching. Commercial optical fibres have a core that captures the light, and which is surrounded by a protective cladding layer. Cladding on commercial optical fibres is about ten microns thick. In order to pack cores closer together and

increase optical light collecting power, the research team shaved the cladding down to five microns by etching with Hydrofluoric acid (HF). This type of chemical etching is very effective but is difficult to replicate uniformly and thus produce the multiple standard-sized optical fibres needed for a hexabundle.

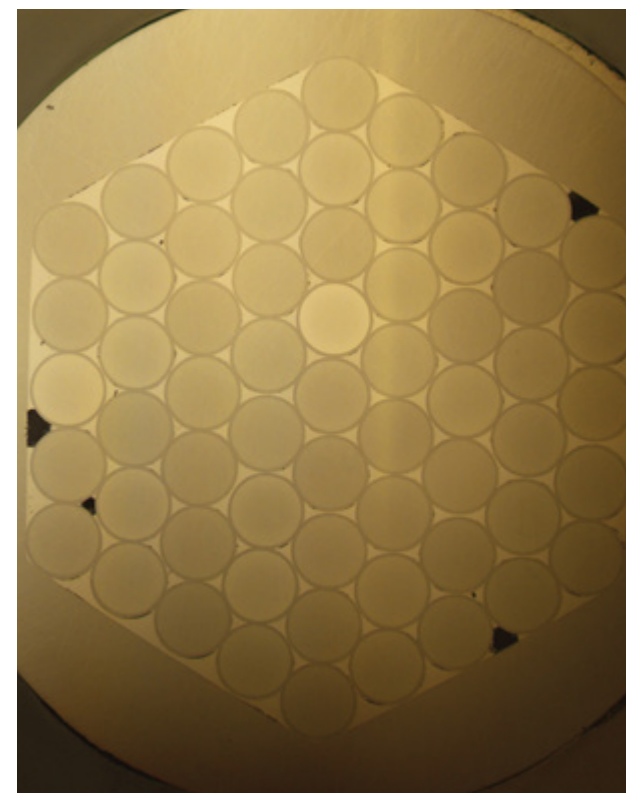
### All bundled up

The **Research and Prototype Foundry** team built a holder to keep the optical fibres in place while etching was carried out on the facility’s cleanroom. They also used a more dilute HF solution to exert more process control. Careful calibration of this process by the **Research and Prototype Foundry** staff, in collaboration with Associate Professor Bryant’s group, resulted in the required highly controlled cladding thickness. This, in turn enabled the team to produce over 4,000 etched optical fibres. These hexabundles are part of an Australia Research Council Linkage Infrastructure and Equipment Facilities grant (2019).

**The fibres fabricated at the Research and Prototype Foundry are due to be deployed on-sky at the AAT telescope when the complete Hector instrument is commissioned.**



Additionally, the process developed for this project is now available to **Research and Prototype Foundry** users and will also be useful for research into semiconductors and photonics.



A ‘hexabundle’ which comprises 61 optical fibres fused into an imaging bundle.. Hexabundles are used on astronomical instruments on large telescopes to take spatially resolved spectra of galaxies. This hexabundle is part of the Hector instrument.



# SYDNEY ANALYTICAL

Sydney Analytical is dedicated to materials, chemical and biological analysis. Their instruments are operated across four principal sections: vibrational spectroscopy, x-ray techniques, magnetic resonance, and drug discovery.



## Find out more

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

## Supporting cultural heritage research

Spectroscopic techniques such as those employed at **Sydney Analytical** can be used to analyse samples of unknown origin. This is especially useful in the cultural heritage context for two very distinct and important reasons. As the world changes and adapts, the skills and materials used in the making of heritage objects become lost. Often, only scientific analysis can reconnect us with the past methods and their links to cultural heritage. Spectroscopic techniques are non-destructive to precious objects and, in many cases, portable instruments can be transported to the artefact rather than requiring large and/or precious artefacts to be transported to a laboratory.

For nearly twenty years the **Sydney Analytical** team have been working with the University's museums on pigments, residues and volatile chemicals.

Today, the expertise at **Sydney Analytical** in cultural heritage analysis is world-class, and the team are working with the Chau Chak Wing Museum to make in-depth spectroscopic research public through exhibitions and publications linked to the "Mummy Project". **Sydney Analytical's** instruments were used to analyse the deteriorated decorations on the outside of an ancient Egyptian sarcophagus to help inform a digital reconstruction, as well as examining some of the contents found inside—including samples of fabric, beads, and resin. This ongoing project is in

collaboration with the Chau Chak Wing Museum which champion the use of in-depth spectroscopic research in the museum context.

Most recently, **Sydney Analytical** has collaborated in an Australian Research Council Linkage Project awarded to Dr Jude Philip (Senior curator, Chau Chak Wing Museum) and Dr Elizabeth Carter (Sydney Analytical). The project focuses on using a range of spectroscopic techniques to analyse chemical residues on a unique and rare collection of zoological taxidermy specimens to investigate their history and origins.

**Sydney Analytical** also boasts specialties in the analysis of early photographic, cinematic and X-ray film. Two types of chemical compounds were used to produce film for cameras, movies and X-rays: cellulose nitrate and cellulose acetate. Cellulose nitrate is extremely flammable and unstable, especially as it degrades over time. As such, identifying films made of cellulose nitrate is vital for safety and preservation. **Sydney Analytical** have worked closely with the Australian National Maritime Museum and Brad Swarbrick (School of Chemistry, Faculty of Science) to develop a method that allows for the rapid identification of different film types using infrared spectroscopy to aid galleries, libraries, archives and museums with this material in their collections. These results were recently published in the journal of *Heritage Science*.



## Developing new drugs to fight Alzheimer's disease

Dementia is the second leading cause of death in Australia with one of the most common forms of dementia being Alzheimer's disease. Alzheimer's disease disrupts the neuronal cells in the brain, leading to progressive loss of memory, language, reasoning, and social behaviour.

While the cause of Alzheimer's disease remains unknown, the molecular and cellular changes that take place in the brain have been well studied, with recent attention being directed to the role of the tau protein. Tau proteins play an important role in the function of healthy neuronal cells, but under some conditions will 'misbehave' and start to stick to each other, forming clumps or neurofibrillary tangles which are the hallmark of Alzheimer's Disease.

### Untangling tau

Professor Michael Kassiou and his research team including Dr Jon Danon (both School of Chemistry, Faculty of Science), are researching and developing a new drug that targets the tau protein in Alzheimer patients. The project is focused on a natural product, altenusin, which has been shown to powerfully inhibit tau protein aggregation "in the test tube" but did not have the required properties to penetrate or operate within living neurons. Traditional medicinal chemistry approaches to modify the molecule yielded limited results, so the group turned to the *Fragment-based Drug Design* service offered by **Sydney Analytical**.



Fragment based drug design starts with a library of 1200 molecular 'fragments', testing each one against the targeted segment of the protein. The results provided several fragments that could be 'grafted' into the original molecule, resulting in a drug with greatly enhanced properties for both binding to tau and penetrating the cell.

This important discovery is a critical step on the path to a potential new treatment for Alzheimer's disease and has already generated commercial interest. The next stage of this project is to test the new hybrid drug in animal disease models for effectiveness.

"The FBDD service provided us with a platform to explore new chemical space that we would not have explored otherwise. Results from the screen directly facilitated the development of new potential drugs that may be used in dementia treatments."

**Professor Michael Kassiou**



## Precision measurement helps discover new material

Coordination frameworks are a new class of materials made up of metal atoms or clusters bridged by organic molecule struts or 'linkers'. Between these linkers are tiny molecule-sized holes, or 'nanopores'. These materials have wide-ranging applications for energy storage molecular sensing and catalysis.

Professor Deanna D'Alessandro's research group including Eleanor Kearns and Lyndon Hall (School of Chemistry, Faculty of Science) have developed a new class of coordination frameworks and, worked with Sydney Analytical to identify and examine their creation.

Normally these linkers are relatively inert, but Professor D'Alessandro's group have developed a class of coordination frameworks in which the linkers can reversibly react with each other under light irradiation, leading to profound differences in the electrochemical, optical and mechanical properties of the material.

### Measuring this new material

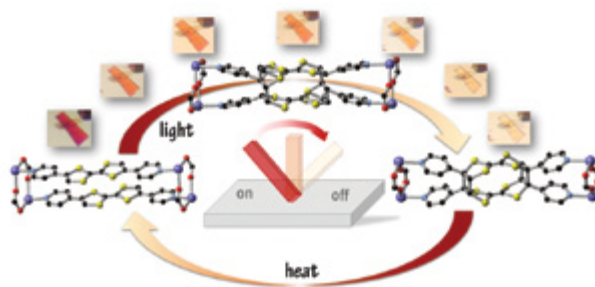
To measure and reaffirm this new phenomena, the **Sydney Analytical** team designed custom rigs to measure the material's structure whilst irradiating samples with light in a controlled way. They used X-ray diffraction to elucidate the structural changes, and Raman spectroscopy to study the progress of the reaction.



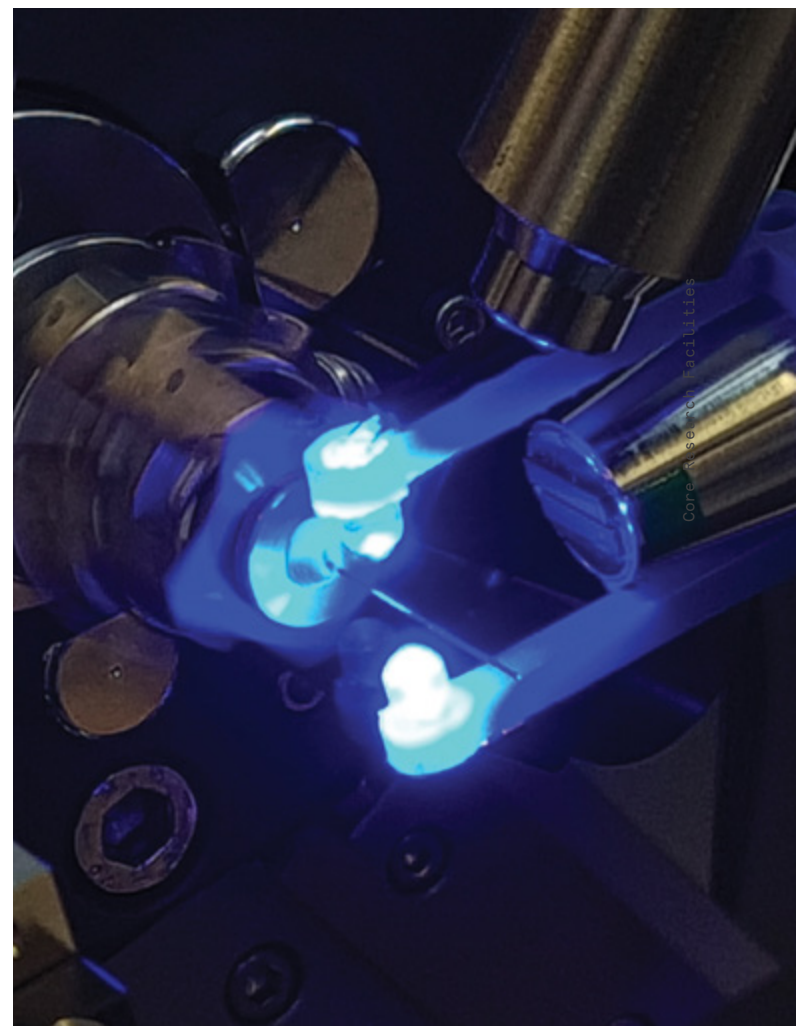
The ground-breaking work was recently published in *Nature Communications* and the team has a provisional patent on the material.

“Support from Sydney Analytical staff has been invaluable [...] The Vibrational Spectroscopy labs within Sydney Analytical are unique within Australia and offer the opportunity for staff and students to use sophisticated instrumentation under the guidance of expert and dedicated staff. These capabilities truly allow us to ‘push the envelope’ with our science.”

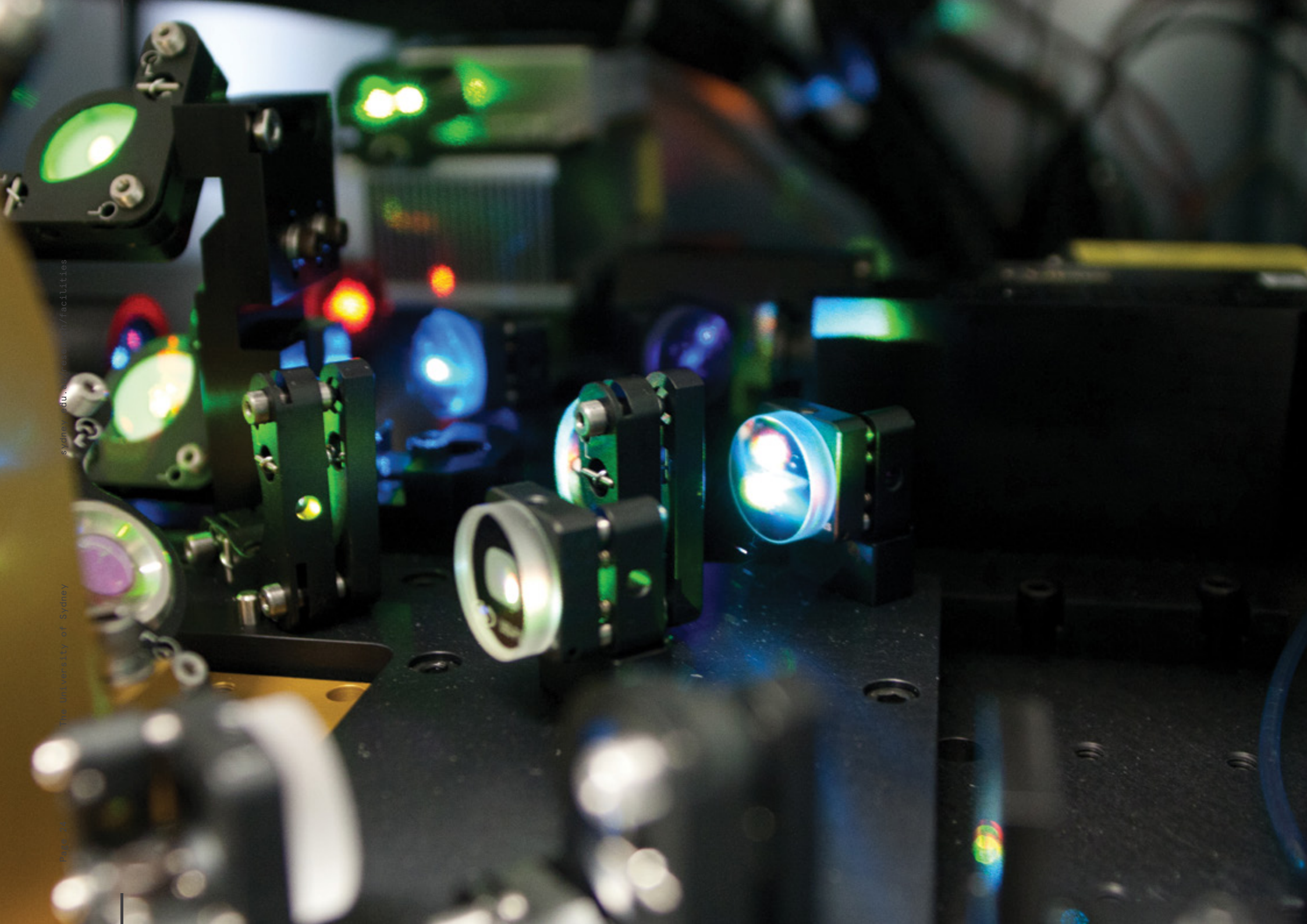
**Professor Deanna D'Alessandro**



Graphic illustrating the reversible change in structure of a coordination framework with irradiation by blue light.



Custom set up by Sydney Analytical to irradiate samples while simultaneously measuring the molecular structure by X-ray diffraction.



# SYDNEY CYTOMETRY

Sydney Cytometry provides access to cytometry and cell-sorting techniques in quantitative cell science to address questions in cell biology and biomedical research, applied clinical research and trials, and the diagnosis of cancer and other diseases.



## Find out more

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

## Immune modifying particles to treat malaria

The World Health Organisation estimates that more than 400,000 people around the world die from malaria each year. Severe malaria occurs when infection of the red blood cells by the malaria parasite makes them stick to blood vessel walls in the brain and lungs. White blood cells then accumulate around these sticky red cells, gradually blocking the flow of blood, causing illness and death.

In 2018, Professor Georges Grau, Professor Nicholas King and PhD candidate Paula Niewold (all School of Medical Sciences, Faculty of Medicine and Health) utilised state-of-the-art analysis capabilities at **Sydney Cytometry**. They examined the body's immune response to malaria parasites in an effort to reduce the amount of white blood cells available that 'stick' to infected red blood cells. The researchers identified the Ly6Clow monocyte as a potential for targeted therapy to alleviate the disease.

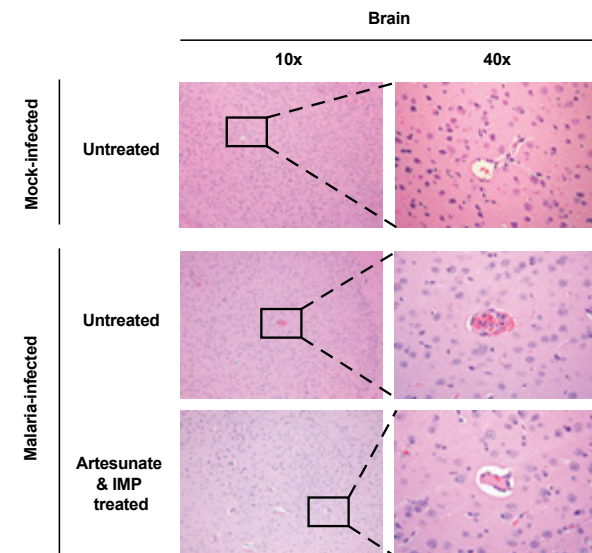
In this specific study, severe malaria was treated with both the conventional treatment and new immune modifying particles that targeted the Ly6Clow monocytes in mouse models.

Right: Stained brain sections from mock-infected mice, malaria-infected mice with no treatment, or malaria-infected mice treated with a combination of artesunate and immune-modifying nanoparticles (IMP). In untreated infected mice, the blood vessels are blocked with accumulations of white blood cells, compared to uninfected mice, and reduced in the immune-modifying nanoparticle (IMP) -treated animals.



As a result, the survival rate increased dramatically – to around 90% (the current conventional treatment yields only a 50% survival rate, while the untreated survival rate is 0%).

The findings of the study were published in the *Nature Communications Biology*. The research was supported by a National Health and Medical Research Council Project grant and a grant from the Merridew Foundation.



## Reducing inflammation in COVID-19 patients

Acute Respiratory Distress Syndrome (ARDS) is associated with widespread inflammation of the lungs, causing severe shortness of breath, with laboured, rapid breathing, and can be fatal. ARDS has been observed in patients with severe COVID-19, requiring the use of oxygen – and in the worst cases can require a ventilator.

A newly awarded, one million dollar Medical Research Future Fund grant – ‘*IMPACT-ICO: Trials of Immune-Modulatory Particles and Colchicine To Improve COVID-19 Outcomes*’ – hopes to reduce the effects of ARDS in patients by reducing the massive inflammatory response that causes the syndrome.

A clinical trial supported by **Sydney Cytometry** will be key to understanding the cellular response to COVID-19, specifically how inflammatory monocytes (normally protective blood cells), can induce ARDS in some patients. In some cases, very large numbers of these cells, equipped with a range of powerful chemical weaponry to control infection, migrate to the lungs to fight the virus infection. However, when inflammatory monocytes accumulate in large numbers, many normal uninfected cells lining the lung passages are inadvertently killed in the massive inflammation triggered, causing significant collateral damage to the lungs. This phenomenon is known as a “cytokine storm”.

### Immune-modifying nanoparticles

This clinical trial is designed to develop a treatment for cytokine storms and aims to reduce inflammation in two ways: by reducing the number of inflammatory monocytes going to the lungs, and by directly reducing the intensity of the inflammation that causes the collateral damage. Reducing the number of inflammatory monocytes going to the lungs will be achieved by injecting immune-modifying nanoparticles intravenously into COVID-19 patients.

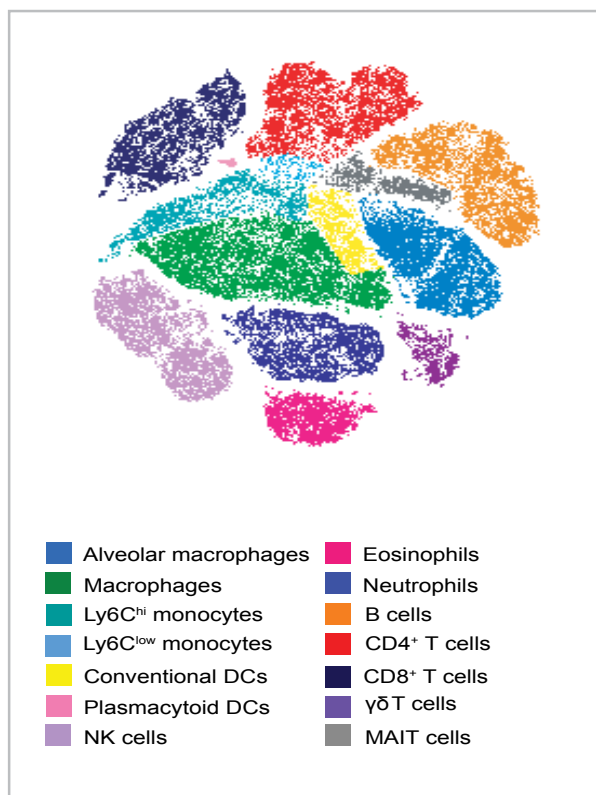


The trial is being led by Professor Tony Keech, Deputy Director of the National Health and Medical Research Council Clinical Trials Centre, Professor Nicholas King, key user of **Sydney Cytometry** and Associate Professor Sanjay Patel, Director of the Cardiac Catheterisation Laboratories at Royal Prince Alfred Hospital and Group Leader at the Heart Research Institute. These investigators are working together with clinicians from the Royal Prince Alfred Hospital, Royal North Shore Hospital, The George Institute and UNSW to treat 240 patients with ARDS related to COVID-19. **Sydney Cytometry** will enable the measurement and analysis of the complex blood cell profiles in the trial patients’ blood samples and allow researchers to monitor changes before and after treatment. This novel treatment has the potential to work not only on ARDS patients but as a complementary therapy on a wide range of illnesses including viral infections, autoimmune diseases and heart disease.

“The cutting-edge instrumentation and world-class analytical data pipeline at Sydney Cytometry will allow us to monitor changes in the blood profiles of patients in this trial in unprecedented detail and are absolutely crucial to its success.”

**Professor Nicholas King**





Representation of the different innate cell types that were activated in the lungs when the Advax vaccine was administered.

## Understanding the immune response in the lungs of tuberculosis patients

Tuberculosis is an infectious disease that mainly affects the lungs but can attack any part of the body. Despite existing with humans for thousands of years, tuberculosis remains the number one killer by a single infectious agent in the world today. It has been estimated that approximately a third of the world's population is latently infected with tuberculosis, meaning they are infected but are not yet experiencing disease.

While there is a vaccine currently in use for tuberculosis, the protection afforded by this vaccine varies and is least effective in the countries with the highest tuberculosis infection rates. While tuberculosis is treatable via administering a cocktail of antibiotics for months on end, the side-effects of this regime often make patients ill.

### Exploring treatment pathways

To combat these issues, researchers from the Microbial Pathogenesis and Immunity lab; Kia Farrell, Erica Stewart and Dr Claudio Counoupas (all School of Medical Science, Faculty of Medicine and Health) have been investigating multiple tuberculosis vaccine candidates. Of particular interest is the subunit-vaccine candidate CysVac2 (Advax), which has been shown to be more effective when administered as an inhaled aerosol.



The research team which was led by Professor James Triccas (School of Medical Sciences, Faculty of Medicine and Health) utilised the capabilities at **Sydney Cytometry** to better understand the immune response to this vaccine as it occurs in the lung, and what leads to its enhanced protective effect when inhaled.

Using the imaging, flow cytometry and mass cytometry facilities of Sydney Cytometry, they were able to study in detail the kinetics of specific cellular uptake by using a fluorescent form of Advax, to determine which cells were creating a stronger immune response in the lungs and lung-draining lymph nodes.

The findings of this study were published in *Mucosal Immunology*. The study was supported by the National Health and Medical Research Council Centre of Research Excellence in Tuberculosis Control and an NHMRC Project Grant.



# SYDNEY IMAGING

Sydney Imaging provides a comprehensive suite of preclinical and clinical imaging modalities, a state-of-the-art hybrid theatre and world class imaging techniques.



## Find out more

- [sydney.edu.au/research/facilities/sydney-imaging](https://sydney.edu.au/research/facilities/sydney-imaging)

## Digital Infrastructure – Australian Imaging Service

The ability to generate imaging data is increasing exponentially thanks to improved imaging technology, making the ability to securely store and analyse these data critical, within both research and clinical settings. The need to track imaging data generated from instruments (for example CT scanners and MRI machines) and to analyse these data has never been greater.

In 2017, **Sydney Imaging**, in partnership with ICT and led by Dr Ryan Sullivan (Research Technology, ICT and School of Bioengineering, Faculty of Engineering), developed the Imaging Data Service (IDS). Utilising customised open-source software, **Sydney Imaging** was able to offer its users seamless transfer, reproducible analysis and (legally compliant) secure storage of imaging data, direct from its instruments (and affiliated equipment) within the Charles Perkins Centre and Brain and Mind Centre. These data could be accessed by researchers from any web browser instead of a dedicated computer, enabling new and more efficient research collaborations.

The success of this institutional platform has enabled the University of Sydney to take a leadership position within the national imaging data ecosystem. In 2019, the Australian Imaging Service (AIS) was established with \$700,000 in investment from the Australian Research Data Commons and an accompanying \$1.1 million in co-investment from other Australian institutions.



As a national federation, AIS extends the capabilities developed in IDS, providing secure management, analysis, and collaboration with clinical and academic partners across the country.

In 2020, AIS has subsequently received \$800,000 to build the Melanoma Imaging and Diagnosis National Research Repository and is partnering with other platforms to expand capability in the areas of neurology, electrophysiology, and veterinary pathology. With University of Sydney as the lead node, AIS has expanded to support 15 academic and six clinical partners, supporting vital research in the fields of neurology, dermatology, oncology and radiology, among others.

The University continues to lead the AIS platform with partners such as NSW Health, ensuring that AIS complies with their data requirements. AIS is working to expand secure analysis capability, providing a national set of reproducible tools and implementing AI tools integrated directly into browser-based viewers for streamlined annotation and segmentation used in the training process.

## Quicker interventions for patients in heart failure

Up to 40 percent of COVID-19 deaths are attributed to heart failure. In a world-first preclinical study, researchers have shown it could be possible to implant a potentially life-saving pump into the heart of those with heart failure, without leaving the intensive care unit or breaking isolation restrictions for the sickest of COVID-19 patients.

The study, published in *Nature Scientific Reports*, details a method of implanting the assistive pump into the main heart chamber guided by three-dimensional wide-angle intracardiac ultrasound – used for the first time in Australia as part of the study.

“The 3D ultrasound images are taken from inside the heart and this results in much better-quality images that can assist in complex procedures such as this,” said Professor Paul Bannon (Central Clinical School, Faculty of Medicine and Health).

**Made possible by the state-of-the-art facilities at Sydney Imaging’s Hybrid Theatre, researchers used intracardiac echocardiography probes to guide the implantation of the Impella device (supplied by Abiomed).**



Unlike traditional ultrasound where probes go onto the skin, three-dimensional intracardiac ultrasound goes inside the blood vessels and navigates inside the heart.

The mechanical pump used in the study is a left ventricular assist device currently in use in Australia. It is used for patients undergoing high-risk heart interventions through the skin or in instances where the heart is failing to pump enough blood to support the body.

The translational study was conducted with sheep to replicate heart anatomy similar to humans.

“The Hybrid Theatre represents a hybrid between the massive technological and academic strengths of the University of Sydney, and the drive for innovative and effective treatments from the hospitals we partner with,”

**Professor Paul Bannon**

## Balancing protein consumption for longevity

Amino acids have long been touted by the fitness and bodybuilding communities for their muscle building benefits. From ultra-bulk protein powders to lean mass-promoting snack bars, there's no shortage of products available for those seeking a muscle boost.

However, protein's popularity has also meant that less attention has been paid to researching its potentially negative side-effects.

Published in *Nature Metabolism*, research led by academics from the Charles Perkins Centre and School of Life and Environmental Science, Faculty of Science, Professor Stephen Simpson and Dr Samantha Solon-Biet suggests that while delivering muscle-building benefits, excessive consumption of branched-chain amino acids (BCAAs) may reduce lifespan, negatively impact mood and lead to weight gain. "While diets high in protein and low in carbohydrates were shown to be beneficial for reproductive function, they had detrimental effects for health in mid-late life, and also led to a shortened lifespan," Dr Solon-Biet explained.

Using state of the art imaging techniques at Sydney Imaging, the research examined the body composition of mice to observe the impact of dietary BCAAs and other essential amino acids such as tryptophan had over their lifespan.

### Too much of a good thing

Mice were fed double the normal amount of BCAAs (200%), the standard amount (100%), half (50%) or one fifth (20%) for life, and their body compositions were assessed using EchoMRI (for body fat, lean mass, water) and Faxitron UltraFocus DXA (2D x-ray, body fat, lean mass and bone density).

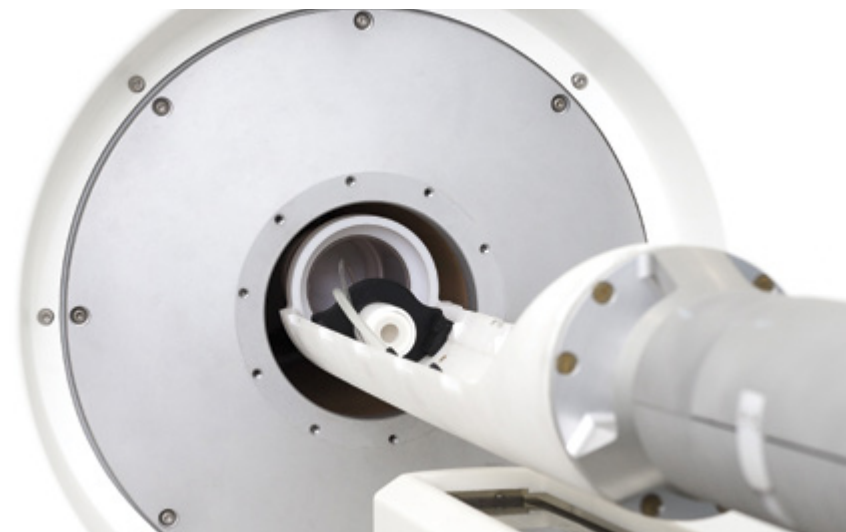
Mice who were fed 200% BCAAs increased their food intake, resulting in obesity and a shortened lifespan.

"Supplementation of BCAAs resulted in high levels of BCAAs in the blood which competed with tryptophan for transport into the brain," explained Professor Stephen Simpson.

"Tryptophan is the sole precursor for the hormone serotonin, which is often called the 'happiness chemical' for its mood-enhancing effects and its role in promoting sleep. But serotonin does more than this, and therein lay the problem," he said.

"This then lowered serotonin levels in the brain, which in turn was a potent signal to increase appetite. The serotonin decrease caused by excess BCAA intake led to massive overeating in our mice, which became hugely obese and lived shorter lives."

The research was supported by a National Health and Medical Research Project Grant and Dr Solon-Biet was supported by a University of Sydney's Sydney Research Accelerator Fellowship.





# SYDNEY INFORMATICS HUB

The Sydney Informatics Hub works with and supports the research community by providing comprehensive support, training, and expertise in research data management, statistics, data science, software engineering, simulation, visualisation, bioinformatics, and research computing.



## Find out more

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

## Supporting high impact research in wildlife genomics

Rapid advancements in genomics technology and decreasing costs has led to the generation of vast amounts of data that is transforming wildlife conservation management and helping prevent the extinction of threatened species. Significant computing power is required to interrogate these large datasets and help achieve these outcomes.

### Genomic sequencing for conservation

**Sydney Informatics Hub** first started working with the Australasian Wildlife Genomics Group, led by Professor Katherine Belov and Dr Carolyn Hogg (both School of Life and Environmental Sciences, Faculty of Science) when they were sequencing the genome of Tasmanian devil to support conservation efforts against the devastating devil facial tumour disease.

**Sydney Informatics Hub** initially assisted the research group with bioinformatics analyses and access to the University's high-performance computing (HPC) cluster, Artemis. The research team has since expanded their genome sequencing portfolio with the Threatened Species Initiative, which has a mission to sequence 50 of Australia's most threatened species in three years.

**Sydney Informatics Hub** played a critical role in helping the research team prepare grants to access National HPC and Cloud facilities including National Computational Infrastructure, Pawsey Supercomputing,



and other HPC facilities. However, the annual grant scheme allocations from these bodies were not enough to keep up with the increasing genomics analysis demands.

**Sydney Informatics Hub** worked closely with ICT and the research team to secure commercial cloud hosted by Amazon Web Services (AWS). Virtual machines could be customised to better fit the resource demands of the data and analyses. The elimination of queues and wait times for a shared HPC facility also accelerated the research output of the group, enabling them to scale up their genome sequencing and allowing them to open their research to new and exciting directions.

A culmination of this effort was recognised in 2020 when Professor Belov was a chief investigator on a successful ARC Centre of Excellence grant that awarded \$35 million for 'Innovations in Peptide and Protein Science'.

**Sydney Informatics Hub continues to support the Belov Group to further accelerate their research, finding practical and executable solutions to their substantial data and computing requirements.**

## AI helping to improve health outcomes

In 2019, Professor Clara Chow (Westmead Clinical School, Faculty of Medicine and Health) and her research team at Westmead Applied Research Centre (WARC), teamed up with **Sydney Informatics Hub** to win the Google.org AI Impact Challenge – which included a \$1 million award.

The award recognises the increasingly important intersection of E-health, personalised medicine and AI in developing and improving patient health outcomes.



Professor Chow's group originally trialled sending text messages to cardiovascular patients, encouraging them to stay aware of their health and help them to improve their health outcomes including weight, cholesterol, and hospital readmission.

The trials showed that, on average, the people receiving the text messages had better health outcomes than those who did not.

**Sydney Informatics Hub** helped curate the collection of sent text messages to try and understand the patterns of how people engaged with the messages. These analyses supported the goals to both scale up the study to larger cohorts, while opening more opportunities for personalised message streams. **Sydney Informatics Hub** built text classifiers that identified the intent of outgoing messages (for example, inform, instruct, motivate) and participant replies (for example, thanks, question, reporting struggle) to understand how messages might be tailored to different cohorts and thus improve patient's health outcomes.

The Google.org AI Impact Challenge funding will help take the WARC's research to the next level as they scale up the project and incorporate data from wearable devices.



## Supporting the NSW public health response to COVID-19

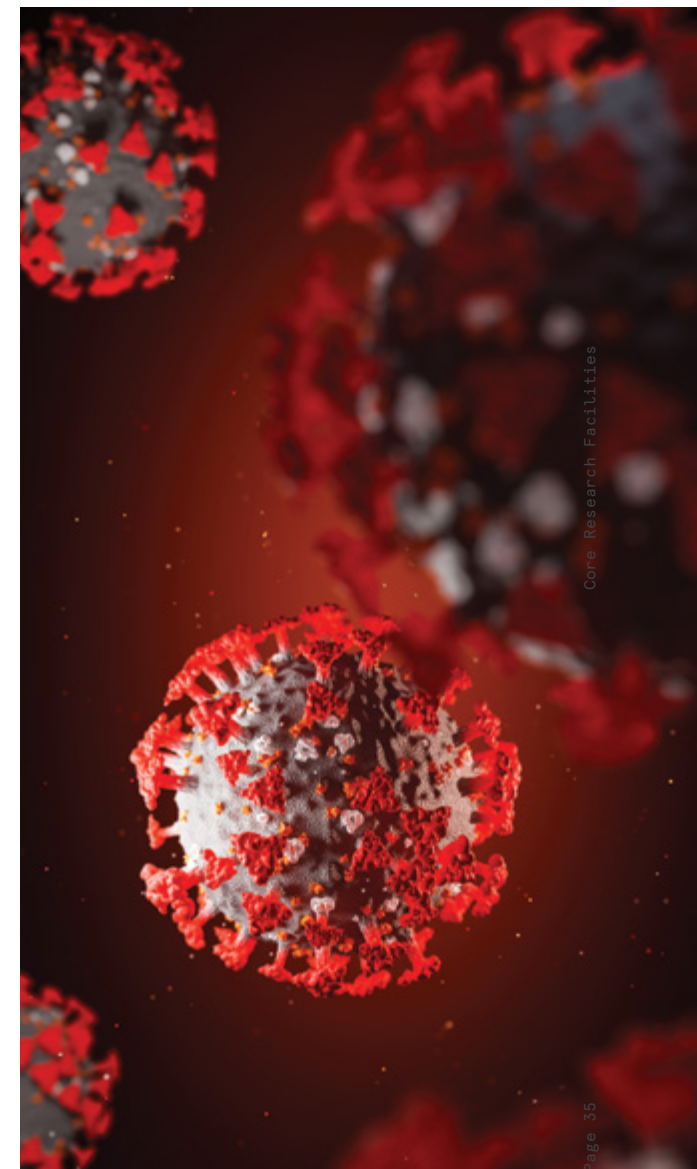
A key part of Australia's successful response to the COVID-19 pandemic has been its ability to efficiently trace infection sources through both contact tracing and genomic sequencing. Within days of the first case of COVID-19 in Australia in 2020, a team of scientists from the University of Sydney and NSW Health Pathology, led by early career researcher, Dr Rebecca Rockett, from the Marie Bashir Institute for Emerging Infectious Diseases (Faculty of Medicine and Health), had designed New South Wales's first genome sequencing test for COVID-19. This test progressed to be an integral component to the management of COVID-19 in NSW, providing insight into likely community acquired and imported cases and guiding NSW public health responses.

The **Sydney Informatics Hub** provided support to the research team by facilitating access to national and institutional (Artemis) High Performance Computing facilities, bioinformatics support, and the synthesis and reporting of genomic, clinical and epidemiological data, helping transition cutting edge genome sequencing research into routine practice for NSW Health.



The results of this research - a report on the real-time application of genome sequencing for tracking outbreak clusters together with simulations predicting the spread of COVID-19 in the first wave in Australia was published in Nature Medicine.

This pioneering work was further supported by the NSW Government's COVID-19 \$25M Grants Program, led by Professor Vitali Sintchenko from the Marie Bashir Institute for Emerging Infectious Diseases, the Westmead Institute for Medical Research, and Director of the Centre for Infectious Diseases and Microbiology Public Health.





# SYDNEY MANUFACTURING HUB

Sydney Manufacturing Hub is a manufacturing-focussed research facility geared to enable concept-to-production demonstration capabilities, including advanced pre- and post-processing of materials.



GE Additive

## Find out more

- [sydney.edu.au/research/facilities/sydney-manufacturing-hub](https://sydney.edu.au/research/facilities/sydney-manufacturing-hub)

## GE Additive partnership underpinning Sydney Manufacturing Hub capability

Additive Manufacturing is a profound scientific and technological disruption that is transforming the nature of manufacturing. The prospective value of the markets for this technology are in the hundreds of billions of dollars. Advanced manufacturing is a disruption to design, materials, supply chains and commerce allowing objects/components/devices and, potentially, whole machines to be transformed from the digital realm to the physical realm, with high precision.

Academically, Australia is a strong performer in advanced manufacturing research. The Sydney Manufacturing Hub, the newest core research facility, places the University of Sydney in a position to contribute leadership in this rapidly burgeoning field.



Via the **Sydney Manufacturing Hub**, the University has locked in a strategic research partnership with global prime GE Additive (GE), and opened new engagement with the NSW State Government. This new facility delivers research capability that positions Sydney's academics to deliver intellectual leadership in advanced manufacturing, leveraging the clear focus on this area by defence, government and industry.

In June 2020 the University of Sydney and GE signed an agreement that will see four state-of-the-art GE 3D metal printers installed in the purpose-built **Sydney Manufacturing Hub** laboratory. GE Additive will also invest in bespoke research and development activities at the University.

A successful and ongoing partnership with GE Additive is aligned with the University's growth agenda in advanced manufacturing in Camperdown, and across our precincts—particularly at the Western Sydney Aerotropolis. Access to GE's remarkable global scientific and engineering network with in-kind access to specialised training and research support across is a major benefit of the partnership for the University.



## Industry Partnership – 3rd Axis

The **Sydney Manufacturing Hub** enables both discovery-based fundamental research with industry-driven applications challenges, creating an exciting innovation capacity advance manufacturing. Partnerships are critical to sustain this capacity. One of our founding industry relationships is with local start up, 3rd Axis.

The University of Sydney and 3rd Axis commenced a partnership whereby the **Sydney Manufacturing Hub** hosts a state-of-the-art ceramic 3D printer owned by 3rd Axis and access is provided to researchers. The 'Cerafab7500' uses lithography-based ceramic manufacturing technology, enabling enormous freedom in design, including the fabrication of bionics such as canals and pore structures, undercuts, cavities and thin-walled structures, that were not previously possible with traditional ceramic manufacturing techniques. The ceramic printing capability has been used for research-based applications ranging from medical implants to components for satellites and has attracted strong interest from the University research community.

Inside 3rd Axis' ceramic 3D printer at  
Sydney Manufacturing Hub



This arrangement with 3rd Axis provides the University's researchers and partners with access to cutting-edge ceramic printing technology. Meanwhile, 3rd Axis conduct developmental work and produce commercial prototypes, and explore collaborative and translational research opportunities that arise with the University community.

The 3rd Axis Managing Director and Chief Technical Officer are regularly onsite at the **Sydney Manufacturing Hub** and readily meet with researchers to identify potential grant and collaboration opportunities.

“Ceramic 3D printing has technical applications across some of the most highly regulated industries such as medical implants and aviation, thus requiring extreme expertise. By partnering with the University of Sydney and the Core Research Facilities, world class expertise and state of the art testing has become a part of 3rd Axis”

**Ash Jain, Director of 3rd Axis**





# SYDNEY MASS SPECTROMETRY

Sydney Mass Spectrometry provides state-of-the-art tools and expertise for proteomics, metabolomics and mass spectrometry imaging for the life and biomedical science communities.

## Establishing new capabilities to fight bowel cancer

The philanthropic organisation Bowel Cancer Australia donated \$6.4 million to the University of Sydney to create the Lawrence Penn Chair of Bowel Cancer research, as well as provide a start-up fund for the recipient.

In 2018 Professor Mark Molloy (Northern Clinical School, Faculty of Medicine and Health) became the inaugural Penn Chair.

Professor Molloy's research centres on molecular analysis of tumour biology, which apart from requiring the use of advanced mass spectrometers, benefits from co-location within a clinical setting.

### Research capability next to a clinical setting

Recognising the research enabling potential for Professor Molloy and other researchers, **Sydney Mass Spectrometry** embarked on the creation of a new node of the facility operating out of the Kolling Institute at Royal North Shore Hospital. This new node has allowed the Molloy group and other University research teams to work across the research and clinical spaces.

The establishment of this new facility leveraged philanthropic donations from both Bowel Cancer Australia, and the Cancer Research Fund at the University. This purchased and installed the new mass spectrometers and funded building work to upgrade the lab space.

The **Sydney Mass Spectrometry** node at the Kolling Institute was officially launched in 2019 and has been highly utilised by Professor Molloy and his research team. Apart from leveraging significant funds to realise the new capability at the Kolling Institute, the Core Research Facility program continues to grow the new facility, attracting a number of other clinical researchers.

“Utilising the Kolling node of the Sydney Mass Spectrometry core has enabled us to propose new biomarker proteins associated with bowel polyps and bowel cancer progression. Our use of the equipment continues to grow and we are seeing interest from other research groups in the Kolling Institute.”

**Professor Mark Molloy**



## Find out more

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

## Supporting high impact research – Professor David James

Professor David James (School of Life and Environmental Sciences, Faculty of Science), the Leonard P Ullmann Chair in Molecular Systems Biology, is a world-leading researcher in metabolic sciences, and was awarded a prestigious Australian Research Council, Laureate Fellowship for his work in systems biology.

Throughout his tenure at the University, Professor James and his research group have been supported by **Sydney Mass Spectrometry** and **Sydney Microscopy and Microanalysis**.

The James Research Group were early adopters and capability drivers for ‘omics research at **Sydney Mass Spectrometry**, developing pioneering multi-‘omic research that demonstrates how changes in the kinome can impact the proteome, metabolome and lipidome and contributes to a ‘systems biology’ understanding of complex diseases.

This cutting-edge research has pushed capability and driven demand for newer mass spectrometers with greater capability. In one research project, which was published in Nature in 2019, the research team embarked on what was then the largest proteomics study **Sydney Mass Spectrometry** had undertaken. The study redefined a ‘large’ quantitative proteomics project, and mapped hundreds of mouse liver and plasma proteomes.

The need to process more samples led Professor James to work with the Ian Potter Foundation and **Sydney Mass Spectrometry** to purchase a robot which will provide **Sydney Mass Spectrometry** with high throughput sample preparation and support the next phase of his and other users’ research. Utilising **Sydney Microscopy and Microanalysis**, Dr James Burchfield (School of Environmental and Life Sciences, Faculty of Science and part of James Research team) has been a key user of the light microscopy capabilities at Charles Perkins Centre, where they have utilised various microscopes to visualise signal transduction mechanisms and protein trafficking in live cells.



Professor James and Dr Burchfield worked with Core Research Facilities after securing a major equipment grant from the National Health and Medical Research Council to upgrade the Live Cell Microscope at **Sydney Microscopy and Microanalysis**, and in 2020 and was awarded another equipment grant from the Australian Research Council for an integrated, multimodal system platform for the multiplexed imaging of signal transduction.

“Mass spectrometry represents the next big transformation in biological research enabling us to dig deeper than ever before into the world of proteins and metabolites thus bridging the gap between genetics, epigenetics and phenotype. The goal over the next decade is take this technology into every single lab so that researchers can discard their gel tanks and power supplies and rely on a much more comprehensive and quantitative technology for protein research.”

**Professor David James**



## Redesigning respiratory virus testing

Effective testing is a key public health initiative to slow and stop the spread of the highly contagious COVID-19 virus. The current gold standard for screening active infections is the PCR assay which directly detects the RNA genome of the virus. While very sensitive, there are some drawbacks to this test – namely that – some people repeatedly test positive but are asymptomatic and it is unclear if they remain infectious. There was also concern in the early phase of the pandemic regarding supply of key reagents for the PCR assay.

An ongoing collaboration between Professors Rita Horvath and Bill Rawlinson (NSW Health Pathology), Professor Stuart Cordwell (School of Life and Environmental Sciences, Faculty of Science) and Dr Ben Crossett (**Sydney Mass Spectrometry**), has delivered a breakthrough that addresses both of these issues.

The team's proof of concept study successfully demonstrated that mass spectrometers could detect SARS-CoV-2 proteins in clinical nasopharyngeal samples.

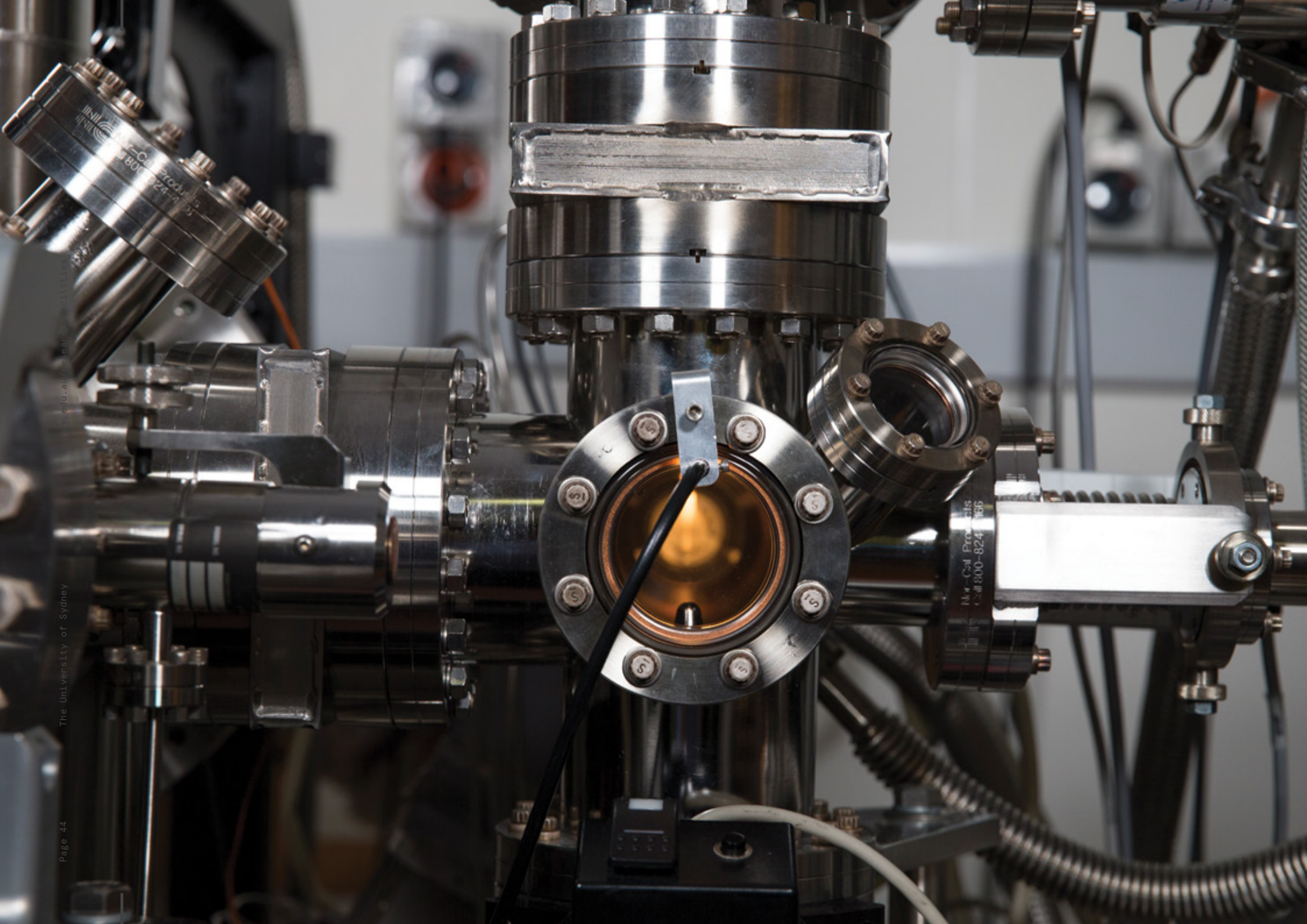
**The project aims to deliver an assay that detects the protein component of the virus and provide a more quantitative result than the PCR assay. The ultimate goal is to create a new assay that is a better predictor of the level of infectivity of a patient and overcome the false-positive drawbacks of the PCR assay.**

The new assay under development uses standard equipment and readily available reagents so could be relatively produced at low cost and at scale.

The project initially received six months' funding from NSW Health to further develop assays utilising the equipment and expertise at **Sydney Mass Spectrometry**. The team are currently seeking additional funding to enable the translation of the assay to NSW Health laboratories in 2021, as well as to investigate if it can identify individual strains of the SARS-CoV-2 virus, screen for new mutations and detect other common respiratory viruses such as influenza.

It is hoped that this COVID-19 research collaboration will lead to a long-term partnership between the University of Sydney and NSW Health, with University researchers gaining access to clinical labs, and NSW Health Pathology staff continuing to develop new assays using the state-of-the-art instrumentation and expertise available at **Sydney Mass Spectrometry**.





# SYDNEY MICROSCOPY AND MICROANALYSIS

Sydney Microscopy and Microanalysis enables insights into how materials work. It explores physical and biological structures at the micro, nano and atomic scale.

## New cryo-capability drives research innovation

Steel can become brittle when exposed to hydrogen, and while atmospheric hydrogen is not abundant enough to cause embrittlement, this phenomenon is a challenge for storing and transporting hydrogen fuel sources – which are key to a low carbon emissions future.

Previous research had observed the unique process of hydrogen accumulation, but up until now researchers have been unable to observe the different microstructural features of hydrogen and steel interactions. A cryogenic sample transfer system established by Professor Julie Cairney and colleagues (School of Aerospace, Mechanical and Mechatronic Engineering, Faculty of Engineering) has made these observations possible and opened up new research into high performance steels, some of which has been published in Science.

The **Sydney Microscopy and Microanalysis** capability provides a cryogenic atmosphere to transfer samples into an atom probe (preventing atmospheric hydrogen from corrupting the samples) for further analysis.



Utilising this ground-breaking technique, researchers have been able to observe that niobium carbides within steel crystals effectively ‘trap’ hydrogen, preventing it from travelling to a boundary or dislocation within the metallic structures.

This discovery provides a potential path to a solution to the issues currently faced by storage of hydrogen, and the development of embrittlement-resistant steels.

What’s more, the cryo microscopy laboratory has built its capabilities over a number of years with successive grants, including a National Collaborative Research Infrastructure Strategy Agility grant in 2017, which enabled the purchase of the cryogenic transfer system. This was followed by an Australian Research Council Linkage Equipment and Infrastructure grant in 2019 to further develop these capabilities.

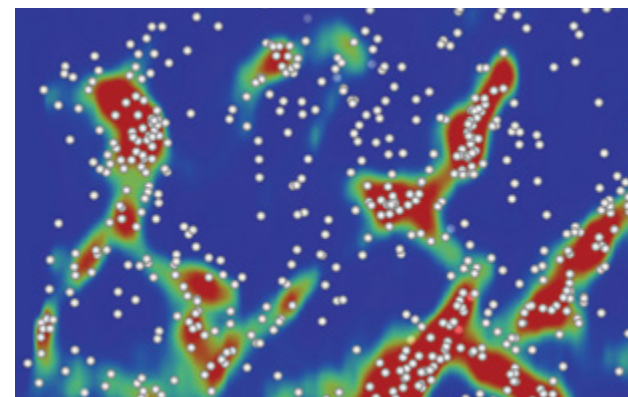
**M** MICROSCOPY  
AUSTRALIA

**NCRIS**  
National Research  
Infrastructure for Australia  
An Australian Government Initiative

## Find out more

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

2-D sliced image of 3-D cryo-APT data. Hydrogen atoms (white) are found to accumulate at microstructural defects of steels that is visualised by the colour-graded carbon concentrations associated with the defects.





Gail Mabo (Australia, b. 1965). Tagai 2020.  
Bamboo, cotton, shellac and plastic, 287 x 290 x 15cm  
Art Gallery of New South Wales  
©Gail Mabo Photo: AGNSW (100.2020)

## The stars and seas of the Torres Strait Islands



Despite what you feel between your fingers, sand is not a uniform material. Individual grains of sand can be an array of shell and debris and single cell organisms called foraminifera. The composition of sand varies from place to place and can distinguish regions.

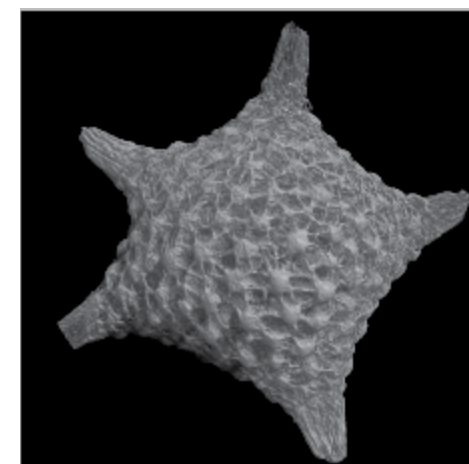
In 2020, Indigenous artist, Gail Mabo used the microCT at Sydney Microscopy and Microanalysis to carefully scan individual grains of sand from the beach of Mer (Murray Island), part of the Traditional Lands of the Meriam people.

The microCT images revealed the star shaped grains of sand to be foraminifera – a single celled protists, common to shallow water species that form calcium carbonate shells with spindles forming a star shape.

After scanning the sand in the microCT, the image data was processed so that 3D models could be printed of the foraminifera at an enlarged scale. Data processing and sample prints were completed by facility staff in the **Sydney Manufacturing Hub**. Other 3D prints were included in Gail's artwork – a bamboo star-map of the constellation Tagai.

Torres Strait Islander culture and spirituality are closely linked to the stars and the stories of Tagai, whom the Torres Strait Islander peoples recognise as the creator of the world. The knowledge of the stars and sea provide the Torres Strait Islander people with valuable information regarding changes in the seasons, when to plant gardens and hunt for turtles or dugongs, and how to navigate the seas.

Gail Mabo's Tagai artwork was exhibited at the Art Gallery of New South Wales where she was an artist in residence.



Rendering of a single grain of sand produced via MicroCT that was used to create 3D prints as part of the Tagai art installation



## Ironing out iron imbalance

More than 30% of the world's population lives with an iron imbalance – having too little or too much iron in the blood.

A leading University of Sydney research team led by Professor Hala Zreiqat and Dr Zufu Lu (both School of Biomedical Engineering, Faculty of Engineering) **have developed nanoscale probes that allow researchers to monitor iron levels in cells, tissue and body fluids.**

Specifically, the team used the two-photon confocal microscope at **Sydney Microscopy and Microanalysis** to measure the depth of the nanoprobe's detectability in biological tissue (observed at 280 micrometres in swine dermis).

The newly developed nanoprobe utilises a fluorescent molecule with negative charges on their surface that preferentially bind to iron ions. When stimulated with UV light, the bound iron interacts with the fluorescent molecules, reducing the fluorescence of the probe. The test is more sensitive and specific than current blood tests for iron disorders, allowing for a more accurate disease diagnosis before the onset of symptoms, potentially allowing for the early treatment and prevention of more serious diseases.

"Our most recent testing demonstrated a rapid detection of free iron ions with remarkably high sensitivity. Iron could be detected at concentrations in the parts per billion range, a rate ten times less than previous nano-probes" said PhD candidate Pooria Lesani (School of Aerospace, Mechanical and Mechatronic Engineering, Faculty of Engineering) who is leading the study.



# ACCESS CORE RESEARCH FACILITIES



## Consultation

Work with users to put together a viable project design, taking into account factors such as experimental scope, instrumental requirements and budget.



## Activation

Assist users in registering their projects in our online facility management system and will guide them through any regulatory approvals necessary.



## Induction

Organise a bespoke training program specific to user's needs, giving them autonomous access to the facilities to complete their project.



## Supervision

Specialist staff will be onsite to provide technical and safety guidance.

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