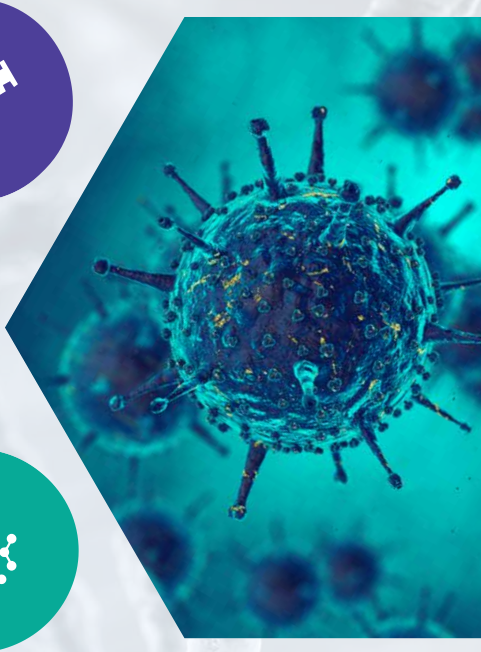
LA TROBE UNIVERSITY

LA TROBE INSTITUTE FOR MOLECULAR SCIENCE

EXPLORE LIMS

La Trobe Institute for
Molecular Science



latrobe.edu.au/lims

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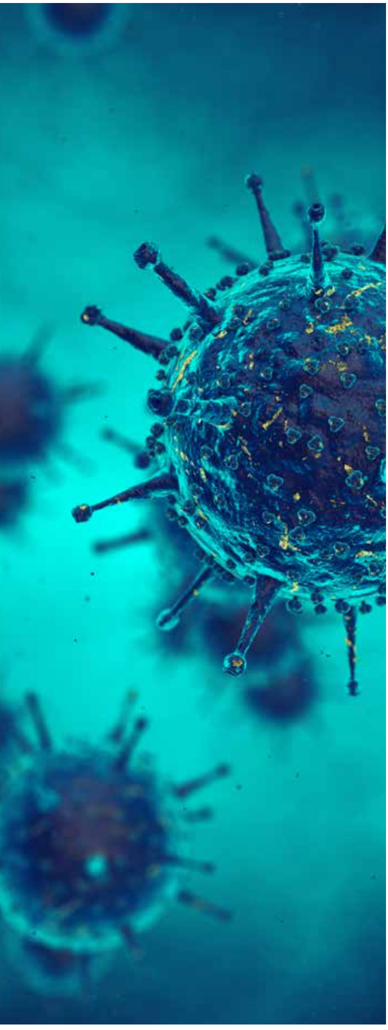
CONTENTS

1 2020 Times Higher Education Impact Ranking (Australia) for La Trobe University

TRANSLATABLE MOLECULAR DISCOVERIES

The La Trobe Institute for Molecular Science (LIMS) brings together La Trobe University's leading researchers. Through research and education, we are working towards solving some of the world's most critical problems at the interface of health and science.



The La Trobe Institute for Molecular Science vision of excellence is achieved through four thematic areas of research strength: Cancer, Infection and Immunity, Molecular Design and Nanoscience.

The research agenda of LIMS is supported by a collaborative culture and modern facilities, where scientists in diverse disciplines work together to achieve remarkable outcomes that would not be possible in traditional academic settings. Our high impact research generates collaborations and partnerships across the globe.

Within LIMS are two embedded biotech companies. Hexima is a biotech company with a novel topical treatment for fungal nail infections in Phase IIb clinical trials. AdAlta is an innovative, clinical stage biotech company developing a unique range of new drug treatments.

LIMS has outstanding links with the Australian Synchrotron. Several of the Institute's physicists design and build synchrotron components to extend the synchrotron's capabilities.

And an important collaboration with the Olivia Newton-John Cancer Research Institute facilitates the sharing of knowledge, skills, training and facilities in the area of cancer research.

These mutually beneficial partnerships raise our research capabilities to new levels of national and international significance.

LIMS
AT A GLANCE

>400
ACADEMIC STAFF AND POSTGRADUATE STUDENTS

60
LABORATORY HEADS

FELLOWSHIPS

2 ARC FUTURE FELLOWSHIPS
2 ARC DECRAs
2 NHMRC FELLOWSHIPS

1 VCA MID-CAREER FELLOWSHIP
1 TRACEY BANIVANUA MAR FELLOWSHIP

259
WEB OF SCIENCE PUBLICATIONS (2020)

1.72
SCOPUS FIELD WEIGHTED CITATION IMPACT (2020)

ERA RANKINGS:

5
BIOCHEMISTRY AND CELL BIOLOGY; ANALYTICAL CHEMISTRY; OPTICAL PHYSICS; CONDENSED MATTER PHYSICS; GENETICS; MEDICINAL AND BIOMOLECULAR CHEMISTRY

4
INORGANIC CHEMISTRY; PHYSICAL CHEMISTRY

LIMS RESEARCH THEMES:

CANCER
INFECTION AND IMMUNITY
MOLECULAR DESIGN
NANOSCIENCE

NETZERO 2029

PART OF LA TROBE UNIVERSITY'S PLAN FOR NETZERO CARBON EMISSIONS BY 2029

LIMS HAS AUSTRALIA'S FIRST INTERNATIONALLY RECOGNISED 'MY GREEN LAB' CERTIFICATION FOR THE HILL LAB

INDUSTRY COLLABORATIONS

NANOMSLIDE / ALLESENSE
VIVAZOME THERAPEUTICS
BEAGLE BIOTECHNOLOGY
WINTERMUTE BIOMEDICAL
IMUNEXUS
METROHM AG

EMBEDDED BIOTECHNOLOGY COMPANIES:

HEXIMA LTD
ADALTA LTD

LIMS **FELLOWS**

The LIMS Endowment Fund was established to create new and sustainable opportunities for scientists with outstanding potential.

The inaugural Bruce Stone Fellowship in Chemical Biology and the Nicholas Hoogenraad Fellowship in Molecular Sciences were awarded in 2015.

Both fellowships are named after two long-serving leaders: Professor Bruce Stone was the foundation professor of Biochemistry from 1972-1989, succeeded by Professor Nicholas Hoogenraad, who later became the first Director of LIMS. Professor Hoogenraad AO retired in 2014.

Nicholas Hoogenraad Fellowship

Dr Nick Reynolds

Dr Nick Reynolds graduated with a PhD from the University of Sheffield in 2009 before undertaking postdoctoral fellowships and research positions at the University of Zurich, CSIRO and the ARC Training Centre for Biodevices (Swinburne University of Technology). His research focuses on the design, discovery and characterisation of self-assembled nanomaterials. These materials have applications in tissue engineering, biosensing, drug delivery and understanding the molecular origins of disease.

Dr Reynolds works closely with biotech companies and hospitals to promote the translation of fundamental research into devices and commercial products that have real-world impact. Dr Reynolds has published 35 research papers (12 first, 10 corresponding author, > 940 citations) in high impact journals including Nature Communications, Chemical Society Reviews, The Journal of the American Chemical Society and ACS Nano. He joined LIMS in 2019.

Donations

For over a decade LIMS has been supporting mid-career scientists to bring their research to the next level. The LIMS fellowships provide the security and support our elite scientists require in advancing research within their specialist fields including cancer and disease prevention. We are actively seeking to broaden the number of fellowships we offer.

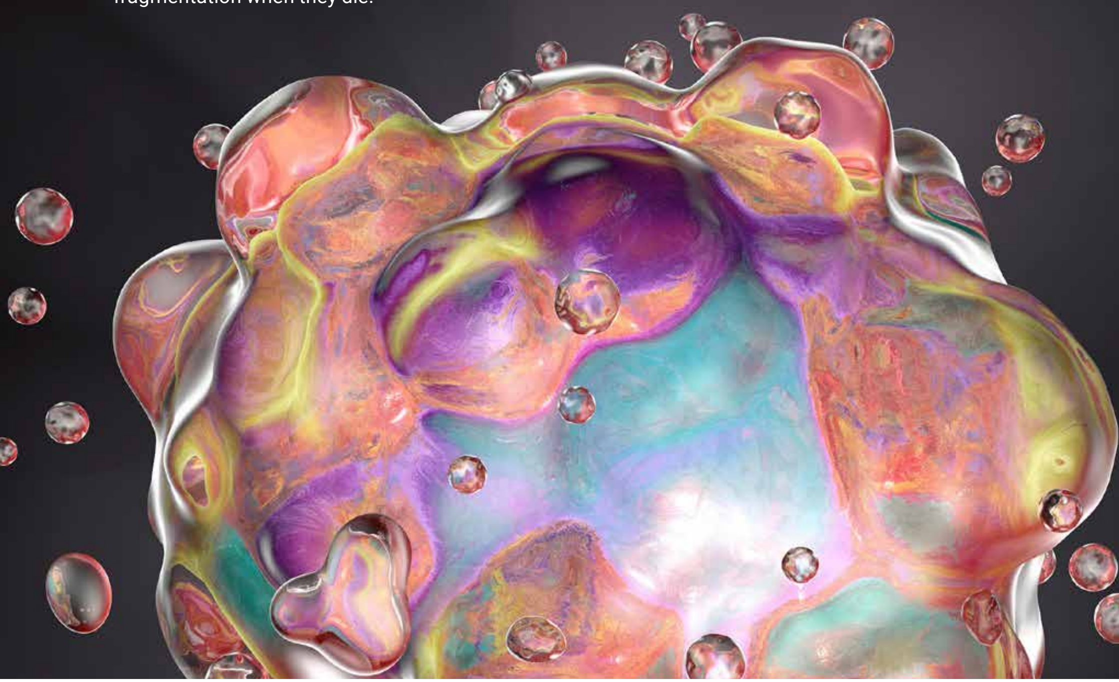
If you would like to find out how you can help by way of a donation or bequest visit **www.latrobe.edu.au/lims/about/support-us**

Or please get in touch for more information.

DISCOVERY HIGHLIGHTS

Cell death

Rapid removal of dying cells is essential to prevent the accumulation of cellular waste and triggering unwanted inflammation. Dr Rochelle Tixeira, Assoc. Professor Ivan Poon and collaborators described the ability of dying cells undergoing cell fragmentation to aid their removal by neighbouring healthy cells. Their findings, published in *Cell Death & Differentiation*, provide new insight into why cells undergo fragmentation when they die.

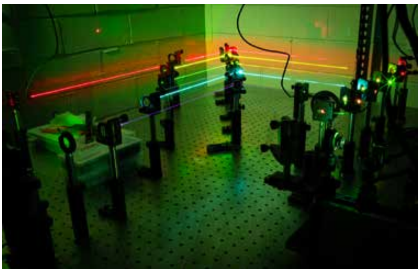


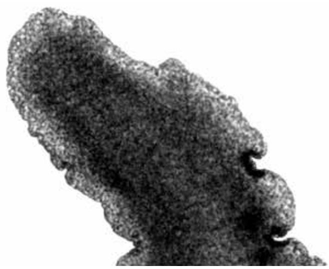
Brilliant diamonds

Diamonds can withstand high-voltage, high-power operations, extreme conditions and hold the promise to enable next-generation technologies. The Atom Scale Research Group, led by Professor Chris Pakes and Dr Alex Schenk, has developed a method of growing silicon carbide on diamond. Findings, in *ACS Applied Electronic Materials*, create a pathway to better thermal management in traditional power electronics and is the first demonstration of a new pathway for forming epitaxial semiconductor heterojunctions with diamond.

Necroptosis hope

Chemotherapy drugs damage DNA with the aim to initiate the death of cancer cells. However this can increase the risk of 'therapy-related' secondary cancers. Dr Mark Miles and Associate Professor Christine Hawkins have determined that a version of cell death, known as 'necroptosis,' fails to damage DNA or mutate cells. Their findings in *Cell Death Discovery* imply anti-cancer drugs that activate necroptotic cell death may reduce the risk of therapy-related cancers.





DNA repair

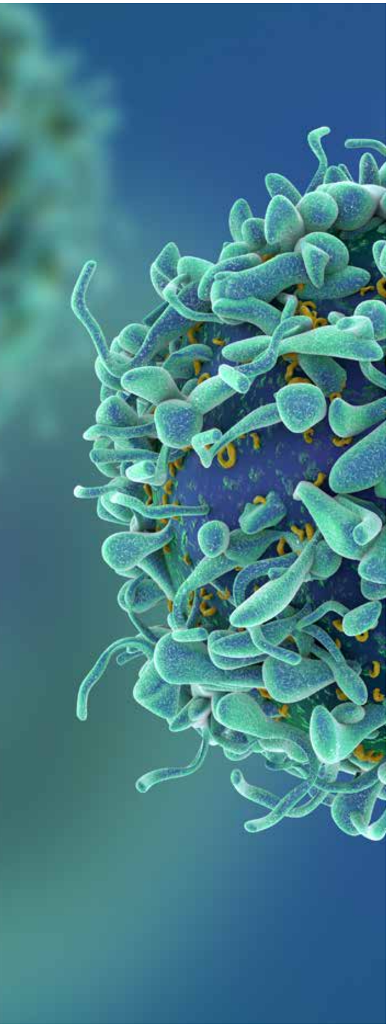
Investigating DNA repair has long been constrained by the limits of conventional microscopy. Dr Donna Whelan developed assays that use single molecule super-resolution microscopy to capture the moment of an individual DNA double strand break. Findings, published in *PLoS Genetics*, unravel how cells work to avoid and mitigate damage, revealing new pathways and proteins and their key roles in maintaining genomic stability. In the future these assays will produce the most comprehensive picture of DNA repair pathways.

Ancient rituals

The similarities between altruistic cell death in *Trichoplax adhaerens*, a tiny marine invertebrate, and a similar but defective process in human cancer cells, provides unexpected insights into the workings of a crucial cell survival pathway. The international research team, including Professors Marc Kvansakul and Patrick Humbert from the La Trobe Institute for Molecular Science, used the Australian Synchrotron to image this ancient mechanism of cell self-sacrifice at the atomic level. Their research was published in *Science Advances*.

CANCER

Our Cancer researchers are investigating the molecular basis of cancer initiation and progression, how cancer cells communicate with their surrounding environment and the discovery of new therapeutic approaches to combat the disease.



Through the use of model systems of cancer, along with the application of cutting-edge technologies and imaging systems, they are identifying and validating new approaches and targets to improve clinical diagnosis and treatment.

A close relationship with the Olivia Newton-John Cancer Research Institute strengthens the ability to achieve bench-to-bedside outcomes.

Research focus

- To understand the molecular mechanisms of cancer including processes that lead to abnormal cell growth and survival.
- To identify new treatment strategies with improved efficacy and fewer side effects.
- To investigate new biomarkers for diagnostic purposes.
- To develop new technologies for imaging and monitoring cancer progression.

Projects

- Identifying biomarkers to monitor and treat cancer cachexia in patients, a muscle wasting condition responsible for 25% of cancer deaths.
- Understanding the mechanisms used by cancer cells to survive within the tumour microenvironment to identify how these processes might be intervened for disease treatment.
- Investigating cancer prevention by understanding how pathways that link tissue organisation and tumour growth can be manipulated.

INFECTION AND IMMUNITY

The Infection and Immunity theme studies the molecules used by viruses, bacteria, parasites and fungi to infect humans, animals and plants – and the immune response associated with these processes.

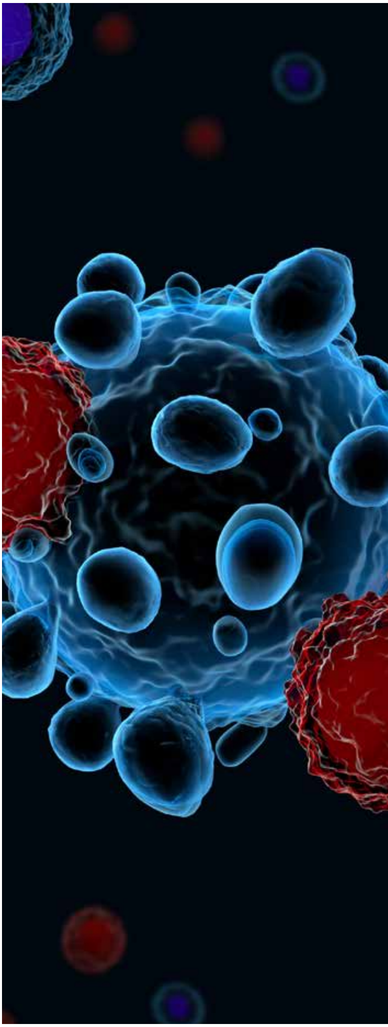
Our researchers are developing next generation therapeutic molecules to fight infection, inflammation and autoimmune diseases. They achieve this using protein and DNA based technologies, imaging and single cell analysis.

Research Focus

- To understand the molecular mechanisms of microbial infections including the biology of pathogens, how microbes establish an infection and the links between inflammation and disease.
- To investigate how the immune system senses and responds to pathogens, and how pathogens subvert the host response and defend against immunity.
- To identify new avenues for treatment strategies relating to bacterial, fungal and viral infections, and investigate the processes that lead to antimicrobial resistance.

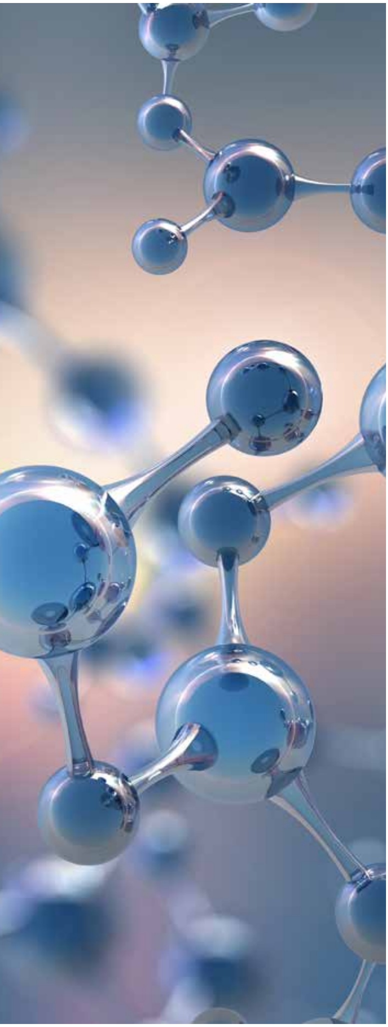
Projects

- Studying the natural defence mechanisms of humans, animals and plants.
- Investigate how misfolding of proteins leads to neurodegenerative diseases.
- Using single domain antibodies from sharks to identify new therapeutics for diseases such as fibrosis.
- Combining T cell immunology and structural biology to understand viral infections including SARS-CoV-2, influenza and HIV.
- Generating the next generation of antimicrobial agents for treating multi-drug resistant pathogens.



MOLECULAR DESIGN

Our Molecular Design researchers create new molecules and study the structure and properties of molecules, and the energetics of chemical reactions.



Using computational techniques, molecular characterisation, synthesis and purification we test the behaviour of molecular systems to aid in the design of next-generation imaging agents, biological probes, drugs and materials.

Research focus

- To understand the structure and mechanisms of small molecules, proteins, polypeptides and complex materials.
- To design and synthesise new organic, inorganic, organometallic and supramolecular compounds for research, diagnostic and therapeutic purposes.
- To examine the structure, function and regulation of biomolecules for pharmaceutical, agrochemical and industrial purposes.

Projects

- Designing and synthesising small molecules, peptides and polymers to understand and treat autoimmune, cardiovascular, and neurodegenerative diseases, pathogen infections, and cancers.
- Developing new catalysts and new chemical reactions to combat synthetic challenges
- Using quantum-mechanical methods to understand enzyme mechanisms and molecular mechanical methods to explore the dynamics of proteins.
- Examining the structure, function and regulation of essential proteins in bacteria and plants to aid the development of new antibiotics and herbicides.

NANOSCIENCE

The Nanoscience theme uses a broad range of methods to characterise molecular structure and function, and to identify and quantitate key chemical and biochemical species in the environment and in the human body.

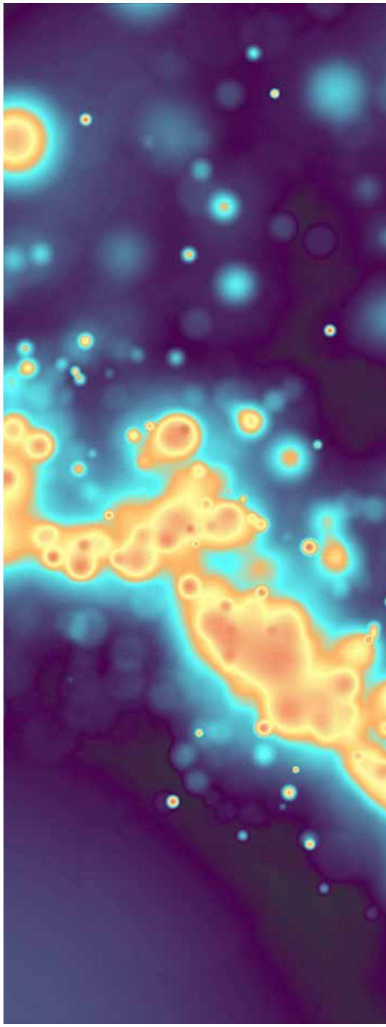
Using super-resolution and electron microscopy, condensed matter physics and infrared spectroscopy we study molecular processes to create new medical diagnostics, environmental sensors and techniques to image molecules in real time.

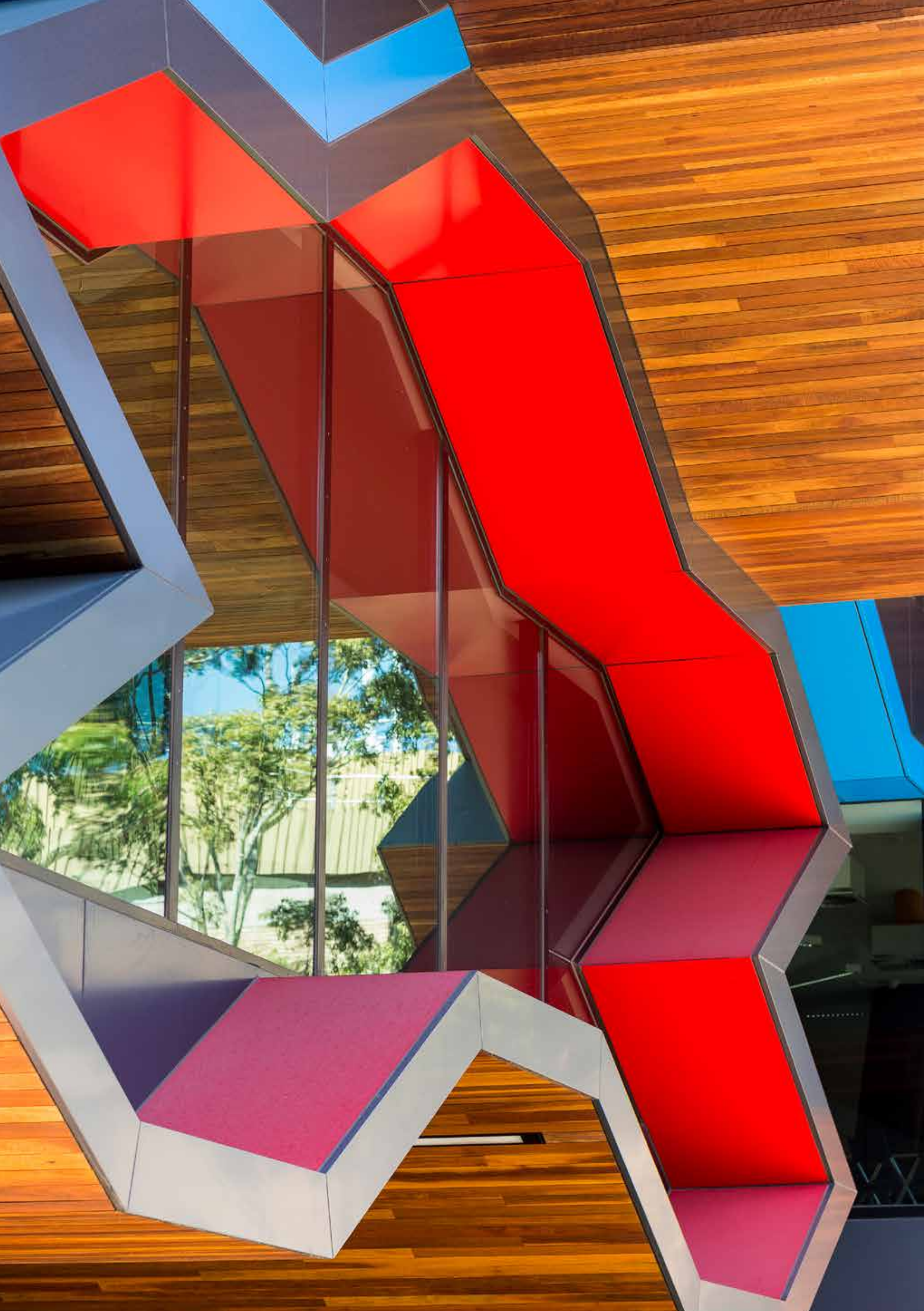
Research focus

- To characterise the molecular structure and function of materials, molecular complexes, proteins and condensed matter.
- To develop methods for identifying and quantifying chemical and biochemical species in environmental or biological specimens for research or diagnostic purposes.
- To understand the composition and molecular properties of materials at the nanometer scale.

Projects

- Developing mobile phone-based sensors to make environmental testing and medical diagnostics more widely accessible.
- Studying neurotransmitter molecules relevant to pharmaceuticals, greenhouse gas molecules, ice cloud particles and molecules in the interstellar medium.
- Developing a label-free alternative to bioimaging and biosensing using nanofabricated glass slides.
- Developing synchrotron instrumentation and methods for imaging dynamical nanoscale systems with X-rays, and for nanopatterning of functional materials.
- Engineering two-dimensional devices for quantum electronics and biosensing using functionalised diamond surfaces.





La Trobe University acknowledges that our campuses are located on the lands of many Traditional Custodians in Victoria and New South Wales. We recognise their ongoing connection to the land and value their unique contribution to the University and wider Australian society.

La Trobe University is committed to providing opportunities for Aboriginal and Torres Strait Islander people, both as individuals and communities, through teaching and learning, research and community partnerships across all our campuses.

The wedge-tailed eagle (Aquila audax) is one of the world's largest, and the Wurundjeri people – Traditional Owners of the land where our Melbourne campuses are located – know the wedge-tailed eagle as Bunjil, the creator spirit of the Kulin Nations.

There is a special synergy between Bunjil and the La Trobe University logo of an eagle. The symbolism and significance for both La Trobe and for Aboriginal people challenges us all to gamagoen yarrbat – to soar.

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General enquiries

La Trobe Institute
for Molecular Science (LIMS)
La Trobe University
VIC 3086
Australia

T +61 3 9479 2160
F +61 3 9479 1266
E LIMSEnquiries@latrobe.edu.au

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latrobe.edu.au/lims

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