



Institute for Photonics & Advanced Sensing (IPAS)

Medical Diagnostics & Biological Sensing

Theme Leaders



Prof Tanya Monro

IPAS research in Medical Diagnostics & Biological Sensing is driven by fundamental questions in biology and the urgent need for improved medical diagnostic techniques. We develop new technologies in conjunction with clinicians and biologists, pushing the boundaries of speed, sensitivity and sample volumes.



Dr Peter Hoffmann

We have produced optical fibre-based dip sensors capable of measuring biomolecules in small sample volumes and/or low concentrations. We have also developed novel label free systems that are capable of sensing pathogens and biomarkers. These have the potential to underpin future 'point of decision' medical diagnostic technologies.

Our researchers in this area investigate the chemistry of proteins and peptides and discover new biomarkers to answer important biological questions about the development and prevention of diseases.

We also work on drug design and development, including the identification and synthesis of novel small molecules to block or activate cellular targets.



Biomarker Discovery

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Methathesis and Click Chemistry

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Protein Structure, Function and Interactions

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Biosensing Platform Development

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Adelaide Proteomics Centre

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STARR Laboratory

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Biomarker Discovery

The Biomarker Discovery work investigates cancers and diseases through the identification of new biomarkers. Focusing on increasing our ability to detect, identify and quantify proteins and peptides with the highest sensitivity and accuracy is a key motivation of this work.

The area use the latest mass spectrometry for structure determination protein identification and quantification. Post-translational modifications are characterised and changes in protein expression levels are quantified using techniques such as 2D fluorescence difference gel electrophoresis and quantitative mass spectrometry using isotopic labelling and label-free approaches. Ultimately this work is driven by the need for new tools for early diagnosis and to treat diseases through a better understanding of changes at the molecular level.

Metathesis & Click Chemistry

Our Metathesis & Click Chemistry researchers design, synthesise and test inhibitors towards clinical solutions.

Our investigations concentrate on proteolytic enzymes and also small heat-shock chaperone proteins (sHsp) that are associated with amyloid fibril formation. An important extension of this work is to incorporate molecular 'switches' into the structures which when activated, then mimic a key protein or peptide. Providing an opportunity to develop treatments and diagnoses of diseases such as Alzheimer's, traumatic brain injury, cataract, and cancer.

Protein Structure, Function & Interactions

The Protein Structure, Function & Interactions researchers undertake chemical, spectroscopic and biophysical investigations on the structures, functions and interactions of peptides and proteins. Nuclear magnetic resonance spectroscopy, circular dichroism, fluorescence spectroscopy, electron microscopy, ultracentrifugation techniques and site directed mutagenesis are used to investigate structure-function relationships of specific amino acids within peptides and proteins.

Biosensing Platform Development

The Biosensing Platform Development work at IPAS is focused on the development of new and improved tools for biomolecule detection. Harnessing the breakthroughs achieved in other research themes, we create new measurement tools for advancing biological research, and by collaborating with medical researchers we enable translation to clinical applications. The strength of this area of research has been recognised by the award of 6 ARC Super Science Fellowships. Three of these Fellowships are focused on creating new sensing platforms and three on advancing new applications. Examples of platforms being developed include new forms of whispering gallery mode, surface plasmon resonance and fluorescence sandwich assays. Applications include rapid disease diagnosis, blood analysis at crime scenes and *in vivo* embryo monitoring.

Adelaide Proteomics Centre (APC)

The Adelaide Proteomics Centre (APC) offers researchers and industry a state-of-the-art proteomics facility. The APC has the latest mass spectrometry (MS) technologies for proteins identification and characterisation of post-translational modifications, such as 2D fluorescence difference gel electrophoresis, isotopic labelling and label free quantitative MS. The APC is the leading research laboratory in tissue imaging MS in Australia and SE Asia.

STARR Laboratory

The Sensing Technologies for Advanced Reproductive Research (STARR) laboratory is dedicated to the development of photonics-based reproductive health technologies. Co-locating sensor development and embryology laboratories in the University of Adelaide enhances interactions between physicists and biomedical researchers and greatly accelerates the integration of sensor development with existing medical instrumentation and animal models.

The STARR facility is a \$1.4M initiative, by the State SA's Premier's Science and Research Fund (PSRF) and is a partnership between The University of Adelaide, Cook Medical Reproductive Health Science Pty Ltd, Fertility SA and Flinders Reproductive Medicine.

Case Study: Gastric Cancer Diagnostics

An NHMRC Project Grant awarded to Dr Peter Hoffmann, Prof Tanya Monro and collaborators is currently underway. Using a new fibre-based SPR sensor developed by Dr Alexandre Francois, postdoctoral researcher Dr Beniamino Sciacca has recently demonstrated the detection of key gastric cancer biomarkers. This project aims to build on serum protein biomarkers of early-stage gastric cancer discovered by the Adelaide Proteomics Centre to create a fibre-based screening tool for early stage gastric cancer.