

UQ Summer or Winter Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	Mapping enzyme activity on tissue by functional mass spectrometry imaging
Project duration:	10 weeks
Description:	<p>Enzymes are central components of virtually every physiological process in the human body and are consequently involved in a wide range of pathologies, including cancers. High resolution spatial information on enzyme location and activity within tissues would thus represent a powerful tool for elucidating enzymatic functions in health and disease with the potential for applications in future diagnostics for a range of pathologies. Until recently, however, no single imaging modality is able to routinely and simultaneously map the distribution and efficacy of enzymes <i>in situ</i>.</p> <p>We have recently developed mass spectrometry imaging (MSI)-based methods for assaying the spatial distribution of enzymatic activity directly from tissue sections at a spatial resolutions of 50 μm (or better). In this project, the candidate will be involved in developing new methods to expand the application of functional MSI to new tissues and enzymes.</p>
Expected outcomes and deliverables:	The candidate will gain basic laboratory skills, as well as skills in both electrospray ionisation (ESI) and matrix assisted laser desorption ionisation (MALDI) based mass spectrometry, mass spectrometry imaging, proteomics, enzyme assays, histology, and light microscopy.
Suitable for:	The project would suit students with a background in biology/chemistry and would be particularly suitable for candidates looking to progress to honours and/or a PhD.
Primary Supervisor:	Dr Eivind A. B. Undheim
Further info:	Email: e.undheim@uq.edu.au

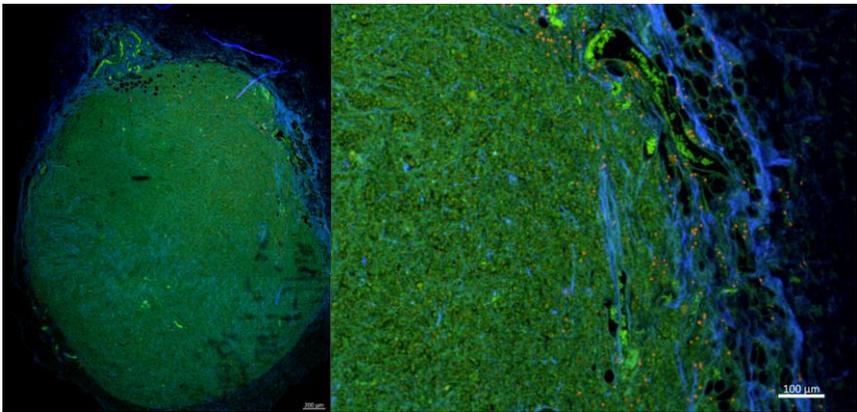
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Project title:	Polymers in Nanomedicine: Development of Polymeric Theranostics.	
Project duration:	<i>10-12 weeks</i>	
Description:	<p>Recent synthetic advances that facilitate control over polymer structure and functionality have led to the advent of polymer theranostics; devices capable of simultaneously diagnosing disease, delivering a therapy and monitoring the treatment and disease progression. While the potential application of such nanomaterials is tremendous, <i>in vivo</i> monitoring remains a significant scientific challenge. While the ultimate aim in polymer theranostics is the development of a multi-modal, multi-functional, biodegradable delivery device with the possibility of facile conjugation of therapeutics, imaging agents and targeting moieties, current methodologies are plagued by poor drug loading, inefficient cell uptake, targeting inefficiencies, synthetic complexities or a combination of all of these factors. This project explores the design, synthesis and preclinical testing of polymeric theranostics that incorporate various molecular imaging modalities (PET, MR, Optical Imaging) as a means of monitoring drug and gene therapies.</p>	 <p>PET-CT image of tumour-targeted nanomedicine.</p>
Expected outcomes and deliverables:	The project will equip scholars with a range of synthetic and analytical skills for the development and characterisation of nanomedicines (e.g. ligation strategies for imaging agents and targeting ligands) as well as provide exposure and initial instruction on the advanced imaging modalities at CAI (e.g. PET-MR; PET-CT, MR, Optical). The generation of publications following the research project is also possible.	
Suitable for:	This project is open to all students with a desire to engage in imaging sciences. However, given the broad nature of the field, students having 2 nd -3 rd year chemistry background will be better placed to achieve the goals of the project.	
Primary Supervisor:	Dr Kristofer Thurecht	
Further info:	For further details, please send enquiries to: k.thurecht@uq.edu.au	

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Project title:	High resolution imaging of nanomedicine distribution
Project duration:	10-12 weeks
Description:	<p>Nanomedicine, the application of nanotechnology and biotechnology to medicine, is a rapidly expanding field of research with great promise for making meaningful changes in the way we treat many diseases including cancer. There are a multitude of approaches to the synthesis of nanomedicines, with our work being focused on developing polymeric nanoparticles able to target cancer cells to delivery therapeutics, while also allowing diagnostic imaging by incorporation of imaging probes. While these materials show great promise, a better understanding of their behaviour and ultimate fate within the body is required for their further development. There has recently been significant work towards monitoring these materials <i>in vivo</i>, however we still lack the approaches to determine their interactions with organs, cells and subcellular compartments at high resolution, which is key to understanding their ability to deliver therapeutics effectively.</p> <p>This project aims to develop imaging approaches to bridge this knowledge gap using combinations of optical microscopy and electron microscopy, while correlating these with preclinical <i>in vivo</i> imaging to allow enhanced monitoring of nanomedicine behaviour and drug delivery.</p>  <p>Confocal microscopy image of tumour slice imaging nanomedicine distribution</p>
Expected outcomes and deliverables:	<p>This project will allow students to gain skills in a variety of synthetic and analytical techniques and provide them exposure to a range of advanced imaging modalities (electron microscopy, optical imaging, PET-CT and PET-MR imaging) at the CAI and AIBN. Being based within the Thurecht Group they will also be able to gain a broad experience and understanding of nanomedicine science, with the opportunity to be involved in multiple projects. The results from this work will potentially form this basis of publications.</p>

Suitable for:	This project utilizes a multidisciplinary approach and will be suitable for all students with an interest in imaging and nanomedicines. However given the technical nature of the work involved 2-3 rd year chemistry/biomedical/biology (or equivalent relevant experience) background will be better suited to achieve the most from the project.
Primary Supervisor:	Dr Nicholas Fletcher and A/Prof Kristofer Thurecht
Further info:	For further details please email n.fletcher1@uq.edu.au or k.thurecht@uq.edu.au