

Bath Monash Global PhD Programme in Sustainable & Circular Technologies

Project Title:	Lipid cubic phases: sustainable nanomaterials to immobilize membrane proteins for biocatalysis and biosensors.
Supervisors at Bath:	Dr Adam Squires (lead), Mirella di Lorenzo
Supervisors at Monash:	Dr Leonie van 't Hag, Prof Andrea Robinson
Home Institution:	Bath
Indicative period at Host Institution:	18 months

Project Summary

The project will investigate new methods to immobilize membrane proteins. The end goal is to harness membrane-bound enzymes in devices for biotechnological applications including sensing and catalysis. Immobilized enzymes have value as highly specific chemical catalysts, in industrial processing (eg flow reactors) and diagnostics (eg biosensors for healthcare). However, immobilisation is a major challenge, especially for membrane-bound proteins. We will exploit nanomaterials known as “lipid cubic phases” (LCPs) – artificial membrane-mimicking “glues” within which membrane proteins maintain activity, which both supervisors have researched extensively. LCPs form spontaneously in water, producing a stable functional film, and can be removed after use by dissolving in ethanol. They therefore offer a sustainable route to device fabrication using low-cost, industrially compatible materials and processes, and green solvents and conditions (ethanol / water, room temperature). Furthermore, we anticipate that LCPs allow incorporation of much more membrane protein, and therefore provide considerable signal amplification, compared with a single flat bilayer.

The project will build in complexity, as follows:

- 1) (Bath, months 1-12) Study incorporation of model proteins (eg porin OmpF) and peptides (eg gramicidin) into lipid cubic phases on electrodes; studies with UV/Vis spectroscopy and SAXS
- 2) (Monash, months 13-31) Synthesise designer functional membrane-bound peptides. Study protein structure upon immobilisation using CD spectroscopy and FTIR (including using AFM-IR in the department and IR microspectroscopy at the Australian Synchrotron). Additionally, FRAP experiments using a confocal microscope will be used to quantify peptide and protein diffusion in the film.
- 3) (Bath, months 32-42) Investigation of electrochemistry of redox-active membrane enzymes immobilized in lipid cubic phases (eg Cytochrome C Oxidase); device fabrication.

The student will learn biophysical sample preparation methods associated with lipids and membrane proteins, and physical chemistry techniques including x-ray and neutron scattering, electrochemistry and spectroscopy.

## Features of the programme

- PhD researchers will be registered at both institutions and will be awarded a joint PhD degree.
- PhD researchers will be jointly supervised by academics from both Monash and Bath Universities.
- All PhD researchers in the joint programme will also undertake a bespoke advanced training plan covering a range of topics focusing on sustainability.
- Applicants can apply to either Monash University or the University of Bath as their nominated home institution.
- PhD researchers will undertake a period of no less than 12 months at the partner institution.
- Up to four scholarships/studentships will be offered. Additional and suitably qualified applicants who can access a scholarship/studentship from other sources will be also considered. Evidence of funding must be provided.
- The scholarships/studentships include:
  - a *full tuition fee sponsorship* provided by Monash or Bath for the course duration (up to a maximum 42 months). **Funding for Bath-based projects, such as the one advertised here, is available to candidates who qualify for Home fee status only.** In determining Home student status, we follow the UK government's fee regulations and [guidance from the UK Council for International Student Affairs \(UKCISA\)](#). Further information may also be found within the university's [fee status guidance](#). EU/EEA citizens who live outside the UK are unlikely to be eligible for Home fees and funding. Funding for Monash-based projects is available to candidates of any nationality.
  - a *living allowance (stipend)* provided by Monash or Bath Universities.

Note: Overseas Student Health Cover (OSHC) must be paid by the student, unless covered by the university.

## How to apply

You MUST express interest for three projects in order of preference. Please submit your application at the Home institution of your preferred project ('Home' institution details can be found in the project summary). However, please note that you are applying for a joint PhD programme and applications will be processed as such.

**The deadline to submit applications is 11th April 2021**

### ***Monash University***

Expressions of interest (Eoi) can be lodged through <https://www.monash.edu/science/bath-monash-program>. The Eoi should provide the following information:

CV including details of citizenship, your Official Academic Transcripts, key to grades/grading scale of your transcripts, evidence of English language proficiency (IELTS or TOEFL, for full requirements see: <https://www.monash.edu/graduate-research/faqs-and-resources/content/chapter-two/2-2>), and two referees and contact details (optional). You must provide a link to these documents in Section 8 using Google Drive (Instructions in Section 8).

### ***University of Bath***

Please submit your application through the following link: <https://www.csct.ac.uk/bath-monash-global-phd-programme/>

Please make sure to mention in the "finance" section of your application that you are applying for funding through the joint Bath/Monash PhD programme for your specified projects.

In the "research interests" section of your application, please name the three projects you are interested in and rank them in order of preference. Please also include the names of the Bath lead supervisors.