

### Bath Monash Global PhD Programme in Sustainable & Circular Technologies

Project Title:	Development of point-of-care soil diagnostics for sustainable agriculture
Supervisors at Bath:	Prof Mirella Di Lorenzo
Supervisors at Monash:	Prof Antonio Patti, Assoc Prof Kellie Tuck
Home Institution:	Year 1 and Year 3 at Bath
Indicative period at Host Institution (Monash):	Year 2 at Monash

#### Project Summary (to include a brief description of the relevance to sustainable & circular technologies)

Precision (or smart) agriculture leverages technologies to enhance sustainability through more efficient use of land, water, fertilizer and pesticides; farmers use less to grow more, thus maintaining soil health, reducing cost and minimising environmental impact. This approach requires the implementation of several sensors to monitor key soil properties and environmental conditions. To date, only a few sensors for soil quality are commercially available, and they suffer from several drawbacks, including: susceptibility to weather variations; limited life span; need for regular maintenance by specialized personnel; and high cost. Especially the latter aspect, prevents a wide implementation of precision agriculture.

With this PhD project, we aim to provide an effective solution to the drawbacks of commercial sensors for soil, with the development of an electrochemical sensor that allows monitoring of both chemical and biological factors, thus becoming a powerful tool for online point-of-care soil diagnostics. Key focus on the technology developed will be cost-effectiveness, simplicity of operation, and concomitant production of electricity for autonomous operations (thus enabling remote operations). A Design of Experiment approach will be used to characterise the electrochemical response of the sensor developed to changes in physico-chemical properties of the soil, such as porosity, salinity, water content, aerobic vs anaerobic conditions and particularly composition and availability of nutrients (i.e. nitrogen, phosphorous and potassium), and biodegradability of the organic matter. The data generated will inform the development of a mathematical model that links the sensor outputs to soil quality and accordingly guides on tailored and precision interventions.

The technology developed can provide affordable, sustainable and inclusive precision agriculture, real-time monitoring to optimise managing agricultural inputs and thus become a powerful means for better land use and effective agriculture, towards ending hunger, food insecurity and malnutrition in all its forms.

The proposed project is inherently multidisciplinary involving the following main areas: fuel cell technology (design and development); sensing (electrochemical detection and data interpretation); chemical engineering (simulation of mass transfer phenomena); chemistry (electrocatalysis, organic chemistry); material science (material development, electrode surface chemistry) and soil science. Consequently, the PhD candidate will receive an interdisciplinary training and develop a highly competitive skills set in the field of sensing and smart agriculture.

## 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). Note, however, that studentships for Bath-based projects will provide cover for UK/EU tuition fees ONLY.
  - 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 30th January 2023**

### ***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.