

Bath Monash Global PhD Programme in Sustainable & Circular Technologies

Project Title:	Developing Thymidine-Based Green Self-healing Polymers
Supervisors at Bath:	Dr. Antoine Buchard
Supervisors at Monash:	A/Prof. Kei Saito (lead)
Home Institution:	Monash University
Indicative period at Host Institution:	2.5 years at Monash; 1 year at Bath with exact dates to be confirmed

Project Summary

Intrinsically self-healing polymers have the ability to heal damage by the use of an appropriate stimulus. This healing can restore the mechanical properties of a damaged polymer allowing for a return to service without the need for replacement of the polymer. When used as a coating, a self-healing polymer can ensure the continued protection of the underlying structure after damage, with minimal downtime of the component and no replacement of the coating necessary.

Photo-stimulated self-healing polymers which can heal the damages via light irradiation are a promising new class of materials especially for coatings. One of the ways to produce photo-stimulated self-healing polymers is to incorporate photo-reversible units in polymer structures and Saito's group has been working on creating self-healing polymers by incorporating thymine, coumarin and other photo-reversible units that can undergo 2+2 cycloaddition reaction in polymer structures.¹ In parallel, Buchard's group has developed thymidine based polycarbonates by ring opening polymerisation to create biodegradable polymers from renewable resources.² Thymidine has the potential to undergo 2+2 cycloaddition reaction and the idea here is to convert this thymidine based polycarbonates into self-healing polymers to prepare self-healing polymers which are biodegradable.

This project will involve organic synthesis, polymer synthesis and polymer characterization techniques.

The student will be based in Monash, and they will initially work with A/Prof Saito on monomer and polymer design. While during their year in Bath, supervised by Dr Buchard, they will incorporate thymidine sugars units, in combination with other building blocks (e.g. CO₂), into degradable polymers (e.g. polycarbonates, but also polyesters using ADMET polymerisation techniques). The self-healing ability of these polymers will be studied back in Monash.

1. T. Hughes, G. P. Simon, K. Saito, *Polym. Chem.*, 2019, 10, 2134-2142

2. G. L. Gregory, E. M. Hierons, G. I. Kociok-Köhn, R. I Sharma and A. Buchard, *Polym. Chem.*, 2017, 8, 1714-1721.

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 23rd February 2020

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.