

Bath Monash Global PhD Programme in Sustainable & Circular Technologies

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| 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 will apply through Monash University as their nominated home institution.
- PhD researchers will undertake a period of no less than 12 months at the partner institution.
- The scholarship/studentship includes:
 - a *full tuition fee sponsorship* provided by Monash for the course duration (up to a maximum 42 months) and 57 months of single Overseas Student Health Cover.
 - a *living allowance (stipend)* provided by Monash.

How to apply

You MUST express interest for three projects in order of preference. However, you are applying for a joint PhD programme and applications will be processed as such.

The deadline to submit applications is 12th July 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).