

Bath Monash Global PhD Programme in Sustainable & Circular Technologies

Project Title:	Sustainable Synthesis of Drug Scaffolds from Biorenewable Feedstocks Using Visible Light Photocatalysis
Supervisors at Bath:	Dr Alex Cresswell
Supervisors at Monash:	Professor Philip W. H. Chan
Home Institution:	Bath
Indicative period at Host Institution (Monash):	12-18 months (depending on project requirements and Prof. Chan's availability)

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

This project will explore the sustainable synthesis of spirocyclic *N*-heterocycle scaffolds for drug discovery, using biorenewable itaconic acid as a key feedstock (generated on large scale annually by the fermentation of glucose). In the Cresswell lab, automated flow chemistry will be used to optimise and conduct visible-light photocatalysed C–H functionalisation reactions on unprotected alkylamines, to generate spirocyclic lactams on multigram scales. In the Chan lab, these novel, polyfunctional scaffolds will be used as a testbed to invent new catalytic reactions for spirocycle functionalisation that address challenges in chemo-, site-, and stereoselectivity control. Together, this will provide sustainable and scalable methodology to access new and highly desirable 3D chemical space for drug design. The project will be ideally suited to anybody with a desire to pursue a synthetic chemistry career in the pharmaceutical industry.

The Cresswell group specialises in the development of new synthetic reactions using visible light photoredox catalysis,[1,2] and all PhD students are exposed to a number of enabling technologies and advanced techniques, including photoredox catalysis, flow chemistry, automation, and mechanistic analysis. Further training will be offered in the form of weekly problem sessions on organic synthesis and participation in compiling an annual review of the literature on synthetic chemistry for drug discovery.

The Chan group focuses on the development of sustainable catalytic strategies for C–C and C–X (X = N, O, S, Cl) bond formation. Recent examples include C(sp³)–H chlorination methodology[3] and gold-catalyzed cycloisomerization of alkynes[4]. These novel catalytic methodologies are applied to the construction of complex bioactive molecules, including natural products.

[1] [“Photocatalytic Hydroaminoalkylation of Styrenes with Unprotected Primary Alkylamines”](#) Cresswell *et al.*, *J. Am. Chem. Soc.* **2021**, *143*, 15936 [most read JACS article of the month]

[2] [“Photocatalytic \$\alpha\$ -Tertiary Amine Synthesis via C–H Alkylation of Unmasked Primary Amines”](#) Cresswell *et al.*, *Angew. Chem. Int. Ed.* **2020**, *59*, 14986

[3] “Copper(I)-catalysed site-selective C(sp³)-H bond chlorination of ketones, (*E*)-enones and alkylbenzenes by dichloramine-T” Chan *et al.*, *Nat. Commun.* **2021**, *12*, 4065

[4] “Chiral Gold Complex Catalyzed Cycloisomerization/Regio- and Enantioselective Nitroso-Diels-Alder Reaction of 1,6-Diyne Esters with Nitrosobenzenes” Chan *et al.*, *ACS Catal.* **2022**, *12*, 7288

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.