PhD Project Advertisement

Project title: ***Engineering Bacteria for Enhanced Degradation of Food-Associated Plastic Waste.***
Project No: FBS25-17-McCarthy-bc

Lead supervisor: Professor Ronan McCarthy, Life Sciences, Brunel University

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Co-supervisors:
Dr Francis Hassard, Cranfield Water Science Institute, Cranfield University
Professor Frederic Coulon, Cranfield Water Science Institute, Cranfield University
Professor George Fern, Chemical Engineering, Brunel University

Project description: As recognised by the UK Plastics Pact, novel solutions are urgently needed to tackle the scourge of waste plastic. From the globally produced 350 million metric tons of plastics per year, the food sector produces 40% of this. In the UK over half of food and drink products are wrapped in unnecessary plastic contributing to 29.8 billion avoidable pieces of plastic packaging annually. These persistent plastics disrupt ecosystems at both macro- and microscopic levels, from inhibiting oxygen-producing bacteria to destabilizing soil microbial communities.

This PhD will use an engineering biology approach to develop an enhanced bacterial strain capable of degrading multiple plastics simultaneously. By integrating high-performance plastic-degrading enzymes from diverse evolutionary lineages with regulatory circuits to control biofilm formation, this project will create a "super-degrader" strain that can attach to mixed plastic waste and convert it into valuable by-products. This work will combine synthetic biology, biofilm and environmental engineering to address a global waste challenge.

Your Role

As a PhD researcher, you'll be at the forefront of a multi-disciplinary effort to engineer bacterial strains with enhanced plastic-degrading capabilities. You'll gain experience in synthetic biology, biofilm engineering, and continuous-flow bioreactor technology, while addressing real-world challenges in microplastic removal and wastewater treatment.

Project Objectives

- Objective 1: Build a Super-Degrading Chassis – Engineer bacterial strains (like Pseudomonas and Acinetobacter) to express multiple high-performing enzymes that target multiple plastic types simultaneously.
- Objective 2: Boost Degradation with Biofilms – Design biofilm-enhancing circuits to create a "sticky" environment where bacteria can secrete higher concentrations of enzymes directly onto plastic waste.
- Objective 3: Test in a Continuous Bioreactor – Apply engineered strains in bioreactors to degrade both single-use and mixed plastics, tracking the production of valuable by-products like ethylene glycol and terephthalic acid.
- Objective 4: Scale-Up at a Wastewater Treatment Plant – Test the best-performing strains at a pilot-scale wastewater treatment plant (WWTP) at Cranfield University, assessing the strain's real-world capacity to degrade microplastics in complex wastewater environments.

Training opportunities: The prospective student will benefit from a multi-disciplinary supervisory team with expertise spanning microbiology, synthetic biology, bioinformatics, biofilms, and water science. They will receive training in a range of cutting-edge techniques, including modular genetic circuit design, biofilm flow cells, and microscale bioreactors. A key highlight is the close association with the Environmental Biotechnology Innovation Centre (EBIC) led by co-supervisor Prof Coulon. The student will join EBIC's Early Career Network, offering access to regular career development and training events. Additionally, a 3-month placement at SEBI Group which will provide hands-on industry experience in food packaging production and sustainability considerations, enhancing the student's practical and professional skills.

Project supervision plan: The student will be primarily based in the McCarthy Lab at Brunel where they will have a core supervisory team consisting of Prof McCarthy and Prof Fern. They will have weekly 1:1 meetings with Prof McCarthy, and Prof Fern will join these meetings monthly. The student will be provided with feedback and support at these meetings. They will meet the wider supervisor team at least every 6 months. The student will also have an independent Research Development Advisor who they will meet quarterly. Brunel has a structured PhD progression programme where progression review meetings are held at 9, 20, 30 and 40 months. At these meetings an independent academic panel will review the students' progress and provide detailed constructive feedback and highlight prospective development opportunities. They will be based in the Hassard Lab for the majority of Objective 4, where they will have weekly meetings with Dr Hassard.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2024/25 this is £21,237 (at Brunel University) and it will increase slightly each year at rate set by UKRI.

Equity Diversity and Inclusion:

The FoodBioSystems DTP is committed to equity, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website and include:

- Offering reasonable adjustments at interview for shortlisted candidates who have disclosed a disability or specific learning difference.
- Guaranteed interview and applicant mentoring schemes for applicants, with UK home fees status, from eligible under-represented ethnic groups.

These are an opt-in processes**.**

Our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

For up to date information on funding eligibility, studentship rates and part time registration, please visit the FoodBioSystems website.