

Structured PhD in Applied Mathematics (4-years full-time)

Project topic: Mathematical modelling of chemical transport in a porous medium with evolving microstructure

Project supervisors: Dr. Kevin Moroney ([Google Scholar](#)), Dr. Doireann O’Kiely ([Google Scholar](#)), Professor Michael Vynnycky ([Google Scholar](#)).

Project location: MACSI, Department of Mathematics and Statistics, University of Limerick

Application deadline: June 30th 2022

Start date: Funding is conditional on the successful applicant being registered before 31st December 2022.

Project description: This project is a full-time 4-year structured PhD project based in the [Mathematics Applications Consortium for Science and Industry](#) (MACSI) in the [University of Limerick](#). The funding includes a tax-free stipend (with fees paid) along with expenses for computing equipment, conference travel and materials.

The research topic is mathematical analysis of porous systems with an evolving microstructure. Dissolving tablets, brewing coffee and battery operation all require transport of chemicals through liquid-filled porous structures. Transport across these systems is strongly dependent on microstructural properties (e.g., porosity, tortuosity, permeability), and often these properties change during interactions between the solid, liquid, and dissolved chemicals.

In this project, perturbation methods (also known as asymptotic analysis) will be developed for accurately modelling macroscale dynamics in structured porous media. The candidate will learn to use mathematical homogenization to systematically account for an evolving microstructure and link microscale phenomena to macroscale behaviour. The derived models will be deterministic in nature and will be analysed and solved using a combination of dimensional analysis, asymptotic methods and numerical techniques. The methodology will be applied to extend models of drug release from tablets, gels and stents to include biodegradation, with the goal of facilitating the understanding and control of such systems. Wider applications include coffee brewing, battery technology and contaminant transport.

Requirements: Applicants should have, or expect to attain (prior to project start), at least a 2.1 honours degree or equivalent in the areas of mathematics, applied mathematics, physics or engineering. Applicants with other relevant qualifications or experience who can show evidence of proficiency in high-level mathematics may also apply. Applicants for whom English is a second language will be required to demonstrate their competence in the English language in line with [University of Limerick requirements](#).

Funding notes: This Structured PhD is funded by the Faculty of Science and Engineering Early Career PhD Scholarship Scheme. Both EU and non-EU applicants will be eligible for a full award including a Researcher Stipend of €18,500 per year for four years (tax free) with fees paid and budget for travel and materials provided.

Application: Applications should email Dr. Kevin Moroney (kevin.moroney@ul.ie) before June 30th 2022 to apply with a 2-page CV and a short cover letter/statement of purpose (2-pages max) indicating their motivation and interest in the position. Please include “PhD Application” followed by your name in the subject line. The application CV should, at minimum, include the applicant’s name, education institution, qualification stating overall grade/percentage (predicted grades are acceptable for those still studying) and contact details of two academic referees. Applications should be submitted in PDF format only.

Informal queries can be made to: kevin.moroney@ul.ie