

Future Fluid Dynamics

Research Internship Programme



Candidate brief

3D printing of hierarchically structured coatings using bio-waste

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Project supervisors: Dr Sepideh Khodaparast, Dr Francis Dent
Department: School of Mechanical Engineering

Duration: 6 weeks FT (or PT equivalent)
Start date: June 2025
Stipend: £3,517
Location: University of Leeds campus

Project summary

Hierarchical micro/nano-structured materials are key in emerging applications across diverse areas, ranging from biomedical technology to energy storage. While great progress has been reported in recent years, the majority of the available approaches for the manufacturing of hierarchical coatings often rely on the application of several processes that add or remove structures of different length scales sequentially. While modern 3D printing techniques offer affordable alternative solutions to this strategy by allowing the printing of intricate hollow structures, the smallest dimensions of the final patterns and dimensions are still limited to microscales. This project investigates the possibility of fabricating hierarchically structured materials through 3D injection printing of phase-changing materials that will spontaneously produce patterns of multitudes of dimensions ranging from nano to millimetres in a scalable manner. The work will especially focus on the utilisation of bio-waste from animals and plants as the source of raw materials.

The experimental work in this project will involve the design of a fluid injection system coupled with high-speed imaging systems that will allow the fabrication of the initial milli- and micro-scale structures. The injectable source material will include viscous bio-polymer substances loaded with organic matter. The organic molecules will crystallise during/after the injection process adding intricate nanoscale structures to the printed pattern. Experimental imaging will allow in-situ visualisation of the injection and stability of the bio-polymer printing at the micro- scale, while material porosity and nano-scale pattern will be resolved ex-situ using scanning electron microscopy and X-ray tomography techniques at the final stage of the project.

Developmental benefits

The project will involve training in experimental fluid mechanics technique, starting from setting up experiments to data processing and analysis. The project will also include training on advanced electron microscopy and x-ray tomography techniques for the characterisation of the fabricated materials.

Essential criteria

Applicants to this project should be able to demonstrate:

- Curiosity
- Critical thinking
- Cross-disciplinary mindset
- Analytical techniques
- Experimental skills

Who should apply

On order to be considered for this opportunity, applicants must be eligible for the **Home (UK) rate of postgraduate academic fees**, must **not** have previously undertaken a research internship with the Leeds Centre for Doctoral Training in Future Fluid Dynamics **and meet one or more** of the below criteria:

- First in family to go to university
- From a Black, Asian or other minoritised ethnic group
- Neurodivergent (e.g. ASD, ADHD) and/or Disability (e.g. physical impairments, mental health condition, learning difficulties, chronic illness)
- Identify as female
- Have caring responsibilities
- Have been outside of education for 5 or more years
- Studying/studied at a university that is not a member of the Russell Group*

If you have any questions or would like to discuss your eligibility, please contact pgrdiversity@leeds.ac.uk

How to apply

Before making an application, you should review the essential and eligibility criteria above. Please note that if you do not meet the stated eligibility criteria your application will not be shared with the shortlisting panel for review.

You can submit your application by completing the form below:

[Future Fluid Dynamics Internship Programme \(2025\): Application form](#)

applying to. If your application is shortlisted, you will be invited to attend a short online panel interview

Applications close at 23:59 on Friday 31 January 2025.

If you have any questions about your application, please contact Emily Bryan-Kinns by email at e.bryan-kinns@leeds.ac.uk.

If you require information for disabled applicants, or would like to request alternative formats, please contact the PGR Diversity Team by email at pgrdiversity@leeds.ac.uk.