

**Title:** Filtering the details: Multiscale modelling for clean air, water, and better batteries

**Abstract:** From the dust in our homes to the pollutants in our water, many essential processes depend on interactions that span microscopic to macroscopic scales. In systems like filters and batteries, tiny particles and pores can determine overall performance. For example, the efficiency of an air or water filter relies on the shape and arrangement of microscopic fibres or grains, while a battery's capacity and lifetime hinge on how ions move through thousands of small electrode particles. Although these details are extremely small, understanding them is key to innovation in filtration and energy storage.

This talk will explore mathematical homogenisation to connect these scales. We will see how models capturing key microscale features can guide practical design. In the context of filtration, tuning the filter's microstructure can prevent premature clogging and maximise contaminant removal, leading to cleaner air and water. By turning detailed physics into effective large-scale descriptions, engineers can design better filters and batteries from the ground up.