Title: Toward overcoming the stability and environmental challenges of organic and perovskite solar cells

Emerging semiconductors, particularly organic conjugated molecules and metal halide perovskites, are transforming the semiconductor industry and serving as foundational materials for next-generation technologies, including solar panels, displays, lighting, and sensing devices. In photovoltaics, perovskite solar cells have already achieved an impressive power conversion efficiency of 27%, while organic solar cells have surpassed 20%. However, despite their remarkable device performance, several challenges still hinder large-scale commercialisation.

A key factor in realising the full commercial potential of organic solar cells is stability; a photovoltaic device must possess a sufficiently long lifespan to exceed the operational requirements of its intended application. The limited stability of conventional fullerene-based organic solar cells has long been recognised as a major challenge, with multiple degradation mechanisms leading to rapid performance losses under illumination, ambient exposure, and thermal stress. Nevertheless, the transition from fullerene to non-fullerene acceptors, alongside significant advances in molecular and device design, has opened exciting opportunities to fully address this issue.

For perovskite solar cells, one of the most critical concerns is their potentially high ecotoxicity, primarily due to the use and subsequent leaching of excessive amounts of lead into the environment over the product’s lifetime. How to minimise the risks of lead release from these materials into the environment without compromising device performance remains a major challenge.

In this talk, I will summarize my group's recent research progress in addressing the stability and environmental challenges of organic and perovskite materials and solar cells. For organic solar cells, I will highlight the distinct roles of donor and acceptor materials in degradation and propose potential strategies to mitigate these degradation mechanisms. For perovskite solar cells, I will examine the lead leaching mechanisms of halide perovskite materials under various environmental conditions and demonstrate how rational materials and device design can help overcome this challenge.

Bio: Zhe Li is Reader (Professor) in Materials Science at the School of Engineering and Materials Science, Queen Mary University of London. He received his Ph.D. from Cavendish Laboratory at University of Cambridge in 2012 and worked as a research associate/research fellow/junior group leader at Imperial College London (2012–2015) and Swansea University (2015–2017), and as a lecturer of Energy Materials at School of Engineering, Cardiff University (2018–2019). His main research interest includes organic, perovskite, and quantum dot photovoltaic cells, including in emerging target applications, stability analysis, and advanced materials and device characterisation.