THE CHINESE UNIVERSITY OF HONG KONG
Department of Electronic Engineering
Seminar

Sustainable Routes for the Synthesis and Circularity of Metal Halide Perovskite Materials and Devices

Professor Martyn A. McLachlan

Professor

Department of Materials, Molecular Sciences Research Hub
Imperial College London,

Date: 21 Sept, 2026 (Monday)
Time: 3:50 pm – 4:20 pm
Venue: Room 222, 2/F, Ho Sin Hang Engineering Building, CUHK

Abstract

Metal halide perovskites (MHPs) have emerged as a highly versatile materials platform for photovoltaics and next generation optoelectronics. Their rapid development is driven by an exceptional combination of properties, including bandgap tunability, strong optical absorption, long charge-carrier diffusion lengths, and high charge carrier mobilities, alongside compatibility with low-cost and scalable processing. Despite this promise, the sustainable manufacture of MHP-based devices remains limited by processing routes that often depend on toxic or environmentally hazardous solvents, complex multi-solvent systems, and thermal annealing steps to achieve the desired crystalline phases. Addressing these limitations is essential if MHP technologies are to move towards scalable, low-impact manufacturing.

In this talk, I will present an overview of recent strategies developed in our laboratory that fundamentally reimagine how MHP thin films, nanocrystals, and single crystals are made. At the heart of our approach is a breakthrough water-based solvent system that enables the ambient, room-temperature synthesis of size-tuneable, compositionally controlled $CsPbBr_3$ nanocrystals no toxic solvents, no thermal annealing, no compromise.1 The resulting nanocrystals achieve photoluminescence quantum yields exceeding 60%, and through post-synthetic anion exchange, we unlock access to the full CsPbX3 family (X = Cl, Br, I), with emission continuously tuneable across 450–660 nm. But perhaps most excitingly, we demonstrate that these same solvent systems can be harnessed to recover and recycle MHP thin films, enabling the fabrication of efficient devices from reclaimed perovskite materials a compelling proof-of-concept for truly circular, sustainable MHP manufacturing.

Together, these advances chart a scalable, low-cost, and greener pathway to high-performance MHP nanomaterials with precisely controlled optical properties, bringing the vision of environmentally responsible next generation optoelectronics meaningfully closer to reality.

Biography

Martyn is Professor of Thin Films, Interfaces and Electronic Devices at Imperial College London. His research spans materials chemistry, physics and engineering, with a focus on metal-halide perovskites, metal oxide semiconductors, sustainable materials processing and emerging optoelectronic devices. He leads the EPSRC-SFI Centre for Doctoral Training in Advanced Characterisation of Materials and serves as the elected Consul for Imperial's Faculty of Engineering and Business School. He is Editor-in-Chief of the Royal Society of Chemistry journals Journal of Materials Chemistry C and Materials Advances (joint). His recent work has focussed ambient, water-based approaches to the synthesis of composition- and size-controlled perovskite nanocrystals, alongside new strategies for recovery, recycling and reuse of metal-halide perovskites. Across his career Martyn has published > 150 peer reviewed papers (h = 47), supervised >30 PhD students to successful completion and has made a sustained contribution to undergraduate education and student support.

***** ALL ARE WELCOME *****

For enquiries: Prof ZHAO, Ni (nzhao@ee.cuhk.edu.hk), Tel: 3943 4347