PhD Position in Advanced Electron Microscopy and FIB Technologies for Energy Materials

The transition toward climate-neutral and sustainable energy systems requires the development of advanced functional materials and devices capable of operating efficiently, reliably and durably under demanding conditions. Materials for energy storage and conversion—such as transition-metal oxides, solid-state ionic conductors, electrocatalysts, battery electrodes, solar cells and hydrogen-related systems—are central to next-generation energy technologies.

However, technological optimisation of these systems is still limited by an incomplete understanding of how their atomic structure, interfaces, defects and chemical composition evolve under realistic operating conditions.

This PhD project aims to investigate the structure–property–performance relationships of advanced energy materials and functional devices through a combined approach based on:

- Advanced Transmission Electron Microscopy (TEM/STEM)
- Spectroscopy (EELS, EDS)
- In-situ and operando methodologies
- Focused Ion Beam (FIB) technologies for site-specific sample preparation and device cross-section analysis

Particular emphasis will be placed on:

- Atomic-scale imaging and chemical mapping of energy-relevant materials
- Interface engineering and degradation mechanisms in batteries, solid-state energy systems and solar cells
- Defect chemistry and strain effects in functional oxides and heterostructures
- Microstructural evolution under electrical bias, temperature, illumination and reactive environments

FIB-based technologies will play a crucial role in enabling site-specific preparation of functional devices (e.g., battery interfaces, solar cell multilayers, catalytic systems), supporting correlative workflows and advanced failure analysis. The integration of FIB and TEM will allow direct investigation of real device architectures at the nanoscale.

A central objective of the project is to move beyond static characterization and probe materials and devices under technologically relevant stimuli, enabling a deeper understanding of activation, degradation and long-term stability mechanisms.

By combining advanced microscopy, precise nanostructuring and quantitative analysis, the project will contribute to the rational design and optimisation of more efficient, robust and sustainable energy materials and technologies.

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