Thin Films and Interfaces
Group Seminar

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16:30 - room OFLG/402

Guiding the Development of Materials for Solid Oxide Electrochemical Energy Conversion Devices through Advanced Ion Beam Analysis

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The performance of electrochemical energy conversion devices such as solid oxide fuel cells (SOFCs) and electrolysers (SOECs) rests upon the exchange of oxygen between the gas phase and the surface of a ceramic electrode, and the subsequent solid-state transport of oxygen ions through the bulk material. Whilst the mechanisms of bulk transport in these materials are for the most part well understood, a clear description of the surface exchange process in atomistic terms is still out of reach. One key to understanding oxygen surface exchange in these materials is knowledge of the composition of the oxide surface actually participating in these reactions.

Surface-sensitive ion beam techniques, such as Secondary Ion Mass Spectrometry (SIMS) and Low-Energy Ion Scattering (LEIS), are making significant contributions to further our understanding of the materials' surface composition and oxygen transport properties, and the degradation processes which limit the lifetime of devices based upon them. LEIS is emerging as a useful technique in this regard, as it is uniquely capable of directly analysing the single outer atomic layer of a surface; *i.e.* precisely the gas-solid interface where the oxygen exchange reaction takes place.

On the other hand, the combination of stable isotope (*e.g.* ^{18}O) tracer techniques and SIMS depth profiling is a powerful tool for the study of mass transport processes, offering the possibility of visualising and discriminating between different solid state diffusion pathways (*e.g.* fast grain boundary diffusion *versus* bulk diffusion) and reaction sites.

In this talk, we will explore how recent instrumental developments and analytical approaches have boosted the application of these powerful techniques for the characterization of surfaces and interfaces in energy conversion and storage devices. The insight gained is helping to advance our theoretical understanding of the electro-catalytic processes and pave the way towards design principles for the development of novel materials with tailored and improved performance.