

Optimising Ion Transport in Ceramics for Energy Conversion and Storage Applications

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High temperature solid state electrochemical devices for the conversion and storage of energy, such as solid oxide fuel cells and electrolyzers, rely upon the transport of mobile ionic species in both the electrolyte and the electrodes. For volume production of these devices, the fabrication of ceramic oxide materials is the most cost-effective route. It is thus essential to understand how to optimise ion transport within the lattice of the oxide and across, and/or along, the interfaces in the ceramic material.

In this presentation we will see how to optimise oxygen ion transport in materials for Solid Oxide Cells (SOCs) by considering the two important parts. First we will take a historical perspective and we will examine the optimisation of lattice transport by examination of the example of the fluorite structured electrolyte materials and the perovskite structured electrolyte and electrode materials. This will include an examination of optimum substitution strategies to promote mobile lattice defects and how this has been developed over the years. Second, we will then look at the effect of interfaces on ion transport, in particular grain boundaries, how they can have a detrimental effect on overall transport rates in ceramic electrolytes and how they can be used to boost the performance of selected electrode materials.