

Exploring diffusion mechanisms in oxide-ionic conductive single crystals

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The development of efficient and cost-effective solid oxide fuel cells (SOFCs) will allow hydrogen or other low-carbon fuels to replace hydrocarbon fuels in commercial energy-generation applications. A wide variety of oxide structure classes are being explored in an effort to discover SOFC electrolyte and electrode materials with competitive ionic conductivity in the “intermediate” temperature range (450-600 °C). In order to rationally design and tune these materials for better performance, a clear understanding of the causes and mechanisms of ionic conductivity in the most promising materials is essential.

Our work utilises a combination of experimental and theoretical methods to investigate the structural and dynamic origins of oxide ion mobility in diverse solid oxide materials. We have used the optical floating-zone furnace facility recently installed at Durham University to grow single crystals of conductive scheelites ($\text{CeNb}_{1-x}\text{M}_x\text{O}_{4+\delta}$ and $\text{LaNb}_{1-x}\text{M}_x\text{O}_{4+\delta}$, $\text{M} = \text{V}, \text{Mo}, \text{W}$), apatites ($(\text{La}, \text{Bi})_{9.33+x}\text{Si}_6\text{O}_{26\pm\delta}$) and “hybrid” hexagonal perovskites ($\text{Ba}_3\text{NbMO}_{8.5}$, $\text{M} = \text{Mo}, \text{W}$), in many cases for the first time. These crystals have enabled a variety of experiments to be performed, including single-crystal x-ray and neutron diffraction, directional quasielastic neutron scattering, and oriented ^{18}O tracer diffusion measurements. Our poster will present new insights obtained from these studies concerning the roles of ionic order and disorder, interstitial site behaviour, low-energy diffusion pathways, and cation coordination environments on efficient ionic conductivity in some of the mentioned materials.

Level of Expertise

Early Career <5 Years since PdD

Do you wish to take part in the poster slam

No

Travel Funding

No

Speakers Gender

Female

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