Contribution ID: **12** Type: **Poster**

The Search for an Improved SOFC Electrolyte Material: Stabilizing the Fm3¯m Phase of Bismuth Oxide to Lower Temperatures

Monday, 11 November 2019 17:00 (1 hour)

SOFCs have emerged as a leading candidate in the search for an efficient and environmentally friendly source of electrical energy.[1-7] SOFCs are, however, marred by a variety of limitations[1,4,6] which have prevented the widespread commercialization of this technology. Most of these limitations stem from the high operating temperature (typically 800-1000 ℃) that is associated with these cells – a feature dictated by the electrolyte material. As such, there exists a need for an improved electrolyte; a material that will display high oxide ion conduction at substantially lower temperatures. One such candidate is the Fm¯3m-structured δ-polymorph of Bi2O3 – the highest known oxide ion conductor. Normally only stable within a high and narrow temperature range (730-824 ℃),[1] this cubic polymorph has been exclusively studied in this work with the primary aim of stabilizing the δ-polymorph structure to lower temperatures by means of yttrium doping. These attempts have been successful; various YxBi2-xO3 members have been found to display the Fm¯3m structure at room temperature. Detailed structural analyses, enabled by synchrotron-based experiments, coupled with ionic conductivity and thermal expansion studies enable the establishment of preliminary material-specific structure-property relationships that allow for the overall suitability of these materials as SOFC electrolytes to be assessed.

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Session Classification: Poster Session 1

Track Classification: Materials