Poster

Anisotropy of Oxide Ion Conductors

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The design of efficient, low temperature solid oxide fuel cells is necessary to achieve carbon free energy generation and relies on oxide ion conductors to act as the electrolytes. Commercially available fuel cells use yttria-stabilized zirconia and gadolinium-doped ceria as electrolytes which have desirable conductivities, however, require operating temperatures between 700 °C and 1000 °C, making them impractical for small scale applications. This has created a drive for intermediate and low temperature oxide ion conductors. One oxide ion conductor is hexagonal perovskite related material $Ba_7Nb_4MoO_{20}$, reported to have a bulk conductivity of 3.1 mS cm^{-1} at 600 °C [1]. $Ba_7Nb_4MoO_{20}$ is best described as an intergrowth of 12R perovskite and palmierite layers (see Fig. 1), forming a 7H perovskite with empty cation sites. Substitution of the Nb^{5+} cation with Ta^{5+}, Cr^{6+}, W^{6+}, and Mo^{6+} cations has increased the oxide ion conductivity, with $Ba_7Nb_{3.8}Mo_{1.2}O_{20.1}$ giving the highest known bulk conductivity of this structure type, 10 mS cm^{-1} at 593 °C [2]. The oxide ion conductivity is mostly anisotropic, and conduction occurs between the O1 and O2 sites in the c' layer.[3] Synthesis of La and V doped materials has been carried out to explore if doping the Mo^{6+} site with V^{5+} can create a more three-dimensional pathway. The rotation flexibility of the VO^{3-} tetrahedra should encourage O3 to O1 oxide ion migration, aiming to increase the three dimensionality of the conductivity by opening three-dimensional ionic hopping pathways.

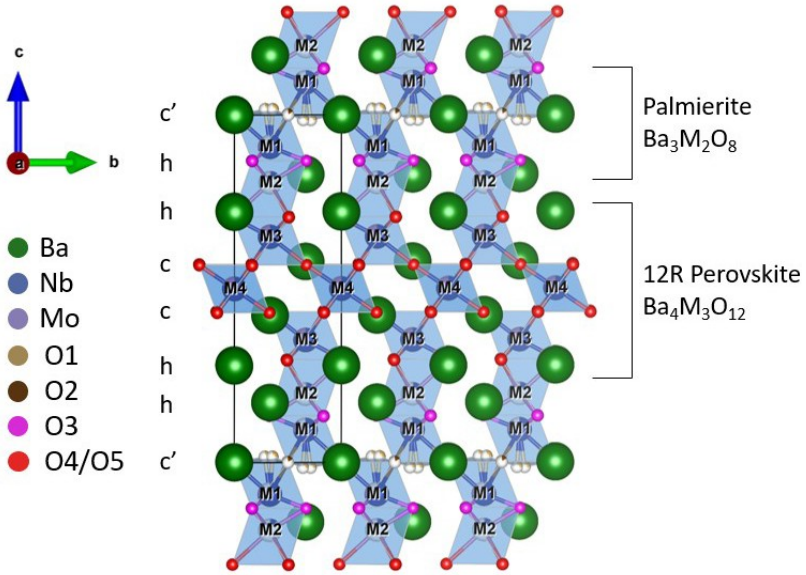

Figure 1. The structure of $Ba_7Nb_4MoO_{20}$, reported by Fop et al. [1].

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[2] Sakuda, Y., Murakami, T., Avdeev, M., Fujii, K., Yasui, Y., Hester, J. R., Hagihala, M., Yoichi, I., Nambu, Y., Yashima, M. (2023). *Chem. Mater.,* **35**, 9774.

[3] Schwaighofer, B., Appel, M., Angel Gonzalez, M. & Radosavljevic Evans, I. (2024). *Mater. Adv,.* **5,** 1676-1682

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