Cycling stability, interfacial impedance, and ionic transport characterization of garnet ceramic electrolyte membranes

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The purpose of this work is to develop bulk ceramic electrolyte technology to enable new Li battery technologies. The ceramic electrolyte is based on the garnet structure, with the nominal formula $Li_7La_3Zr_2O_{12}$, exhibiting the unique combination of: i) electrochemical stability between 0-6 V vs Li/Li^+, ii) 1mS/cm conductivity at 298K, and iii) stability in air. While this electrolyte shows promise, there have been few studies that investigate DC Li transport and interfacial phenomena when coupled with metallic Li anodes. The data will include complex impedance analysis to characterize interfacial resistance, cyclic voltammetry, DC polarization and temperature dependent transport measurements. Pre and post cycling X-Ray diffraction and electron microscopy data will also be presented.

This work builds upon recent work to optimize the garnet formulation(s) for maximum conductivity including various doping approaches [1, 2]. Efforts to prepare low porosity robust membranes will also be discussed in the context of correlating microstructural parameters with electrochemical and mechanical stability [3,4]. Additionally, ultrahigh electrochemical impedance spectroscopy data (1 GHz – 1Hz) was conducted to resolve the lattice and grain boundary transport in high density (>98%) garnet membranes [5]. Essentially, this presentation will discuss fundamental and applied aspects to provide a preliminary assessment for the feasibility of garnet electrolyte membranes for use in advanced Li battery technology.

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