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Proton Transport in Mixed Rare-Earth/Alkaline Earth Metaphosphate Glasses[1] GABRIEL HARLEY, UC Berkeley/Lawerence Berkeley National Laboratory/Max Planck Institute (FKF), LUTGARD C. DE JONGHE, UC Berkeley/Lawerence Berkeley National Laboratory — The transport properties of $[La_{(1-x)}M_x]$-P_3O_9 metaphosphate glasses, where M_x is Ba, Sr, Ca, and $0 \leq x \leq 0.8$ were investigated in the 300 – 500 $^\circ$C range. Protons are found to be incorporated as charge compensation for the substituting divalent cation. A model for proton conduction in phosphate glasses is presented where aliovalent cations within the phosphate network act as trapping sites for protons. Protons are transported via trapping center to trapping center along phosphate tetrahedra. The diffusion of protons is found to be between $\sim 10^{-8}$ cm^2/s and $\sim 10^{-6}$ cm^2/s in the 300-500 $^\circ$C range. The conductivity increases two orders of magnitude from the unsubstituted to the 60% substituted glass reaching a maximum conductivity of $\sim 10^{-6}$ S/cm at 450 $^\circ$C. The average transport distance between proton centers predicted by the electrical analysis is on the order of tens of nanometers, which is the same magnitude of proton-proton distance calculated from the structural data. The activation energy is found to be independent of concentration though dependant on modifying substitutional cation, and increases from 0.92 eV for Ba to 1.02 for Sr.

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Gabriel Harley
UC Berkeley/LBNL

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