Thermomigration kinetics: A novel method to determine the heat-of-transport and chemical diffusivity of a mixed ionic electronic conductor compound

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The kinetics of nonstoichiometry(\(\delta\)) thermomigration in a mixed ionic electronic conductor compound, e.g., \(\text{CaTiO}_3\) has been solved analytically in closed form over the entire time span for the first time ever, and thereby the temporal variations of the measurable ionic and electronic thermo-voltages. This allows one to determine the chemical diffusivity (\(D_0\)) of the mobile chemical component, say, O, and its heat-of-transport(\(q_0^*\)) governing the thermotransport under a temperature gradient more simply, easily and quickly compared to the conventional relaxation method and Soret-equilibrium method for \(D_0\) and \(q_0^*\), respectively.

Analytic solution of the transient thermomigration by the Laplace-transform method is introduced, and its validity and workability demonstrated by measuring \(D_0\) on a known system and comparing with those as measured conventionally. Finally, the novel method is applied to determine \(q_0^*\) on a prototype mixed conductor oxide, \(\text{CaTi}_{0.90}\text{Sc}_{0.10}\text{O}_{2.95+\delta}\) against oxygen activity at a fixed temperature.