

Mechanistic Investigation of Densification and Na-ion Transport in Cold Sintered and Conventional Sintered Mg-doped NASICON-type Solid Electrolyte

Tuesday, 1 September 2026 18:10 (20 minutes)

Cold sintering processing (CSP) has emerged as a promising route for densifying ceramic solid electrolytes (SEs) at significantly reduced temperatures. Assisted by a transient liquid phase (acetic acid), CSP promotes dissolution–reprecipitation-driven particle rearrangement, leading to intimate grain contact and refined microstructures. However, the fundamental densification mechanism and its impact on grain-boundary conduction remain poorly understood. In this study, Mg-doped $\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{12}$ (NMZSP) prepared via CSP followed by annealing is systematically compared with conventionally sintered counterparts. Cylindrical pellets were fabricated by CSP with post-annealing at 600–1175 °C and by conventional sintering at 600–1250 °C. Phase evolution was analysed by X-ray diffraction with Rietveld refinement to quantify lattice parameters and phase fractions. Microstructural development and densification were examined using scanning electron microscopy. Electrochemical impedance spectroscopy was employed to separate bulk and grain-boundary contributions and to evaluate their temperature dependence. The variation of bulk and grain boundary resistances with annealing temperature reveals a strong coupling between transient-phase-assisted densification, grain boundary chemistry, and Na-ion transport. This work establishes a processing–structure–transport relationship, providing insight into low-temperature fabrication strategies for high-performance NASICON SE.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

Journal of the European Ceramic Society (Elsevier)

Invitation letter for visa

Yes

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Session Classification: Poster Session

Track Classification: Group 2: Cold sintering