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Reactive ultra-fast high temperature sintering of oxide electrolytes for all-solid-state batteries

Ultra-fast high temperature sintering (UHS) has recently emerged as a promising approach for the densification of ceramic materials, offering significantly reduced processing times and energy consumption as compared to conventional sintering routes. In this work, reactive UHS of oxide solid electrolytes is investigated, with particular focus on Al and Ta-doped $Li_7La_3Zr_2O_{12}$ (LLZO).
Reactive UHS is performed on the pelletized mixed oxide precursor powder uniaxially pressed at 240 MPa. For UHS, currents are applied in the range of 13-19 A using a homemade UHS setup. Special attention is given to the influence of current, heating rate, and dwell time on the phase formation, microstructure and ionic conductivity. A clear increase in relative density with increasing current is observed with values up to ~98%. X-ray diffraction confirms the formation of cubic LLZO phase with samples exhibiting ionic conductivities up to 0.5 mS cm^{-1} at room temperature. Like conventional sintering routes, a tradeoff is observed. Low currents lead to incomplete reactions, while higher currents promote lithium volatilization and secondary phases. Overall, the results demonstrate that reactive UHS enables rapid synthesis (in 30 s) of cubic LLZO while simultaneously highlighting need for improved process control to enhance reproducibility and mitigate lithium loss. Future work includes reactive sintering of thin LLZO tapes as well as the simultaneous sintering of multiple samples.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

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