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Field-assisted sintering of NaSICON-type NZSP solid-state electrolyte for all-solid-state batteries in decentralized energy storage

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Energy storage remains a key factor in the successful transition from carbon-intensive to renewable energy sources. However, the high cost and limited availability of lithium and cobalt accelerate research into cost-effective alternatives. Sodium-ion all-solid-state batteries, particularly those based on sodium superionic conductor (NaSICON) electrolytes, are promising candidates for next-generation energy storage. This work aims to develop an all-solid-state sodium-based battery for decentralized energy storage, offering a cost-effective and safer alternative to liquid-electrolyte battery technologies. Therefore, NaSICON-type powder with the chemical formula $Na_3Zr_2Si_2PO_{12}$ (NZSP) is synthesized using planetary ball milling followed by a calcination process. The milled powder is characterized in detail and further densified using field-assisted sintering to overcome the limitations of conventional sintering. The limitations include secondary-phase formation and insufficient densification, which promote dendrite growth and compromise battery safety and cycle life. A systematic study of sintering parameters, including temperature, heating rate, dwell time and applied pressure, is conducted to improve density, phase purity and ionic conductivity (targeting ~10^{-3} $S \cdot cm^{-1}$). As a result sintering curves, surface morphologies, phase compositions and Nyquist plots are presented. The solid electrolyte is subsequently combined with a novel composite cathode and the hard carbon anode.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

No interest

Invitation letter for visa

No

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