

MS14-1-7 Sintering and surface treatments for fabrication of $\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{12}$ NASICON solid electrolyte for sodium-metal solid-state batteries

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Abstract

Factors such as the growing number of electric cars and the need to balance the demand and supply of energy related to the constantly increasing share of renewable energy sources make energy storage a very important issue. Currently, the most common electrochemical energy storage technology is Li-ion cells, but due to the growing requirements for energy density, price and availability, new, more efficient solutions are sought. All-solid-state sodium metal batteries (Na-ASSB) may be the answer to these challenges. The use of a solid electrolyte should reduce the possibility of sodium dendrite build-up, and the use of a metallic anode will allow for high energy density. The basic element of this type of cell is a dense ceramic electrolyte with a high mobility of sodium ions, which forms a barrier to growth of dendrites. Good contact between the electrolyte and electrodes is also essential, ensuring a low resistance to charge transfer through the interface.

This work demonstrates the influence of synthesis conditions on properties of $\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{12}$ - a solid electrolyte for Na-ASSB. The influence of temperature, sintering time and sodium excess on the phase composition of NASICON was investigated using the X-ray diffraction method.

In order to improve the contact of the electrolyte with the electrodes, three methods of electrolyte surface modification were used: mechanical (controlling surface roughness), thermal (heat treatment in an inert atmosphere) and chemical (hydrochloric acid or sodium hydroxide etching). The influence of the applied modifications were investigated using Raman, Fourier-transform infrared spectroscopy, X-ray photoelectron spectroscopy and scanning electron microscopy. Electrochemical performance and charge transfer resistance through the sodium metal electrode/electrolyte interface was determined in a symmetrical Na|NZSP|Na cell and evaluated using galvanostatic and impedance spectroscopy methods.

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