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Influence of Nb^{5+}, Ti^{4+}, Y^{3+} and Zn^{2+} doped $Na_3Zr_2Si_2PO_{12}$ solid electrolyte on its conductivity

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ABSTRACT: In this study, $Na_3Zr_{2-x}Nb_{0.8x}Si_2PO_{12}$, $Na_3Zr_{2-x}Ti_xSi_2PO_{12}$, $Na_3Zr_{2-x}Y_xSi_2PO_{12-0.5x}$, $Na_3Zr_{2-x}Zn_xSi_2PO_{12-x}$ ceramics with x=0.1, 0.2, 0.3 and 0.4 were sintered to explore the influence of the valence state and the content of dopants on the conductivity of NASICON solid electrolyte. Archimedes method, X-ray diffraction, scanning electron microcopy and complex impedance spectroscopy were used to characterize the sintered samples. Results show that the dopant with +2 oxidation state cations improves the bulk conductivity mainly due to the less electrostatic interactions between Zn^{2+} ions and Na^+ ions. The optimal doping content of Nb^{5+}, Ti^{4+} and Y^{3+} doped NASICON ceramics is 0.1 mol and that of Zn^{2+} doped NASICON ceramic is 0.2 mol for the highest ionic conductivity. Among all the doped NASICON ceramics, $Na_3Zr_{1.8}Zn_{0.2}Si_2PO_{11.8}$ ceramic displays the highest total conductivity of 1.44×10^{-3} S/cm and bulk conductivity of 3.41×10^{-3} S/cm at room temperature. Furthermore, doping strategy both increases the density and decreases the sintering temperature of $Na_3Zr_2Si_2PO_{12}$ ceramic.

Keywords: $Na_3Zr_2Si_2PO_{12}$; Valence state; Ionic conduction; Dopant

1. Introduction

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