Ionic conduction and dielectric properties of yttrium doped $LiZr_2(PO_4)_3$ obtained by a Pechini-type polymerizable complex route

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ABSTRACT

We report on the ion transport properties of $Li_{1+x}Zr_{2-x}Y_x(PO_4)_3$ ($0.05 \le x \le 0.2$) NASICON type nanocrystalline compounds prepared through a Pechini-type polymerizable complex method. Structural properties were characterized by means of powder X-ray diffraction, Raman spectroscopy and electron microscopy with selected area electron diffraction. Impedance spectroscopy was utilised to investigate the lithium ion transport properties. Y^{3+}doped $LiZr_2(PO_4)_3$ compounds showed stabilized rhombohedral structure with enhanced total ionic conductivity at 30 °C from 2.87×10^{-7} S cm^{-1} to 0.65×10^{-5} S cm^{-1} for x=0.05 to 0.20 respectively. The activation energies of $Li_{1+x}Zr_{2-x}Y_x(PO_4)_3$ show a decreasing trend from 0.45 eV to 0.35 eV with increasing x from 0.05 to 0.20. The total conductivity of these compounds is thermally activated, with activation energies and pre-exponential factors following the Meyer-Neldel rule. The tanδ peak position shifts to the high-frequency side with increasing yttrium content. Scaling in AC conductivity spectra shows that the electrical relaxation mechanisms are independent of temperature.

KEYWORDS:

Lithium ionic conductor; Impedance spectroscopy; Activation energy; AC conductivity; Dielectric properties