 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 ≤ x ≤ 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 $2.87 \times 10^{-7}$ S cm$^{-1}$ to $0.65 \times 10^{-5}$ 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