

PROTON CONDUCTIVITY AND LUMINESCENCE PROPERTIES OF LANTHANIDE AMINOTRIPHOSPHONATES

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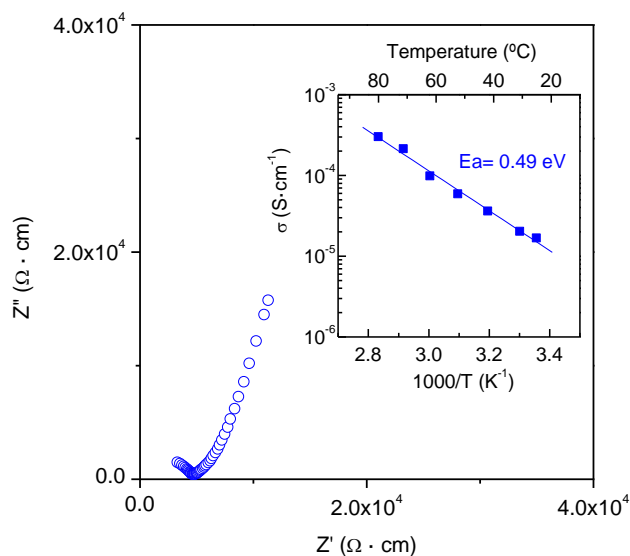
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Metal phosphonates are multifunctional solids with tunable properties, such as internal H-bond networks, and high chemical and thermal stability [1].

In the present work, we describe the synthesis, structural characterization, luminescent properties and proton conduction performance of a new family of isostructural cationic compounds with general formula $[\text{Ln}(\text{H}_4\text{NMP})(\text{H}_2\text{O})_2]\text{Cl}\cdot 2\text{H}_2\text{O}$ [$\text{Ln} = \text{La}^{3+}, \text{Pr}^{3+}, \text{Sm}^{3+}, \text{Gd}^{3+}, \text{Tb}^{3+}, \text{Dy}^{3+}, \text{Ho}^{3+}$, $\text{H}_6\text{NMP} = \text{nitrilotris}(\text{methylphosphonic acid})$]. These solids are formed by positively charge layers, which consist of isolated LnO_8 polyhedra and bridge chelating NMP^{2-} ligands, held apart by chloride ions and water molecules. This arrangement result in extended interlayer hydrogen networks with possible proton transfer pathways.



The proton conductivity of Gd^{3+} sample, selected as prototype of the series, was measured. In the range between range 25° and 80 °C, the conductivity increase with the temperature up to a maximum value of $3 \cdot 10^{-4} \text{ S}\cdot\text{cm}^{-1}$, at relative humidity of 95 %. The activation energy obtained from the Arrhenius plot (Figure 1) is in the range corresponding to a Grotthuss transfer mechanism.

Figure 1: Complex impedance plane plot for Gd^{3+} compound at 70 °C and 95% RH. The inset shows the Arrhenius plot.

References

[1] Ramaswamy, P.; Wong, N. E.; Shimizu, G. K. H. *Chem. Soc. Rev.*, **2014**, 43, 5913–5932.