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Study of Electrical Conductivity of Pr^{3+} Containing Lithium Borate Glasses by Impedance Spectroscopy

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Lithium borate glasses are very interesting to study because of their technological applications in various field. The complexity and functionality of these glasses are defined by boron anomalies and the concentration of the Li ions. Impedance spectroscopy plays a vital role in characterization of these glasses for solid electrolyte applications. An impedance study provides multidimensional electrical and structural information about the conducting glasses. Though lithium borate glasses offer good conductivity, their conductivity performance under the influence of rare earth ions is less known. In the current trend rare earth (RE) oxides are used for a variety of optical applications due to their interesting $4f$ and $5d$ orbitals. Among the RE ions, the Pr ion is of a particular interest, because it gives rise to a number of energy levels. The intention behind the present work is to understand the conductivity behavior of glasses in the presence of Pr^{3+} . In order to comprehend the conduction properties, the glass series was prepared with the general formula $27.5\text{Li}_2\text{O}-(72.5-X)\text{B}_2\text{O}_3-X\text{Pr}_6\text{O}_{11}$ ($X=0.5, 1, 1.5$ and 2) by a melt quench technique. The prepared glasses were analyzed by using the impedance spectroscopy technique. The conductivity of prepared glasses decreases and activation energy increases with increase in Pr^{3+} . The decrease in conductivity is mainly due to the higher molecular weight of Pr^{3+} . To understand the conduction mechanism of these glasses, scaling were performed. The overlapping of the data on the single master curve reveals that the conduction mechanism is compositional dependent. This study demonstrate the role of Pr^{3+} ions on the conducting properties glasses.

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