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Ionic conductivity and dielectric relaxation studies of a low-temperature form of silver zinc phosphate

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Abstract

Polycrystalline α-$AgZnPO_4$ was prepared by the conventional solid-state reaction method.
X-ray diffraction analysis at room temperature indicated the formation of a single phase hexagonal structure (space group $P6_3$). It crystallizes with a structure similar to those of high-temperature $NaCoPO_4$ and $KZnPO_4$. Besides, all vibration modes of tetrahedral PO_4 appeared in the Raman spectrum. Two phase transitions at (438, 462) K were obtained by means of Differential scanning calorimetry (DSC).
Furthermore, the electrical conductivity and the dielectric properties of this material were analyzed by means of the impedance spectroscopy technique, in a frequency ranging from 209 Hz to 1 MHz and temperature range (395–526) K. The phase transition observed in the calorimetric study was confirmed by the σ_{dc} and $f_p$variation as a function of temperature. The conduction mechanism was interpreted by the CBH model in phase I and II and by the NSPT model in the phase III.

Keywords: α-$AgZnPO_4$, X-ray diffraction, Phase transition, Conduction mechanism, Dielectric properties.

1. Introduction

Orthophosphate materials have been the subject of numerous investigations for their excellent electronic, magnetic and optical properties. They are currently exploited in several areas such as glass, ceramic and electrochemical solid matter. Interestingly, compounds with the chemical formula $ABPO_4$ (where A is amonovalent element and B is adivalent element) are useful for many industrial applications such as fuel cells, sensors, bone surgery, luminescence, ceramics, ionic conductors, etc [1, 2]. Generally, these compounds crystallize with different structural types such as spinel, olivine, maricite, and stuffed tridymite [3, 4].