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Structural, Dielectric and Impedance Characteristics of $(Bi0.5Na0.5)TiO_3$-$BaTiO_3$ Electronic System

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ABSTRACT

A lead-free solid solution of two ferroelectrics, bismuth sodium titnate and barium titanate, of a composition Batio0.96($Bi_{0.5}Na_{0.5}TiO_3$)-0.04($BaTiO_3$) (termed as BNT-BT-4) was prepared by a standard low-cost ceramic technology. The phase analysis of the solid solution, carried out using X-ray diffraction pattern, shows a major tetragonal phase and a minor impurity phase at room temperature. The surface morphology of the prepared system showed the formation of the high-density sample with uniform distribution of grains of varying dimensions. The phonon mode statistics, width location and intensity of the peaks were analyzed by Raman spectroscopy. The temperature-frequency dependence of dielectric parameters (permittivity and tangent loss) and AC conductivity were analyzed. The apparent activation energy of BNT-BT-4 was evaluated with help of AC conductivity data. The effect of grain and grain boundary on the capacitive and resistive properties has been studied using an impedance spectroscopy technique. The decrease in the value of grain resistance on rising temperature shows the semiconductor or negative temperature coefficient behavior of the material. Based on an analysis of complex modulus spectrum, the conduction mechanism in the material has been suggested. As BNT-BT-4 shows a remarkable temperature independent relative dielectric properties and low tangent loss, it is a potential candidate for devices.

Keywords: Lead-free ferroelectric, X-ray diffraction, Raman Spectroscopy, Dielectric parameters, Conductivity

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