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Dielectric Study of Lead-Free Double Perovskite Structured Polycrystalline BaFe0.5Nb0.5O3 Material

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Abstract : Material with high value of dielectric constant has application in the electronics devices. Existing lead based materials have issues such as toxicity and problem with synthesis procedure. Double perovskite structured barium iron niobate (BaFe0.5Nb0.5O3, BFN) is the lead-free material, showing a high value of dielectric constant. Origin of high value of the dielectric constant in BFN is not clear. We studied the dielectric behavior of polycrystalline BFN sample over wide temperature and frequency range. A BFN sample synthesis by conventional solid states reaction method and phase pure dens pellet was used for dielectric study. The SEM and TEM study shows the presence of grain and grain boundary region. The dielectric measurement was done between frequency range of 40 Hz to 5 MHz and temperature between 20 K to 500 K. At 500 K temperature and lower frequency, there observed high value of dielectric constant which decreases with increase in frequency. The dipolar relaxation follows non-Debye type polarization with relaxation straight of 3560 at room temperature (300 K). Activation energy calculated from the dielectric and modulus formalism found to be 17.26 meV and 2.74 meV corresponds to the energy required for the motion of Fe3+ and Nb5+ ions within the oxygen octahedra. Our study shows that BFN is the order disorder type ferroelectric material.

Keywords : barium iron niobate, dielectric, ferroelectric, non-Debye
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