$SmCoO_3$ DOPED $(K.Na)NbO_3$ LEAD FREE PIEZOELECTRIC CERAMICS

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Abstract

$(K_{0.5}Na_{0.5})NbO_3$ (KNN) has been considered a promising material for lead-free piezoelectric ceramics because of its high Curie temperature (above 420 ◦C), good ferroelectric properties (Pr =33μC/cm^2), large piezoelectric longitudinal response (d_{33} ~160 pC/N), and high planar coupling coefficient (k_p ~46%).[1,2,3]

An environmental friendly piezoceramic material based on $(K_{0,5}Na_{0,5})NbO_3$ (noted KNN) was prepared by solid state synthesis. In order to increase the quality of the material we used $SmCoO_3$ as a dopant. Recently alkali oxide materials, including potassium sodium niobate, have been given attention in view of their ultrasonic application and also as promising candidates for a piezoelectric non lead-based system[4].X-ray diffraction technique shows that the amount of $SmCoO_3$ changes the perovskite structure from orthorhombic to tetragonal, with small amount of impurities. The obtained materials were mixed with PVA and pressed into disks in order to examine the dielectric behavior. The dielectric measurements (from 100Hz up to 5MHz) were performed with a 42 Hz–5 MHz Programmable Impedance/LRC meter TEGAM model 3550, namely the variation of dielectric constant (ε_r) and dielectric loss (tan δ) at different frequencies. The dielectric constant generally decreases with the increase off frequency. The decreasing behavior of ε_r with the increase in frequency can be explained on the basis of dispersion of polarization with frequency. Dielectric polarization in the material is the sum of total different polarization mechanisms such as: electronic, ionic, dipolar and interfacial polarization [5,6]. The values that we measure for ε_r at 1 KHz are between 812 for low dopped (1% $SmCrO_3$) material and 678 for KNN doped with 5%$SmCrO_3$ at room temperature conditions. In conclusion the addition of $SmCoO_3$ in KNN structure produce a phase transition at room temperature and enhance the value of the real part of the dielectric constant.

References

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