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Ferroelectric Properties of Lead-free Non-stoichiometric $Bi_{0.5+x}(Na_{0.78}K_{0.22})_{0.5-3x}TiO_3$ Ceramics for Energy Conversion

Jeong Ho Cho
Korea Institute of Ceramics Engineering and Technology, Korea

In order to create A-site vacancy, lead-free $Bi_{0.5+x}(Na_{0.78}K_{0.22})_{0.5-3x}TiO_3$ ceramics were synthesized by a conventional solid state reaction method.

In this paper, we investigated the dielectric and electrical properties of $Bi_{0.5+x}(Na_{0.78}K_{0.22})_{0.5-3x}TiO_3$ ceramics with an excess $Bi^{3+}$and a deficiency of Na^+ and K^+. The structure and morphology of $Bi_{0.5+x}(Na_{0.78}K_{0.22})_{0.5-3x}TiO_3$ ceramics were characterized by X-ray diffraction and field emission scanning electron microscopy. Also the temperature dependent dielectric constant and loss and the electric field dependent polarization and strain were measured.

From these results, it is found that an antiferroelectric phase can be induced through a modulation of the mole ratio of Bi^{3+}, Na^+ and K^+. A phase boundary between ferroelectric and antiferroelectric phases can be observed at ambient temperature. The antiferroelectric phase can be induced to the ferroelectric phase by an applied electric field. The stability of the induced ferroelectric phases strongly depends on the mole ratio of Bi^{3+}, Na^+ and K^+. A recoverable strain of 0.33% was achieved in $Bi_{0.5+x}(Na_{0.78}K_{0.22})_{0.5-3x}TiO_3$ ceramics.