

Effect of $\text{Bi}_{3.99}\text{Ti}_{2.97}\text{Nb}_{0.03}\text{O}_{12}$ Addition on Dielectric and Ferroelectric Properties of PZT Ceramics

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In this study, bismuth niobium titanate $\text{Bi}_{3.99}\text{Ti}_{2.97}\text{Nb}_{0.03}\text{O}_{12}$; BNbT which is known as a bi-layer structured ferroelectric material was added into lead zirconate titanate ($\text{Pb}(\text{Zr}_{0.52}\text{Ti}_{0.48})\text{O}_3$; PZT). The ceramic with formula $(1-x)\text{PZT}-x\text{BNbT}$ ($x = 0.03, 0.05, 0.07, 0.15$ and 0.20) were prepared by a solid state mixed oxide method. Phase analysis using XRD indicated that the pattern of the ceramic showed the single phase tetragonal of PZT, however, a BNbT peak appeared as BNbT content ($x = 0.20$) was increased. The microstructure of ceramic $x = 0.03$ – 0.15 had an equiaxed grain. With the addition of BNbT up to 0.20BNbT , the SEM micrographs also showed that plate-shaped grains started to dominate. The $0.97\text{PZT}-0.03\text{BNbT}$ ceramic showed the maximum dielectric constant ($\epsilon_r \sim 679$). With increasing amount of BNbT content, the dielectric constant and dielectric loss tangent gradually decreased. An addition, small amounts of BNbT content could improve normalized polarization ($P_r \sim 14.97 \mu\text{C}/\text{cm}^2$) of the ceramic.

Keywords Doped-bismuth titanate; dielectric properties; ferroelectric properties; PZT-BNbT

Introduction

Lead zirconate titanate, $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ (PZT), having a perovskite-type structure, is an important ferroelectric materials for many applications such as, capacitors, actuators, sensors and transducers because of their excellent dielectric, piezoelectric and pyroelectric properties [1–3]. Recently, PZT and their solid solution have been investigated, especially on the morphotropic phase boundary (MPB) compositions with Zr/Ti ratios of 52/48 because of their enhanced electrical properties [3–5]. However, PZT still suffers from several problems, particularly severe polarization fatigue after switching pulses [6–8]. Many researchers have extensively studied on how to improve the properties of PZT with elemental and compound substitutions [9–11]. Bismuth titanate, $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ (BIT) has bismuth-layered structure ferroelectrics which are thought to be a promising lead-free ferroelectric oxide material for device applications. It has attracted much attention for

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