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Comparative study on structure, dielectric, and piezoelectric properties of $(\text{Na}_{0.47}\text{Bi}_{0.47}\text{Ba}_{0.06})_{0.95}\text{A}_{0.05}\text{TiO}_3$ ($\text{A}=\text{Ca}^{2+}/\text{Sr}^{2+}$) ceramics: effect of radii of A-site cations

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Abstract

Lead-free ceramics $(\text{Na}_{0.47}\text{Bi}_{0.47}\text{Ba}_{0.06})\text{TiO}_3$, $(\text{Na}_{0.47}\text{Bi}_{0.47}\text{Ba}_{0.06})_{0.95}\text{Ca}_{0.05}\text{TiO}_3$, and $(\text{Na}_{0.47}\text{Bi}_{0.47}\text{Ba}_{0.06})_{0.95}\text{Sr}_{0.05}\text{TiO}_3$ (BNBT, BNBT-Ca, and BNBT-Sr, respectively) were obtained via solid-state sintering. Due to the different radii between Ca^{2+} and Sr^{2+} , the mean radii of the A-site cations in BNBT-Ca, BNBT, and BNBT-Sr are different. Effects of radii of the A-site cations on crystallite structure, microstructure, piezoelectric, and dielectric properties of the ceramics were investigated comparatively. X-ray diffraction and Raman spectroscopy results reveal the lattice distortion due to the doping. With the increase in the mean radii of the A-site cations, lattice parameters, tolerance factor, band-gap energy, average size of grains, dielectric constant, and piezoelectric constant of the ceramics increase. The results imply that structure and electrical properties of BNBT-based ceramics are associated with radii of the A-site cations, which provides a possible route to tune structure and electrical properties of BNBT-based materials by changing radii of the A-site cations.

Keywords: Ceramic; Microstructure; Dielectric properties; Piezoelectric properties

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