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PROCEEDINGS

Size Dependent Structures and Properties of $Na_{0.5}Bi_{0.5}TiO_3$-Based Ceramics for Piezoelectric Sensors

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ABSTRACT

Generally, film dielectric materials often exhibit size-dependent structure and electric properties. In this work, we demonstrate a similar behavior in bulk $Na_{0.5}Bi_{0.5}TiO_3$ (NBT)-based polycrystalline ceramics. According to the results from X-ray diffraction, the $(Na_{0.5}Bi_{0.5})_{0.92}Ba_{0.08}Ti_{0.99}Mg_{0.01}O_{2.99}$ (NBT8M1.0) ceramic showed a complex structure that consists of rhombohedral, tetragonal and cubic symmetries. We found, when decreasing the thickness of a ϕ 10 mm NBT8M1.0 ceramic from 1230 μm to 230 μm, the ceramic showed increased content of cubic symmetry (CC) from 28% to 56%. Meanwhile, the piezoelectric response (d_{33}) increased from 107 pC/N to 134 pC/N and the depolarization temperature (T_d) decreased from 170 ℃ to 142 ℃. Similarly, when decreasing the diameter of a 1 mm thick NBT8M1.0 ceramic from ϕ 22 mm to ϕ 6 mm, the ceramic showed increased CC from 18% to 44%. Meanwhile, the d_{33} increased from 125 pC/N to 135 pC/N and the T_d decreased from 165 ℃ to 156 ℃. The origin of size-dependent structure and properties in macroscopic size range of NBT8M1.0 ceramics were further studied by investigating the difference of the size-dependence between the ceramics sintered from green bodies prepared by uniaxial pressing and isostatic pressing. The results demonstrated that the size-dependent structure and properties of NBT-based polycrystalline ceramics are closely related to the residual stress from the inhomogeneous densification during sintering process, as a result of the inhomogeneous density distribution in the pressed green body.

KEYWORDS

Size-dependence; piezoelectric ceramics; $Na_{0.5}Bi_{0.5}TiO_3$; inhomogeneous densification

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Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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