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Stress and electric-field dependence of the induced phase symmetry in BNT-xBT

The solid solution system Bi1/2Na1/2TiO3 – xBaTiO3 (BNT-BT) has attracted wide research interest in the scientific community as a potential high-strain lead-free piezoelectric material. The electro-mechanical coupling mechanisms in a series of BNT-BT solid solutions with the BT content ranging from 5 mol% to 8 mol% in 0.25 mol% steps have been studied using in situ high-energy synchrotron x-ray diffraction (XRD). Unipolar stress cycling with a maximum stress ~600 MPa, and bipolar electric-field cycling with maximum field of 5 kV/mm were applied in two separate experiments. In the initial state, the BNT-xBT series exhibited a region of pseudo-cubic symmetry between x~5-8. During application of both stress and electric field, lower BT content samples (x < 5.25) tended to transform to rhombohedral symmetry, while higher BT content (x > 7.75) tended to go tetragonal. Compositions between these tended to transform to mixed phase symmetry. The results show that the stress and electric-field-induced phase transformation mechanisms are highly analogous in this material system within the range studied here.

Keywords: Piezoelectricity, Diffraction, Strain, Ferroelectric

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