Accepted Manuscript

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PII: S0925-8388(18)30577-2

DOI: 10.1016/j.jallcom.2018.02.132

Reference: JALCOM 45008

To appear in: *Journal of Alloys and Compounds*

Received Date: 13 November 2017

Revised Date: 7 February 2018

Accepted Date: 12 February 2018

Please cite this article as: W. Feng, X. Wang, Z. Cen, B. Luo, Q. Zhao, Z. Shen, L. Li, Enhancement of strain by electrically-induced phase transitions in BNKT-based ceramics, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.02.132.

Enhancement of strain by electrically-induced phase transitions in BNKT-based ceramics

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Abstract

A series of piezoelectric $[Bi_{0.48}(Na_xK_{1-x})_{0.48}Sr_{0.04}](Ti_{0.977}Nb_{0.023})O_3$ (BNKT-Nax, x=0.80-0.88) ceramics were prepared with a pseudocubic phase. Through the selected area electron diffraction (SAED) patterns, it is found that the phase is tetragonal-based when x=0.80. With the increasing of Na, tetragonal-based phase switches to rhombohedral-based phase. The BNKT-Na0.85 ceramic exhibited a giant field-induced strain of 0.45% at 5 kV/mm (900 pm/V). In-situ X-ray diffraction (XRD) and electrical properties examinations were used to identify the main origin of the giant strain and ascertain the evolution of the crystal structure under electric fields. By observing the in-situ XRD of the samples, it can be found that the polar nano-regions orientationally grow along the c-axis and the phase changed from pseudocubic to tetragonal and then from tetragonal to rhombohedral. When removing the field, the phase turned to pseudocubic phase again. The relation between the content of Na and electrical induced phase transitions was further discussed.

Keywords

piezoelectric materials, electrical induced phase transformations, relaxor ferroelectric, BNT-BKT