Author's Accepted Manuscript

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 PII:
 S0272-8842(18)30748-X

 DOI:
 https://doi.org/10.1016/j.ceramint.2018.03.180

 Reference:
 CERI17817

To appear in: Ceramics International

Received date: 10 January 2018 Revised date: 7 March 2018 Accepted date: 20 March 2018

Cite this article as: Han-li Lian, Xiao-jing Shao and Xiao-ming Chen, Structure and electrical properties of Ca²⁺-doped (Na_{0.47}Bi_{0.47}Ba_{0.06})TiO₃ lead-free piezoelectric ceramics, *Ceramics International*, https://doi.org/10.1016/j.ceramint.2018.03.180

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Structure and electrical properties of Ca²⁺-doped (Na_{0.47}Bi_{0.47}Ba_{0.06})TiO₃ lead-free piezoelectric ceramics

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Abstract

The lead-free piezoelectric ceramics $(Na_{0.47}Bi_{0.47}Ba_{0.06})_{1-x}Ca_xTiO_3$ (x = 0, 0.01, 0.02, 0.03, 0.05, and 0.08, abbreviated as BNBTC/0, BNBTC/1, BNBTC/2, BNBTC/3, BNBTC/5, and BNBTC/8, respectively) were obtained using the solid-state reaction method. The structure, electric conductivity, and dielectric, ferroelectric, and piezoelectric properties of the Ca²⁺-doped (Na_{0.47}Bi_{0.47}Ba_{0.06})TiO₃ ceramics were thoroughly investigated. The ceramics sintered at 1200 °C exhibit dense microstructures, having relative densities higher than 96%. The X-ray diffraction results demonstrate that all ceramics have a pure perovskite structure. The mean grain sizes of the ceramics are related to the Ca²⁺ quantity. A small quantity of Ca²⁺ ions (x≤0.03) improves the piezoelectric and ferroelectric properties of the samples. The dielectric behavior of the samples is sensitive to the Ca²⁺ content and electric poling. The results demonstrate that the electrical properties of the (Na_{0.47}Bi_{0.47}Ba_{0.06})TiO₃ lead-free ceramics can be well tuned by varying the Ca²⁺ quantity.

Keywords: A. Sintering; B. X-ray methods; C. Dielectric properties; C. Ferroelectric properties.

1. Introduction

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