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C.H. Yang, Y.J. Han, X.S. Sun, J. Chen, J. Qian, L.X. Chen



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Effects of Nd³⁺-substitution for Bi-site on the leakage current, ferroelectric and dielectric properties of Na_{0.5}Bi_{0.5}TiO₃ thin films

C.H. Yang^{a,b,*}, Y.J. Han^a, X.S. Sun^a, J. Chen^{a,b}, J. Qian^a, L.X. Chen^a

^a School of Materials Science and Engineering, University of Jinan, Jinan 250022, China

^b Shandong Provincial Key Laboratory of Preparation and Measurement of Building Materials, University of Jinan, Jinan 250022, China

Abstract

Perovskite Na_{0.5}(Bi_{1-x}Nd_x)_{0.5}TiO₃ (x = 0, 0.01, 0.03, 0.05; xNd: NBT) ferroelectric films were synthesized on indium tin oxide (ITO)/glass substrates via chemical solution deposition. Structural characterization shows the similar phase-pure perovskite structures in all the films and gradually decreased grain sizes with Nd³⁺ doping amount increasing. For all the films, the leakage behaviors are dominant by the Ohmic conduction in low electric field region and interface-limited Fowler-Nordheim tunneling mechanism in high electric field region. Additionally, the space-charge-limited conduction is involved in 0.03Nd: NBT sample. Compared with the sample of x = 0, the resistivity can be improved through Nd³⁺-substitution in NBT. Enhanced ferroelectricity can be obtained from the dynamic polarization-electric field test, and the reversible domains switching in film can be confirmed by static dielectric constant-electric field measurement. Especially, the 0.03Nd: NBT possesses optimal electrical performances with a large remanent polarization ($P_r = 26.7 \mu\text{C}/\text{cm}^2$) and a high dielectric tunability (19.6 % at 100 kHz).

Keywords: Perovskite; Thin film; Cation substitution; Microstructure; Electrical property

* Corresponding author. Tel./fax: +86 531 82767915.

E-mail address: yang_changhong@163.com (C. Yang).

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