FERROELECTRICS
https://doi.org/10.1080/00150193.2022.2034440

Temperature-dependent electrical and magneto-dielectric properties of $0.7Bi_{0.99}Nd_{0.01}Fe_{0.99}(Co, Ti)_{0.01}O_3$-$0.3CaTiO_3$ composite

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ABSTRACT

$0.7Bi_{0.99}Nd_{0.01}Fe_{0.99}(Co, Ti)_{0.01}O_3$-$0.3CaTiO_3$ (BNFCTO-CaTO) composite was prepared by using sol-gel method. The structural formation was investigated using the XRD pattern, which confirms the presence of distorted rhombohedral structure with space group R3c and the superlattice orthorhombic crystal structure with space group Pbmn. The dielectric behavior of BNFCTO-CaTO has been studied within the frequency range of 100 Hz to 1 MHz from 300 K to 773 K. The sample shows dielectric dispersion in low frequency region that can be explained by Maxwell-Wagner type interfacial polarization. The temperature-dependent dielectric plot shows an anomaly near to magnetic transition temperature (T_N) of $BiFeO_3$ and shows relaxor behavior. Furthermore, BNFCTO-CaTO shows a strong magneto-dielectric coupling effect at room temperature.

ARTICLE HISTORY

KEYWORDS
Multiferroics; dielectric constant; polarization; AC conductivity; magneto-dielectric effect

1. Introduction

In recent years, multiferroic materials have brought a lot of attention because of their unique properties like the coexistence of more than one ferroic order parameter such as ferroelectric, ferroelastic, and ferromagnetic/antiferromagnetic in single-phase materials [1,2]. Moreover, these materials give freedom to mutually control the coupling between ferroic order parameters due to the interaction between spin and charge [1]. These materials show very interesting phenomenon called as magnetoelectric (ME) coupling effect, where the magnetization can be switched by an electric field and electric polarization by a suitable magnetic field [2–5]. Hence, these materials are useful for device applications such as sensors, spintronic devices, memory devices etc. [1–4]. Relatively in nature, few single-phase multiferroic materials exist, such as $BiFeO_3$ (BFO), $YMnO_3$, and $TbMnO_3$ etc. due to the chemical incompatibility and mutual exclusiveness of electrical and magnetic ordering and most of them possess very weak ME coupling due to lack of interaction between ferroic order parameters [2–5]. Thus, the search for new multiferroic material with strong ME coupling for device applications still continues.

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