Structural, Electrical and Magnetic properties of rare-earth and transition element co-doped bismuth ferrites

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Abstract

Pure and doped multiferroic samples of bismuth ferrites (BFO) were successfully synthesized by the sol-gel technique. Detailed investigations were made on the influence of (Sm and Mn, Co, Cr) co-doping on structural, electrical, ferroelectric and magnetic properties of the BFO. A structural phase transformation from rhombohedral to orthorhombic with co-doping is confirmed through XRD. It is also observed that Sm-doping increases the symmetry and decreases the second phases noticeably. Microstructure investigation using the scanning electron microscope showed a reduction of grain size with doping in BFO. Magnetic hysteresis loops showed that retentivity (Mr), coercivity (Hc) and saturation magnetization (Ms) of the doped samples were improved. Furthermore, the co-doping enhances the dielectric properties as a result of the reduction in the Fe^{2+} ions and oxygen vacancies. The room temperature P-E loop study shows that ferroelectric properties are strongly depend on doping.

Keywords: Multiferroic; Ferrites; Sol-gel; Structural; Magnetic; Dielectric; Ferroelectric

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1. Introduction

Multiferroic materials that simultaneously show electric and magnetic ordering have been extensively studied in recent years due to their promising multifunctional device applications as well as presenting an interesting fundamental physics [1-3]. $BiFeO_3$ (BFO) is the only single phase material which shows multiferroic phenomenon at room temperature having relatively high ferroelectric Curie temperature (Tc ~ 1103 K) and antiferromagnetic Neel temperature (T_N ~ 643 K)