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Strain driven structural phase transformation and correlation between structural, electronic, and magnetic properties of $Bi_{1-x}Ba_xFeO_3$ ($0 \leq x \leq 0.30$) system

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Abstract:

In this study a series of $Bi_{1-x}Ba_xFeO_3$ $(0 \leq x \leq 0.30)$ multiferroic samples have been prepared and a correlation between structural, electronic and magnetic properties has been drawn. Systematic changes in Mössbauer parameters with Ba^{2+} concentration are observed. Mössbauer spectroscopy results confirmed the presence of Fe^{3+} oxidation state which suggests the presence of oxygen vacancies in the system. Ba^{2+} ion substitution driven structural transition from rhombohedral to cubic symmetry $(R3c \rightarrow Pm\bar{3}m)$ has been confirmed from Rietveld refinement results. It is observed that the $R3c$ and $Pm\bar{3}m$ coexisting phases persists up to $x = 0.30$. This structural transformation leads to enhanced saturation magnetization due to suppression of spiral spin structure. Moreover, we demonstrate that local lattice distortions induced by size mismatch between the host and the dopant and presence of oxygen vacancies produced by aliovalent (Ba^{2+}) doping in $BiFeO_3$ also results in a systematic increase in magnetization by affecting the Fe−O−Fe canting angle. The observed decrease in values of magnetic coercivity at low temperatures is suggested to be indicative of magnetoelectric coupling in these multiferroic samples.

Introduction

Multiferroics materials which show simultaneous ferromagnetism (antiferromagnetism) and ferroelectricity (anti-ferroelectricity) in the same phase have attracted much attention for their practical applications in the emerging field of electromagnetic wave attenuation, spintronics, non-volatile memory devices, sensors and actuators, multistate memories and for their unique

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