

# Structural characterization and magnetic properties of $\text{Bi}_{0.84}\text{La}_{0.16}\text{Fe}_{1-x}\text{Ti}_x\text{O}_3$

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Perovskite-typed bismuth ferrite ( $\text{BiFeO}_3$ ) belonging to the  $R3c$  space group is a multiferroic material exhibiting simultaneously ferroelectric and antiferromagnetic (AFM) properties above room temperature. In spite of having weak-ferromagnetic order due to Dzyaloshinsky-Moriya interactions, cycloid spin structures found in  $\text{BiFeO}_3$  leads to zero net magnetization. It has been found that replacing Bi by a rare-earth or alkaline-earth element, and Fe by a transition metal element can improve remarkably the physical properties of  $\text{BiFeO}_3$ . Dealing with this problem, we prepared  $\text{Bi}_{0.84}\text{La}_{0.16}\text{Fe}_{1-x}\text{Ti}_x\text{O}_3$  (BLFTO) ( $0 \leq x \leq 0.1$ ) compounds and then studied the influence of the Ti doping on their structural and magnetic properties. The BLFTO samples were fabricated by solid-state reaction at 1200 °C in air for 12 h. The structural analyses were based on an X-ray diffractometer, Raman scattering spectroscopy, and the Rietveld method upon the GSAS-II program. Magnetic measurements were performed on a superconducting quantum interference device (SQUID) magnetometer. All of these investigations were carried out at room temperature.

The results of structural analyses indicated a gradual change from the rhombohedral structure to tetragonal one along with the shrink of lattice volume when the Ti-doping concentration increases. This is in good agreement with the variation tendency of Raman scattering spectra, and with the results obtained from Rietveld refinement, indicating the decrease of structural distortion with increasing Ti content. Particularly, magnetization measurements revealed a magnetic phase separation with the coexistence of AFM and ferromagnetic (FM) phases. While AFM interactions are predominant in the samples  $x = 0, 0.04$  and  $0.06$ , the others show the domination of the FM interactions. These are related to the structural changes of the rhombohedral and tetragonal phases in BLFTO. According to the results of Rietveld refinement, we found that the AFM phase is mainly from the rhombohedral phase. The change from the AFM to FM phases can be explained to be due to the rotation of oxygen in the octahedron, and the change of the bonding angle Fe-O-Fe in the rhombohedral structure.