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Stabilization of α -BiFeO₃ structure by Sr²⁺ and its effect on multiferroic properties

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Abstract

We report a study on the effect of the substitution of Bi³⁺ by Sr²⁺ on the stabilization of *R3c* structure of Bi_{1-x}Sr_xFeO₃ ($0 \leq x \leq 0.3$, $\Delta x = 0.05$), and its effect in the magnetic and dielectric behavior. Stoichiometric mixtures of Bi₂O₃, Fe₂O₃ and SrO were mixed and milled for 5 h using a ball to powder weight ratio of 10:1 by high-energy ball milling. The obtained powder were pressed at 900 MPa to obtain cylindrical pellets and sintered at 800°C for 2 h. X-ray diffraction and Rietveld refinement were used to evaluate the effect of Sr²⁺ on the crystal structure. In addition, vibrating sample magnetometry (VSM) and dielectric tests were used for describing the multiferroic behavior. The results show that Sr-doped BiFeO₃ particles present rhombohedral structure (*R3c*) characteristic of α -BiFeO₃ when the doping is below 0.10 mol of Sr. Additionally, a gradual decrease in the amount of secondary phases with the increase of the amount of strontium is observed. For doping concentration higher than 0.15 mol of Sr, a phase transition to an orthorhombic symmetry (β -BiFeO₃, *Pbnm*) is detected. Besides, changes in relative intensities of reflection peaks planes (110) and (104) are associated with the phase transformations and with the magnetic and dielectric behavior. The α -BiFeO₃ phase show antiferromagnetic behavior and high values of dielectric permittivity, whereas the β -BiFeO₃ phase show a ferromagnetic behavior and low dielectric permittivity.

Keywords: Bismuth ferrite; strontium doped BiFeO₃; multiferroic; high-energy ball milling; mechanochemical processing.

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