

Temperatūrinės ir dažninės $\text{Bi}_{1-x}\text{La}_x\text{FeO}_3$ elektrinių savybių ypatybės

Temperature and Frequency Dependent Electrical Properties of $\text{Bi}_{1-x}\text{La}_x\text{FeO}_3$

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Bismuth ferrite doped with lanthanum is a perspective multiferroic material for application in electronics and spintronics [1]. The synthesis, structure, valency, dielectric, magnetic and optical properties have been already analysed and reported [2-5], but still remains the lack of the investigation of the electrical properties at different temperatures and frequencies.

Ceramic samples of $\text{Bi}_{1-x}\text{La}_x\text{FeO}_3$ ($x=0.10$, $x=0.15$, $x=0.20$) were sintered by rapid liquid-phase sintering (RLS) method [1,2]). The hexagonal $R3c$ (ICDD: 98-001-5299) perovskite structure was reported by XRD measurements [3].

The electrical properties of $\text{Bi}_{1-x}\text{La}_x\text{FeO}_3$ were investigated by the method of the impedance spectroscopy. The measurements of the sintered ceramics were performed in the frequency range of 10 Hz – 3 GHz and 300-800 K temperature interval.

All the conductivity values were taken from the Arrhenius representation. The total conductivity value is $2.47 \cdot 10^{-7}$ S/m for $\text{Bi}_{0.85}\text{La}_{0.15}\text{FeO}_3$ and $1.22 \cdot 10^{-7}$ S/m for $\text{Bi}_{0.8}\text{La}_{0.2}\text{FeO}_3$ at 500 K on the heating stage. Activation energies remain almost the same in all temperature ranges and are about 1.12-1.15 eV with possible tenuous transition point and insignificant inflection at 640 K for both compounds. The total conductivity value of $\text{Bi}_{0.9}\text{La}_{0.1}\text{FeO}_3$ is $6.22 \cdot 10^{-8}$ S/m at 500 K on the heating stage. Activation energy decreases from 1.34 eV to 1.15 eV at about 660 K temperature point. Inflection is slightly more apparent and conductivity value is smaller than that of the samples with higher concentration of lanthanum. On the cooling stage all the electrical characteristics tends to become almost the straight-line type on the Arrhenius representation plane.

The dielectric permittivity values are 14.0 for $\text{Bi}_{0.9}\text{La}_{0.1}\text{FeO}_3$, 13.2 for $\text{Bi}_{0.85}\text{La}_{0.15}\text{FeO}_3$ and 14.7 for $\text{Bi}_{0.8}\text{La}_{0.2}\text{FeO}_3$ at 300 K temperature and 1 GHz frequency.

Keywords: ceramics, multiferroic, ionic conductivity, impedance spectroscopy.

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