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Composition, structure and dielectric properties of multifunctional single-phase $Bi_{1-x}La_xFeO_3$ ceramics

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Composition, structure, microstructure and dielectric properties of the $Bi_{1-x}La_xFeO_{3-\delta}$ multiferroics were studied by the methods of X-ray diffraction, thermogravimetric analysis, scanning electron microscopy and dielectric spectroscopy. Ceramic samples of the $Bi_{1-x}La_xFeO_{3-\delta}$ (x = 0, 0.1, 0.3 and 0.5) were prepared by the rapid liquid-phase sintering method. According to the X-ray data the single-phase $Bi_{1-x}La_xFeO_{3-\delta}$ ceramics have rhombohedral type of crystal structure distortion with changing of lattice parameters and space group from $R3m$ ($x = 0$) to $R3c$ ($x = 0.1$), $R3m$ ($x = 0.3$) and $Pnma$ ($x = 0.5$). Molar formulas of a real structure Bi1-$_x$La$_x$FeO$_{3-\delta}$ have been determined. The real crystal structure is defective and contains anionic $V^{(a)}$ and cationic $V^{(c)}$ vacancies. SEM investigations data have confirmed chemical composition of $Bi_{1-x}La_xFeO_{3-\delta}$. The microstructure of $Bi_{1-x}La_xFeO_{3-\delta}$ consists of crystallites which size decreases from 10 to 1 μm with the growth of the concentration x from 0 to 0.5. An analysis of the relative permittivity ε(f) and dielectric loss tangent tan$\delta(f)$ frequency dependencies in the low frequency $f = 1\text{-}10^6$ Hz and microwave $f = 8.24\text{-}12.05$ GHz bands indicates a monotone for $\varepsilon(f)$ and non-monotonic for tan$\delta(f)$ dispersion. The composition $Bi_{0.9}La_{0.1}FeO_3$ has the greatest value of $\varepsilon(1\text{ Hz}) = 5 \bullet 10^5$, which decreases to $\varepsilon(1\text{ MHz}) = 209$ and $\varepsilon(12\text{ GHz}) = 10.5$. The appearance of two peaks on non-monotonic dependencies of the tan$\delta(f)$ is caused by the presence of relaxation polarization processes in the defect structure of $Bi_{1-x}La_xFeO_{3-\delta}$.

Biography

Aleksey Pashchenko is a Doctor of Science at the Phase Transitions Department of the Donetsk Institute for Physics and Engineering named after O.O. Galkin NAS of Ukraine. He has published more than 186 publications, which consist of reputed journals (*Acta Mater., J. Magn. Magn. Mater., J. Alloys Comp., etc.*), books, patents and abstracts. His main research interests are investigation and determination of structure defects of multiferroics, manganites, nanostructures and novel multifunctional materials.

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