METASTABLE PEROVSKITE PHASES - MULTIFERROICS IN THE $BiFeO_3$ - $BiScO_3$ - $LaFeO_3$ - $LaScO_3$ SYSTEM

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Perovskite bismuth ferrite is one of the most studied multiferroics since this compound can be obtained using the conventional preparation methods. $BiFeO_3$ is ferroelectric until T_C=1083 K, while the antiferromagnetic phase transition occurs at T_N=643 K. The temperatures of both transitions are too high and far from each other which makes difficult a beneficial use of the lattice-magnetic coupling effect.

Recently, we initiated a systematic study of the quasi-quadruple $BiFeO_3$–$BiScO_3$–$LaFeO_3$–$LaScO_3$ perovskite system. Three end members of this system, $BiFeO_3$, $LaFeO_3$ and $LaScO_3$, can be obtained using the conventional methods, while a bulk perovskite $BiScO_3$ phase can be synthesized under the high-pressure conditions only. One of the ideas of exploration of the $Bi_{1-x}La_xFe_{1-y}Sc_yO_3$ system is to control the temperatures of the magnetic and the polar transitions. In this system, all the constituent cations are trivalent that makes possible to vary the parameters x and y independently. Hence, one can decrease the temperature of polar transition by means of a replacement of bismuth by lanthanum and decrease the temperature of magnetic transition through an iron-to-scandium substitution. Such substitutions are expected to result in formation of new structural phases.

Single-phase perovskite ceramics of two particular sections of the $Bi_{1-x}La_xFe_{1-y}Sc_yO_3$ system were synthesized under high pressure. In the $BiFe_{1-y}Sc_yO_3$ section, the as-prepared phase in the compositional range of $y\leq0.25$ is the rhombohedral $R3c$ (with the $\sqrt{2}a_p\times\sqrt{2}a_p\times2\sqrt{3}a_p$ superstructure). The orthorhombic $Pnma$ phase ($\sqrt{2}a_p\times4a_p\times2\sqrt{2}a_p$) is observed for $0.30\leq y\leq0.60$, while phase with the y=0.70 composition is the monoclinic $C2/c$ ($\sqrt{6}a_p\times\sqrt{2}a_p\times\sqrt{6}a_p$) [1,2]. In the $Bi_{1-x}La_xFe_{0.5}Sc_{0.5}O_3$ section, the orthorhombic $Pnma$ phase ($\sqrt{2}a_p\times4a_p\times2\sqrt{2}a_p$), an incommensurately modulated phase with the $Imma(00\gamma)s00$ superspace group and the orthorhombic $Pnma$ phase ($\sqrt{2}a_p\times2a_p\times\sqrt{2}a_p$) were associated with the compositional ranges of $x\leq0.05$, $0.10\leq x\leq0.33$, and $x\geq0.34$, respectively [3,4].

Magnetic structures of the obtained metastable perovskite phases determined from the neutron diffraction experiments and the precision magnetic measurements are discussed in terms of coupling between the dipole, magnetic, and elastic order parameters.

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