EFFECT OF La^{3+} SUBSTITUTION ON PHYSICAL PROPERTIES OF $BiFe_{0.85}Mn_{0.15}O_3$

Ramunas Diliautas[1], Aldona Beganskiene[1], Kestutis Mazeika[2], Dalis Baltrunas[2], Dovydas Karoblis[1], Aleksej Zarkov[1], Aivaras Kareiva[1]

[1] Institute of Chemistry, Vilnius University, Naugarduko 24, LT-03225 Vilnius, Lithuania
[2] Center for Physical Sciences and Technology, Vilnius LT-02300, Lithuania
Ramunas.diliautas@chgf.stud.vu.lt

Research in multiferroic type materials dates back to 1950s, but crucial discoveries regarding theory, characterization techniques and synthesis were found in past 15 years. Nowadays, term multiferroic are used to label materials, where ferroelectric order coexists with ferromagnetic, antiferromagnetic or ferromagnetic orders in single or multiphase materials [1]. $BiFeO_3$, $BiMnO_3$ and $RMnO_3$ (where R=Tb, Y, Ho, Lu) are one of the few oxide type materials displaying multiferroicity. Between them $BiFeO_3$ has a ferroelectric Curie temperature $T_C \approx 1100$ K and an antiferromagnetic Neel temperature $T_N \approx 640$ K [2]. Impurities, like $Bi_2Fe_4O_9$ or $Bi_{25}FeO_{39}$ [3], can form when preparing this compound, which result in changes in physical properties, including magnetization. One of the ways to avoid neighboring phase formation is preparing solid solutions, having sufficient amount of $BiFeO_3$.

Due to similarity in valence and ionic radii, La^{3+} can be intercalated in Bi^{3+} and Mn^{3+} can substitute Fe^{3+}. By previous studies it was observed that even small amount of La^{3+} can cause structural changes, increase in dielectric constant and reduction of Curie temperature T_C [4]. On the other hand, Mn^{3+} does not result in changes T_C or ferroelectric properties, but can cause enhancement in magnetization [5].

In this work $Bi_{1-x}La_xFe_{0.85}Mn_{0.15}O_3$ solid solutions with different step sizes were prepared by sol-gel technique using ethlenglycol as complexing agent. Two different temperatures (500 °C and 650 °C) were used for calcination of the gels. Lower temperature demonstrated possible formation of monophasic compounds up to x=0.1 with higher concentrations resulting in formation of impurity phases or amorphous compounds. Calcination at 650 °C temperature did not lead to formation of monophasic $BiFe_{0.85}Mn_{0.15}O_3$, but La^{3+} intercalation lead to formation of pure samples in all compositional range. All samples were characterized by X-ray diffraction, scanning electron microscopy, FT-IR spectroscopy and Mössbauer spectroscopy. Furthermore, magnetization studies were carried out for all compounds.

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