International conference

Functional Inorganic Materials

FIM 2022

Abstract book

VILNIUS UNIVERSITY PRESS

Vilnius University

CENTER FOR PHYSICAL SCIENCES AND TECHNOLOGY

ktu kaunas university of technology

Lithuanian Chemical Society

Investigation of Various Types of Ferrites and Manganites Prepared via Sol-Gel Synthetic Approach

D. Karoblis[1,*], A. Žarkov[1], R. Diliautas[1], K. Mažeika[2], D. Baltrūnas[2], G. Niaura[3], M. Talaikis[4], E. Garškaitė[5], A. Beganskienė[1], A. Kareiva[1]

[1]*Institute of Chemistry, Vilnius University, Naugarduko 24, 03225, Vilnius, Lithuania*
[2]*Center of Physical Sciences and Technology, Sauletekio Ave. 3, 10257, Vilnius, Lithuania*
[3]*Institute of Chemical Physics, Faculty of Physics, Vilnius University, Sauletekio Ave. 3, 10257, Vilnius, Lithuania*
[4]*Department of Bioelectrochemistry and Biospectroscopy, Sauletekio Ave. 7, 10257, Vilnius, Lithuania*
[5]*Wood Science and Engineering, Department of Engineering Sciences and Mathematics, Luleå University of Technology, Forskargatan 1, 931 87, Skellefteå, Sweden*
**Corresponding author, e-mail: Dovydas.karoblis@chgf.vu.lt*

Multiferroics are described as materials with the presence of two or more ferroic orders (such as magnetic, electric or elastic). While both piezoelectrics (where ferroelectricity occurs with ferroelasticity) and piezomagnetics (where ferromagnetism and ferroelasticity coexists) are investigated, the main research focus is on magnetoelectric multiferroics [1]. Out of all multiferroics, the bismuth ferrite ($BiFeO_3$) is considered to be the most prominent one [2]. It displays antiferromagnetic and ferroelectric properties with a strong remnant polarization of ~100 $\mu C/cm^2$ at room temperature [3]. Moreover, bismuth manganite ($BiMnO_3$), yttrium ferrite ($YFeO_3$), yttrium manganite ($YMnO_3$), gadolinium ferrite ($GdFeO_3$) and gadolinium manganite ($GdMnO_3$) have also demonstrated multiferroic properties.

One of the ways to tune the physical properties of the materials is by preparing solid solutions. For this reason few different composition $Y_{1-x}Gd_xFeO_3$ [4], $Y_xGd_{1-x}Mn_{0.97}Fe_{0.03}O_3$ [5] and $Bi_{1-x}Gd_xFe_{0.85}Mn_{0.15}O_3$ solid solutions series were prepared by sol-gel synthesis technique using ethylene glycol and citric acid as complexing agents. For the obtained samples structural, morphological and magnetic properties were investigated with different characterization techniques. It was observed that by varying Gd^{3+} content for $Y_{1-x}Gd_xFeO_3$ samples, the magnetization changed from hysteresis characteristic of $YFeO_3$, to almost linear dependence of magnetization of $GdFeO_3$. With the increasing amount of the Gd^{3+} the crystal structure of $Y_{1-x}Gd_xMn_{0.97}Fe_{0.03}O_3$ gradually transformed from hexagonal to orthorhombic one. While most samples were monophasic, the sample containing 60 mol% of yttrium was mixture between hexagonal and orthorhombic structures. After annealing $Bi_{1-x}Gd_xFe_{0.85}Mn_{0.15}O_3$ compounds at 500 °C temperature, it was seen that only 10 mol% of Gd^{3+} ions can be introduced into the $BiFe_{0.85}Mn_{0.15}O_3$ structure. Heat treatment at higher temperatures (650 and 800 °C) led to formation of solid solutions in the whole compositional range.

References

1. C. Lu, M. Wu, L. Lin, J. M. Liu, Natl. Sci. Rev. **6** (2019, 653-668.
2. N. Wang, X. Luo, L. Han, Z. Zhang, R. Zhang, H. Olin, Y. Yang, Nanomicro Lett. **12(1)** (2020), 1-23.
3. B. Jana, K. Ghosh, K. Rudrapal, P. Gaur, P. K. Shihabudeen, A. Roy Chaudhuri, Front. Phys. (2022), 810.
4. D. Karoblis, A. Zarkov, E. Garskaite, K. Mazeika, D. Baltrunas, G. Niaura, A. Beganskiene, A. Kareiva, Sci. Rep., **11(1)** (2021), 1-14.
5. D. Karoblis, A. Zarkov, K. Mazeika, D. Baltrunas, G. Niaura, A. Beganskiene, A. Kareiva, Solid State Sci. **118** (2021), 106632.