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Synthesis and magnetic properties of $BiFe_{1-x}Co_xO_3$ (x = 0-0.07)

M.V. Kandaurov, A.V. Dmitriev, E.V. Vladimirova

Institute of Solid State Chemistry, Urals Branch of the Russian Academy of Sciences
620990, Ekaterinburg, Russia
mukaejib@gmail.com

In recent years there has been growing interest in multiferroic materials, in particular to bismuth ferrite. $BiFeO_3$ (BFO) exhibit multiferroic properties at room temperature that is leading to prospective applications in various fields (microelectronics, spintronics, medicine, etc.).

The big part of current researches is devoted to BFO magnetic properties. Of particular interest is their enhancing. $BiFeO_3$ is known to be anti-ferromagnetic with a G-type magnetic structure. The decreasing crystallite size leads to the exhibition of soft ferromagnetic behavior due to cycloid canting. However, ferromagnetic behavior can be achieved through the partial substitution of Fe-ions in B-sublattice that is described in large scientific data. Moreover, magnetic properties are strongly connected with the synthesis technique and the morphology of obtained samples.

The purpose of this research consists in the identification of Co-substituted bismuth ferrite samples obtained through such methods as self-combustion (Pechini) and ultrasonic spray-pyrolysis. These methods provide the opportunities of nanostructured $BiFeO_3$ fabrication with a distinct morphology. In particular, the utilizing of ultrasonic spray-pyrolysis leads to the formation of spherical agglomerates with outstanding properties due to the specific interface of particles.

Owing to little data on the Co-doping of BFO B-site Co was chosen as a dopant. Synthesis of single-phase samples was challenging due to the appearance of $Bi_{25}FeO_{40}$, $Bi_2Fe_4O_9$, and $Bi_{13}Fe_{6.5}Co_{6.5}O_{40}$ impurities. To the best of our knowledge the addition of chelating agents can assist in annealing temperature decreasing and uniform dopant distribution. Tartaric acid meets these requirements, thus it was added in ratio 1:1, 2:1, and 3:1 to metals.

Obtained samples constitute the porous spheres of $BiFeO_3$ which is confirmed with SEM and helium pycnometry. Samples exhibit soft ferromagnetic response due to the results of magnetic measurements. The value of remnant magnetization increases with the amount of Co-substitution as well as with the amount of TA used. Moreover, the substantial leap of remnant magnetization is observed for spray-pyrolyzed BFO in comparison to samples obtained through the Pechini method due to lesser crystalline size.

This research was carried out under the financial support of the Russian Foundation for Basic Research №17-08-00893.