STRUCTURAL AND MAGNETIC CHARACTERISTICS OF ANISOTROPIC COMPOSITE MATERIALS BASED ON Y-TYPE HEXAGONAL FERRITES*

V.A. ZHURAVLEV[1], D.V. WAGNER[1], O.A. DOTSENKO[1,2], K.V.DOROZHKIN[1]

[1]*Tomsk State University, Tomsk, Russia*
[2]*Tomsk State University of Control Systems and Radioelectronics, Tomsk, Russia*

Currently, there are many adverse environmental factors in cities. Among them there are electromagnetic emitters, receivers, high-frequency radio equipment, etc. All this entails the development and manufacture of new radio materials that could effectively interact with high-frequency radiation. There are a huge number of articles that are devoted to the study of such materials. The most promising materials for use at high frequencies are composites based on oxide ferrimagnets with hexagonal crystal structures (hexaferrites) [1, 2].

Recently, composites have been widely used instead of solid materials. The reason is that it is possible to change the properties of composite materials without changing their composition.

This report presents the results of a study of composite material based on hexaferrite Y-type.

Hexagonal Y-type ferrite ($Ba_2NiCuFe_{12}O_{22}$) [3] was synthesized using ceramic processing technology. After that the bulk ferrite was crushed. A filler with a particle size of less than 60 microns was taken to make the composite. Epoxy was used as a matrix. The mixture was placed into toroidal mold. After that mixture was treatment by a permanent magnetic field.

Figure 1 are shown the surface morphology of a composite material based on Y-type hexaferrite without/with treatment by an external magnetic field. It can be seen that the sample, which was exposed to a magnetic field, has a layered structure. This leads to the anisotropy of the magnetic properties of the sample.

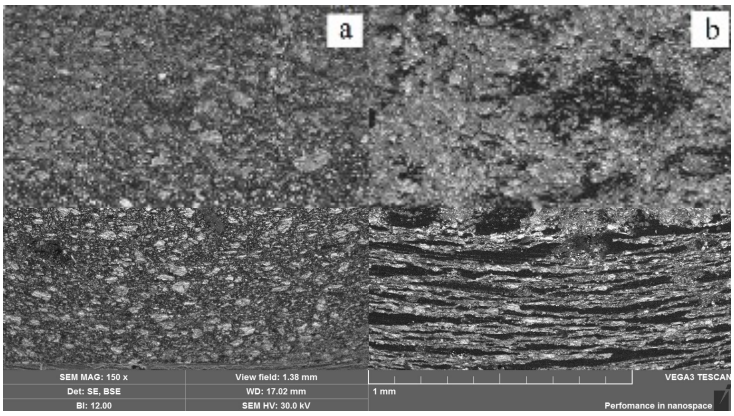

Fig.1. Surface morphology of a composite material based on Y-type hexaferrite manufactured (a) without treatment and (b) with treatment by an external magnetic field.

The results of X-ray diffraction analysis of this sample are shown that structural properties also changed and magnetic texture appeared.

The measurements and calculations by the magnetic permeability spectrum of magnetic composites based on planar hexaferrites in the frequency range 20 MHz - 18 GHz were carried out. The efficiency of magnetic treatment of composites to control the values of magnetic permeability in a wide frequency range is estimated.

REFERENCES

[1] J. Smit and H.P.J. Wijn, Ferrites, London: Cleaver-Hume Press Ltd., 1959.

[2] V.A. Zhuravlev, A.A. Nevmyvaka, V.I. Itin, V.A. Svetlichnyi, D.V. Lapin, D.V. Wagner, “Influence of the reagent types on the characteristics of barium hexaferrites prepared by mechanochemical method,” Mater. Today Commun., vol. 21, pp. 100614-1-100614-9, December 2019.

[3] D.V. Wagner, O.A. Dotsenko, V.A. Zhuravlev, “Structure, magnetic properties and electromagnetic response of Y-type hexaferrites and hexaferrite-based composite materials,” Russ. Phys. J., vol. 62, no. 4, pp. 581–588, April 2019.

* The work was supported by Tomsk State University Improvement Program and supported by the RFBR grant No. 19-32-90150 “Postgraduate students”. Experimental studies were carried out on the equipment of the collective use center of Tomsk State University «Center for Radiophysical Measurements, Diagnostics and Research of Parameters of Natural and Artificial Materials».