Composite Synthesis Using Nanoceramic Method and Properties of BaTiO$_3$-Ni-Co-ferrite ferroic

V. Bushkova$^1$, A. Kopajev$^1$, I. Yaremiy$^1$, U. Tomyn$^2$

$^1$Vasyl Stefanyk Precarpathian National University, 76000 Ivano-Frankivsk, Ukraine
$^2$Ivano-Frankivsk National Medical University, 76000 Ivano-Frankivsk, Ukraine

Volume ferroics have become very important in the design of various types of electronic devices [1]. They are characterized by high value of magnetoelectric effect coefficient – the electric field intensity upon application of a certain external magnetic field. Compared with layered magnetoelectrics they are easier to produce and mechanically stronger. However, due to the relatively low electrical resistance of the magnetic phase of composite, induced by the magnetic field electric charges rapidly annihilate. In this report a possibility of improving the fabrication technology of bulk ferroics was investigated. Ferrimagnetic ingredient of composite was obtained by milling of Ni-Co-ferrite synthesized by the ceramic technology. BaTiO$_3$ piezoelectric phase was obtained by sol-gel method. Piezoelectric particles are 50-100 times smaller and more active during sintering than the ferrite particles. The mixture of components was pressed and sintered under high temperature. Obtained product had a structure of the ferrite particles in a medium of solid piezoelectric with high electric resistance. Size of ferrite particles is very important. Large demagnetizing fields are generated around too small particles [2]. On the other hand, the larger the magnetic particles, the smaller the contact area with the piezoelectric phase. In both cases, the magnetoelectric effect decreases.

In the presented research the Mössbauer study, as well as the complex of structural studies of produced by the new technology composites were performed. Experimental results indicate that produced composites consist of spinel and perovskite phases. Spinel lattice parameter insignificantly differs from the parameter of pure Ni-Co-ferrite. BaTiO$_3$ lattice parameter corresponds to the published data for the perovskite of specified chemical composition. Mössbauer spectra of the samples indicate the presence of the characteristic magnetic order in the structure of Ni-Co-ferrite. Measurements of magnetic and electrical properties of the obtained composites were made. Data of carried out research indicate that the chemical interaction between the phases at the used synthesis modes is insignificant.

Obtained by nanoceramic method ferroics have higher parameters compared with the materials produced by the conventional technique, in which both of the composite component are produced using the same methods.