DETAIL COMPOSITIONAL AND STRUCTURAL CHARACTERIZATION OF LOW DIMENSIONAL MATERIALS

Vasilyeva I.G[*]. Edelman I.S. Sychev D.A.*** Chernov V.F.*****

[*]Nikolaev Institute of Inorganic Chemistry, Novosibirsk,
***Kirenskii Institute of Physics, Krasnoyarsk*
****Budker Institute of Nuclear Physics, Novosibirsk*

The preparation of nanostructured ferrites potentially useable for mass storage media is of great scientific and technological interest. We present here a study of nanosized magnetic particles $Mn_{1+x}Fe_{2-x}O_4$, which are formed during crystallization of the K-Al-B-O glasses doped by Mn and Fe oxides. The glasses possess unique properties showing magnetic order and optical transparency in the IR and visible region.

However, a significant dependence of these properties not only on size of ferrites, but also on chemical composition, valence and location of the Fe and Mn cations in octahedral and tetrahedral interstices of cubic close packing of oxygen anions, show that the problem of full and precise characterization of the nanosized ferrites in glasses is of primary importance.

To obtain these characteristics, to estimate degree and type of chemical order as well to find real structural formulae of the ferrite particles in the glasses we used different techniques. Along with known techniques such as X-ray diffraction, transmission electron microscopy, Мцssbauer spectroscopy suitable for characterization of finely divided ferrites, abilities of new methods such as differential dissolution analysis, XANES and EXAFS are also demonstrated here. They provide data on real stoichiometry, valence state of Mn and Fe cations and their location in the spinel lattice as well on crystalline state of the smallest particles.

It was shown that both Mn^{2+} and Mn^{3+} cations enter into composition of the ferrite and ferrite particles even of 5 nm in size are crystalline and show structure of cubic spinel.

The small (2-5 nm) and large (30-50 nm) particles being nanostructured dictate magnetic properties of the glasses. The measurements show that the saturation magnetization of the glasses with the ferrite particles remains just below than that for bulk manganese ferrite. The main factors responsible for this finding are discussed.