Magnetic and magneto-optic properties of oxides

MECHANOSYNTHESIS AND MAGNETIC PROPERTIES OF NANOSTRUCTURED MnZn FERRITE


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Ferrites with the spinel structure are commercially important materials because of their excellent electrical and magnetic properties. Among different magnetic materials, Zn-substituted spinel ferrites are especially attractive because Zn substitution alters their properties in a relatively wide range [1,2]. In the present work, nanocrystalline Mn$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ was prepared via high-energy milling of the mixture of two single phase ferrites, MnFe$_2$O$_4$ and ZnFe$_2$O$_4$. The microstructure and the magnetic properties of the mechanosynthesized MnZn ferrite were studied by $^{57}$Fe Mössbauer spectroscopy, X-ray diffraction, HR-TEM and SQUID.

In-field Mössbauer spectroscopy revealed that the mechanosynthesized ferrite is structurally and magnetically disordered due to the nonequilibrium cation distribution and the canted spin arrangement. Nanosized Mn$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ consists of particles mostly in the 10-30 nm size range. The saturation magnetization of mechanosynthesized Mn$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$ takes a value of 82.7 emu/g, which is about 41% lower than the value reported for bulk Mn$_{0.5}$Zn$_{0.5}$Fe$_2$O$_4$. The reduced saturation magnetization can be attributed to the effect of spin canting that dominates over the effect of site exchange of cations. It was also concluded that the mechanosynthesized material exhibits higher Néel temperature than the bulk sample.

References