

Local Structure and Magnetic Behavior of Nanocrystalline MnZn Spinel Ferrite Prepared by a One-Step Mechanochemical Route

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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. In the present work, nanocrystalline $\text{Mn}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ was prepared via high-energy milling of a mixture of two single phase ferrites, MnFe_2O_4 and ZnFe_2O_4 . Moreover, the local structure and the magnetic properties of the as-prepared material are studied. The microstructure and the magnetic properties of the mechanosynthesized MnZn ferrite were investigated by ^{57}Fe Mössbauer spectroscopy, X-ray diffraction, HR-TEM and SQUID [1,2].

Based on the analysis of the present room-temperature ^{57}Fe Mössbauer spectra of the milled $\text{MnFe}_2\text{O}_4/\text{ZnFe}_2\text{O}_4$ mixture, it can be presumed that the following mechanochemical reaction took place: $\text{MnFe}_2\text{O}_4 + \text{ZnFe}_2\text{O}_4 \rightarrow 2 \text{Mn}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$, see Fig 1.

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 $\text{Mn}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ consists of particles mostly in the 10-30 nm size range. The saturation magnetization of mechanosynthesized $\text{Mn}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ takes a value of 82.7 emu/g, which is about 41% lower than the value reported for bulk $\text{Mn}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$. 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 [1,2].

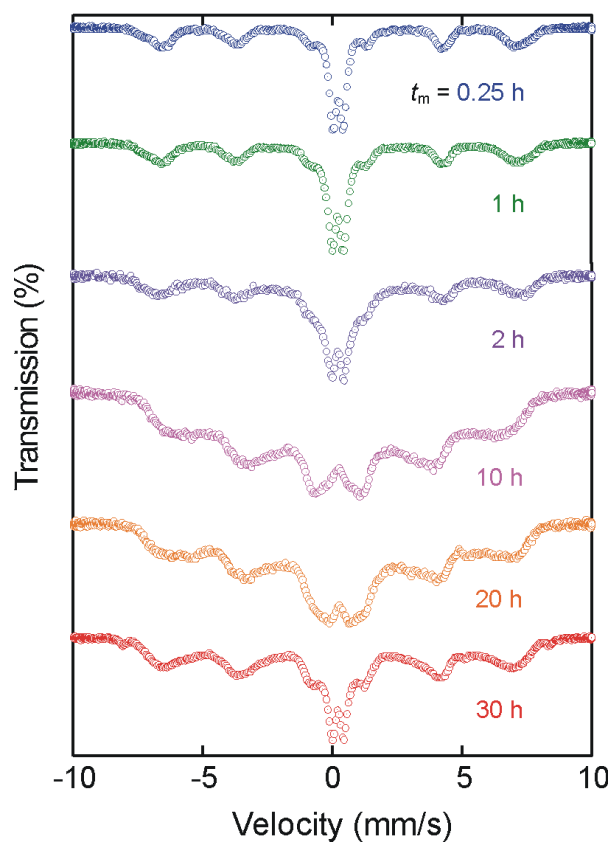


Fig. 1 Room-temperature ^{57}Fe Mössbauer spectra of the $\text{MnFe}_2\text{O}_4/\text{ZnFe}_2\text{O}_4$ mixture milled for various times.

References

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