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ФАКУЛТЕТЕН СЕМИНАР

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Phase composition and magnetic properties of nano-sized spinel ferrite crystallized from oxide glasses

Spinel (Mg and Mg-Zn)Fe_2O_4 nanoparticles were successfully prepared by the crystallization of iron containing borate glasses. Glasses in the system 51.7 B_2O_3 / 9.3 K_2O /1 P_2O_5 /(27.6-x) MgO /10.4 Fe_2O_3 / x ZnO (with x = 0, 5, 10, 13.8 and 20 mol%) were melted using the conventional melt quenching technique followed by a subsequent thermal treatment at various temperatures ranging from 530 to 604 ^oC for different periods of time. The resulting magnetic glass ceramics were characterized using X-ray diffraction (XRD), vibrating sample magnetometer (VSM) and transmission electron microscopy (TEM) including energy dispersive X-ray analysis (EDX). The results showed that $MgFe_2O_4$ nanoparticles were crystallized with an average size slightly increase from 6 to 15 nm with increasing the crystallization temperature. Magnetization curves indicate superparamagnetic behavior for the samples crystallized at low temperatures T≤ 550 C, while at the higher temperatures the samples were ferromagnetic with a superparamagnetic fraction. Substituting MgO by ZnO in glasses resulted in the incorporation of Zn^{2+} ions into the crystal phase and the precipitation of (Mg-Zn) Fe_2O_4 nanoparticles. Increasing the ZnO concentration, the lattice parameter was increased, while the crystallite size does not change significantly. The magnetic behavior of the crystallized samples showed a strong dependency on the ZnO concentration in the glass. At the low concentrations (1-10 mol% ZnO), the magnetization curves indicate superparamagnetic (SPM) behavior, while no magnetic contribution was detected at the higher ZnO concentrations.