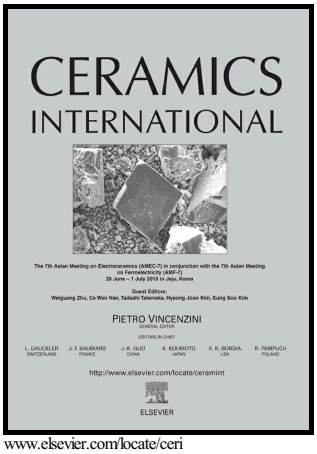

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The effect of zinc substitution on the magnetism of magnesium ferrite nanostructures crystallized from borate glasses

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Abstract

Glasses in the system 51.7 B_2O_3/ 9.3 K_2O/ 1 P_2O_5/ 10.4 Fe_2O_3/ (27.6 – x) MgO/ x ZnO (with x = 0, 5, 10, 13.8 and 20 mol%) were prepared by the conventional melt quenching method. The as prepared glass samples were thermally treated at 560 °C for 3 or 6 h. The effect of substituting MgO by ZnO in the glass network on the crystallized phase was studied. 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 substitution of Mg by Zn resulted in a larger lattice parameter of the precipitated crystals, while the crystallite size does not change significantly. TEM micrographs, recorded from extracted particles, showed the formation of small aggregates with about 30 nm in diameter. These agglomerates contain crystals with sizes in the range from 7 to 9 nm. EDX measurements proved the incorporation of Zn^{2+} ions into the crystal phase. Room temperature magnetic measurements of the samples with up to 10 mol% ZnO showed hysteresis loops which are characteristic for super paramagnetic (SPM) behavior. A magnetic contribution was not detected for samples with higher ZnO concentrations. The maximum magnetization varied with the composition of the glass ceramics to a great extent.

Keywords: C Magnetic properties; D Glass ceramics; D Spinel