PREPARATION AND MAGNETIC PROPERTIES OF ZIRCONIA–MAGNETITE NANOCOMPOSITES

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Abstract

Zirconia (ZrO_2) has three polymorphs: monoclinic (*m*-ZrO_2), tetragonal (*t*-ZrO_2) and cubic (*c*-ZrO_2). Among them, only the monoclinic is thermodynamically stable at room temperature and the other two are metastable polymorphs. In this study Zirconia (ZrO_2)-magnetite (Fe_3O_4) composites composed of Fe_3O_4 particles embedded in the ZrO_2 matrix were prepared by the combustion method followed by heat treatment at reduced gas. The influence of Fe_3O_4 on the structure and magnetic properties of the composites was analyzed by the X-ray diffraction (XRD) and magnetic measurements. XRD patterns show that the structure of composites was composed of spinel and monoclinic (*m*-ZrO_2) phases. A pronounced feature of the coercivity (H_c) and remanence reduced to saturation magnetization (σ_r / σ_s) observed in samples is the drastic change which appears at about 125 K and is a characteristic of the Verwey transition. Temperature dependence of the zero-field-cooled (ZFC) magnetization curves, measured at low magnetic field, also indicate that the Verwey phase transition occurs. In other words, the Verwey transition is an indication that the magnetite particles exactly grew up in the synthesized compounds. Composition dependence of the coercivity of $(ZrO_2)_{100-x}(Fe_3O_4)_x$ composites shows that a strong magnetic anisotropy appears near the percolation limit of the volume fraction (x = 35 %).

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