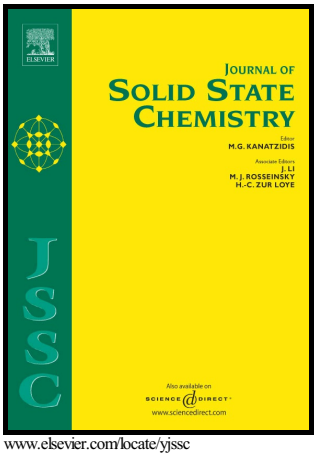

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High Pressure Synthesis and Magnetic Properties of Corundum-type $Ga_{1-x}Al_xFeO_3$ ($x = 0, 0.25, 0.5$)

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Abstract

Metastable phases of $Ga_{1-x}Al_xFeO_3$ (x = 0, 0.25, 0.5) have been prepared under high pressure (4.5 GPa) and high temperature (1000 °C) using a cubic-anvil high pressure apparatus. X-ray diffraction studies show that application of pressure transforms the structure of these compounds from the polar $Pna2_1$ to the non-polar $R\bar{3}c$ phase. Intriguingly, the orthorhombic phases of the compounds with x = 1.0, synthesized at ambient pressure decompose into their constituent oxides, Al_2O_3 ($R\bar{3}c$) and Fe_2O_3 ($R\bar{3}c$) under the same conditions of pressure and temperature. Magnetization measurements reveal antiferromagnetic ordering with a weak ferromagnetism below T_N ~ 450 K, 590 K and 650 K, respectively. All these oxides exhibit a spin glass behavior at low temperatures. Analysis of ac susceptibility measurements indicate the existence of a cluster spin glass phase below T^* ~ 45, 40 and 43 K respectively for x = 0, 0.25, 0.5. Such a re-entrant spin glass behavior arises due to antiferromagnetic interactions among the disordered Fe^{3+} ions in the octahedral site of the corundum structure.

Keywords: Oxides; High pressure synthesis; spin glass; crystal structure