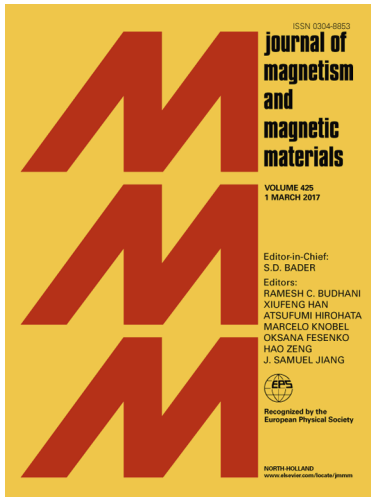

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Tuning the Magnetic Properties of a Ferrimagnet

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Abstract

Magnetic properties of manganese ferrite doped with lanthanum and gadolinium having compositional formula $MnRE_xFe_{2-x}O_4$ (where RE = La^{3+}, Gd^{3+} and x = 0.02, 0.04, 0.06, 0.08, 0.10) synthesized by co-precipitation method have been investigated. The compositional variation of the magnetic properties for each rare earth ion was studied individually first. Then, the variation of the magnetic properties with the substitution of the two different ion having different magnetic moments was compared. Saturation magnetization of non-magnetic ion (La^{3+}) substituted $MnFe_2O_4$ was found to be superior to that of magnetic ion (Gd^{3+}) substituted $MnFe_2O_4$. The observed result was explained in terms of Neel's theory of ferrimagnetism, distribution of cations and magnetic moment of the associated cations. Law of approach to saturation (LAS) was adopted to investigate the dependency of magnetization on the applied field. A strong dependence of magnetic property on the distribution of cations which is specific to the particular rare earth ion was revealed in the present study.

Keywords: Rare earth; spinel ferrites; magnetic property; ferrimagnetism; law of approach to saturation.

1. Introduction

Spinel ferrites having AB_2O_4 structure are the important class of ferrimagnetic materials used in the various technological applications. The spinel structure is formed by FCC packing of oxygen ions leaving behind two interstitial sites namely the tetrahedral site (A site) and the octahedral site (B site). Manganese ferrite belongs to the category of mixed spinel ferrite in which a fraction of manganese ion occupies the B site (0.2 in most cases) [1]. Substitution of different divalent and trivalent metal ions in these interstitials determines their properties [2–5]. Different researcher had tried to improve magnetic properties of spinel ferrites by substituting

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