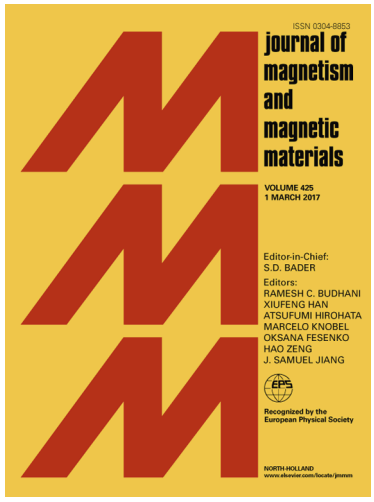

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Influence of La^{3+} ion doping on physical properties of magnesium nanoferrites for microwave absorption application

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Abstract

Lanthanum (La^{3+} ions) doped magnesium ferrite nanoparticles i.e. $MgLa_xFe_{2-x}O_4$ (x= 0, 0.05, 0.075, 0.1, 0.125) have been prepared using sol-gel technique. These as-prepared nanomagnetic particles were characterized by using X-ray diffractometer (XRD), Fourier transform infrared spectroscopy (FTIR), High resolution field emission scanning electron microscopy (HRFESEM) with energy dispersive spectroscopy (EDS), Transmission electron microscopy (TEM) and Vibrating sample magnetometer (VSM) techniques. X-ray diffraction analysis reveal that the samples are single phase cubic spinel crystals with size 12-15 nm. Lattice parameter increases with the increase in La^{3+} ion concentration. The induced strain calculated from Williamson-Hall plots shows that strain decreases from x=0.0 to x=0.075 and then increases from x=0.1 to x=0.125. FTIR spectra show that Fe-O stretching vibration peaks of octahedral (FeO_6) and tetrahedral (FeO_4) group broadness increases with lanthanum content due to gradual decrease in the grain size. These variations are attributed to lattice deformation induced by interparticle interactions, cation distribution, and La^{3+} ions concentration in the spinel structured samples. SEM micrographs revealed the existence of superfine particles and agglomerated patterns for higher La^{3+} ion content. The average particle size obtained from TEM images are in close agreement with the crystallite size calculated from the XRD patterns. The magnetic studies exhibited the saturation magnetization, retentivity, anisotropy constant and magnetic moment of the particles decrease with increasing La^{3+} ions concentration indicating the superparamagnetic nature of lanthanum doped magnesium ferrite samples.

Keywords: Ferrites; Lanthanum; Sol-gel; Phase; Saturation magnetization; Anisotropy constant