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## New scheme for cation distribution and electrical characterization of nanocrystalline aluminum doped magnesium ferrite MgAl<sub>x</sub>Fe<sub>2-x</sub>O<sub>4</sub>

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### Abstract

MgAl<sub>x</sub>Fe<sub>2-x</sub>O<sub>4</sub> (x=0.0 up to 1 step 0.2) was prepared using co-precipitation method. The value of lattice constant is found to decrease with increasing Al<sup>3+</sup> concentration. The particle size of the samples calculated using the Sheffer formula was obtained in the range of 15-28 nm. The two main bands corresponding to tetrahedral and octahedral sites were observed to be around 600 cm<sup>-1</sup> and 450 cm<sup>-1</sup>, respectively. These bands are shifted to high frequencies with more doping of Al<sup>3+</sup> ions which may be attributed to the decrease in the mean radius of the tetrahedral and octahedral sites. The threshold frequency (ν<sub>th</sub>) for the electronic transition decreases with increasing the Al<sup>3+</sup> content. The tetrahedral force constant (K-T) increases continuously with Al<sup>3+</sup> concentration. The bandwidth of the tetrahedral site is found to increase gradually with the Al<sup>3+</sup> content. The validity of the proposed cation distribution is confirmed by considering the X-ray intensity ratios of diffraction lines sensitive to the tetrahedral and octahedral sites. DC conductivity measurements exhibited metallic and semiconductor-like behavior with temperature for all compositions. The decrease of Curie temperature with the increase of non-magnetic ions of aluminum indicates their preference to the octahedral sites as well and confirms the validity of the cation distribution. (C) 2013 Elsevier B.V. All rights reserved.

### Keywords

**Author Keywords:** Magnesium ferrite; Cation distribution; X-ray diffraction; Infrared spectroscopy; Nano-crystalline

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