New scheme for cation distribution and electrical characterization of nanocrystalline aluminum doped magnesium ferrite MgAlxFe2-xO4

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Abstract

MgAlxFe2-xO4 (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 Al3+ 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(-1) and 450 cm(-1), respectively. These bands are shifted to high frequencies with more doping of Al3+ ions which may be attributed to the decrease in the mean radius of the tetrahedral and octahedral sites. The threshold frequency (v(th)) for the electronic transition decreases with increasing the Al3+ content. The tetrahedral force constant (K-T) increases continuously with Al3+ concentration. The bandwidth of the tetrahedral site is found to increase gradually with the Al3+ 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.

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