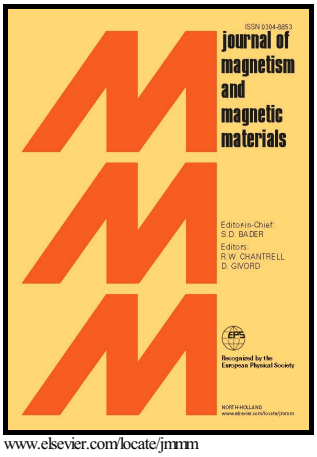

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PII: S0304-8853(16)31473-1
DOI: http://dx.doi.org/10.1016/j.jmmm.2016.11.076
Reference: MAGMA62151

To appear in: *Journal of Magnetism and Magnetic Materials*

Received date: 18 July 2016
Revised date: 3 November 2016
Accepted date: 13 November 2016

Cite this article as: Junmoni Barman and S. Ravi, Sign reversal of magnetizatio and exchange bias in $Ni(Cr_{1-x}Al_x)_2O_4$ (x = 0 – 0.50), *Journal of Magnetism an Magnetic Materials,* http://dx.doi.org/10.1016/j.jmmm.2016.11.076

Sign reversal of magnetization and exchange bias in $Ni(Cr_{1-x}Al_x)_2O_4$ (x = 0 – 0.50)

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Abstract

$Ni(Cr_{1-x}Al_x)_2O_4$ (x = 0 – 0.50) samples were prepared in single phase form by using sol–gel method and their structural and magnetic properties were studied. Al substitution transforms the crystal structure of $NiCr_2O_4$ from tetragonal cell with space group $I4_1/amd$ to cubic cell of $Fd\bar{3}m$ space group. Magnetization measurements by varying the temperature and magnetic field were carried out to investigate the interesting magnetization reversal and exchange bias behaviors. Magnetization reversal is observed for x = 0.10 sample with a magnetic compensation temperature of 40 K and it is explained by considering different temperature dependences of magnetic moments of the two sublattices. Shifting of magnetic hysteresis loops towards the negative magnetic field axis and hence the presence of negative exchange bias field is observed for x = 0.15 sample. The x = 0.10 sample exhibits the tunable positive and negative exchange bias field. Exchange bias in these samples is explained considering the anisotropic exchange interaction between the ferrimagnetic and the antiferromagnetic components of magnetic spins. However, the sign reversal of exchange bias field is due to the change in domination of one ferrimagnetic sublattice over the other with variation in temperature. Both normal and inverse magnetocaloric effects are observed for x = 0.10 sample.

Keywords: Ferrimagnetic; Antiferromagnetic; Exchange bias field; Magnetization Reversal

Introduction: