INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	JUNMONI BARMAN
Roll Number	:	126121013
Programme of Study	:	Ph.D.

Thesis Title: Magnetic Properties of $NiCr_2O_4$ and $MnCr_2O_4$ Based Spinel Chromites

Name of Thesis Supervisor(s)	:	Prof. S. Ravi
Thesis Submitted to the Department	:	Physics
Date of completion of Thesis Viva-Voce Exam	:	24/11/2017
Key words for description of Thesis Work	:	Spinel Chromite, Exchange Bias, Magnetization Reversal

SHORT ABSTRACT

In the present thesis work we have studied the magnetic properties of Fe and Al substituted $NiCr_2O_4$ and $MnCr_2O_4$ series. $Ni(Cr_{1-x}M_x)_2O_4$ and $Mn(Cr_{1-x}M_x)_2O_4$ (M = Fe and Al) samples were prepared in single phase form by using sol-gel route. The parent compound $NiCr_2O_4$ is found to crystallize in tetragonal structure with $I4_1/amd$ space group while all the Fe and Al doped samples exhibit cubic spinel structure with $Fd\overline{3}m$ space group. Unlike the $Ni(Cr_{1-x}M_x)_2O_4$ series, all samples in $Mn(Cr_{1-x}M_x)_2O_4$ (M = Fe and Al) series including the parent compound (x = 0) exhibit cubic spinel structure. All samples in both the series undergo ferrimagnetic transition. The ferrimagnetic transition temperature is found to increase with increase in Fe concentration whereas it decreases with increase in Al concentration. Fe substituted $NiCr_2O_4$ samples show the most interesting magnetic properties. Fe substitution leads to the magnetization reversal behavior with enhanced magnetic compensation temperature such as 358 K, 366 K and 396 K respectively for x = 0.30, 0.40 and 0.50 samples. This temperature induced magnetization reversal is explained by considering different temperature dependence of the magnetic moments of the two sublattices. These samples exhibiting magnetization reversal also show tunable positive and negative exchange bias field in the vicinity of room temperature which is explained in terms of change in domination of one sublattice moment over the other as the temperature is varied. Moreover, for the first time we have demonstrated the bipolar switching of magnetization at room temperature for x = 0.30 and 0.40 samples. Similar to Fe substitution, Al substitution also gives rise to magnetization reversal as well as tunable exchange bias behavior for x = 0.10 sample; but with a low magnetic compensation temperature of 40 K. $Mn(Cr_{1-x}M_x)_2O_4$ (M = Fe and Al) series do not show any magnetization reversal or exchange bias behavior except x = 0.40 sample due to low magnetic anisotropy of the samples. So, in brief we have developed a set of $NiCr_2O_4$ based samples with bipolar switching capability and tunable exchange bias in the vicinity of room temperature.