INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	RAM KUMAR
Roll Number	:	126121028
Programme of Study	:	Ph.D.

Thesis Title: Influence of magnetic structure on the magnetic properties of compensated substituted compounds of $CoCr_2O_4$.

Name of Thesis Supervisor(s)	:	Prof. DILIP PAL
Thesis Submitted to the Department/ Center	:	Physics
Date of completion of Thesis Viva-Voce Exam	:	17 Dec 2018
Key words for description of Thesis Work	:	Spinel Oxides, Neutron Diffraction, Ferrimagnets

SHORT ABSTRACT

Among oxides materials, spinel oxides having structure AB_2O_4, exhibit a rich spectrum of functional responses due to their interesting magnetic, electric and multiferroic properties. In the family of magnetic spinel oxides, Cobalt chromate ($CoCr_2O_4$) is famous as magnetoelectric (ME) multiferroic material which exhibits a rich phase diagrams involving spin and orbital degrees of freedom, geometrical frustration and complex spiral ferrimagnetic (FIM) orderings. $CoCr_2O_4$ exhibits a long range collinear FIM ordering at (T_C) ~94 K followed by another magneto-structural transition (T_S) ~24 K below which an incommensurate conical spin-spiral order exists. It is the existence of the conical spin-spiral order in this compound, which gives rise to ME coupling as predicted by the spin-current model. Further, through neutron scattering experiment, another transition is also observed at T ~15 K, known as lock-in transition (T_L) in $CoCr_2O_4$. The presence of weak magnetic frustration, which is very much intangible to superexchange interactions present along different paths such as A−O−A, B−O−B and A−O−B give rise to all above enthralling features. This thesis presents detailed study to understand the crystalline and magnetic structure by performing neutron powder diffraction experiments and other physical properties of A and B site substituted spinel compounds. (i) $Co(Cr_{1-x}Fe_x)_2O_4$ with x = 0.05, 0.075, (ii) $Co(Cr_{1-x}Mn_x)_2O_4$ with x = 0.27, 0.30, and (iii) $Co_{1-x}Cu_xCr_2O_4$ with x = 0.20. Structural analysis of these polycrystalline compounds shows that substituted compounds of Fe and Mn retains the cubic phase till the lowest measuring temperature (i.e. 3 K) whereas a structural distortion is observed in case of Cu (20%) substituted sample. Magnetization measurements have revealed many interesting magnetic properties including negative magnetization, sign change in exchange bias field and sign change in MCE across T_{comp}. Temperature dependent NPD experiments have been performed on the compensated substituted compounds which provide a detailed magnetic structure responsible for observed fascinating magnetic properties of these compounds.