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Structural and magnetic properties of $Co_xNi_{(1-x)}Cr_2O_4$ (x = 0.75, 0.80, 0.85) nanoparticles

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The $Co_xNi_{1-x}Cr_2O_4$ (x = 0.75, 0.80, 0.85) were synthesized by co-precipitation technique [1]. The doping of Ni at the Co site was increased in order to understand how this affects the morphology, structural and magnetic properties. All the samples were prepared using co-precipitation techniques and calcined at 900 ℃ to achieve crystalline and pure phase samples. The structural properties of samples were studied using x-ray diffraction (XRD) techniques. The peaks in the XRD profile obtained were well matched with the cubic crystal structure of $CoCr_2O4$ (JCPDS card no. 00-022-1084) having the space group of Fd-3m [2]. The particle size and morphology of the material were obtained by transmission electron microscopy (TEM). The particle size was observed to be non-uniform, thus, the particle size for each sample was determined through analyzes of several TEM micrographs and using a log-normal distribution function [3]. The magnetic behaviour of the samples was studied in both the zero-field cooled warm (ZFCW) mode and the field-cooled warm (FCW) mode [4]. The Curie temperature (T_C) values vary as doping concentration changes. The T_C value decreases from 90 ± 0.5 K to 81 ± 6 K as Ni increases from x = 0.75 to 0.85. In addition, the spiral order transition temperature (T_S) decreases as the concentration of Ni increases. The magnetic field dependent magnetization measurements, M(μ_0 H), measured with different probing fields under the ZFC protocol at different constant temperatures. For all the samples, the coercivity decreases with an increase in temperature. The hysteresis loop does not show classical saturation for all the samples and this behaviour has been reported previously [5]. The magnetic saturation is calculated by linear extrapolation of high field magnetization to zero fields. Also, the samples show an increase in magnetic saturation near the T_C and after T_C the magnetic saturation decreases. The magnetic parameters are determined by using the fitting function [6]:
$M=M_S$ ((2/(π)){arctan[(H+H_C)/H_C] tan(πS/2) })+χH
The paramagnetic component of the three samples were subtracted and loop is fitted with a simple Langevin equation [7] and the saturation magnetisation values were calculated from the fit.
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PhD

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