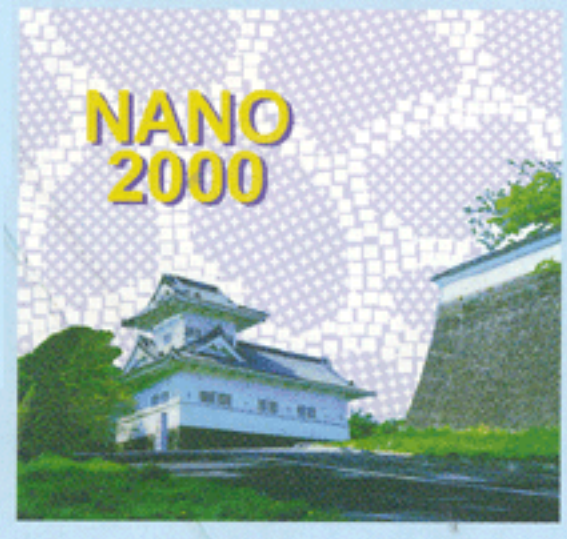

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Abstracts

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radiation and the formation of spinel $CdFe_2O_4$ was confirmed. The average grain size determined from the X-ray line broadening decreases with increase of milling time. The lattice parameter initially increases and then decreases with milling time.

Zero field cooled (ZFC) and field cooled (FC) measurements have been carried out for samples of two different grain sizes, 77 and 9 nm. The magnetization at 4.2 K increases by almost three times when the grain size is reduced from 77 to 9 nm. The saturation magnetization of the sample with 9 nm grain size measured at 5 K using 9T field is 24 emu/gm. In bulk form, $CdFe_2O_4$ is a normal spinel and is anti-ferromagnetically ordered below 10 K. The observation of such a large magnetic moment for the 9 nm particle could be possible only if cation inversion takes place and the system exhibits ferrimagnetic ordering. The presence of surface anisotropy in this sample is revealed by ZFC and FC measurements carried out with 1 T magnetic field. But this anisotropy almost disappears in 9T magnetic field. The coercivity increases with decrease in grain size and also it decreases rapidly with temperature because of superparamagnetic behavior.

^{57}Fe Mössbauer studies show that the sample with 9 nm grain size is ferrimagnetically ordered even at 100 K and all other samples except the one with 77 nm grain size are magnetically ordered at 16 K. The quadrupole splitting increases with milling time suggesting increase in atomic disorder with milling. The isomer shifts are found to be characteristic of Fe^{3+} charge state. The EXAFS measurements also suggest cation inversion.

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ATOMIC MIGRATION AND SUPEREXCHANGE INTERACTION IN $CoCr_{0.1}Fe_{1.9}O_4$

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$CoCr_{0.1}Fe_{1.9}O_4$ ferrite has been studied with Mössbauer spectroscopy, vibrating sample magnetometer (VSM) and x-ray diffraction. The crystal structure is found to be a cubic spinel with the lattice constant a_0=8.390 ± 0.005 Å. Mössbauer spectra of $CoCr_{0.1}Fe_{1.9}O_4$ measured at various absorber temperatures of 17 to 750 K. Its Néel temperature T_N is found to be 720 K. The Mössbauer spectra consist of two six-line patterns corresponding to Fe^{3+} at the tetrahedral (*A*) and octahedral (*B*) sites. It is found that Debye temperature for the *A* and *B* sites of $CoCr_{0.1}Fe_{1.9}O_4$ is found to be Θ_A = 827 ± 5 K and Θ_B = 218 ± 5 K. The intensity ratio of the *A* to *B* patterns is found to increase at low temperatures with increasing temperature due to the large difference of Debye temperatures of the two sites and to decrease at high temperatures due to migration of Fe^{3+} ions from *A* to *B* sites. Atomic migration of $CoCr_{0.1}Fe_{1.9}O_4$ starts near 295 K and increases rapidly with increasing temperature to such a degree that 64 % of the ferric ions at the *A* sites have moved over to the *B* sites by 600 K. The temperature dependence of both the magnetic hyperfine field and magnetization of $CoCr_{0.1}Fe_{1.9}O_4$ is explained by the Néel theory of ferrimagnetism using three superexchange integrals: $J_{A\text{-}B}$=-16.6 k_B, $J_{A\text{-}A}$=-7.4 k_B, and $J_{B\text{-}B}$=9.7 k_B.