Mössbauer studies of multiferroic spinel $CoCr_{1.98}{}^{57}Fe_{0.02}O_4$

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In order to elucidate the role of Cr ions in $CoCr_2O_4$ exhibiting multiferroic property, we have substituted a small amount of Fe ions for Cr sites and investigated the magnetic behavior of Fe ions on atomic scale, using Mössbauer measurement. Polycrystalline $CoCr_{1.98}{}^{57}Fe_{0.02}O_4$ compound was prepared by wet-chemical process. The crystal structure was found to be a single-phase cubic spinel with space group of *Fd*-3*m*. The lattice constant (a_0) and the internal structural parameter (x) of the oxygen were determined to be 8.340 and 0.264 Å, respectively. Mössbauer absorption spectra at 4.2 K show that the well developed two sextets are superposed with small difference in hyperfine field. Isomer shift values (δ) of the two sextets are found to be 0.34 and 0.35 mm/s relative to the Fe metal, which are consistent with the high spin Fe^{3+} charge state. With increasing temperature, the sextets gradually split into two subspectra, and then around 28 K the absorption line broadening of outer sextet appears rapidly. Above the Néel temperature (T_N=97 K) the paramagnetic doublets are observed. The sudden change of outer sextet is observed above 28 K, which corresponds to the spin transition temperature. Mössbauer measurement results suggest that Cr^{3+} ions have two different magnetic sites, and the temperature dependent magnetic property is attributable to the different behaviors of magnetic ions in the two sites. © *2007 American Institute of Physics*.
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