10TH JOINT MMM/INTERMAG CONFERENCE

JANUARY 7-11, 2007

BALTIMORE, MARYLAND

ABSTRACTS

GQ-18. Interpretation of ferromagnetic Fe doped ZnO by the Mössbauer spectroscopy. *S. Park*[1], G. Ahn[2] and C. Kim[1] *1. Department of Physics, Kookmin University, Seoul, South Korea; 2. Neutron Physics, HANARO, Korea Atomic Energy Research Institute, Daejeon, South Korea*

Transition metal(Fe, Co, Ni etc.) doped ZnO base diluted magnetic semiconductor is studied with many international researchers by the various methods. Single phase $Zn_{0.95}{}^{57}Fe_{0.05}$ sample by the sol-gel method was obtained to be with annealing at 650 °C for 6 h in H_2 5%/Ar bal. gas atmosphere. The X-ray diffraction pattern shows that the doping of iron does not change the wurzite structure of ZnO for Fe concentration. The crystalline structure of $Zn_{0.95}{}^{57}Fe_{0.05}O$ is determined to a *P63mc* hexagonal structure with lattice constants $a_0 = 3.255$ Å and $c_0 = 5.207$ Å at room temperature. The result of x-ray diffraction pattern analysis was indicated that the Bragg factors R_B and R_F were 2.84 and 2.02 % by Rietveld refinement. The Mössbauer spectra were obtained at various temperatures ranging from 4.2 to 295 K. The values of the isomer shifts show that all temperature ranges are in the ferrous(Fe^{2+}) state. The magnetic hyperfine field (H_{hf}) and electric quadrupole splitting (ΔE_Q) in the weak ferromagnetic state at 4.2 K have been analyzed, yielding the following results : $H_{hf} = 37.8$ kOe, $\theta = 67.5°$, $\phi = 0°$, $\eta = 0.75$, $\Delta E_Q = 2.06$ mm/s, and $R = 7.4$, respectively. As the Mössbauer spectrum at 77 K, the paramagnetic quadrupole phase is appeared to the temperature dependence of spin-lattice relaxation. As the temperature increase, the paramagnetic quadrupole phase increase, however weak ferromagnetic phase is still remained at 295 K. It is notable that, as the temperature decreases below at 295 K, quadrupole splitting increases, suggesting the presence of an electric field gradient and accompanying spin-lattice relaxation effects. The magnetic susceptibility measurements by a vibrating sample magnetometer(VSM) show that weak interaction between Fe^{2+} ions and oxygen occupancy ratio in ZnO lattice are weak ferromagnetic.