Journal of Magnetics 5(1), 16-18 (2000)

Synthesis and Mössabuer Spectroscopy Studies of $Nd_{1-x}Bi_xY_2Fe_5O_{12}$ Nano-Particles

Young Rang Uhm[1], Jae-Gwang Lee[2] and Chul Sung Kim[1]

[1]*Department of Physics, Kookmin University, Seoul 136-702, Korea*
[2]*Department of Applied Physics, Konkuk University, Chungbuk 380-701, Korea*

(Received 10 December 1999)

The garnets $Nd_{1-x}Bi_xY_2Fe_5O_{12}$ (x=0.0, 0.25, 0.5, 0.75 and 1.0) have been studied by x-rays, electron microscopy, ferromagnetic resonance, vibrating sample magnetometer and Mössbauer spectroscopy. Ultra-fine polycrystalline cubic samples have been prepared by a melt-salt routed sol-gel method. The Mössbauer spectra consist of two sets of six-line patterns corresponding to Fe^{3+} at the tetrahedral 24(d) and octahedral 16(a) sites. Magnetic hyperfine fields of $Nd_{0.5}Bi_{0.5}Y_2Fe_5O_{12}$ at 12 K are found to be 548 kOe (octahedral site) and 475 kOe (tetrahedral site), respectively. It is found that Debye temperatures for the tetrahedral and octahedral sites of $Nd_{0.75}Bi_{0.25}$-$Y_2Fe_5O_{12}$ are θ_{tet}=436 K and θ_{oct}=285 K, respectively. The iron ions at both sites are highly covalent ferric. The Néel temperature decreases linearly with Bi concentration, from 630 K for x=0.0 to 600 K for x=1.0, suggesting that the superexchange interaction for the Nd-O-Fe link is stronger than that for the Bi-O-Fe link. As a consequence, the coercivity of $Nd_{1-x}Bi_xY_2Fe_5O_{12}$ drastically decreases and the magnetization remains almost constant as x increases.