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The electron beam irradiation effect on nickel ferrite

Chan Hyuk Rhee, In-Bo Shim, and Chul Sung Kim

Department of Physics, Kookmin University, Seoul 136-702, Korea

The nickel ferrite samples prepared by solid state reaction method were irradiated with electron beam of various irradiation conditions to improve the magnetic properties [1]. The crystal structures of the NiFe$_2$O$_4$ samples were determined to be cubic with the space group of $Fdar{3}m$ at room temperature. The irradiation dependent macroscopic magnetic properties of the nickel ferrites were measured by VSM. The saturation magnetization $M_S$ increases and the coercivity $H_C$ decreases with increasing electron beam irradiation dose as shown in Fig. 1. From result of Mössbauer spectroscopy, the states of Fe ions at A site ($\delta = 0.24 \sim 0.25$ mm/s) and B site ($\delta = 0.13 \sim 0.14$ mm/s) were Fe$^{3+}$ state regardless of the electron beam irradiation. The $H_{hf}$ of Fe at A sites (tetrahedral site) and B sites (octahedral site) was not almost changed with various electron beam irradiation condition. The occupancy rates of Fe ion at A site and B site were 47% and 53%, respectively. In the result of XPS, Fe ions were not changed by electron beam irradiation as result of Mössbauer spectroscopy. In contrast, the Ni$^{2+}$ ions of NiFe$_2$O$_4$ sample before irradiation coexist with Ni$^{3+}$ ion. The Ni$^{3+}$ ions of irradiated NiFe$_2$O$_4$ sample decrease with increasing electron beam irradiation dose.

![Graph](image)

Figure 1: The saturation magnetization and the coercivity for NiFe$_2$O$_4$ with various electron beam irradiation dose at room temperature.