Magnetic Properties and Mössbauer Studies of $Y_{3-x}Ce_xFe_5O_{12}$ ($x = 0.00$, 0.01, and 0.3) Fabricated Using a Sol-Gel Method

Jun Sig Kum, Sam Jin Kim, In-Bo Shim, and Chul Sung Kim, *Member, IEEE*

***Abstract*—Compounds of composition of $Y_{3-x}Ce_xFe_5O_{12}$ ($x = 0.0$, 0.1, and0.3) were prepared using the sol-gel method. The vibrating samples magnetometer measurements showed no sizable changes in saturation magnetization. A small coercivity ($H_c = 5.8$ Oe), however, was obtained from the $Y_{2.9}Ce_{0.1}Fe_5O_{12}$ sample, comparable with that of an undoped $Y_3Fe_5O_{12}$ sample ($H_c = 54.1$ Oe). Mössbauer spectra of $Y_{3-x}Ce_xFe_5O_12$ were measured at various absorber temperatures from 4.2 K to Néel temperature. The temperature dependence of the magnetic hyperfine field in ^{57}Fe nuclei at the tetrahedral ($24d$) and octahedral ($16a$) sites were analyzed based on the Néel theory of ferrimagnetism. For $Y_{2.9}Ce_{0.1}Fe_5O_{12}$, the intersublattice a–d superexchange interaction was found to be antiferromagnetic with strength of $J_{a-d} = -21.42\ k_B$, while the intrasublattice interactions a–a, d–d were found to be ferromagnetic with a stregth of $J_{a-a} = 4.50\ k_B$ and $J_{d-d} = 0.02\ k_B$, respectively.**

***Index Terms*—Garnet, Mössbauer spectroscopy, sol-gel process, superexchange interaction.**