

Crystallization and Mössbauer Studies of $Y_{3-x}La_xFe_5O_{12}$ ($x=0.0, 0.25, 0.5, 0.75, 1.0$)

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(Received; May 6, 1998 Accepted; August 26, 1998)

Magnetic and structural properties of garnet $Y_{3-x}La_xFe_5O_{12}$ ($x = 0.0, 0.25, 0.5, 0.75, 1.0$) have been studied by using X-ray diffraction, Mössbauer spectroscopy, and vibrating sample magnetometer. Polycrystalline cubic powders have been prepared by a metal-salt routed sol-gel method. Mössbauer spectra of $Y_{3-x}La_xFe_5O_{12}$ have been taken at various temperatures ranging from 12 to 700 K. The lattice parameter increases linearly with increasing La concentration and follows Vegard's law approximately. Magnetic hyperfine fields of $Y_{2.5}La_{0.5}Fe_5O_{12}$ at 12 K are found to be 543 kOe (octahedral site) and 469 kOe (tetrahedral site). The values of the isomer shifts show that all of iron ions are in the ferric (Fe^{3+}). The Curie temperature, T_c , is found to depend strongly upon La concentration, i.e., 578 K for $x=0$ and 625 K for $x=0.5$. The dependence of the Curie temperature suggests that the strengthen of superexchange interaction by La-O-Fe link is stronger than that by Y-O-Fe link.

Key words : YIG, Magnetic hyperfine field,

Isomer shift, Debye temperature