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BOOK OF ABSTRACTS

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CRYSTALLOGRAPHIC AND MAGNETIC PROPERTIES OF $Y_3Fe_{5-x}Al_xO_{12}$

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Al^{3+} substituted garnet $Y_3Fe_{5-x}Al_xO_{12}$ (x = 0.0, 0.25, 0.5, 0.75, 1.0) was fabricated by a sol-gel method. The crystallographic and magnetic properties of $Y_3Fe_{5-x}Al_xO_{12}$ have been studied with Mössbauer spectroscopy, X-ray diffraction (XRD), thermogravimetry analysis (TGA), differential thermal analysis (DTA), and vibrating samples magnetometer (VSM). The crystal structure $Y_3Fe_5O_{12}$ is found to be a cubic with the lattice constant a_0 = 12.381 ± 0.005 Å. The lattice constant a_0 decreases linearly from 12.381 to 12.304 Å as the Al concentration (x) increases from x = 0.0 to 1.0 and follows Vegard's law approximately. Mössbauer spectra of measured at $Y_3Fe_{5-x}Al_xO_{12}$ various absorber temperatures of 20 to 700 K. The curie temperature T_C decreases with increasing Al^{3+} concentration (x) from x = 0.0 to 1.0 . The curie temperature T_C is determined to be 555 ± 3 K for x = 0.25. As the temperature increased toward T_C a systematic line broadening effect in the Mössbauer spectra was observed and interpreted to originate from different temperature dependencies of the magnetic hyperfine fields at various iron sites. It results from the distribution ($_6C_n$) of Fe^{3+} and Al^{3+} at tetrahedral site. The isomer shifts indicated that the iron ions were ferric at the octahedral *16a*-site and the tetrahedral *24d*-sites. The quadrupole splitting showed that the orientation of the magnetic hyperfine field with respect to the principal axes of the electric field gradient was random. Mössbauer spectra was analyzed with 3 subspectra of Fe sites *($16a_1$, $16a_2$* and *24d*) for $Y_3Fe_{4.75}Al_{0.25}O_{12}$, each hyperfine field of subspectra at 20 K were H_{hf} ($16a_1$) = 550, H_{hf}($16a_2$) = 547, and H_{hf}(24d) = 473 kOe, respectively. The area fractions of the Fe sites, $16a_1$, $16a_2$, 24*d* in $Y_3Fe_{4.75}Al_{0.25}O_{12}$ at 20 K were 25, 15, and 60 %, respectively. As increases Al concentration (x) from x = 0.0 to 1.0, the area saturation magnetization *Ms* is decreased from 32.9 to 7.8 emu/g at room temperature under an applied field of 10 kOe annealed at 1200 °C in air atmosphere for 6 hours.