ISPMM/ISAMT2001

International
Symposium on
Physics of
Magnetic
Materials

International Symposium on Advanced Magnetic Technologies

Grand Hotel Taipei, Taiwan May 13~16, 2001

Hosted By:

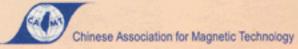
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MÖSSBAURE STUDIES OF Y3Fe4.75Al0.25O12

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Al³⁺ substituted garnet $Y_3Fe_{4,75}Al_{0.25}O_{12}$ was fabricated by a sol-gel method. The crystallographic and ma gnetic properties of $Y_3Fe_{4,75}Al_{0.25}O_{12}$ have been studied with Mössbauer spectroscopy, X-ray diffraction (XRD), thermogravimetry analaysis (TGA), differential thermal analysis (DTA), and vibrating samples magnetometer (VSM). The crystal structure is found to be a cubic with the lattice constant $a_0 = 12.361$ 2 ± 0.0005 Å. Mössbauer spectra of $Y_3Fe_{4,75}Al_{0.25}O_{12}$ measured at various absorber temperatures of 20 to 700 K. Its curie temperature T_C is found to be 555 ± 3 K. 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 io ns were ferric at the octahedral 16a-site and the tetrahedral 24d-sites. The quadrupole splits showed that the orientation of the magnetic hyperfine field with respect to the principal axes of the electric field g radient was random. Mössbauer spectra was analyzed with 3 subspectra of Fe sites $(16a_1, 16a_2, and 24d)$, 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 average hyperfine field $H_{hf}(T)$ of the $Y_3Fe_{4,75}Al_{0.25}O_{12}$ shows a temperature dependence of

$$[H_{hf}(T) - H_{hf}(0)] / H_{hf}(0) = -0.28(T/T_c)^{3/2} - 0.14(T/T_c)^{5/2}$$

for $T/T_N < 0.7$, indicative of spin-wave excitation. The area fractions of the Fe sites, $16a_1$, $16a_2$, 24d in $Y_3Fe_{4.75}Al_{0.25}O_{12}$ at 20 K were 25, 15, and 60 %, respectively. The saturation magnetization M_S was 21 emu/g at room temperature under an applied field of 10 kOe annealed at 1200 °C in air atmosphere for 6 hours.

Presentation: Poster

Category Code: B. Advance Magnetic Technologies

9. Soft Magnetic Materials and Applications

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