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Mössbauer studies of $NdFe_{10.7}Ti_{1.3}N_{\delta}$

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Abstract

$NdFe_{10.7}Ti_{1.3}N_{\delta}$ has been studied with X-ray diffraction, Mössbauer spectroscopy and vibrating-sample magnetometer (VSM). The alloys were prepared by arc melting under an argon atmosphere. The $NdFe_{10.7}Ti_{1.3}N_{\delta}$ contains some α-Fe, this was confirmed with X-ray diffraction and Mössbauer measurements. The $NdFe_{10.7}Ti_{1.3}N_{\delta}$ has the $ThMn_{12}$-type tetragonal structure with lattice constants $a_0 = 8.638$ Å and $c_0 = 4.819$ Å and its Curie temperature T_c is 743 ± 3 K. Mössbauer spectroscopy was performed at various temperatures ranging from 13 to 800 K. Each spectrum below T_c was fitted with six subspectra of Fe sites in the structure ($8i_1$, $8i_2$, $8j_2$, $8j_1$, 8f and α-Fe). The area fractions of the subspectra at room temperature are 16.3, 13.3, 11.8, 20.5, 31.9 and 6.2%, respectively. Magnetic hyperfine fields for the Fe sites decrease in the order, $H_{hf}(8i) > H_{hf}(8j) > H_{hf}(8f)$. The average hyperfine field $H_{hf}(T)$ of the $NdFe_{10.7}Ti_{1.3}N_{\delta}$ shows a temperature dependence of $[H_{hf}(T) - H_{hf}(0)]/H_{hf}(0) = -0.41(T/T_c)^{3/2} - 0.14(T/T_c)^{5/2}$ for $T/T_c < 0.7$, indicative of spin-wave excitation.

Keywords: Mössbauer spectroscopy; Magnetization; Rare-earth transition metal compounds – interstitial nitrides; Anisotropy fields