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Room-temperature ferromagnetic properties and Mössbauer investigation of the $0.7FeTiO_3$–$0.3Fe_2O_3$ solid solution

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Abstract

The $0.7FeTiO_3$–$0.3Fe_2O_3$ solid solution were prepared by slow cooling and quenching heat treatments and studied by X-ray diffraction, Mössbauer spectroscopy, and vibrating sample magnetometer (VSM). The crystal structure of samples were found to be rhombohedral structure with the lattice constants of the slow-cooled sample $a = 5.082$ Å and $c = 13.945$ Å, and those of the quenched sample $a = 5.085$ Å and $c = 13.964$ Å. Mössbauer spectra of two samples were taken at various temperatures ranging from 4.2 to 400 K and anomalous absorption curves are observed. Mössbauer spectra was fitted to three magnetic components correspond to Fe^{3+} and Fe^{2+} in A and B sublattices. At 4.2 K, the magnetic hyperfine fields were $H_{hf} = 512$, 481, and 309 kA/m for the slow-cooled sample and 512, 479, and 305 kA/m for the quenched sample, respectively. The Mössbauer spectra below the Néel temperature, T_N, reveal line broadening accompanying relaxation effects and intensity ratio different from usual powder pattern, indicating preferred spin orientation. The Néel temperature, T_N, was determined to be 380 K for the slow-cooled sample and 400 K for the quenched sample. The temperature dependence of the magnetization taken in zero-field-cooling (ZFC) and field-cooling (FC) condition of the slow-cooled and quenched samples exhibits the great irreversibility between ZFC and FC magnetization. Magnetization measurements have shown ferromagnetic hysteresis loops at room temperature.

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