

## Mössbauer studies of Fe<sup>2+</sup> and Fe<sup>3+</sup> mixed state in ilmenite–hematite solid solution

Woochul Kim · Seung Je Moon · Chul Sung Kim

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**Abstract** The 0.9FeTiO<sub>3</sub>–0.1Fe<sub>2</sub>O<sub>3</sub> solid solution was prepared by solid state reaction with FeTiO<sub>3</sub> and α-Fe<sub>2</sub>O<sub>3</sub> powders, and studied by x-ray diffraction, Mössbauer spectroscopy, and vibrating sample magnetometer (VSM). The crystalline structure was found to be single phase rhombohedral structure with lattice constant  $a = 5.089 \text{ \AA}$  and  $c = 14.051 \text{ \AA}$ . Mössbauer spectra of 0.9FeTiO<sub>3</sub>–0.1Fe<sub>2</sub>O<sub>3</sub> solid solution were taken at various temperatures ranging from 4.5 to 300 K. The anomalous absorption curves at low temperature are observed. Mössbauer spectra at 4.5 K was fitted to four six-line hyperfine pattern with magnetic hyperfine fields  $H_{\text{hf}} = 504, 424, 115, \text{ and } 58 \text{ kOe}$ , respectively. At 40 K the spectrum shows the mixture of ferromagnetic six-line pattern and paramagnetic two-line and above 50 K it show asymmetry two-line patterns. The fitted curves at room temperature are obtained by superimposing two doublets corresponding to Fe<sup>2+</sup> and Fe<sup>3+</sup>. The isomer shift  $\delta$  and quadrupole splitting  $\Delta E_{\text{Q}}$  of sample are 0.92 and 0.69 mm/s for Fe<sup>2+</sup> and 0.14 and –0.29 mm/s for Fe<sup>3+</sup>, respectively. Corresponding relative absorption subspectral areas are 89.2% for Fe<sup>2+</sup> and 10.8% for Fe<sup>3+</sup>. Magnetization measurements indicate ferromagnetic behaviour with 92 Oe coercivity value at 50 K but at 300 K it show no hysteresis loop.

**Keywords** Mössbauer spectroscopy · Ilmenite · Hematite