STRUCTURAL PROPERTIES OF $(Mn_{1-x}Fe_x)_2O_3$ SOLID SOLUTIONS

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Manganese-iron oxides with bixbyite structure are an active field of research, because there are technologically important materials with unusual physical properties [1, 2, 3]. Earlier studies showed that a solid state solution exists for the system $(Mn_{1-x}Fe_x)_2O_3$ with $0 \le x \le 0.6$ [4, 5].

The samples of composition $(Mn_{1-x}Fe_x)_2O_3$ with the range of $0.0 \le x \le 0.3$, were synthesized by coprecipitation of amorphous manganese-iron-hydroxides from the mixed Mn^{2+}/Fe^{3+}-nitrate solutions of the mole ratio of n_{Fe} = Fe/(Fe+Mn) = 0.0, 0.1, 0.2 and 0.3, with sodium hydroxide. Washed and dried at the room temperature, they were dehydrated for 2 h at 250ºC, and then underwent the thermal treatment in air, successively at 400ºC, 500ºC and 600ºC for 4 h. After heating, the preparations were cooled slowly to the room temperature, at a rate of about 20-30ºC per hour, during 24 h.

The X-ray diffraction experiments were carried out at the Desy/Hasylab high-resolution powder diffractometer at the beamline B2, equipped with Image Plate OBI detector [6, 7]. The wavelength, determined by calibration using NIST standard, was λ = 0.49602 Å. Full patterns were collected at room temperature in the 2-theta range of 4.0º – 60.0º, with a step size of 0.004º. The structure refinements were performed using the FullProf program [8].

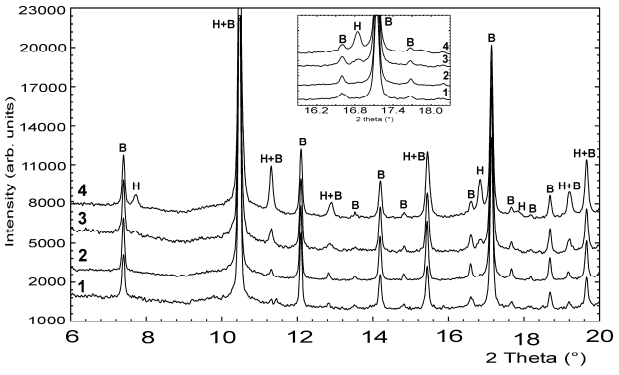

Figure 1. Experimental X-ray powder diffraction patterns of 1. Mn_2O_3 (n_{Fe} = 0.0), 2. $Mn_{1.8}Fe_{0.2}O_3$ (n_{Fe} = 0.1), 3. $Mn_{1.6}Fe_{0.4}O_3$ (n_{Fe} = 0.2) and 4. $Mn_{1.4}Fe_{0.6}O_3$ (n_{Fe} = 0.3) oxides, recorded at the room temperature, (B – bixbyite phase, H – hematite phase).

The preliminary studies have shown single crystalline phase with bixbyite structure only up to the first compound with the iron ions, $Mn_{1.8}Fe_{0.2}O_3$ (n_{Fe} = 0.1). Furthermore, at higher iron concentrations, second different phase of hematite-like structure was found. The X-ray diffraction patterns of these samples are shown in Fig. 1. An example of two-phase system fitting for the $Mn_{1.6}Fe_{0.4}O_3$ (n_{Fe} = 0.2) pattern is presented in Fig. 2.

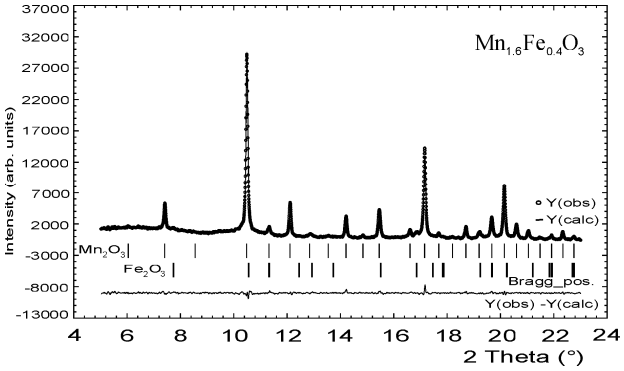

Figure 2. Rietveld refinement pattern of the $Mn_{1.6}Fe_{0.4}O_3$ (n_{Fe} = 0.2) oxide for the XRD data measured at room temperature.

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