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ABSTRACTS

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○ Session ST[Spin transfer torque for magnetic memory]

○ Session JR[Junior Session]

Magnetic properties of $NaFe_{0.9}Mn_{0.1}PO_4$ by Mössbauer spectroscopy

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Maricite-type $NaFePO_4$ is promising for use as the cathode in Na-ion batteries because it is advantages of environmental friendliness and low-cost. However, it has low electrochemical conductivity and poor performance than other materials. Mn-based phosphate has higher redox reduction potential than Fe-based phosphate. Therefore, $NaMnPO_4$ can obtain higher potential than $NaFePO_4$. In this paper, we have substituted other transition-metal ions such as Mn ions for Fe sites and investigated the hyperfine electromagnetic interaction of Fe ions. The crystal structure and magnetic properties of the as prepared materials were studied by X-ray diffraction (XRD), vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The $NaFe_{0.9}Mn_{0.1}PO_4$ sample was prepared using the ball mill method. Structure refinement of $NaFe_{0.9}Mn_{0.1}PO_4$ was analyzed using Fullprof program. The crystal structure of $NaFe_{0.9}Mn_{0.1}PO_4$ sample was found to be orthorhombic with space group of *Pmnb*. Lattice parameters of $NaFe_{0.9}Mn_{0.1}PO_4$ are as follows: a_0 = 6.866 Å, b_0 = 8.988 Å, c_0 = 5.047 Å, and V = 311.544 $Å^3$. The zero-field-cooled (ZFC) and field-cooled (FC) curves were examined by VSM at 100 Oe from 4.2 to 295 K. The magnetic susceptibility curves showed that antiferromagnetic behavior below Néel temperature (T_N = 14 K). We have investigated the magnetic hyperfine interaction using Mössbauer spectroscopy at various temperatures between 4.2 and 295 K. At 4.2 K, the magnetic hyperfine field (H_{hf}), the electric quadruple splitting (ΔE_Q), and isomer shift (δ) are found to be H_{hf} = 166.09 kOe, ΔE_Q = 2.18 mm/s, and δ = 1.24 mm/s. The room-temperature Mössbauer spectrum showed one-doublet with measured values of ΔE_Q = 2.20 mm/s and δ = 1.08 mm/s. We confirmed that T_N of $NaFe_{0.9}Mn_{0.1}PO_4$ are lower than those of pure $NaFePO_4$ (T_N = 15 K). This is due to the Fe-O-Mn superexchange interaction being lower than that of the Fe-O-Fe link.

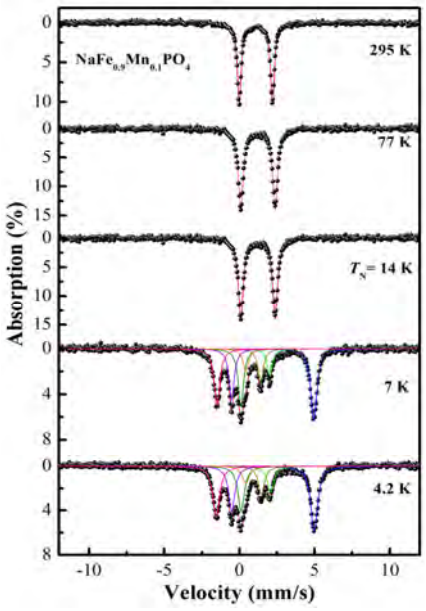

Fig. 1. Mössbauer spectra of $NaFe_{0.9}Mn_{0.1}PO_4$ at various temperature range from 4.2 to 295 K.