Magnetic Structure and transition temperature of $SrV_{0.3}Fe_{0.7}O_{2.8}$

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The magnetoresistance effect has attracted considerable attention due to its potential for industrial applications, such as magnetic sensors and memory devices. We focus our attention on magnetoresistance on iron-based oxides since iron is earth abundant and many iron-based compounds have high magnetic transition temperature. Here, we successfully synthesize a novel iron-based oxide, $SrV_{0.3}Fe_{0.7}O_{2.8}$ (Fig. 1). In this compound, oxygen vacancies are ordered, leading layered structure of double tetrahedral and triple octahedral layers. Metal ions are also ordered. 100% of Fe ions occupy octahedral sites and 25% of Fe and 75% of V ions occupy tetrahedral site. This compound exhibits magnetic ordering and shows a large negative magnetoresistance at room temperature. So, we carried out neutron powder diffraction (NPD) measurement to determine magnetic structure and clear the origin of magnetoresistance. In previous NPD measurement, we observed new peaks at the position of the lattice with $c' = 2c$. There are two possible origins of these peaks, magnetic ordering with the magnetic propagation vector $\boldsymbol{k}$ = (0 0 3/2), and cation ordering at tetrahedral layers hidden in XRD measurement. In this study, we carried out the NPD measurement of $SrV_{0.3}Fe_{0.7}O_{2.8}$ at high temperature (300 – 550 K) to determine the origin of new peaks and determine magnetic structure. The NPD measurements were carried out on HERMES of the Institute for Material Research, Tohoku University, installed at the T1-3 port in the guide hall of JRR-3 reactor. The incident neutron was monochromated to 2.19647 Å by the 331 reflection of Ge Crystals. A polycrystalline sample of 2.23 g was placed into an N2-filled vanadium cylinder. The data were collected with a 3He tube detectors in a 2theta range from 5° to 155° with a step width of 0.1°.

Figure 2 shows the temperature dependence of NPD patterns of $SrV_{0.3}Fe_{0.7}O_{2.8}$. The intensities of new peaks decrease with increasing temperature and disappear at 500 K. If there is the cation ordering at tetrahedral layers, peaks are expected to remain at higher temperature. So, these peaks are originated from only magnetic ordering. We carried out Rietveld refinement for the ND data to obtain magnetic structure. According to the refinement, this compound is G-type antiferromagnet.

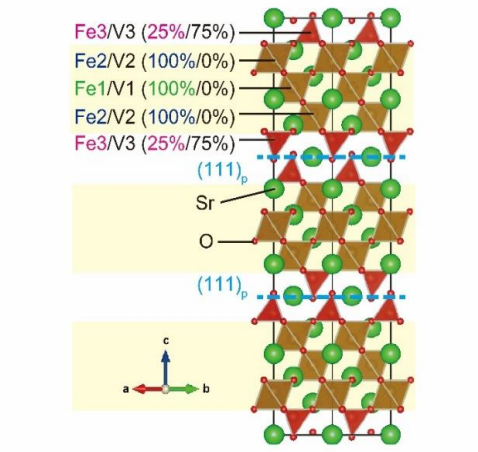

Fig. 1. Crystal structure of $SrV_{0.3}Fe_{0.7}O_{2.8}$

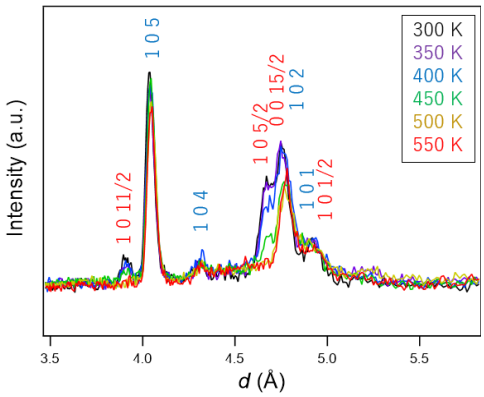

Fig. 2. Neutron diffraction patterns of $SrV_{0.3}Fe_{0.7}O_{2.8}$ on high temperature (300 – 550 K). Magnetic peaks (red index) disappear at 500 K.