

# Magnetic structure of Cr doped $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$

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Perovskite oxides show various properties due to its various composition and related structures. We focus our attention on perovskite with ordered oxygen vacancies along  $[111]_{\text{pc}}$  (pc: pseudo cubic) direction, namely 15R-structure (Fig. 1a). This structure is composed of stacking of double tetrahedral and triple octahedral layers. We reported novel 15R-structure oxide,  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$  in previous work [1].  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$  shows negative magnetoresistance of  $-5.6\%$  at 9 T and room temperature. This oxide also shows weak ferromagnetism by canted moments, namely large MR-magnetism ratio. So, if magnetism is made larger by chemical substitution, the magnetoresistance is expected to be enhanced. Here, we synthesized Cr-doped  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$ . The saturation moment and the magnetoresistance become larger as Cr increases. The magnetoresistance is enhanced from  $-5.6\%$  to  $-8.6\%$  at 9 T and room temperature in 5% Cr doped sample. However, the relationship that magnetoresistance is proposal to square of magnetization was broken. There are several possible origins of enhancement and change of magnetoresistance behavior, such as the change of magnetic structure including canted moments. So, it is important to determine the magnetic structure for understanding the magnetoresistance. In addition, we determine the crystal structure including occupancies of Cr in Fe/V sites.

In this study, we measured neutron powder diffraction of 5%Cr-doped  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$  at 30, 100, 200, 300, 400, 500, 550, 600 K. A polycrystalline sample of 2.15 g was placed into a He-filled vanadium cylinder. The neutron powder diffraction data was collected using HERMES of the Institute for Material Research, Tohoku University, installed at the T1-3 port in the guide hall of JRR-3 reactor in Japan Atomic Energy Agency (JAEA), Tokai.

Figure 1b shows the temperature dependence of powder neutron diffraction patterns. There are same magnetic reflections around  $d = 2.4, 3.9,$  and  $4.6 \text{ \AA}$ . These peaks show the existence of magnetic ordering with the magnetic propagation vector,  $\mathbf{k} = (0 \ 0 \ 3/2)$ . This propagation vector is same to that of non-doped  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$ . So, the magnetic structure is expected to be basically unchanged by chemical doping. We also compared magnetic phase transition temperature. The magnetic reflections disappear at 550 K, suggesting the magnetic phase transition temperature is between 500 and 550 K. It is higher than that of non-doped  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$ . This increasement came from the replacement of  $\text{V}^{5+}$  without d-electron to  $\text{Cr}^{5+}$  with a d-electron. To understand the magnetic behaviors, we will determine the detailed crystal and magnetic structures by Rietveld analysis for powder neutron diffraction patterns at 600 K and 300 K.

[1] T. Nagase *et al.*, *Inorg. Chem.* **61**, 8987–8991 (2022).

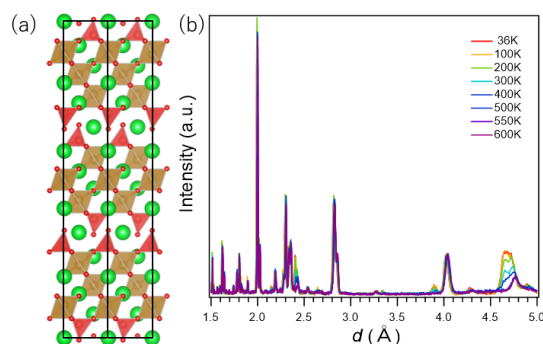


Fig. 1. (a) 15R-structure. (b) Neutron diffraction patterns of Cr-doped  $\text{SrV}_{0.3}\text{Fe}_{0.7}\text{O}_{2.8}$  at 30, 100, 200, 300, 400, 500, 550, 600 K.