

Effect of Cationic Ordering in Double Perovskite $\text{Sr}_2\text{FeReO}_6$ on Its Magnetic Properties

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Double perovskites with formula $\text{A}_2\text{BB}'\text{O}_6$ have been extensively studied in the last years because their half-metallic ferromagnetism leads to promising expectation for spin devices and effect of tunneling magneto-resistance[1]. $\text{Sr}_2\text{FeReO}_6$ (SFRO) has been known as a conduction ferromagnet with a fairly high magnetic transition temperature (T_c) of 401K[2]. The magnetic structure of $\text{A}_2\text{BB}'\text{O}_6$ is known to originate from the ordered arrangement of parallel $\text{Fe}^{3+}(3d^5, S=5/2)$ magnetic moments, antiferromagnetically coupled with $\text{Re}^{5+}(5d^2, S=1)$ spins. In these oxides, the properties of the material are thought to critically depend on this ordering (B-site)[3]. In this study, effects of excessive Re on the cationic ordering and the magnetic properties in $\text{Sr}_2\text{FeReO}_6$ (SFRO) perovskite have been investigated. The SFRO and the SCRO powder was prepared via a conventional solid state reaction for 24hr and annealed at 1000°C(SFRO) for 10hr in Ar. The prepared powders were sintered by Spark Plasma Sintering (SPS) at 1150°C for 20min in Ar. Their structural and morphological properties were characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM), and their magnetic properties were measured via Vibrating Sample Magnetometer (VSM). The measured values of the saturated magnetizations(M_s) of SFRO which are lower than the predicted value; it is commonly thought that this effect could be related to antisite defects in the B/B' sublattices. XRD results also confirm that cationic ordering of Fe and Re, which is well known to be one of major parameters to affect the magnetic properties in SFRO, maintain with a high degree (99%) in case of excessive 15wt% Re addition in Fig. 1. VSM measurements also show that M_s value of SFRO-15wt% Re sample were increased. Because the M_s value of SFRO are mainly originated from the cationic ordering percentage, these results directly demonstrate that excess of Re enhance cationic ordering in SFRO shown in Fig. 2. TEM results show that cationic ordering is well aligned in SFRO-15wt% Re sample, compare to SFRO-0wt% Re sample in Fig 3.

References

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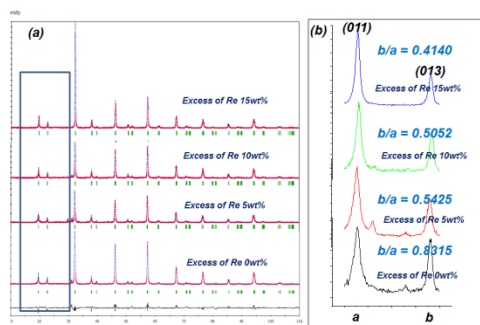


Figure 1. (a) X-ray diffraction refinement; (b) Enlarged view of the spectrum between 19° and 21° .

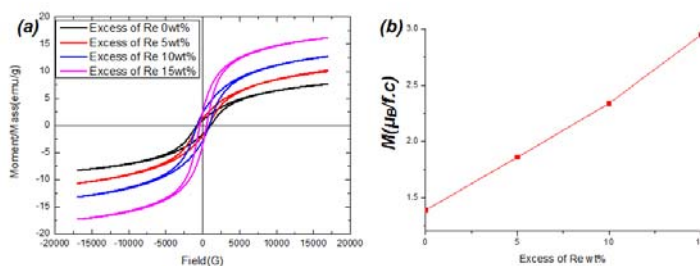


Figure 2. (a) Measured magnetic moment via VSM on increasing amount of Re content; (b) change of the magnetic saturation (M_s)

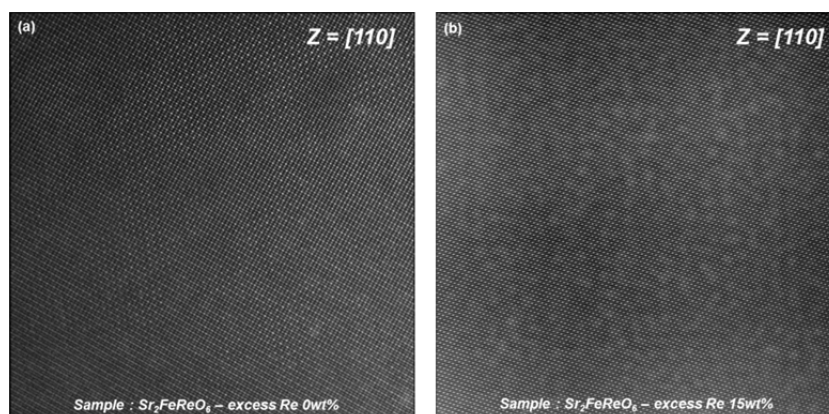


Figure 3. High-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) images of the (a) SFRO-0wt% Re sample, and (b) SFRO-15wt% Re sample.