

## Supporting Information

### **Sr<sub>2</sub>FeO<sub>3</sub> with Stacked Infinite Chains of FeO<sub>4</sub> Square Planes**

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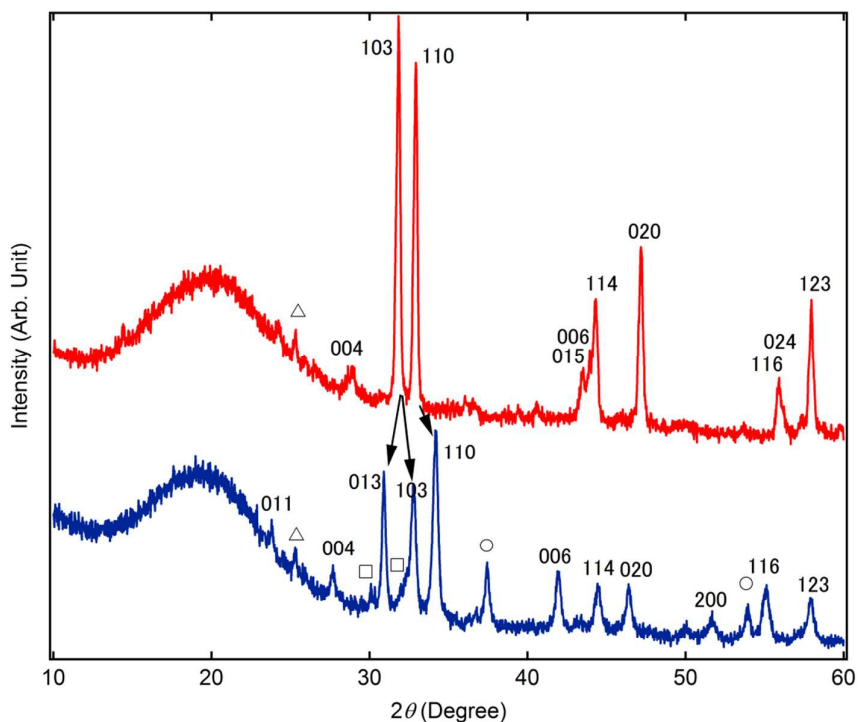
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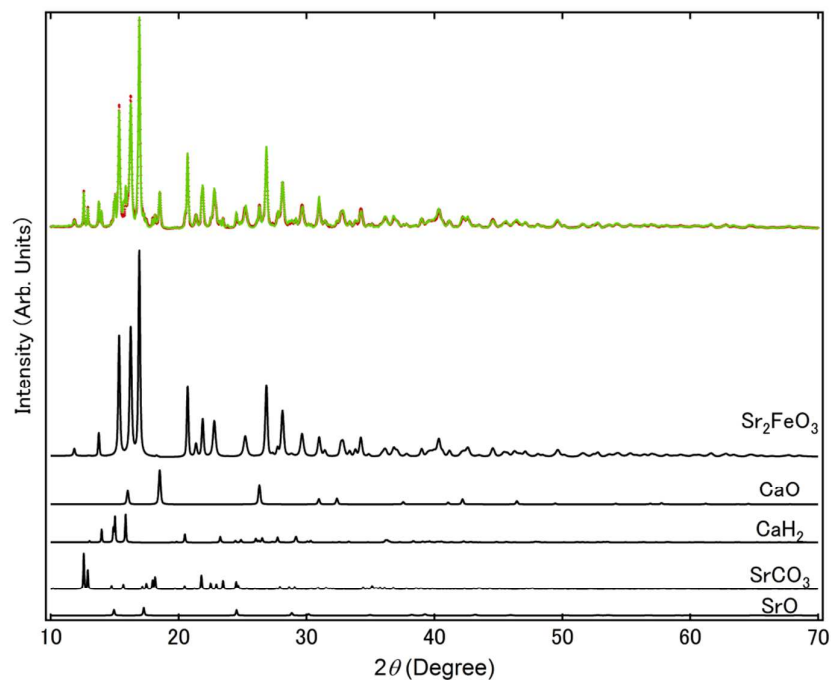
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#### **FIGURE S1. Laboratory x-ray powder diffraction pattern of Sr<sub>2</sub>FeO<sub>4</sub> and Sr<sub>2</sub>FeO<sub>3</sub>**

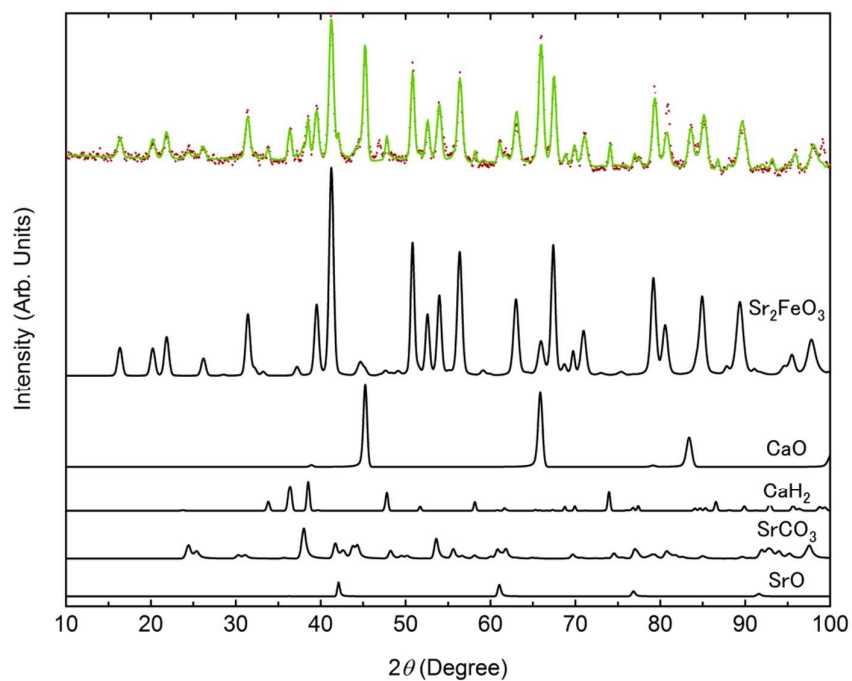
The red and blue curves represent the Sr<sub>2</sub>FeO<sub>4</sub> and Sr<sub>2</sub>FeO<sub>3</sub> data, respectively. The black triangle, square and circles indicate peaks of SrCO<sub>3</sub>, CaH<sub>2</sub> and CaO, respectively.



**FIGURE S2. Split view of the patterns of the different phases for the synchrotron x-ray powder diffraction at room temperature.**



**FIGURE S3. Split view of the patterns of the different phases for the Neutron powder diffraction at 9 K.**

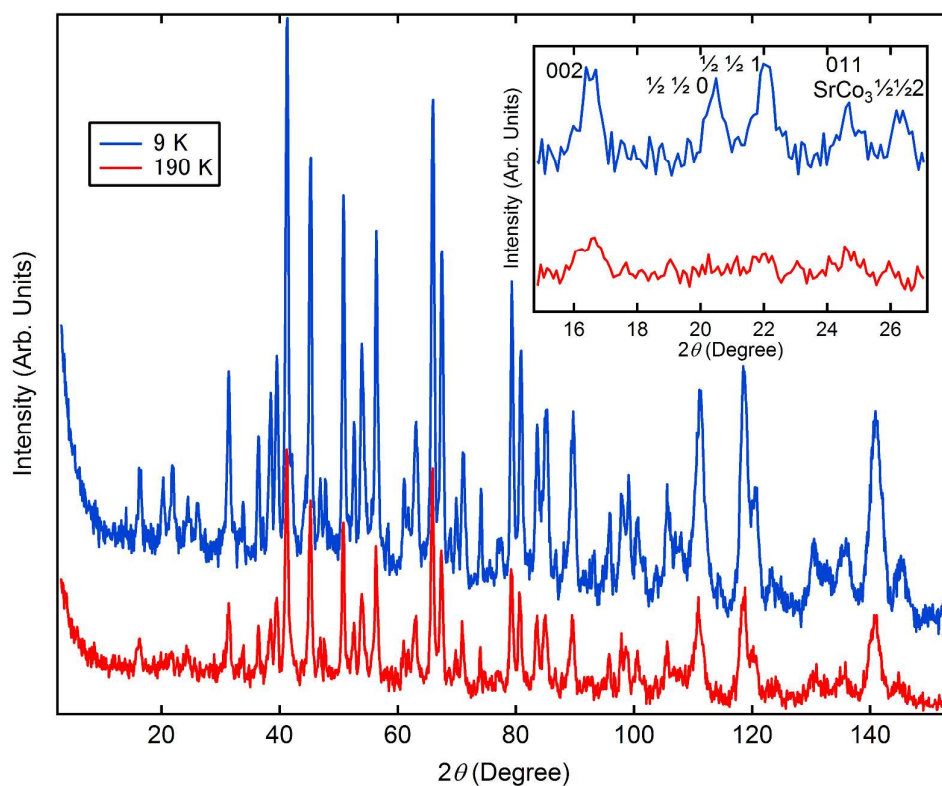


**TABLE S1. Selected Full Width at Half Maximum (FWHM) of several peaks of  $\text{Sr}_2\text{FeO}_3$  from SXRD.**

The position and FWHM of the peaks were determined using a Voigt profile.

	Position $2\theta$ (°)	FWHM (°)
011	11.84	0.168
013	15.35	0.146
103	16.25	0.177
110	16.92	0.159
002	6.86	0.084
004	13.75	0.107
006	20.7	0.139

**FIGURE S4. Neutron powder diffraction: Evolution of the magnetic peaks of  $\text{Sr}_2\text{FeO}_3$  against temperature.**



**FIGURE S5. Partial representation of the spin arrangement of  $\text{Sr}_2\text{FeO}_3$ . The 4 spins of one  $ab$  plane and 1 spin of the adjacent plane.**

