Single-crystal structure analysis of spinel oxide FeV$_2$O$_4$ having orbital degree of freedom both in Fe and V ions

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Introduction

Crystal Structure of Spinel Oxide

- Various types of spinel oxides with orbital degree of freedom

Experimental

- Sample size: ~ 20 mg
- Temperature range: 150K~90K
- Crystal growth: Sample size ~ 25 μm × 25 μm
- Synchronous x-ray diffraction
- X-ray wave length: λ = 0.3486Å

Results and Discussion

- Temperature dependence of lattice constants and three-dimensional plot of x-ray oscillation photographs at each phase in FeV$_2$O$_4$
- Almost single domain state was obtained in every phase, and we carried out single-crystal structure analysis using the most strong peak surrounded by a blue circle.

Temperature dependence of distortion of FeO$_4$ and VO$_6$ in FeV$_2$O$_4$

- 1. Successive structural phase transition (cubic→orth.-octa.→orth.→cubic)
- 2. Magnetic-field-induced crystallographic domain switching

Forbidden reflection by $d_{g6}$-fold symmetry operation.

- Global distortion almost corresponds to FeO$_4$ distortion, suggesting FeO$_4$ distortion is more dominant than VO$_6$, one.

Conclusion

We have carried out a single-crystal structure analysis of FeV$_2$O$_4$ and MnV$_2$O$_4$ by means of synchrotron x-ray diffraction.