Neutron diffraction study in a new multiferroic compound SrCo2V2O8

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SrCo2V2O8 is a model compound for one dimensional S = 3/2 spin chain.
Co2+ ions that carry localized magnetic moments form four-fold spiral chain along the crystallographic c axis. Magnetic susceptibility exhibits broad maximum at T ˜ 40 K due to antiferromagnetic short range order. The ground state is weak ferromagnetic ordered state with TN = 5 K of which the origin would be Dzyaloshinskii-Moriya interaction. In magnetic field, the ordered state is suppressed and the disordered state seems to appear. This type of phase diagram is typical of one dimensional XXZ spin chain. The most prominent behavior of this compound is enhanced magnet-electric effect. Spontaneous electric polarization is identified in the weak ferromagnetic ordered phase and the polarization disappears in the disordered phase. To understand the origin of the multiferroic behavior, the determination of the magnetic structure is important. In addition it would be interesting to study the field dependence of the weak ferromagnetic structure.

Fortunately, we obtained a single crystal sample then we changed our plan.
We performed neutron scattering measurement at four-circle diffractometer, TriCS installed at a neutron spallation source SINQ, PSI. A single crystal (5mm cubic) of SrCo2V2O8 was used in this measurement. Nuclear and magnetic Bragg peaks were corrected at T = 2 ? 10 K with magnetic field H = 0 ? 60 kOe using liquid He cryostat with a superconducting magnet. The magnetic field was induced along c-axis of which magnetization was sensitive to magnetic field. We collected the data for two setting and collected the peaks on (h k 0) plane with magnetic field and on (h 0 l) with zero field. At 10 K with zero field, small forbidden peaks were observed; the crystal structure had lower symmetry than reported structure. The magnetic peaks with k = (1 0 0) was observed below TN = 5.014(7) K. In magnetic field, those magnetic peaks were suppressed and vanished above 5 kOe. We also measured the intensity mapping using on zero magnetic field and 60 kOe at 2 K (Fig. 1). Other peaks were not observed at H = 60 K. As with macroscopic measurement, the disordered state was observed. The magnetic structure of the ordered state was nearly collinear structure and antiparallel along c-axis. The evidence of small modulation which would be the origin of magnet-electric properties were observed as small magnetic peaks at (0 0 l), but accurate structure model could not proposed.

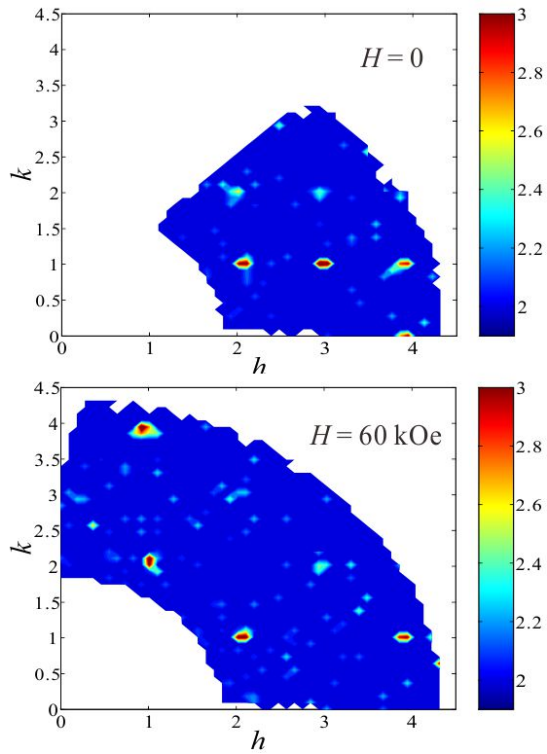

Fig. 1. Neutron diffraction data of SrCo2V2O8