Antiferromagnetic ordering of Ca3Ru2O7

Y. Yoshida(A), K. Iwata(B), N. Aso(C), S. Katano(B)
(A)AIST, (B)Saitama univ., (C)ISSP-NSL Univ. Tokyo,

Double layered Ruddlesden-Popper (R-P) type Calcium ruthenate, Ca3Ru2O7, shows an antiferromagnetic ordering below 56K and a metal-nonmetal transition at 48K.[1] Recent study revealed that Ca3Ru2O7 shows anisotropic behavior in the transport properties, and is a quasi-two-dimensional metal below 30K.[2] Powder neutron diffraction study and thermal expansion measurement clarified that the transition at 48K accompanies jumps of all lattice parameters.[3,4] As to the magnetic structure of Ca3Ru2O7, it was speculated by the magnetic peak from the powder neutron diffraction study. In the magnetic ground state, magnetic moments align ferromagnetically along b-axis within the double layer and antiferromagnetically between the double layers.[4] Since the magnetic anisotropy in the magnetic susceptibility was changed at the structural transition, the magnetic structure between 48 and 56K has not been clarified yet.

In order to clarify the magnetic structure of Ca3Ru2O7, we performed a neutron diffraction study with a single crystalline Ca3Ru2O7. Elastic neutron scattering experiments were performed on the triple-axis spectrometer T1-1 installed at the reactor hall at JRR-3. The incident neutron wave number was 2.555 -1. The spectrometer was operated with a 2-axis mode with the holizontal collimaitons of G-80′-60′. A PG filter was used to reduce the higher-order contaminations. The sample was placed in an aluminum can filled with He gas, and mounted in a conventional cryocooler. The nuclear and magnetic peaks were obtained below 70K.

Besides nuclear peaks, inequivalent 22 magnetic peaks were observed at 10K in both (0, k, l) and (h, 0, l) planes. Figure 1 shows temperature dependence of the peak intensities of the magnetic Bragg (0,0,1) and (0,2,1). With increasing temperature, the peak intensity of (0,0,1) suddenly decreased at 48K, while that of (0,2,1) increased abruptly. This indicates that the direction of magnetic moments changes from the b-axis to the a-axis at the structural transition.

[1] G. Cao et al., PRL 78, 1751, (1997).
[2] Y. Yoshida et al., PRB 69, 220411 (2004).
[3] E. Ohmichi et al., PRB 70, 104414 (2004).
[4] Y. Yoshida et al., PRB 72, 054412 (2005).

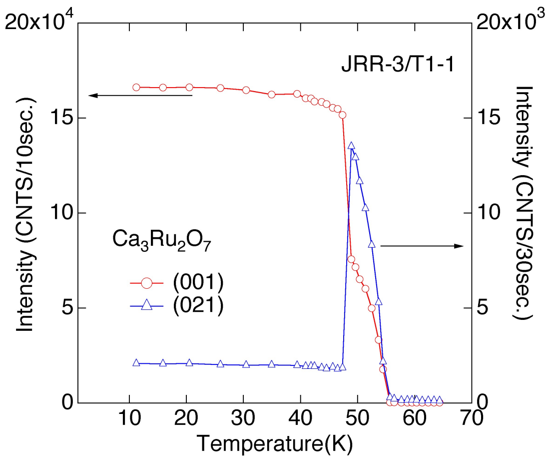

Fig. 1. Temperature dependence of the peak intensities of (0,0,1) and (0,2,1)