Magnetic Correlation in the Kondo-Semiconductor-like Material $CeOs_4Sb_{12}$

K. Iwasa[1], S. Itobe[1], M. Kohgi[2], C. Yang[1], K. Kuwahara[2], H. Sugawara[3], H. Sato[2], N. Aso[4]

Tohoku Univ.[1], *Tokyo Metropolitan Univ.*[2], *The Univ. of Tokushima*[3], *Univ. of Tokyo*[4]

$CeOs_4Sb_{12}$ has been considered as a Kondo semiconductor characterized by a band gap of around 10 K estimated from the temperature dependence of electrical resistivity, while it shows the large T-linear coefficient of specific heat γ = 200 mJ/K^2/mol (E. Bauer *et al.*: J. Phys.: Condens. Matter **13** (2001) 4495, H. Sugawara *et al.*: Phys. Rev. B **71** (2005) 125127). Previous inelastic neutron scattering experiment revealed no clear crystal filed excitation, in contrast to the Curie-Weiss behavior of magnetic susceptibility above 100?K (C. P. Yang *et al.*: J. Phys. Soc. Jpn. **74** (2005) 2862). It is notable that this material shows a phase transition at 0.9 K under zero magnetic field and the ordering temperature is enhanced by applied magnetic fields. The low-temperature magnetic instability is expected to be a formation of spin density wave (SDW) by the enhanced density of state at the Fermi level under magnetic field, as discussed in the theoretical arguments based on the periodic Anderson model (T. Ohashi *et al.*: Phys. Rev. B **70** (2004) 245104).

We performed neutron diffraction experiment using the triple-axis spectrometers TOPAN (6G) and HER (C1-1) and the dilution refrigerator of ISSP, Univ. of Tokyo. We succeeded in observing weak antiferromagnetic reflections characterized by the wave vector **q** = (1 0 0) below the ordering temperature. Assuming the magnetic ordering at the Ce-ion sites forming the bcc lattice, we evaluated the ordered moment magnitude of $(0.07 \pm 0.02)\mu_B$/Ce that is consistent with the SDW scenario. On the other hand, the antiferromagnetic peak disappears above 1 T in contrast to the reported enhancement of the transition temperature. The electronic state changes from the less-conductive state with the antiferromagetic ordering in the low field region to the metallic one above 1 T without the antiferromagnetic state. We have tried to identify an order parameter in the higher magnetic field region above 1 T, and carried out the polarized neutron diffraction using PONTA (5G) and TOPAN (6G). The observed flipping ratio intensities were transformed into the magnetic form factor, as shown in Fig. 1. Although the data points scatter owing to low statistics from the tiny magnetic moment even under magnetic moment, the overall feature against the scattering vector coincides with the calculated one for Ce^{3+} based on the dipole approximation shown by the solid line. No clear change was seen in the form factor across the phase boundary, thus the magnetic moment distribution has no trace of the ordering nature. We will continue the measurement to reveal the order parameter in the high magnetic field region.

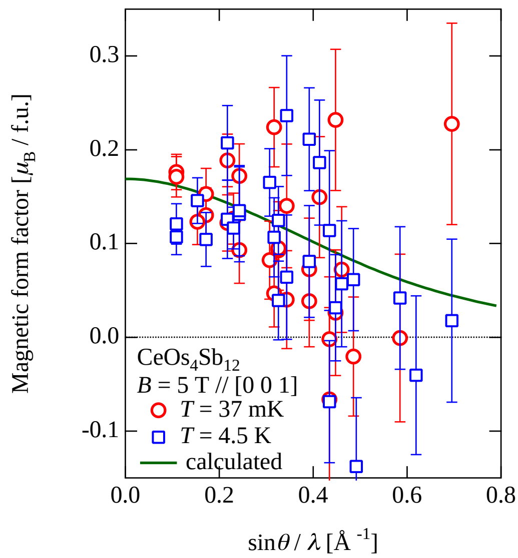

Fig. 1. Magnetic form factors of $CeOs_4Sb_{12}$ at 5 T.