Antiferromagnetic Phase Transition in the Kondo Semiconductor $CeOs_4Sb_{12}$

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$CeOs_4Sb_{12}$ has 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 $\gamma = 200\mathrm{mJ/K^2/mol}$ (E. Bauer *et al.*, J. Phys.: Condens. Matter 13 (2001) 4495, H. Sugawara *et al.*, Phys. Rev. B 71 (2005) 125127). Our previous inelastic neutron scattering experiment revealed no clear crystal-filed excitation, in contrast to the Curie-Weiss behavior of magnetic susceptibility in higher temperature region (C. P. Yang *et al.*, J. Phys. Soc. Jpn. 74 (2005) 2862). These facts indicate that $CeOs_4Sb_{12}$ is a so-called Kondo semiconductor due to the strong c-f hybridization. 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. SDW or CDW transitions are suggested from the Sb-NQR result in the ordered phase (M. Yogi *et al.*, J. Phys. Soc. Jpn. 74 (2005) 1950).

In order to identify the nature of ordering in $CeOs_4Sb_{12}$, we performed neutron diffraction experiment at the triple-axis spectrometer TOPAN (6G) and HER (C1-1). We adopted the dilution refrigerator of ISSP, Univ. of Tokyo. A single crystal sample synthesized by the Sb-flux method was cooled down to 0.1 K.

We succeeded in observing weak antiferromagnetic reflections characterized by a wave vector $\mathbf{q} = (1\ 0\ 0)$ below the ordering temperature, as shown in the figure. Assuming the magnetic ordering at the Ce-ion sites forming the *bcc* lattice, we evaluated the ordered moment value of around $0.05\mu_B/\mathrm{Ce}$. Such a tiny ordered magnetic moment as well as the unusual phase diagram are consistent with the SDW-like antiferromagnetic instability due to the c-f hybridization as proposed in the theoretical works on Kondo semiconductors (T. Ohashi *et al.*, Phys. Rev. B 70 (2004) 245104, Y. Imai *et al.*, J. Phys. Soc. Jpn. 75 (2006) 033706). On the other hand, the antiferromagnetic peak disappears above 1 T in contrast to the reported phase diagram. The antiferromagnetic region coincides with that of large magnitude of electrical resistivity. Thus, we expect that the electronic state change from the gapped state in the low field region to the metallic one above 1 T correlates with the magnetic state.

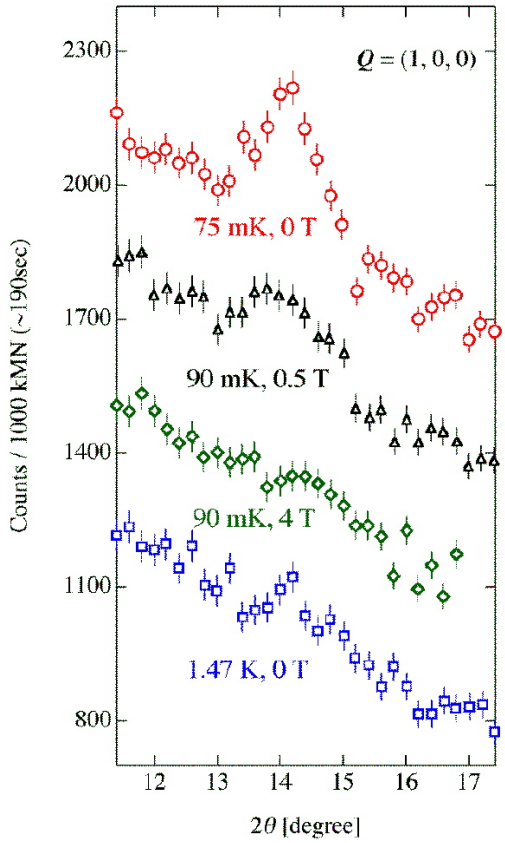

Fig. 1. Scan profiles through $\mathbf{Q} = (1\ 0\ 0)$ of $CeOs_4Sb_{12}$.