Magnetic Torque Anomaly in the Heavy Fermion Antiferromagnet U_2Zn_{17}

Y. Haga, Y. Matsumoto (Japan Atomic Energy Agency); E. D. Bauer (LANL); E. S. Choi (NHMFL); Z. Fisk (JAEA/UC-Irvine/LANL)

Introduction

A heavy fermion compound U_2Zn_{17} is known to show a long range antiferromagnetic ordering at T_N = 10 K. The large electronic specific heat in paramagnetic and magnetically ordered state indicates that the antiferromagnetism is carried by the heavy 5f electrons. Earlier magnetization measurements demonstrate that antiferromagnetic state is destroyed to form a field-induced paramagnetic state through a metamagnetic transition around 30 T. It should also be noted that the metamagnetic-like anomaly remains above T_N [1]. The aim of the present study is to investigate the metamagnetic transition/crossover from the viewpoint of magnetic anisotropy.

Experimental

Single crystal samples of U_2Zn_{17} were prepared using Bridgman method at LANL. The sample located on a cantilever magnetometer. The sample was cooled down in a 3He cryostat and magnetic field up to 35 T was applied as a function of field angle.

Results and Discussion

Figure 1 shows the magnetic torque signal measured on U_2Zn_{17} single crystal with the magnetic field H parallel to the c-plane. The measurement was carried out at different temperatures both in the antiferromagnetic ground state (T < 10 K) and paramagnetic state (T > 10 K). At sufficiently high temperature 40 K, magnetic torque signal follows H_2 at low field corresponding to the $_H$-linear magnetization in the paramagnetic state. There is slight deviation at high fields. The deviation becomes more significant with decreasing temperature down to 5 K. The present result demonstrates the development of in-plane anisotropy at low temperature, which is most likely closely related to the metamagnetic behavior observed in the high-field magnetization. This anomaly is also related with the broad maximum in magnetic susceptibility and formation of coherent heavy Fermi liquid state observed in resistivity. The present observation would therefore contribute to understanding the formation of heavy fermion state in this compound as well as other system with metamagnetic behavior.

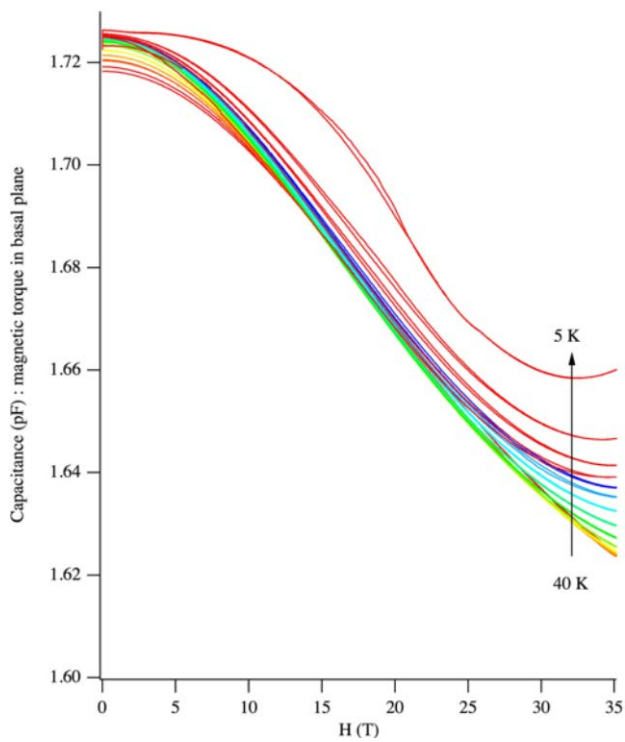

Figure 1. Magnetic torque measured under magnetic field parallel the c-plane in U_2Zn_{17}.

Concluding remark

We have observed a significant in-plane anisotropy of a heavy fermion antiferromagnet both in antiferromagnetic and paramagnetic states at high field. Further analyses of this result would lead to the determination of magnetic easy axis and origin of magnetic anisotropy.

References

[1] Tateiwa, N., *et al.*, J. Phys. Soc. Jpn., **80**, 014706 (2011).