Upper critical field of layered organic superconductor, $(TMTSF)_2ClO_4$

Hidetaka Satsukawa[1], Motoi Kimata[1], Atsushi Harada[1], Taichi Terashima[1], Shinya Uji[1, 2] and Jun-ichi Yamada[3]

[1] *National Institute for Materials Science, Japan.*

[2]*Graduate School of Pure and Applied Sciences, University of Tsukuba, Japan*

[3]*University of Hyogo, Japan*

Email: SATSUKAWA.Hidetaka@nims.go.jp

One of the Bechgaard salts, $(TMTSF)_2ClO_4$ exhibits superconducting transition at about 1.4 K. When the magnetic field is applied parallel to the conducting *ab* plane, it is reported that the upper critical field (H_{C2}) amounts to about 5 T at low temperatures, which is much higher than Pauli limit field (H_{Pauli}~2.6 T) [1-3]. So far, T_C and H_{C2} have been mainly determined by resistance measurements. In low dimensional systems, it is well-known that resistance decrease due to large superconducting fluctuations might cause over-estimation of T_C and H_{C2}. Therefore, thermodynamic measurements are required to determine the superconducting phase diagram unambiguously.

To re-examine H_{C2} of $(TMTSF)_2ClO_4$, we have performed systematic measurements of the field-angle-dependence of magnetic torque and interlayer resistance (R_{ZZ}) for a same single crystal. The magnetic torque curves (Fig. 1) show characteristic angular dependence at field angles close to 90 degrees (H//plane). Distinct steep linear slope at 90 degrees is caused by Meissner or pinning effect of vortices along the perpendicular to the superconducting *ab* plane. The sudden changes to the background are interpreted as lock-in transitions of the vortices.

These behaviors are suppressed as the field increases, and is not appreciable above H_{Pauli}. The resistance R_{ZZ} is zero within the experimental error below H_{Pauli}, but shows finite values above H_{Pauli}. These results clearly show that H_{C2} does not exceed H_{Pauli}. We will show the phase diagram determined from these measurements and discuss the superconducting fluctuation effect on these quantities.

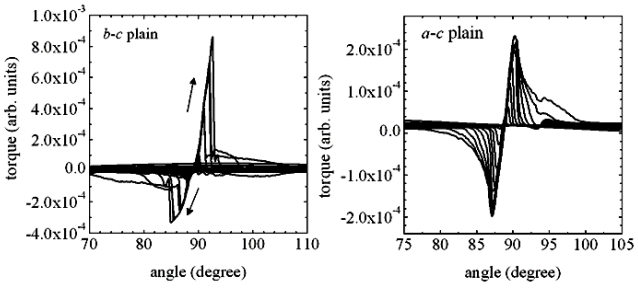

Fig. 1: Angular dependence of magnetic torque at about 0.2 K

[1] J. I. Oh *et al*., Phys. Rev. Lett. **92** (2004) 067001.

[2] I. J. Lee *et al*., Synth. Met. **70** (1995) 747.

[3] S. Yonezawa *et al*., J. Phys. Soc. Jpn. **77** (2008) 054712.