Superconducting Phase Diagram of $(TMTSF)_2ClO_4$

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The organic superconductor $(TMTSF)_2X$ (X = ClO_4, PF_6, etc.) is an archetypal quasi–one-dimensional (Q1D) system with a simple electronic structure. The superconducting phase diagram of this family is an interesting and important issue. It has been revealed that superconductivity in $(TMTSF)_2X$ survives in magnetic fields 2-4 times larger than H_P [1] if the field is applied parallel to the second conducting direction, the *b*' axis. The origin of this behavior can be attributed to either a spin-triplet state or a Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state [2]. Furthermore, recent theoretical studies suggest possibilities of a singlet-triplet transition [3] or singlet-FFLO-triplet transitions [4] in magnetic fields.

We have studied superconductivity in $(TMTSF)_2ClO_4$ (the onset temperature T_c^{onset} = 1.45 K at H = 0) by precisely controlling the magnetic-field direction, by measuring the *c**-axis resistance of extremely clean single crystals with their mean-free-paths of as high as 1 μm [5]. We have revealed that anomalous behavior of the *ab*'-plane field-angle ϕ dependence of T_c^{onset} developing above 20 kOe. One example is the appearance of the new principle axis in the $T_c^{onset}(\phi)$ curve, which suggests a "spontaneous change in the spatial symmetry" in the superconducting state in high fields. We also demonstrated that T_c^{onset} at H = 50 kOe remains finite not only for H // *b*' but also for fields parallel to the most conducting *a* axis. We propose that our results are consistently explained with a scenario that FFLO states are realized in high magnetic fields above H_P [5].

In the presentation we present the superconducting phase diagram based on results of the resistive measurement described above. We would also like to present results of our recent specific heat study.

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