COMMENSURATE-INCOMMENSURATE CROSSOVER AND MAGNETORESISTANCE OF QUASI-ONE-DIMENSIONAL SUPERCONDUCTORS, $(TMTSF)_2ClO_4$ and $(DMET)_2I_3$

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Introduction

Oscillations of the magnetoresistance (MR) when the magnetic field (***B***) is rotated within a plane slightly tilted from the most conducting ***xy*** plane of Q1D metals are known as L-N oscillations, after Ref. [1]. Theoretical studies [2] suggested that the L-N oscillations are associated with a kind of crossover of electronic system between coherent and incoherent. Recent experimental studies [3] on $(TMTSF)_2ClO_4$ to 10 T at 0.1K showed that an unconventional nonsaturating field dependence of MR is observed at angles of the maxima in contrast with high field saturation at the minima. We extended the MR measurements up to much higher ***B*** (33 T) and lower temperature (~30 mK) in the present study. MR of $(DMET)_2I_3$, which has a simpler Fermi surface than $(TMTSF)_2ClO_4$, was also measured to investigate the unconventional behavior of MR in Q1D materials.

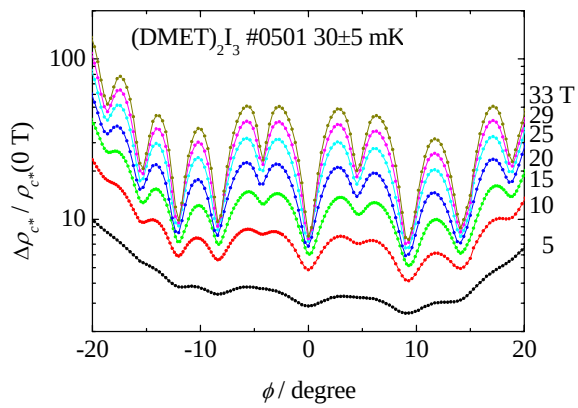

Fig. 1. Angular-dependent MR of $(DMET)_2I_3$.

Experimental

The MR of $(TMTSF)_2ClO_4$ and $(DMET)_2I_3$ was measured along the most resistive direction by a conventional AC four-terminal method. The frequency of applied electrical current was in the order of 300 Hz. The 33-T resistive magnet in Cell 12 was used in combination with the portable dilution refrigerator to measure the MR at the lowest possible temperature. The sample was rotated in the magnetic field, within a plane that was tilted from the most conducting planes of the materials by θ = 5-10 degrees.

Results and Discussion

The ϕ–angular dependence of the MR of $(DMET)_2I_3$ is shown in Fig. 1. L-N oscillations were clearly observed above 5 T. Similar results were also obtained for two samples of $(TMTSF)_2ClO_4$ at slow cooling state. The data at minima and maxima of $\rho(\phi)$ in Fig. 1 were plotted against the magnetic field in Fig. 2. The saturating behavior at the minima (Fig. 2(a)) contrasts with divergent behavior at the maxima (b). This is consistent with the 1D-2D dimensional crossover picture mentioned above [3]. Preliminary numerical calculation suggests a conventional semiclassical theory does not reproduce the saturating behavior of the MR. The fitting of the data to a theoretical equation that is based on quantum mechanics is in progress. The detailed results will be published elsewhere.

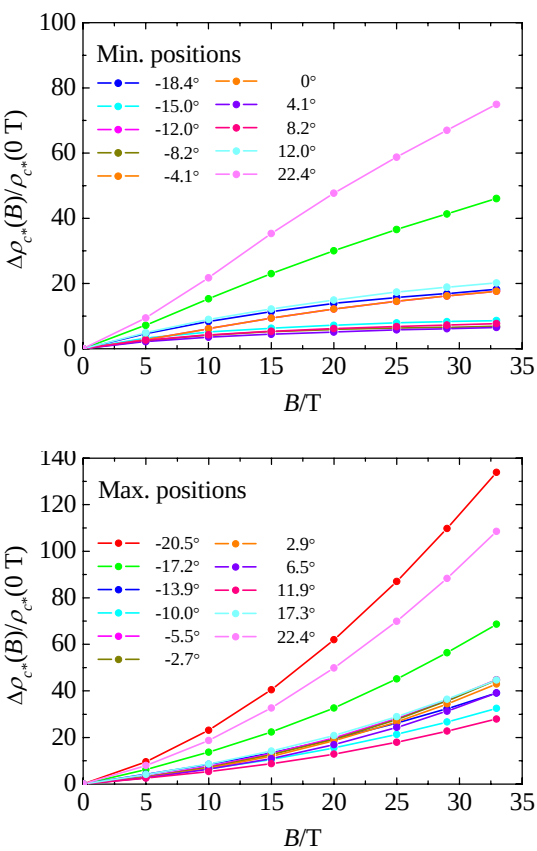

Fig. 2. Field dependence of magnetoresistance of $(DMET)_2I_3$ at (a) min. and (b) max. of angular dependence in Fig. 1.

References

[1] Lee, I.J. and Naughton, M.J., Phys. Rev. B, **57**, 7423-26 (1998).
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[2] Ha, H.I, *et al*., cond-mat/0503649 (2005) [Phys. Rev. B – to appear].