Comparison of the Low Temperature Ground State Phase Diagram Probed by the Measurements of Interlayer Resistance and of Magnetization of the Organic Conductor $(TMTSF)_2ClO_4$

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Introduction

Magnetic quantum oscillations in quasi-one-dimensional organic conductors subjected to a high magnetic field has been studied for long time, but attracted much less attention compared with a cascade of FISDW transitions forming an interesting *T-H* phase diagram. In an effort to better understand the oscillations in $(TMTSF)_2ClO_4$, we compared those appearing in the interlayer resistance R_{zz} and in the magnetization.[1,2] Among the features manifest in both quantities, the anomaly at 17 T, previously identified in R_{zz}, is also present in the magnetization. While the phase and the amplitude of oscillating magnetization are continuous across the anomaly at 17 T, the baselines have successive discontinuity. The temperature where the phase reverses is different between magnetoresistance and magnetization.

Experimental

A 33 T DC magnet at the NHMFL was used in combination with a He-3 cryostat. Interlayer resistance was measured by putting two electrical pads on each surface perpendicular to the c* direction. Self-sensing piezoelectric cantilever from the Seiko Instruments was used to measure the magnetic torque from which the magnetization of the sample was derived.[3]

Results and Discussion

Figure 1 shows the magnetic field dependence of (a) the interlayer resistance R_{zz} and (b) the FISDW contribution to the magnetization. While the interlayer resistance shows many additional discontinuities either in the background resistance or in the phase of oscillations in addition to the previously reported phase separation lines, the magnetization derived from the torque suggests much simpler phase diagrams. Nonetheless, the anomaly around 17 T is more clearly present in the field dependence of the magnetization. It suggests that the phase transition at 17 T at low temperature may have a thermodynamic origin and joins smoothly to the 3.5 K phase transition line.

Conclusions

FISDW contribution to the magnetization showed rapid oscillations in which some phase transitions could be distinguished from discontinuities of oscillation amplitude or their phase. The transitions around 17 T and around 28 T are manifest. However, some of discontinuities found in R_{zz} are missing in the magnetization. All of them may not be of the thermodynamic origin. But the transition at 17 T may have a thermodynamic origin and joins smoothly to the 3.5 K phase transition line.

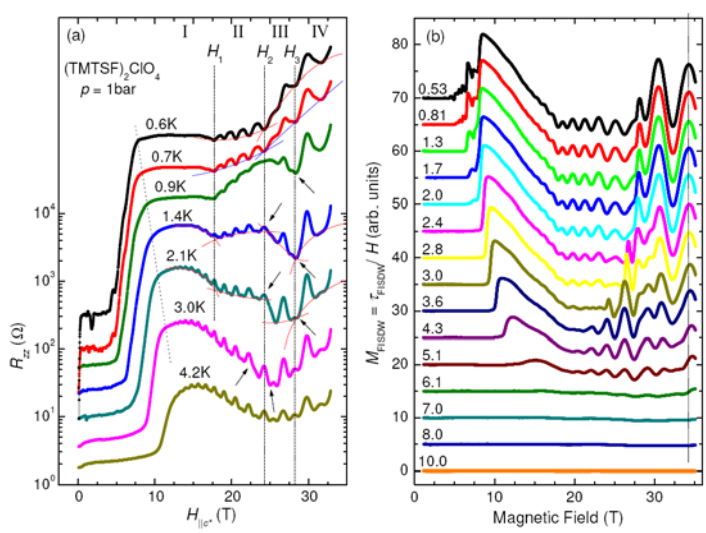

Fig. 1. Interlayer resistance Rzz and the FISDW contribution to the magnetization as a function of the field component along the c* axis at several temperatures between 0.4 and 10 K. Successive curves are equally shifted for clarity.

Acknowledgements

This work has been supported by the KOSEF (Grant Nos.\ R01-2007-000-20576-0, R11-2008-053-02002-0).

References

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