Evolution of Superconductivity from a Charge Density Wave Ground State in $(Per)_2Au(mnt)_2$

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Introduction

The charge density wave (CDW) ground state of the quasi-one-dimensional organic conductor, $(Per)_2Au(mnt)_2$ can be largely suppressed by a strong magnetic field [1]. When pressure is applied above ~ 5.0 kbar, superconductivity appears below a transition temperature of ~ 300 mK (Fig. 1a).

Experimental

Small needle-shaped samples were mounted into a BeCu pressure cell where the resistance was measured transverse to the conducting chains (I⊥*b*-axis) with ac transport techniques. Fig. 1a shows a dependence on the cooling rate of the samples through the freezing point of the pressure medium (upper inset to Fig. 1a). The field and temperature dependence of the samples were measured (after slow cooling through the freezing point) simultaneously by cooling the dilution refrigerator while sweeping the magnetic field back and forth.

Results and Discussion

As Fig. 1b shows, a widening SC state is observed below a T_c of 300 mK (defined by 10% decrease in resistance). This proved reproducible with a second sample at a similar pressure. Using the data from Fig 1b, a phase boundary was constructed, which is fit well by the expression for a Type I superconductor with a critical field of ~ 50 mT (Fig. 1c).

Conclusions

The temperature and field dependence of $(Per)_2Au(mnt)_2$ for P > 5.0 kbar suggest a SC phase transition, though the sample resistance does not reach zero. There is the possibility that the material becomes phase separated under these conditions, leaving a residual resistance from small domains where the CDW persists. It is also possible that the non-zero resistance reflects the fraction of the Fermi surface that remains nested, even under pressure. Measurements are being conducted to study the anisotropy of this phase transition as well as determine the pressure-temperature phase boundary in more detail.

Acknowledgements

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References

1) D. Graf, *et al.*, Phys. Rev. B, **69** 125113 (2004).
2) D. Graf, *et al.*, Euro. Phys. Lett., submitted (2008).

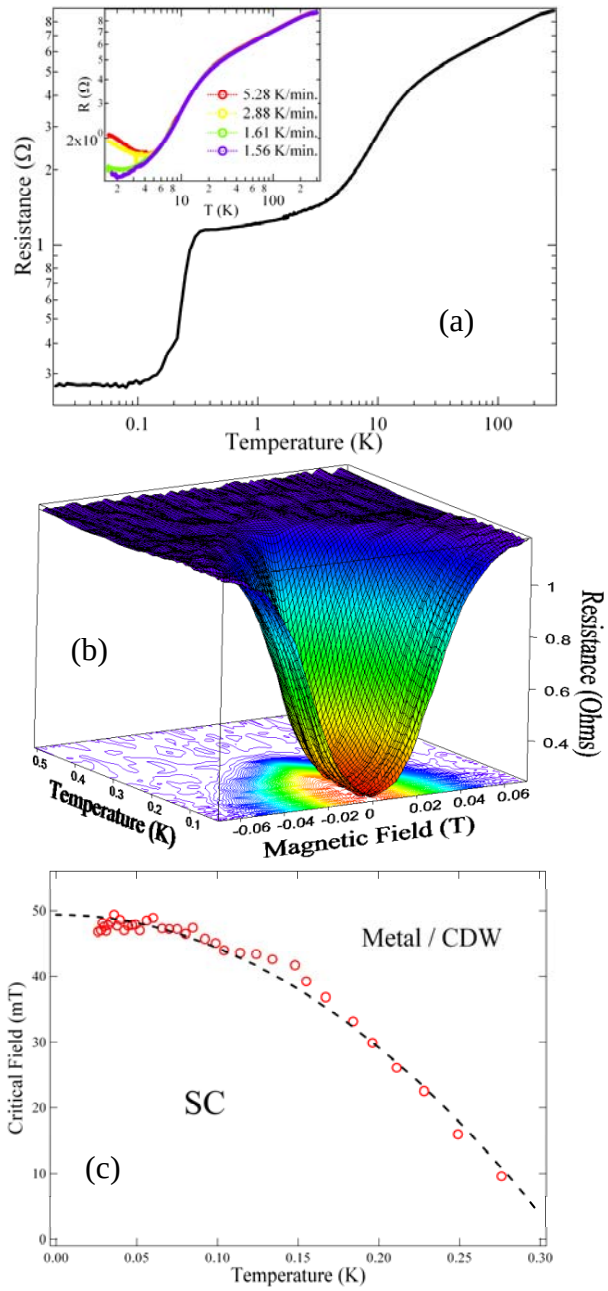

Fig. 1. (a) Cooling curve for $(Per)_2Au(mnt)_2$. Inset: Temperature dependence based on the cooling rate while passing T ~ 220K (freezing point of the pressure medium). (b) The temperature dependence of magnetoresistance at a pressure of 5.7 kbar. (c) Field-temperature phase diagram of $(Per)_2Au(mnt)_2$.