ANGULAR DEPENDENCE OF THE MAGNETORESISTANCE OF $(PER)_2PT(MNT)_2$ UNDER HYDROSTATIC PRESSURE

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Introduction

A charge density wave (CDW) state in a quasi-one dimensional metal can be suppressed with the application of a strong magnetic field. Previous studies of the Q1D materials, $(Per)_2M(mnt)_2$ (where M = Au, Pt), have shown this behavior[1,2]. Theoretical work indicates that as the imperfect nesting is increased (by pressure for instance), the field dependence of the CDW will undergo dramatic changes[3,4]. Here, we report on the angular dependent magnetoresistance (MR) of the M=Pt system under hydrostatic pressure.

Experimental Results

A shortened version of a standard NHMFL double-clamp pressure cell was used to measure MR using typical ac lock-in techniques. Fields up to 18 T were obtained using one of the Oxford superconducting magnets (SCM2) in the NHMFL milliKelvin facility. The temperature dependence of the resistance can be seen in Figure 1a in the orientation of B//c-axis under an applied pressure of 6.2 kbar. As the field is increased the resistance rises almost two orders of magnitude and several resistance peaks appear. The angular dependence of the resistance is shown in Figure 1b where 0° indicates the orientation of Figure 1a. Rotation away from B//c results in the peaks decreasing in amplitude and shifting to higher magnetic fields. The 0° behavior is repeated when the sample is rotated 180° from its original position.

Discussion and Conclusion

The conventional low field CDW (CDW_0) is strongly suppressed by 6.2 kbar, as indicated by the initial increase in MR in low fields (Fig. 1a). At ambient pressure, tight binding calculations produce the ratio of the transfer integrals given by $t_b:t_a:t_c$ ~ 75:1:0.1. Though adding pressure will increase the dimensionality of the material, the peaks in the MR are not strictly periodic in inverse field and may not originate from closed orbits. However, the results of Fig. 1b show that orbital effects, which have an approximate $1/\cos(\theta)$ dependence on field orientation, play a role in the ground state at lower temperatures. The increase in the resistance with increasing field is accompanied by a corresponding increase in the activation energy, which reaches 30 K at about 8 T, and then decreases again. Although more work is necessary to resolve the nature of the field induced states in the pressurized material, there appears to be some correspondence with theoretical predictions (i.e. a cascade-like structure) where the CDW is first suppressed by pressure[3,4].

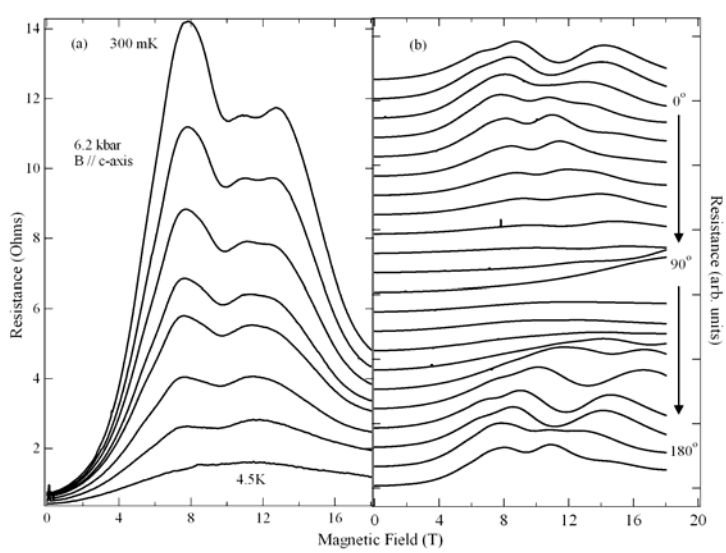

Fig. 1 – (a) Temperature dependence of MR of $(Per)_2Pt(mnt)_2$ from T = 0.3 – 4.5K in the orientation of B//c. (b) Angular dependence of the same sample at 270mK (data offset for clarity).

Acknowledgements

Work at FSU was funded by NSF-DMR-02-03532.
DG is funded by a NSF GK-12 fellowship.

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