High Magnetic Field Measurements of the Organic Conductor $Per_2[Pt(mnt)_2]$ Using a Tunnel Diode Oscillator

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Introduction

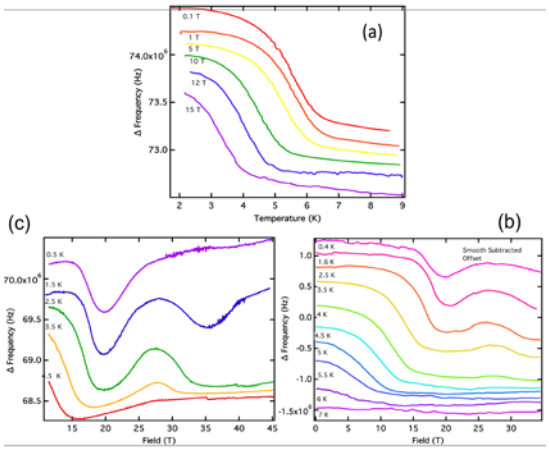
$Per_2[Pt(mnt)_2]$ is a quasi-one dimensional organic conductor that consists of conduction perylene chains in parallel with insulating-magnetic $Pt(mnt)_2$ chains, which undergo a charge density wave (CDW) and spin-Peierls (SP) transition simultaneously. Previous electrical transport[1] and ^{1}H NMR[2] studies have developed a B vs. T phase diagram up to 45 T, however the NMR finds a slightly lower temperature transition (T_c ~ 6) than the generally reported T_c~ 8 K. To further investigate the possible difference between the electrical and magnetic measurements we conducted high frequency tunnel diode oscillator (TDO) measurements that probe the magnetic susceptibility of the sample.

Experimental

For our experiment, 3 single crystals with a combined size of roughly 6 x 0.45 x 0.45 mm were contained inside of a 39 turn coil with an estimated filling factor of 60-75% and a resonant frequency of ~ 365 MHz. The long b-axis of the crystals was collinear with the coil and perpendicular to the applied magnetic field. Experiments were initially carried out in a superconducting magnetic (SCM-2) up to 16T, and subsequently in resistive magnets up to 35 T (Cell 12) and 45 T (Hybrid) all at the NHMFL DC facility.

Results

Using magnetic and temperature sweeps we developed a phase diagram for the paramagnetic to SP state that is in reasonable agreement with NMR data from Green *et al.*[2], suggesting that the lattice instabilities induce the dimerization of the Pt spins in the material. At magnetic fields above 25 T we saw an additional increase in frequency after exiting the SP state, which corresponds to a decrease in susceptibility, possibly in agreement with the field induced CDW reported by Graf. *et al.*[2]. At this point it is unclear as to the nature of the magnetic state, and future experiments are planned to investigate this in more detail.



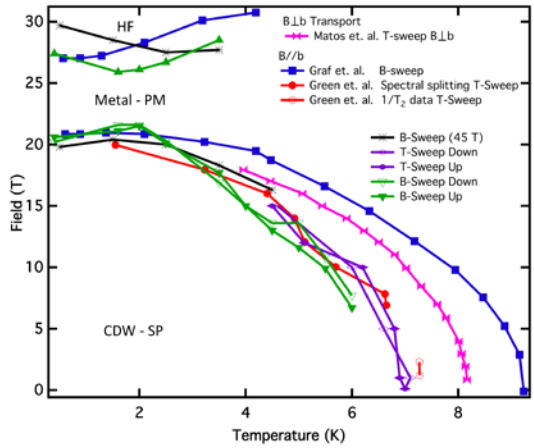


Figure 1: (a) Temperature sweeps at set fields up to 15 T show an increase in frequency when entering the SP state. (b) Field sweeps up to 35 T from 7 - 0.5 K show a decrease in frequency as the SP state is suppressed and then an increase when entering the high field state. (c) Data taken up to 45 T for T = 4.5 K and below shows more details of the high field transition. **Figure 2:** Our developed phase diagram when compared to NMR and resistivity data shows that our results are in better agreement with the NMR data but also show signatures of the high field induced state observed in resistivity measurements.

Acknowledgements

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References

[1] Graf, D., *et al.*, Phys. Rev. Lett. **93**, 076406 (2004).
[2] Green E.L., *et al.*, Phys. Rev. B **84**, 121101 (2011).