High Field Study of the CDW Ground States of (Per)$_2$M(mnt) (where M = Ni, Pt)

D. Graf, E., S. Choi (NHMFL); J. S. Brooks (NHMFL / FSU); M. Almeida, J. C. Dias, R. T. Henriques (CFMCUL, Estrada Nacional, Portugal); S. Uji (NIMS, Tsukuba, Japan)

Introduction

The quasi-one-dimensional (Q1D) molecular conductors (Per)$_2$M(mnt)$_2$, where M = Pt, Au and Ni have charge density wave (CDW) ground states below transition temperatures ($T_{CDW}$) of 8, 12 and 25 K, respectively. The perylene donor molecules stack along the $b$-axis, forming conducting chains. The M(mnt)$_2$ anion chains are insulating with zero spin for the M = Au compound and $S = \frac{1}{2}$ for the M(mnt)$_2$ components when M = Pt and Ni. The low transition temperatures of these compounds allow large (experimentally accessible) magnetic fields to suppress the CDW ground state via Zeeman splitting of the energy bands [1]. Recently, measurements have also shown that applied pressure also suppressed the CDW state of the M = Au material [2]. Here we report on the first measurements of the M = Ni compound in high magnetic fields and on the effect of pressure on the M = Pt material.

Experimental

Transport measurements for all samples were made along the conducting chains ($b$-axis) of the needle-shaped single crystals. Ambient pressure measurements were taken utilizing a rotating sample probe. Measurements made under pressure were made using a double-clamp BeCu pressure cell. Magnetic fields to 45 T were provided by the NHMFL hybrid magnet.

Results and Discussion

The angular dependence of the M = Ni magnetoresistance (MR) is shown in figure 1a. At lower fields, almost no change is observed with rotation but as the field is increased the MR drops steeply when field aligned with the conducting chains of the material ($B//b$-axis). MR measurements of the M = Pt compound under 5.7 kbar of pressure are shown in figure 1b.

Conclusions

For comparison with M = Ni, previous measurements (at 4.2K) of the analogous M = Pt compound have also shown a large drop in MR beyond ~ 15 T and a resistance minimum at ~ 22 T. Given that the transition temperature of M = Ni is approximately three times larger than M = Pt, the CDW ground state is firmly established at 4.2K and higher fields (i.e. pulsed fields to 60 – 70 T) will be needed to suppress the CDW state for this compound. Measurements of pressure dependence (inset, figure 1a) differ from the other measured perylene materials, with a shift of $T_{CDW}$ to higher temperatures with increased pressure. Under applied pressure, $T_{CDW}$ for M = Pt lowers to ~ 5K (inset, Fig. 1b). The MR differs from that of M = Au under pressure since no peaks from quantum interference are apparent.

Acknowledgements

This work was supported by NSF Cooperative Agreement DMR-0084713 (NHMFL), DMR-0602859 (JSB Group), the State of Florida and the NHMFL Crow Fellowship (DG).

References