High Pressure Angular Dependent Magnetoresistance Measurements at 31 tesla of (Per)$_2$Au(mnt)$_2$

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Introduction

The charge density wave (CDW) transition temperature in the quasi-one dimensional (Q1D) organic material (Per)$_2$Au(mnt)$_2$ is relatively low ($T_{\text{CDW}} \sim 12$ K). [1] The large resistance expected in the CDW phase is mostly suppressed by pressures of ~ 6 kbar, though an underlying CDW-metal mixed state is suggested by activated temperature dependence. With a magnetic field aligned with the $c$-axis of the material, the Stark quantum interference (QI) effect has been observed (between the closely spaced Fermi surface sheets) through oscillations in the magnetoresistance (MR). [2] Measurements of the angular dependent MR under pressure have been undertaken to pursue MR effects observed in other Q1D organic systems (i.e. Lebed oscillations).

Experimental

Three single crystals of the title compound were measured in a BeCu double-clamped pressure cell mounted to a single axis rotation probe. Typical sizes of the thin needle crystals were $\sim 20 \times 40 \times 500 \, \mu m^3$ along the $c$, $a$ and $b$ axes, respectively. Low temperatures were achieved using the He-3 system of SCM2 in the NHMFL mK facility. Four-terminal transport measurements were made along the most resistive axis ($c$-axis) using conventional ac lock-in techniques.

Results and Discussion

As shown in Figure 1, the angular dependent MR shows a number of features during sample rotation in high magnetic fields. The dips at constant angles of $0^\circ$ and $66^\circ$ (red lines), indicate an alignment between the magnetic field and the $a$ and $c$ crystal axes of the material. The dips at $\sim 33^\circ$ (blue line, which does not change location at different fields) result from the alignment of the magnetic field and the diagonal of the $ac$-plane unit cell (i.e. at a Lebed magic angle or LMA).

Conclusions

Previous measurements of this material (for $B \leq 18$ T) under pressure have shown that electrons moving along the Q1D Fermi surface (FS) experience QI at closely spaced nodes of the FS sheets. The QI effect depends on the k-space area between FS sheets and strength of the magnetic field. Therefore, the MR features associated with QI will shift to different angular locations with changing magnetic fields. Above 15 T, a MR dip at a LMA ($33^\circ$) begins to appear. The LMA dip is deepest at $\sim 25$ T and then limited by a higher resistance state observed in the high field limit. [1] QI features are not observed in the MR under higher pressures (11.5 kbar, not shown) which suggests a shift in the spacing between FS sheets.

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References