ANISOTROPIC CURRENT-VOLTAGE CHARACTERISTICS OF (PER)$_2$AU(MNT)$_2$ IN HIGH MAGNETIC FIELDS

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Introduction

Magnetic fields have been shown to suppress charge density waves (CDW) in low dimensional materials as Zeeman splitting of the bands prevents the Fermi surface from nesting. [1] When a CDW forms at low temperatures ($T_{CDW} \approx 12$ K for (Per)$_2$Au(mnt)$_2$) the conductivity of the material drops as an energy gap opens at the Fermi surface. When a strong enough electric field is applied, the charge density wave is depinned and begins to “slide”, which is shown by a rapid increase in sample current at the threshold electric field ($E_{th}$).

Experimental

Current was applied along the b-axis (most conducting axis) using a Keithley 6221 current source which provided 500 μs pulses of current with a 85 ms waiting period between each pulse. This technique of using pulsed currents greatly decreases the power applied to the samples which prevents results from being affected by sample heating. Sample voltages were monitored with Keithley 2182A nanovoltmeters. To maintain constant temperatures, a He-3 cryostat was filled with exchange gas which condensed at lower temperatures of 1.4 K and 0.5 K. Figure 1a shows selected data traces in high fields at $T = 0.5$ on a log-log plot.

Results and Conclusions

As seen in Figure 1b, results at higher temperatures (4.3 K) show the depinning field for magnetic fields aligned with the conducting axis ($B//b$-axis) are consistently lower than for the perpendicular orientation. Mean field theory (MFT) does not predict a dependence on the orientation of the conducting chains and applied field [2]. The threshold fields were found to be much higher at lower temperatures (0.5 K) where the CDW is better established. $E_{th}$ drops more than two orders of magnitude the field is parallel to the chains ($B//b$-axis) but remains almost unaffected when the field is applied perpendicular to the conducting chains ($B//c$-axis).

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References