The 65 T pulse-field study of correlated $Ce_3Bi_4Pd_3$

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Introduction

$Ce_3Bi_4Pd_3$ is a narrow-gapped Kondo system with much lower energy scale compared to the above-mentioned candidates. Our goal is to perform transport and magnetization measurements in high magnetic fields to 65 T available at the pulsed field facility in Los Alamos. In correlated materials, *f*-electrons hybridize with conduction bands with *d* character, resulting in the opening of a hybridization gap. The opposite parity of *f*-electrons and *d*-band give rise to topological phases – e.g. topological Kondo insulators and semimetals. Under strong magnetic fields of the order of the Kondo temperature, the Zeeman splitting of the bands results in the tunneling of electrons through the gap and leads to the destruction of the Kondo state towards a metallic ground state.

Experimental

The 65 T pulse field transport and magnetization measurements were carried out at different temperatures. Preliminary measurements were performed in a commercial Quantum Design PPMS with 9 T and 14 T.

Results and Discussion

The temperature dependent resistivity for two typical $Ce_3Bi_4Pd_3$ crystals is shown in FIG 1(a), with three distinct regions marked as I, II and III. At low temperatures, $Ce_3Bi_4Pd_3$ exhibits large negative magnetoresistance (NMR), and the resistance almost saturates for fields above 15 T, as shown in FIG.1(b). The large NMR suggests closing of the estimated gap of 0.85 meV at ~12.5 T. A peak at ~12.5 T in the derivative plot of **M** confirms a crossover due to destruction of the Kondo singlet states. This result is a confirmation of the closing of the Kondo gap due to the Zeeman energy of 12.5 T. The carrier density obtained from our Hall measurements further suggests an anomalous enhancement at higher magnetic fields above ~12.5 T.

Conclusions

We have performed pulse-field transport and magnetization measurements on $Ce_3Bi_4Pd_3$. Our results show evidence for the breakdown of the Kondo insulator state into a metallic state.

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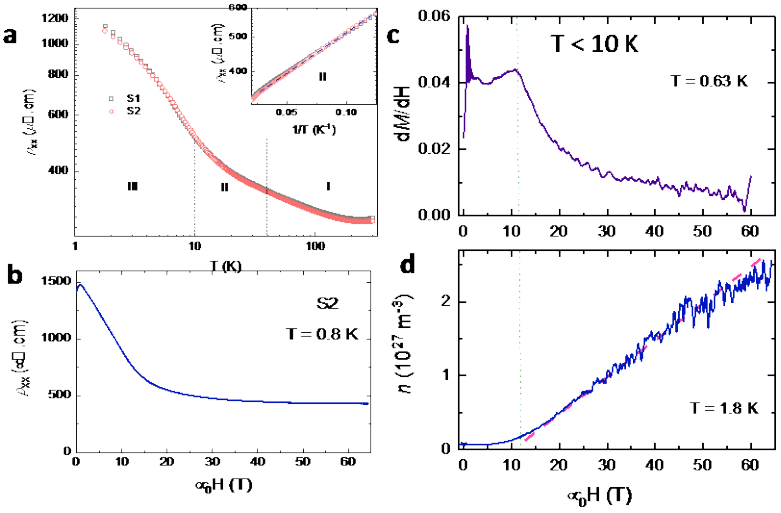

FIG. 1 (a) Temperature dependent resistivity of two typical samples, in the absence of magnetic field, for $Ce_3Bi_4Pd_3$ – a narrow-gapped Kondo system. An insert shows an Arrhenius fit plot for an activation region. (b) (c) and (d) respectively are the field dependent magnetoresistance, derivative of magnetization and carrier density plots. The dotted green and red lines in (c) and (d) are guide to the eye for a value of magnetic field.