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[Proposal: P14728]

Author(s): Stritzinger, Laurel Elaine Winter
Lai, Y.
Mcdonald, Ross David
Baumbach, R. E.

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Temperature Dependent Magnetoresistance of CeCu₂Si₂ up to 60 T [Proposal: P14728]

Winter, L. E. (LANL); Lai, Y. (FSU, Physics); McDonald, R. D. (LANL); Baumbach, R. E. (FSU, Physics)

Introduction

We recently investigated the chemical substitution series CeCu₂Si_{2-x}P_x, for $x = 0, 0.01$, and 0.14 , using a contactless tunnel diode oscillator technique. These measurements revealed previously unreported Shubnikov-de Haas oscillations above 45 T with an unusual temperature dependence that could potentially be explained by a high magnetic field transition. To investigate this possible transition, magnetoresistance measurements were desired. However, initial magnetoresistance measurements on CeCu₂Si₂ showed poor signal-to-noise due to the small value of the sample's resistivity. To overcome this obstacle, we performed micro-structuring of a single crystal specimen to increase the sample's resistance.

Experimental

Temperature dependence of the magnetoresistance of CeCu₂Si₂ in pulsed magnetic fields up to 60 T was obtained at the NHMFL Pulsed Field Facility. The sample was polished to approximately 18 μm and then cut using focused ion beam (FIB) lithography to increase the effective resistance of the sample (Fig 1a insert). Due to the difficulty and time it takes to prepare the samples, only CeCu₂Si₂ was measured.

Results and Discussion

Through the use of FIB microstructuring, the magnetoresistance of a crystal of CeCu₂Si₂ was increased by over a factor of 100, as shown by the before and after temperature dependence of the resistance in Figure 1. The sample was then measured up to 60 T for temperatures both above and below the Kondo coherence temperature $T_{\text{CO}} = 17$ K (Figure 1b). For temperatures 10 K and above the magnetoresistance continuously decreases as the field is increased. However, as the temperature is decreased towards 7 K we begin to see first an increase in the magnetoresistance before it decreases with increasing field. Not only does this trend continue as the temperature decreases further, the magnetic field at which the magnetoresistance switches from positive to negative also moves to higher field as highlighted by the difference between 7 K and 0.5 K. This behavior is similar to measurements reported by Rauchschalbe *et al.* up to 30 T and suggests at very low temperatures the coherent state can be affected by the high magnetic fields [1]. Unfortunately though, no high magnetic field transitions or quantum oscillations were observed.

Acknowledgements

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References

[1] U. Rauchschalbe *et al.*, J. Magn. Magn. Mat., **63-64** 347-350 (1987).

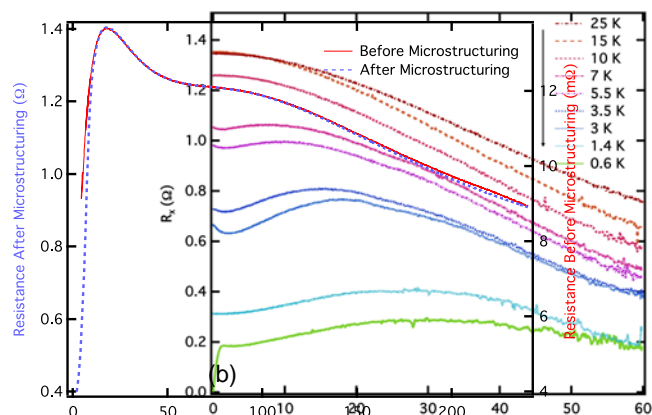


Fig.1 (a) The use of microstructuring via focused ion beam (FIB) lithography increased the resistance of CeCu₂Si₂ by a factor of ~100 as shown by the resistance both before the cutting (red solid line, right axis) and after (blue dotted line, left axis). (Insert) The roughly 1000 μm sample is ~18 μm thick and has three 10 μm wide cuts spaced 30 μm apart. (b) Magnetoresistance as a function of field for temperatures between 0.6 – 25 K that exhibits a sign change of the magnetoresistance below 10 K.