OBSERVATION OF KONDO-HOLES IN La-DOPED $CeOs_4Sb_{12}$

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Introduction

$CeOs_4Sb_{12}$ belongs to the family of filled skutterudites yielding a large variety of ground states. $CeOs_4Sb_{12}$ has been classified as a Kondo-insulator[1] although its ground state is not completely understood. Anomalous low temperature resistivity has been ascribed to both decreasing density of carriers upon lowering temperature as well as scattering of carriers by strong spin fluctuations[2]. In addition, its specific heat exhibits a week anomaly at 1.1 K, most probably of itinerant character[3]. This anomaly is completely suppressed by small amounts (2%) of La-impurities. We have studied paramagnetic La-doped alloys, to provide insight into anomalous transport and thermodynamic properties of $CeOs_4Sb_{12}$.

Experimental

Single crystalline samples of $Ce_{1-x}La_xOs_4Sb_{12}$ with x=0.02 and 0.1 have been previously investigated by magnetic susceptibility, specific heat and electrical resistivity down to 0.35 K. Here we report on measurements of specific heat and electrical resistivity down to 20 mK and in fields to 18 T.

Results and Discussion

Both x=0.02 and 0.1 crystals are paramagnetic to the lowest temperatures according to the specific heat measurement. The 20 mK magnetoresistance of $Ce_{0.98}La_{0.02}Os_4Sb_{12}$ is large and its sign is field dependent. Even more exotic is the temperature dependence of the resistivity in a fixed magnetic field. At the lowest temperatures, it has a conventional Fermi-liquid variation $\rho=\rho_0+AT^2$. However, in small fields the A coefficient is negative, thus inconsistent with the Fermi-liquid behavior. Such a negative coefficient has been postulated for Kondo-holes. The magnitude of A indicates that these Kondo-holes are extremely heavy. A is –43 $\mu\Omega cm/K^2$ in H=0. A is approximately 0 in 4 T and becomes is positive for fields larger than 4 T. In 7 T, A reaches 18 $\mu\Omega cm/K^2$. Qualitatively similar results were obtained on a more dilute alloy, $Ce_{0.9}La_{0.1}Os_4Sb_{12}$. The magnetoresistance for x=0.1 has the magnetic field dependence similar to that for x=0.02, however its magnitude is by a factor of 10 smaller.

Conclusions

To the best of our knowledge, this is the first (theoretical or experimental) investigation of A on H for a Kondo-hole system. Transport and thermodynamic properties of $CeOs_4Sb_{12}$ and its weakly La-doped alloys are dominated by incomplete Kondo screening of *f*-electron moments in this low carrier density system.

Acknowledgements

Work supported by the Department of Energy, grant number DE-FG02-99ER45748.

References

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