MAGNETO-OPTICAL MEASUREMENTS OF HEAVY FERMION $YbFe_4Sb_{12}$ THIN FILMS

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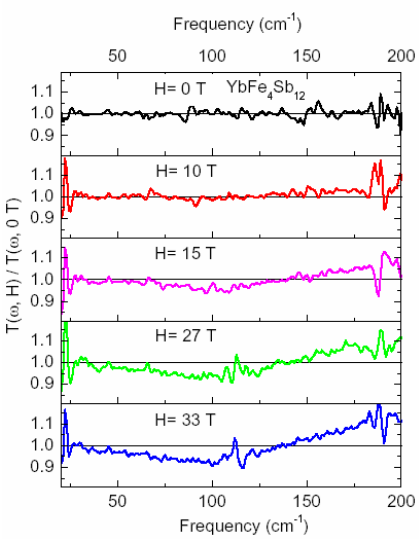
Introduction

Properties of heavy fermions in high magnetic field have recently attracted a lot of attention. External magnetic field can tip the balance of competing interaction and in some cases even drive the system across a quantum phase transition. Effect of magnetic field on infrared properties has not been explored in details. In this project we attempt to close that gap by studying the magneto-optical properties of heavy fermion filled skutterudite of $YbFe_4Sb_{12}$ in 33 Tesla magnetic field.

Experimental

Thin films of $YbFe_4Sb_{12}$ were grown on MgO substrate using pulsed laser deposition technique at UCSD. Optical measurements were performed at NHMFL in transmission geometry, using the resistive 33 Tesla magnet. The magnetic field was oriented perpendicular to the film. The field dependence was measured at several temperatures between 5 and 50 K.

Results and Discussion



In our previous magneto-reflection study [1] of heavy fermion filled skutterudite $CeRu_4Sb_{12}$ in 17 Tesla we observed suppression of the heavy fermion state with magnetic field. In particular the effective mass of charge carriers was reduced compared to the zero-field value, in accord with theoretical predictions [2]. On the other hand, the hybridization gap in the density of states was found to be essentially unaffected by magnetic field. Moreover, the so-called meta-magnetic transition, expected to occur in heavy fermions at high magnetic field was not reached in $CeRu_4Sb_{12}$ in 17 Tesla. To address this issue we have performed magneto-optical study of $YbFe_4Sb_{12}$ at even higher magnetic fields.

Figure 1 displays the magneto-transmission ratios $T(\omega, H) / T(\omega, 0\ T)$ for $YbFe_4Sb_{12}$ at 5 K. Combined with our previous results in zero magnetic field [3] these results reveal suppression of heavy fermion state with magnetic field, and recovery of a more conventional metallic state. Further analysis of the results will uncover if they are in quantitative accord with the theory [2]. Interestingly, the meta-magnetic transition was not reach in $YbFe_4Sb_{12}$ even at 33 Tesla.

Figure 1. *Magneto-optics results for $YbFe_4Sb_{12}$ in 33 Tesla magnetic field. The magneto-transmission ratios $T(\omega, H) / T(\omega, 0T)$ are displayed for several different fields.*

Conclusions

The results on $YbFe_4Sb_{12}$ presented here, together with our previous results on $CeRu_4Sb_{12}$ [1] reveal suppression of heavy fermion state with magnetic field, and recovery of a more conventional metallic state. The meta-magnetic transition was not reached in either system, even with 33 Tesla. We plan similar measurements on other heavy fermion systems in the future.

References

[1] Dordevic, S.D., *et al*., Physical Review Letters, **96**, 017403 (2006).

[2] Beach, K.S.D., cond-mat/0509778.

[3] Dordevic, S.D., *et al*., Physical Review Letters, **86**, 684 (2001).