HIGH FIELD PHYSICAL PROPERTIES IN La, Lu, AND Sn DOPED $CeIn_3$

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Introduction

Quantum Criticality is a highlighted problem in condensed matter. External parameters like alloying, pressure or magnetic field is effective to tune the electronic state of condensed matter toward a quantum critical point. In $CeIn_3$ and $CePd_2Si_2$, the discovery of superconductivity with suppressing antiferromagnetic ordering by pressure stimulated precise measurements under a controlled external parameter.

The electronic state of $CeIn_3$ changes from an antiferromagnetic state to QC state when we apply high pressure. The Neel temperature of $CeIn_3$ is suppressed by magnetic field in a similar manner in which T_N is suppressed by pressure. The Quantum Criticality is induced after T_N is suppressed when we apply high magnetic field. The estimated QC field from magnetic susceptibility measurements is 62T. The effective mass determined by de Haas-van Alphen effect where H||<111> becomes heavier as magnetic filed increases. The effective mass is angular dependent because spin fluctuation is concentrated in narrow region along <111>-axis. Although $LaIn_3$ possesses multiple connected Fermi surface, Fermi surface of $CeIn_3$ is a small and spherical one. The Fermi surface of $CeIn_3$ could be truncated into small Brillouin zone because antiferromagnetic periodicity could fold Brillouin zone. In $CeIn_3$, one small spherical Fermi surface implies large multiple connected Fermi surface folded.

By La doping, multiple connected Fermi surface may revive and continuing change of Fermi surface from pure $CeIn_3$ to pure $LaIn_3$ may occur. For clarifying change of Fermi surface topology and of spin fluctuation hot spot, high field dHvA in $Ce_{0.5}La_{0.5}In_3$ is measured.

Experimental

The single crystals were grown with the flux method. The samples are characterized by X ray powder diffraction and Laue method. The Orientated samples were etched down to the size fitting into the pick-up coil. The Haas-van Alphen measurements were carried out in short pulse 65T magnet with ^{3}He cryostat.

Results and Discussion

The de Haas-van Alphen oscillations were observed where H||<100> as shown in Fig. 1. In Fig. 2, temperature dependence of dHvA amplitudes is shown. Red solid circles show data in field range from 45T to 60T and blue solid squares show data in the field range from 50 to 64T. The solid curves show fitting. In both field ranges, the effective mass is almost $2m_0$. Thus in <100>, effective mass is magnetic field independent.

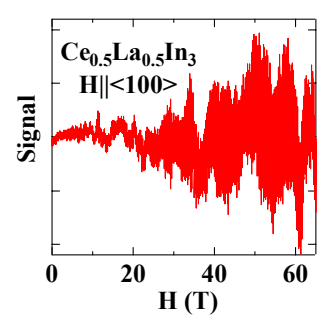

Fig. 1 dHvA Oscillation

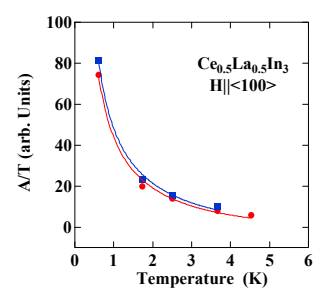

Fig. 2 Temperature dependence of dHvA amplitudes.

Conclusions

The de Haas-van Alphen oscillation in single crystal of $Ce_{0.5}La_{0.5}In_3$ was observed. The effective mass in <100> is magnetic field independent.

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References

[1] Pagliuso., *et al*., Physical Review B, **66**, pp.54433 (2002).