Quantum Oscillations in Kondo Insulator SmB_6

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Introduction

The discovery of topological insulators and possible topological superconductors opens a new area of study and brings hope to more exciting applications such as topological quantum computation [1,2]. Strong electronic interaction generally does not favor topological states. However, on the surface of Kondo insulator SmB_6, a topologically protected surface state is predicted to exist as a result of gap forming through the hybridization of the local orbital and the mobile electrons [7]. The surface conductance has been demonstrated with non-local experiments [8]. Our group has recently observed the dHvA effect in SmB_6. The angular dependence of the oscillation period shows that the observed Fermi surfaces are two-dimensional, and exists on the (101) surface and the (100) surface [9].

Experimental

High-resolution torque magnetometry was used to measure the magnetic moment of the samples [3-6]. Torque is measured as the change of the capacitance between the metal cantilever and a nearby metal plate.

Results and Discussion

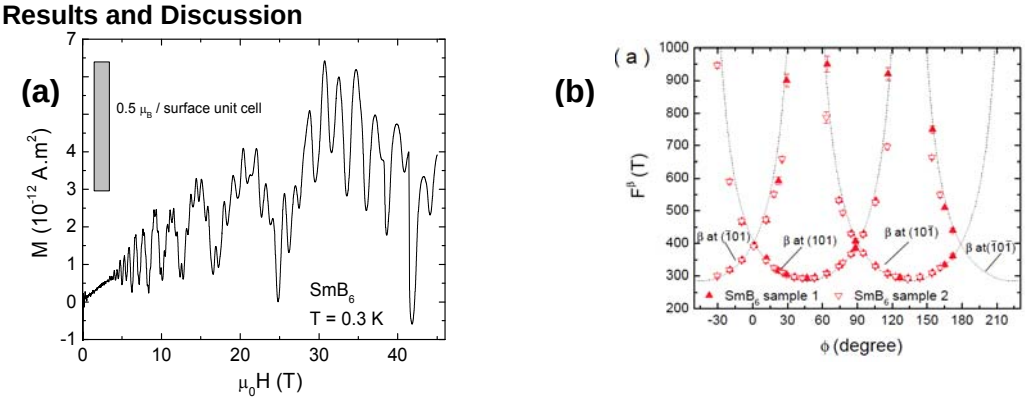

Fig. 1 (a) The oscillatory magnetization signal of Heavy Fermion Kondo insulator SmB_6. The magnetic moment is normalized by the number of surface unit cells, and the gray scale bar corresponds to M=0.5 μ_B per unit cell. The measurement used the Hybrid magnet. (b) The angular dependence of the dominant fast oscillation frequency in SmB_6. The oscillation frequency is determined from FFT from torque data up to18 T in SCM2. The oscillatory frequency follows the inverse cosine function of tilt angle, demonstrating the two-dimensionality of surface state.

Conclusions

Using torque magnetometry we observed Fermi-liquid-like quantum oscillations from Kondo insulator SmB_6. Three Fermi surfaces are observed, and the angular dependence reveals the two-dimensionality of the observed Fermi surfaces. Our observation demonstrates a two-dimensional metallic surface states along the (101) and the (100) cleavage planes.

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