Study of the Frustrated Magnet Yb_2Pt_2Pb in a Pulsed Magnetic Field

L. Jiao, H.Q. Yuan (Department of Physics, Zhejiang U.); J. Singleton, C. Topping, J. Marcelo (LANL); L.S. Wu, M. Aronson (Department of Physics and Astronomy, Stony Brook U.)

Introduction

Frustrated magnets usually contain a large degeneracy of ground states. In such a system, the local spins may strongly compete with each other and give rise to exotic orders, which are quite different from the conventional magnetic order. Yb_2Pt_2Pb crystallizes in the tetragonal Mo_2FeB_2-type structure with the rare earth atoms forming the Shastry-Sutherland (SSL) network, a typical frustrated system. Heavy fermion behavior and an antiferromagnetic (AFM) order (T_N=2.1K) have been revealed in this compound at low temperatures. The recent magnetization measurements indicate a field-induced quantum critical point (QCP) around 1.23T for B//[110] [1]. However, this compound shows a strong magnetic anisotropy. In the AFM state, the in-plane magnetization is saturated by applying a small magnetic field, but the out-of-plane magnetization does not saturate up to 14T [2]. Measurements of magnetization in higher fields are demanded in order to uncover the nature of magnetic behavior in Yb_2Pt_2Pb.

Experimental

Measurements of magnetic susceptibility and magnetization at various temperatures were performed by using the facilities of 65T/100T pulsed magnets at NHMFL-LANL. We also tried to measure the magnetostriction for this compound, but it failed due to its extremely large magnetostriction.

Results and Discussion

Figure 1 shows the magnetic field dependence of the magnetization, *M*(H), at various temperatures for Yb_2Pt_2Pb (H//c). At low temperatures (*T*<5K), a plateau-like kink can be observed in *M*(H) around μ_0H=10T and 30T, which becomes more pronounced with decreasing temperature. Such magnetization plateaus are a typical feature of the SSL systems, which is likely attributed to the fractionalization of the spin structure in a magnetic field. Its existence above T_N suggests that the spin frustrations persist in the paramagnetic state, at temperatures well above T_N. For H//c, the magnetization is not saturated even up to 90 T (not shown here), showing rather linear field dependence at high temperatures. Such an anisotropic magnetic behavior supports the recent neutron data (M. Aronson *et al.*, unpublished), which suggests a scenario of Ising-type spin interactions for Yb_2Pt_2Pb. On the other hand, we have also performed the dHvA measurements for this compound; quantum oscillations with several low frequencies were detected at low temperatures. Angular dependence of the dHvA oscillations is still demanded in order to map out the Fermi surface. In addition, signals of a huge magnetostriction for this compound were observed, which prevented us from measuring the magneostriction of this compound in a pulsed magnetic field by using the method of fiber Bragg grating. Other experiments are needed in order to look into the large magnetostriction and its mechanism.

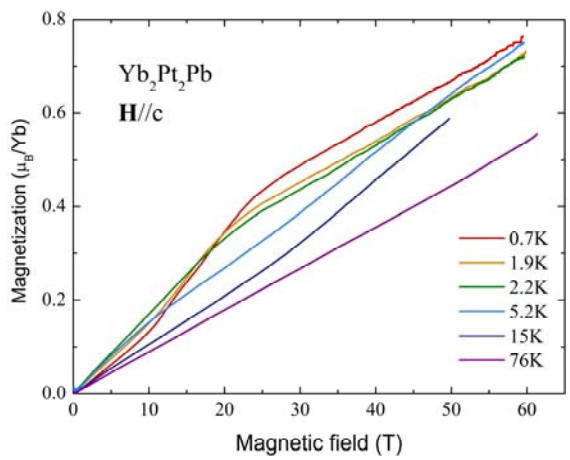

Fig. 1 Field dependence of the magnetization M(H) at various temperatures for Yb_2Pt_2Pd.

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References

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