(28b1)

Low temperature magnetization and the phase diagram of $PrFe_4P_{12}$

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The filled Pr skutterudite compound $PrFe_4P_{12}$ exhibits a second-order transition at T_A = 6.5 K. It is likely that the A phase is a nonmagnetic ordered state, since neutron scattering experiments have failed to detect any magnetic Bragg peaks at zero field in the A phase. Consequently, an antiferro-quadrupolar ordering is expected to occur below T_A, although a clear-cut evidence for that has not been found until now. On the other hand, a non-Fermi-liquid behavior has been reported from electrical resistivity and specific heat measurements in magnetic fields applied along the [111] direction in the low-temperature normal state. The origin of the non-Fermi-liquid (NFL) behavior is not clear yet. In order to investigate the origin of the NFL behavior we have performed dc magnetization and specific heat measurements on single crystals of $PrFe_4P_{12}$ in fields along the [111] direction. We found a λ-like anomaly at around 0.3 K in the temperature dependence of the specific heat $C(T)$ at 8 T, which is slightly higher than the A-phase transition field $H_A(T = 0)$. The observation indicates an appearance of new ordered phase (B phase). We also confirmed the existence of the B phase in the temperature dependence of the magnetization, which shows a rather weak anomaly compared to that for the A phase transition. As the field is increased up to $\sim$ 11 T, the transition temperature gradually increases up to $\sim$ 0.5 K. Figure 1 shows the field-temperature $H - T$ phase diagram of $PrFe_4P_{12}$ determined from the present experiments. The phase diagram clearly demonstrates the existence of high-field phase B in addition to low-field phase A. The observed NFL behavior might be associated with the appearance of the B phase. Further investigations are needed to understand the unusual phase diagram of this compound.

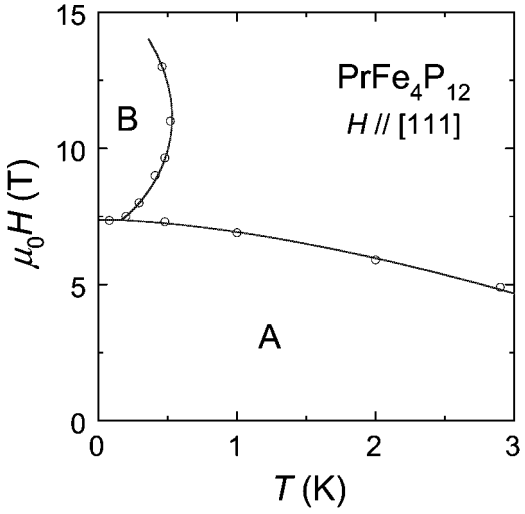

Figure 1: $H - T$ phase diagram for $H \parallel$ [111] in $PrFe_4P_{12}$.