Pressure effect on the Hall resistance of the Dirac semimetal $PdTe_2$

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Superconductivity in $PdTe_2$ was discovered in 1961 but was not investigated in detail until recently. $PdTe_2$ has been classified as a type-II Dirac semimetal following results of electronic structure calculations and angle-resolved photo emission spectroscopy. Interestingly, dc-magnetization measurements revealed that $PdTe_2$ is a bulk type-I superconductor. This was further confirmed by the observation of the differential paramagnetic effect in the ac-susceptibility measured in applied magnetic dc-fields [1]. The critical field H_c(T) follows the standard quadratic temperature variation with $\mu_0 H_c(0)$ = 13.6 mT. Further investigations of superconductivity on $PdTe_2$ were carried out under high pressures, which revealed that its type-I character is maintained even in high pressure below 2.5 GPa [2]. However, the dependency T_c(p) on pressure is not monotonically but shows a maximum T_c = 1.91 K around 0.91 GPa, followed by a gradual decrease to 1.27 K at 2.5 GPa. In the present work, in order to enhance the understanding of the variation of superconductivity under high pressure, we focus on the Hall resistivity and the effect of pressure on the carrier concentration.

The Hall effect was measured on two $PdTe_2$ crystals in a piston-cylinder clamp cell developed for the Physical Property Measurement System (PPMS, Quantum Design) up to 2.07 GPa. Two crystals were placed in two stages along a compression axis perpendicular to the sample plane. The Hall coefficient, R_H, was obtained from the difference between the values of the resistance measured for opposite polarities of the magnetic field.

$R_H \cdot B$ vs B plots at 2K at several pressures are shown in Figure 1 for one of the crystals. This figure reveals that R_H, which is derived from the linear slope of the curve below 2 T, does hardly changes under pressure. Consequently, the change in carrier density of $PdTe_2$ near T_c is very small. Moreover, no anomalous behavior is observed around 0.9 GPa, where $T_c(p)$ has a maximum. At 2 K, n amounts to about 1.7×10^{22} cm^{-3} at 0.25 GPa for this crystal. For the other sample, n amounts to about 1.5×10^{22} cm^{-3}.

We will present results of the Hall resistance measurements at other conditions and the analysis in higher magnetic fields.

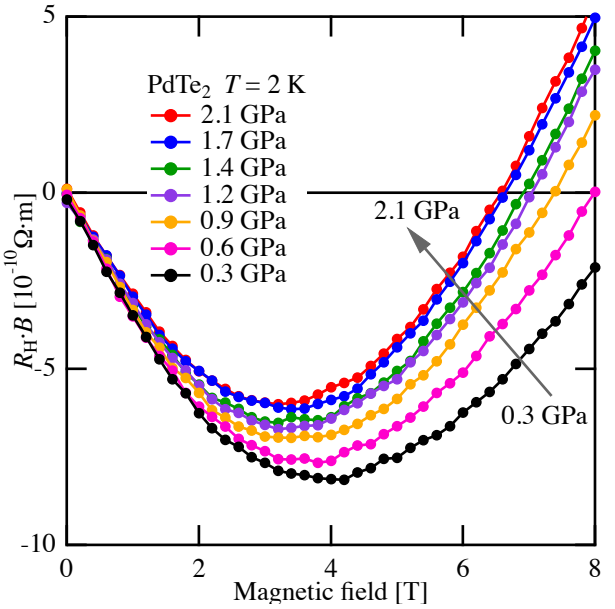

Figure 1. $R_H \cdot B$ vs B plot for $PdTe_2$ at 2 K. Hall coefficient, R_H, is obtained from the initial slope of the curve below 2 T.

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