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Hall effect in the pressure-induced insulating state of $PrFe_4P_{12}$

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In the electrical resistivity (ρ) measurement under high pressure, we have found a pressure–induced transition from metal to insulator above 2.4 GPa in $PrFe_4P_{12}$. [1] However, $PrFe_4P_{12}$ with Pr^{3+} is an uncompensated metal and then it could not be the insulator within the same primitive unit cell. It requires the doubled unit cell to be the insulator. In addition, Harima *et al.* have calculated a band structure, suggesting that this compound has good nesting property in the main conduction band, but it has an extra hole-like band of Fe ion crossing the Fermi surface, which prevents from a perfect nesting effect. [2] These facts suggest that $PrFe_4P_{12}$ could not be the band insulator.

In this work, we have carried out the Hall effect measurement under high pressure in order to make clear whether the energy gap opens or not. Fig.1 shows the temperature dependence of ρ and the Hall coefficient R_H at ambient pressure and 2.93 GPa. $\rho(T)$ and $R_H(T)$ at ambient pressure show the upturn at 6.5 K due to the antiferro–quadrupolar ordering. At 2.93 GPa, $\rho(T)$ shows the metal–insulator (M–I) transition and R_H increases drastically corresponding to the increase of ρ. The value of R_H at 150 mK ($\sim$ 4.7x10^{-5} m^3/C) is about 4 orders of magnitude larger than that above T_{MI}. This increase of R_H at 2.93 GPa is quite larger than that at ambient pressure. This result suggests that the band insulator is realized against the prediction of the band calculation. If the extra hole–like band disappears as pressure effect, the M–I transition originating from the transition which doubles the unit cell might occur.

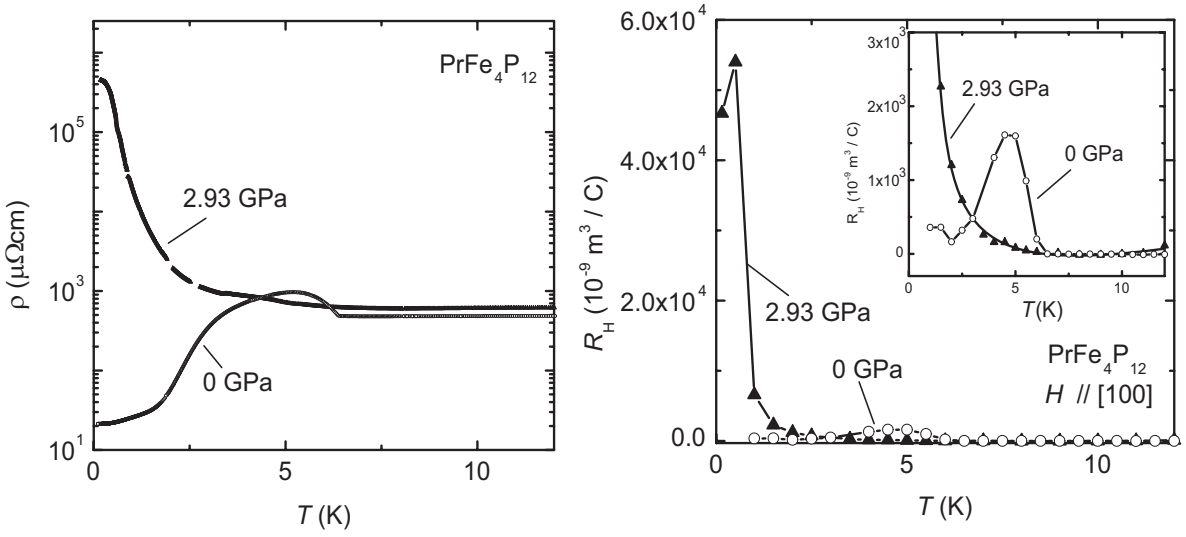

Figure 1: (left) T dependence of ρ at ambient pressure and 2.93 GPa. (right) T dependence of the Hall coefficient R_H at ambient pressure and 2.93 GPa.

[1] H. Hidaka *et al.*, PRB in the press.
[2] H. Harima *et al.*, J. Phys. Soc. Jpn. **71** Suppl. 70 (2002).