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Electronic states of $PrFe_4P_{12}$ under high pressure

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$PrFe_4P_{12}$ is the first case exhibiting heavy Fermion state among Pr based filled skutterudite compounds [1]. The electrical resistivity shows anomalous temperature dependences at ambient pressure: Kondo-like behavior of $\rho \propto -\ln T$ dependence between 300 and 100 K, a sharp upturn at $T_Q = 6.5$ K due to antiferroquadrupolar (AFQ) ordering, and a decline at lower temperature. On the other hand, a peculiar metal-insulator phase transition (MIT) occurs under pressure[2]. Rapid increase of resistivity is shown below T_{MI} above 2.4 GPa and wraps over T_{Q} above 2.7 GPa. It is noticeable that this high-pressure insulator phase is very sensitive to a magnetic field and suppressed to a metalic state above 3 tesla at 2.7 GPa and 6 tesla at 3.3 GPa. The stability of this higher-pressure insulator phase is also an unique matter of interest in this compound. In order to know the change in electronic states under high pressure, we performed optical reflectivity measurements in the regions of far- infrared (FIR) and mid-infrared (MIR) by using spectromicroscope at BL43IR in SPring-8. High pressures were induced using a diamond anvil cell (DAC) with pressure determination by ruby fluorescence technique. Figure 1 shows the change of reflectance in FIR region up to 16 GPa at 15 K. Drude-like reflectance derived from conduction electrons gradually decreases with applying pressure and clear phonon peaks uprise at higher pressure. It demonstrates the reduction of conduction electron in the higher pressure phase around 16 GPa.

[1] H. Sugawara et al.,Phys. Rev. B 66 (2002) 134411.
[2] H. Hidaka et al., Phys. Rev. B 71 (2005) 1.

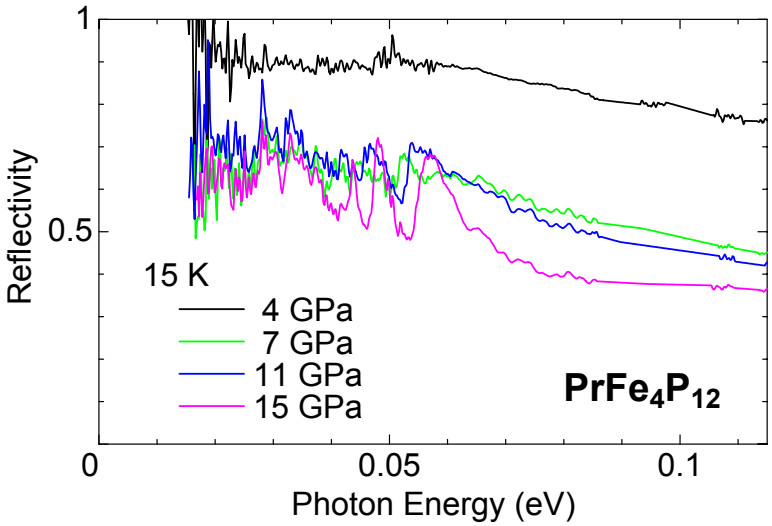

Figure 1: Reflectance spectra of $PrFe_4P_{12}$ under high pressures at 15 K.