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A study of the crystal structure at low temperature in the metal-insulator transition compound $\text{PrRu}_4\text{P}_{12}$

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Filled skutterudite compounds RM_4X_{12} (R = rare-earth; M = Fe, Ru or Os; X = P, As or Sb) has attracted great attention due to variety of physical properties originated in f electron instability. Particularly, $\text{PrRu}_4\text{P}_{12}$ has been studied with interest of the mechanism of a metal - insulator (M-I) transition occurred at $T_{MI} = 60$ K. Interestingly, $\text{PrRu}_4\text{P}_{12}$ does not show magnetic anomaly at T_{MI} nor anti-quadrupolar ordering. Furthermore, there is no clear change in Pr atom valence from trivalent according to our previous Pr L_2 - edge XANES measurements [1]. Subtle lattice distortion, on the other hand, has been detected by the observation of weak superlattice spots below T_{MI} as we reported previously using electron diffraction, which indicates a structural phase transition from body centered cubic ($\text{Im}\bar{3}$) to simple cubic [2].

To clarify the mechanism of the M-I transition, further information about the precise crystal structure especially space group at insulator phase is required. In this study, therefore, we have performed x-ray and electron diffraction measurements at low temperatures. Fig. 1 shows a typical diffraction pattern at $T = 10$ K. Clear Bragg spots are observed at a high S/N ratio with a low background, which allows us to conduct crystal structure analysis with a high accuracy. As the results, the space group is determined to be $\text{Pm}\bar{3}$. Details will be discussed on the conference.

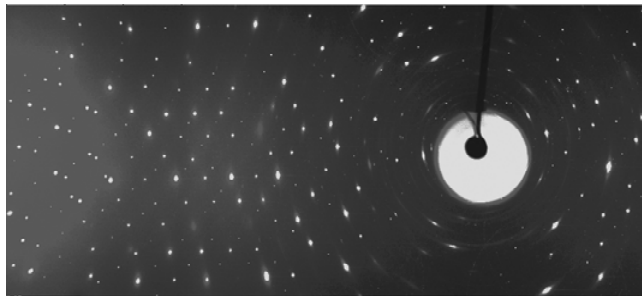


Figure 1: X-ray diffraction pattern of $\text{PrRu}_4\text{P}_{12}$ at $T = 10$ K.

[1] C. H. Lee, H. Oyanagi, C. Sekine, I. Shirotnani and M. Ishii, Phys. Rev. B **60** (1999) 13253.

[2] C. H. Lee, H. Matsuhata, A. Yamamoto, T. Ohta, H. Takazawa, K. Ueno, C. Sekine, I. Shirotnani and T. Hirayama, J. Phys.: Condens. Matter **13** (2001) L45.