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Metal-insulator transition of filled skutterudite systems

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$PrRu_4P_{12}$ shows an anomolus metal-insulator (M-I) transition at T_{MI}=62K [1]. The M-I transition is a non-magnetic one of second order. An observation of superlattice spots below T_{MI} and a study of band calculations gave a scenario for the mechanism of M-I transition, which is the opening band gap caused by a perfect three-dimensional nesting of Fermi surface. $SmRu_4P_{12}$ is another filled skutterudite compound which exhibits M-I transition around 16K [2]. The M-I transition of $SmRu_4P_{12}$ has magnetic origin and occurs in two successive steps. The specific heat, thermal expansion coefficient, the temperature derivative of the resistivity and of the magnetization show two distinct anomalies in field. The field dependence up to 30T (Fig. 1) of the two anomalies suggests that the two successive transitions are antiferro-quadrupolar ordering (T_Q) and antiferro-magnetic ordering (T_N) [3]. Furthermore, nesting of Fermi surface may be also important for this transition. The dissimilarity is due to the difference of the crystal electric field (CEF) ground state of $PrRu_4P_{12}$ and $SmRu_4P_{12}$. Recent experimental results are presented and the mechanisms of these anomalous M-I transitions are discussed.

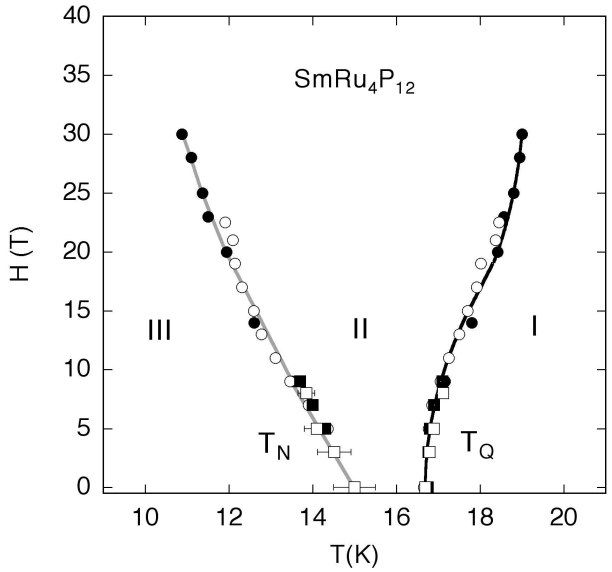

Figure 1: Fig. 1: H-T phase diagram deduced from anomalies of resistivity (◯), magnetization (●), thermal expansion coefficient (□) and specific heat (■).

[1] C. Sekine et al., Phys. Rev. Lett. **79** (1997) 3218.
[2] C. Sekine et al., Science and Technology of High Pressure, Proceedings of the International Conference on High Pressure Science and Technology (AIRAPT-17), ed. M. H. Manghnani et al., pp 826-829, Universities Press, Hyderabad, india, 2000.
[3] C. Sekine et al., Acta Physica Polonica B **34** (2003) 983.