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High pressure synthesis and physical properties of $CeRu_4As_{12}$

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The filled skutterudite compounds have attracted much attention of their wide variety of strongly correlated electron behaviors. Among these compounds, CeT_4P_{12} (T=Fe, Ru and Os) exhibit semiconducting properties and have the smaller lattice constant than that expected from the trivalent lanthanide contraction, indicating a strong hybridization between Ce 4f states and conduction electron states. Therefore, it has been considered that the energy gap in CeT_4P_{12} originates from the hybridization. On the other hand, the lattice constant of CeT_4Sb_{12} follows well the lanthanide contraction, indicating a nearly trivalent state of Ce 4f with a weak hybridization. CeT_4As_{12} is an important system to study the hybridization because it has been considered to be intermediate between CeT_4P_{12} and CeT_4Sb_{12}. We have succeeded in synthesizing single-phase samples of the filled skutterudite compound $CeRu_4As_{12}$ at high temperatures and high pressures. The samples had a cubic structure with lattice parameter a_0=8.4963Å (compared with a_0=8.4908Å in [1]). The crystal structure of $CeRu_4As_{12}$ has been refined by the Rietveld analysis of the powder X-ray diffraction data. $CeRu_4As_{12}$ exhibits a semiconducting behavior, with an small activation energy of 50K at low temperature (fig.1). In $CeRu_4P_{12}$ and $CeFe_4As_{12}$ the hybridization gap was estimated to be 1000K [2] and 115K [3], respectively. Electrical and magnetic properties of $CeRu_4As_{12}$ are discussed.

[1] D. J. Braun and W. Jeitschko, J. Solid State Chem. 32 (1980) 357.
[2] I. Shirotani et al., J. Solid State Chem. 142 (1999) 146.
[3] F. Grandjean et al., J. Phys. Chem. Solids 45 (1984) 877.

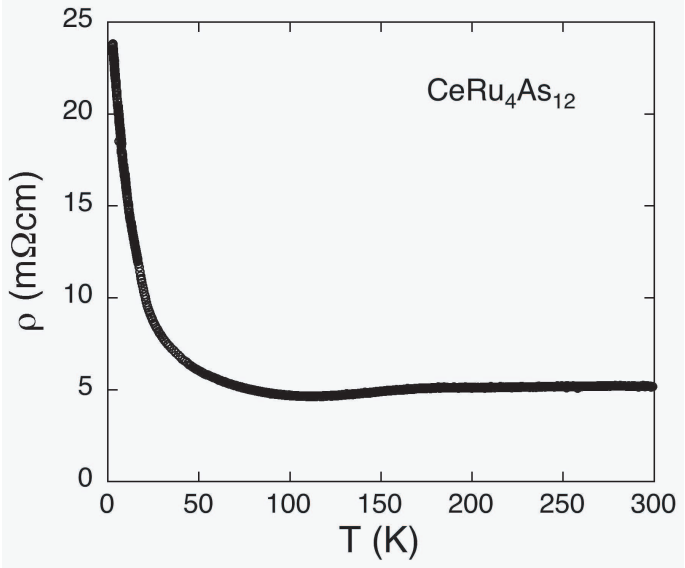

Figure 1: Temperature dependence of the electrical resistivity for $CeRu_4As_{12}$.