(O1-12)

Anomalous physical properties of new fiilled-type compound $Tm_2Rh_{12}P_7$

K. Tatematsu[1], N. Takeda[2],Y. Kobayashi[2], T. Nishioka[3], K. Kodama[4], K. Shimizu[5], T. Matsushita,[5], N. Wada[5], S. Naratsu[6], T. Takabatake[6], K. Fukuda[1], Y.Yamada[7]

[1]Graduate School of Science and Technology, Niigata University, Niigata 950-2181
[2]Faculty of Engineering, Niigata University, Niigata 950-2181
[3]Faculty of Science, Kochi University, Kochi 780-8520
[4]Center for Advenced Marine Core Research, Kochi University, Kochi 783-8502
[5]Graduate School of Science, Nagoya University, Nagoya 464-8602
[6]Graduate Schoold of Matter, Hiroshima University, Higashi-Hiroshima 739-8530
[7]Faculty of Science, Niigata University, Niigata 950-2181

One of the structural characteristics of filled skutterudite is the presence of unfilled skutterudites. It is well known that the rare-earth ions occupy the voids of unfilled skutterudite. We are exploring new filled-type materials other than filled skutteridite. Pivan et al. reported the crystal structure of $R_2Rh_{12}P_7$ (R=Rare Earth) and $Rh_{12}P_7$. Both compounds have the same space groupe of P63/m. According to the report, the crystal strucutre of $Rh_{12}P_7$ has voids and R-ions occupy their voids in $R_2Rh_{12}P_7$.

$Tm_2Rh_{12}P_7$ is one of the most interesting material in $R_2Rh_{12}P_7$. Powdered samples were prepared by solid-state reaction. The magnetic susceptibility, $\chi(T)$, follows a Curie-Weiss law down to 2K with a paramagnetic Bohr-magneton of 7.4 μ_B and a Weiss temperature of -4K. The paramagnetic Bohr-magneton is very close to the theoretical value of trivalent state with $S = 1, L = 5$ and $J = 6$. No magnetic transition is observed in $\chi(T)$ down to 2 K. The electrical resistivity of high-density pellets prepared by a spark-plasma sintering technique is metallic. We show in Fig.1 the temperature dependence of C/T below 1K. The value of C/T attains as large as 1 J/mol-Tm·K^2. The $J = 6$-multiplet splits into five nonmagnetic singlets and four doublets. If the ground state is singlet, the ground state would be Van-Vleck paramagnet. In this case, the large C/T is not expected. If the ground state is a doublet, the ground state would be magnetic and the magnetic entropy attains Rln2. The experimental result for entropy is much less than Rln2. The reduced entropy is a characteristic feature of heavy-fermion systems. It is likely that the heavy-fermion state is realized in $Tm_2Rh_{12}P_7$.

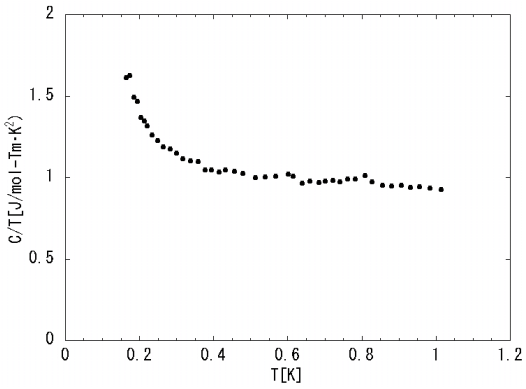

Fig. 1: The temperature dependence of C/T.