

Preparation and properties of new filled skutterdites and their related compounds with 14 group elements

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The filled skutterudite structure is composed of 15 group elements like P, As, and Sb, which are bound to transition metal atoms and form a three-dimensional network. Especially filled skutterudite compounds with rare-earth elements have attracted much attention of researchers because of their interesting heavy fermion behaviors due to the f electrons. Many compounds with this structure have been prepared and their physical properties have been extensively investigated on theoretical and experimental aspects. However, the effect of substitution of the host network atoms to other group elements has not been well studied. In the present project, I am planning to prepare Ge or Sn substituted skutterudite compounds, and to compare their physical properties with those of original skutterudite compounds. New compounds having skutterudite-related structures involving rare-earth elements are also investigated.

In the present study, a cerium germanide, CeGe_3 was prepared by the reaction of a stoichiometric mixture of CeGe_2 and Ge under a pressure of 5 GPa at 1600 °C. It crystallized in a cubic unit cell with $a = 4.354(4)$ Å. It was isotypic with CeSn_3 having the Cu_3Au structure. The temperature dependence of the resistivity of CeGe_3 is shown in Figure 1. It showed a metallic property and the resistivity gradually decreased with decreasing temperature. The resistivity became constant from 2 K to 20 K and the residual resistivity of 0.014 mΩ·cm was observed at 2 K. CeGe_3 showed a Curie-Weiss paramagnetic behavior from room temperature to 20 K with a Curie constant C of 0.0495 emu mol⁻¹·K. The effective magnetic moment of 0.63 μB was observed. It was much smaller than the theoretical value of 2.54 μB for Ce^{3+} ($4f^1$) ions. Further investigation should be necessary for the understanding of the magnetic behavior of this compound.

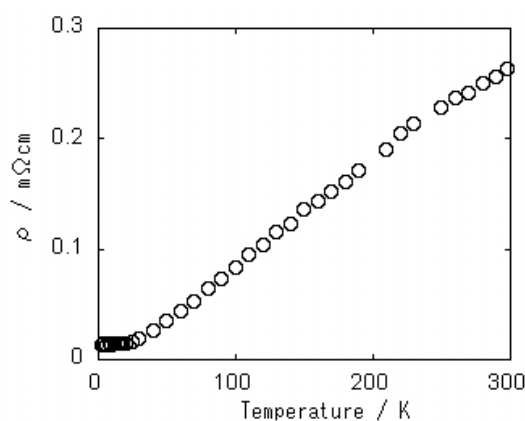


Figure 1: Temperature dependence of the resistivity of CeGe_3