TU.B-P51 - Magnetic and transport properties of mixed-valent europium sulfide $EuPd_3S_4$

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We have investigated the magnetic and transport properties of a ternary intermetallic compound $EuPd_3S_4$. The mixed-valent behavior was previously reported from magnetization measurements and ^{151}Eu Mössbauer spectroscopy using polycrystalline samples [1]. $EuPd_3S_4$ undergoes an antiferromagnetic transition at T_N = 3.4 K [2]. The experimental results can be explained by assuming the valence of $Eu^{2.5+}$. In particular, two absorption peaks in Mössbauer spectra, which indicate the divalent and trivalent state, were well defined even at room temperatures. This result may suggest the charge ordered state, the ratio of Eu^{3+} : Eu^{2+} = 1 : 1. On the other hand, the broad maximum around 150 K in the temperature dependence of the thermoelectric power is reminiscent of the behavior observed in the valence fluctuation compounds [3]. Accordingly, the details of the valence state in this compound are still controversial.

In this study, we have succeeded in growing single crystalline samples by using chemical transport method. The saturation magnetization is determined to be 3.3 μ_B at 1.8 K. This is almost the half of the expected value of gJ = 7 μ_B, suggesting that the ratio of Eu valence is estimated to be Eu^{3+} : Eu^{2+} = 1 : 1. The evaluated magnetic entropy also supports this suggestion. Moreover, we have performed measurements of electrical resistivity and powder X-ray diffraction in high temperature regions in order to obtain an anomaly corresponding to a transition to the valence fluctuate state, if the charge ordered state is realized at room temperatures, such as Eu_4As_3 [4]. The resistivity of $EuPd_3S_4$ is linearly proportional to temperature up to 600 K, and lattice constant also increases monotonically with increasing temperature up to 900 K, without any transition. In many valence fluctuation compounds, the deviation from linear temperature dependence is observed on resistivity. We speculate that the charge ordered state is stabilized up to 900 K.