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Cubic Pr compounds with non Kramers doublet Γ_3 ground state

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Systems including non-Kramers rare-earth ion under cubic symmetry are of special interest from the viewpoint of their characteristic crystalline-electric-field (CEF) states. For example, the Hund's rule ground state for $^3H_4$ of Pr^{3+} ion splits in a cubic CEF into one singlet, Γ_1, one doublet, Γ_3, and two triplet, Γ_4 and Γ_5. Here, it is noted that the non-Kramers doublet of Γ_3 is non-magnetic but has quadrupolar moments. When Γ_3 ground state with a relatively large CEF splitting is realized, it is suited for the investigation of a pure quadrupolar system. They are, however, rare cases, for example, $PrPb_3$, $PrInAg_2$ and PrPtBi. We have investigated such Cubic Pr compound systems with non Kramers doublet Γ_3 ground state by means of the magnetic and quadrupolar susceptibilities, the specific heat and the inelastic neutron scattering measurements. Recently, the polycrystalline sample of $PrInNi_4$ with the cubic $MgSnCu_4$-type structure has been prepared and found to be an induced-moment ferromagnet with Γ_3 ground state. A balance between the CEF splitting and the ferromagnetic interaction introduces the field and temperature induced ferromagnetic transition. In the series of $PrInX_2$ (X = Cu, Ag , Au), X = Cu was found to take the Γ_3 ground state with a relatively large CEF splitting compared with X = Ag, reflecting the volume effect, i. e. the lattice constant of X = Cu is smaller than that of X = Ag. We have also succeeded in the preparation of the single crystal and the observation of the dHvA signal for $PrInAg_2$. At the lowest temperature of our measurement, T = 30 mK, the electrical resistivity is going to decrease with the decrease of the temperature, and is decreased with the applied field, showing a minimum around H = 4 T (Fig. 1). The AC susceptibility shows a broad peak around this field. We will present mainly the results of $PrInAg_2$, including the results of the dHvA effect.

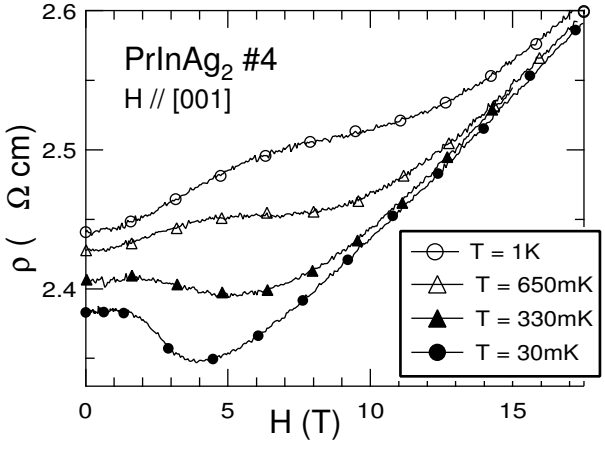

Figure 1: The magnetic field dependence of the resistivity for various temperatures in $PrInAg_2$.