(PS50)

Electronic state of $5f$-itinerant antiferromagnets $UPtGa_5$.

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$UPtGa_5$ has the $HoCoGa_5$-type tetragonal crystal structure (P4/mmm), which belongs to a family of a heavy fermion superconductor $CeCoIn_5$, an antiferromagnet $NpCoGa_5$ and a superconductor $PuCoGa_5$. We have succeeded in growing the high-quality single crystal of $UTGa_5$ by the Ga self-flux method and measured the magnetic susceptibility, neutron scattering and de Haas-van Alphen (dHvA) effect.

It is clarified from the present magnetic susceptibility and neutron scattering measurements that $UPtGa_5$ is an antiferromagnet with a small magnetic moment $\mu_s = 0.26\ \mu_B$. The effective magnetic moment $\mu_{eff} = 3.5\ \mu_B$, obtained from the Curie-Weiss law of the magnetic susceptibility in $UPtGa_5$ at high temperatures up to about 800 K, is close to a free magnetic moment of 3.6 μ_B in the $5f^2(5f^3)$ configuration, suggesting a $5f$-localized character at high temperatures, as shown Fig 1. From the dHvA experiment, it was clarified that Fermi surfaces of $UPtGa_5$ consist of four nearly cylindrical Fermi surfaces. The cyclotron mass for these Fermi surfaces, which is in the range from 10 to $24\,m_0$, is also consistent with the electronic specific heat coefficient of $57\,mJ/K^2{\cdot}mol$. The relatively large mass is a strong evidence of the $5f$-electron contribution to the conduction band, indicating the $5f$-band magnetism in $UPtGa_5$. In fact, the result of dHvA experiment was well explained by the results of $5f$-itinerant spin-(and orbital-) polarized LAPW energy band calculation, indicating that the $5f$ electrons are itinerant and also produce the magnetic moments at the uranium sites.

It is thus concluded from these results that a crossover effect of the $5f$ electrons from the localized nature at high temperatures to the itinerant one at low temperatures occurs in an antiferromagnet $UPtGa_5$.

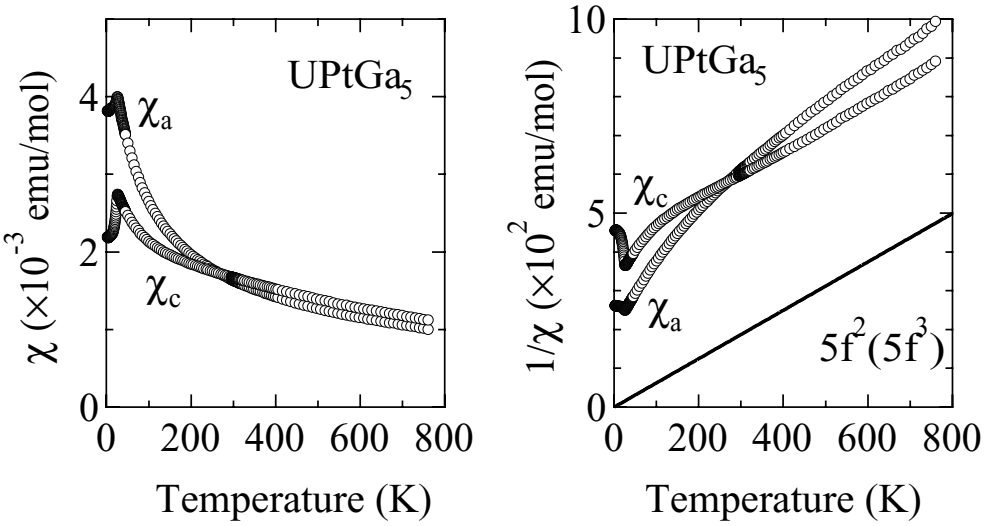

Figure 1: Temperature dependence of magnetic susceptibility and reciprocal magnetic susceptibility in $UPtGa_5$