HALL EFFECT IN THE LOW CHARGE-CARRIER DENSITY FERROMAGNET $UCo_{0.5}Sb_2$

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9.7 cm

The Hall coefficient R_H of ferromagnetic $UCo_{0.5}Sb_2$ (T_C = 74.5 K) has been measured on a single crystal in the temperature range 2 - 300 K and in magnetic fields up to 7 T. The values of the normal R_0 and anomalous R_s coefficients were estimated by comparing the $R_H(B)$ with magnetization $M(B)$ data. Both $-R_0$ and R_s show a maximum near T_C and a minimum at $T_{min} \approx 20$ K. Below T_{min}, R_0 and R_s tend to a saturation. The ratio R_s/R_0 reaches a value of ~ 1000 for $T \leq T_C$ and of ~ 21000 at higher temperatures, implying that R_H is dominated by R_s. The negative sign of R_0 is found to be unchanged down to 2 K, which is indicative of electron-type carriers. The carrier concentration $n_e = |1/eR_0|$ is found to decrease rapidly when the system undergoes the ferromagnetic ordered state, i.e., it varies from 0.785 e/f.u in the paramagnetic state to about 0.024 e/f.u at 2 K. The charge mobility μ_e was evaluated from the $R_H(1\mathrm{T})$ and electrical resistivity ρ values. $\mu_e = R_H(1\mathrm{T})/\rho$, passes over a maximum (≈ 450 cm^2/Vs) at T_{min} and falls down by as many as two orders of magnitude for $T = 2$ K (≈ 3.7 cm^2/Vs). Since the effective mass $m^* = 3\gamma\hbar^2/(3\pi^2 n_e)^{1/3}k_B^2$ shows weak temperature dependence (from 53.8 m_e at T_{min} to 69.5 m_e at 2 K), the decline in μ_e with decreasing temperature seems to be associated with an enormous decrease of the carrier collision time.

13.4 cm

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