Physical properties and electronic structure of antiferromagnet URhIn₅

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RTX₅ family (R = rare earth and actinide T = transition metal, X = In, Ga tetragonal HoCoGa₅ type structure) is one of the most studied system in the strongly correlated f electron system. In R = actinide, PuCoGa₅ which is heavy fermion superconductor with much higher transition temperature Tₐ = 18 K is intensively studied [1]. In R = U, UTGa₅ compounds only have been reported and they exhibit antiferromagnetism or enhanced Pauli-paramagnetism [2, 3]. There was no UTIn₅ compounds so far. Therefore we have searched for UTIn₅ compounds. As a result, single crystals of URhIn₅ have been obtained [4].

We have measured the magnetic properties, electrical resistivity and specific heat of URhIn₅. URhIn₅ is an antiferromagnet with antiferromagnetic transition temperature Tₐ = 98 K. The moderately large electronic specific heat coefficient γ = 50 mJ/K² mol demonstrates the contribution of 5f electrons to the conduction band. On the other hand, magnetic susceptibility in the paramagnetic state roughly follows a Curie-Weiss law with a paramagnetic effective moment corresponding to a localized uranium ion. The crossover from localized to itinerant character at low temperature may occur around the characteristic temperature 150 K where the magnetic susceptibility and electrical resistivity show a marked anomaly.

We have also performed the de Hass-van Alphen (dHvA) effect measurement of URhIn₅ to obtain its electronic structure [5]. By analyzing the dHvA oscillations, existence of two Fermi surfaces was concluded.

Reference: