

## MAGNETORESISTANCE OF UPdSn AND PRESSURE EFFECT\*

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Results of electrical-resistivity measurements for a UPdSn single crystal (current along the  $c$ -axis of orthorhombic structure) at various temperatures, magnetic fields and hydrostatic pressures are presented. Large magnetoresistance effects are observed in antiferromagnetic (AF) state, but also at temperatures far above  $T_N$ . The latter result is attributed to the existence of AF correlations or short-range AF ordering in paramagnetic range. The value of  $T_N$  is found increasing with increasing applied hydrostatic pressure whereas  $T_1$ , the temperature of the AF-1  $\longleftrightarrow$  AF-2 transition, simultaneously decreases. As a consequence, the stability range of AF-1 phase becomes extended with applied pressure.

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### 1. Introduction

UPdSn, which crystallizes in the GaGeLi-type orthorhombic structure, orders antiferromagnetically (AF-1) below  $T_N = 40$  K and undergoes an order-order magnetic phase transition to the ground state AF-2 phase at  $T_1 = 25$  K [1]. In the AF-1 phase, the U magnetic moments are aligned in the  $bc$ -plane and below  $T_1$  turn out of the  $bc$ -plane by about  $45^\circ$  forming the AF-2 phase. In magnetic fields applied within the  $ab$ -plane, the AF-2

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phase is transformed towards a canted antiferromagnetic state (CAF) with a non-negligible spontaneous moment [1]. The magnetic phase transitions in UPdSn are accompanied by considerable electrical resistivity anomalies [2]. In the present work, we measured the electrical resistivity (for current along the  $c$ -axis) as a function of temperature  $\rho(T)$  and magnetic field  $\rho(B)$  while applying various hydrostatic pressures up to 0.95 GPa.

## 2. Experimental

The UPdSn single crystal has been grown by Czochralski method in a tri-arc furnace. The electrical resistivity for current along the  $c$ -axis was measured by means of a standard four-probe method using an AC resistance bridge. Magnetic fields up to 18 T were applied in the  $ab$ -plane and a hydrostatic pressure up to 0.95 GPa was generated by conventional clamp type piston-cylinder device.

## 3. Results and discussion

Fig. 1 shows the magnetoresistance (MR) curves measured at various temperatures in an ambient pressure. At temperatures below  $T_1$ , both dramatic decrease of resistivity and hysteresis accompany the AF-2  $\leftrightarrow$  CAF magnetic phase transition. When applying pressure the onset field of this transition becomes reduced.

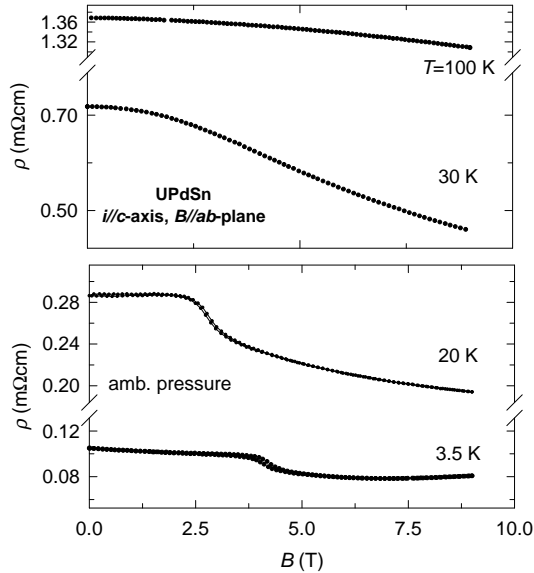


Fig. 1. MR curves measured on a UPdSn single crystal in ambient pressure.

The change of slope of the MR curve at 30 K around 1.3 T can be attributed to the onset of transition from the AF-1 phase to another CAF phase. Pronounced negative MR phenomena were found also at temperatures above  $T_N$ . Although decaying with increasing temperature, a considerable negative MR effect ( $\sim 5\%$  at 9 T) is seen still at 100 K ( $2.5 \times T_N$ ).

The  $\rho(T)$  dependencies, measured in  $p = 0.95$  GPa in several magnetic fields are shown in Fig. 2. In the inset the  $d\rho/dT$  data are displayed. The two clear  $\rho(T)$  anomalies in the zero-field data, are attributed to the magnetic phase transitions at  $T_N$  and  $T_1$ , respectively. Inspection of  $\rho(T)$  data collected for different values of applied pressure reveals that  $T_N$  increases ( $T_1$  decreases) with increasing pressure with a rate of 1.9 K/GPa ( $-1.9$  K/GPa), *i.e.* that the stability range of the AF-1 phase expands with pressure. The positive pressure effect on  $T_N$  can be connected with large stable U magnetic moments, which corroborates the scenario the  $5f$ -electron states close to localization in the physics of UPdSn [1].

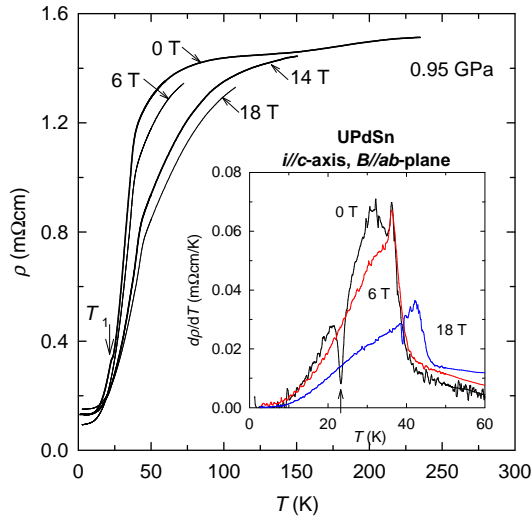


Fig. 2. The temperature dependence of electrical resistivity of UPdSn under pressure 0.95 GPa and various magnetic fields.

When applying magnetic field the  $T_1$ -related resistivity drop is suppressed already in the 6-T data, which indicates only one field-induced CAF phase at temperatures up to  $T_N$ . The  $T_N$ -related anomaly is shifted in field of 18 T to a somewhat higher temperature, which reflects the gradually increasing spontaneous-moment component in the CAF phase. The resistivity changes at this anomaly become strongly suppressed with field. The considerable field-induced reduction of resistivity decays with temperature increasing above  $T_N$ , nevertheless it can be traced up to 150 K. This result,

together with the magnetoresistivity data in Fig. 1, can be conceived with a scenario considering a strongly enhanced conduction-electron scattering on the AF correlations or short-range AF order of U moments, which persist in paramagnetic range at temperatures far above  $T_N$ , but can be suppressed in sufficiently large magnetic fields. To proof the relevance of this scenario, microscopic experiments, especially neutron scattering and  $\mu SR$  measurements are strongly desirable.

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