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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 $T_{\rm N}$. The latter result is attributed to the existence of AF correlations or short-range AF ordering in paramagnetic range. The value of $T_{\rm N}$ 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 $T_{\rm N} = 40$ 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° 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 $\Longleftrightarrow$ CAF magnetic phase transition. When applying pressure the onset field of this transition becomes reduced.

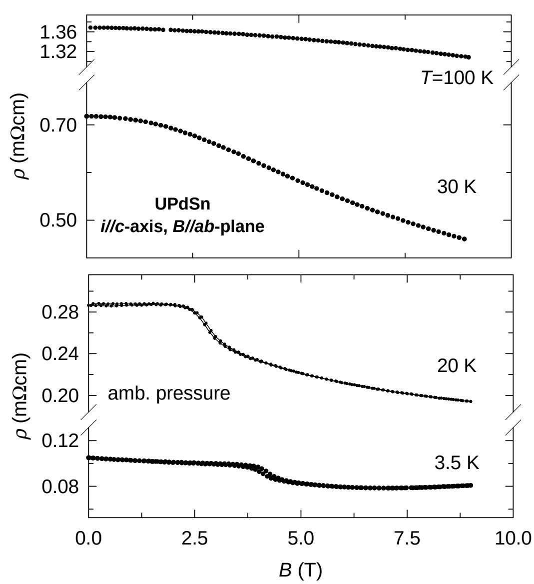

Fig. 1. MR curves measured on a UPdSn single crystal in ambient pressure.

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 ($2.5 \times T_{\mathrm{N}}$).

The $\rho(T)$ dependencies, measured in $p = 0.95$ GPa in several magnetic fields are shown in Fig. 2. In the inset the $\mathrm{d}\rho/\mathrm{d}T$ 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].

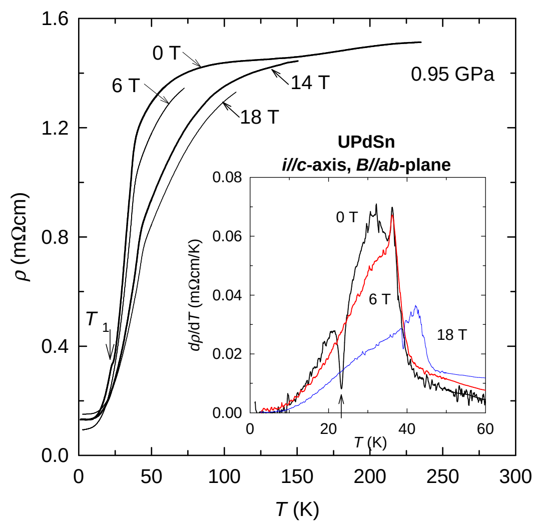

Fig. 2. The temperature dependence of electrical resistivity of UPdSn under pressure 0.95 GPa and various magnetic fields.

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 μSR measurements are strongly desirable.

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