Investigations of pressure-temperature phase diagram of Ce_3PdIn_{11} and Ce_3PtIn_{11}

The electrical resistivity of antiferromagnetic heavy-fermion superconductor Ce_3PdIn_8 was measured under high pressure conditions. Both, the Néel and superconducting transition temperatures shift towards lower temperatures with increasing pressure.

The ground state of Ce-based compounds depends on subtle balance between Kondo and RKKY-type interactions. Both depend on the product $JN(E_F)$, where J is an exchange coupling between spins of electrons from 4*f* and conduction bands, and $N(E_F)$ is the density of states at the Fermi level. Thus, the ground state in Ce-based compound can be easily tuned by external parameter such as pressure, magnetic field or doping.

The Ce-based ternaries Ce_3PdIn_{11} and Ce_3PtIn_{11} crystallize with the tetragonal unit cell, strongly elongated along the *c* axis (space group *P*4/*mmm*), in which Ce atoms occupy two inequivalent crystallographic sites. Both compounds undergo two magnetic phase transitions at T_{N1} and T_{N2} into antiferromagnetically ordered state, and subsequent transition at T_C into superconducting state (T_{N1} = 1.67 K, T_{N2} = 1.53 K, T_C = 0.42 K and T_{N1} = 2.2 K, T_{N2} = 2 K, T_C = 0.32 K for Ce_3PdIn_{11} and Ce_3PtIn_{11}, respectively) [1,2,3]. The complex ground states in both compounds may be attributed to the presence of two inequivalent Ce-atom sites in their unit cells. The Kondo and RKKY temperatures are expected to be different for both Ce positions, which may lead to coexistence of antiferromagnetism and superconductivity, yet occurring in two different sublattices [1].

In the framework of the project, the resistivity of Ce_3PdIn_{11} was studied under high-pressure conditions, using Bridgmann pressure cells in He-free cryostat (between 1.3 and 300 K) and in dilution refrigerator (down to 130 mK).

The low-temperature dependence of the resistivity of the compound is presented in Fig. 1. The antiferromagnetic phase transition, marked with arrows, manifests itself as a tiny kink on the curve. It shifts towards lower temperatures with changing pressure from 0.15 to 0.9 GPa. The superconducting transition at 0.15 is quite broad and shows a step. At 0.9 GPa, the transition is broader and the step is more distinct. The resistivity measured at 2.2 GPa shows a kink near 200 mK, possibly of superconducting origin.

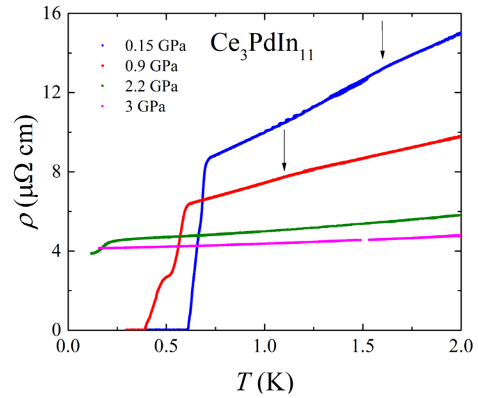

Fig.1

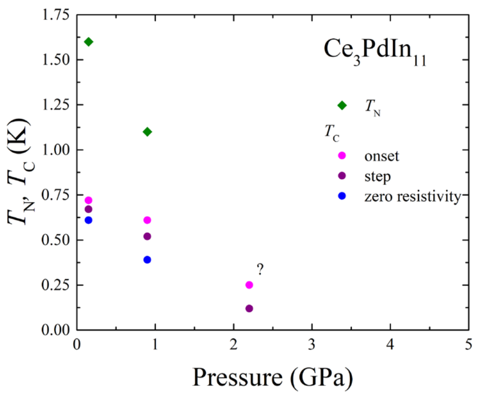

Fig. 2

The curve taken at 3 GPa does not show any singularity down to 150 mK. The preliminary *p*-*T* phase diagram of the system is shown in Fig. 2. It is highly important to continue measurements in order to gather more experimental data in the pressure window between 0.9 and 2.2 GPa.

References

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