Pressure effect on ZrNiAl compounds from UTX family

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In recent years interest in phase diagrams and quantum criticality in ferromagnets has increased due to development of BKV theory [1,2]. Four different classes of behavior has been proposed depending on the amount of disorder present in the compound. One of them is discontinuous phase diagram which is observed only in clean compounds. In this phase diagram second order phase transition is suppressed as a function of control parameter (typically pressure) and changes into first order transition at the tricritical point (TCP). First order transition changes into quantum phase transition (QPT) at zero temperature. At TCP another transition from paramagnetic to ferromagnetic states appears by application of external magnetic field. These transitions are observed even in pressures above QPT, but they disappear in so called quantum critical wingpoint located in the T = 0 K B-p plane. The sheet made of metamagnetic transitions in the phase diagram is often called metamagnetic wing. Most compounds exhibiting this kind of phase diagram or part of it are weak ferromagnets e.g. ZrZn2, UGe2 and UCoAl.

Last mentioned compound, UCoAl is 5f electron paramagnet in which metamagnetic transition is observed at ~0.7 T. It crystallizes in hexagonal ZrNiAl structure. By applying hydrostatic pressure the critical magnetic field increases and temperature range decreases until it completely dissappers at 2.9 GPa and 13 T [3]. Another compound crystallizing in ZrNiAl structure is URhAl, it is ferromagnet with Tc = 27 K and exhibits TCP at 4.9 GPa and signs of metamagnetic transition [4]. Many UTX compounds crystallizing in ZrNiAl structure are weak ferromagnets and therefore possible candidates to exhibit discontinuous phase diagram. This group of compounds offers possibility to explore changes of discontinuous phase diagram by changing basic magnetic properties and keeping same crystal structure.

We present data obtained on single crystals of $UCo_{0.990}Ru_{0.010}Al$, URhGa and UCoGa. UCoAl doped by 1% of Ru on Co position is ferromagnetic with T_C = 16 K, putting close to TCP. Measurement of magnetic and electric transport properties done in hydrostatic pressure will be present with focus on behavior near TCP and QCWP. The results will be discussed in framework of BKV theory and compared to published results on pure UCoAl. URhGa and UCoGa are ferromagnets with T_C = 41 K and 48 K, respectively. Experiments in hydrostatic pressures were done to determine evolution of Curie temperature. URhGa shows increase of TC with pressure behavior, which is unusual in comparison to other ZrNiAl compounds. Origin of this behavior will be discussed with connection to uranium magnetism and spin fluctuation theory.

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