Evolution of magnetic phase dagram of $UIrSi_3$ upon application of pressure

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The $UIrSi_3$ compound is the Ising-like non-centrosymmetric antiferromagnet crystallizing in the tetragonal $BaNiSn_3$-type crystal structure [1]. The magnetization and specific heat measurements performed on the single crystal sample revealed strong uniaxial anisotropy below $T_N = 41.7$ K and easy magnetization direction along *c*-axis. Application of external magnetic field along the crystallographic c-axis suppresses the antiferromagnetic order at $H_C = 7.3$ T. The first order metamagnetic transition exhibits asymmetric hysteresis at H_C. The hysteresis narrows with increasing temperature and vanishes around 28 K. At higher temperatures a second order metamagnetic transition is observed up to T_N [2]. Measurements of other physical quantities show unequivocally different character of first-order and second-order metamagnetic transition. These different characters of magnetic phase transitions are separated by a tricritical point appearing around 28 K at 5.6 T (see phase diagram Figure 1). The above mentioned results bear witness about complex AF ground-state magnetic structure which originates in the competition of ferromagnetic and antiferromagnetic exchange interactions.

Application of hydrostatic pressure causes shift of the Néel temperature to higher temperatures whereas the critical field of metamagnetic transition decreases with increasing pressure up to 3 GPa (see Figure 2). Generally, application of high pressure causes increasing overlap of 5*f*-wave functions leading to suppression of itinerant U magnetic moment and therefore decreasing of the Néel temperature is expected above certain pressure. Nevertheless, the opposite evolution of H_C and T_N promises the shift of the tricritical point to low magnetic fields and higher temperatures.

Results from measurement in the extended pressure range up to 6 GPa will be presented in the context of other Uranium compounds and as a consequence of exchange interactions.

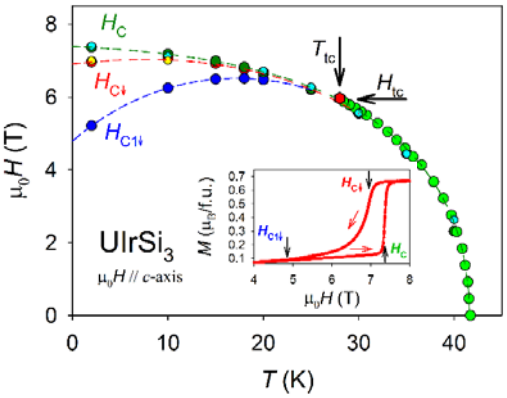

Figure 1. Ambient-pressure magnetic phase diagram of $UIrSi_3$ when the magnetic field is applied along the *c*-axis. The labels H_c, $H_{c\downarrow}$ and $H_{c1\downarrow}$ are defined in the inset figure where the detail of asymmetric hysteresis in magnetization loops is plotted. Colors of the data points represent data from measurements of: $M(H)$ … H_c - dark green, $H_{c\downarrow}$ - red, $H_{c1\downarrow}$ - blue; $C_p(H)$ … H_c - light blue, $H_{c\downarrow}$ - yellow; $C_p(T)$… H_c - light green followed by a red hexagon indicating the tricritical point (T_{tc} = 28 K, H_{tc} = 5.8 T).

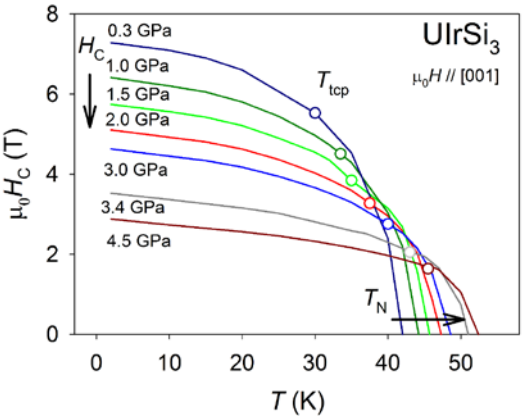

Figure 2. Pressure evolution of the phase diagram obtained from measurements of magnetoreistance with magnetic field applied along *c*-axis and under hydrostatic pressure up to 3 GPa.

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