

## STRESZCZENIE W JĘZYKU ANGIELSKIM (Abstract)

### Title:

Superconductivity and structure of selected metals from groups  $5f$  and  $(3-5)d$  and their hydrides.

### Key words:

uranium,  $\gamma$ -U phase, cubic structure, superconductivity, hydrides, ferromagnetism

### Abstract:

Metallic uranium exists in three allotropic phases, between room temperature and its melting point:  $\alpha$ -U,  $\beta$ -U, and  $\gamma$ -U. The high-temperature  $\gamma$ -U phase with cubic structure can be retained to the room temperature by using a combination of ultrafast-cooling and alloying with  $3d$ ,  $4d$  and  $5d$  elements in groups IV - VIII of the periodic table; i.e. the  $U_{1-x}T_x$  systems;  $T = Mo, Zr, Nb, Ru, Pd, Pt, Ti$ .  $U_{1-x}T_x$  alloys absorb hydrogen when exposed to high hydrogen pressures ( $> 4$  bar), forming hydrides of the  $(UH_3)_{1-x}T_x$  type.

The aim of the dissertation was to investigate the crystal structure and superconductivity of selected  $U_{1-x}T_x$  systems ( $U$ -  $n$  at.%  $T$ ;  $x = n/100$ ; at.=atomic percentage  $T = Nb, Ru, Pt, Pd, Ti$ ) alloys synthesized via an ultrafast-cooling method with the cooling rate in the range of  $10^6$  K/s. The results will be compared with the earlier results obtained for the U-Mo and U-Zr systems. Stabilization of the  $\gamma$ -U phase is possible for the concentration of  $n \geq 15$  at.%  $T$ . The investigated U-T alloys ( $T = Nb, Pt, Pd, Ru, Ti$ ) become superconducting in the temperature range of 0,40 – 1,95 K. Detailed investigations of the superconducting state at ultra-low temperature to 70 mK and in the magnetic field up to 5 T allowed to determine the values of the upper critical field and the critical slope, which is respectively in the range of 1,0 - 4,3 T and 2,0 - 4,3 T/K. (For a comparison: the highest value of  $T_c$  and value of upper critical fields and of the critical slope for U- 15 at.% Mo is respectively 2.11 K, 6.7 T i 4,7 T/K).

The investigated hydrides  $(UH_3)_{1-x}T_x$  ( $T = Nb, Ru, Ti$ ; presented in this work) have a mixture of  $\alpha$ - $UH_3$  and  $\beta$ - $UH_3$  phase. They are ferromagnets with the Curie temperature in the range of  $\sim 151 - 195$  K and a spontaneous magnetization  $M_s$  in the range 0,80-1,05  $\mu_B/U$ . (For a comparison: hydride  $(UH_3)_{0,85}Mo_{0,15}$  is a nanocrystalline ferromagnet with pure  $\beta$ - $UH_3$  phase ( $T_C = 200$  K;  $M_s = 1,09 \mu_B/U$ ); hydride  $(UH_3)_{0,70}Zr_{0,30}$  is a crystalline ferromagnet with  $\alpha$ - $UH_3$  phase  $T_C = 170$  K;  $M_s = 0,89 \mu_B/U$ ).