Title: U-based thin films: electronic structure and physical properties

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Abstract: This thesis presents studies of U-based thin films synthesized by means of the DC sputter deposition, which allows to vary the composition and microstructure and perform in photoelectron spectroscopy studies. The subjects are U-Mo and U-Zr alloys, Uranium hydrides (UH_3 and UH_2), and U hydrides with Zr/Mo substitution.

In-situ analysis was followed by *ex-situ* studies of structure, magnetic and transport properties. Despite the superconducting ground state of the U-T alloys, only one film ($U_{0.92}Mo_{0.08}$) exhibited superconductivity, with the transition at 0.55 K.

All hydrides are ferromagnetic, with Curie temperatures around 120 K for UH_2 and 170 K for both α- and β-UH_3. This ferromagnetism is robust and independent of structural details. By varying sputtering parameters, one can obtain UH_2 (nonexistent in bulk form), β-UH_3, or a mix of UH_2 and α-UH_3 (first observed in film form). Inclusion of hydrogen atoms drastically changes properties, shifting from paramagnetic alloys to ferromagnetic hydrides, with the U-H polar bond being crucial for magnetism. The nature of UH_3 as a band ferromagnet was clarified by comparing DMFT calculations with XPS and UPS spectra, revealing final-state $5f^2$ multiplet and emphasizing electron-electron correlations in UH_3.

Zr substitution in hydride films stabilized UH_2 instead of the expected α-UH_3 phase. Series $(UH_3)_{1-x}Mo_x$, $(UH_3)_{1-x}Zr_x$, and $(UH_2)_{1-x}Zr_x$ have lower Curie temperatures than their bulk counterparts and pure UH_2 or UH_3 films. This decrease is attributed to a destabilization of hydrogen caused by the incorporation of transition metals and the excessive energy from the deposition process.

Keywords: Thin Films, Uranium, Superconductivity, Hydride, Electronic Structure, Magnetism