Title: **Electronic properties and structure of selected rare earth and uranium compounds; influence of impurities**

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Abstract: This thesis is devoted to studies of influence of impurities and/or chemical varieties on magnetic and superconducting properties of selected metallic materials containing rare earth and uranium. The research generally consisted of the defined preparation of studied materials, detailed composition and structure characterisation, experiments focussed on determination of mutually related magnetic, transport and thermal properties followed by data analysis of relations between material composition/quality and material properties. The technology phase was carried out in two ways – 1) preparation of the best pure materials as possible and 2) controlled doping of pure materials. Three main study cases have been chosen: $SmPd_2Al_3$ – the representative of the complex magnetism of the Sm^{3+} ion, the so far unexplored superconductor YPd_2Al_3 were selected as the *RE* materials candidates and the controversial ferromagnetic superconductor UCoGe.

The key ingredient of the initial technology phase was the refining the commercially available best element metals to the laboratory best achievable purity grade by the unique Solid State Electrotransport (SSE) method. SSE has been also applied for refining a compound, namely UCoGe.

A high-quality $SmPd_2Al_3$ single crystal has been prepared and characterized within this work, to our knowledge the world wide only crystal of this material. The detailed measurements of electronic properties of this crystal allowed determining for the first time the anisotropic magnetism of this material with the specific aspects of the Sm^{3+} ion physics.

YPd_2Al_3, originally selected as a non-*f*-electron analogue to $SmPd_2Al_3$, has been found by us as a new superconductor in the $REPd_2Al_3$ group of materials. T_{SC} is strongly sample dependent – 0.6 K in the as cast samples and 2.2 K in the annealed samples. The observed superconducting behaviour of YPd_2Al_3 was discussed in terms of BCS concept and influence of internal stresses of the material.

A considerable influence of sample state and purity was found in the case of UCoGe. While the as cast samples were poor superconductors and paramagnets the annealed samples were characterized by a robust superconductivity at $T_{SC} \approx 0.7$ K and anomalous magnetic ground state. The ferromagnetism did not develop and only strong spin fluctuation regime was found below 2 K. The unique phase diagram of the UCoGe has been established on the basis of all experimental results. A ferromagnetic state develops under the low (10 mT) magnetic field, which leads to an anomalous increase of T_{SC}. The large high-quality single crystals fabricated by targeted growth processes revealed the strong magnetocrystalline anisotropy and existence of the uniaxial spin fluctuations at high temperatures (≈ 100 K) but after none of them exhibited superconductivity. Superconductivity has not appeared even after proper thermal treatment. The doping has a strong influence on both magnetism and superconductivity of UCoGe. The transition metals promote the ferromagnetism – the T_C increased almost up to 10 K but only on the narrow concentration region (0-10 %). Contrary the transition metals the Th doping suppresses the ferromagnetism. The superconductivity is instantly suppressed by doping (1 %) which supports the unconventional UCoGe superconducting state in accordance with the Gorkov Abrikosov theory predictions.