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Summary of the doctoral dissertation entitled

Structural and magnetic properties of selected $RPdIn_{1-x}Sn_x$ compounds (R - rare earth) and their hydrides

In the field of magnetic materials research, intermetallic compounds containing rare earths (R) and transition metals (T) are of particular interest due to their non-trivial magnetic properties. Among the intermetallic compounds, the RTX family (where X is a p-electron element) consists of many compounds with complex and exotic magnetism as well as application potential. The variety of structural, magnetic and transport properties is of particular interest is these compounds exhibit.

The main aim of this work was to show the influence of p-electron doping and hydrogen absorption on the magnetic properties of RPdIn intermetallic alloys (R = Ce, Nd, Gd, Tb, Ho, Er). The intention was to obtain the hydrides of the above-mentioned compounds and to determine the changes that occur in structural and magnetic properties during the hydrogenation process. The motivation for the selection of such compounds was the desire to quench the Kondo coupling occurring in the CePdIn compound through structural substitution and hydrogen sorption. An equally important point was to study the structural properties of these compounds and their hydrides at low temperatures in order to determine the lattice dynamics.

Achieving assumed goals was possible by conducting complementary X-ray and neutron diffraction measurements, as well as magnetic (vibrating magnetometer) and calorimetric (dilution refrigerator) tests.

The analysis of the results showed a variety of physical properties of the tested compounds, such as: magnetic moments frustration, atomic disorder, heavy fermion behavior or the behavior of a nonfermi liquid. The most important result was obtained for $CePdIn_{1-x}Sn_x$ compounds, showing that a quantum critical phase is achieved while maintaining a weak magnetism. It has been proposed that such a unique state is responsible for the atomic disorder that leads to local quantum criticality. It has also been proven that both introducing tin instead of indium into the structure and hydrogen saturation reduces the integral of the exchange between the 4f electrons and the conduction electrons, which results in the weakening of the RKKY and Kondo interactions. Noteworthy are the observed anomalies in the temperature dependencies of the lattice parameters (a or c) for the compounds $RPdIn_{1-x}Sn_x$, (R = Ce, Gd, Tb, Er) - this behavior, occurring at low temperatures (30 - 220 K), seems to be an intrinsic feature of the studied alloys and their deuterides/hydrides, most likely resulting from lattice dynamics anisotropy and/or crystal field effects.

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