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EINLADUNG zum IFP-SEMINAR

Thema: **Implementation of a microfabrication technique in research of $Ce_nPd_mIn_{3n+2m}$ heavy fermion compounds**

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Ort: Institut für Festkörperphysik, TU Wien
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Host: Silke Bühler-Paschen
Förderer: ERC-AdG-227378 QuantumPuzzle

The family of $Ce_nT_mIn_{3n+2m}$ (n = 1, 2; m = 1; T = transition metal) heavy fermion compounds have been intensively studied owing to variety of magnetic ordering and superconductivity. They crystallize in tetragonal type structure with $CeIn_3$- and TIn_2- layers alternating along the c-axis. Besides the well-known $CeTIn_5$ and Ce_2TIn_8 (T = Co, Rh, Ir) compounds, new materials $CePtIn_7$, Ce_2PtIn_8, Ce_3PtIn_{11}, Ce_2PdIn_8, $Ce_5Pd_2In_{19}$ and Ce_3PdIn_{11} have been discovered recently [1-3].
Our investigations revealed that the series of $Ce_nPd_mIn_{3n+2m}$ compounds covers the widest known composition range. The existence of a system of compounds with various layer-stacking opens a possibility to study a scenario of evolution of magnetism and superconductivity with the dimensionality of the Fermi surface. Ce_2PdIn_8 shows no magnetic ordering but becomes superconducting below T_c = 0.7 K. In Ce_3PdIn_{11}, we have observed coexistence of superconductivity and antiferromagnetism (T_c = 0.4 K, T_N = 1.7 K). To complete the scenario the antiferromagnetic $CeIn_3$ (T_N = 10 K) is worth of consideration.
A specific feature of the $Ce_nPd_mIn_{3n+2m}$ compounds is the lattice parameter a of their tetragonal structure being almost identical with the lattice parameter of the cubic $CeIn_3$. This may play an important role in the stability of various compounds with different combinations of $CeIn_3$- and $PdIn_2$- layer stacking; however, it also seems to result in difficulties with sample preparation. Multilayer inclusions of neighboring phases are hardly avoidable in growing single crystals from metallic flux. While tuning the growth conditions of Ce_3PdIn_{11} and Ce_2PdIn_8, thin layers of $CePdIn_5$ have been found in several samples. Further attempts to obtained larger samples of $CePdIn_5$ were not successful.
In order to isolate the $CePdIn_5$ single crystals and verify the results obtained on Ce_3PdIn_{11} and Ce_2PdIn_8 single crystals, microfabrication of samples by focused ion beam (FIB) microscope has been developed. By this method, few tens of micrometers long bars can be cut from desired area of sample and transferred on a substrate. In combination with electron beam lithography, the sample can be subject to electric transport measurement, microcalorimetry etc. Our current progress in sample preparation for electrical measurements as well as a recently published high magnetic field study of $CeRhIn_5$ [4] have shown the power of the focused ion beam microscopy technique in the studies of heavy fermion compounds.

[1] Z. M. Kurenbaeva et al., Intermetallics 16 (2008) 979
[2] A. Tursina et al., J. Sol. State Chem. 200 (2013) 7
[3] M. Kratochvílová et., al. J. Cryst. Growth 397 (2014) 47
[4] P. Moll et al., Nature Communicatios 6 (2015) 6663

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