

“X-ray powder diffraction on Cerium and Cerium-Lanthanide alloys for the determination of equations of state and phase transitions“

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The investigation of the behaviour of solids under extreme conditions attained great importance for a fundamental understanding of solids as well as for geophysics. Lanthanide as well as actinide elements are of special interest due to their complex phase diagrams and their special magnetic interactions, as well as their chemical similarities. For the “regular” lanthanides a common series of structures is observable at moderate pressures. Deviations from these systematics are observed in cerium, europium and ytterbium. Current questions of this work are related to the general systematics of the lanthanides under extreme pressures and/or at the same time high pressures and high temperatures. Furthermore the high pressure behaviour of different alloys including the anomalous element cerium is still a special interest. The experiments were performed at HASYLAB/DESY in Hamburg at the beamline F3 with diamond anvil cells and at the beamline F2.1 with the multi anvil press MAX80 using energy dispersive methods. Angle dispersive measurements within ranges of complex structures were done at the European synchrotron radiation source ESRF in Grenoble, France, and for the first time also at the new ADXD setup at beamline F3 in Hamburg.

A refinement of the high p-T- phase diagram of cerium was obtained, as the α - ϵ phase transition could be proven to be continuous. Starting from the phase transition of cerium a semi-empirical model for its equation of state was tested and extended for cerium alloys. Furthermore a generalised alloy phase diagram for all cerium lanthanide alloys could be set up.