

Opponent report on the thesis

Mgr. Martin Míšek

MAGNETIC AND TRANSPORT PROPERTIES OF F-ELECTRON COMPOUNDS UNDER EXTREME CONDITIONS

This presented thesis of Mgr. Martin Míšek deals with the magnetic and transport properties of f-electron compounds under extreme conditions with special stress on the high-pressures. Important part of thesis is the introducing of several new experimental techniques based on high pressures into the JLMP laboratory, which yielded to important enlargement of the experimental possibilities in this laboratory. Second part of thesis is devoted to the particular study of magnetic and transport properties of f-electron compounds by using these possibilities. Among them I would like to especially stress the observation the presence of superconducting dome in the vicinity of quantum critical point in Ce₂PtIn₈ sample.

Thesis has following organisation. Chapter 2 describes the theoretical background for the observed phenomena. In chapter 3 the existing experimental methods in Prague for study of the properties of compounds are presented. Moreover, the information about neutron diffraction is added. In chapter 4 the results of the experimental work, including the building of the new high-pressure cells, are summarized. This chapter is divided into four sections, devoted into the goals of the thesis. First of these sections is devoted to the achieved instrumentation development. Second section presents the high pressure study of selected members of the $R(\text{Co},\text{Si})_2$ family with the main focus on the ErCo₂ compound. Third section shows the results of the uniaxial and hydrostatic pressure study of the UNiGa single crystal. The last section presents the results of high-pressure measurements on the novel Ce-based superconductors. Finally, the main conclusions are given in last chapter. The structure of the thesis is appropriate, the text is very clearly written. The results are properly documented by figures.

I would like to stress that thesis represents a large amount of methodical experimental work connected with the construction of several new experimental high-pressure cells, which will broaden the possibilities of JLMS laboratory. The results are published in 14 papers in prestigious journals, including Physical Review B. On the other hand I appreciate the obtained physical results. The author observed for the first time the pressure induced change of the type of the magnetic phase transition from the first to second order-type in pure ErCo₂ and the

decoupling of the ordering of Er and Co magnetic sublattices. These effects were only theoretically predicted.

The author performed the study of phase diagram of UNiGa single crystal in high pressures and high magnetic fields. Here I would like to mention the study of effect of uniaxial stresses on this hexagonal single crystal.

In thesis, there are almost no misprints. I shall mention the wrong number of equation in the text in page 35 – twice instead (3.9) it should be (3.10).

Comments and questions:

- 1) Did author perform the measurements of magnetic properties (DC susceptibility) of ErCo_2 at small excitation field (order of 100 Oe) in order to study the tiny effect connected e.g. with paramagnetism? Are there some pressure effects?
- 2) page 79, Fig. 4.30 – what is the origin of splitting of peak at T_C in HoC_2 ? Why it is not presented in tentative phase diagram in Fig. 4.31?
- 3) page 105 – author wrote: “The results are very recent and their evaluation is still ongoing”. Could he present some new results on this subject?

As conclusion, the presented work clearly demonstrates the ability of Mgr. Martin Míšek to perform individual research. I recommend after successful defending of thesis to award his work with title Ph.D..

Košice, 02.12.2012

prof. RNDr. Marian Reiffers, DrSc.