

## **Review of PhD thesis:**

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### **Impurities in rare earth metallic systems:**

#### **from super-purified metals to heavy fermion superconductors**

Submitted PhD thesis deals with the preparation of selected rare earth (RE) intermetallic compounds and their physical properties. It is focused mainly on three pure RE metals (Ce, Tb, Er) and intermetallic compounds of the compositions of  $\text{CePt}_3\text{X}$  and  $\text{CeRu}_2$ . The compounds were prepared both in polycrystalline and monocrystalline forms in high vacuum apparatus. The purification of the materials was carried out using solid state electrotransport. Phase characterization was realized using techniques generally used for solid state materials (XRD, neutron diffraction, SEM, etc...). Respective physical properties were studied using number of corresponding techniques (e.g. specific heat measurement, magnetization and a.c. measurements, resistivity measurements etc...) with and without external magnetic field.

The extent of this thesis is very large. The work has 256 pages with relatively dense text. I have to appreciate mainly extensive review of some selected physical properties of heavy fermion compounds (e.g. Fermi level, superconductivity and magnetism) in Chapter 2, which was compiled by very explanatory way and easy to comprehend. Following chapters concerning state of art of studied materials contain full-range list of references (more than 400 references). The chapters handling the results and discussions involve the results of different groups of structure types arranged in logical way from base structure to its substituted derivatives. The exhaustive list of 566 references is given at the end of this thesis.

The high quality of this thesis is underlined by the fact that the author has already 54 articles in impacted journals up to date (after Web of Science). Most of them are used in the submitted thesis.

I have following remarks and subjects to discussion concerning submitted thesis:

- 1) Why the term "Impurities" was chosen for the thesis title? Only impurities discussed in the thesis (from the chemical point view) concern gases (as  $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{H}_2$ , etc...) which play minor role in studied materials. The terms "substituted" or "doped elements" would be more suitable for controlled substitution or adding other elements into  $\text{CePt}_3$  or  $\text{CeRu}_2$  structures.
- 2) page 60 - Is it general rule that the shape of ingot is controlled by the fact, whether the material is melting congruently or incongruently?

- 3) page 67 – What is the type of Quadrupole Mass Spectroscopy apparatus (is it commercial or home-built)? What is the sensitivity and is this apparatus suitable for quantitative analysis?
- 4) page 116 – Maybe, it would be better if the papers published by the author of the thesis and given as the references in the chapter concerning state of art were given in the chapter “Results and discussion ...” because they represent author’s own work.
- 5) page 128 – What exactly represents “Ion pump error”? Was there some impact on quality of processed material?
- 6) page 134 – Figure 7.6. – I do not understand why there is practically no diffraction peak in XRD patterns of the Ce samples. Did these materials exhibit amorphous properties?
- 7) Was the resistivity measurement only method how to evaluate the efficiency of purification using solid state electrotransport (SSE)? It is in fact indirect method. What's about direct analytical methods as e.g. AAS?
- 8) Is it possible to say, that using of purified Ce has influence only at the ease of preparation of Ce compounds and this parameter do not influence the phase relationship?

In spite of that remarks I must state that this work has excellent level. This thesis fulfils the conditions set out for the defence of doctoral thesis and can be taken for the PhD defence procedure. I recommend, on the basis of this work, to confer the degree PhD.

Praha, 19 August 2007



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