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Evaluation of the doctoral thesis submitted by Ms. Marie Kratochvilova with the title "The ground-state properties of new $(RE,U)_nTIn_{3n+2}$ intermetallic compounds".

The key point of interest in strongly correlated f-electron systems is that the nature of their ground state is critically determined by the competition between different energy scales (RKKY exchange interaction, Kondo effect) as well as the energy of crystal electric field, which leads to the formation of novel ground states including unconventional superconductivity. Understanding the cooperative and correlation effects in this class of materials involved in the formation of new quasi-particles, new phases and unexpected phenomena requires successful synthesis and characterization of new high quality materials.

In this context, the doctoral thesis submitted by Ms. Marie Kratochvilova deals with the synthesis of a variety of high quality single crystals of selected Ce (in part U) intermetallic compounds and investigation of their structural and low-temperature transport and magnetic properties. The experimental methods used are mainly x-ray diffraction, scanning electron microscopy as well as magnetization, specific heat, and resistivity (also under high pressure) measurements.

The thesis is well written and very good organized. It contains a general introduction/ motivations and the necessary theoretical background for the physics of f-electrons (Chapter 1). A useful description of the applied experimental techniques including the problematic of the growth of single crystals is given in Chapter 2.The experiential results and discussion of the different compounds organized according to specific aspects are presented in Chapters

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3,4,5 and 6. Each chapter contains its own introduction and short summary. This is very pleasant and helpful for the reader. Details of the experimental data presented in Chapters 3 and 4 are given in Appendix A. Appendix B is devoted to the use of the solution growth technique for growing single crystals of RECo2 compounds. The general conclusions of the thesis are given in Chapter 7.

The core theme of the thesis is devoted to some selected Ce (U)-based intermetallic compounds crystallizing in the tetragonal $Ho_nCo_mGa_{3n+2m}$ -type structure, which exhibits a layer character. Thus, it allows one to investigate the dependence of the nature of the ground state on the dimensionality as well on the type of the f electrons (4f and 5f) within the same type structure. On top of that, as it is possible to synthesize Ce-based compound close to a quantum critical point, one would expect the observation of unusual ground states. The synthesis and investigation of this class compounds $(RE,U)_nTIn_{3n+2}$ are presented and discussed in Chapter 3 (Ce_3TIn_{11} (T=Pd, Pt)) and Chapter 5 (U_nRhIn_{3n+2} ,n=1,2). In addition, the synthesis of Ce_2RhIn_8 and the impact of the crystal field energy on the magnetic ground state and the anisotropic magnetic properties of RE_2CoIn_8 (RE=Pr,Nd, Dy) single crystals are presented in Chapter 4 and Chapter 6, respectively.

The enormous number of the synthesized samples, their thoroughly investigation using different experimental techniques and the analytical work to handle the experimental data are very impressive. Also the critical discussion of the results and their comparison with related models reflect the high scientific quality of the thesis.

Ms. Kratochvilova not only succeeded to grow new high quality single crystals in most of the studied materials mentioned above, but also discovered in some cases novel magnetic and superconducting ground states. Apart from the variety of the interesting results presented and discussed in the thesis, I only would like to dignify some results which represent to my opinion the highlights of the thesis: The first observation of a coexistence of superconductivity and long range magnetic order in a Ce-based centrosymmetric system, Ce_3TIn_{11} (T=Pd, Pt), at ambient conditions. Ms. Kratochvilova explains such a coexistence with the assumption that that superconductivity and antiferromagnetism reside on two crystallographically inequivalent Ce sites, where the Ce1 site is Kondo screened and thus responsible for superconductivity, and the Ce2 exhibits long range magnetic order. This interesting concept of two Ce sites is in accordance with the Kondo lattice model proposed by by Benlagra et al; Phys. Rev. B84, 075126 (2011) with two inequivalent local moment sublattices linked to

different Kondo couplings to conduction electrons. However, to explore the origin and nature of the observed novel and complex ground states in Ce_3TIn_{11} (T=Pd, Pt) further microscopic measurements as well as band structure calculations are required.

I have some comments/ questions to the author:

I strongly appreciate your expertise in synthesis for growing of high quality single crystals despite the difficulties and the problems you have to solve in each case. Do you see any potential for improving the techniques you have used to obtain larger single phase samples of even "higher" quality?.

In Chapter 3: As I mentioned above the concept of two inequivalent Ce-sites in Ce_3TIn_{11} (T=Pd, Pt) is in line with the model introduced by Benlagra et al. I personally missed a short description of the model in the thesis to justify its relevance to your case. I, thus, would like to know more information about that point.

According to the temperature-pressure phase diagram of CePtIn11 (Fig. 37) you nicely show that at lower pressures and below 0.5 K one finds a mixture of magnetic and superconducting phases. With further increasing pressure magnetic order disappeared at and on observes a pure superconducting phase. You claim that these two superconducting phases are entirely different. Which arguments/ evidence you have for such a statements?. And difference you expect?

In summary, the thesis of Marie Kratochvilova is indeed a state of the art in the field of strongly correlated electron systems and covers many relevant important and fundamental aspects. The obtained results are original and scientific output of thesis provide valuable information and lead to a better understanding of the origin and nature of the electronic correlations in this class of materials. The thesis proves the author's ability for creative scientific work.

For the reasons given above, the doctoral thesis submitted by Ms. Marie Kratochvilova fulfils all requirements for the Ph.D degree.

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(Prof. Dr. Mohsen Abd-Elmeguid)