Posudek práce

předložené na Matematicko-fyzikální fakultě
Univerzity Karlovy v Praze

❑ posudek vedoucího ☑ posudek oponenta
❑ bakalářské práce ☑ diplomové práce

Autor/ka: **Bc. Marie Kratochvílová**
Název práce: **Study of magnetic and thermodynamic properties of ternary compounds with strongly correlated 4*f* electrons**
Studijní program a obor: Fyzika, Fyzika kondenzovaných soustav a materiálů
Rok odevzdání: 2011

Jméno a tituly oponenta: Dr. rer. nat. Jeroen Custers
Pracoviště: Katedra fyziky kondenzovaaných látek
Kontaktní e-mail: custers@ifp.tuwien.ac.at

Odborná úroveň práce:
☑ vynikající ❑ velmi dobrá ❑ průměrná ❑ podprůměrná ❑ nevyhovující

Věcné chyby:
☑ téměř žádné ❑ vzhledem k rozsahu přiměřený počet ❑ méně podstatné četné ❑ závažné

Výsledky:
☑ originální ❑ původní i převzaté ❑ netriviální kompilace ❑ citované z literatury ❑ opsané

Rozsah práce:
☑ veliký ❑ standardní ❑ dostatečný ❑ nedostatečný

Grafická, jazyková a formální úroveň:
☑ vynikající ❑ velmi dobrá ❑ průměrná ❑ podprůměrná ❑ nevyhovující

Tiskové chyby:
☑ téměř žádné ❑ vzhledem k rozsahu a tématu přiměřený počet ❑ četné

Celková úroveň práce:
☑ vynikající ❑ velmi dobrá ❑ průměrná ❑ podprůměrná ❑ nevyhovující

Slovní vyjádření, komentáře a připomínky vedoucího/oponenta:

The general theme of this thesis is the investigation of strong interplay of localized magnetic moments and conduction electrons, which is known to be responsible for unexpected and exotic physical properties in several, mostly Rare Earth based, compounds. For this purpose two classes of intermetallic materials have been prepared, characterized and measured by the candidate; YPd_2Al_3 and substitution series of $CeRh_{1-x}Pd_xIn_5$ and $Ce_2Rh_{1-x}Pd_xIn_8$. With YPd_2Al_3 a non *f*-electron counterpart of this well-known Rare Earth series is investigated for comparative study. In the latter class of materials often a coexistence of superconductivity and magnetism is found.

The candidate is to be commended for the excellent manuscript which is extremely detailed with introduction to the physical systems and known results as well as exhaustive description of the basis of the technical methods that have been employed. The style of the general introduction to each theme is extremely easy and pleasant to read. The problems are clearly placed in their context.

The first chapters of the thesis cover an introduction to the physical phenomena in Rare Earth compounds. Magnetism, the RKKY-interaction, Kondo effect, Fermi liquid theory and superconductivity are briefly discussed, focusing on the relevant issues of the thesis. This theoretical part is followed by a general overview of the compounds to be investigated. A detailed overview of the used methods for sample growth and experimental techniques is outlined in chapter 4. It contains a nice pedagogical part about flux growth.

The second part of the thesis shows the experimental results. Chapter 5 is devoted to YPd_2Al_3. The main issue is the superconducting state which is of BCS type. The contradiction between the measured superconducting transition temperature and the expected value using the McMillan formula is thoroughly discussed. Chapter 6 shows results on the substitution series $CeRh_{1-x}Pd_xIn_5$ and $Ce_2Rh_{1-x}Pd_xIn_8$. Interestingly, as pointed out by the candidate, the $CeRh_{1-x}Pd_xIn_5$ up to $x = 0.25$ (higher x-values were not possible yet) is reminiscent to the behavior of stoichiometric $CeRhIn_5$. The superconducting state found under pressure in $CeRh_{0.75}Pd_{0.25}In_5$ begs for further investigation. Contrary to the previous, the prepared series of $Ce_2Rh_{1-x}Pd_xIn_8$ show a larger response to Pd-substitution.

In conclusion, this thesis contains a large amount of original material. The clarity of the manuscript is excellent. The candidate has demonstrated a high degree of expertise in crystal growth and a variety of experimental methods. The results are explained in a very satisfactory fashion. I have no hesitation in recommending that this thesis fulfills the requirements meriting the award of Mgr. from the Charles University in Prague.

Případné otázky při obhajobě a náměty do diskuze:

In $CeRh_{1-x}Pd_xIn_5$, antiferromagnetism is suppressed upon increasing substitution level. But what is the reason of the reduction of T_N?

The superconducting state found under pressure in $CeRh_{0.75}Pd_{0.25}In_5$ begs for further investigation. The interesting question arises, if indeed antiferromagnetism and superconductivity coexist on a microscopic scale?

Práci

☑ doporučuji

☐ nedoporučuji

uznat jako diplomovou/bakalářskou.

Navrhuji hodnocení stupněm:

☑ výborně ☐ velmi dobře ☐ dobře ☐ neprospěl/a

Místo, datum a podpis vedoucího/oponenta: Praha, 24.4.2011