Review of the Doctoral Theses

of RNDr. Jiří Kaštil

'Magnetocaloric properties of rare-earth compounds'

The Doctoral Theses by of RNDr. Jiří Kaštil is the consistent work focused on the investigation of the magnetocaloric properties of the selected rare-earth compounds. It has all formal and actual features expected from such type of the research project: the general introduction, the presentation of the experimental methods, state of the art for the studied compounds, and the actual contribution of the author, which is clearly discernable. The Theses consist of the two logical parts. The first one is devoted to the description of the design and operation of the new apparatus developed by the author. The second part presents the experimental investigation of the selected rare-earth compounds by the conventional techniques such as the magnetization and specific heat measurements, as well as the newly developed device. The advantages of the direct MCE measurements become obvious, particularly in the cases like Ni_2MnG. The scientific results of the second part are novel and of the appropriate scientific quality. The author demonstrates the rigorous attitude to the experiments and the data evaluation. His methodology not only eliminates the ambiguity about the obtained numerical values but is also useful as an instructional reading for the researches starting the work in the field of the magnetocaloric studies.

Remarks:

1. Generally, only the brief description of the microscopic phenomena leading to the reported changes of the magnetocaloric effect is presented. It remains unclear, though, which exactly phenomena lead to the increase or decrease of the entropy changes at the magnetic transitions.

   For example, in the case of (Tb,Y)NiAl the modification of the magnetocaloric properties due to the Y doping is explained in 1 sentence mentioning the changes of the magnetic structure type in the magnetically frustrated TbNiAl. This does not clarify why the entropy change increases after the replacement of Tb by non-magnetic Y and what is the role of the magnetic frustration. If the numeric or at least the general analytic analysis of this effect is beyond the scope of the present work, it still would be useful to present the reference to a work with such analysis. Similarly, for TbNi(Al,In) the changes in MCE are explained by the change of the magnetocrystalline anisotropy and the magnetic structure type. It is advisable to elaborate on the relation between these changes in the magnetic structure and the entropy. Also what could be the reason for the non-monotonous evolution of $\triangle S(T)$ with the increasing In doping (Fig. 4.16) vs. the monotonous one in the case of Al doping (Fig. 4.15) ?
2. Structural features of GdFeAl and TbFeAl such as the site occupation and symmetry relations are extensively discussed in the chapter. The graphic

presentation of these structures would improve the understanding of the material.

3. According to the work, the 1% impurity content in RFeAl was estimated from the X-ray diffraction. Was it indeed possible to achieve such precision?
4. The author mentions the possible mixed Fe/Al site occupation when discussing the phase transitions in RFeAl. What is the basis of such assumption – the structural investigation of these compounds by the author or the previous work by the other groups?
5. The chapter on RFeAl ends with the comparison of their relative cooling power with that of some other materials. It would be advisable to explain why exactly those materials were chosen – are they used in the industry or do they have the highest known RCP values?
6. The chapter **General discussion** contains rather detailed description of prospective MCE cooling techniques developed by different groups. Such information belongs rather to the introductory part of the Theses since it is not directly related to the findings presented by the author.

Despite the issues listed above, the quality of the research work presented in the Thesis is of the high scientific standard and the author, RNDr. Jiří Kaštil, deserves to be awarded the doctoral title in the case of the successful defence.

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