Review of the thesis

In-situ neutron diffraction studies of deformation and transformation processes in modern types of steels

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Submitted thesis deals with neutron diffraction and mechanical studies of several types of modern steels –thermomechanically controlled processes of low-alloyed (Nb-added, Nb-free, Si-Mn added) steels and also to the deformation behaviour of single ferritic and duplex stainless steels. In my opinion, the topic is important and up-to-date and the method used – *in situ* neutron study of deformation and transformation processes is quite unique and very useful.

At the beginning of thesis, useful list of used symbols is inserted.
The first part is devoted to the introduction to current problems of steels, demands for strength and ductility at the same time and several types of steels are characterized. The second part deals with the TRIP-aided steels are characterized including the particular effect of individual alloying elements, thermo-mechanically controlled processing, martensitic transformation and stability of retained austenite. The third part describes the deformation mechanism of steels including hot deformation. I think that whole this introduction (about 20 pages) is concise and helpful for the reader. As a non-specialist in this part of metal physics, I have appreciated also the good readability and it seems to me as a very good introduction to the problems.

The fourth part is a brief classification of internal stresses which is also necessary for correct understanding of later interpretation of results. The following chapter describes the methods of stress and strains measurements by XRD, synchrotron radiation and neutron diffraction. It is also well written but I think that the popular $\sin^2\psi$ method can be listed even if not directly used. *There is a question whether this method could be of any use in the applied technique.*

The part Goal of the project should have been numbered as all the other parts.

The experimental part begins with the chapter 6 on thermo-mechanically controlled processing, the description of the materials investigated and also the experimental equipment and it modification made by the author. The unique equipment installed on the neutron diffractometer allowed detailed *in-situ* studies of stresses in separate phases during deformation.
What effects the calibration curve for temperature dependence of ferrite {100} intensity (Fig. 6.23) includes? I assume the effect of thermal vibrations. Is it possible that the texture is also changed during heating? In principle, could the texture variation of ferrite {100} at the austenite transformation be different?

Part 7 describes the results on deformation behavior of trip-aided steels.
It is written, that X-ray and neutron diffraction analysis was performed (p. 61, bottom). No details are given on XRD measurements, the XRD results are not shown, either. Were there any differences between XRD and neutron results found (especially due to the surface effects)?

Were the full powder patterns (Fig. 7.19) fitted by the GSAS program or the program was used just to simulate the patterns (Fig. 7.17)? Were any texture found in the samples (the question concerns all the samples)?

Final part 8 deals with the tensile behavior of single and multiphase steels. A method of separation of different kind of stresses is suggested and applied. This task is in particular important also for the interpretation of results of diffraction measurements. *The method is based on the measurement of diffraction profile with in dependence on the applied stress and assumption that the curve on load includes the second and third kind of stresses while the curve on unload contains only the third kind stresses. Can we be sure about this?*

Each chapter of the experimental part is finished by a brief summary. This also improves the readability of the overall text.

I think that in some places of experimental part, the repeating of some sentences in the text can be avoided. For example, it could be stated at the beginning that all in-situ experiments were performed on the dedicated diffractometer TKSN … This information is repeated in several places.

Conclusions should also be numbered. The author summarizes the most important results obtained in the work which are significant also for practical applications. It has been found for example that for the low-alloyed steels the austenite pre-deformation and a small amount of the Nb addition enhances the starting temperature of the austenite-to-ferrite phase transformation. The transformation temperatures were determined. It was also found that the retained austenite is harder phase in the TRIP-aided multiphase steels while it is more compliant than ferrite in ferritic and duplex steels.
Conclusion that "overall mechanical properties of the alloy strongly depends on microstructural characteristics of the present phase constituents" is too general and not new, though.

At the end, the author clearly specifies his own contribution to the presented work and lists all his related publications.

It may be criticized that the thesis is not strictly focused on one specific problem; however, taking into account the quality, extent and usefulness of the whole work, I think that this is not a fault.

In my opinion, all the aims of the thesis were successfully fulfilled, the work is of high quality and hence it can be accepted as the PhD thesis. Results obtained from in-situ measurements during deformation of steels are original and they significantly contribute to understanding of the deformation and transformation processes in steels.

August 28, 2006