A review of Mgr. Maria Zimina's doctoral thesis „Microstructure and mechanical properties of lightweight structural AZ31 alloy prepared by twin-roll casting method".

The presented thesis claims to evaluate properties of AZ31 magnesium alloy with respect to its processing route. For this purpose the alloy has been processed by using twin-roll casting method or (conventional) casting. Moreover further thermo-mechanical processing (e.g. ECAP – equal channel angular pressing, CGP – constrained groove pressing) has been applied on the alloy. The properties of processed alloy have been studied with emphasis on microstructure and its relation to mechanical properties (i.e. microhardness and tensile properties). Quite a large extent of this work (121 pages) corresponds to the complexity of studied problems.

The work is divided into several chapters. In the first part the author describes theoretical aspects of correlation between microstructure and mechanical properties for structural materials as well as brief overview of magnesium alloys. Also some basic information about used processing techniques is presented.

In the experimental part the parameters of material processing are described. The author also put emphasis on experimental techniques used for microstructure evaluation as well as other properties characterization.

In the third part Mgr. Zimina described obtained results of studied specimens. The microstructure has been characterized by using various techniques including X-ray tomography, scanning electron microscopy or light microscopy that enabled detailed microstructural characterization of specimens. Mechanical properties were studied by using microhardness measurement and tensile test (at various temperatures) for studied specimens. Obtained results are discussed in the next chapter and then summarized in conclusions. The chosen structure of the result presentation and their discussion well corresponds to the extent of solved problem.

The results of this thesis, their presentation and discussion show that the author managed to work with various experimental techniques and apply them to in order to obtain valuable scientific results. Moreover the author is capable to evaluate obtained results, present and discuss them. The presented work contains complex and well structured information about the AZ31 magnesium alloy and its properties with respect to processing route and testing conditions (temperature). The author also proved her ability to present large amount of obtained information from scientific literature (including contemporary literature) – in the work more than 200 references is presented.

I found only few mistakes (of low importance) in the work concerning inaccurate formulations:

Page 38 : “In RD particular grains are observed”.

Page 40: “Large elongated grains with size 200 μm” (size in what direction?).

Page 41: Fig.4.6 – Figure caption is not correct (e.g. caption for Fig.4.6f is missing, SE maps of Al and Mn should be EDS maps).

Page 44: Fig. 4.9 to what images the pole Figures belongs?

Page26: (Heat treatment – what was the annealing period?

Page 97: “.... slight rotation of <00$\bar{1}$1> orientations...” – does not correspond to Miller-Bravais indices.

In my opinion those mistakes does not significantly decrease neither technical nor formal the high level of work quality.

I have some questions concerning the presented work:

1) How can be explained the increase in both ultimate tensile strength and ductility during the tensile test at 100°C (or at 50°C) compared to the RT test (Fig4.54 page 83)? The increase in strength is from ~125 MPa to ~220Mpa (RT vs. 100°C)?
2) After two ECAP passes the majority of coarse grains is marked blue colour (i.e. corresponds to (10$\bar{1}$0) plane parallel to ZY plane). Is there any explanation for such phenomenon?
3) The ECAP processing has been done at 230°C which is close to the temperature where unexpected decrease in ductility has been observed almost at all studied specimens. May this decrease in ductility influence the ECAP process (e.g. microstructure, texture or mechanical properties after ECAP)?

As a conclusion I declare that to my best knowledge the aims of the work were fulfilled. Mgr. Maria Zimina proved her ability of individual scientific work and of clear presentation of scientific results. Therefore I recommend this work for defending.

Reviewer of doctoral thesis:

Ing. Jaroslav Málek, Ph.D.

In Prague 1.9.2016