Review

on Dr. Patrik Dobron's habilitation thesis entitled

„AN ACOUSTIC EMISSION STUDY OF PLASTICITY IN CRYSTALLINE MATERIALS"

The topic of this thesis is the application of acoustic emission technique on the study of plastic behavior of single and polycrystalline materials. Acoustic emission is an effective method for the characterization of deformation processes, such as collective dislocation motion, twinning and crack propagation. The most important advantages of this technique are its non-destructivity and the good statistics of the results. In the last decades, the interest in acoustic emission has been raised due to its effectiveness in studying the deformation mechanisms in advanced materials, such novel Mg-alloys. The knowledge of the deformation mechanisms in these materials is essential for the understanding of their mechanical behavior. Without these information, it is impossible to develop advanced materials with improved mechanical performances. Consequently, the topic of the research of Dr. Dobron is adequate to the current interest of his research field and his results have received much attention from the scientific community.

The thesis consists of 113 pages and its construction is logical. The first 10 pages contain a preface and a brief introduction to the method of acoustic emission. The next 20 pages give an overview of the scientific results of Dr. Dobron. Finally, the reprints of the most important ten publications are presented. The aims of the research are clearly stated and the basic references are presented and discussed correctly. The research results of Dr. Dobron were presented in two sections. The first one shows his achievements obtained in the study of the critical character of plasticity using the technique of acoustic emission. Dr. Dobron showed the universality of power law scaling in avalanche statistics, irrespectively of the level of strain hardening (i.e., the exponent was the same for all stages of deformation). He showed a consistency between the power law scaling of the displacement velocities and the acoustic emission signals. Therefore, the scale-invariant character of the distribution of acoustic emission amplitudes suggests a universal avalanche-type nature of plasticity in the studied Mg and Al alloys. It was shown that the power law exponent of the the acoustic emission data depends on the strain rate and the chemical composition. In addition, Dr. Dobron also studied the effect of the finite sample size on the development of dislocation avalanches. The second part of the Results section summarizes the scientific achievements of Dr. Dobron obtained in the investigation of the plastic deformation mechanisms in novel Mg alloys by acoustic emission. He studied the ways of the reduction of the tension-compression asymmetry of the yield strength in novel Mg alloys, as well as the effect of the grain size and the Al alloying element content on the deformation mechanisms. Dr. Dobron revealed that the tension-compression asymmetry was caused by the different twinning activities in tension and compression due to the initial texture in extruded Mg-Al-Zn samples. The asymmetry decreased with the reduction of the grain size and the increase of Al content. Besides the extruded Mg alloys, Dr. Dobron studied wrought and rolled materials. The detwinning process during reverse loading (i.e., during tension after compression) in ZE10 and AZ31 alloys was also investigated.

After reading the thesis the following comments have been raised:

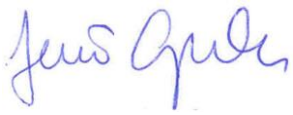
1. At the bottom of page 6, the author selected the crystal diameter as 4 mm. It seems to be in contradiction with the depth value under the surface (D) of 4 cm.
2. I think that the surface displacement amplitude for polycrystalline materials is 10^{-15} m and not 10^{15} m (see at the bottom of page 6).
3. The shear modulus of Al is about 26 GPa and not 2.6 GPa (see the bottom of page 7).

Dr. Dobron conducted his research partly in international cooperations. He spent longer periods (3-6 months) at his Austrian and German collaborators. He received about ten research grants from Czech and international organizations. He was invited as a plenary speaker to Thermec-2016 conference. He acted as a member of the organizing committees of several international conferences. Dr. Dobron published his results in 41 journal papers with impact factors and 10 conference publications. His papers received 169 independent citations. Dr. Dobron plays a significant role in the education in Charles University as he teaches different courses, such as Continuum mechanics, Physical metallurgy and Physics. He was the supervisor of one BSc, two MSC and three PhD students.

Summary

The thesis of Dr. Dobron proves that he can lead scientific research at an internationally high level. His acoustic emission measurements significantly contributed to a deeper understanding of the deformation mechanisms in single- and polycrystalline Mg alloys. In addition, together with his coauthors Dr. Dobron applied first the concept of self-organized criticality on the evaluation of acoustic emission data. He published his results in high-standard journals and these papers received a considerable attention from the scientific community. He proved his ability to supervise BSc, MSc and PhD students, as well as to give university lectures. I evaluate the habilitation thesis of Dr. Dobron as excellent, and suggest its discussion in an open defense.

Budapest, March 14, 2017.



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