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Report of the member of the Dissertation Council Holm Altenbach

on the PhD thesis presented by GLEB MICHAILOVICH SHUVALOV

*The effect of surface stresses
on topological defects formation in layered structures*

*submitted for the Candidate of Physical and Mathematical Sciences
in specialization 1.1.8 – Mechanics of deformable body*

One of the key problems in the field of mechanics of materials is the description of materials with improved properties. As an example materials with thin-film coatings in the thesis are studied. They are used, for example, in microelectronic devices, MEMS, etc. However, despite the significant success in applying of such structures, the problem of destruction of the films used to create devices of the microelectronic industry remains relevant.

The focus of the present PhD thesis is on the following topics:

- Surface morphological stability of multilayer film coating (chapter 1),
- Morphological stability of nanostructured solid surface (chapter 2),
- Surface morphological stability ultra-thin film coating (chapter 3),
- Morphological stability nanostructured junction boundary of two materials (chapter 4)

The candidate first presents some photographs of structures that are to be modeled and simulated in the work. This is embedded in a detailed literature analysis. He proves that he is very familiar with the relevant Russian and international sources. With 148 references, the dissertation is adequately equipped and it can be assumed that these have also been properly evaluated.

The candidate proposed methods and approaches to studying the effect of surface stress on the formation of surface defects in solids and thin-film coatings, which are associated with the construction of an analytical solution to the conjugate problem of mechanics and thermodynamics. These analytical solution techniques have a long tradition in St. Petersburg university starting with the pioneering works of Kolosov, later developed, for example, by Muschilishvili,

and today used in the research team of Grekov and Kostyrko. The main result is that the candidate has applied to a new class of problems.

The scientific correctness of the results has been checked several times. The candidate has attached 5 important publications to his documents. Springer publisher (Continuum Mechanics and Thermodynamics) has published two of these. The rest have been published in Russia. It can be assumed that approx. 10 reviewers rated the work positively.

After reading the thesis, there is only one open question:

- Is there any upper or lower bound for the thickness of the coating, for which the suggested theory can be applied?

This question related to the problem of the necessity to use two-dimensional theories as suggested in the papers of P.A. Zhilin, Altenbach & Eremeyev, or Altenbach, Eremeyev, and Morozov.

The thesis is presented on a high scientific level using the direct tensor calculus making the thesis "clear and simple" for the reader. The literature survey is very good. The graphs illustrating the results are presented in a proper manner.

Despite the above – mentioned remarks/comments the thesis deserves to be positive evaluated.

Gleb Mikhailovich Shuvalov's dissertation on the topic: "The effect of surface stresses on topological defects formation in layered structures" meets the basic requirements established by Order No. 6821/1 dated 01.09.2016 "On the procedure for awarding academic degrees in the St. University". The applicant Gleb Mikhailovich Shuvalov deserves the award of the academic degree of candidate of physical and mathematical sciences in the specialty 1.1.8. Mechanics of deformable solid. The candidate for the degree has not violated clauses 9 and 11 of this Order.

Member of the Dissertation Council



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