



TU Bergakademie Freiberg · 09596 Freiberg

Paní
 Ing. J. Jágrová
 MFF UK
 Ke Karlovu 3
 CZ-121 16 Praha 2
 Czech Republic

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Supervisor's comments to the PhD thesis of Mgr. Milan Dopita:
 "Microstructure and Properties of Nanocrystalline Hard Coatings and Thin Film Nanocomposites"

The PhD thesis of Mgr. Milan Dopita is devoted to the detailed investigation of the microstructure in the nanocrystalline hard coatings and thin film nanocomposites based on the Cr-Al-Si-N, Ti-Al-Si-N and Zr-Al-Si-N systems. These nitrides of the transition metals with addition of aluminium and silicon are often used industrially to protect cuttings tools, drills and moulds for casting or deep drawing. For such applications, high hardness, high toughness and good heat resistance are usually required. Therefore, the results of the microstructure study within this PhD thesis were expected to build a basis for both, the explanation of the above materials properties and the custom-made modification of the materials properties.

In his PhD thesis, Milan Dopita utilised results of several complementary experimental techniques for building the appropriate microstructure models.

- The electron probe microanalysis and glow discharge optical emission spectroscopy were used for "overall" chemical analysis of the coatings, particularly for determining the aluminium and silicon contents in the coatings.
- The "calotte-grinding" technique was used for determination of the thickness of the coatings.
- The glancing-angle X-ray diffraction was employed for the analysis of the phase composition of the coatings and for determination of the lattice parameters, of the stress-free lattice parameters in individual phases, of the macroscopic lattice deformations, of the crystallite size and of the local disorientation of neighbouring crystallites.

- The X-ray pole figure measurements were utilised for qualitative and quantitative analysis of the preferred orientation of crystallites.
- Finally, the transmission electron microscopy and the transmission electron microscopy with high resolution helped to create the microstructure models for the X-ray diffraction methods and to verify the results of the X-ray diffraction measurements.

Milan Dopita employed the above methods for the microstructure analytics with success like really complementary ones. Moreover, he succeeded to exploit the whole potential and the synergy of these methods. He complemented the microstructure analysis by nano-indentation and correlated the microstructure models based on the results of the microstructure analytics with the results of the micro-hardness measurements. He was able to build a consistent and plausible microstructure model that harmonises with the experimental results obtained from all microstructure analytical methods and elucidate the consequences of the microstructure features for the hardness of the nanocrystalline thin films and thin film nanocomposites.

The most important result of the PhD thesis of Mgr. Milan Dopita is a significant contribution to the description and explanation of the microstructure phenomena that are related to the crystallographic anisotropy of the physical properties of solids. During his work, Milan Dopita tested, extended and further developed various physical models suitable for description of the anisotropy of the X-ray elastic constants. Furthermore, he contributed significantly to the explanation of the development of the preferred orientation in nanoscaled crystallites through the microstructure model based on the competition between the surface, interface and strain energy. This approach builds a very important basis for the tailored adjustment of the materials properties via materials design.

Mgr. Milan Dopita is author or co-author of numerous publications in peer-reviewed journals that are related to the topics discussed in his PhD thesis. Therefore, he was encouraged to submit his PhD thesis in form of a "cumulative dissertation".

In my opinion, Mgr. Milan Dopita did show both in his work and in his PhD thesis that he is capable of scientific work. Thus, I would like to recommend to the examination committee and to the Faculty council to accept the thesis submitted by Mgr. Milan Dopita as a PhD thesis and to award his work by the title "doctor of philosophy, PhD".



Supervisor