

Supervisor Report on PhD Thesis

Faculty: **Central European Institute of Technology**
Student: **Pavel Komarov**

Academic year: **2021/22**

Doctoral study program: **Advanced Materials and Nanosciences**
Field of study: **Advanced nanotechnologies and microtechnologies**
Supervisor: **doc. Ing. Ladislav Čelko, Ph.D.**

PhD thesis title: Advanced hydrophobic and hydrophilic surface treatments
for non-nuclear energetics

Evaluation of doctoral thesis:

MSc. Pavel Komarov joined our Research Group after finishing his Master's studies at the Novosibirsk State Technical University (NSTU) in Russia in 2016. He started his study on advanced hydrophobic and hydrophilic surface treatments performed by means of thermal spray technologies in close collaboration with the NSTU, where the first of manufactured coatings were characterised. During the study, he made decision, in agreement with the NSTU, to terminate double degree diploma and continue to finalize his study at CEITEC BUT in the Czech Republic. Here, he was the principal investigator of one Ph.D. topic-related project and was also involved as a team member in solution of other six interdisciplinary research and development projects.

Pavel's dissertation thesis deals with the highly topical research on hydrophobic and hydrophilic surface treatments, which in the near future will become of great importance in many key industrial applications. His thesis consists of two main parts. The first, Theoretical part clearly summarizes the recent theories on material's surface wetting behaviour and introduces the thermal spray technologies selected for surface treatment manufacturing. The second, Experimental part of the thesis, consists of the definition of aims of the thesis, the design of experiments and methods utilized for the study of thermally sprayed surfaces, the results and discussion, and the conclusions. The results and discussion section is very well organized, beginning with a screening of different thermal spraying surface treatments, and followed by plasma sprayed ceramic coatings based on Ytria stabilized Zirconia (YSZ) and high-velocity oxyfuel sprayed ceramic-metallic coatings based on Tungsten Carbide / Cobalt-Chromium (WCCoCr) selected for detailed study. The significant role of the coating microstructure on its surface wetting behaviour was proven in the case of YSZ, which belongs to the group of recently discovered phenomena and is discussed in the up-to-date chapter on influence of the rare earth oxide composition and microstructure on wetting behaviour. Combining the robust wear resistance and stability of its wetting behaviour, the WCCoCr coating with highest contact angle was sprayed and presented for the first time. The influence of modification of WCCoCr coatings using Si-base oil was also studied successfully and the importance of a proper combination of microstructure, surface topography, and chemical composition on the desired surface wetting behaviour was clearly explained and proven by utilizing various unconventional tests.

During his study, Pavel successfully learned and enhanced his skills in the problematics of various thermal spray technologies, powder mixtures and suspension formulations, heat treatment, specific testing technologies (slurry abrasion resistance testing, ultrasound erosion testing, wettability testing, acid- and ice-phobic testing, etc.), methods of structural and phase

analyses of materials (metallography, LM, SEM, XRD, XPS, etc.), and other complementary methods of evaluation of material properties (nano-, micro-, hardness measurements, etc.). Moreover, he successfully completed three two-months research stays abroad: (i, ii) in 2017 and 2018, four months in total, at the Department of Materials Science and Technology at the NSTU in Russia in the Research Group of Prof. Dr. Vladimir Bataev, an excellent Russian researcher in the field of materials science, where he dealt under his direct supervision with characterization of manufactured hydrophobic and hydrophilic surface treatments, and (iii) in 2018 at the department of Materials for high-temperature technologies at the Forschungszentrum Jülich in Germany in the Research Group of Prof. Dr. Robert Vaßen, an excellent European researcher in the field of thermal spray technologies, where he made under his direct supervision a significant progress in suspension formulations and processing, as well in thermal spraying technologies. He accepted the topic and all the laboratory work in an excellent and responsible manner. The written thesis is well organized, systematic, and clear for the scientific audience working in the field of thermal spray technologies and advanced surface treatments. I am also noting a high formal and stylistic level of the work, except for some minor typos.

The results of the doctoral thesis and Pavel's other work related to interdisciplinary projects in which he was involved were published in two highly reputable impact journals (*Journal of Thermal Spray Technology* and *International Journal of Refractory Metals and Hard Materials*), presented at five international conferences, and published in twelve conference manuscripts (listed in WoS and/or Scopus). Moreover, he is also a co-author of one functional sample: (i) Areal heater coating with high temperature homogeneity.

Overall, I found Pavel a valuable member of the research team and an independently working and critically thinking person who was always ready to help solving current scientific issues. **I am delighted to recommend his thesis for the defence** leading to the PhD degree.

In Bmo, 22nd February, 2022

doc. Ing. Ladislav Čelko, Ph.D.

Supervisor of doctoral thesis