Review of the habilitation thesis

A. Dubček University of Trenčín

Field of habilitation	Inorganic Technology and Materials
Author	Amirhossein Pakseresht, PhD.
Author's affiliation	FunGlass – Centre for Functional and Surface Functionalized Glass
Habilitation thesis	Plasma Sprayed Coatings: from Splat Morphology to New Themal Barrier Coatings
Opponent	Doc. RNDr. František Lofaj, DrSc.
Opponent's affiliation	Institute of Materials Research of the Slovak Academy of Sciences, Košice, Slovakia

The first part of the habilitation thesis is focused on the description of a new methods of powder preparation for plasma spraying and on the increase of the level of the properties of various types of plasma sprayed TBC coatings. The studied systems include Al_2O_3, YSZ, Ce- and Sc-doped ZrO_2, mixed Al_2O_3/ZrO_2 systems and system reinforced with whiskers. Thus, the work covers very wide range – from the improvement of the initial powders via microstructure control, including multilayer and reinforced structures and various compositions up to thermal, mechanical, corrosion and tribological properties in relatively large number of specific material systems. In the thesis, the improvements of various properties in the studied coating systems were demonstrated depending on the preparation conditions and compositions. Thus, the results of the work exhibit sufficient potential for practical applications.

The habilitation thesis consists of a summary 35 pages long and including introduction, 4 chapters, conclusions and 13 attachments. The attachments are the publications based on which the results in the individual chapters were described. Obviously, such a short summary of the results covering wide range of topics from preparation of input powders up to the final properties of plasma sprayed TBC resulted in large number of shortcuts and simplifications. Sufficient understanding of the processes in individual systems requires detail study of each publication. However, despite these shortcuts, the thesis provide very good general overview of the activities of A. Pakseresht in the field of TBC. High level of the thesis is supported not only by sufficient number of publications in the field of ceramic coatings (Surface and Coating Technology, Appl. Surf. Sci., Ceramics Int., J. Eur. Ceram. Soc.) and ceramic technologies (Int. J. Adv. Manuf. Technol. a pod.) in the journals included in Current Content database. but also by high number of their citations. Typical number of citations on the publications in the attachments is several tens and one work from 2015 (attachment No. 11) accumulated already 75 citations. The current total number of citations on 42 publication of A. Pahseresht in Scopus database is 946 (without self-citations) and his Hirsch index is 15.

The habilitation thesis includes several new results and the most important among them, on my opinion, involve:

1. The involvement of several statistical approaches to increase the reliability of the correlations between deposition parameters and properties of TBC coatings (attachments No. 6 a 7).
2. Determination of the limits of the application of multilayer Al_2O_3-ZrO_2 coatings with improved corrosion resistance resulting from the delamination of the protective layer (attachment No. 8).
3. Application of SPS to the development of protective layers with improved corrosion resistance (attachment No. 9).
4. Introduction of alumina whiskers in combination with APS in YSZ TBC.

It can be concluded that the results of 13 papers summarized, in the habilitation thesis demonstrate and confirm high scientific level of A. Pakseresht, PhD., required for habilitation and his work is a valuable contribution to the development of improved plasma sprayed TBC.

Questions to the author of the habilitation thesis

1. SPS, despite number of well-known advantages, exhibits certain limits given by geometry. Possibly the most prominent application of APS made TBC is on the blades of turbines with rather complex geometry. Would it be possible to use SPS instead of SPS in this case? If not, what would be the other applications where protective coatings made by SPS can be used?
2. Why is the size of Al_2O_3 grains decisive factor for the damage mechanism in CSZ-nano/micro Al_2O_3 TBC? Does CTE in Al_2O_3 depend on the grain size? What would be the role of grain boundaries in comparison with γ phase content in this case (attachment No. 10)?
3. Since hardness of Al_2O_3 is usually higher than that of ZrO_2, exfoliation of alumina whiskers from YSZ matrix into the friction contact would mean their fracture into debris acting as an abrasive medium and therefore, wear enhancement can be expected. How is it possible that the addition of Al_2O_3 whiskers in your work reduced the wear in comparison with that in YSZ without whiskers (attachment No. 13)?

Habilitation thesis of A. Pakseresht, PhD., „Plasma Sprayed Coatings: from Splat Morphology to New Themal Barrier Coatings“, **fulfils** the requirements to the habilitation in the field „Inorganic Technology and Materials ”.

Košice, September 30.2021

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F. Lofaj