



To whome it may concern

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Geesthacht, 28. Mai 2025

**Review of PhD Thesis authored by Yeshmanova Gaukhar, titled "Development of a technology for applying protective coatings of electrolytic-plasma oxidation the surface of the products made of aluminium alloys", submitted to Kazakh National Research Technical University named after K.I. Satpayev in specialty of 8007103 - Materials Science and Engineering**

The production and study of the properties of protective coatings for wear and corrosion protection of aluminium alloys, which are the aim of the study conducted by Yeshmanova G., is of considerable interest due to the broad field of applications of aluminium alloys in light weight constructions. Increasing their wear and corrosion resistance by the plasma electrolytic oxidation process, which was studied in detail, can further broaden the field of applications. This study has resulted in the development of cost-effective and optimized processing conditions, understanding of the coating formation and an in-depth analysis of the coating microstructure and properties.

Among these innovations is the optimisation of an electrolyte composition that allows energy savings despite fast coating growth at reasonable low current densities and lower voltage using unipolar PEO processing as an alternative to bipolar PEO processing under soft sparking mode. Later is considered as one of the most promising alternatives for energy savings while using PEO processing. However, the mechanisms of soft sparking mode are still not fully understood, suffering quite often from problems related to reproducibility and uniformity of the produced coatings.

The scientific novelty of this study lies in the development of an alternative cost-



effective method based on electrolyte optimisation to produce PEO coatings on aluminium alloys and a contribution to a better understanding of the problems involved in using the soft sparking phenomena for stimulating coating growth. The newly developed electrolyte composition is a good alternative in cases where the soft sparking is difficult to obtain in a controlled manner.

Yeshmanova G. has demonstrated significant achievements in producing wear and corrosion resistant PEO coatings such as lower energy consumption, improved wear resistance by adding particles and understanding of the incorporation mechanism of those particles as well as a contribution to a better understanding of the soft sparking phenomena and influences on it.

In completing this dissertation, Yeshmanova G. has exhibited a deep understanding of the subject, a rigorous scientific approach, and a noteworthy contribution to the field of PEO surface treatment of aluminium alloys. The work is characterized by its relevance, originality, and practical significance. Main tasks outlined by Yeshmanova G. have been addressed, resulting in substantial scientific findings.

Please be aware that this review is based on an English translation of the thesis which I had received from Yeshmanova G. on Monday 05.05.2025 per email. I would like to point out a few suggestions how the thesis can be further improved, not knowing if they are related to translation issues.

- 1) The title of the thesis is not perfectly fitting to the performed work as no technology was developed.
- 2) During soft-sparking phenomena no new oxide layer breakdown appears, the type and location of the discharges are changing.
- 3) The influences on the onset of soft sparking can be better elaborated.
- 4) Not all results are obviously presented in chapter 3, therefore it is difficult to understand some figures for an external reader.
- 5) Energy savings due to soft sparking are not considered and discussed in chapter 4, but they are an important aspect for the overall thesis.

Overall, the dissertation work of Yeshmanova G. meets the requirements for the content and design of PhD dissertations, and I can recommend Yeshmanova G. for seeking a PhD degree.



(Dr. C. Blawert)