

Review Report on PhD Thesis

Faculty: **Central European Institute of Technology**
Brno University of Technology in Brno

Academic year: **2019/2020**

Student: **Ing. Michaela Remešová**

Doctoral study program: **Advanced Materials and Nanosciences**

Field of study: **Advanced nanotechnologies and microtechnologies**

Supervisor: **prof. Ing. Jozef Kaiser, Ph.D.**

Reviewer: **prof. Dr. Salvador Pané Vidal**

PhD thesis title: Research and development of a technology of hard anodization of nonferrous alloys

Topicality of doctoral thesis:

The topic of the thesis is of high interest from the point of view of research on applied materials and electrochemistry, and also from technological prospects. Metal anodization offers many opportunities in applied research and innovation.

Meeting the goals set:

The dissertation meets the goals as summarized in the abstract. Interestingly, the anodization of various metals (aluminum, magnesium, zinc-titanium alloy)are investigated.

Problem solving and dissertation results:

The thesis addresses the anodization of AA1050 aluminum, pure magnesium and zinc-titanium alloy in order to generate coatings with enhanced hardness and tribological features. Special challenges are the presence of intermetallics in AA1050 aluminum, which impairs negatively in the formation of a continuous aluminum coating and leads to structural defects (cracks and hillocks). To address this issue, a combination of a polishing pre-treatment, low electrolyte temperature, low anodic current density and addition of nanoparticles allows producing coatings with minimal defects. Hence, the dissertation also deals with anodized AA1050-alumina-based composite dispersion coatings. For dispersion coatings, is crucial to formulate electrolytes that can disperse nanoparticles in a stable manner. Efforts dedicated to produce anodized magnesium oxide dispersion compact coatings are also reported. Compact composite films were obtained leading to compact coatings at 20 V. Anodization of Zn alloy (2% Ti) is also investigated for the first time. Interestingly, different morphologies are obtained as a function of the applied voltage. Compact composite ZnO coatings are successfully obtained.



Importance for practice or development of the discipline:

Anodization of metals is an important area in electrochemistry. A plethora of technologies and parts are today functioning owing to metal anodization. This dissertation is an important contribution as not only the possibility of creating anodized dispersion coatings are investigated but also other metals such as Zn alloys are researched. Particularly, the Mg coatings are interesting specially for implants and biomedical applications. Also, there are other possibilities to be explored (catalysis, biomedical).

Formal adjustment of the thesis and language level:

The dissertation is well written and organized. The level of results are not only acceptable for publication but also are sufficient to estimate the scientific merits of the PhD applicant.

Questions and comments:

- What are the differences between mild and hard anodization? Perhaps, an explanation is missing in the text.
- Can anodization occur at neutral pH?
- Z-potential measurements of the particles? The physicochemical nature of the particles should be more discussed.
- Why did you use an anionic surfactant for dispersing the nanoparticles?
- It is mentioned in the thesis that when a low voltage is used in anodization of Mg a layer of magnesium hydroxide is formed. But at 80 V, MgO is formed. Why?
- ZnTi2 is an alloy having small amounts of Ti (2%). What is the function of Ti in this alloy?
- ZnO is an amphoteric oxide? What about the stability of the coating in basic/acidic media?
- Could you mention any application beyond protective functionalities for the anodized coatings?

Conclusion:

In my opinion, the reviewed thesis fulfills all requirements posed on theses aimed for obtaining PhD degree. This thesis is ready to be defended orally, in front of the respective committee.

In Zürich, 03/09/2020

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prof. Dr. Salvador Pané Vidal

