

# TITANIUM ANODIZATION IN ETHYLENE GLYCOL-BASED ELECTROLYTES FOR SURFACE STRUCTURIZATION

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## Introduction

Anodization of titanium is a very popular technique used in order to obtain the titanium dioxide protective coatings [1]. Among many electrolytes that can be used to obtain different structures and properties of TiO<sub>2</sub>, ethylene glycol based solutions with the addition of water and fluoride-containing salts or acids can be used for the development of nano-tubular and nano-structurized coatings, among which TiO<sub>2</sub> nanotubes arrays are one of the most common. Organic additive to the electrolyte slows the dissolution of the formed oxide and thus, the more regular structures are created [2-4].

This work is devoted to evaluate the dependence of the different ethylene glycol based electrolytes on structure and the antimicrobial properties of anodized titanium.

## Materials and Methods

Ti6Al4V disks of d=16 mm were mechanically polished and subjected to the anodization in solutions with different water to ethylene glycol ratios. All electrolytes were containing 2% vol. of hydrofluoric acid. Samples were deposited in constant voltage of 20 V and the deposition time was 20 minutes.

Scanning electron microscopy was used for surface complexity evaluation. What is more, roughness of the samples to evaluate the level of surface structurization was investigated. What is more, the bacterial (*Escherichia coli*) and fungal (*Candida albicans*) adhesion to the anodized surfaces was evaluated.

## Results and Discussion

The water to ethylene glycol ratios were 10:90, 20:80, 30:70, 40:60 and 50:50, respectively. The scanning electron microscopy evaluation revealed that the highest structurization was obtained for sample being anodized in the solution of 70% vol. of ethylene glycol. When there was about 90% vol. of ethylene glycol in the solution, the surface changed its character from structurized to micro-porous. Also, the porous surfaces had an average roughness Ra being almost 3 times higher than for structurized samples.

Bacterial colonisation on manufactured surfaces showed almost the linear growth of the total area occupied by bacteria in comparison to control sample when ethylene glycol to water ratio was increased. However, for *Candida albicans* there is no linear dependence between the electrolyte composition and fungal surface colonisation. In this case, almost for all samples the number of cells occupying the surface was similar, with the only exception for sample deposited in electrolyte with water to ethylene glycol ratio being 40:60 – here the number of *Candida* cells attached was much higher in comparison to others.

## Conclusions

The study showed that the anodization of titanium is possible by means of use of organic electrolytes. However, as it is known that the reduction of water may cause the help of formation of more tubular, longer structures of the coating, our study has not showed that dependence. For each of the sample, different surface character and structure was obtained. However, all the samples exhibited the anti-adhesive character for the purpose of inhibiting the bacterial and fungal biofilm development.

## References

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