IN VITRO BEHAVIOR OF TITANIUM DISCS COATED WITH HYDROXYAPATITE

Bogdan-Ovidiu Taranu, Alexandra Ioana Bucur, Paula Svera (m. Ianasi), Corina Orha

National Institute for Research and Development in Electrochemistry and Condensed Matter
no. 144, Dr P.A. Podeanu, Timisoara 300569, Romania
e-mail: alexandra.i.bucur@gmail.com

Abstract

Titanium, one metal with a very wide application range in the dental or orthopaedic fields, and hydroxyapatite (HA), a very versatile and biocompatible ceramic, can be combined to achieve medical implantable devices bearing the advantages of both materials [1, 2].

A new approach for the achievement of HA coated-titanium discs is presented, involving simultaneous precipitation and electrodeposition. One precursor is present in the electrolysis cell and the other precursor is dropwisely added, while an electrochemical potential is applied. The addition order of the precursors was alternated, and the Ti substrate surface modifications were evidenced using various analysis methods. XRD data shows that all the specimens contain HA as the single crystalline phase.

A double ceramic layer configuration is present, with one layer comprised of submicrometric crystals and the second one made up of micrometric constituents. The density of the continuous lower layer is higher, while the upper layer is discontinuous and its density is lower. For both layers the HA crystals are arranged into semi-spherical aggregates.

The roughness observed in AFM results, coupled with data from XRD and SEM analyses, indicates that the HA specimens deposited for longer time periods (4h vs. 1h) are more suited for biointegration.

Since the intended applications concern the dentistry and orthopaedics fields, in vitro tests using artificial saliva solution conducted at 37 °C for 30 and 60 days were followed by XRD and SEM characterizations. Artificial saliva solution was prepared with the same recipe used by Veys-Renaux *et al.* [3]. Results showed the presence of HA throughout the entire testing period, as well as the rapid development of large octacalcium phosphate and dicalcium phosphate crystals. Integrity and resilience of the coatings base layer under corrosive conditions was evidenced by their detachment from the Ti substrate - as opposed to their potential cracking, which would indicate a low corrosion resistance and lack of integrity.

References

1. Cattini, A., Bellucci, D., Sola, A., Pawłowski, L., Cannillo, V.: Suspension plasma spraying of optimised functionally graded coatings of bioactive glass/hydroxyapatite. Surf. Coatings Technol. 236, 118–126 (2013). doi:10.1016/j.surfcoat.2013.09.037
2. Afzal, M.A.F., Kesarwani, P., Reddy, K.M., Kalmodia, S., Basu, B., Balani, K.: Functionally graded hydroxyapatite-alumina-zirconia biocomposite: Synergy of toughness and biocompatibility. Mater. Sci. Eng. C. 32, 1164–1173 (2012). doi:10.1016/j.msec.2012.03.003
3. Veys-Renaux, D., Ait El Haj, Z., Rocca, E.: Corrosion resistance in artificial saliva of titanium anodized by plasma electrolytic oxidation in Na_3PO_4. Surf. Coatings Technol. 285, 214–219 (2016). doi:10.1016/j.surfcoat.2015.11.028