Surface modification by anodic oxidation of a Ti β-alloy for biomedical applications: effect of Plasma treatment and drug load on cell culture

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SUMMARY

There was a time when only suitable bulk properties were enough to elect a material to biomedical applications. Today, with the advance of biomaterial science, and the better understanding of the host response it is no longer the case and adapted surface properties are mandatory for the success of an implant (1). To achieve this goal multiple techniques were proposed over the years, working on surface morphology and/or composition. In this work, we proposed the nano structuration of the surface of a Titanium-Molybdenum alloy by anodic oxidation to obtain a homogeneous layer of titania nanotubes (TNT). These nanotubes present the advantage of, at the same time, miming the structure of trabecular bone, inducing better osteointegration, and can be used as a nano reservoir, enabling local drug delivery (2). The strategy of this work was to apply over the nanotubes a plasma polymer layer produced by Plasma Enhanced Chemical Vapor Deposition (3). This technique was chosen as a simple, clean, and reproducible way to create a surface able to act as an intermediate to the electrostatic interaction of drugs and the nanotubes. The plasma-treated surface was then charged with chlorhexidine, a well-known disinfectant for dental applications (4). The treated

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surfaces were characterized by contact angle measurements, confocal microscopy, and FTIR. The drug-charged and uncharged surfaces were also submitted to bacterial colonization and cell culture. The results showed that it was possible to depose and, more important, modulate the thickness of plasma films from oxazoline precursor over anodized surfaces. It was also possible to verify the incorporation of the drug on treated surfaces and the strong bactericidal behavior of the chlorhexidine. Nevertheless, the results of in vitro cell culture showed a highly cytotoxic response on drug-loaded samples, a great reminder of how the indiscriminate use of drugs can represent a potential danger for patients if the toxicity threshold is reached.

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