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Influence of oxygen content on the electrochemical behavior of Ta1-xOx coatings

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Ta and tantalum oxide coatings have been proven bioactive materials, recently proposed to enhance osseointrgration and performance of medical devices such as dental implants. In this study, $Ta_{1-x}O_x$ coatings were deposited by reactive magnetron sputtering in an $Ar+O_2$ atmosphere aiming at the enhancement of the electrochemical stability of stainless steel 316L. The coatings were produced using variable oxygen content in order to determine its influence on the films morphological features and corrosion resistance. Structural and morphological characteristics were correlated with corrosion behavior in artificial saliva. Potentiodynamic and electrochemical impedance spectrocospy (EIS) tests were complemented with X-ray photoelectron spectroscopy (XPS) to determine the electrochemical behavior of the coatings. X-ray diffraction results show that pure Ta coating revealed a body-centered cubic phase (bcc), typical alpha-phase; when the oxygen was added the crystal structure changed to a mixture of alpha (bcc) and beta (tetragonal) phases. Increasing the oxygen content, the coatings became amorphous. The increase in the oxygen amount retrieved more compact and smother $Ta_{1-x}O_x$ coatings. Corrosion results reveal a more protective behavior of the coatings as the oxygen amount increases in the films, as well as pitting inhibition in the coated stainless steel, independently of the film composition. A synergetic effect between Ta_2O_5 and phosphate-based passive layers is suggested as the protective mechanisms of the coatings; while the more active electrochemical behavior of low oxygen content films is evidenced as a consequence of the metallic tantalum on the surface with a more open morphology and larger density of defects on the surface.

Keywords
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EIS