

Biocompatibility and Surface Characteristics of PEO-treated Ti-40Ta-xZr Alloys for Dental Implant Materials

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Abstract: In this study, new titanium alloys were prepared by adding elements such as tantalum (Ta), zirconium (Zr) and the like to complement the biological, chemical and mechanical properties of titanium alloys. The Ti-40Ta-xZr ternary alloy was formed on the basis of Ti-40Ta alloy with the contents of Zr in the contents of 0, 3, 7 and 15 wt. %. Plasma electrolytic oxidation (PEO), which combines high-voltage sparks and electrochemical oxidation, is a novel method to form ceramic coatings on light metals such as Ti and its alloys. These oxide film produced by the electrochemical surface treatment is a thick and uniform porous form. It is also composed of hydroxyapatite and calcium phosphate-based phases, so it has the characteristics of bone inorganic, non-toxic and very high bioactivity and biocompatibility.

Ti-40Ta-xZr alloys were homogenized in an Ar atmosphere at 1050 ° C for 1 hour and then quenched in ice water. The electrochemical oxide film was applied by using a power supply of 280 V for 3 minutes in 0.15 M calcium acetate monohydrate ($\text{Ca}(\text{CH}_3\text{COO})_2 \cdot \text{H}_2\text{O}$) and 0.02 M calcium glycerophosphate ($\text{C}_3\text{H}_7\text{CaO}_6\text{P}$) electrolyte. A small amount of 0.0075M zinc acetate and magnesium acetate were added to the electrolyte to enhance the bioactivity. The mechanical properties of the coated surface of Ti-40Ta-xZr alloys were evaluated by Vickers hardness, roughness test, and elastic modulus using nano-indentation, and the surface wettability was evaluated by measuring the contact angle of the coated surface. In addition, cell activation and differentiation were examined by cell culture of HEK 293 (Human embryonic kidney 293) cell proliferation. Surface properties of the alloys were analyzed by scanning electron microscopy(FE-SEM), EDS, and X-ray diffraction analysis (XRD). (Supported by Ministry of Science, ICT and Future Planning: 17GJ1006;hcchoe@chosun.ac.kr)