Corrsoion Behavior of Hydroxyapatite/Titanium Nitride Coated Ti-29Nb-5Zr Alloy

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Titanium (Ti) and its alloys have high mechanical resistance, excellent corrosion resistance, biocompatibility characteristics, and they are therefore used extensively as dental implants. Ti-6Al-4V, the most common titanium alloy is good material for surgically implanted parts, such as knees, hips and shoulder replacement. However, the element V has been found to react severely with tissue in animals. Also, the use of Al is of concern because it may be connected to neurological disorders and Alzheimer's disease. Therefore, near β phase alloys composed of non-toxic element such as Nb, Ta, Zr and Mo showing lower modulus of elasticity and greater strength should be developed [4]. Recently, many researchers are focusing on the development of beta titanium alloy such as Ti-Nb-Zr alloy. It is a good biocompatibility and workability due to beta structure. For this reason, in this study, we manufactured the Ti-29Nb-5Zr wire for dental implant and orthodontic wire. In this present study, HA/TiN multi-layered coatings were fabricated by magnetron sputtering system. We demonstrated that the insertion of a TiN buffer layer at the interface completely stops this process acting as a very efficient diffusion barrier. On the other side, this interlayer improves the hardness and adherence of the HA coatings. Diffusion phenomena and oxidation of Ti were also reported for HA thin films obtained by other deposition techniques. Therefore, we need to observe the surface property of HA/TiN coated film to use the developed Ti-29Nb-5Zr alloy. In this study, corrsoion behavior of Hydroxyapatite/Titanium nitride coated Ti-29Nb-5Zr alloy has been researched by using electrochemical method.

The sample were CP titanium (G&S Titanium, Grade 4, USA), Niobium and Zirconium (Kurt J. Lesker Company, 99.95 wt% purity, USA) prepared by vacuum arc-melting furnace (SVT, KOREA) with a water-cooled copper hearth and a high-purity argon atmosphere. The wire was produced to final 6mm rod, and then again annealed at 860°C, 1h in Ar atmosphere, followed by water quenched. TiN buffer layer were coated using pure Ti target. The base pressure was lower 10^{-6} Torr and the sputtering was carried out in Ar (35sccm)+N_2(5sccm). Sputtering power was 100Wat 2h. In order to obtain a crystalline HA/TiN film, the samples were annealed at 300℃ for 1h in air atmosphere. Potentiodynamic polarization scans were carried out with a scan rate of 1.667 mV/s in the range from -1500 mV to 2000 mV. Also, AC impedance test was performed from 10m Hz to 100 kHz in SBF solution at 36.5 ± 1 °C (PARSTAT 2273, EG&G Company, USA). An equivalent circuit was assigned for the acquired data and the data were curve fitted using ZSimpWin software. The HA coating films consisted of granular particles with craters of 200nm size and the average surface roughness (R_a) was 4.22nm. The average thicknesses of HAfilm, TiNfilm and HA/TiN film were 67.5nm, 92.5nm and 167.4nm, respectively. The corrosion current density of HA/TiNfilms was much lower than that of the non-coated alloy. The polarization resistance (R_p) of HA/TiN coated alloys was higher compared to uncoated alloys(Supported by NRF-2009-0074672).