P-46

EFFECTS OF SURFACE ROUGHNESS AND MULTILAYER COATING ON THE CORROSION RESISTANCE OF Ti-6Al-4V ALLOY

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The dental implant materials required good mechanical properties, such as fatigue strength, combined with a high resistance to corrosion. For increasing fatigue resistance and delaying onset of stress corrosion cracking, shot peening has been used for > 50 years to extend service life of metal components, However, there is no information on the electrochemical behavior of shot peened and hydroxyapatite(HA) coated Ti-6Al-4V alloys. To increase fatigue strength, good corrosion resistance, and biocompatibility, the electrochemical characteristics of Ti/TiN/HA coated and shot peened Ti-6Al-4V alloys by electron beam physical vapor deposition(EB-PVD) have been researched by various electrochemical method in 0.9%NaCl. Ti-6Al-4V alloys were prepared under the condition of hydrogen and vacuum arc furnace. The produced materials were quenched at 1000°C under high purity dried Ar atmosphere and were hold at 500°C for 2 hrs to achieve the fatigue strength(1140MPa) of materials. Ti-6Al-4V alloys were prepared under the condition of hydrogen and vacuum arc furnace. Shot peening(SP) and sand blasting treatment was carried out for 1, 5, and 10min. on the surface of Ti-6Al-4V alloys using the steel balls of 0.5mm and alumina sand of 40um size. Ti/TiN/HA multilayer coatings were carried out by using electron-beam deposition method(EB-PVD) as shown Fig. 1. Bulk Ti, powder TiN and hydroxyapatite were used as the source of the deposition materials. Electrons were accelerated by high voltage of

4.2kV with 80 - 120mA on the deposition materials at 350°C in 2.0 X 10-6 torr vacuum. Ti/TiN/HA multilayer coated surfaces and layers were investigated bySEM and XRD. A saturated calomel electrode as a reference electrode, and high density carbon electrode as a counter electrode, were set according to ASTM G5-87. The potentials were controlled at a scan rate of 100 mV/min. by a potentiostat (EG&G Co.273A) connected to a computer system. Electrochemical tests were used to investigate the electrochemical characteristics of Ti/TiN/HA coated and shot peened materials in 0.9% NaCl solution at 36.5°C . After each electrochemical measurement, the corrosion surface of each sample was investigated by SEM.

The hardness of shot peened Ti-6Al-4V alloys increased as shot peening(SP) time increased. Electrochemical measurements showed that, in the case of shot peened Ti-6Al-4V alloys, the corrosion and pitting potential increased due to the shot peening induced removal of defects, such as inclusion, scratch, and pore on the surface, whereas passivation and active current density decreased as the SP time increased. For the HA coated samples, pitting potential increased in the order of Ti/TiN/HA > TiN/HA > Ti/HA > HA coated SPA.