Surface Analysis and Electrochemical Corrosion Behavior of Anodic Oxide Films on Pure Titanium

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Anodic oxide films were formed on commercially pure titanium by using a sulfuric acid anodizing process. The surface characteristics and corrosion behavior were evaluated via atomic force microscopy, X-ray photoelectron spectroscopy, polarization curves, electrochemical impedance spectroscopy, and scanning electron microscopy. The results revealed the hill-and-valley-like topography of, and nano-scale holes occurring in, the anodic oxide film. These holes increased in size and the oxidation degree of the film improved with increasing potential. Furthermore, the electrochemical test results revealed that the corrosion resistance of the film depends mainly on the dense inner oxide film. The oxide film obtained at high potential is less susceptible to corrosion compared with those formed at low potentials. The possible corrosion process of the oxide film is discussed. We believe that the corrosion of the film is closely correlated with the action of Cl^- ions. Defects on the film surface immersed in a NaCl solution will be damaged first, due to the invasion of Cl^- , leading to the formation of corrosion holes. Micro-cracks will form when adjacent holes become interconnected via corrosion.

Keywords: Anode oxidation; titanium oxide film; electrochemical characterization; corrosion resistance

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