EFFECT OF HEAT TREATMENT, OXIDATION AND PASSIVATION ON CORROSION BEHAVIOR OF TITANIUM ALLOY IN SIMULATED BODY FLUID

by

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Supervisor

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Abstract

EFFECT OF HEAT TREATMENT, OXIDATION AND PASSIVATION ON CORROSION BEHAVIOR OF TITANIUM ALLOY IN SIMULATED BODY FLUID

By Vu Si Man

Thesis Supervisor: Associate Professor Kwok Chi Tat
Electromechanical Engineering

Commercial pure titanium (CP Ti) and Ti alloy (Ti6Al4V), with alpha (α) and alpha-beta (α–β) structures, respectively, were subjected to three different treatments: heat treatment, thermal oxidation, and nitric acid passivation. The microstructure, structural characteristics, macro-hardness and corrosion resistance of the treated and untreated CP Ti and Ti6Al4V were compared. Cyclic polarization tests were used to study the electrochemical behavior of CP Ti and Ti6Al4V with and without treatments in simulated human body environment (0.9 wt. % NaCl solution at 37 ℃). Corrosion parameters such as corrosion current density (Icorr) and corrosion potential (Ecorr) were determined by the Tafel extrapolation method. The microstructure of the heat-treated and untreated CP Ti and Ti6Al4V were investigated by scanning electron microscope and optical microscope. The volumetric percentage of β and grain size of the heat-treated Ti6Al4V were determined from the SEM micrographs. The sub-surface structure and phase transformation of the heat-treated Ti6Al4V were determined by XRD. After heat treatment, the α, α' and β phases were identified in different specimens. The distribution of Al and V within phases was determined by energy dispersive X-ray spectroscopy (EDX) and macro-hardness profiles were

measured with a hardness tester (Rockwell HRC) for evaluating their mechanical properties. The corrosion behavior of heat-treated, thermal oxidized, and passivated Ti6Al4V were compared in the present study. In general, aging can effectively enhance the corrosion resistance of Ti6Al4V. The thermal oxidized specimen at 600 OC for 36 hours possesses the highest corrosion resistance. Among the three passivation conditions (passivation time, temperature, and concentration), temperature and concentration of the nitric acid were found to the most important factors affecting the corrosion resistance of passivated Ti6Al4V.

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