Evaluation of Corrosion behavior of bioceramics coated commercially pure titanium and Ti-6Al-4V alloy

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ABSTRACT

Introduction: The clinical success of implants has been achieved not only because of the mechanical strength or excellent biocompatibility of the implant material but also because of other characteristics such as surface properties and corrosion behavior.

Objective: The purpose of this study is to evaluate the corrosion behavior of commercially pure titanium and Ti-6Al-4V alloy samples without coating and with hydroxyapatite ,partial stabilized zirconia and mixture of partial stabilized zirconia and hydroxyapatite coating and comparison between them through electrochemical polarization tests in 37 ^{0} C Hank's solution.

Materials and method: Electrophoretic deposition technique (EPD) was used to achieve the coating from each one of three types of the coating materials (HAP, PSZ and mixture of 50% HAP and 50%PSZ) on Cp Ti and Ti-6Al-4V alloy samples.

The electrochemical corrosion test was performed when samples were exposed to Hank's solution prepared in the laboratory and the polarization potential, corrosion rate and the open circuit potential of the samples were measured.

Results: The results indicated that the corrosion rate is significantly higher for Ti-6Al-4V than for Cp Ti .The three types of coating significantly reduced the corrosion rate for Cp Ti while did not for Ti-6Al-4V alloy .After coating the corrosion rate for Ti-6Al-4V remained significantly higher than the coated Cp Ti samples .

The open circuit potential (OCP) for both Cp Ti and Ti-6Al-4V samples was in the following sequence PSZ(Cp Ti= -0.212 V , Ti-6Al-4V =-0.265 V)> HAP(Cp Ti= -0.225 V , Ti-6Al-4V =-0.40 V) >mixture(Cp Ti= -0.358 V , Ti-6Al-4V =-0.550 V)>uncoated (Cp Ti= -0.383 V , Ti-6Al-4V =-0.825 V).

Conclusions: Cp Ti showed less corrosion rate than Ti-6Al-4V alloy with and without coating .Coating significantly decreased the corrosion rate of Cp Ti but did not for Ti-6Al-4V alloy this might due to that alloy is composed of three main different elements Ti, Al and V each with different electromotive force so this might affect on the attraction of charged particles and the movement toward the alloy surface and then on bonding of the coating materials with the alloy therefore influence the thickness of the coating .