Electrochemical Characteristics of Zn and Si Ion-doped HA Films on Ti-6Al-4V by PEO Treatment

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초 록 : Commercially pure titanium (cp-Ti) and Ti alloys (typically Ti-6Al-4V) display excellent corrosion resistance and biocompatibility. Although the chemical composition and topography are considered important, the mechanical properties of the material and the loading conditions in the host have, conventionally. Ti and its alloys are not bioactive. Therefore, they do not chemically bond to the bone, whereas they physically bond with bone tissue. The electrochemical deposition process provides an effective surface for biocompatibility because large surface area can be served to cell proliferation. Electrochemical deposition method is an attractive technique for the deposition of hydroxyapatite (HAp). However, the adhesions of these coatings to the Ti surface needs to be improved for clinical used.

Plasma electrolyte oxidation (PEO) enables control in the chemical composition, porous structure, and thickness of the TiO_2 layer on Ti surface. In addition, previous studies have concluded that the presence of Ca^{+2} and PO_4^{3-} ion coating on porous TiO_2 surface induced adhesion strength between HAp and Ti surface during electrochemical deposition.

Silicon (Si) in particular has been found to be essential for normal bone and cartilage growth and development. Zinc (Zn) plays very important roles in bone formation and immune system regulation, and is also the most abundant trace element in bone. The objective of this work was to study electrochemical characteristcs of Zn and Si coating on Ti-6Al-4V by PEO treatment.

The coating process involves two steps: 1) formation of porous TiO_2 on Ti-6Al-4V at high potential. A pulsed DC power supply was employed. 2) Electrochemical tests were carried out using potentiodynamic and AC impedance methoeds. The morphology, the chemical composition, and the micro-structure an alysis of the sample were examined using FE-SEM, EDS, and XRD. The enhancements of the HAp forming ability arise from Si/Zn-TiO_2 surface, which has formed the reduction of the Si/Zn ions. The promising results successfully demonstrate the immense potential of Si/Zn-TiO_2 coatings in dental and biomaterials applications. (This work was supported by NRF : 2015H1C1A1035241,hcchoe@chosun.ac.kr)