Chemical Bonding Characteristics of Biocompatible TiO_2 Oxide Multilayer by the XPS Depth Analysis

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Most recently, to improve the biocompatibility, various processes that aim at coating an implant material with a bioactive nanoparticles such as synthetic hydroxyapatite have been proposed[1]. For this purpose, barrier and porous/tubular type of anodic oxide films could be formed by electrochemical anodization using a set of specific conditions including optimized potential, electrolyte composition, and temperature. Also, the chemical component of the electrolyte is essential in determining the type of morphology that is eventually formed, and the geometric morphology of TiO_2 oxide film is mutually important in direct contact with biological tissue in dental or surgical implants. In addition, the specific ions in the contact surface with the bone site plays a critical role in terms of adhesion and stability for long periods in the living body.

Thus, in this work, the manufacture of the TiO_2 barrier-type multilayer was accurately performed in a mixed electrolyte containing HAp, Pd, and Ag nanoparticles. The temperature of the solution was kept at approximatively 32℃and was regularly rotated by a magnetic stirring rod in order to increase the ionic diffusion rate. The manufactured specimens were carefully analyzed by XPS depth profile to investigate the result of chemical bonding behaviors. From the analysis of chemical states of the TiO_2 oxide multilayer using XPS, the peaks are showed with the typical signal of Ti oxide at 459.1 eV and 464.8 eV, due to Ti 2p(3/2) and Ti 2p(1/2), respectively. The Pd-3d peak was split into Pd-3d(5/2) and Pd-3d(3/2)peaks, and shows two bands at 334.7 and 339.9 eV for Pd-3d3 and Pd-3d5, respectively. Also, the peaks of Ag-3d have been investigated. The chemical states consisted of the O-*1s*, P-*2p*, and Ti-*2p* were identified in the forms of PO_4^{2-} and PO_4^{3-}. Based on the results of the chemical states, the chemical elements into the TiO_2 oxide multilayer were also inferred to be penetrated from the electrolyte during anodic process. The structure characterization of the modified surface were performed by using FE-SEM, and from the result of biological evaluation in simulated body fluid(SBF), the biocompatibility of TiO_2 oxide multilayer was effective for bioactive property(Supported by NRF: 2016R1D1A1B01016542 & NRF: No.2008-0062283 ; hcchoe@chosun.ac.kr).

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