Surface Characteristics of Type II Anodized Ti-6Al-4V Alloy for Biomedical Applications

이수원[a], 정태곤[a], 양재웅[a], 정재영[a], 박광민[a], 정용훈[a,*]
[a*]오송첨단의료산업진흥재단 첨단의료기기개발지원센터
(E-mail: yonghoonj186@kbiohealth.kr)

초 록: Titanium and its alloys offer attractive properties in a variety of applications. These are widely used for the field of biomedical implants because of its good biocompatibility and high corrosion resistance. Titanium anodizing is often used in the metal finishing of products, especially those can be used in the medical devices with dense oxide surface. Based on SAE/AMS (Society of Automotive Engineers/Aerospace Material Specification) 2488D, it has the specification for industrial titanium anodizing that have three different types of titanium anodization as following: Type I is used as a coating for elevated temperature forming; Type II is used as an anti-galling coating without additional lubrication or as a pre-treatment for improving adherence of film lubricants; Type III is used as a treatment to produce a spectrum of surface colours on titanium [1]. In this study, we have focused on Type II anodization for the medical (dental and orthopedic) application, the anodized surface was modified with gray color under alkaline electrolyte. The surface characteristics were analyzed with Focused Ion Beam (FIB), Scanning Electron Microscopy (SEM), surface roughness, Vickers hardness, three point bending test, biocompatibility, and corrosion (potentiodynamic) test. The Ti-6Al-4V alloy was used for specimen, the anodizing procedure was conducted in alkaline solution (NaOH based, pH>13). Applied voltage was range between 20 V to 40 V until the ampere to be zero. As results, the surface characteristics of anodic oxide layer were analyzed with SEM, the dissecting layer was fabricated with FIB method prior to analyze surface. The surface roughness was measured by arithmetic mean deviation of the roughness profile (Ra). The Vickers hardness was obtained with Vickers hardness tester, indentation was repeated for 5 times on each sample, and the three point bending property was verified by yield load values. In order to determine the corrosion resistance for the corrosion rate, the potentiodynamic test was performed for each specimen. The biological safety assessment was analyzed by cytotoxic and pyrogen test. Through FIB feature of anodic surfaces, the thickness of oxide layer was 1.1 um. The surface roughness, Vickers hardness, bending yield, and corrosion resistance of the anodized specimen were shown higher value than those of non-treated specimen. Also we could verify that there was no significant issues from cytotoxicity and pyrogen test.

Acknowledgements

This work was supported by the Medical Device Development Program (10049761) funded By MOTIE(Ministry of Trade, Industry & Energy)

References

[1] SAE AMS 2488D, Aerospace Material Specification, 2011.