Formation of an anti-bacterial oxide film on Ti-Ta alloy by anodic oxidation

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Titanium and its alloys are widely used as dental and orthopaedic implant materials[1]. Nevertheless, for long-term implantation loosening of the prosthetic devices caused by "stress shielding effect" of the inserted implant on adjacent bone can occur[2]. To alleviate this effect, Ti-Ta alloys have been developed, and they are expected to be candidates for dental implants because of their moderate mechanical properties. Moreover, it is evident that Ti-Ta alloys exhibit better corrosion resistance than Ti-6Al-7Nb alloy in a saliva containing fluoride[3]. However, Ti-Ta alloys do not possess ability to protect against bacteria adhesion or infection. When bacteria adhesion occurs on an implant surface, it is very difficult to be treated clinically because of the formation of biofilm, which can obstruct immune response, systemic antibiotic therapy, and the integration of the indwelling implants with the surrounding tissues[4]. Therefore, it is necessary to develop an anti-bacterial implant by adding various active anti-bacterial agents to combat biofilm formation without sacrificing any useful mechanical or biological properties. Ag ions and Ag-based compounds possess strong anti-bacterial ability and suitable biocompatibility as compared with other heavy metal ions. The aim of this study is to fabricate an Ag-containing surface on a Ti-Ta alloy by anodic oxidation.

The material used in this study is Ti-50Ta plates with size of ϕ10×1 mm. Ti-50Ta specimens were abraded with silicon carbon papers up to grade 800, and were then cleansed with acetone for 5 min followed by ethanol for 3 min in an ultrasonic cleaner, and finally dried at room temperature. The Ag-containing electrolyte for anodic oxidation was made by adding Ag powders into phosphate acid solution. The Ti-50Ta specimens were galvanostatically anodized at a constant current density of 50 mA/cm^2 up to 300 V for 2 min using a direct current power supply, and a high-density graphite plate was used as the cathode.

After anodizing, an anodic oxide film with craters formed on a Ti-50Ta plate, as shown in Fig. 1. The average surface roughness of the anodic oxide films was approximately 1.6 μm. The average pore size was about 1.58 μm. Furthermore, 0.89 wt% Ag containing in the anodic oxide film was found by the EDS detection. The porous morphology and Ag-containing of the anodic oxide film is attributed to sparking occur on the surface. Our previous study indicated that AISI 316L alloy has an Ag content 0.2 wt%, and it has excellent antibacterial properties against both *Staphylococcus aureus* and *Escherichia coli*, with an antibacterial rate of nearly 100%[5]. According, the Ag-containing anodic oxide film on the Ti-Ta alloy in the present study can be considered that it has anti-bacterial ability.

References

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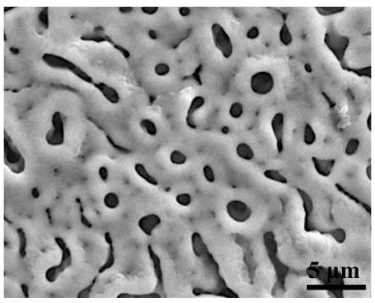

Fig. 1 Surface morphology of the anodic oxide film.