Nanotube Morphology Changes of Ti-xNb-Ag-Pt Alloy according to Nb Content

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1. INTRODUCTION

- Ti-6Al-4V alloy is the most widely used dental implant material in modern society. This is because physical and mechanical properties such as tensile strength, corrosion resistance, and wear resistance are suitable for sending implants. However, vanadium and aluminum have the problem of showing harmful effects on the human body. Also, the difference in mechanical properties between human bone and Ti-based metal has undesired effects such as poor bone conduction and stress shielding. This can cause bone re-fractures and loose implants. Therefore, many preliminary studies are underway to make alloys by adding stabilized β-type elements such as Hf, Ta, and Nb to solve these problems. The addition of Ag and Pt elements can improve the biocompatibility of the implant, and cell proliferation and differentiation can be confirmed through surface modification such as forming nanotubes on the surface of the implant.

- In this study, nanotube morphology changes of Ti-xNb-Ag-Pt alloy with Nb content for biomaterials were researched using various experimental instruments.

2. MATERIALS AND METHOD

- Ti-xNb-Ag-Pt alloys (x = 10, 30 and 50 wt.%) were prepared in an Ar atmosphere using a vacuum arc-melting furnace. The prepared alloy was heat treated at 1050°C for 1 hour, and then quenched in water at 0°C.

- The microstructure of the alloy was observed by optical microscopy after etching in a solution consisting of 2 mL HF, 3 mL HCl, 5 mL HNO_3 and 190 mL H_2O before nanotube formation.

- Nanotube formation on the samples was performed using anodization method with a DC power supply at 30 V for 2 h in 1 M H_3PO_4 + 0.8 wt % NaF at 25 °C.

- The surface morphology was observed using OM, FE-SEM, EDS and XRD.

3. RESULTS & DISCUSSION

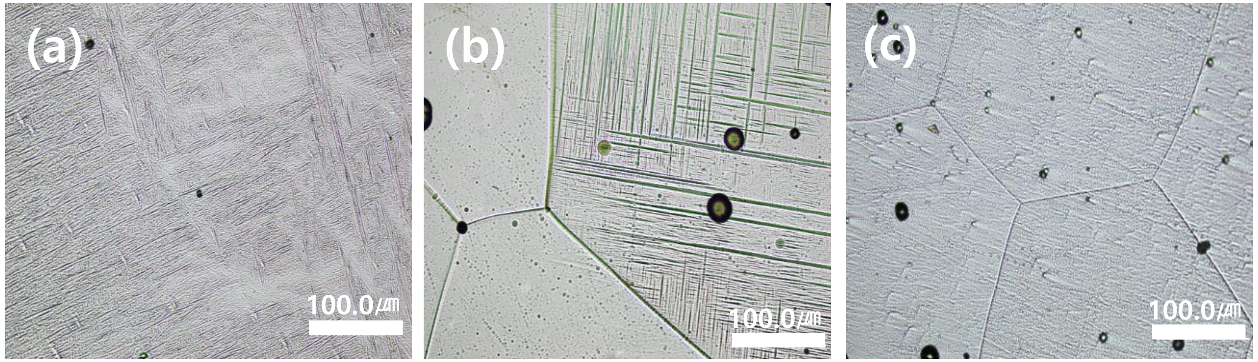

Figure 1. OM images of Ti-xNb-Ag-Pt alloys after heat treatment at 1050 °C for 1 h in Ar atmosphere, followed by 0 °C water quenching: (a) Ti-10Nb-Ag-Pt alloy, (b) Ti-30Nb-Ag-Pt alloy, (c) Ti-50Nb-Ag-Pt alloy.

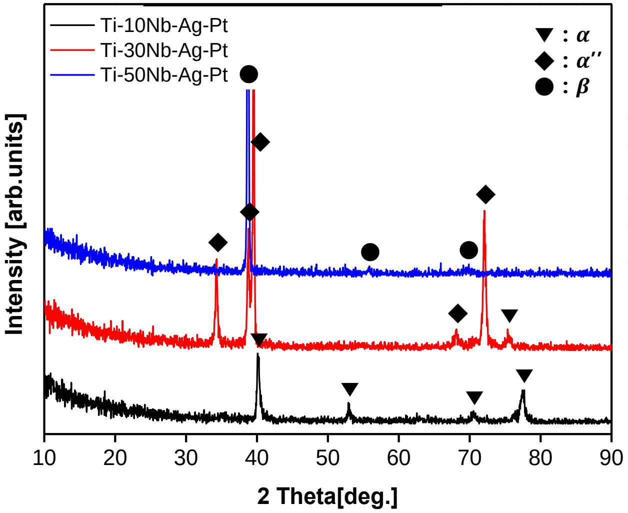

Figure 2. XRD patterns for the homogenized Ti–xNb–Ag-Pt alloys.

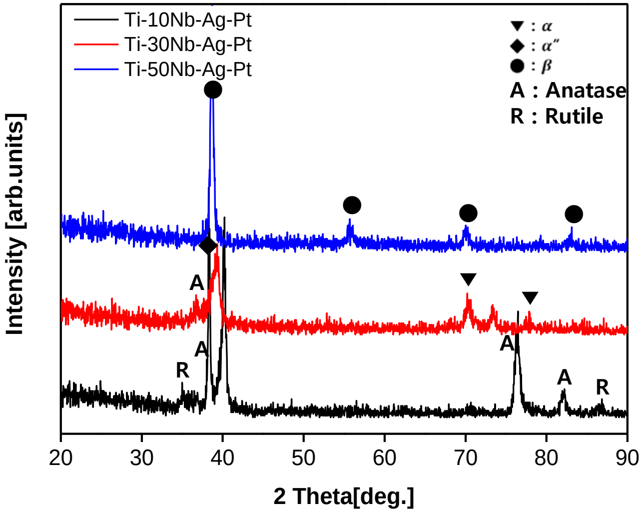

Figure 3. XRD patterns for the nanotube-formed Ti–xNb–Ag-Pt alloys.

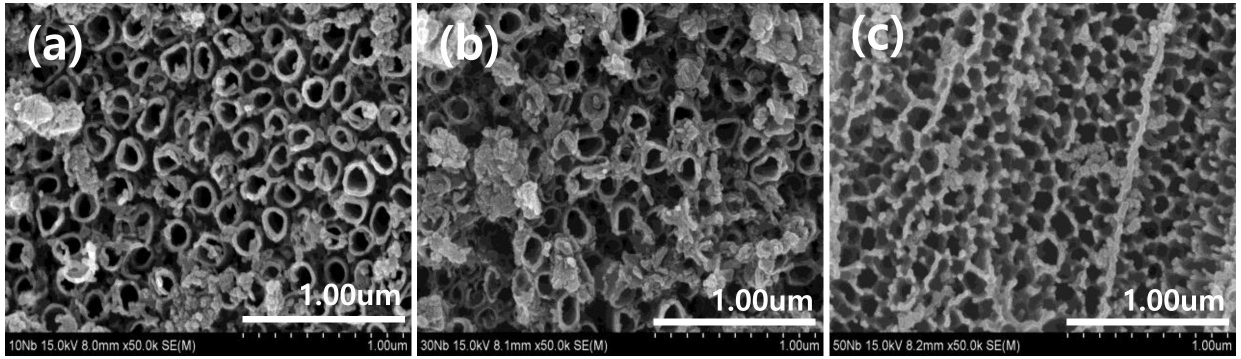

Figure 4. FE-SEM micrographs showing views of the surfaces of the nanotube layers formed on the Ti-Nb-Ag-Pt alloys in 1.0 M H_3PO_4 with 0.8 wt. % NaF electrolyte after anodization for 2 h at 30V : (a) Ti-10Nb-Ag-Pt, (b) Ti-30Nb-Ag-Pt, (c) Ti-50Nb-Ag-Pt.

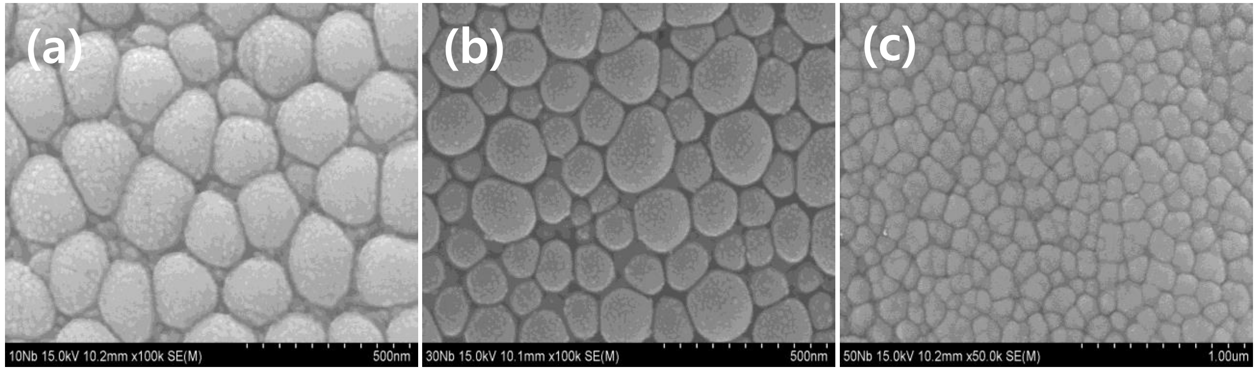

Figure 5. FE-SEM micrographs showing views of the bottom of the nanotube layers formed on the Ti-xNb-Ag-Pt alloys in 1.0 M H_3PO_4 with 0.8 wt. % NaF electrolyte after anodization for 2 h at 30V : (a) Ti-10Nb-Ag-Pt, (b) Ti-30Nb-Ag-Pt, (c) Ti-50Nb-Ag-Pt.

3. RESULTS & DISCUSSION

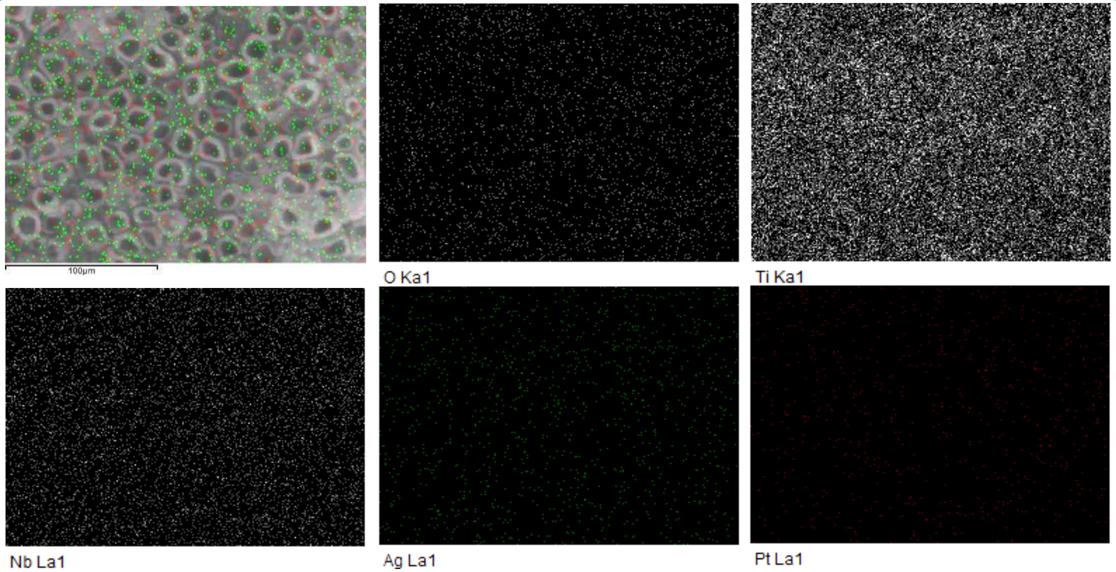

Figure 6. EDS mapping analysis results of the surface of the nanotube formed : Ti-10Nb-Ag-Pt alloy.

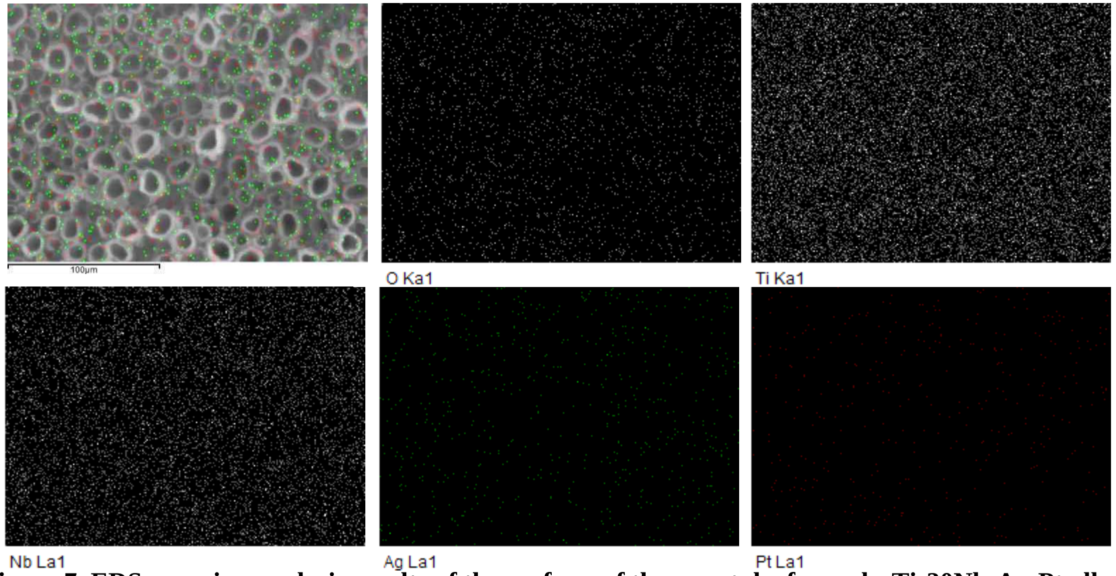

Figure 7. EDS mapping analysis results of the surface of the nanotube formed : Ti-30Nb-Ag-Pt alloy.

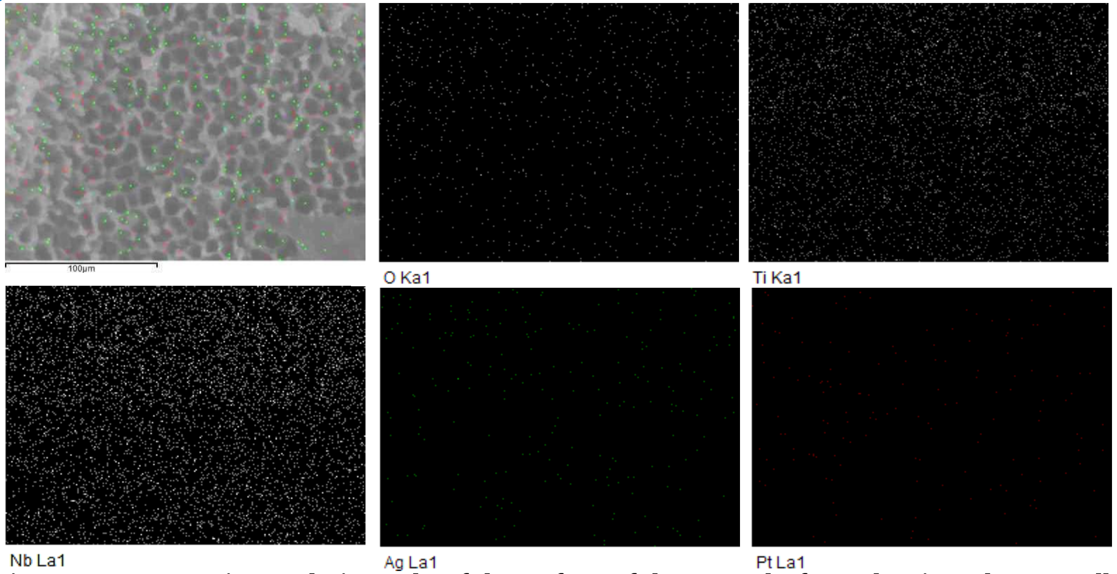

Figure 8. EDS mapping analysis results of the surface of the nanotube formed : Ti-50Nb-Ag-Pt alloy.

4. CONCLUSIONS

- **A Ti-xNb-Ag-Pt alloy was prepared using a vacuum arc-melting furnace, and nanotubes were formed on the Ti-xNb-Ag-Pt alloy surface using an anodizing method.**

- **As the Nb content increased, the microstructure changed from a needle structure to an equiaxed structure, and the α-phase changed to a β-phase.**

- **From the XRD peak after nanotube formation, the anatage phase and Rutile phase appears in the Ti-xNb-Ag-Pt (x = 10, 30, 50 wt%) alloy, and Nb, Ag, and Pt elements were observed in the top and bottom views by EDS mapping. It was found that it was evenly distributed on the alloy surface.**

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