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Corrosion behavior of nickel-titanium alloy with TiO2 layer formed via anodization in HNO3 electrolyte

Anodization of NiTi alloy using HNO3 electrolyte enables the formation TiO2 layer hardly including Ni over 100 nm in thickness. The TiO2 layer on a metallic surface is expected to play a role of a protective layer against chemical reaction. In the present study, thus, variations of corrosion behavior on NiTi surface derived by forming TiO2 layer via anodization in HNO3 electrolyte with various concentrations was evaluated.
The NiTi alloy was chemically polished using a colloidal silica suspension with an average particle size of 40 nm, and thereafter, the ally was anodized in HNO3 solution with the concentration range from 1 to 1000 mM. A substrate and a counter electrode made of Ti were set at a distance of 50 mm, respectively, after which a galvanostatic direct current (DC) was applied for 60 min at a constant value of 50 mA·cm-2. The elemental depth profiles and chemical compositions of the anodized surface were analyzed by XPS, and the surface morphologies of the samples were observed using SEM. Moreover, SPM was used for obtaining information regarding the surface topology and potential distribution. Release rate of Ni ion from the surface was evaluated by soaking the samples into a simulated body fluid for 4 h and subsequently determining the Ni concentration in the fluids
The HNO3 concentration used affects the layer thickness as well as the pore generation on the surface. In the range below 100 mM, raising the concentration led to the formation of thicker oxide layer with larger pores. In the range over 100 mM, the thickness turned into decrease due to the dissolution of the oxide layer formed. Unfortunately, the corrosion resistance of the anodized layer was lower than that of an untreated NiTi alloy because of the generation of pores, and concomitantly, Ni release rate from the surface was also accelerated. The rate related with the thickness of layer formed, and the anodic layer fabricated in 100 mM was the thickest and showed the lowest release rate.

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