# Investigation of Corrosion Property of Beta-Type Titanium Alloys in Simulated Body Fluid

In order to obtain corrosion behavior of new β-type titanium alloy, Ti-29Nb-13Ta-4.6Zr (TNTZ) in Simulated Body Fluid (SBF), corrosion rate of TNTZ was investigated using a potensiostat test in Kubokko's solution (simulated body fuluid) as a model of a human body fluid. This would contribute to the advance of TNTZ usage as a prospective implants.

It has been reported that TNTZ alloy can have a wide range of mechanical properties by performing heat or thermo-mechanical treatments [1]. In order to know the potential of this alloy using as a new implant material, behavior of this alloy in body fluid is necessary to investigate.

Materials used in this study is TNTZ rods containing (in mass%) 31.5Nb, 11.6Ta, 4.7Zr, 0.03Fe, <0.02Al and bal. Kubokko's solution body fluid was prepared, according to related instruction [2] with temperature controlled in water bah at 37° and pH 7.4. Corrosion test was conducted using a potentiostat model controlled by a personal computer. After corrosion tests, TNTZ specimen surfaces were observed by OM and EDX.

Typical Tafel curves of TNTZ specimens (CP TNTZ 1, CP TNTZ 2, and CP TNTZ 3), which were obtained from potensiostat tests, are shown in Fig.1. The corrosion rate of TNTZ is also not too much different to that of Ti-6Al-4V ELI. Averaged corrosion rate of TNTZ in Kubokko's solution is $5.71 \times 10^{-9}$ *mmy*$^{-1}$, while that of Ti-6Al-4V ELI is $4{,}49 \times 10^{-9}$ *mmy*$^{-1}$. This value is very much smaller than those of the conventional surgeon implant materials such as stainless steel SUS316L ($2.13 \times 10^{-3}$ mmy$^{-1}$) [3].

Pitting corrosion in TNTZ is found in some pattern-like such as elliptical and undercutting (Fig.2). EDX examination near pitting area shows that the content of oxygen in the corrosion area is much higher than that of the other area on the surface of TNTZ. This confirms the formation of pitting corrosion in the alloy.

The corrosion rate of TNTZ in this SBF fluid is almost same as that in the artificial saliva of Fuyusama Meyer: that is reported separetely by Gunawarman [4]. The high corrosion resistance of TNTZ is due to the formation of $TiO_2$ layer in the surface oxide layer of TNTZ in addition to the Nb, Zr and Ta oxides, whic acts as a transpassive layer. It can be said that the oxide layer formed on the TNTZ alloys is more stable, less soluble and thus more biocompatible than those of Ti-6Al-4V ELI. However, corrosion pitting attack is more potential in TNTZ as compared to Ti-6Al-4V ELI.

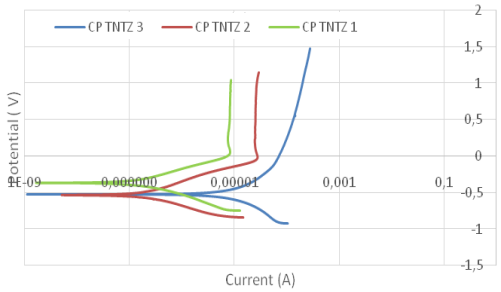


Fig. 1. Tafel plot TNTZ

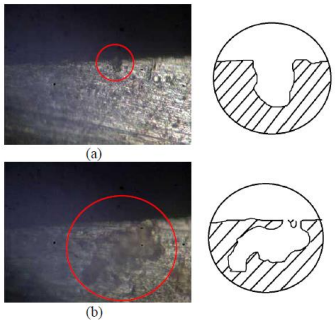


Fig.2 Pitting corrosion pattern-like on corroded TNTZ (a) Eliptical (b) Undercutting

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During staying here, I could learn not only about this work, but also about Japanese culture. I have heard long time about Japanese spirit and discipline, and now I can prove it. It is better than what I previously imagined.

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