The effect of surface metallographic preparation on corrosion behaviour of Ti-6Al-4V alloy in the simulated physiological solution of artificial saliva

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Titanium alloys are found in various sectors, such as aviation, biomedicine, and marine industry.[1] The formation of protective passive layers on the surface of titanium alloys occurs spontaneously, contributing also to their remarkable corrosion resistance. For biomedical use, the preference for Ti-6Al-4V is due to its suitable mechanical properties.[1] The microstructure of Ti-6Al-4V comprises both alpha (α) and beta (β) phases, with aluminium (Al) stabilizing the α-phase and vanadium (V) stabilizing the β-phase. Apart from elemental composition variations, surface properties affect its corrosion resistance.[2] Overall, mechanical preparation has an important impact on optimizing surface characteristics, ensuring enhanced performance across diverse fields. According to the literature, different surface preparations and treatments, including mechanical, physical, chemical, or biochemical methods, can significantly impact the properties of the passive layer.[2,3] Usually, mechanical preparation (grinding and polishing) of Ti-6Al-4V surfaces involves a series of steps to tailor surface properties for specific applications to modify surface texture and morphology.[4]

This work was focused on commercial Ti-6Al-4V distributed by Goodfellow. The main aim was to study the influence of mechanical surface preparation (after grinding using SiC emery papers (grids 320, 1200, 2400, and 4000), diamond (DP-L) polishing, and silica (OP-S) polishing) on its surface. The surface roughness was measured using a contact profilometer. The surface appearance and microstructure characterization were performed using scanning electron microscopy (SEM) coupled with energy-dispersive X-ray spectrometry (EDS). Electrochemical behaviour after 1.5 hours of immersion to physiological solutions (simulating the components and pH of the natural saliva fluid) at 37 °C was assessed using cyclic potentiodynamic measurements in a three-electrode corrosion cell.

The results revealed that surface preparation significantly impacts roughness, surface microstructure, and corrosion behaviour, especially at potentials above 3 V vs. Ag/AgCl, Figure 1.

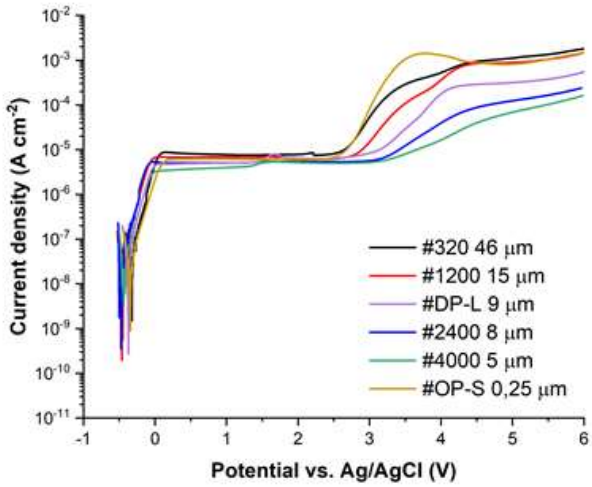

Figure 1. Potentiodynamic polarisation curves of Ti-6Al-4V samples subjected to various metallographic preparations. Curves were measured after 1.5 hours of immersion in artificial saliva solution (simulating the components and pH of the natural saliva fluid) at 37 °C.

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