Electropolishing Mechanism of Ti-6Al-4V Alloy Fabricated by Selective Laser Melting

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In this study, the electropolishing mechanism of Ti-6Al-4V alloy fabricated by selective laser melting was analysed by using the electrolyte of perchloric acid and glacial acetic acid. The influences of electropolishing time on the surface morphology and corrosion performance of the Ti-6Al-4Al alloy were investigated, with regard to the surface morphology, chemical compositions and corrosion behaviours, using scanning electron microscopy, atomic force microscopy, X-ray photoelectron spectroscopy, potentiodynamic polarization and electrochemical impedance spectroscopy. The results show that after electrochemical polishing, the surface of the Ti-6Al-4V alloy was covered with a thin layer of oxide film composed of titanium, aluminium and vanadium oxides. The surface roughness of the Ti-6Al-4V alloy with an electropolishing time of 15 min was at its minimum, reaching an ideal polishing effect. The electropolishing mechanism of the Ti-6Al-4V alloy was the shedding of spherical particles on the alloy surface and the smoothing of prominent parts under the electrochemical reaction. As the electropolishing time increased, the corrosion resistance of the Ti-6Al-4V alloy in Ringer's solution initially increased then decreased. The increment in VO_x content and oxidation of unstable and low-valence TiO , or Ti_2O_3 into stable and compact TiO_2 in the oxide film triggered by prolonging polishing time were found to enhance corrosion resistance.

Keywords: Ti-6Al-4V alloy; Electrochemical polishing; Surface morphology; Oxide film; Corrosion performance

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