

Tribo-corrosion Evaluation of Electron Beam Melting Ti6Al4V-ELI for Biomedical Applications

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Abstract:

Biomaterials surfaces need to be adequate to the function they perform; for this reason, the importance of studying surface finish increases as design requirements grow, regarding geometry and precision requirements in bioengineered materials. These biomaterials are subject to several types of premature failure, such as wear, fatigue, micro movements, particle detachment and degradation, which may generate the need for new interventions [1]. Titanium alloys have been widely used in the production of biomaterials due to their high physicochemical stability, mechanical resistance and biocompatibility. Currently, a route widely used on the implants production is the additive manufacturing using Selective Laser Melting (FSL) technology and Electron Beam Melting (EBM). The surfaces built by these technologies are covered with a certain amount of adhered material, which is partially melted on its surface, being a disadvantage in melting techniques using a bed of particulate materials, where a very smooth and low roughness surface cannot be achieved [2].

Additionally, surface characteristics are still influenced by the process parameters used in consolidation, in particular: power, speed, movement directions of the laser beam and other parameters.

The objective of this work was to evaluate the tribological and corrosion behavior of electron beam melting Ti6Al4V samples.

Titanium alloy samples was produced with Ti6Al4V-ELI (extra low interstitials) powder by electron beam melting technique, at 5 different speed parameters. Confocal microscopy was also used to evaluate samples roughness and topography. The tribo-corrosion tests were carried out during 10 min, solid spheres of 52-100 chrome steel, with 10 mm in diameter, were used as counter-bodies. The electrolyte used to simulate body fluids was Ringer's solution at 37°C. Current density and open circuit potential *versus* time were monitored throughout the test.

There is a tendency towards an increase in friction force values according to the surface topography.

The results indicated that the tribo-corrosion behavior is influenced by the Ti6Al4V-ELI surfaces finishing, and the wear rate is dependent of the normal force and the roughness of each sample; which is closely linked to the change in the speed parameters used in the preparation of the samples. Therefore, it is necessary to constantly advance research on the use of electron beam melting for biomaterials surfaces produced with titanium powder alloys.

Keywords: Titanium alloys, tribo-corrosion, electron beam melting, biomedical devices.

References:

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