

SURFACE INVESTIGATION OF A LASER ETCHED METALLIC BIOMATERIAL

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Introduction and objective: Surface treatments are used to improve characteristics, such as: markings, texturing and polishing. The texturizations are produced to provide roughness and, consequently, adherence in specific locations of implantable medical devices of permanent character, that is, implants of prolonged use. Sometimes this process can generate stress concentrators and regions with probability for the occurrence of failures that can lead to fracture; in addition to damaging the passive layer, favouring the initiation of various forms of corrosion [1]. This work aims to evaluate the effect of the laser beam texturing technique in metallic implants on the corrosion resistance of ASTM 316L stainless steel.

Methodology: Samples were prepared from the stainless steel textured by fiber optic laser doped with ytterbium (Yb) by changing the values of the frequency of the laser pulse cadence and keeping the other parameters constant. As a comparison, samples of the biomaterial without any type of laser treatment were also evaluated. The electrochemical tests performed consisted of open circuit corrosion potential (OCP) monitoring and cyclic potentiodynamic polarization measurements, determined after hours of immersion at 37°C body temperature. The scanning vibrating electrode electrochemical technique (SVET) was used as a tool to determine the corrosion current density in 0.1M NaCl solution.

Results and discussion: The results obtained revealed the highest anodic current densities in the regions engraved by the laser beam and cathodic current densities in the regions farthest from the engravings, which indicates that laser engraving, in addition to increasing the roughness of the surfaces, makes them essentially anodic, changes the passive layer, affects the distribution of corrosion current densities and decreases the resistance to localized corrosion of this biomaterial.

Conclusions: The change in the laser pulse frequency values is directly related to the behaviour observed on the analysed surfaces, indicating that the laser texturing treatment affects the passive layer of the material decreasing the resistance to localized corrosion.

References

[1] PIERETTI, E. F., PESSINE, E. J., CORREA, O. V., ROSSI, W., NEVES, M. D. M., Effect of Laser Parameters on the Corrosion Resistance of the ASTM F139 Stainless Steel, International Journal of Electrochemical Science, 10, 1221 – 1232, 2015.

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