Characterization of modified Ti6Al4V alloy after fretting-corrosion tests using near-field microscopy

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Abstract

Fretting wear and corrosion of Ti6Al4V alloys at the bone/implant stem interface produce the release of wear particles and corrosive ions from the stem into the surrounding tissue that can induce bone resorption. In this work, oxidation treatments at 500° and 700. °C for 1. h have been studied for increasing the friction-corrosion resistance at these interfaces. The friction-corrosion process of thermally treated Ti6Al4V disks against pins of cadaver bone was evaluated in bovine serum medium for 1. million. cycles of loading at 4. Hz with maximum contact pressures of 10. MPa. Cyclic displacement of 120 μm for pin-on-disk samples in a linear motion was applied. Samples were characterized, before and after the oxidation treatment, by atomic force microscopy (AFM), scanning Kelvin probe (SKP) and scanning electrochemical microscopy (SECM). The characterization of the Ti6Al4V samples showed the growth and the different morphologies of the oxides as a consequence of the temperature. SKP and SECM revealed that the surface of oxidized samples had lower electrochemical activity than as-received surfaces. After the fretting-corrosion test, the thermally treated samples showed low electrochemical reactivity; specifically oxidation treatment at 700. °C revealed that the rutile scale formed potentially improves the performance of Ti6Al4V in fretting-corrosion against bone.

Surface and Coatings Technology

Volume 212, November 2012, Pages 134-144