Tribocorrosion of commercially pure titanium in oral simulating environments

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According to several studies, commercially pure (cp) titanium presents the required properties for dental applications such as mechanical resistance, low density, corrosion resistance and biocompatibility [1-3]. Also, it is widely accepted that the surface properties of the metallic material will play an essential role in the interaction between implanted materials and tissue. Whatever Ti is used in crowns or implants, a relative displacement between the implant and the adjacent material (gum, bone, porcelain…) might occur, always in the presence of an environment constituted by inorganic and organic species. Therefore, a tribocorrosion system may be formed, and the synergistic effect of wear and corrosion may lead to accelerated failure of the system. Nevertheless, few studies have focused on the tribocorrosion behavior of titanium in oral simulating environments, considering the presence of fluoride solutions and/or bacterial biofilms [4-8].

The aim of this work was to study the effect of sliding wear of cp titanium in the presence of artificial saliva containing different amounts of fluoride. Also, the behavior of the tribocorrosion system when a biofilm is present at the surface of the metallic materials was evaluated.

Samples of grade 2 Ti were prepared by grinding using SiC sandpapers till 1200 mesh. Tribocorrosion tests were accomplished in Fusayama's artificial saliva (AS) containing two different fluoride concentrations: 30 and 227 ppmF^-. Open-circuit potential (OCP) was monitored during the entire experiment and electrochemical impedance spectroscopy tests (EIS) were carried out at 50 mV above corrosion potential (E_{corr}) at frequencies from 100 KHz to 15.8 mHz, before and after sliding. The sliding tests were carried out using an alumina sphere as counterbody under a normal load of 3 N, an amplitude of 2 mm for 20 min. Results were statistically analyzed at significance level of $p < 0.05$. Samples were inspected by SEM-EDS and AFM.

As shown in fig. 1, the addition of 227 ppmF^- to the AS resulted in a higher E_{corr} during sliding. However, in the same solution, Ti presents a significantly higher passive current density in the absence of mechanical action. During sliding, third-body particles were produced, and chemical analysis of the solution revealed a significant release of Ti ions. The influence of the presence of bacterial cultures of *S.mutans* on the corrosion and tribocorrosion behavior of titanium is also discussed.

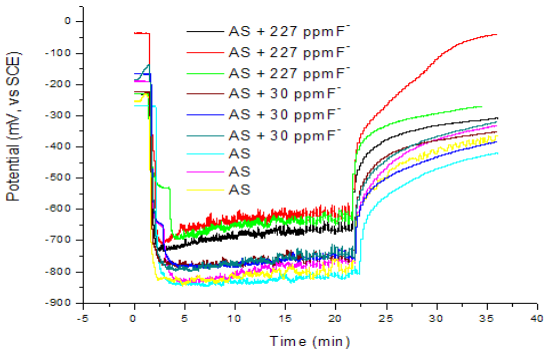

Figure1. Evolution of the open circuit potential (OCP) during tribocorrosion tests

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