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Tribocorrosion studies on commercially pure titanium for dental applications

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Abstract

Tribocorrosion refers to a complex degradation of materials occurring due to the interaction between a tribological process and a corrosive environment. From the tribological point of view, the interaction with the material may include sliding or abrasive wear, erosion, impact, fretting or fatigue processes. The environmental solicitation may result from temperature, humidity, liquids or gases in permanent or intermittent contact with the materials. Failure in the metallic part or of the metal/ceramic interfaces existing in dental restorations, such as crowns and bridges, are still relatively frequent. Also, excessive degradation of dental materials is sometimes observed in other dental materials. Most of the failures are due to the simultaneous action of mechanical (wear, fretting and fatigue) and chemical (saliva) solicitations. As a consequence, the investigation of the tribocorrosion mechanisms in such systems becomes essential. Regarding this aspect, in last years particular focus is being given to the exploitation of electrochemical methods as a tool for the investigation of the combined corrosion-wear degradation of the materials. Also, it is known that the mechanical contact geometry is of crucial importance regarding the degradation behaviour.

In this work the tribocorrosion behaviour of commercially pure titanium in contact with artificial saliva solutions was investigated. Tests were conducted in a reciprocating sliding geometry with movement amplitudes varying from 200 μm (fretting) up to 6 mm (wear), and normal loads between 2 and 10 N. The electrochemical noise technique was used in order to follow the evolution of both the corrosion current and of the open circuit potential of the system during the wear tests. The pH of the artificial saliva solution was varied between 4 and 7.

Results show that the behaviour of the material is strongly influenced by the pH of the solution. In fact, acidification of the solution improves the electrochemical response of the material, in particular the repassivation kinetics after sliding, in all the test conditions used in this work. However, the characteristics of the passive film formed on the material surface appear to be less protective than that formed at neutral pH. Also, an abnormal amount of titanium is removed from the material at low pH, when the normal load applied during the wear test is increased.

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