

## Electrochemical study of the repassivation of titanium in different artificial saliva solutions

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The passive film presented at the dental implant surfaces can be damaged or eventually destroyed during insertion and implantation into hard tissue due to abrasion/wear with bone or other materials. However, when the wear action stops, the surface will tend to regenerate immediately, and a new passive film will be formed. In such conditions we are in the presence of a tribo-electrochemical phenomenon which comprises the analysis of two different processes and of the synergism effects between them. In fact, the mechanisms of mechanical degradation due to wear might be influenced by the presence of a corrosive environments, but the electrochemical behaviour of the material is likely to be modified by the presence of the mechanical solicitation and by the presence of wear debris and/or the formation of tribolayers. Also, the repassivation kinetics of the tribocorrosion system during or after mechanical damage becomes an important issue to be studied. This work deals with the study of the repassivation of titanium when in contact with artificial saliva solutions, after mechanical damage.

Samples were immersed in different kinds of artificial saliva solutions (artificial saliva (AS), AS + citric acid, AS + anodic, cathodic or organic inhibitor). After stabilisation the passive film was mechanically disrupted and the open-circuit potential (OCP) was monitored both during the mechanical damage and until the repassivation was completed. Additionally, and in order to evaluate the quality of the passive film, EIS measurements were performed before and after mechanical disruption of the passive film. The effect of pH variation and of electrolyte composition on the repassivation evolution was also investigated.

Considering the evolution of the open circuit potential represented in figure 1 the approximation  $\ln(E) = \ln(k) + b \cdot \ln(t)$  was used to study the repassivation evolution with the time.

As it can be observed, the open circuit potential achieved before and after the mechanical damage varies, which indicates that the nature of the electrolyte influences the properties of the passive film. As indicated by the b values presented in Table 1, after repassivation, the AS + citric acid is the solution that provides better repassivation evolution with the time. In contrast, the AS + cathodic inhibitor is the solution that provides worst repassivation evolution. However, the EIS results suggests that AS solution is that providing the most stable and thick passive film. The results obtained with the AS + cathodic or + organic solution shows that these solutions do not have a good influence on the film growth.

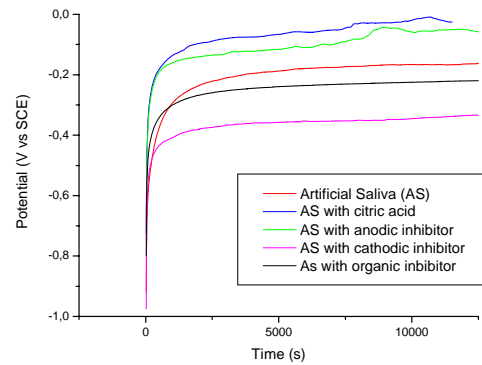


Figure 1: Repassivation plateaus obtained after mechanical damage, in different artificial saliva solutions.

	b values (Average $\pm$ SD)	R $\pm$ SD
Artificial Saliva (AS)	0.24 $\pm$ 0.02	-0.99 $\pm$ 0.01
AS with citric acid	0.43 $\pm$ 0.01	-0.99 $\pm$ 0.06
AS with anodic inhibitor	0.21 $\pm$ 0.04	-0.99 $\pm$ 0.03
AS with cathodic inhibitor	0.105 $\pm$ 0.001	-0.96 $\pm$ 0.03
AS with organic inhibitor	0.17 $\pm$ 0.04 before 40 min 0.08 $\pm$ 0.04 after 40 min	-0.985 $\pm$ 0.02

Table 1: Constant b values calculated from the evolution of the open-circuit potential with time.