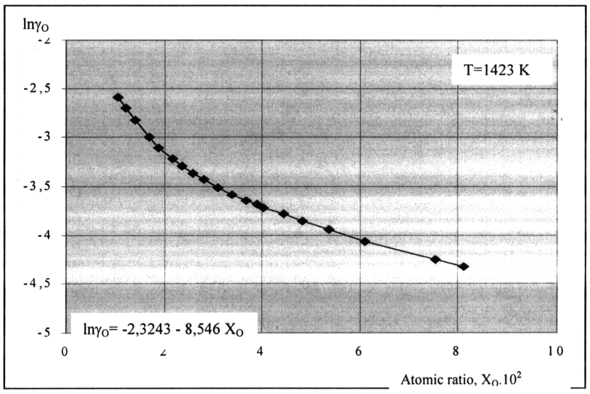

Fig. 1 Activity coefficient logarithm as a function of the oxygen atomic ratio at 1423 K

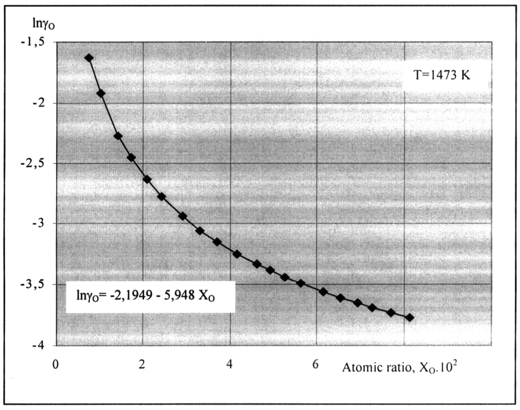

Fig. 2 Activity coefficient logarithm as a function of the oxygen atomic ratio at 1473 K

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STUDY OF GALVANIC CORROSION FOR TITANIUM AND ALLOYS USED IN DENTAL IMPLANTOLOGY

Cezar TOADER, Nicolae BĂNCILĂ, Anamaria DĂSCĂLESCU, Radu COTEȚIU

North University of Baia Mare, Romania, Baia Mare 4800, st.Dr.Victor Babes NR 62A

Эта статья представляет оценку гальванической коррозии для титана и сплавов, используемых в зубной имплантации. Экспериментально определено изменения потенциала во времени для различных зубных материалов: Ti5Al2,5Fe,Gaudor, Gaudent, Wisil, сталь 10NiCr18, чистый коммерческий титан.

This paper present evaluation of galvanic corrosion for titanium and alloys used in dental implantology. It's been determined experimentally the potential change in time for different dental materials: Ti5Al2,5Fe, Gaudor, Gaudent, Wisil, steel 10NiCr18, pure commercial titanium.

The conjoint degradation processes of corrosion and wear of metal surfaces is clearly of great importance in the design of orthopedic and dental prostheses. It is also clear that in a situation in which corrosion and wear are both possible degradation mechanisms each could have a profound effect on the other. Both processes will be controlled to a certain extent by the properties of the oxide layer on the surface of the material and the interaction of the environment which that surface. The passivation process will depend on the properties of the oxide formed, and thus the alloy composition, and the constituents of the environment.

In terms of wear without corrosion the amount of wear or the susceptibility of a surface to wear will be controlled to a certain by the hardness of the surface oxide. The depth of the wear scar, however, will depend on the wear mechanism that is occurring. If the main mechanism is wear of a softer material by a harder material in abrasive wear then one would expect the softies material to wear to the greatest depth.

Titanium and titanium alloys are now widely used in dental implantology because of their excellent characteristics such as chemical inertia, mechanical resistance, low density absence of toxicity, and above all for their biocompatibility.

The complexity of the electrochemical processes involved in the implant-structure joint is linked to the phenomena of galvanic corrosion. [2]

As the assessment corrosion resistance is closely linked to the experiment conditions, We decided to establish a comparative assessment of the electrochemical measurements obtained using different techniques and different preparations to the study the galvanic couple in Ti /dental alloy.

The recorded potentials depend on:

- metallic material, alloy type, composition, solidification conditions, thermal treatment
- the surface of metallic piece
- the composition of the electrolyte.

Experimental data and discussion

The experimentally analyzed materials are:

- Experience 1- Ti-Al5-Fe2,5 and Gaudor –figure 1
- Experience 2 - Ti-Al5-Fe2,5 and Wisil (Co-Cr alloy, from Krupp Essen, Germany) –figure2
- Experience 3 - Ti-Al5-Fe2,5 and steel 10NiCr18 -figure3
- Experience 4 :- Ti-Al5-Fe2,5 and commercial pure titanium –figure 4
- Experience 5: - Ti-Al5-Fe2,5 and Gaudent –figure 5
- Experience 6: - Ti-Al5-Fe2,5 and commercial pure titanium with differential aeration–figure6.

In the sixth experience the sample made of commercial pure titanium was in an air flow produced by a variable fan system. In the following figures the curves tension-time for different dental materials are presented.

After the analysis of experimental curves it can be stated that the tension between different dental materials is the base of the appearance of a phenomena called "oral galvanism". These materials combined with the electrolyte act like an

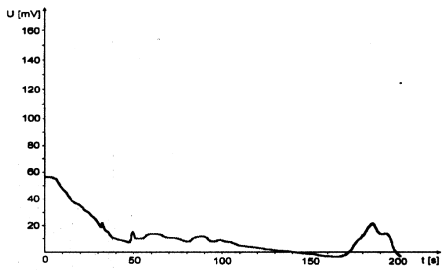

Figure 1

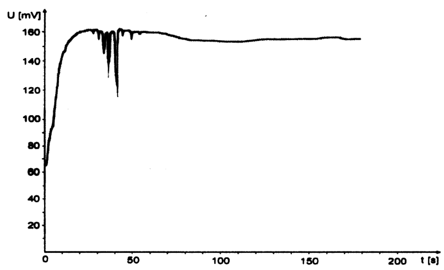

Figure 2

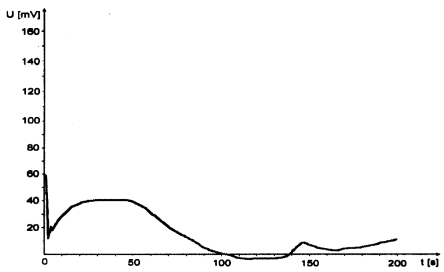

Figure 3

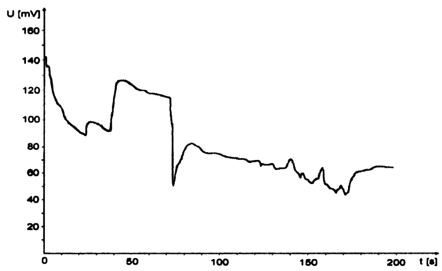

Figure 4

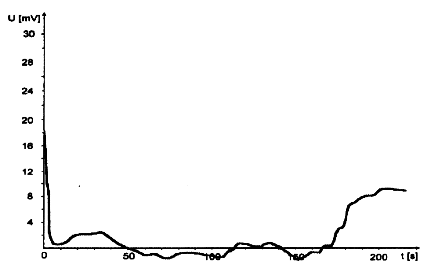

Figure 5

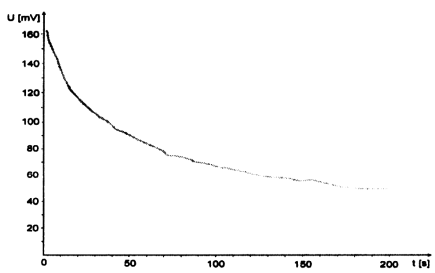

Figure 6

electric battery. The oral cavity offers an ideal medium for the development of electrochemical corrosion phenomena. The interaction between metal and spittle leads to electrical micro-currents which can determine different effects.

The theory is based on two hypotheses: (1) any electrochemical reaction can be divided into two or more oxidation or reduction reactions, and (2) there can be no net accumulation of electrical charges during an electrochemical reaction. When two different corroding alloys are coupled electrically in the same electrolyte, both alloys are polarized so that each corrodes at a new rate.[3]

In practice, the application of the mixed potential theory allows us to trace the Tafel lines for each alloy, and to sun the measurements of the anode and cathode lines of the couple under investigation. [4]

The study of surface oxidation on titanium was carried out in two stages. The first stage consisted of measuring the erosion speed of the layer of titanium oxide formed by anodisation at 5 V in sulfuric acid. The thickness of the oxidized layer was calculated at between 1,15 and 1,25 nm. In these experimental conditions, the speed at which the oxidized layer is formed is approximately 2,3 nm/V. [5]

The dental implants made of pure metals, such as titanium, aren't sensible to the appearance of galvanic cells.

Fom those above-mentioned, it can be stated that the oral galvanism is more emphasized in the case when two dental materials are used. the use of no more than one type of dental material is, therefore, recommended.

In the case of stainless steels, the passivity layer isn't as vigorous as in the case of pure titanium or co-cr titanium.

In the case of dental amalgam, although the phases are passive to a neutral pH, the trans-passive potential for gamma phase is easily surpassed, due to the interphazic galvanic cells which appear under the dental plate after the variable aeration. This is the reason for the amalgam is the most liable to corrosion material used in stomatology.

The big galvanic currents between metallic alloys can determine the corrosion and even the injury of the human tissue. The non-noble alloys used in dental operation are less galvanic active than the golden ones.

The permanent circulation of the spittle hampers the dynamic ionic equilibrium, the alloy losing a big amount of ions, according to the tension and the intensity of galvanic current between two metallic alloys.

CONCLUSION

The big galvanic currents between metallic alloys can determine the corrosion and even the injury of the human tissue. The non-noble alloys used in dental operation are less galvanic active than the golden ones.

The conclusion is: the patients with oral galvanism have the level of sensibility for the electrical stimulation of the taste lower than those without oral galvanism.

The results obtained presents the intensity of the corrosion process in the case of the Ti/dental alloys.

The anodic and cathodic parts had the same surface area where as in vivo, the surface area, where as in vivo, the surface areas can be considerably different, possibly modifying the intensity of the galvanic corrosion current.

The favorable suprastructure/implant couple is the one which is capable of resisting the most extreme conditions that could possibly be encountered in the mouth.

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