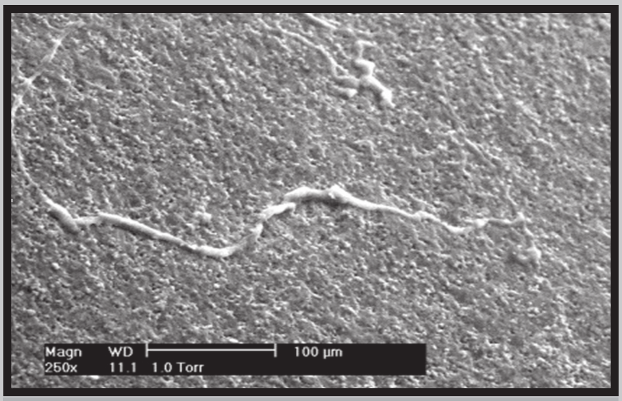

FIG.2. The view of the surface (250x)

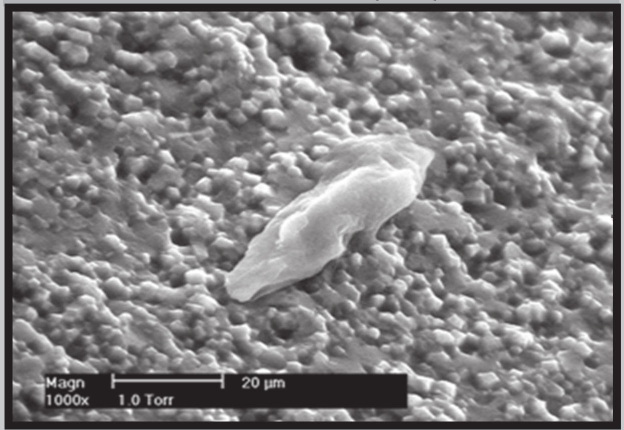

FIG.3. The view of the surface with biofilm (1000x)

Conclussions

The contemporary medicine takes interest in the materials, which have the most similar properties to natural substances. Therefore the material, which apart from bioactive properties has suitable porosity enables proper joining of tissue and implant, as well as it makes it possible to cover implants with drugs or maternal cells, which in turn allows concentration of antibiotic in the place of implantation, without affecting the whole body [7].

Biomaterials can have different impact on the body. In case of a person, who has underwent implantation, that impact may carry dangerous results for the patient`s body and the success of the implantation.

After six months` stay of the specimens in bacteria liquid the biofilm could be observed on the microporosity glass-ceramics surface.

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ELECTROCHEMICAL OXIDATIONAND CORROSION RESISTANCE OF THE Ti13Nb13Zr ALLOY

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Summary

This paper presents the results of oxidation andcorrosion tests carried out on titanium alloy Ti13Nb13Zr. The oxide film was prepared by electrochemical environment 2MH_3PO_4 for 30 min and 1h, at a constant voltage 40 V. The tests of corrosion resistance were performed by potentiostatic method in Ringer's solution at different pH values: 7, 5 and 3. The change in an appearance of surface and the increase in corrosion resistance even in an acidic environment is an evidence that the electrochemical treatment of theTi13Nb13Zr alloy results in formation of dense, compact and likely amorphous oxide layer.

***Keywords**: titanium alloys, electrochemical oxidation, corrosion resistance*

[Engineering of Biomaterials, 122-123, (2013), 4-5]

Introduction

Titanium alloys are a group of metallic biomaterials that due to the high biocompatibility, lack of mutagenic and carcinogenic effects, good corrosion resistance and high strength/density ratio, are widely use as load-bearing implants [1-3]. Almost 40 titanium alloys proposed so far to use as the load-bearing implants but only the Ti6Al4V, Ti6Al7Nb and Ti13Zr13Nb alloys have been certified and applied[1]. An important factor in the use of titanium alloys is their long term stability in the human body.It is estimated that the average life-time of implants is not over 15 yrs., and in order to extend this period, a number of new technologies, based on modification of chemical composition of an alloy, modification of the surface layer of a base metal or application of coatings possessing superior physical, chemical and biological properties have been investigated [3,4]. Among them, the formation of titanium oxide film is the most plausible as concerns the increase in corrosion resistance, and well developed by electrochemical oxidation [5-12], and chemical, gaseous and CVD method [3]. The aim of this work was to determine the effects of anodic oxidation of the Ti13Zr13Nb alloy on corrosion resistance of the Ti13Zr13Nb alloy in neutral and acidic environments, for which such research has not been extensive and some data are lacking.

Experimental methods

The study was conducted on a two-phase titanium alloy Ti13Nb13Zr which chemical compositions is shown in FIG.1.

The specimens of dimensions 15x10x2 mm were cut from the metal sheet. Then the specimens were polished with abrasive papers, No. 2500 as the last. After wards the specimens were cleaned in ultrasonic chamber filled in, subsequently, with acetone, isopropanol and distilled water. The oxidation was performed electrochemically in $2MH_3PO_4$ in an acidic environment. The process was carried out at 20°C, at a potential 40 V for 30 min. or 1h.

The resulting amorphous oxide layers were examined with the scanning electron microscope (JEOL JSM-7600F). The corrosion tests were carried out with potentiodynamic method in the Ringer`s solution at different pH - 7, 5 and 3, obtained by adding thehydrochloric acid into solution. The potential, the rate of change of the potential 10 mV/min.

Results and discussion

FIG.1 illustrates the results of electrochemical oxidation by the view of the surface. The formation ofan oxide layer on the test rate is relatively easy and confirmed even without XRD examinations by change in the colour, which may also inform about crystallinity and non-crystallinity of the alloy, and on thickness of the oxide layer.

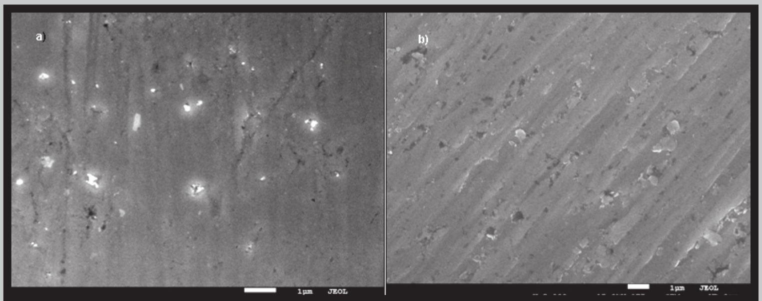

FIG.1. An image(SEM) of the surface of titanium alloy coated with the dense oxide film obtained by the electrochemical environment of $2MH_3PO_4$, 40 V, 20°C, the time of a) 30 min, b) 1h.

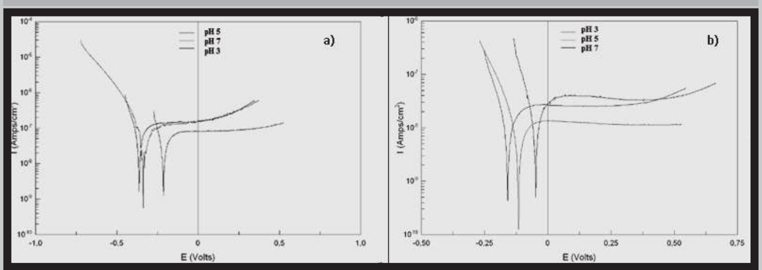

FIG.2. Studies polarization potentialsat 20°C Ringer's solution at pH 3, 5 and 7, the solid sample: a) non-oxidised, b) oxidised.

The results of corrosion tests are shown in FIG.2 are shown as a nukmber of potentiodynamic polarisation curves obtained at pH 3, 5 and 7; non-oxidised is given as a reference. The shift in polarisation curves, even at pH=3, and decrease in corrosion current are evident and prove that the electrochemical treatment has resulted in formation of more corrosion resistant oxide layers. Thus, such electrochemical behaviour may be used as a method of an increase in biocompatibility and long term stability of the Ti-based joint implants.

Conclusions

1. The electrochemical oxidation of the Ti13Zr13Nb in 2M phosphoric acid improves its corrosion resistance.
2. The improvement of corrosion resistance results very likely from an appearance of dense and compat oxide layer.

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