ELECTROCHEMICAL OXIDATION OF THE Ti6Al4V ALLOY IN SUCCINATE ELECTROLYTES

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The main consumers of titanium and titanium alloys are the aircraft industry, the rocket production, shipbuilding and chemical industries that use these material for the production of crucial items that combine an excellent specific strength, a low weight and a high corrosion resistance. Due to the availability of natural oxide film, titanium materials possess the properties of bioinertness and biocompatibility and cause no allergic reactions and are quickly overgrown with musculoskeletal tissue whose structure remains unchanged throughout the entire life of a patient in the future. Pure titanium is elastic and it has insufficient strength therefore the titanium alloy Ti6Al4V is widely used for the production of mechanically loaded implants. A drawback of titanium alloys is a decrease in the corrosion resistance with an increase in the amount of alloying elements. Natural oxide films have a shallow thickness (5 to 6 nm), therefore in order to impart functional properties to the surface of titanium materials ceramic, phosphate and oxide coatings are formed. Oxide films are formed on titanium using several methods, in particular the method of thermal oxidation and plasma oxidation, combined method of electrochemical and hydrothermal treatment, diffusion and also the method of electrochemical oxidation (anodizing) [1, 2]. The latter method of oxidation is the most widely spread, because it enables the formation of uniform films of a specified thickness and structure on the items of any configuration.

Electrochemical oxidation of the surface of titanium materials can occur either with the formation of the soluble products of anodic reaction or it can result in the formation of oxide layer. The oxide structure obtained in the second case is mainly defined by the interaction of electrolyte components with the obtained film. If the oxidation is carried out in the electrolyte of a weak etching action with regard to oxide it will result in the formation of the dense homogeneous TiO_2 layer of a barrier type. In this case, the oxidized surface will acquire the coloring resulting from the light interference at the "metal-air" interface and the film of a certain thickness will correspond to each color of it. From this standpoint, the investigation of the processes of electrochemical oxidation of the titanium alloy Ti6Al4V in the solution of such a weak electrolyte as succinic acid whose first stage dissociation constant is equal to $K_{a1} = 7{,}4 \cdot 10^{-5}$ is of great interest. Anode polarization of Ti6Al4V alloy in succinate electrolytes results in the formation of thin proportional to the current density in the range of j_a = 2–5 A·dm^{-2}. A maximum film thickness for the given conditions is defined by the cell voltage and it is independent of the electrolyte concentration and the electrolysis current density. The obtained data are explained by that the film growth occurs in the case of availability of an appropriate potential gradient that contributes to the migration of ions through the oxide lattice. An increase in the specified value of *U* results in the proportional increase of a maximum oxide thickness that defines the electrolysis length.

References

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