INVESTIGATIONS OF ELECTROCHEMICAL PROPERTIES OF TITANIUM AND TITANIUM COVERED BY NANOCRYSTALLINE DIAMOND COATINGS USED FOR BIOMEDICAL APPLICATIONS

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Carbon - in the form of nanocrystalline diamond coatings (NCD) on suitable materials, has attractive properties for medical applications. The specimens obtained earlier have been tested by means various physicochemical, biomedical and medical methods [1]. The corrosion behaviour of these materials has been investigated by means of traditional, general methods of corrosion investigations. Pitting corrosion, very important in real conditions, in the specific aqueous electrolytes have not been tested yet including the basic titanium materials as well as titanium covered by NCD layers.

Nanocrystalline diamond coatings, obtained by a method of RF dense plasma CVD, have a thickness of about 0.5 - 1 μm and are composed of 97% of diamond. They are created from crystallites of the order of 1 nm in size, so they are referred to as nanocrystalline diamond NCD [2]. The electrochemical properties *i.e.* current - potential and impedance characteristics determine the corrosion features as well as pitting corrosion. These characteristics, pits creation and breakdown potential investigations have been carried out *in situ* by means of cyclic voltammetry (CV), incorporated with STM-ECSTM and EIS apparatus and *ex situ* SEM-EDX methods for Ti and Ti/NCD working electrodes investigated in KCl, KBr, Tyrode's and/or Hank's aqueous solutions. The strong differences of electrochemical properties between these two types of electrode, especially of pitting corrosion parameters *i.e*. breakdown voltage, number and shape of pits obtained in basic KCl and KBr solutions have been observed. Some obtained results for Ti in 0.1 M KBr solution are presented in Fig. 1-3. The analogous pictures will illustrate Ti/NCD electrochemical behaviour when the protective layer of NCD increases the corrosion resistance of matrix material.

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References

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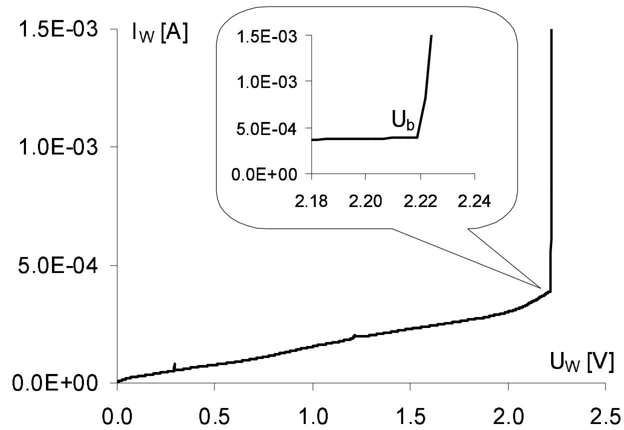

Fig.1. The breakdown potential of titanium in 0.1 M KBr aqueous solution; dU/dt = 20 mV s^{-1}

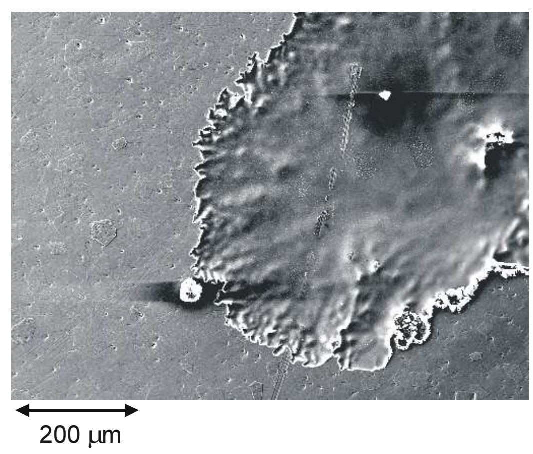

Fig. 2. The corrosion pit on the titanium surface (SEM) obtained in 0.1 M KBr solution

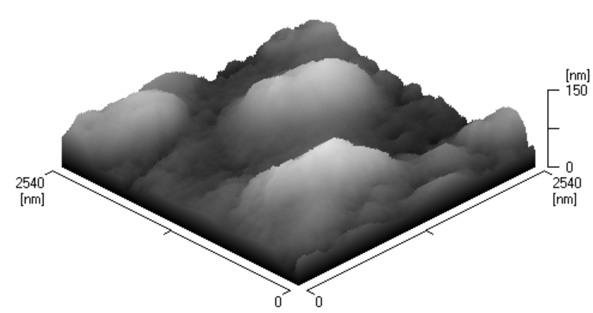

Fig. 3. Topography of the bottom of pit (STM in air); scanning tip Pt(90)Ir(10), E_T=1.3 V, I_T=1.0 nA