

## OBTAINING SAMPLES FOR TITANIUM ALLOY COATING BY PLASMA ELECTROLYTIC OXIDATION

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**Abstract:** In the PEO method electrical discharges create conditions for embedding solution components, electrolytic precipitation, including products of their thermolysis and high-temperature interactions into the layers formed on the basis of the treated metal oxide. Based on the peculiarities of the method, several approaches to forming oxide layers with zirconium compounds on valve metals have been proposed.

**Key words:** plasma electrolytic oxidation, titanium, eletrolite, sample, galvanostatic and pulse modes.

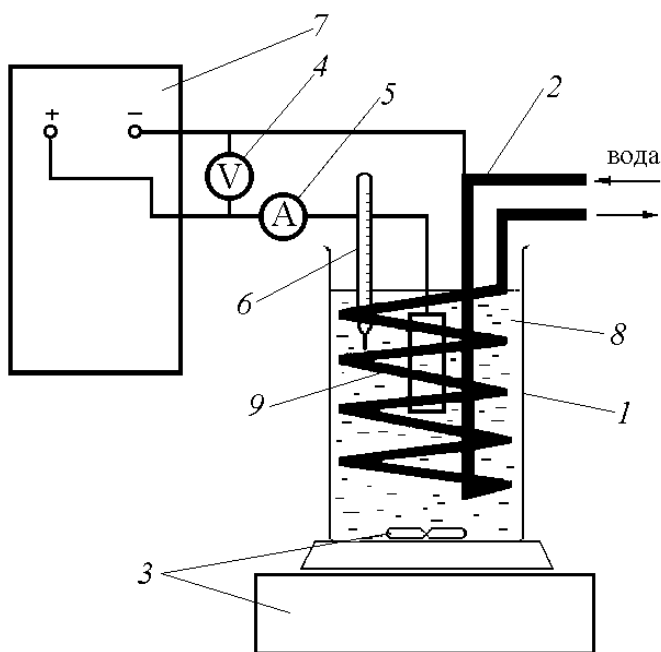
Oxide coatings were formed on samples from technically pure titanium of grade VT1-0 (Fe-0.25, C-0.07, Si-0.1, N-0.04, Ti-99.24-99.7, O-0.2, H- 0.1, others 0.3 wt%). We used flat specimens from sheet titanium (VT1-0) 20\*20 mm.

To determine the specific surface and conduct catalytic tests of the "coating metal" compositions, samples of titanium wire (BT1-0) of 1.2 mm cross-section, twisted into a spiral, were prepared. The working surface of such samples was 20 cm<sup>2</sup>. Before anodizing, flat samples were machined to round sharp corners and remove burrs. To remove the surface layer of metal and standardize the surface,

titanium samples were polished in a mixture of hydrofluoric and nitric acids  $\text{HF:HNO}_3=1:3$  at  $70^\circ\text{C}$ . The mixture of acids was placed in a plastic beaker, which was heated in a water bath. After polishing, all samples were washed first with running tap water, then with distilled water and dried in air.

**Preparation of electrolytes** Electrolytes for plasma electrolytic oxidation of samples were prepared based on distilled water and commercial reagents. Zirconium sulfate-based solutions consisting of  $0.1 \text{ mol/L Zr(SO}_4)_2$  were used. Using distilled water, two base electrolytes containing  $34.8 \text{ g/L Zr(SO}_4)_2 \cdot 4\text{H}_2\text{O}$  were prepared. Formation of anode-spark structures PEO layers on technical titanium were formed in the galvanostatic mode for 10 min at effective current densities of  $0.08\text{-}0.2 \text{ A/cm}^2$ . Zirconium sulfate solutions were used to obtain oxide coatings on titanium.

The electrochemical cell for anodizing (Fig. 1) consisted of a glass beaker with a volume of 1000 ml, a cathode made in the form of a coil of a hollow tube of nickel alloy, which simultaneously served as a refrigerator, and a magnetic stirrer. Voltmeter and ammeter were used to control voltage and current through the sample, and thermometer was used to control the temperature of electrolyte. Thyristor converter TER-100/460H-2-2UHL4 with a pulse form of current of positive polarity was used as a current source.



**Fig. 1. Scheme of installation for sample anodizing. 1 - beaker of heat-resistant glass, 2 - cathode, 3 - magnetic stirrer with a magnetic element, 4 - voltmeter, 5 - ammeter, 6 - thermometer, 7 - thyristor unit TER4-100/460N-2-2UHL4, 8 - electrolyte, 9 - sample to be treated.**

Oxide layers on the samples were formed in the galvanostatic and pulsed modes. In the galvanostatic mode the current density was  $I_a=0.08$  A/cm<sup>2</sup>. In the pulse mode the anode current density was also set equal to 0.08 A/cm<sup>2</sup>, and the cathode current was changed from  $\frac{1}{4}$  of the anode current to  $1.5-I_a$ . The treatment time was 10 min. During the spark oxidation, the electrolyte temperature did not exceed 26°C. After treatment, the coated samples were thoroughly washed with flowing, then distilled water and dried in the air at 20-70°C.

The value of the sparking voltage was estimated visually by the appearance of the first sparks on the anode surface or from the analysis of the curves (by the beginning of the deviation of the voltage-time relationship between the electrodes and the linear one). The amount of electricity passed through the electrochemical cell at the given moment of time was taken as  $Q^*$  (kl-l-1) for the electrolyte workup.

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