Zhirukhin Denis Aleksandrovich

Development of titanium surface activation processes and chemical deposition of nickel

Relevance of the research topic.

Titanium and its alloys are used as a structural material in various industries, which covers the totality of its mechanical and physico-chemical properties. Compared to steel, aluminium, copper and their alloys, titanium has greater corrosion protection due to the formation of a dense oxide film on the surface. Titanium has a high resistivity specific density ($\rho = 0.58$ Ohm·mm^2/m), which, as a result of detection, reveals the need for galvanic or chemical treatment of the skin with a higher electrical conductivity (copper, silver). The application of galvanic coatings makes it possible to widely use titanium products. The high propensity of titanium to passivation complicates the process of its pre-treatment of the surface to the appearance of the skin and leads to the need for a large number of intermediate operations to reliably ensure adhesion of the coating to the thickness.

It is known from the technical literature that usually the preparation of titanium and its alloys before detection is detected during activation (etching) with concentrated acid solutions, the propagation of modifications of oxide films on the surface of titanium.

Depending on the type of titanium alloy, a suitable surface option is selected. As a rule, mixtures of nitric, hydrochloric, hydrofluoric and sulfuric acids are used. The use of acidic solutions leads to etching of the surface and the formation of sludge, and the accumulation of the crystalline surface of titanium leads to a significant deterioration in its mechanical properties. Another way to prepare the surface is carburizing (contact coating of zinc and nickel) on pre-treated titanium, but because of the complexity, this type of preparation is required, which is greatly reduced.

Expected development of the topic.

The titanium surface treatment processes currently in use are not widespread adhesive-chemical coatings on rather nickel surfaces.

Therefore, the development of titanium surface treatment technology VT1-0 and widespread in the alloy industry OT4-1 before the subsequent chemical treatment of nickel-phosphorus surfaces with high adhesion becomes an urgent task.

This work was carried out within the framework of the scientific direction of the MUCTR of D. I. Mendeleev "New technologies and materials for surface treatment and damage protection".

Targets and goals.

The purpose of this work was to develop processes for activating the surface of titanium and noticeable nickel coatings that provide high adhesion of coatings.

To achieve this goal, the following tasks were solved:

1. Establishing the relationship between the elemental composition of a flammable film on titanium and the adhesion value of the chemical surface of the nickel coating.

2. Development of titanium surface activation activation before nickel plating allergy.

3. Development of a nickel-phosphorus coating chemical solution on titanium that provides high adhesion to the activated titanium surface.

4. Study of the physicomechanical and operational properties of the obtained nickel coatings and determination of the activation parameters of the titanium surface and the chemical substance of the nickel-phosphorus coating.

Scientific novelty.

1. A relationship has been established between the adhesion value of the nickel-phosphorus coating and the titanium base and the composition of the explosive titanium oxide film. It is shown that the formation of nonstoichiometric titanium oxides (TiOx, $x < 2$) on the surface is characterized by the best adhesion of the deposited nickel coating to the titanium base.

2. For the first time, the proposed modifications of the surface film based on titanium of the fine chemical origin of nickel were discovered at lower temperatures.

Theoretical and practical fixation.

A new composition of the solution is proposed, which will consider the process of surface activation of titanium VT1-0 and its alloy OT4-1 to solve the problem of applying galvanic or chemical surfaces with high adhesion. A solution for chemical nickel plating of titanium has been developed, providing high adhesion (patent № RU 2762733 C1). Research results initiated by manufacturing company “NPP SEM.M”, Moscow and limited liability company “Special Coatings”, Korolev.

Methodology and research methods.

The methodological basis of the dissertation is devoted to the analysis of modern scientific literature on the topic of work, as well as the laboratory of generally accepted experimental research and experimental data.

Possible provisions are identified for protection:

– experimental data on the influence of the components of the activating solution on the structure and elemental composition of a flammable film on titanium and the subsequent adhesion of chemical materials of nickel coatings;

– experimental data on the effect of the components of the activating composition on the process of chemical nickel plating, as well as the structure and properties of titanium-based beam nickel coatings.