

## MULTILAYER CORROSION-RESISTANT CERAMIC-METAL COATINGS (METAL/NITRIDE CERAMICS/ METAL/OXIDE CERAMICS) ON STAINLESS STEEL OBTAINED BY MAGNETRON SPUTTERING\*

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During long-term operation in aggressive conditions (sea water and mechanical stress) stainless steel products require additional protection. A corrosion-resistant coating with enhanced physical and mechanical characteristics provides such protection. The coating may have a different composition, and the methods of formation may be different.

In this work, multilayer cermet coatings (Metal/nitride ceramics/ Metal/oxide ceramics) with increased corrosion resistance were obtained. The metal layer is presented in the form of the nickel layer, which makes it possible to minimize the arising stresses at the substrate–coating interface. Nickel is easily passivated in air and under the action of strong oxidizing agents, which can lead to corrosion resistance, but only if the coating is absolutely continuous. Nitride ceramics layer is presented in the form of silicon aluminum nitride, which is characterized by high hardness and wear resistance. It does not interact with most inorganic acids, but penetration of solvent ions along the grain boundaries to the substrate is possible if the coating structure is inhomogeneous. The outer layer of oxide ceramics is silicon alumina, consisting of silicon oxides and aluminum oxides, which are characterized by high hardness and corrosion resistance. In our case, this layer seals all previous layers, preventing the penetration of solvent ions, in particular, oxygen ions and, especially, chlorine ions, through the intercrystalline space.

Coatings are formed in one cycle under a changing gas atmosphere (argon, nitrogen, oxygen) using magnetron sputtering in a UVN-05MD "KVANT" vacuum unit equipped with two magnetrons. The thickness of the metal layer is about 0.5  $\mu\text{m}$ , the nitride and oxide layers are about 2-2.5  $\mu\text{m}$ . The resulting coating is gray with a mirror sheen (Figure 1).

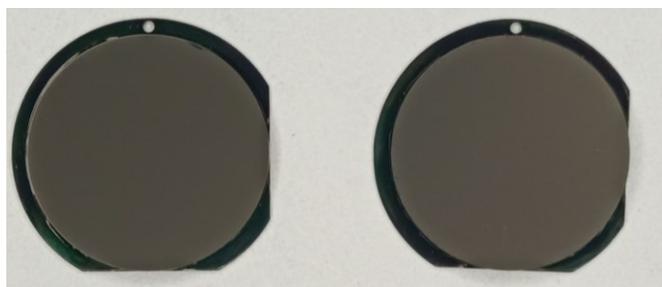


Fig.1. The photos of samples with multilayer metal-ceramic coating (Metal/nitride ceramics/ Metal/oxide ceramics) on stainless steel obtained by magnetron sputtering.

In the study of the cross section of the obtained coatings on a transmission microscope, it was revealed that metallic nickel has a fine-crystalline structure. The second layer has a nanocrystalline structure and contains the AlN phase. The outer layer is amorphous. During accelerated corrosion tests in a sea salt solution, the resulting coatings showed a decrease in the corrosion rate by several times. The corrosion rate was estimated using the Tafel equation.

Thus, the multilayer cermet coatings (Metal/nitride ceramics/ Metal/oxide ceramics) obtained by magnetron sputtering on stainless steel acquired the properties of each of the layers, and a synergistic effect appeared. In addition, the layering created several barriers to the diffusion of chloride ions from the environment. The thinness of these layers increased the elasticity of the final coated material.

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