RESEARCH OF ESA TECHNOLOGY FOR FORMATION OF Al_2O_3 FUNCTIONAL COATINGS ON MACHINE PARTS WORKING SURFACES

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There are considered the features of the structural and phase state of the aluminized coatings obtained by the method of electric spark alloying (ESA) on the specimens made of 20 steel and 40 steel grades. The ESA advantages are characterized by ecological safety of the process, high strength of bond between an alloyed layer and base material, the possibility of applying any conductive material onto the surface being processed, low energy consumption for processing procedures, and the simplicity of performing technological operations. The comparative analysis of the influence of the substrate on the qualitative parameters of the surface layer during the process of aluminizing by the ESA method showed that, when 20 steel having been replaced by 40 steel, there was increased the thickness of the white layer and the transition zone, namely, the depth of the strengthened zone, as well as its microhardness. For practical use, it is possible to recommend aluminizing by the ESA method under modes 4 and 5 (Wp = 4.6-6.8 J and productivity 2.0-3.0 cm^2 / min), which would ensure the formation of a white layer with the thickness of 70-130 μm, Hμ = 5000-7500 MPa, Ra = 6-9 μm and a continuity of 95-100%. In order to reduce the roughness of the surface layer and obtain continuous coatings, it is recommended to conduct the ESA process by the same electrode (aluminum), but with a lower discharge energy.

The comparative studies of the heat resistance of the aluminized coatings obtained by the classic technology (in aluminum melt) and the ESA method by an aluminum electrode showed that the electric spark coatings are characterized by high heat resistance. The metallographic analysis of the oxidation state of the specimens after the heat resistance test indicates that after the test the base metal is oxidized, as evidenced by the presence of oxides in the surface layer.

Aluminum coatings obtained in aluminum melt and with the use of the ESA method retain increased hardness, protect the base metal against oxidation, as evidenced by the results of the tests for heat resistance, as well as a lower content of oxides in the near-surface layer of the base metal and also the sufficient hardness of the coating. The results of the study make it possible to recommend the ESA technology with an aluminum electrode to increase the resistance of the steels to oxidation at elevated temperatures.