INFLUENCE OF RESIDUAL STRESSES OF ALLOY COATINGS OBTAINED WITH THE USE OF COMPLEX POWDER CHARGES ON THE CORROSION RESISTANCE OF STEELS

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Protective coatings, which are obtained by thermal self-ignition using complex powder charges, lead to changes in the phase and chemical composition of alloyed alloy coatings, which causes residual stresses. During the cooling of the reactor, as a result of the elastic interaction of alloyed alloy coatings and structural material, due to thermal effects, thermal expansion is observed. All this leads to the appearance of residual stresses on the surface. Tensile residual stresses in the surface are particularly harmful to metal products that operate under alternating loads. Such stresses contribute to the destruction of fatigue. Harmful effects of residual stresses affect the increase in the total chemical activity of the metal. The level of residual stresses increases with increasing difference in temperature conditions and thermophysical properties of the structural material and alloy coating. In order to influence the nature of the residual stress distribution, alloyed alloys were alloyed. The value of residual stresses in the alloy coating is also affected by the ratio of the volume of the coating and the core. It is established that compressive stresses occur on the surface of steel 45, which reach 170÷200 MPa during titanium doping, 210÷240 MPa during chromium doping, 90÷120 MPa during doping with silicon. As the process temperature increases, the residual compressive stresses decrease. Residual stresses largely determine the possibility of practical use of structural materials. The size, sign and nature of their distribution affect the strength of adhesion of the coating to the material.

Residual stresses arising in the surface of the part, lead to micro cracks, chips and destruction of the coating. Increasing the concentration of alloying elements in alloy coatings, leads to an increase in their level compared to known alloy coatings obtained under stationary conditions. The study shows that the process temperature affects the magnitude and nature of the distribution of residual stresses. As the temperature of the SHS process increases, the level of residual compressive stresses on the surface decreases. It is established that the residual compressive stresses within the coating on steel, associated with a gradient of volumetric changes at the boundary between the alloyed alloy coatings, which have the phases: $(Cr,Fe)_{23}C_6$, Fe_2Al_5, FeAl i Fe_3Al alloyed Ti, $TiAl_3$, Ti_3Al, TiAl, $(FeAl)_3Si$ and – α-solid solution of chromium, aluminum, silicon in iron.

Diffusion coatings obtained under conditions of thermal self-ignition of SHS-charges have significant advantages over other types of coatings, as their bond strength with the base metal, due to the penetration of alloying elements into the crystal lattice of the material, significantly exceeds the bond strength of other coatings.

References

1. Surface strengthening of working materials in the conditions of complex influence of aggressive substances: monograph / B.P. Sereda, L.P. Bannikov, S.V. Nesterenko, O.S. Gaidaenko and others. DDTU, 2019. 173 p.

2. Burkin S.P. Residual stresses in metal products: textbook / S.P. Burkin, G.V. Shimov, E.A. Andryukov. - Yekaterinburg: Publishing House of the Ural University. – 2015. – 248 c.