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COMPLEX MODIFICATION OF STAINLESS HIGH-ALLOY STEEL - STRUCTURE AND PROPERTIES *

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Modification of the steel 310 (Fe-0.2C-23Cr-18Ni) surface layer was carried out by the pulsed electron-beam treatment ("SOLO" setup) methods [1, 2]. It is shown that with an increase in the energy density of the electron beam, an increase in microhardness (from 1.7 GPa in the initial state to 2.4 GPa after irradiation at 30 J/cm^2) and wear parameter (from 1.9*10^{-4} mm^3/N*m at 10 J/cm^2 up to 5.2*10^{-4} mm^3/N*m at 30 J/cm^2) of the specimen's surface layer. The steel wear parameter before irradiation is 4.9*10^{-4} mm^3/N*m.

Nitriding was carried out ("QUINTA" setup) of steel 310 specimens previously irradiated with a pulsed electron beam in a low-pressure gas discharge plasma by two methods: by heating the samples with plasma ions (hereinafter, method 1) [3] and by heating the samples with plasma electrons (hereinafter, method 2) [4].

It is shown that during nitriding according to method 1, the maximum microhardness, 19 GPa (exceeds the hardness of steel before modification by 11.2 times and the hardness of steel after irradiation with an electron beam by 8 times), and the minimum wear parameter, k = 0.7 * 10^{-6} mm^3/N*m (more than 700 times less than the steel wear parameter before modification and more than 750 times less than the steel wear parameter after electron beam irradiation) are observed on specimens irradiated at an electron beam energy density of 30 J/cm^2, 200 μs , 3 imp. and subsequent nitriding at a temperature of 520^{0}C for 3 hours.

The thickness of the hardened layer is 40 μm. It has been established that the specimens that demonstrated the highest values of hardness and wear resistance have the maximum (90.6%) content of nitride phases (chromium and iron nitrides) in the surface layer.

The elion method of nitriding (method 2) leads to close (nitriding at 450^{0}C, 3 hours) or lower (nitriding at 520^{0}C, 3 hours and 600^{0}C, 5 hours) values of the steel surface layer microhardness, in relation to nitriding by the method one. During tribological tests, it was found that after nitriding at a temperature of 450^{0}C, 3 hours and 600^{0}C, 5 hours, the wear resistance of steel specimens modified according to method 1 is higher than the wear resistance of steel after nitriding according to method 2. Nitriding at a temperature of 520^{0}C, 3 hours leads to better results when using method 2, namely, the wear resistance of steel samples modified according to method 1 is lower than the wear resistance of steel after nitriding according to method 2 by 2.9 (E_S = 10 J/cm^2) and 1.2 times (E_S = 30 J/cm^2). It has been established that nitriding (method 2) at 450^{0}C and 520^{0}C temperatures for 3 hours of specimens previously irradiated with an electron beam (10 J/cm2, 200 μs, 3 pulses) is accompanied by the formation of a ceramic layer containing only iron and chromium nitrides. For the first time, during electron-ion-plasma nitriding (method 2), the phenomenon of blistering was discovered - the formation of bubbles on the surface of the material. It has been established, in the study of specimen's fracture surface previously irradiated with an electron beam and subjected to nitriding by two methods, that the destruction of steel surface layer nitriding according to method 1 proceeds mainly through a viscous mechanism; the destruction of the steel surface layer nitriding according to method 2 proceeds mainly by the quasi-brittle mechanism.

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