STRUCTURE AND MECHANICAL PROPERTIES NANOCRYSTAL ZrN COATINGS, OBTAINED BY METHOD OF VACUUM ARC EVAPORATION.

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Nanocrystal fields ZrN was synthesized by vacuum arc method using high frequency discharge on the surface of stainless steel grade AISI 430 at 150ºC. For study the phase composition, microstructure and nanohardness of coatings was used X-ray fluorescence analysis (XRF), transmission electron microscopy (TEM), as well as the nanohardnesstests method.. The developed technology provides low-temperature synthesis of coatings, reducing the formation of macro particles, and also allows coatings to settle ZrN with a hardness of 26.6-31.5 GPa. Established the formation of single-phase polycrystalline films ZrN cubic modification with a grain size of 20 nm.

The microhardness of the coating strongly depends on structural parameters such as crystallographic orientation, microstress, and crystallite size. One of the main characteristics of the material is the ratio of its hardness to the elastic modulus H/E, called plasticity index.The ratio H^3/E^{*2} (where $E^* = E/(l - \mu^2)$–the effective elastic modulus; μ–Poisson's ratio is also qualitative comparative characteristic of the plastic deformation resistance. To increase the plastic deformation resistance it is required to strive for the lowest possible elastic modulus at high hardness which, in particular, takes place at grain sizes of less than 10 nm. In general, the low module is good, because it allows to distribute load within a wide area.The effective elastic modulus E*, the shear modulus G, yield stress point σ_T and coefficient of resistance to plastic deformation H^3/E^{*2}were determined using model equations.The shear modulus and yield stress are defined as: $G = E / 2 \times (1+\mu)$ (1), $\sigma_T = H / 3$ (2).

The G, σ_T, H^3/E^{*2} parameters were measured only for average H and E values. According to nanohardnesstests ZrN coating has much higher elastic properties than initial stainless steel. The average value of nanohardness for stainless steel was 4.09 GPa, and it reached 29.39 GPa for the ZrN coated sample. The average value of elastic modulus for the ZrN was 320.81 GPa, whereas without the coating it comprised 201.151 GPa with a data spread of 9.54 %. With increase of the ratio *H*/*E* decreases plasticity of material and increasing of its relative hardness. The high hardness of the coatings can be associated with an improvement of homogeneity of ZrN coatings on the one hand and on the other the hardness growth can be related to the grinding of the grain structure (according to Hall-Petch rule) by ion bombardment upon application high-voltage RF pulses to the substrate during the deposition process.