Ni-W ELECTROLYTIC COATINGS

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Ni-W electroplated coatings were deposited at different current densities. It was ≈22%. The coating consists of crystals with a size of 200-300 nm, which are a solid solution of tungsten in nickel. The dependence of the current yield of the Ni-W alloy on the deposition current density was established. It was shown that the maximum coating deposition efficiency (56%) is characteristic of a deposition current density of 4A/dm$_2$.

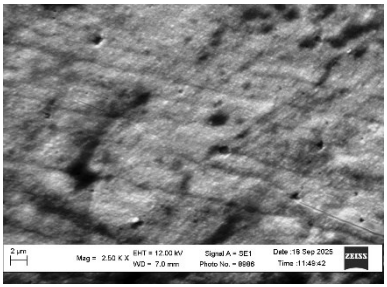
Keywords: electroplated coatings, deposition current density, tungsten, electrolyte

Introduction. Due to the high hardness and wear resistance of nickel-tungsten alloys, they are used as hard and wear-resistant coatings. In addition, the high corrosion resistance of these alloys has made it possible to use them as hard coatings with increased resistance to tribocorrosion [1]. Also, the Ni-W structure has high electrocatalytic properties and resistance to high-temperature oxidation. Therefore, the development of the technology for applying such coatings and the study of their properties are extremely relevant.

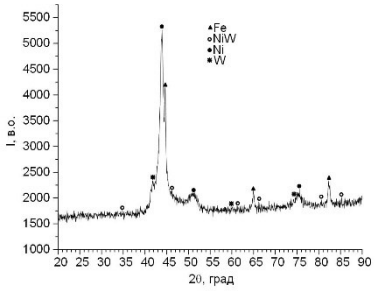
Methods. The coating was deposited on a steel substrate. The topography, microstructure and chemical composition of the steels were studied on a scanning electron microscope EVO 40XVP with a micro-X-ray spectral analysis system using an INCA ENERGY 350 energy-dispersive spectrometer. X-ray phase analysis was performed on a DRON-3.0 diffractometer. The crystal structure of all available phases was clarified by the full-profile Rietveld method using the FullProf program.

Results and discussion. The deposition of Ni-W coatings was carried out in electrolytes containing nickel sulfate 52 g/l $NiSO_4 \cdot 7H_2O$, potassium pyrophosphate $K_4P_2O_7 \cdot 3H_2O$ 230 g/l, sodium tungstate $Na_2WO_4 \cdot 2H_2O$ 60 g/l and $(NH_4)_2SO_4$ 20 g/l. The pH of the electrolytes was 9.0, the electrolyte temperature was 60±1°C. The deposition current density was varied within 1…..8 A/dm2.

When applying the coating, a layer is formed, which consists of crystallites with a size of 200-300 nm (Fig. 1 a). Such coatings are (Fig. 1 b) a solid solution of W-Ni with a tungsten structure (Im-3m), as evidenced by the lattice periods a=3.0786 Å, which are slightly smaller than the lattice period for pure W (a= 3.1648 Å). The saturation of the body-centered cubic lattice of tungsten with nickel occurs until the formation of a Ni-W compound with an orthorhombic structure (traces of the Ni-W phase are present in the diffractogram).



a



b

Element	Mass (%)	Atom. %
Ni	72,95	89,41
W	27,05	10,59
Разом	100.00	100.00

c

Fig. 1. Ni-W electroplated coating deposited at a current density of 4A/dm2 (a), its diffractogram (b) and chemical composition (c).

The regularities of the influence of current density on the concentration of tungsten in the coating and the current yield of the Ni-W alloy have been established (table). It is shown that with increasing deposition current density, the concentration of tungsten decreases and is maximum at 3A/dm^2. However, the current yield is low (26%) and increases in the range of current densities of 4-6 A/dm^2.

Table 1. Dependence of current output and tungsten concentration in the coating on the deposition current density.

D_k, А/дм^2	1	2	3	4	5	6	7	8
Current output, %	20	22	26	47	56	50	43	34
Tungsten concentration, %	35,2	37,3	38,5	27,4	22,1	22,8	23,2	23,9

Conclusions. The dependence of the current output of the Ni-W alloy on the deposition current density has been established. It has been shown that the maximum coating deposition efficiency (56%) is characteristic of a deposition current density of 4A/dm^2. It has been shown that the maximum coating deposition efficiency (56%) is characteristic of a deposition current density of 4A/dm^2. X-ray phase analysis has shown that the coating is a solid solution of tungsten in a nickel matrix.

1. *M.H. Allahyarzadeh, M. Aliofkhazraei, A.R. Rezvanian,V. Torabinejad, A.R. Sabour Rouhaghdam, Ni-W electrodeposited coatings: Char-acterization, properties and applications // Surface & Coatings Technology Surface and Coatings Technology . – 2016. – Volume 307, Part A, 15. – P. 978-1010* https://doi.org/10.1016/j.surfcoat.2016.09.052