Nanodiamond influence on a microstructure of galvanic nickel coatings

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Detonation synthesis nanodiamonds are common additives for metal-diamond galvanic coatings. Introduction of nanodiamonds in the electrolyte allows to obtain coatings with more fine-grained structure, which improves their quality. Surface modification of nanodiamonds with multivalent metal salts leads to additional increase of their application effectiveness in galvanic technologies.

Galvanic nickel coatings are widely used. Layers of galvanic nickel coatings to increase lifespan and improve the quality of stamping and pressing tools, parts of friction etc.

On photomicrographs (scanning electron microscope Hitachi TM-1000), we obtained samples of nickel coatings, coatings with nanodiamond and with modified nanodiamonds (modifier nickel chloride) was established reducing number-average radius of nickel coating grains from 0.83 to 0.74 micrometers with introduction of nanodiamonds, nanodiamonds surface modification leads to its reduction up to 0.66 micrometers.

On a powder diffractometer Bruker D8 Advance X-ray investigation of coating samples was carried out. Analysis of the diffraction patterns of all samples showed that intense reflection (200) is the most for the nickel coatings and coatings with nanodiamonds, reflection (111) for coatings with modified nanodiamonds. Experimental and literature data allows to suggest that as a result of the introduction of modified nanodiamonds in the coating is implemented high content of solid solution in the nickel matrix, as compared with unmodified nanodiamonds.

The lattice parameter, calculated by extrapolating of dependence of a from $\cos^2\theta/\sin\theta$ to $\theta = 90°$, was 0.35023, 0.35111 and 0.35136 nm, respectively, for nickel coatings, coatings with nanodiamonds and with the modified nanodiamonds. Calculated by the Debye-Scherrer for coherent scattering region also have the lowest value for the coating with the modified nanodiamonds (for (111) reflection is 14.5 ± 0.7 nm).

Coating with the modified nanodiamonds are also characterized by increase in microstrain lattice. Collection of X-ray structural analysis data about the effect of nanodiamond surface modification on the microstructure of obtained coatings allows to explain increase of nickel coatings microhardness with modified nanodiamonds.