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Ultra-Dispersiods as the Modificators from Some Compositional Coatings with Anti-Friction Properties

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Annotation *– The conditions, which must be met by modifying additives into electrolyte for receiving of the effective composite Ni-P coatings with anti-friction properties, and the possibility of choice of the effective modificators were discussed. The efficiently of the ultra-dispersion powders of oxides with the corunde and rutile structures, the carbon and boron nitride with diamond-like structures, and powders of the some W and Mg type structures was examined.*

Chemical modification of the composition and the surface friction of composite coatings (CC) is one of the most promising ways to protect products against corrosion and mechanical wear (1, 2). It is known that when receiving CC based on Ni-P coatings use various modifying additives, leading to the formation of coatings of the Ni-modifier-P systems (2). The role of a modifier is usually perform the ultra-fine solid materials of different nature, which should ensure the presence of the phases with anti-frictional properties and significantly improving the tribological surface characteristics. General requirements for the modifiers can be formulated as follows: the necessary character of the phase disordered state into CC, the simultaneous existence into modified layer the solid wear-resistance phases and phases with lubricating properties and the formation of protective layer on the modified surface with high adhesion to it (1).

As a result of possible chemical and physical-chemical processes of CC formation and during contact with the friction surface into CC and at its surface are form the next: 1) the dynamic equilibrium of the some coexisted phases which are characterized as a solid and lubricant components of the CC, and the phases which are ensured the adhesion of the CC to metallic basis of the protected friction knots; 2) a certain distribution of these phases into volume of the CC (uniform distribution onto surface and the distribution with a positive hardness gradient on thickness). In this case the synergy effect of the anti-friction properties of all components CC was showed (1, 3-6). Therefore the introduction of modifiers, satisfying these conditions, should lead to an improvement of the properties of CC surface compared with the analogical properties of Ni-P coating (without modifier) and decrease the corrosion and mechanical wear.

The quantitative criteria for selection ultra-fine materials that can be used as effective modifiers for receipt of anti-frictional composite Ni-P coatings were proposed (1, 7-9). As a modifying additives the possibility of using the simple oxides Al_2O_3, Cr_2O_3 (with corundum type structure) and TiO_2, ZrO_2 (with rutile type structure), as well as the powdered metals Ti, Zr (with hexagonal structure type Mg), the powder of Cr, Mo, W, V, Ta (with cubic structure type W), nano-diamond powder and ultra-fine BN were analyzed. To get of the effective composite Ni-P coatings except dispersed materials the solid lubricant materials, in particular the fluoroplastic, MoS_2 (IV) (hex.) and graphite were used.

For all disperse materials when friction the processes of the micro-particles de-units and their dispersion before the formation of nano-particles are intended. In particular, for coatings modified by nano-diamond expected the destruction of the carbon nano-particles units, the "graphite" of their surface membranes and the forming of the same "cores" as the fullerene-like nanostructures including small Fullerenes with diameter up to 0.7 nm (1).

For coatings modified with BN, the metal of the composition are oxidized by non-metallic components with the formation of ultra-fine phases of the corresponding compounds with the law containing of boron (2). For probable nano-particles C and BN with fullerene-like shells, in particular C_n (were n = 18, 20, 24, 30, 36, 45, 48, 54, 60), the possible equivalent symmetric and deformation modifications that are may be obtained from the continuous transformation of the original symmetric Fullerenes (10-15).

The anti-friction properties of composite coatings are designed in accordance with the synergic model (1, 2, 4-6). A comparative analysis of similar data for composite Ni-P coatings with modifiers MoS_2 (hexagonal) and C (graphite) were established their potential effectiveness as a nice modifiers to improve durability and firmness to wear. The calculated data are indirectly confirm, in particular, the results of appropriate tests of anti-frictional CC which were received by using nano-particles of BN, ultrafine powder of the Al_2O_3 and powder of nano-diamond.

The global principles of the possible structural states formation from nano-dimensional components, taking into account the properties of the multitude of corresponding nano-objects were formulated in (16). The spatial components of the all possible structural states of deterministic modular structures of composite materials with nano-dimensional component into 3D space, in particular (nnn), (rnn), (fnn), (rrn), (ffn) and (rfn) classes were described (17-24). The possible states of the distribution of the modular structure of crystalline, nano-dimension and fractal objects onto surface and into volume of anti-frictional composite coatings and options for the nature of their site and size-distributions were described (25-27).

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