Materials of Conferences

ANALYSIS OF SYNERGIC EFFECT IN COMPOSITIONAL NI-P-COATINGS

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The principal properties of the anti-frictional and firmness for wear of the compositional coats (CC), namely, the velocity of linear wear and the friction coefficient, may be presented in following forms: $I_{lin} = \alpha <I_{lin,sol}> + (1–\alpha) <I_{lin,lub}> + \Delta\alpha (<I_{lin,sol}> – <I_{lin,lub}>)$ and $f=\alpha<f_{sol}> + (1–\alpha)<f_{lub}> – \Delta\alpha(<f_{sol}>–<f_{lub}>)$.

In formulae the symbol $\alpha = \alpha_{sol}$ is denotes the volume share of solid CC component (in two-component approach), the value $\Delta\alpha = 4(1–\alpha)\alpha^2 (1–k(1 + k_n))$ is the relative synergic effect of the corresponding property, the parameter k is the dimensional factor, which determined the relationship between particle size of solid CC component r_{sol} and the "width" of the "concentration wave" $\Delta x<$ i.e. $k = [r_{тв}/(\Delta x + r_{тв})]$, where $0,5 \le k < 1$, and the symbol k_n is the nanostructural parameter, which denotes the volume share of the possible nanofragments with definite (spherical or cylindrical) form for solid CC component ($r_{тв} \cong \Delta x$ by $k \cong 0,5$; $0 \le k_н \le 1$, for example [1–3]).

The main calculation problem of those CC diagnostic properties is the definition of the volume share α and the mean value of I_{lin} and f for both solid and lubricant CC components. The basic causes of approximate information only about qualitative and quantitative phase CC composition under friction and wear are the accompanying processes: a processes of the chemical composition change which is limited by the formation of new possible phases, a processes of the pounding and formation of phase's micro-particles which make difficult the solution of experimental phase analysis problem, and the phases redistribution processes of the chemical system components which may be a cause of origin of the concentration's gradient of some phases.

Taking into account those causes the theoretical way of the phase problem decision is the only way of the dates receiving which may be the base for the possible forecasting of CC diagnostic properties. The technique of the CC receipt is defines the phase composition of cover. The chemical joint precipitation of Ni- and P-containing components from water solution about $t = 90\,°C$ and $pH = 5,0 \pm 0,5$ with the following thermal processing about $t = 360\,°C$ during one hour. The composition of this solution is following: $NiCl_2 6H_2O$ (30 g/liter), $NaH_2PO_2 H_2O$ (10 g/liter), $CH_3COONa H_2O$ (10 g/liter) and the polyvinyl alcohol (0,5 g/liter) as a stabilized addition. For receipt of the corresponding CC the BN (2 g/liter) or/and teflon suspension (T, 5 ml/liter) were added. After thermal processing of CC the Ni and Ni_3P phases of solid component and the BN or/and T phases of lubricant component were obtained. The $Ni_{12}P_5$, Ni_2P and NiB phases were discover into surface layers under dry friction condition and by specific loading 1 MPa (and by the friction velocity $V = 0,048$ m/s).

The possible chemical transformations as a probable cause of the $Ni_{12}P_5$, Ni_2P and NiB phases formation are the next:

(1)-$Ni_3B \rightarrow Ni_2B + Ni \rightarrow NiB + 2Ni$;

(2)-$5Ni_3P \rightarrow Ni_{12}P_5 + 3Ni \rightarrow 2Ni_5P_2 + Ni_2P + 3Ni \rightarrow 3Ni_2P + 4Ni$;

(3)-$6Ni_3P \rightarrow Ni_{12}P_5 + Ni_2P + 5Ni$;

(4)-$6Ni + 4BN \rightarrow 2Ni_3B + N_2 + 2BN \rightarrow 3Ni_2B + 1,5N_2 + BN \rightarrow 6NiB + 2N_2$.

It's necessary to note the transformations (1) are will be accompanied by partial extraction of the atoms Ni from positions of Ni_3B crystal structure (after that from positions of Ni_2B structure) and the deformational reconstruction of the Ni-nets and the P-layers (in Ni_3P structure) or P-layers only (in Ni_2P structure). The first chemical transformation in (2) and (3) may be the result of atoms phosphorus diffusion from domain with lowery concentrations of P under local temperature and pressure gradients influence.

Taking into account the solution's phase composition, the possible mechanism of the chemical joint of nickel and phosphorus-containing components from water solution, the possible capture's variants of micro-particles BN and T by these components under CC formation, and the possible chemical transformations processes were received the dates for determination of probable qualitatively and quantitatively phase composition of the solid and lubricant CC components and the corresponding values of α. The certain average values of the $<I_{lin}>$ under dry friction condition for the phases of solid CC component Ni and Ni_3P ($\cong 6$ μm/h), NiB ($\cong 4$ μm/h) and for the phases of lubricant CC component $Ni_{12}P_5$ and Ni_2P ($\cong 7,5$ μm/h), BN ($\cong 9,5$ μm/h) and T ($\cong 38$ μm/h) were evaluated.

The certain average values of <f> under dry friction condition for the phases of solid CC component Ni and Ni_3P ($\cong 0,30$), NiB ($\cong 0,31$) and for the phases of lubricant CC component $Ni_{12}P_5$ and Ni_2P ($\cong 0,04$), BN ($\cong 0,03$) and T ($\cong 0,05$). For corresponding values of $\Delta\alpha$ (by $k = 0,5$ and $k_n = 0$) the values $<I_{lin}>^{calc}$ and $<f>^{calc}$ were calculated. Obviously, that the obtained values are corresponds to experimental dates satisfactorily [4, 5].

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