USE OF ULTRADISPERSE MODIFIERS FOR PRODUCTION OF WEAR RESISTANT POWDER COATINGS AND MATERIALS

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One of the perspective ways to increase the wear resistance of powder coatings and materials is to use the ultra-dispersed powders from refractory metals, carbides, oxides, nitrides, etc. as modifiers. The result of such modification is the obtaining of a fine-grained, strong and homogeneous microstructure which provides high resistance to wear process at a sliding friction.

At the V.P.Larionov Institute of Physical and Technical Problems of the North, Siberian Branch of the Russian Academy of Science the wear resistant powder coatings and materials with ultra-dispersed modifying additives of spinels $CoAl_2O_4$, $CuAl_2O_4$, $MgAl_2O_4$ and silicon carbide SiC have been developed.

The coatings from powders of the system Ni-Cr-Si-B with the ultra-dispersed modifying additives of spinels $CoAl_2O_4$, $CuAl_2O_4$ (the average size of particles is ≈100 nanometers) have been obtained by a gas-flame dusting. They are intended for technology of hardening and recovery of the friction surface detail engineering. The metallographic analysis of coatings has shown that the introduction of ultra-dispersed additives influences the structure of fused coatings as follows: at introduction of 0,02% additives the structure practically doesn't change, however micro-hardness raises 20% in comparison with a coating without modifiers. The introduction from 0,02 to 0,1% of additives $CoAl_2O_4$ and $CuAl_2O_4$ leads to the structure dispersion and the micro-hardness increases 1,2-1,4 times. The increase in the content of modifiers from 0,05% to 0,2% leads to the increase of dispersion of strengthening phases, uniformity of their distribution, as well as the degree of super saturation of a solid solution on the basis of Ni. At the content of 0,2% ultra-dispersed additives the coating micro-hardness increases 1,3-1,4 times. A further increase of ultra-dispersed additives leads to emergence in the structure of nonmetallic inclusions located on the borders of sprayed particles in the amount to 6% for $CoAl_2O_4$ and to 4% $CuAl_2O_4$ at the content of ultra-dispersed additives 1%. In that case the dispersion of structure and micro hardness worsen.

It is established that improvement of structure and increase in hardness of coatings with initial increase in the content of ultra-dispersed additives in a material leads to the increase of coatings wear resistance. The coating with 1% of $CoAl_2O_4$ and 0,5% of $CuAl_2O_4$ (1,6 and 1,5 times higher in comparison with a coating from a pure powder, accordingly) has high wear resistance.

Ultra-dispersed powders spinel magnesium $MgAl_2O_4$ and silicon carbide SiC are used as modifiers of powder tungsten cobalt material of boring plates. The variation of percentage of modifiers in the composition of hard-alloyed material has been conducted: for ultra-dispersed powders of spinel $MgAl_2O_4$ - from 0,1% to 1,0%; silicon carbide - 0,1% and 0,2% according to the mass content. The complex analytical research of pre-production models of boring plates from hard-alloyed materials with ultra-dispersed modifying additives has been carried out. This allowed estimating the volume, properties of strengthening phases and features of a microstructure that define the wear resistance of a material.

The optimum combination of opposite properties - hardness and plasticity – is requisite for wear resistance maintenance of hard-alloyed materials of the boring plates working under conditions of complex dispatch-abrasive loadings. It is established that introduction of ultra-dispersed additives of magnesium spinel leads to micro hardness fluctuations, hence, to possibility of control of a microstructure hard-alloyed material of pre-

production models of boring plates in the range of the content of 0,1 % – 0,8 % mass.

It is established that with the increase of quantity of ultra-dispersed additives of magnesium spinel the hardness on Rockwell of a material for boring plates changes non-uniformly. The disorder of hardness in the range of 85-89 HRA is observed. With increasing concentration of ultra-dispersed additives of silicon carbide the hardness decrease on Rockwell is observed. The hardness of a material of the developed structure with 0,1% silicon carbide is higher than the hardness of an initial material; the hardness of a material of structure with 0,8% magnesium spinel is comparable to hardness of a material without modifying additives. With increasing of quantity of ultra-dispersed additives of magnesium spinel the standard deviation of hardness on Rockwell of a material for boring plates practically doesn't change. The disorder in the range of 2,5-3,5 HRA is observed. With increasing of silicon carbide content, there is a sharp increase of a standard deviation of hardness on Rockwell. The structure and properties of a material become heterogeneous on the volume of pre-production models of boring plates.

Thus, it is revealed that as a material of a working element of boring machines the developed powder hard-alloyed structure with ultra-dispersed silicon carbide of 0,1% content is the most perspective. Because the increase of hardness to 89 HRA is observed. Almost homogeneous microstructure with a value of a standard deviation of hardness ≈1,5 HRA is observed.