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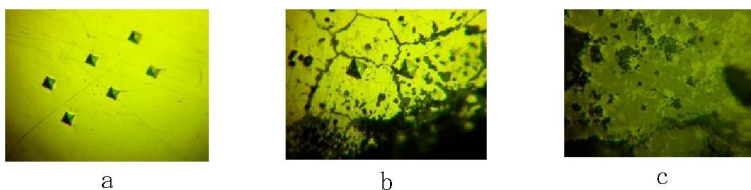
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THE EFFECT OF ALLOYING ON THE MICROHARDNESS OF SEALING COATINGS

Increasing the engine's efficiency is possible by improving the completeness of fuel combustion. For example, an increase in temperature by 50° C leads to an increase in efficiency by 12.5%.

One way to increase engine efficiency is to minimize air losses in the compressor and turbine. The minimum radial clearance is determined by the manufacturing technology, the radial movement of the rotor, and also depends on the heating of the stator and rotor components.

As a base material for the research, we chose a serialized KNA coating, which is currently used in aircraft engines manufactured by Motor Sich JSC. The following ligature compositions with different yttrium content were investigated: composition No. 1 - KNA -82 + NiY; composition No. 2 - KNA -82 + Y; composition No. 3 - KNA -82 + CoNiCrAlY, composition No. 4 - KNA, composition No. 5 - CNA-82. KNA-82 is a base - KNA coating, which is supplemented with VKNA powder, according to TU 48-5-226, charge composition: 15.0...19.0 % boron nitride, 1.5...2.0 % graphite, 1.0...3.0 % aluminum, 1.4. 2.5 % silicon, nickel base. The microhardness was determined, as stated in the methodology, by measuring the indenter print. Starting from the base material, transition zone and coating surface. Samples after exposure for 50 hours and 100 hours. Figure 1 shows examples of the microstructure of the indented samples.



a - base; b - transition zone; c – coating

Figure 1 – An example of the microstructure of sample from composition No. 2 after 50 hours of aging

A significant increase in microhardness after prolonged heat treatment in an oxidizing environment at 1100o C for 50 and 100 hours is explained by an increase in oxide and intermetallic phases in the structure (Figure 2-3).

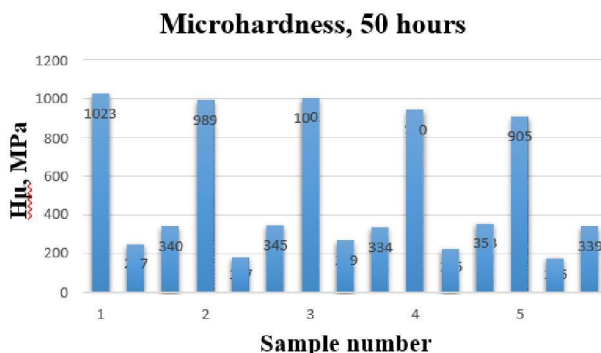


Figure 2 – Dependence of the microhardness of coatings on the content of ligatures at a temperature of 1100°C, holding time 50 hours

The higher hardness of the coatings additionally alloyed with different ligature compositions in the initial state after sputtering is due to, firstly, the enhancement of diffusion interaction during the formation of gas-thermal coatings, and secondly, the presence of oxides Al_2O_3 , Y_2O_3 and the preservation of intermetallics Ni_5Y , $NiAl$, Ni_3Al , Co_2Al_5 , $CoCr$ after sputtering.

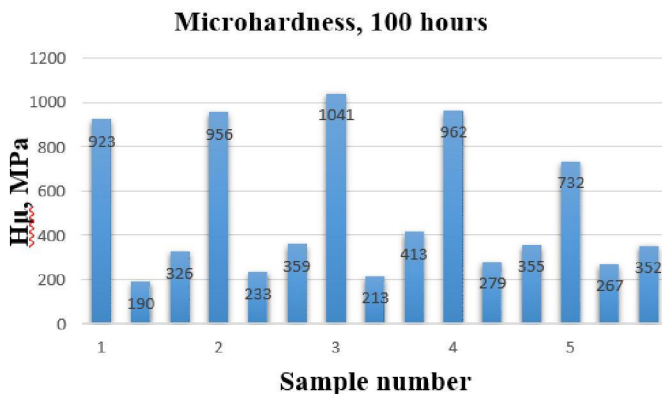


Figure 3 – Dependence of the microhardness of coatings on the content of ligatures at a temperature of 1100°C, holding time 100 hours

If we compare the compositions of the coatings, we can see from the histograms that coating No. 3 has the highest microhardness after 100 hours of exposure, which is the result of the formation of complex spinel oxide compounds (NiCr_2O_4 , CoAl_2O_4) and a significant number of intermetallic compounds of different nature (NiAl , Ni_3Al , Ni_5Y , Co_2Al_5 , CoCr_2). Thus, it was found that composition No. 3 corresponds to the best combination of microhardness indicators.