COATING IN THE NI-AL SYSTEM USING THE SHS METHOD

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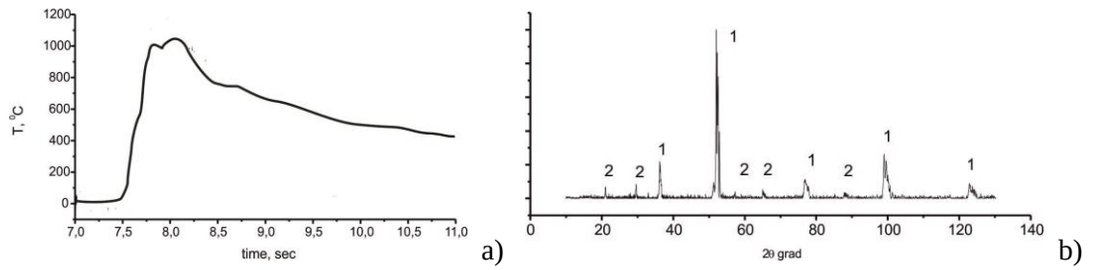
Intermetallides formed in the Ni-Al system have high heat resistance, heat resistance and electrical conductivity. Therefore, such materials are promising for use in high-temperature film electric heaters. SHS processes in the Ni-Al system have been studied in sufficient detail. However, such studies were carried out for samples pressed from powders in the form of a cylinder. For samples in the form of coatings, studies of processes in the combustion wave, the regularities of the change in velocity, and other parameters of the process have not been practically carried out. Therefore, such studies are relevant.

The aim of the work is to study the influence of the layer thickness and the degree of dilution of the initial mixture with an inert diluent on the temperature and speed of propagation of the combustion wave, the structure and electrical conductivity of the coating.

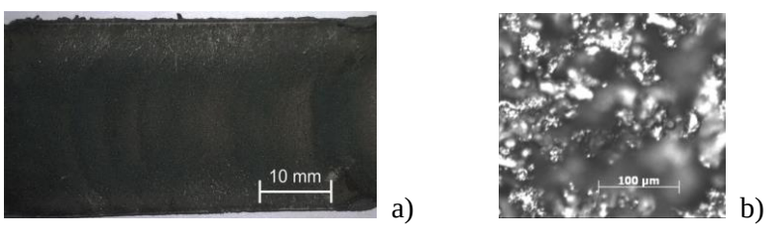
To prepare the coating, a mixture of nickel and aluminum powders in the form of a suspension in isopropyl alcohol was applied to a VK-1 ceramic plate through a stencil 0.3 to 2 mm thick, 20 mm wide, and air dried at room temperature. The THA thermocouples were fixed at a distance of 35 mm from each other. To register thermograms, thermocouples were connected to the ADC and a personal computer. The propagation velocity was determined by the delay of the signal from the two thermocouples. The structure of the coating was studied by X-ray phase analysis and optical microscopy.



a) b)

Fig. 1The thermogram of the SHS process a) and the diffraction pattern of the coating b). Phases: 1 – NiAl, 2 – Ni_3Al.

The process thermogram is shown in Fig. 1a. Studies have shown that the temperature in the combustion wave is significantly lower than for cylindrical samples of similar composition. This is explained by the large heat dissipation of flat samples. The propagation velocity of the wave (about 10 mm / s) is also considerably smaller than for cylindrical samples of the same composition. The dependence of the maximum temperature of the combustion wave and its propagation velocity on the coating thickness and the degree of dilution of the powder mixture with an inert substance is studied.



a) b)

Fig. 2 Appearance of the coating a) and its microstructure b).

X-ray phase analysis showed that the coating contains the NiAl and Ni_3Al phases (Fig. 1b). The predominant phase is NiAl. This indicates a significant underreaction in the combustion wave. Increasing the coating thickness increases the concentration of the target NiAl phase. The coating consists of small crystals fused together (Figure 2a). In addition, in Fig. 2b that the front is not flat. The electrical resistance of the coating is 2-5 Ω and decreases with increasing coating thickness.

Thus, in the course of the work, the influence of the coating thickness and the degree of dilution of the powder mixture with an inert substance on the maximum temperature of the combustion wave and its propagation velocity is shown. It is shown that the coating consists of small crystals of NiAl, Ni_3Al, fused together. The coating has good electrical conductivity and can be used as electric heaters. The obtained experimental data served to construct a mathematical model of the process.