SIALON-SIC-FE COMPOSITION SYNTHESIS BASED ON FERROSILICOALUMINUM, ALUMINUM OXIDE AND SHUNGITE IN COMBUSTION MODE

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The method of self-propagating high-temperature synthesis (SHS) is one of the promising methods for the production of nitrides and carbides. The work investigates the influence of the addition of shungite into the phase composition of the products of SHS combustion of mixtures of oxide and ferrosilicoaluminum in nitrogen in order to obtain a ceramic material - a catalyst carrier. Ferrosilicoaluminum grade FSA15 was used as the starting material; the oxide is exposed to alumina and shungite from the Zazhoginsky field. The synthesis was performed at a constant pressure setting according to the method [1].

The share of shungite in the charge varied in the range of 0 – 30%. Shungite is an inert additive because it is not subject to nitriding, contains 53–58% SiO_2 and about 30% carbon and can increase the depth of the reaction. As the experiments have shown, an increase in the proportion of shungite to more than 10 wt.% during nitriding of a mixture of FSA and aluminum oxide makes it possible to transfer the non-stationary combustion mode (in which ferrosilicoaluminum combustion occurs without the addition of shungite) into a stationary one, and the combustion product is a porous material homogeneous throughout the entire volume. It was not possible to organize the combustion process of a mixture of FSA and aluminum oxide when the charge was diluted by more than 30 wt.%. With an increase in the shungite additive, the propagation speed of the combustion wave decreases. Moreover, the amount of absorbed nitrogen decreases noticeably with increasing degree of charge dilution in the range of 10–30% (Fig. 1).

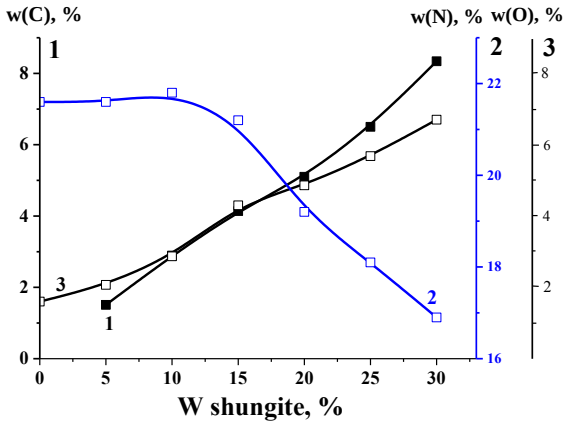

Figure 1. Dependence of the mass fraction (%) of carbon (1), nitrogen (2) and oxygen (3) in the combustion products of a mixture of ferrosilicoaluminum and aluminum oxide on the amount of shungite additive

We believe that diluting the charge with shungite leads to a double effect. On the one hand, an increase in the inert additive reduces the combustion temperature, as evidenced by process thermograms. The decrease in combustion temperature occurs due to the fact that during the nitriding process the total reaction mass increases, and the inert diluent does not contribute to the heat release. On the other hand, dilution affects the nature of nitrogen filtration in the charge. As the shungite addition increases, the sintering processes in the material slow down, which increases the gas permeability of the sample.

According to X-ray phase analysis data, when 15 wt.% shungite is introduced into the charge, the reflections of β-$Si_3Al_3O_3N_5$ significantly prevail over the reflections of β-Si_3N_4, and the combustion products practically do not contain the original reagents. An increase in the reflex of the synthesis product, the α-iron phase, indicates a deeper reaction. Further dilution of the charge with shungite leads to a significant decrease in the synthesis temperature and, as a result, to a decrease in the degree of nitriding. In this case, a significant amount of unreacted initial components (Fe_2Si) is observed in the combustion products.

REFERENCES

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