PLASMA MODULE FOR SYNTHESIS OF FUEL OXIDE COMPOUNDS

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There are many methods for obtaining powder materials, which can be divided into 4 large groups: chemical reactions in solution and gas phase; condensation in the gas phase; chemical reactions in solids; nucleation from solutions or melts (sol-gel). Each of them has its own technological features, and accordingly advantages or disadvantages.

When it comes to obtaining compounds for the fabrication of nuclear fuel, such factors as product purity, homogeneous phase distribution, and powder monodispersity come to the fore. All these advantages are provided with the use of plasmachemical technology [1]. It has been shown that oxide compounds obtained by this method belong to the nanosized class, which contributes to the homogenization of products, an increase in their density, which leads to a decrease in the compacting pressure and temperature of sintering of fuel pellets [2].

Figure 1 shows a photograph (a) and a scheme (b) of a plasma module based on a high-frequency torch (HFT) plasmatron.

Figure 2 shows a scheme of the plasma module reactor based on the HFT-plasmatron.

Air flow 1 is supplied to the reactor through an impeller with a variable swirl angle. Air plasma stream 2 is initiated along the axis of the reactor. Disperser 3 converts initial solutions into drops. Exhaust gases and products 4 are removed from the reactor.

Figure 3 shows the typical temperature distribution in the longitudinal section of the reactor during the synthesis of fuel oxide compounds.

In the process of calculations and experiments, it was determined that the optimal parameters for plasmachemical synthesis (at a generator power of 60 kW and a frequency of 13.56 MHz) are the following: temperature 1200 ± 100 °C, plasma-supporting gas – air, mass ratio of phases 65 % wt. air – 40 % wt. initial solution.

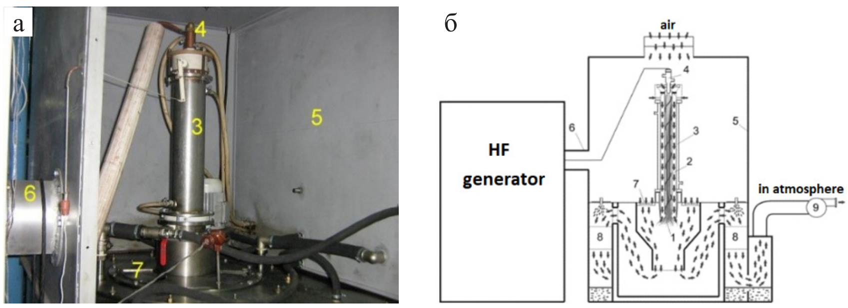

Fig. 1. *Plasma module based on the HFT-plasmatron*

1 – HFT-discharge, 2 – discharge chamber of quartz glass, 3 – plasmatron case, 4 – electrode, 5 – module protective case, 6 – HF-generator feeder, 7 – reactor with an impeller, 8 – unit for wet cleaning of exhaust gases, 9 – exhaust fan

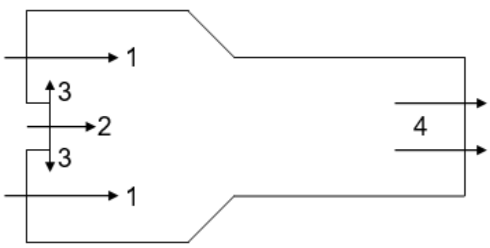

Fig. 2. *Scheme of the plasma module reactor based on the HFT-plasmatron*

1 – air flow, 2 – air plasma stream, 3 – solution disperser, 4 – exhaust gases

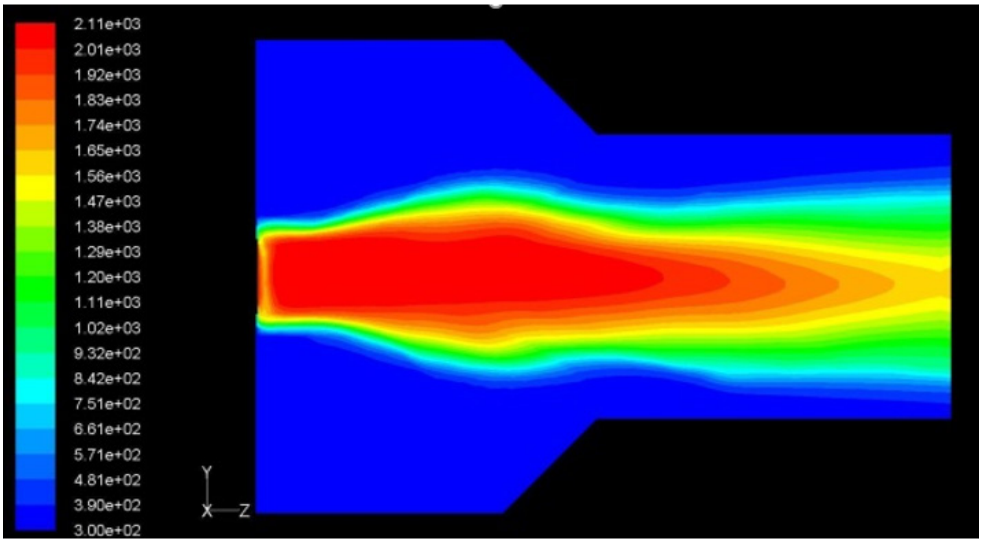

Fig. 3. *Typical temperature distribution in the longitudinal section of the reactor during the synthesis of fuel oxide compounds*

References

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STUDY OF THE EFFECT OF Nb ADDITION ON THE ACTIVITY OF SULFIDE CATALYSTS IN THE DIBENZOTHIOPHENE HYDROGENOLYSIS AND NAPHTHALENE HYDROGENATION

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Hydrotreating is one of the most important processes in the modern oil refinery. It makes it possible to remove sulfur compounds from oilfractions and improve their quality. But, hydrotreating technologies need optimization and the most logical way is thecatalysts improvement.

One way to improve the efficiency of hydrotreating catalysts is to introduce inorganic modifiers into their composition [1]. A wide variety of compounds have been proposed as modifying additives. The optimal content of these additives is usually determined empirically. The mechanism of action of modifiers is not clear and therefore research is needed for each specific additive. From this point of view, Nb-containing compounds are of practical interest, since, according to the latest results, their use in catalysis can be carried out both as an active component or modifier, and as a support [2].

The aim of the researchis to study the catalytic properties of Nb-modified Mo/Al_2O_3 sulfide catalysts in the dibenzothiophene hydrogenolysis and naphthalene hydrogenationreactions, as typical compounds in motor fuelpetroleum cuts.

A series of $Nb–Mo/Al_2O_3$ catalysts and a reference Mo/Al_2O_3 catalyst were prepared for testing. The content of metals in the samples Mo, MoNb-1, MoNb-2 is presented in Table 1.

The catalysts were synthesized by wetness impregnationusing a solution of phosphomolybdic acid and niobium oxalate, followed by drying at 120 °C. The activity of the samples in the hydrodesulfurization reaction (HDS) of dibenzothiophene (DBT) was determined on a laboratory flow unit. Testing conditions: temperature 320–340 °C, pressure 3,0 MPa, WHSV = 4,5–9 h^{-1}, H_2/feedstock – 600 nl/l. feedstock: mixture of DBT (0,86 % wt.) and naphthalene (3 % wt.) in toluene. The composition of the