Commercial fuel was chosen as the test sample at the first stage of the work, since its composition practically does not contain heteroatomic compounds after the hydrotreating process. In future work, it`s planned to conduct research and study the role of the addition of individual heteroatomic compounds to the test sample on the low-temperature properties and effectiveness of depressor additives.

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RESEARCH OF PLASMA-CHEMICAL SYNTHESIS OF NANOSTRUCTURED OXIDE FUEL COMPOSITIONS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS

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One of the promising directions for the development of nuclear hydrogen energy in Russia is the use of high-temperature gas-cooled reactors for the energy-efficient production of hydrogen in the process of methane steam reforming.

The used nuclear fuel (NF) in the form of ceramic uranium oxide fuel enriched with the uranium-235 isotope, along with its advantages, also has significant disadvantages: brittleness, low thermal conductivity and the risk of cracking, a short operating cycle (3–5 years), limited natural reserves of the uranium isotope-235, production of power-grade plutonium [1]. While the use of thorium-232 reduces the cost of isotopic enrichment [2].

The approximate content of thorium in the earth's crust is 3–5 times higher than the reserves of uranium, and the use of such nuclear fuel drastically reduces the production of power-grade plutonium, allows you to create ultra-small (up to 10 MW) and small (up to 100 MW) nuclear power plants for the production of hydrogen in remote and hard-to-reach regions.

However, this NF still has a flaw – low thermal conductivity. It is promising to use dispersive nuclear fuel (DNF) in the form of fuel oxide compositions (FOC), including oxides of fissile metals (uranium, thorium), uniformly distributed in an oxide matrix, which has a high thermal conductivity and a small neutron absorption cross section.

The common disadvantages of the technologies used for obtaining FOC (separate production and mechanical mixing, the “sol-gel” process, etc.) are the multistage nature, duration and high energy and labor costs [1, 2].

The use of gas-discharge plasma for plasma-chemical synthesis of FOC from dispersed aqueous-organic nitrate solutions (AONS), including an organic component (alcohols, ketones) and solutions of an aqueous nitrate solution, should be attributed to one-stage, uniform distribution and the required composition phases, low energy and labor costs [3].

The paper presents the results of theoretical studies of the process of plasma-chemical synthesis of FOC from dispersed solutions of AONS, including an organic component (ethanol, acetone), aqueous nitrate solutions of fissile (uranium, thorium) and matrix (magnesium, aluminum, yttrium) metals, as well as the results of experimental studies of the process on model solutions of AONS containing neodymium (instead of uranium) and cerium (instead of thorium).

The effect of temperature and mass fraction of air (oxidizer) on the process of synthesis of FOC is shown in Fig. 1.

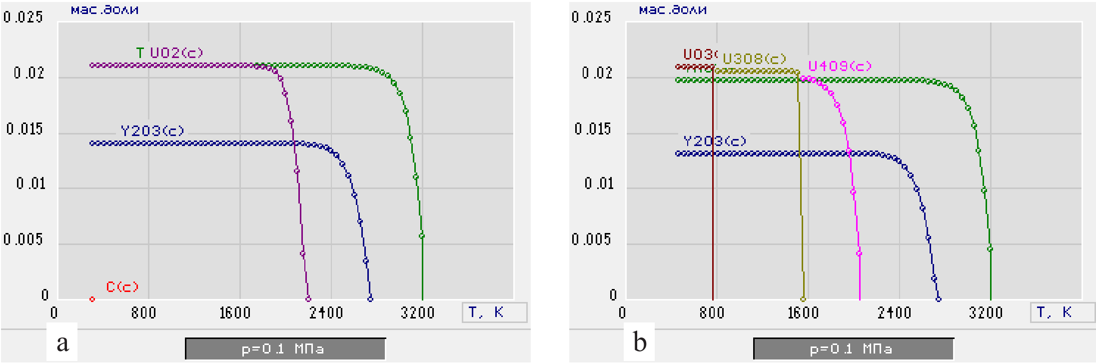

Fig. 1. *The influence of temperature on the equilibrium composition of the main products of plasma processing of the AONS solution based on acetone (α = 0.5) at a mass fraction of air of 68 % (a) and 70 % (b)*

It follows from the obtained data that the increase the mass fraction of the matrix material in the WOC leads to an increase in specific energy consumption. It is also shown that an increase in the mass fraction of air leads to the production of uranium oxide U_3O_8 instead of uranium dioxide.

It is most expedient to use a matrix based on magnesium oxide, due to the highest value of the thermal conductivity coefficient, melting temperature and other performance characteristics.

The results obtained can be used to create a technology for the plasma-chemical synthesis of FOC DNF for high-temperature gas-cooled reactors for hydrogen production.

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THE CONCENTRATION OF THE DEPRESSOR ADDITIVE FOR DIESEL FUELS AS A FACTOR OF ITS EFFECTIVENESS

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The pour point (PP) of diesel fuel (DF) is the temperature at which diesel fuel loses its mobility when a standard test tube is tilted by 45° for one minute. By adding depressant additives (Add) to diesel fuel, it is possible to achieve a decrease in PP.

The aim of the work is to identify trends of the Add concentration effects on the PP of the DF sample.

Blends of the straight-run DF and three different additives using concentrations of 0.5, 0.7, 1.0, 1.5, and 2.0 c.u. (where 1.0 c.u. is the manufacturer's suggested concentration) were prepared during the research. Further, following to the method presented in [1], the PP of straight-run DF samples and prepared blends was determined. The obtained results are presented in Table.

Table shows that with an increase in the concentration of Add No. 1 PP of blends decreases and reaches its minimum at a concentration of 1.5 c.u., further increase in the concentration of Add No. 1 is not advisable, PP remain stable. The temperature depression was 40 °C relative to the original sample and 1 °C relative to the sample with the concentration recommended by the manufacturer. In this case the concentration recommended by the manufacturer is optimal.