

INVESTIGATION OF PLASMA CHEMICAL PROCESS OF SYNTHESIS OF FUEL OXIDE COMPOSITIONS FROM WATER-ORGANIC NITRATE SOLUTIONS OF URANIUM, PLUTONIUM, AND MAGNESIUM

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Today, nuclear power plants produce a significant part of the world's power generation capacity. Trends in the development and expansion of this industry are enormous. Also, this industry is given considerable attention because of its environmental friendliness and reliability, which is why various ways are being considered to improve the performance of nuclear power plants in every possible way.

One way is the transition to a closed fuel cycle and, as a consequence, the creation of the necessary fuel, which would be suitable for this process. Such fuel, as of today, is REMIX fuel, which refers to dispersed nuclear fuel (DNF).

The use of REMIX fuel leads to uranium savings, since it is potentially possible to recycle plutonium without significant degradation. Thus, re-processing with some re-enrichment can provide multiple returns of fuel to the reactor, thus reducing reactor uranium consumption and the accumulation of spent nuclear fuel. Whereas conventional fuel degrades so much that it becomes completely unusable.

Plasma-chemical method of obtaining highly dispersed powders of oxide compositions can seriously compete with existing methods, as it has several advantages, such as: one-stage, compactness of technological equipment, high speed. The aim of

the work was to model and investigate the process of plasma-chemical synthesis of oxide compositions using the licensed program "TERRA" and to determine the optimum composition of WON solutions, providing their energy-efficient plasma processing.

This paper presents the results of theoretical studies of the process of plasma chemical synthesis of oxide compositions from WONS solutions, including an organic component (ethanol, acetone), aqueous nitrate solutions of fissile (uranium, plutonium) and matrix (magnesium).

Magnesium was chosen because of its low thermal neutron capture cross-section (0.06 barns), lack of interaction with uranium, relative ease of production and the strength of alloys [1].

The lowest calorific value of an aqueous organic nitrate solution was determined by the following equation [2].

$$Q_H^p = \frac{(100 - W - A)Q_H^c}{100} - \frac{2.5W}{100}, \quad (1)$$

A more objective indicator of the combustibility of an aqueous organic nitrate solution is the adiabatic combustion temperature, which was estimated using this formula:

$$T_{ад} = \frac{(100 - v_{ox})Q_H^p + v_{ox}c_{ox}t_{ox}}{100VC}, \quad (2)$$

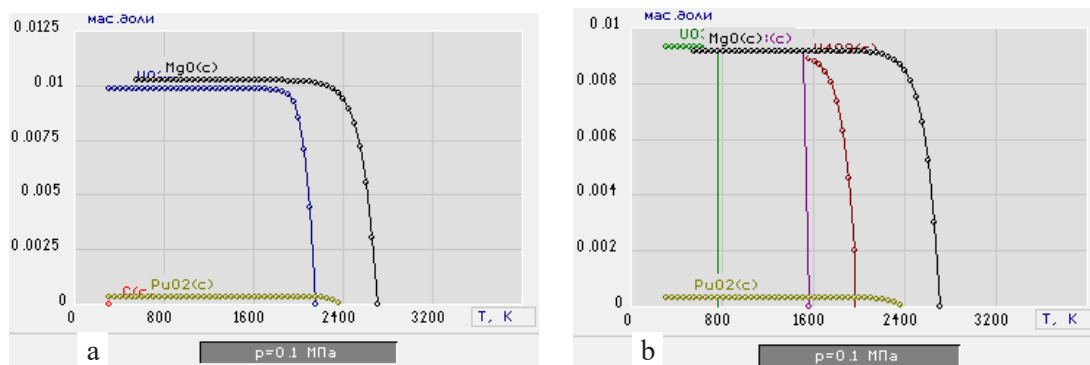


Fig. 1. The dependence of the composition of the main ethanol-based products on the temperature after plasma treatment with $\alpha = 0.033$ and a mass fraction of air 71 % (a) and 74 % (b). (MgO 50 %)

Water-organic nitrate solutions having a $T_{ad} \approx 1500$ K, ensure their energy-efficient plasma processing in an air-plasma stream [3].

The optimum calorific and temperature value is shown in fig 1.

It has been experimentally confirmed that acetone has a higher calorific value, but it was only

possible to achieve the necessary characteristics with the available compositions with ethanol.

The results of the calculations can be used to create technology and equipment for the plasma chemical synthesis of oxide compositions from water-organic nitrate and other solutions.

Reference

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DEEP EUTECTIC SOLVENTS AS THE BASIS OF AN OIL-DISPLACEMENT COMPOSITION FOR INCREASING OIL RECOVERY OF FORMATIONS

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At present, high-viscosity oils are considered as the main reserve of world oil production, which determines the relevance of fundamental research work on the formation of new approaches to solving the problems of extracting high-viscosity oils. The most common methods for increasing oil recovery of high-viscosity oil are thermal methods [1].

Recently, the literature reports on the use of DES as a "green" alternative to surfactants in conventional chemical methods for enhanced oil recovery. DES has a lower melting point compared to the melting points of individual components due to complexation and charge delocalization occurring through hydrogen bonds.

One of the DES components acts as an acceptor of hydrogen bonds, the other component of the DES is a hydrogen bond donor [2, 3].

More recently, the Institute of Petroleum Chemistry, Siberian Branch, Russian Academy of Sciences, has developed a new acidic chemical oil-displacing composition based on DES "boric acid – urea – glycerol", which has a high oil-displacing ability and environmental safety [1].

The paper presents the results of a study of the binary systems of DES "boric acid – urea", "boric acid – glycerol" and "glycerol – urea" and the ternary

system "glycerol – urea – boric acid" underlying the oil-displacing composition.

To study the phase equilibrium of binary DES systems, mixtures of components were prepared in a molar ratio of 1:10–10:1, followed by heating and determining the melting or crystallization temperature. The established dependences of the melting and crystallization temperature of binary systems "boric acid – urea", "boric acid – glycerol" and "glycerol – urea" on the molar ratio of their components made it possible to construct phase diagrams and determine eutectic points characterized by a lower crystallization temperature than individual components (table 1).

Based on the phase diagrams of binary systems of DES, a phase diagram of the ternary system "glycerol – urea – boric acid" was constructed, in which a eutectic point was found, characterized by a significantly lower crystallization temperature than the eutectic points in binary systems, and is minus 36.8 °C.

Figure 1 shows a diagram of the donor-acceptor interaction of the three-component system "glycerol – urea – boric acid".

Thus, on the basis of double and ternary DES systems, an oil-displacing composition was pre-