OBTAINING OF COMPOUNDS FOR DISPERSION NUCLEAR FUEL OF PLUTONIUM-THORIUM IN PLASMA

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The use of ^{239}Pu and ^{232}Th does not require expensive isotopic enrichment and makes it possible to create power plants up to 100 MW for use in remote and hard-to-reach regions. Therefore, it is promising to create a dispersion nuclear fuel in the form of fuel oxide compounds (OC), including oxides of fissile metals (Pu, Th) distributed in a matrix with high thermal conductivity and low neutron absorption [1].

For energy-efficient production of OC, plasmachemical synthesis from water-organic nitrate solutions (WONS) with a lower calorific value of at least 8.4 MJ/kg can be used [2].

Experimental studies of synthesis of fuel OC in air-plasma flow were carried out through the plasma installation based on a high-frequency generator with the use of model WONS including an organic component (acetone) and mixed water nitrate solutions of Mg, and also Sm and Ce, which have similar properties to fissile metals (Pu and Th), and simulate the plasmachemical synthesis of OC PuO_2–ThO_2–MgO.

The prepared WONS were fed at a constant flow rate (300 l/h) into the disperser and then dispersed into the reactor, where the synthesis of model OC was carried out in air-plasma flow at a temperature about 1000 °C. As a result of the study, the regularities of the influence of WONS composition, the modes of their dispersion, as well as the quenching rate on the properties of OC were established.

An increase in the mass fraction of the matrix (MgO) from 10 % to 30 % in the OC Sm_2O_3–Ce_2O_3–MgO leads to reduce the size of the OC agglomerated particles from 9.4 μm to 7.4 μm (laser diffraction method). In this case, the specific surface area of OC increases from 7.9 m^2/g to 11.2 m^2/g, and the size of grains in the composition of OC decreases from 110 nm to 86 nm (BET analysis).

Thus, the compositions of the model WONS and the modes of their plasma processing have been determined, which ensure the synthesis of nanosized complex OC in air-plasma flow.

The research results can be used to create a technology for the plasmachemical synthesis of nanosized fuel OC for plutonium-thorium dispersion nuclear fuel.

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