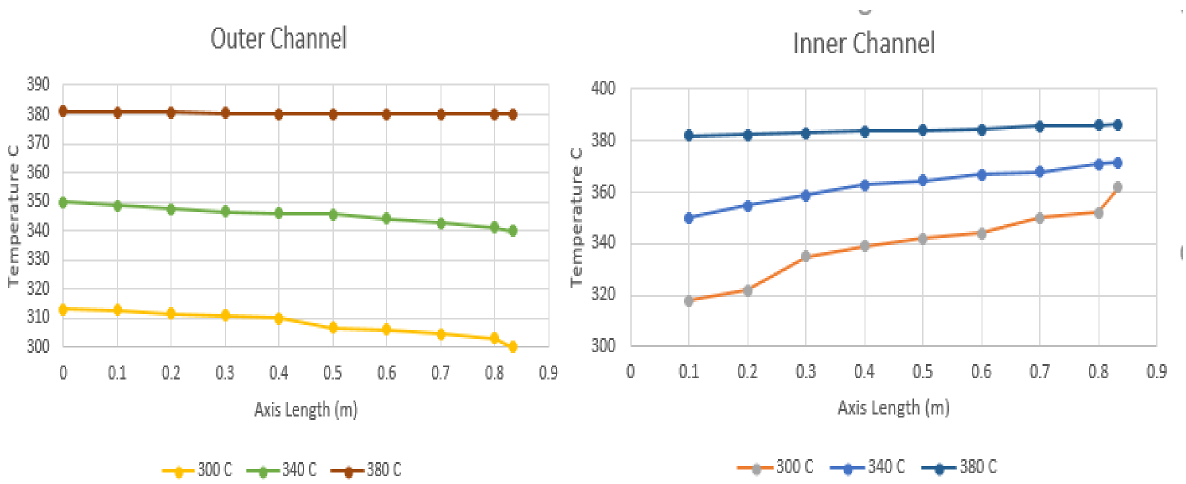


Fig. 1. Dependence of the coolant temperature at 300°C, 340°C , 380°C on the channel length

The results obtained from CFD simulation comes in close agreement with the experimental data as shown in Fig 1. Temperature is plotted along the radial length for inner and outer channels. The graph obtained is compared with the experimental results. All three turbulence models give results in acceptable range closer to the experimental data (5-10) %. The results were obtained for three inlet temperature of 300 °C, 340°C and 380 °C for 25 MPa pressure.

REFERENCE

1. H.Y. Gua, Z.X. HuD. Liua; X. Cheng, Experimental studies on heat transfer to supercritical water in 2 × 2 rod bundle with two channels //Nuclear Engineering and Design Volume 291, September 2015, Pages 212-223

PLASMA UNIT FOR SYNTHESIS OF OXIDE COMPOUNDS FOR NUCLEAR FUEL

A.E. Tikhonov, I.Yu. Novoselov

National Research Tomsk Polytechnic University,

Russia, Tomsk, Lenin Ave., 30, 634050

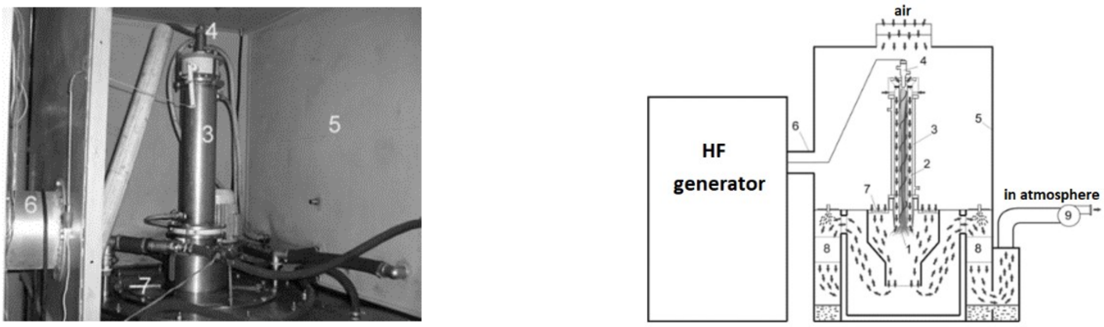
E-mail: aet13@tpu.ru

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.

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.



a) b)

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

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

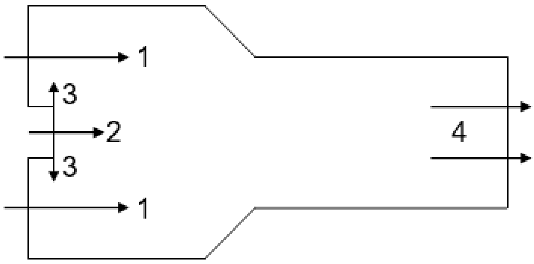


Fig. 2. Scheme of the plasma module reactor based on the HFT-plasmatron: 1 – air flow, 2 – air plasma stream, 3 – solution disperser, 4 – exhaust gases

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.

REFERENCES

1. Boyko V.I., Vergun A.P., Dolmatov O.Yu., Dyadik V.F., Petlin I.V. // Atomic Energy. – 2021. – Vol. 131. – Iss. 1. – P. 3–7 [in Russ.].

2. Novoselov I.Yu, Tikhonov A.E. Plasmachemical synthesis of oxide compositions for nuclear fuel of uranium-thorium cycle // Polzunov's Bulletin. – 2020. – Vol. 1. – P. 100–104 [in Russ.].

RADIATION SAFETY AND METHODS FOR ENSURING IT

I.Godwin, N. Ninyio, E.Yeboah

National Research Tomsk Polytechnic University,

Russia, Tomsk, Lenin ave., 30, 634050

E-mail: godwin@tpu.ru

Radiation is the release or transmission of energy in the form of waves or as moving subatomic particles. These particles are high-energy particles that cause ionization. Ionizing radiation is when an atom loses or gains an electron, while non-ionizing radiation is the bounce off or the passing of rays through matter without displacing the atoms. The major types of ionizing radiation are alpha rays, beta rays, gamma rays, and x rays. Non-ionizing radiation sources include ultraviolet rays, visible light, infrared rays, and microwaves. Radiation sources are normally natural or artificial. Natural radiation sources are cosmic, terrestrial, and internal radiation. Sources from medical, industry, and consumer activities are elements of artificial radiation [1]. Radiation safety refers to safety issues related to radiation hazards arising from the handling of