DOI: 10.34854/ICPAF.51.2024.1.1.009

MICRODISENSION MATERIALS SYNTHESIS IN CHAIN REACTIONS IN PROCESSES INITIATED BY THE MICROWAVE RADIATION OF A POWERFUL GYROTRON IN A MIXTURE OF METAL AND DIELECTRIC POWDERS: SYNTHESIS, STRUCTURE AND CYTOTOXICITY *)

Skvortsova N.N.

Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia; mukudori@mail.ru

A plasmachemical stand based on gyrotrons the MIG-3 gyrotron complex of the L-2M stellarator was developed at Prokhorov General Physics Institute of the Russian Academy of Sciences [1]. At this stand, it was shown that, under certain conditions, powerful pulses of microwave radiation produced by the gyrotron can initiate chain reactions in mixtures of metallic and dielectric powders in the reactor of this facility, which initiate the synthesis of micro- and nano-particles with controlled physical and chemical characteristics [2]. The resulting structures have reproducible characteristics that are promising for numerous applications, from the creation of new types of heterogeneous catalysts and luminescent materials to biomedical materials [3, 4].

The report presents the developed methodology for analyzing the obtained fine-grained materials for cytotoxicity. This technique was used for the first time to study a series of samples of particles with a developed surface obtained in mixtures of Ti/B, Ti/BN (cub/hex) powders [5]. The study of the obtained samples for cytotoxicity against human cells (lines HEK293T, MCF7, A549, VA13) showed toxic effects only at concentrations of tens of mg/L and the absence of detectable toxic effects in the bacterial system (E. coli). The obtained technique was applied to the analysis of micro- and nanomaterials synthesized in different mixtures of metal powders and dielectrics (Pt/Al_2O_3, Ag/Al_2O_3, etc.). Low toxicity at the cellular level indicates the potential for safe use of the proposed microstructures, yet further safety testing at the body level is required for their possible further application.

This work was supported by the Ministry of Science and Higher Education of the Russian Federation (State Assignment GZ BV10-2024) "Study of innovative synthesis of micro- and nanoparticles with controlled composition and structure based on microwave discharge in gyrotron radiation".

References

[1]. Batanov G.M., Borzosekov V.D., Golberg D. et al. // J. Nanophoton. 2016, V. 10 (1), 012520.
[2]. Skvortsova N.N., Shishilov O.N., Akhmadullina N.S. et al. // Ceramics International. 2021, V. 47 (3), p. 3978. https://doi.org/10.1016/j.ceramint.2020.09.262
[3]. Batanov G.M., Borzosekov V.D., Konchekov E.M. et al. // RF Patent No. 2523471. A method for producing nanodisperse powders of boron nitride and titanium diboride. Registered in the State Register of the Russian Federation on May 26, 2014.
[4]. Gusein-zade N.G., Skvortsova N.N., Stepakhin V.D. et al. // RF Patent No. 2772704. A method for applying metal nanoparticles to the surface of ceramic carriers using a microwave discharge. Registered in the State Register of the Russian Federation on May 24, 2022.
[5]. Skvortsova N.N., Obraztsova E.A., Stepakhin V.D., et al. // Fusion Science and Technology. 2023. https://doi.org/10.1080/15361055.2023.2255442

*) abstracts of this report in Russian