PARAMETERS OF THE scattering OF PARTICLES IN THE PLASMA-CHEMICAL SYNTHESIS OF MATERIALS IN GR-1 REACTOR [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2022.49.1.161

Zakletskii Z.A., Malakhov D.V., Petrov A.E., Skvortsova N.N.

Prokhorov General Physics Intstitute of the Russian Academy of Sciences, [malakhov@fpl.gpi.ru](mailto:malakhov@fpl.gpi.ru)

As part of a series of studies on the synthesis of materials with a controlled composition and structure based on a microwave discharge in gyrotron radiation, an algorithm for estimating the characteristics of reaction particles is proposed. The previously developed synthesis technique [1] assumes the use of a mixture of metal particles and dielectrics as starting materials. To register the parameters of particle expansion, high-speed cameras are used (Fastec Imaging IN250M512, 640x478, monochrome, 8bit, 250fps, 200µs; Contrastech MARS640-815UC 640x480, color, 10bit, 1000fps, 5µs) and various light sources. Calibration of the actual sizes of objects in the images is carried out using calibration slides (USAF 1951 target and similar), taking into account the telecentricity of the lenses. The object of observation is a mixture of luminous gas formations and particles moving from the bottom up, which was shown in early works [2]. Of interest is the assessment of the characteristic dimensions of the formations and the velocities of their movement. The existing diagnostics makes it possible to obtain a projection of particles in one plane. The speed of particle movement is determined by the displacement of the luminous points in the frame along the intended trajectory and ranges from 1 to 45 m/s for different modes of operation of the reactor (Fig. 1a). An important characteristic of ongoing processes is also the size of particles and luminous areas. It was shown that in the course of experiments, some reaction particles at the initial moment of time are surrounded by a luminous halo with characteristic sizes up to 1...2 mm (Fig. 1b). These formations move together with the nucleus and disintegrate in 1 to 20 ms. At the same time, luminous particles move along complex trajectories and glow for a long time. Depending on the reaction mixture, the afterglow time of the nuclei is up to 0.5 sec. The expansion parameters of reaction mixtures are the basis for the creation of a theoretical model. The work was carried out within the framework of the state assignment GZ BV10–2021 "Study of the innovative synthesis of micro- and nanoparticles with a controlled composition and structure based on a microwave discharge in gyrotron radiation".

skv2.tif

Fig.1. a - An example of an integrated image obtained after averaging data from a high-speed camera. b - Photo of the combustion process of the reaction mixture, where positions 1 and 2 are particles with a halo in the form of luminous gas bubbles, and 3 are single particles without an environment.

References

1. G.M. Batanov, I.A. Kossyi. Plasma Physics Reports, 2015, V. 41, N. 10, pp. 847–857.
2. A.S. Sokolov, D.V. Malakhov, N.N. Skvortsova. Engineering Physics, 2018, V.11, pp 3-7.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Pt/ru/HJ-Malakhov.docx) [↑](#footnote-ref-1)