MACROSCOPIC CHARACTERISTICS OF MICROWAVE SUBTHRESHOLD DISCHARGE IN ATMOSPHERIC PRESSURE GASES [[1]](#footnote-1)\*)

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Gas discharges of various forms and types have long been the object of applied research to create new plasma-chemical technologies. One of these technological directions is associated with the effect of the discharge plasma on gases of atmospheric pressure: the conversion of various gases into economically more valuable ones or the destruction of environmentally harmful gases. The GPI RAS (Moscow) investigates the possibility of using a subthreshold microwave discharge excited in a Gaussian beam of gyrotron radiation (wavelength λ = 4 mm, power up to 500 kW, pulse duration up to 20 ms) to purify atmospheric air from a wide range of environmentally harmful impurities. The discharge is characterized by high gas temperatures (*T*g = 4000 - 7000 K), which are reached in a short time (d*T*g / d*t* ≥ 106 kK/s), as well as fast cooling (–d*T*g/d*t* ≈ 104 kK/s). Such discharge parameters are realized due to the nonlinear growth stage of the of ionization-overheating instability in the plasma halo of a non-self-sustained discharge, and the discharge itself is an alternation of stages of non-self-sustained and self-sustained discharges. Although this type of discharge has already become an object of research (see, for example, [1]), in order to proceed to the first attempts to implement the technology, it is necessary to study in more detail its basic properties (propagation velocity, gas temperature) under various experimental conditions (type of gas, pressure , the intensity of microwave radiation).

The report presents the results of experiments on the study of the dependence of the propagation velocity of a subthreshold microwave discharge on the radiation power of the gyrotron within 70 - 400 kW in air and carbon dioxide at atmospheric pressure, the propagation velocity in argon at microwave powers of 70 - 200 kW. In almost the entire power range, dependences can be represented by a quadratic parabola. The lowest propagation velocities were observed in carbon dioxide, and the highest in argon. The gas temperatures determined from the continuum of the discharge glow spectrum [2] do not have an explicit dependence on the power and lie in the range of 5–6 kK for air and argon, and ~ 10 kK for carbon dioxide. Also, in the experiments, the dependence of the velocity of propagation of the discharge front on the gas pressure (in air and carbon dioxide) was determined, which turned out to be proportional to *N*0–0.8, where *N*0 is the initial gas concentration. The obtained shadow photographs of the discharge in air indicated the existence of shock waves ahead of the discharge front at microwave radiation powers above 250 kW, and also confirmed the possibility of considering this discharge as a system of multitude plasma "micro explosions". Experiments carried out at low powers of the microwave radiation of the gyrotron made it possible to find the threshold power (35 kW) at which the discharge front loses its inherent cellular structure, and the propagation velocity decreases significantly.

References

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2. *Spectral pyrometry*. Magunov A.N. (Fizmatlit, Moscow, 2012), p. 248 [in Russian].
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Lt/ru/FG-Borzosekov.docx) [↑](#footnote-ref-1)