CREATION OF PLASMA DIFFUSE JETS AT AIR PRESSURE 0.01-3 TORR, THAT ARE ANALOGUES OF RED SPRITES [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.123

Tarasenko V., Baksht E., Panarin V., Sorokin D.

Institute of High Current Electronics, [VFT@loi.hcei.tsc.ru](mailto:VFT@loi.hcei.tsc.ru)

Plasma of pulsed diffuse discharges constantly attracts the attention of researchers and is widely used in various fields. Since the end of the last century, much attention has been paid to the study of atmospheric discharge plasma at altitudes of 20–100 km above sea level [1–5]. These discharges were called transient light phenomena (TLPs). TSYA include red sprites, blue jets, elves, halos, and others. The main role in the formation of some of them is played by the streamer breakdown mechanism; see, for example, [1].

The purpose of this work is to study under laboratory conditions streamers (ionization waves) that have the shape, color, and speed of propagation of the glow front similar to those observed in “columnar” sprites, as well as to increase the length of the plasma diffuse jet (PDS).

Studies have shown that at low pressures of air and nitrogen (0.01–3 Torr), creating a plasma of a repetitively pulsed barrier discharge with various electrode designs, it is possible to form diffuse plasma jets - cylindrical streamers, with a shape close to the shape of “columnar” type sprites. At the same time, in a wide range of pressures and stresses, cylindrical streamers have a red color, which is due to the radiation of the 1+ nitrogen system. It has been established that the length of streamers at a generator voltage of 7 kV and an air pressure of 0.4 Torr or less can exceed 1 meter. It is shown that the value of the reduced electric field strength E/p affects the color of streamers. At high values ​​of E/p, the color of the discharge changes and becomes blue near the outer electrodes, as well as at the end of the PDS. The blue color is determined by the radiation of the 1- and 2+ systems of the molecular ion and the nitrogen molecule, respectively. At low pressures of 0.04 Torr and below the PDS in air, they are white. The color of the streamers becomes white at low air pressures due to an increase in E/p and dissociation of air particles, including admixture of water vapor. Due to molecular and atomic transitions of new neutral particles and ions, broadband radiation appears in the visible and ultraviolet regions of the spectrum. Preliminary results of the conducted studies, obtained in 2022, are published in [6–8].

References

1. Pasko V.P., Inan U.S., Bell T.F., Taranenko Y.N. Journal Geophys. Res., 1997, **102**, 4529–4561.
2. Rodger C.J. Reviews of Geophysics, 1999, **37**(3), 317-336.
3. Jehl A., Farges T., Blanc E. Journal of Geophys. Res.: Space Physics, 2013, **118**(1), 454-461.
4. Chanrion O., Neubert T., Mogensen A., Yair Y., Stendel M., Singh R., Siingh D. Geophys. Res. Lett., 2017, **44**, 496–503.
5. Neubert T., Chanrion O., Heumesser M., Dimitriadou K., Husbjerg L., Rasmussen I.L., Østgaard N., Reglero V. Nature 2021, **589**(7842), 371-375.
6. Tarasenko V., Vinogradov N., Baksht E., Sorokin D. Journal of Atmospheric Science Research,2022, **5**(4), 26–36.
7. Baksht E.Kh., Vinogradov N.P., Tarasenko V.F. Atmospheric and Oceanic Optics, 2022, **35**(9), 777–781. (In Russian).
8. Tarasenko V.F., Baksht E.Kh., Vinogradov N.P. Applied Physics, 2022, (4), 11–17. (In Russian).

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Lt/ru/EP-Tarasenko.docx) [↑](#footnote-ref-1)