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CHARACTERISTICS OF STATIONARY NEGATIVE CORONA DISCHARGE*

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Corona discharge is a specific type of self-sustained discharge. For its formation, it sufficient to apply high voltage to the electrode with a small radius of curvature. However, there is a range of applied voltage value, at which the corona discharge has an unstable mode [1]. Our previous work [2] has shown that the negative corona discharge in atmospheric-pressure air has four evolution stages including unstable mode, stationary glow and unstable-to-stationary transition. Characteristics of stationary mode is of interest for practical application. In this paper we investigate the characteristics of negative corona discharge's stationary mode and unstable-to-stationary transition.

Gas discharge model is based on the two-moment drift-diffusion hydrodynamic time-dependent model including two continuity equations for the electron component (density & mean energy) and a number of ion continuity equations. The transport equations are coupled to the Poisson's equation in order to consider the electric field self-consistently. The gas discharge diode represents the pin-to-plate structure with small radius of curvature. To take into account the most important reactions in atmospheric air (production of single charged ions, important conversion reactions, various electron energy losses) the simplified plasma-chemical reaction set is implemented in the model. The calculations are performed using the COMSOL Multiphysics software.

Numerical calculations have been shown that the stationary discharge structure consists of a positive space charge (mainly of N_2^+ and O_2^+ ions) layer with characteristic width of $r_{curv}/10$, where r_{curv} is curvature radius of the tip, and a plasma channel consisting mainly of O_2^- and O_4^+ ions. Electric field in plasma channel is almost uniform.

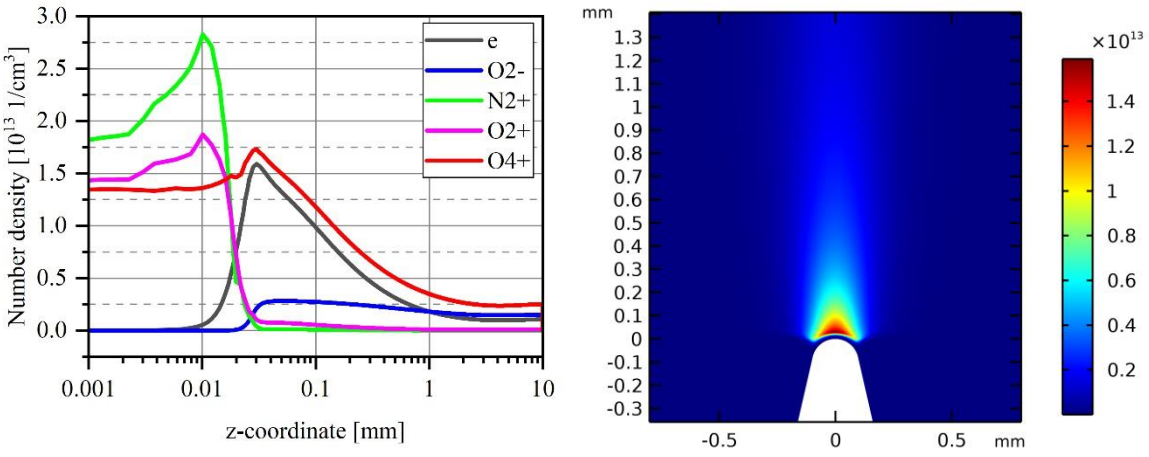

Fig.1. Plasma components number density at symmetry axis (left) and electron number density (right) distributions.

REFERENCES

[1] G.W. Trichel, "The mechanism of the negative point to plane corona near onset," Phys. Rev., vol. 54, pp. 1078, 1938.

[2] A.O. Kokovin, A.V. Kozyrev and V.Yu. Kozhevnikov, "Simulation of negative corona discharge in atmospheric air: from mode of Trichel pulses to stationary discharge", J. Phys. Conf. Ser., vol. 2064, 2021.

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