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GAS DISCHARGE PLASMAS AND THEIR APPLICATIONS



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The book contains abstracts of oral and poster reports presented at the 17th International Conference "Gas Discharge Plasmas and Their Applications" (GDP 2025). This event is a continuation of conferences on gas discharge physics held in Russia since 1984, as well as seminars and conferences on the technological application of low-temperature plasma. The conference is held every 2 years in different cities of the Russian Federation. This year, the wonderful city of Ekaterinburg, located in the heart of the Urals on the border of Europe and Asia, was chosen as the venue. The program of the Conference covers a wide range of technical areas and modern aspects of the physical processes occurring in generators of low temperature plasma, low and high-pressure discharges, pulsed plasma sources, surface modification, and other gas-discharge technologies.

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CHARACTERIZATION OF NORMAL GLOW DICHARGE AT ATMOSPHERIC PRESSURE DEPENDING ON DIFFERENT CATHDODE SHAPES

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Various types of discharges, such as corona, barrier, and especially microdischarges, are widely used to create a nonequilibrium plasma. In many of them, the structure of a classic normal glow discharge is formed. The cathode region plays a key role in glow discharge. The processes occurring in it determine the properties and stability of the discharge [1-3]. Rod electrodes, electrodes with holes, or grid electrodes, etc. are used in discharge devices. The non-planar shape of the cathode is one of the factors influencing the parameters of the cathode region.

In the present work, we investigated experimentally and numerically the DC normal self-sustained glow discharges in helium at atmospheric pressure, operating with planar and rod cathodes (Fig. 1 (a), (b)) and a cathode with a hole (backside of cathode in Fig. 1 (c)). Particular attention was paid to the parameters of the cathode fall layer. Polarized Stark spectroscopy of hydrogen and helium lines was applied to determine the spatial profiles of electric field strength. Spatial distributions of gas temperature in the interelecrode gaps were obtained using the rotational bands of nitrogen and hydroxyl. The distributions of equipotentiales in these discharges were also obtained.

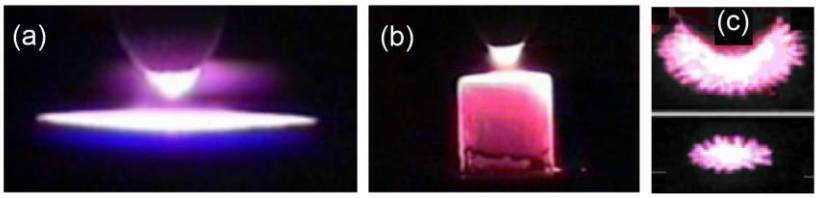


Fig.1. Photos of normal glow discharges in helium at atmospheric pressure with plane (a), rod (b) cathodes and cathode with hole (backside) (c). Discharge current is 1 A, gap is 5 mm.

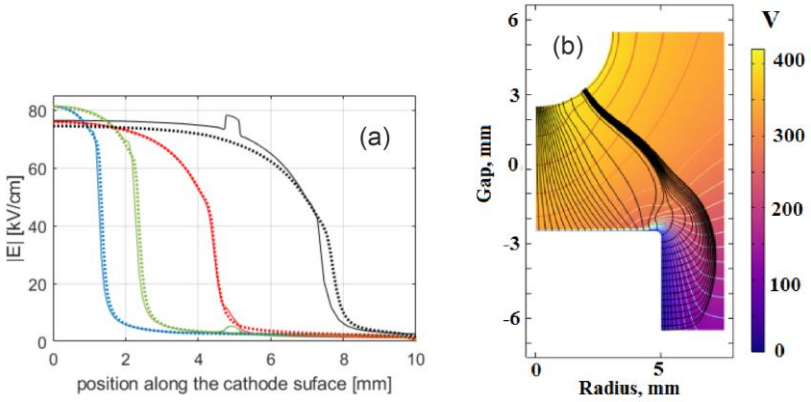


Fig. 2. Electric field strength on the cathode surface for helium APGDs with rod (solid) and planar (doted) cathodes (a) and profile of the electrostatic potential alongside with equipotentials (b).

The developed numerical model is spatially two-dimensional and is based on the drift-diffusion theory of gas discharges [3]. The simulation results show practically identical profiles of the electrical field strength when the cathode fall layer expands with increasing current both on the surface of the planar cathode and the lateral surface of the rod cathode (Fig. 2(a)). The current flow lines streamline the cathode region on the lateral surface of the cathode (Fig. 2 (b), black lines). The simulations demonstrated good qualitative and, to some extent, quantitative agreement with experimental observations for the discharge regimes with cathodes of different shapes.

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