Decay of radiation of the sliding surface discharge and the combined volume discharge

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The radiation decay of the sliding surface discharge and of the combined volume discharge with plasma electrodes lasting hundreds of nanoseconds in air have been studied experimentally by means of time resolved nanosecond ICCD imaging and streak diagnostics of the discharges development. Investigations were carried out at a voltage of 20-30 kV at air pressure of 2-160 torr. Analysis reveals the differences in the character of the radiation decay of two types of discharges. The radiation decay time of volume discharge decreases with increasing pressure at pressure of 10-100 torr. The decay time of the diffuse channels of sliding surface discharge is almost constant at pressure below 60 torr and increases at higher pressures.

1. Experimental setup and measurements

High efficiency contribution to gas heating during nanosecond discharge is used to control high-speed flow characteristics in aerodynamics [1-2]. In this work, the features of radiation of the sliding surface discharge [2] and the combined volume discharge [3] are investigated with nanosecond resolution using High-speed ICCD cameras of spectral range 380-880 nm (BIFO Company).

The experiments were conducted in the discharge chamber with rectangular channel [2, 3]. Sliding surface discharge of 30×100 mm^2 area consists of diffuse and bright channels moving over a dielectric surface [2]. Combined volume discharge occurs between two sliding surface discharges, which form two plasma electrodes at 24 mm distance between them. 20-30 kV voltage pulses initiated the discharges. The discharge current pulse had amplitude of ~1 kA and duration of ~200 ns. The radiation spectra were recorded using AVASpec-2048FT spectrometer in the range 174-1100 nm.

2. Results and discussion

The second positive system of molecular nitrogen (C→B) determines the main part of the spectra of the discharges. Volume discharge reveals the diffusive uniform radiation with duration of ~200 ns. Duration of diffuse part of sliding surface discharge close to 200 ns. The radiation of the bright channels lasts several times longer (Fig. 1) and increases with increasing pressure.

We have determined the decay time of radiation by processing the dependence of radiation intensity on time for two types of discharges (Fig. 1). Decay times of the radiation of volume discharge and diffuse radiation of the sliding surface discharge are close when pressure less than 100 Tor and have the value of ~40 ns. The radiation decay time of volume discharge decreases weakly when the pressure is rising. The decay time of the diffuse channels of the surface sliding discharge remains nearly constant when pressure is lower than 60 torr but increases significantly at higher pressures. This can be due to kinetic processes that lead to a population of the $C^3\Pi_u$ state of the nitrogen molecule.

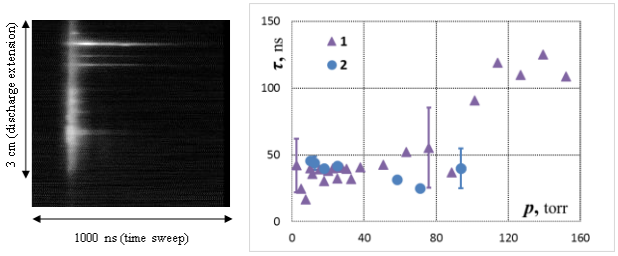

Fig. 1. Streak image of sliding surface discharge at pressure 76 torr (left); the decay time of the diffuse channels of surface sliding discharge (1) and the decay time of the volume discharge (2) (right). Voltage is 25 kV.

3. Acknowledgements

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4. References

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