DYNAMICS OF SUBNANOSECOND BREAKDOWN OF HIGH-PRESSURE GASES

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Recent results on computational study of subnanosecond discharge formation are presented. Their comparison with available experimental data is given. The effects of various factors governing the discharge characteristics are discussed.

Pulsed discharges in high-pressure gases are of considerable interest as sources of non-equilibrium plasma for various technological applications: pollution control, pumping of laser media, plasma assisted combustion, etc. Discharge development typically proceeds via the stage of formation near stressed electrodes and propagation inside the gap of ionization waves – streamers. The growth of front steepness supplies conditions when streamer formation occurs at strong overvoltages, resulting in generation of wide plasma channels, with radii of several millimeters [1-3]. Such plasma structures, similar to glow discharges, are of interest to applications due to quasi-uniformity of plasma parameters in relatively large gas volumes. The specific features of subnanosecond ionization waves are extremely high propagation velocities and large currents. Very high electric fields at the stressed electrodes and in the ionization wave fronts often lead to generation of runaway electrons and x-rays.

In this talk, results of numerical simulations of the development of subnanosecond discharges are discussed. Calculated spatial-temporal profiles of plasma parameters during streamer propagation are presented. A comparison of numerical data with results of experimental study is given. The efficiency of subnanosecond discharges for production of reactive species is evaluated. The effects of variation of applied voltage pulse parameters (voltage rise time, polarity, etc.) on discharge characteristics are considered. Possible role of runaway electron beams and x-rays in the process of discharge formation is discussed.

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