NS pulse discharge development in inhomogeneous magnetic field

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Numerical characterization of nanosecond pulsed discharges has been conducted in a strong magnetic field environment. Streamer discharge development and plasma generation in pure CO_2 was analyzed when magnetic field was directed along the axis of the discharge cell. Numerical simulations were based of a two-dimensional fluid model. It is shown that strong magnetic field affect dramatically on the plasma formation. The NS streamer diameter decreases significantly, plasma density increases. Calculations were carried out for different magnetic field values for fixed CO_2 pressure $P = 50$ Torr and fixed NS pulse voltage $U = 20$ kV.

With a field value in the range $B = 0 - 10$ T, the dynamics of the streamer discharge at $P = 50$ Torr changes insignificantly. An increase in the magnetic field in the gap leads to a sharp deceleration of the radial ionization wave, a decrease in the streamer radius, and an increase in the local electric field on the streamer head. As a result, the development of the discharge is sharply accelerated, and the electron density in the streamer channel sharply increases. A very large longitudinal electric field is formed near the head of the streamer. The electron drift in the radial direction is significantly suppressed, and the ionization rate is low due to low electron energy. It can be concluded that the streamer discharge sharply changes its characteristics in inhomogeneous magnetic fields and this control mechanism could be used in numerous applications.