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Self-sustaining conditions for nanosecond pulsed volume discharges under airflows

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The research of nanosecond pulse discharge has received extensive attention, it is important to study on self -sustaining condition of gas discharge in atmospheric air flow. In this paper, we are focus on the initiating and extinguishing boundaries of nanosecond pulse discharge under different air different airflow conditions. An DBD volume discharge is generated between two parallel stainless steel plates (80×30×1.5 mm3) which were covered by the mica sheets(150×60×1 mm3). The discharge gap is 3 mm. The stainless electrodes are connected to a nanosecond pulsed power supply (voltage amplitude U: 0-30 kV, pulse repetitive frequency PRF: 0-3.8 kHz). The voltage and current are measured by a capacitive divider (bandwidth: 200 MHz, divider ratio: 2200) and a Pearson current probe (Pearson 6585). Both the waveforms are recorded by an oscilloscope (DPO 3014 2.5 GHz). The discharge current signals, obtained by total currents minus displacement currents, are used to identify the initiating and extinguishing of volume discharges. With a regulating valve and a throttle orifice, the airflow velocity can be changed between 0 and 100 m/s. Under such airflow velocities, the airflow is always considered as under incompressible state, and the airflow velocity can be measured by a pitot tube based on Bernoulli equations.

There are two important excitation factors for initiating and extinguishing conditions of volume discharge under airflows. At a give voltage amplitude, the needed PRFs for discharge initiating and extinguishing both increase with the increasing airflow speeds. It can be explained with the transformation actions of metastable particles and active particle to the downstream region. At lower voltage amplitude, the needed PRF of initiating and extinguishing discharge boundary are mostly not affected by airflows. While at a higher voltage amplitude, the needed PRFs of initiating and extinguishing discharge boundary are hardly affected by airflows.

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