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Study on Nanosecond Pulse Discharge in Upstream and Downstream Flow

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Recently, the widely application of nanosecond pulse discharge, such as flow control, enhance combustion, etc., has led to much more attention to the research of discharge under airflow.
Nanosecond pulse discharge under airflow is a typical multi-field coupling model, which contain a variety of time scales. Pulse discharge has a nanosecond time scale for a single pulse, as well as the PRF of the millisecond time scale; the charged particles in the space have a certain time of generation and extinguish. For a fixed flow field structure, the transport time of airflow is controllable. In our research, a multi-electrodes structure is designed to explore the multi-scale coupling characteristics of nanosecond pulse discharge under airflow.
The schematic diagram is shown in Fig.1, which includes a subsonic air wind tunnel (with a maximum value of up to 250m/s), a nanosecond pulse generator (pulse width:5ns and the max PRF:3kHz), discharge systems, and measurement systems. The details are shown in Fig.1.

Fig.1 Experimental Setup
As shown in Fig.2, the amplitude of upstream decreased from 46A to 33A, and for the downstream discharge, the amplitude of discharge current increased from 33A to 46A, And with the increase of airflow speed, the discharge mode transferred from the filamentary to diffuse discharge, and for a specific speed, the mode of upstream is a typical diffuse discharge, however, the downstream illustrate a filamentary mode.

Fig.2 Experimental Results
For pulse discharge, the electrons transferred from cathode to anode by the applied electric field. With applying of airflow, the charged particles transport from upstream to downstream discharge area, and influence the distribution of charged particles. For a specific airflow speed, the transport effect of airflow is much more obvious, revealing a specific coupling relationship.

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