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Pre-ionization roles of upstream discharges for downstream discharges under airflows

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Airflows always bring the change of the distribution of charged particles, and also induce the discharge mode transitions. With a specific arrangement of discharge electrodes, this work focus on the interaction between discharges and airflows, and present the pre-ionization actions of upstream discharges for downstream discharges under airflows
The DBD reactor consists of two pair of plane-parallel ITO electrodes. Both upstream and downstream electrodes are made of 2mm thick glasses covered by 130nm ITO film. The size of glasses and ITO film are 180*60mm and 60*30mm, respectively. The ITO electrode was symmetrical along the horizontal and vertical position, the distance between the upstream and downstream electrodes can be adjusted. The gap distance between barriers was 5mm. The discharge system is installed after a wind tunnel, and with the flow direction perpendicular to the electrode surface. A nanosecond pulsed power is supplied to discharge excitation with the voltage amplitude U of 0-30 kV and the pulse repetitive frequency PRF of 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).
In static air condition, the discharge signals were same between the upstream and downstream. With the increase of airflow velocity, the second discharge current in downstream was significant higher than in upstream. The metastable particles generated by upstream discharge are transferred to downstream by airflow, and such transformation played a pre-ionization actions of of upstream discharges for downstream discharges, which can be enhanced and controlled with airflow speeds.

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