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Investigation of the Dynamic Behaviour of an Atmospheric RF-Micro-Plasma Source

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Micro-plasma was generated by a capacitive coupled RF-discharge at atmospheric pressure. The micro-plasma-source investigated uses metallic electrodes which are arranged in a coaxial configuration forming a nozzle at the gas-outlet. The inner electrode is connected via a capacitor to the RF-generator. The frequency applied was 65 kcs^{-1}. The discharge filaments are growing mainly inside of the nozzle. The diagnostics was performed in the downstream plasma in three directions: a) measurement of the outer electric parameters (time-dependence of voltage and current, phase shift, effective power), b) time-resolved measurement of the charge transfer and the floating potential of a probe in the downstream plasma, c) observation of the time-dependent-behaviour of the downstream plasma with a high speed camera up to 150 fps (frames per second).
The time dependence of voltage/current shows three different ranges: during ignition voltage amplitude of about 25 kV is applied. Beyond ignition the voltage amplitude breaks down to about 300 V and after a transition time of about 22 ms the voltage amplitude remains constant in the steady state regime with amplitudes of about 3.5 kV. The phase shift measured is in the range of 5° - inductive behaviour of the discharge and capacitive behaviour of the arrangement capacitance-discharge. A phase shift between the discharge- and the probe-current could not be observed. The electron density was calculated from the probe measurements in a rough approximation. In front of the nozzle exit we measured electron densities in the order of 10^{15} to 10^{16} m^{-3}. The sequences of the high speed camera showed the development of a plasma bullet at the nozzle exit which moves toward the probe. The speed of the bullet in relation to the outer parameter will be discussed in detail.

Keywords
Atmospheric plasma
RF-discharge
Plasma diagnsotics
High-speed photography