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Diagnostics of atmospheric pressure microplasma in close proximity to liquid using image method

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Microplasmas typically refer to high pressure plasmas produced over small length scales. These discharges have applications in lighting, nanomaterial synthesis, plasma medicine, and ozone production. In this talk, our main achievements in diagnostics of atmospheric pressure microplasma (listed below) are presented, further research work is still underway.

1. The non-linear behaviors were observed in the micro discharge with water cathode, which is different from that of the discharge with water anode. When water acts as an anode, the water surface falls at a constant rate, and the total brightness of micro discharge increase linearly with time. However, when water acts as a cathode, the water surface falls exponentially, and the light curve of the total brightness of micro discharge was similar to a logistic growth curve, suggesting a self-inhibition process. The discharge-water interactions, especially, the charged particle bombardment on water surface, cause the micro discharge to evolve.
2. The plasma size determined by the intensified charge coupled device (ICCD) imaging was related to the plasma inductance. The plasma density was then derived from the plasma inductance in open air. The electron densities measured by the ICCD imaging agreed well with the reliable Stark broadening method. This work presents a novel way to diagnose the size and electron density the plasma in open air.
3. A short duty cycle was observed to be beneficial to improve the electron energy and the electron density of pulsed discharge. The numerical simulations were performed to explain the experimental results. The results reveals that the density of the remnant electrons left by the previous pulsed discharge influences the energy of the electrons in the next pulsed discharge, and the electron density in the open air is coupled with the discharge volume which is a function of duty cycle.

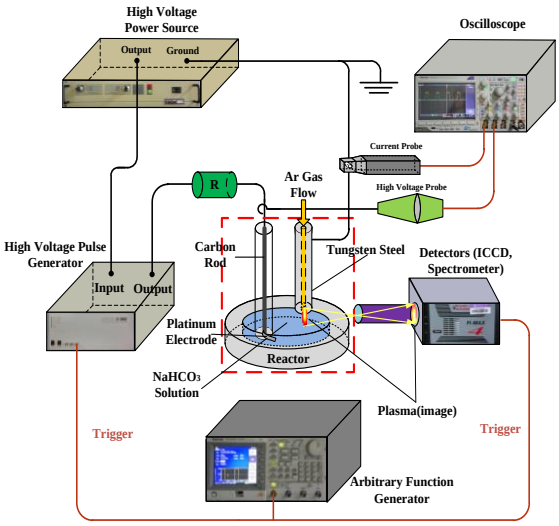

Fig.1 Experimental setup for pin-water discharge plasma diagnostics

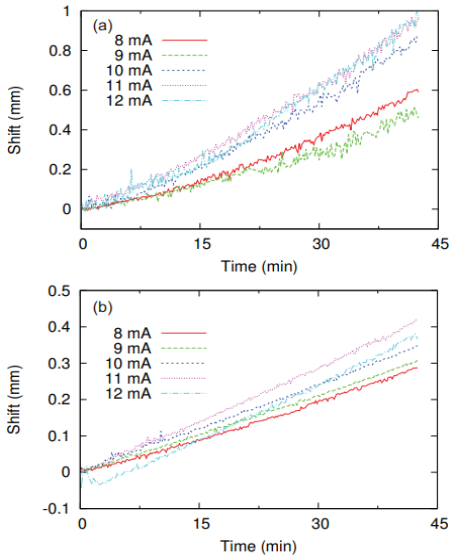

Fig.2 Motion of a water surface exposed to an argon jet at different discharge currents over 43min. Water acting as (a) a cathode and (b) an anode.

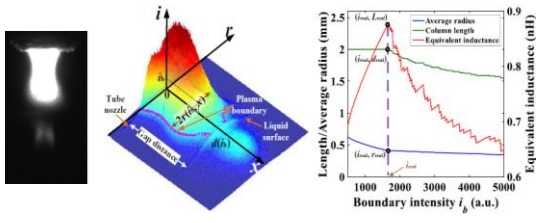

Fig.3 Image method for diagnostics of plasma density

Reference

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