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(G*) Statistical investigation on the number and electrical charge of streamers propagating at air-water interface under various discharge conditions.

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Non-thermal plasmas produced by nanosecond discharges is a novel field of plasma physics that have huge interest for medical physics or in liquid treatments due to their high reactivity. Although this field is under investigation since more than one decade, our understanding of the fundamental mechanisms is still at an embryonic level. Moreover, when such a plasma is coupled with a solid or liquid surface, novel processes are identified.

In this paper, we study the dynamics of pulsed nanosecond discharges produced by a positively polarized voltage in air in contact with water. The investigated parameters are the gap distance between the anode and the water surface and the volume of water. The former was adjusted from 10 to 1000 µm, while the latter was adjusted at 20, 60, and 160 ml. These different volumes produce a water film that has a thickness of ˜6, 17, and 45 mm, respectively. The discharge dynamics, under different magnitude of voltage (from 8 to 20 kV) was monitored using ICCD camera, and the acquired images were integrated during 2ns.

We observed that the streamer ignites in air at the anode tip and propagates towards the water surface. Initially, it has a disk-like shape that evolves (after a few nanoseconds) to a ring. Another few nanosecond later, the ring breaks into dots that propagate on the water surface. Automated statistical analysis performed on a large number of bullets as well as on their electrical characteristics has revealed that each plasma dot has a constant charge (˜ 3-5 nC), regardless the discharge condition.

As for the influence of the gap distance, we observed that its augmentation leads to a reduction of the plasma dots number. This finding can be interpreted by the decrease of the electric field at water surface as well as by the available energy (or charge) in the streamer when this latter reaches the water surface. As for the influence of water volume, we find that the number of dots and the charge pert dot are not significantly affected. However, the propagation velocity is highly affected. More quantitative results will be provided during the conference.

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