

Electric field and ionization waves in Pulsed Atmospheric Plasma Streams (PAPS): complementary *in situ* diagnostics

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In the field of cold atmospheric pressure plasmas in noble gases, pulsed atmospheric plasma streams (PAPS) are all induced by guided ionization waves often propagating within a capillary and expanding into the ambient atmosphere [1]. Many applications take advantage of such discharges. For instance, in biology and medicine, plasma is used to activate biological responses such as cell proliferation or cell death while plasma can also activate liquid resulting in the production of reactive oxygen and nitrogen species (RONS). Meanwhile, some intriguing features of PAPS have already been observed and reported. For example, long distance propagation, ionization front splitting and merging and transfer from a single PAPS to an electrodeless across second capillary and yielding the propagation of another PAPS [1].

Although these features must be beneficial for some specific processes and the development of new plasma sources like multi-jet plasma arrays [2], the involved mechanisms are not entirely understood and controlled. In this work, one focuses on the diagnostic of PAPS through the investigation of the electric field (EF) induced by the ionization wave. Experimental EF characterizations are extremely beneficial for the comprehension of plasma mechanisms and particularly for the validation of numerical simulation results. Lately, measurement techniques of EF in cold atmospheric plasmas have been developed significantly and are currently under great interest.

In this contribution, the authors present the results of strength EF obtained with two different methods. The first technique is a custom-made electro optic sensor based on the Pockels effect. This apparatus consist of a 4 mm diameter alumina tube which contains a BSO crystal 1.75 mm diameter. It allows us to record simultaneously two orthogonal components of the EF vector, time and spaced resolved in the vicinity of the jet [3]. The second method uses Stark polarization emission spectroscopy of the He I line at 492.19 nm [4]. As a non-perturbative technique, it has the advantage of measuring exclusively the EF strength of the ionization wave within the capillary as well as in the plasma expansion into the ambient. Depending on the experimental conditions, both methods will be either complementary or compared with each other. The outcomes will bring important information about the reliability of each methods but will also be of high interest for the comparison with numerical simulations in order to validate the computed results.

This work was supported by the bilateral project PHD Pavle Savic 2016 (n°36216UA). XD acknowledges his grant funding INEL/Région Centre Val de Loire.

References

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