Electric field characterization of plasma gun and multi-jet plasma arrays

S. Iséni[1], X. Damany[1], T. Darny[1], C. Douat[1], S. Dozias[1], J.-M. Pouvesle[1], E. Robert[1]
[1] GREMI, UMR 7344, CNRS/Université d'Orléans, 14 Rue d'Issoudun, Orléans, 45067, France
e-mail: sylvain.iseni@univ-orleans.fr

Room temperature Pulsed Atmospheric Plasma Streams (PAPS) have already demonstrated their unique potential in biology and medicine. Lately, the validation of multi-jet plasmas resulting from metallic and dielectric assemblies - containing many orifices - plugged to a single Plasma Gun (PG) and operating at moderate feed gas flow rate (from hundreds to thousands standard cubic centimeters) has been demonstrated [1]. This technological improvement enhances the credibility of plasma jets to treat large areas and volumes being beneficial in biomedical and recently in agriculture applications. Although the role of reactive oxygen and nitrogen species (RONS) produced by plasma is currently under many

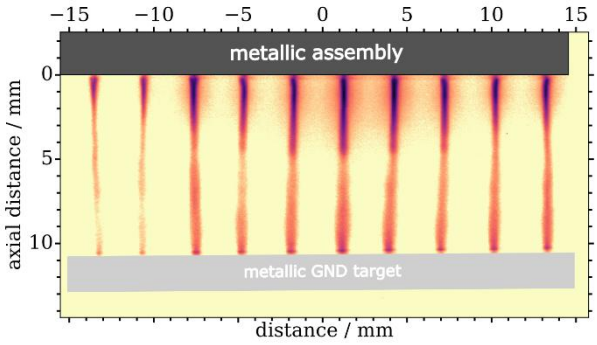

Fig. 2: Multi-jet with metallic assembly. Visible emission, 10 ns gate.

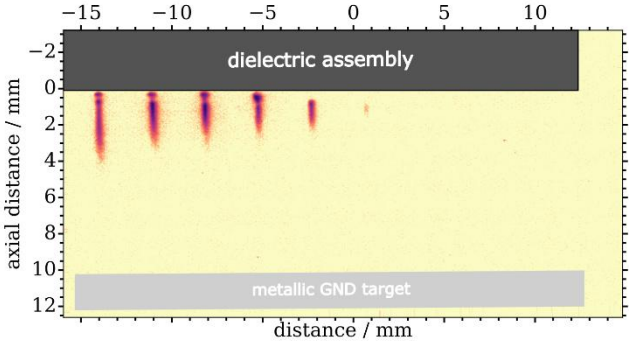

Fig. 1: Multi-jet with dielectric assembly. Visible emission, 10 ns gate.

investigations, the simultaneous contribution of intense pulsed electric fields (EF) in the activation of biological mechanisms still remains unclear. Therefore, in this work, the authors focus on the characterization of EF in PAPS applied to the treatment of cells and culture medium. EF maps [2] time and space resolved have been recorded with an electro optic sensors [3] and contribute to the interpretation of biological responses, *e.g.* electroporation, electropermeabilization and the impacts on cell viability.

The controlled propagation of multi-jet plasmas depends on the nature of the assemblies and is observed by time resolved iCCD imaging as shown in Fig. 1 and Fig. 2. While the metallic one allows for simultaneous ignitions of multiple PAPS, the dielectric one leads to a controlled splitting of the PG ionization wave, inducing a propagation delay between each orifice. Effects of multi-jet plasmas on the hydrodynamic of the gas are studied together via fast-schlieren imaging and by EF characterization. The outcome of this work will be of significant interest towards the use of multiple jets in plasma treated cells, agriculture and biomedical applications.

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References

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