

**PLASMA JETS AND MULTIJETS IN CONTACT WITH LIQUIDS IN  
BIOMEDICAL EXPERIMENTS: ELECTRO FLUID DYNAMIC AND  
REACTIVE SPECIES DISTRIBUTION**

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**Abstract.** Plasma jets are being intensively studied for biomedicine applications but their fine control remains challenging due to the mutual interactions between plasma and target. Even considering perhaps one of the simplest scenario in a research laboratory, using a plasma jet to treat a 2D culture of cells in a plastic multi-well plate, it is not known in detail how the physical environment of the micro-well may influence the nature of the plasma jet treatment. [see Mohades 2020 and Stancampiano 2019] This study aims to shed light on this topic by investigating how electro fluid dynamic (EFD) flows influence the delivery of the bioactive plasma-generated RONS when a plasma jet is used to treat a biologically-relevant liquid (i.e. PBS) in a standard tissue culture grade 24-well plate. The results show how the formation of complex EFD flows in the liquid induce a non-uniform distribution of the RONS, especially within the first few seconds of treatment. Shortly after the ignition of the plasma jet an initial rapid liquid stream can reach the bottom of the well, whereas a stable vortex mixing is observed few seconds later (Fig.1). Electric charge accumulation on the liquid surface and plasma induced gas swirling could be the causes of the liquid motions. Furthermore, the liquid depth/volume and the voltage polarity are found to be critical parameters in controlling the delivery of the RONS to the bottom of the well.

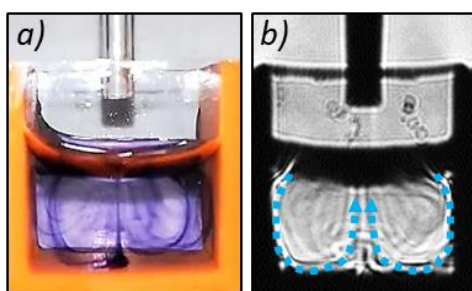


Figure 1: Plasma jet induced (a) distribution of violet colored RONS-indicator (KI-starch) and (b) Schlieren image of vortex mixing in a well containing PBS.

### References

- Mohades, S., Lietz A., Kruszelnicki, J., Kushner, M. J. : 2020, *Plasma Processes and Polymers*, **17**, 3
- Stancampiano, A., Chung, T.-H., Dozias, S., Pouvesle, J.-M., Mir, L. M., Robert, E. : 2019, *IEEE Trans. Radiat. Plasma Med. Sci.*, **4**, 3