Plasma in interaction with water droplets

Augusto Stancampiano(*)[1], Alexandre Devos[1], Pradeep Murugesan[1], Sébastien Dozias[1], Julien Lemaire[1], Pablo Escot-Bocanegra[1], Eric Robert[1]

[1] *GREMI – CNRS/Université d'Orléans, Orléans, France*

(*) augusto.stancampiano@univ-orleans.fr

Cold plasma at atmospheric pressure in or above water is widely studied nowadays for its application in several fields like medicine, agriculture or for the treatment of wastewater. The effects of plasma treated water are due to the creation, inside the water, of reactive oxygen and nitrogen species (RONS) during the plasma treatment. The formation of RONS and therefore the efficiency of plasma system is somewhat limited by the interface between plasma and liquid phases.
The combination of plasma and micrometric droplets (ie. aerosol and spray) could greatly improve the performances of plasma-water systems [1]. Anyway, one of the key point in the study of multiphase plasmas is the understanding of the complex physical and chemical processes occurring during the interaction between plasma and droplets [2]. In order to study those physicochemical aspects, we consider one single water micro droplet trapped in an acoustic levitator exposed to a microplasma. A pin-to-pin tungsten electrodes configuration, connected to a custom high voltage pulse generator (developed by the GREMI) creates a cold atmospheric plasma discharge pathing through or around the droplet (Figure 1). To be able to observe the path of the plasma and the morphology of the droplet we used a double shutter camera coupled with a pulsed laser allowing to take an image of the droplet hit by the plasma as well as follow the droplet evolution at different instants after the interaction.
The study investigate the effect of different parameters, like the size or the conductivity of the water or the voltage delivered to the high-voltage electrode. The obtained results provide new insight on the interaction between plasma and water droplets and encourage the development of new optimized plasma-aerosol devices in the field of agriculture or medicine.

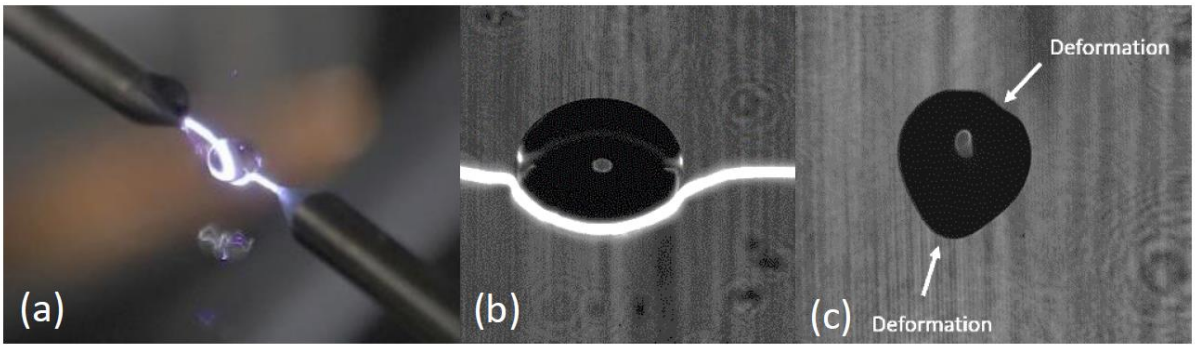

Fig. 1: Photography (a) and high-resolution acquisition (b) of the microplasma droplet interaction between two electrodes, droplet deformation after microplasma droplet interaction.

Acknowledgements: National founded project PLASMASOL - ANR-23-CE04-0003

[1] N. S. L. Chew, K. S. Wong, W. S. Chang, C. W. Ooi, L. Y. Yeo, et M. K. Tan, « Nanoscale plasma-activated aerosol generation for in situ surface pathogen disinfection », *Microsyst. Nanoeng.*, vol. 8, p. 41, 2022, doi: 10.1038/s41378-022-00373-3.

[2] A. Stancampiano *et al.*, « Plasma and Aerosols: Challenges, Opportunities and Perspectives », *Appl. Sci.*, vol. 9, nº 18, Art. nº 18, janv. 2019, doi: 10.3390/app9183861.