The effect of water recirculation on the chemical composition and antimicrobial activity of plasma-activated water

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Plasma activated water (PAW), produced from the interaction between low-temperature plasmas and water, exhibits enrichment in reactive oxygen and nitrogen species (RONS), alongside reduction of pH and increase of electrical conductivity. These chemical and physical properties contribute to the PAW bio-chemical activity, which is strictly connected to the design of the production setup, corresponding to an immense flexibility in terms of final output. For this reason, PAW is suitable for a broad spectrum of applications, spanning from the biomedical to the agricultural field.

In this work, we explore the potential of PAW for decontamination purposes, using as model organisms *Escherichia coli*. We present a novel design for a portable reactor, developed for the production of PAW by water exposure to a surface dielectric barrier discharge. In which water "activation" is achieved solely by RONS diffusion into the liquid phase. This talk will present the role of water recirculation on altering the nitrogen species balance in PAW, consequently enhancing the antimicrobial outcome, and establishing a key factor for further optimization. To this end, plasma and aqueous phase are fully characterized through Fourier Transform Infrared Spectroscopy, UV absorption spectroscopy and spectrophotometry. Subsequently, the PAW samples are tested on *E.coli*, to explore how chemical variations induced by water recirculation translate into distinct bacteria inactivation outcomes.

A necessary step for the development and optimization of PAW based technologies is understanding the fundamental mechanisms for bacteria inactivation. In this talk, the latter are investigated through flow cytometry, by applying fluorescent staining to identify membrane integrity. The loss of membrane integrity is also verified by measuring the release of intracellular components: DNA/RNA and protein.