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CHEMICAL AND ANTIMICROBIAL EFFECTS OF DC CORONA WITH WATER ELECTROSPRAY COMPARED WITH SURFACE MICRODISCHARGE

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Cold air plasmas DC corona discharges of low power (~0.2 W) have been demonstrated to decontaminate biofilm and bacterial spores on polypropylene plastic surfaces. The antimicrobial plasma effect was enhanced by electro-spraying of water (0.05 ml/min) through the active plasma[1]. In a higher power (~2 W) transient spark discharge mode with an electro-spray of aqueous solutions with *E. coli* bacteria, the bactericidal effect was associated to reactive oxygen and nitrogen species formed in the solutions[2].

Antimicrobial effects of air plasmas of surface microdischarge (SMD), which is a type of DBD, were tested on dry surfaces[3] and in aqueous solutions along with measurements of key chemical species produced in solutions by plasma action[4]. It was found that the inactivation of *E. coli* correlated well with the aqueous-phase ozone concentration, suggesting that ozone was the dominant species for bacterial inactivation under low power SMD mode (0.05 W cm^{-2}). On the other hand, nitrogen oxides became dominant at higher power (0.3 W cm^{-2}), leading to formation of nitrites and nitrates in the solutions.

As we expect similar actions of corona vs. low power SMD, and of transient spark vs. high power SMD, we are comparing these plasma systems in terms of the antimicrobial effects and the associated reactive chemical species induced in air and plasma treated water. The antimicrobial effect of ozone is tightly related to its solubility in water, so mixing the gas in water is crucial. The electro-spray system is particularly efficient by increasing the mass transfer into micrometric water droplets of water with large (total) surface area.

Such comparisons contribute to deeper understanding of the plasma-induced air and water chemistry related to its antimicrobial activity and will enable us for designing an ambient air plasma sterilizer for developing world applications.

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3. M. J. Pavlovich, Z. Chen, Y. Sakiyama, D. S. Clark and D. B. Graves, Plasma Process Polym 10 (2013) 69
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