Physical characterization of biological experiments in Plasma Medicine

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Résumé

Plasma jets are being intensively studied for biomedicine applications but their fine control remains challenging due to the mutual interactions between plasma and target. In Plasma Medicine especially, testing and validation range over very different targets making difficult to compare achieved results and to transit toward clinical trials.
Even considering perhaps one of the simplest scenario in a research laboratory, using a plasma jet to treat a 2D cells culture in a plastic multi-well plate, it is not known in detail how the physical environment of the micro-well influence the nature of the plasma jet treatment.

In this work are presented results showing how the impinging of a plasma jet can induce liquid recirculation in vessels commonly adopted for biomedical in vitro studies. The generated vortexes strongly affect the distribution of long-lived reactive species inside the liquid. Furthermore it is discussed the relevance of taking into account the total impedance of the treated samples as this could greatly affect the plasma characteristics and the treatment outcome itself. A new simple, but effective, method for the mimicking of the human body electrical characteristics during plasma medicine experiments is presented. Last but not least, the possible penetration of the plasma induced electric field inside the treated liquid is also taken into account as it could possible lead to the electropermeabilization of tested cells during plasma treatment in vitro.

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The final aim of the work is to raise awareness, trough examples, on the critical role played by physical investigation of the setups commonly adopted in biomedical research for the understanding of plasma biomedical effects.

Mots-Clés: cold atmospheric pressure plasma, plasma medicine, plasma, target interaction, thermo, fluid dynamics, target impedance, human body equivalent circuit, electric field