Instant dissipated power monitoring process of a RF atmospheric pressure micro-plasma jet device : application to biological materials

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Atmospheric pressure micro-plasma jet devices are non-equilibrium plasma sources being a sizable part of the low temperature plasma community [1]. With a great future ahead of its extensive development worldwide, micro-plasma jet devices contribute to very large panel of applications such as surface activation, active flow control and liquid activation. Plasma jets are also involved in societal challenges as an innovative medical approach to activate healing biological mechanisms and as promising cancer therapies. There exists plenty of different plasma jet devices among them, the so-called kINPen [2] has become a leading plasma source in the field of plasma applied to biology, veterinary and medicine purposes [3]. With the production of reactive oxygen-nitrogen species (RONS) at room temperature, the kINPen is a versatile source. However, the control of the RONS production remains a key issue as it is directly related to the elementary processes involved in the discharge considering all the input parameters such as the gas flow, molecular impurities, *electrical characteristics*…

In this study one focuses on the control of the dissipated power with regards to the molecular gas precursors and the effects on the cell viability of some human cells. The plasma source is a radio-frequency (RF) plasma jet adapted from the kINPen operated in Ar with O_2 and N_2 gases as precursors to generate a rich RONS chemistry [2]. To measure accurately the dissipated power, a simple method inspired from Hofmann et al[4] is proposed. While the geometry of the plasma jet device is rigorously identical to the kINPen head, the embedded high-voltage generator is substituted with an external circuit.

After a validation of the method, human blood mononulear cells are treated with the plasma jet for different values of dissipated power and gas mixtures. Following the biological protocols, the cell viability is then investigated and analyzed by means of multi-color flow cytometry.

The results of this work bring interesting information on the following[5],

- A convenient method to monitor the dissipated power by an accurate control of the current,
- The possibility to fix the RF dissipated power to the plasma for a specific value of the current while changing the admixture ratio from 0.0% up to 1.0% of O_2 and N_2. This leads to a very flexible capability to tailor the production of RONS.
- The first experiment of operating the kINPen with pure N2.
- The direct impact of cytotoxicity after Ar and N2 plasma treatments on cells at control or constant dissipated power.

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