

# Cold atmospheric single plasma jet for RONS delivery on large biological surfaces

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## Abstract

Several attempts have been made to deliver reactive oxygen and nitrogen species (RONS) produced by non-thermal plasma onto large surfaces in a controllable way compatible with skin treatments. In this paper, the effect of pulse frequency, in the range 0.5–20 kHz, on the discharge behavior was studied on skin tissue models to evaluate potential treatment changes. This has been done through electrical characterization, visualization of the helium flow (by Schlieren technique), produced plasma jet modifications (ICCD imaging) and RONS measurements. The results show that, in addition to its well known important role in the production of the chemical species, the applied discharge frequency plays a very significant role in the size of the treated surface. An enhancement of NO\*, OH\* and O\* production in the gas phase at the higher frequency is reported and assigned to the stronger mixing of the helium flow with ambient air. The efficacy of plasma jet on transporting RONS on/into agarose gel and pig skin has been evaluated. The distribution of the reactive species on the target, or passing through, is strongly dependent on the discharge frequency and consequently induces pH variations. The present study supports a new way for enlarging the treated surface by using a simple jet at high frequency in the 20 kHz range, leading, with appropriate gas flow and distance to target, to conditions of RONS production that are compatible with potential uses for biomedical or cosmetic applications.

Keywords: plasma jet, high repetition rate, RONS delivery, agarose gel, pig skin, biomedical application, cosmetics