Biocidal effects of nanosecond repetitively pulsed discharges

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Résumé

Nanosecond Repetitively Pulsed (NRP) discharges are increasingly used in the cold plasma community for various applications such as plasma-assisted combustion or nanomaterials synthesis [1-3]. These discharges are particularly interesting because they can efficiently produce high concentrations of chemically active species such as atomic oxygen, nitrogen metastables, or ozone, in atmospheric pressure and ambient temperature air. In particular, we have shown recently that an NRP discharge can dissociate up to 50% of molecular oxygen with very high energy efficiency [4,5]. Given the importance of reactive oxygen species in biodecontamination, we investigate in the present work the effects of NRP discharges on bacteria inactivation in water, on teeth surfaces, and on agar plates. The NRP discharges are produced using short-duration (10 ns) high-voltage (4-10 kV) positive-polarity pulses at a pulse repetition frequency of 1-30 kHz across a discharge gap of a few mm. The electrode system is comprised of a needle (HV positive pulse) and a grounded plate or grid, in the configuration previously proposed by Machala et al. [6-7]. Two regimes of NRP discharges have been investigated: glow and spark [8]. Preliminary results indicate that both regimes produce a noticeable effect on the decontamination of the media studied. Although the spark regime is more effective, the glow regime has nevertheless a significant effect on bacteria despite the much lower power deposited.

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