The separation of photons and reactive particles in the effluent of He/O_2 atmospheric pressure plasma jet

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The radiofrequency glow discharges operated in He at atmospheric pressure with small admixture of oxygen are known to be effective sources of reactive oxygen species (ROS) such as O atoms, ozone molecules, or $O_2(a^1\Delta_g)$ metastables, and of VUV and UV photons. It is well known that the treatment of bacteria with the effluents of these plasmas leads to their effective inactivation. A specially constructed atmospheric pressure plasma jet source, so-called X-Jet, allows effective separation of plasma-generated ROS and photons and can be used to study their separate and combined effect on bacteria [1,2].

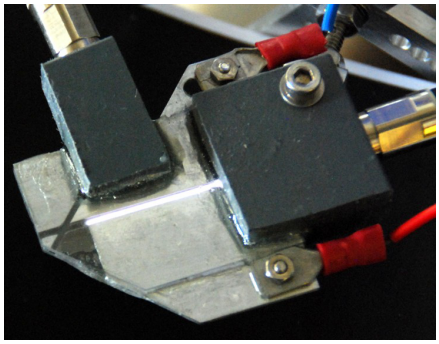

Figure 1: *Photograph of the X-Jet*

Additionally, the possible photo-chemical reactions can be studied with its help. Here, we present the characterisation of the X-Jet performance by means of mass spectrometry of neutral and ionic species, VUV optical emission spectroscopy, etching experiments, shadow photography, and fluid model of the gas flow and chemical kinetics in the jet. The measurements are correlated with the effects of the plasma effluent on *E. coli* cells on agar plates. It is demonstrated that i) ozone dominates the inactivation of bacteria at larger distance from the jet, ii) atomic oxygen can etch the biological material including bacteria, iii) the direct radiation damage induced by plasma generated photons is much less effective than the effect of ROS, and iv) the photons generate in the photochemistry reactions some reactive species (probably ions), which also inactivate bacteria. The X-Jet source is an ideal source to study the interaction mechanisms and synergistic effects of different reactive components of the plasma effluent on bacteria [2,3]. The results of more detailed studies on the effects of the plasma effluent and its components on bacteria and bio-macromolecules will be presented in the talk of Julia Bandow.

References

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