Atmospheric pressure RF plasma jets for biomedical applications : bacteria inactivation processes analyzed by gas and liquid phase diagnostic methods

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In this contribution we present plasma(-gas) and liquid phase diagnostics of an argon atmospheric pressure plasma RF jet used for bacteria inactivation. The plasma is characterized in terms of electron density, (V)UV flux and flux of reactive and ion species reaching the surface. We motivate further with measurements of the time resolved plasma dissipated power and the spatial resolved gas temperature the chosen conditions for the treatment of bacteria, i.e. a remote plasma, not in contact with the liquid surface (distilled water), created with an electric field electrode configuration perpendicular to the argon gas flow. We show that with the used treatment conditions, liquid chemistry induced by the reactive species and possibly also by the flux of (V)UV created by the plasma is the main player for bacterial inactivation.

For further investigations we measured the nitrite, nitrate and H_2O_2 concentration in the liquid phase via ion chromatography and colorimetric methods. Combined with estimated gas fluxes of NO, O_3 and OH we developed a 0D-solution kinetics model to estimate concentrations of not measured species which are known to play a role in the inactivation of bacteria. It is shown that the model is in good correspondence with the measured values of pH and the H_2O_2 concentration and that the calculated concentrations of HNO_2, ONOO- and $H_2O_2$are in the same order of magnitude as from literature reported minimum inhibitory and bactericidal concentrations of those species.