Feed Gas Humidity: A Hidden Parameter affects Cold Atmospheric Pressure Plasma Jet and Plasma-Treated Human Skin Cells

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Gas humidity is an important parameter in cold atmospheric pressure plasma treatment of biological systems [1, 2]. This is especially true for humidity change in the feed gas of a cold argon plasma jet since the humid working gas is transported through the active plasma zone entirely. Hence, water molecules become dissociated and are significant for the active plasma component composition. Besides the intended admixture of water vapor, working gas humidity can originate from different unknown or hard to control sources. Polymeric feed gas tubes are prominent examples for a hidden humidity source.
In this work the humidity amount introduced by feed gas tubes is measured and the impact of the resulting working gas humidity on the active plasma agents is investigated. An example of the humidity-plasma interaction is given in figure 1. It displays the spectrally integrated optical emission signal of a plasma jet (kinpen, neoplas GmbH, Germany) in dependence on the humidity and the axial position. Two excited plasma species are evaluated, namely argon atoms (figure 1a) and hydroxyl molecules (figure 1b). In the case of argon the highest intensity is detected for dry working gas. When humidity is artificially added to the working gas, the emission of argon decreases while the emission of OH increases. The increase of OH emission continues until the maximal OH emission is reached at a humidity admixture of 400 ppm. From here the OH emission decreases steadily. In addition to plasma diagnostics humidity influence on plasma treated HaCaT skin cells is presented. The treatment effect on cells is tested in an in vitro model using proliferating human keratinocytes. Cell viability is determined using the Alamar Blue Assay. A strong effect of the water admixture to the feed gas on cell viability is shown, which correlates to the plasma diagnostic findings.

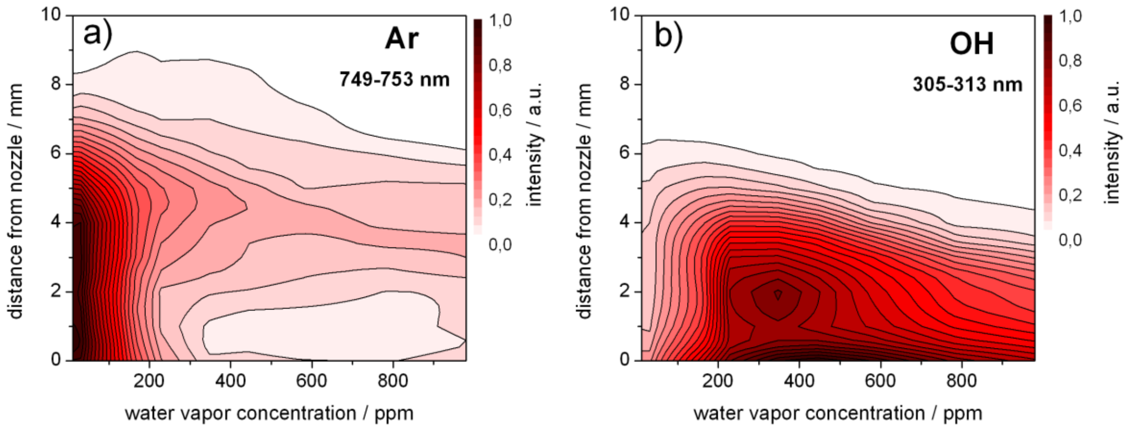

Figure 1: *Integrated optical emission in dependence on water vapor concentration and axial position for excited argon atoms (a) and hydroxyl molecules (b).*

References

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