Ozone detection and production rate measurement by Mid-Infrared absorption spectroscopy in a plasma jet operating at atmospheric pressure

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It is already known that reactive species such as ozone have biological effects and have been used for sterilization of non-living objects [1]. In plasma medicine field, ozone is also investigated for healing wounds as an antibacterial agent. Therefore, we investigate the ozone production of a MHz radiofrequency plasma jet operating at atmospheric pressure in order to control the concentration of ozone in the effluent part. It is known that ozone molecules absorb infrared (IR) radiation [2]. By using very high resolution mid-infrared absorption spectroscopy in the *fingerprint* region (500-1500 cm^{-1}), we have been able to detect ozone tracks. The diagnostic is done by a tunable quantum cascade laser which generates a narrow infrared radiation. The absorption beam goes through a multipass cell in which the plasma jet is operated. Due to an additional air inlet, the inner atmosphere is adjusted to be similar to the application conditions in ambient air.

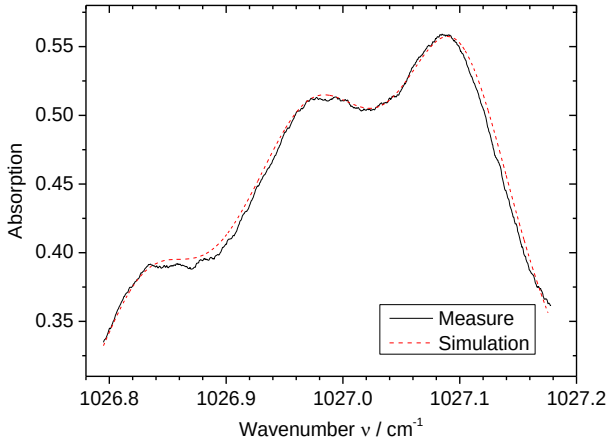

Figure 1: *Detection of ozone molecules. Absorption spectrum and simulation based on HITRAN database [2].*

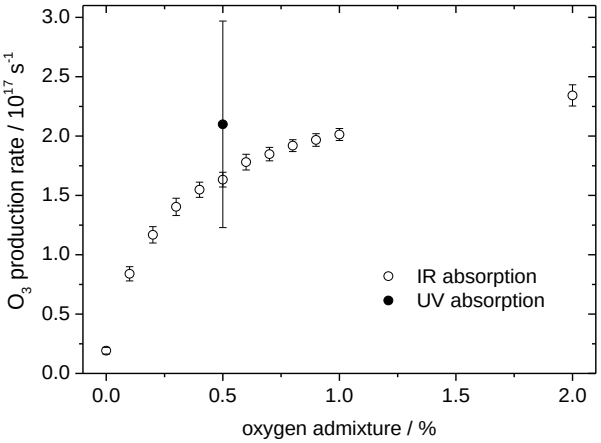

Figure 2: *Ozone production rate of the investigated plasma jet in dependence on oxygen admixture.*

Figure 1 shows an absorption spectrum compared *on-line* with a simulated spectrum yielding excellent results for the concentration measurement [3]. With the assumption that the ozone density is homogeneous within the cell and that ozone is not destroyed in the vessel, we can determine the production rate as shown on figure 2. This IR ozone measurement is compared with a UV absorption spectroscopy technique. It provides a higher accuracy of the absolute ozone concentration [3].

References

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