On recent progress applying cavity-enhanced spectroscopy techniques to characterize atmospheric pressure plasma jets

J.H. van Helden

Leibniz Institute for Plasma Science and Technology (INP Greifswald), Felix-Hausdorff-Str. 2, 17489 Greifswald, Germany

Over the last decade the application of non-equilibrium atmospheric pressure plasmas for materials processing has increased due to their favourable properties such as low space requirements, in principle no restriction on substrate size and, as no vacuum is needed any more, a significant reduction in capital cost. At the same time, cold non-equilibrium atmospheric plasma jets (APP jets) have emerged worldwide and opened new fields of applications such as plasma medicine, where the high reactivity at low gas temperature is crucial for interaction with sensitive biological systems. Although these type of molecular plasmas are being increasingly used not only for basic science but also for technical applications, it remains the case that many processes and properties are far from being completely understood. Therefore, it is essential to diagnose the fluxes of the species generated by these plasma sources to identify relevant fundamental processes and to improve process efficiency. Especially for a comprehensive understanding of the kinetics of the transient species involved, high precision measurements of reactive molecular precursors, free radicals and to identify of any short lived species are of crucial importance. However, (cold) non-equilibrium APP jets pose a challenge for diagnostic techniques as these plasmas have small dimensions and high density gradients in space and time. Only recently, absorption spectroscopy has been in the focus of this field as it has several advantages over other optical diagnostic techniques [1]. Increasing the effective absorption length by employing high finesse optical cavities can provide increased sensitivities as path lengths in the kilometre range can be achieved at inherently small base lengths in a small volume. In this contribution, the latest results concerning the detection of transient species in APP jets employing cavity-enhanced absorption spectroscopy (CEAS) in the near- and mid-infrared spectral range will be presented. Two main topics will be discussed in more detail. Firstly, the detection of CH_4 created in the dissociation process of the hexamethyldisiloxane (HMDSO) precursor in the deposition process of SiO_2 thin films using APP jets. Secondly, the detection of the highly reactive HO_2 radical in a cold APP jet used in plasma medicine.

[1] S. Reuter, J. S. Sousa, G. D. Stancu, and J. H. van Helden, Plasma Sources Sci. Technol. **24**, 054001 (2015).

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