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Reactive species distribution and quenching coefficients in the effluent of an atmospheric pressure plasma jet using picosecond TALIF[1]
SANDRA SCHROETER, J. BREDIN, A. WEST, J. DEDRICK, K. NIEMI, E. WAGENAARS, T. GANS, D. O'CONNELL, York Plasma Institute, Dep. of Physics, University of York — Atmospheric pressure plasmas (APPs) can be used as sources for reactive oxygen and nitrogen species (RONS), which are believed to play a key role in different plasma applications, such as industrial processing or biomedical applications. To investigate the effects of APP jets on treated media, it is necessary to quantify RONS and determine their spatial distribution in the plasma effluent region. Here, we present measurements of absolute atomic species densities of O, N, and H, in the effluent of a radio-frequency capacitively coupled plasma jet in helium with admixtures of N_2, O_2, and H_2O, using picosecond two-photon absorption laser-induced fluorescence (ps-TALIF). The fast decay of the laser-excited states is typically a limiting factor of conventional nanosecond TALIF systems when investigating APPs due to the fast quenching rates of the laser-excited states, which have to be calculated from literature quenching coefficients, and an estimate of the gas composition. Using ps-TALIF, we are able to measure lifetimes of laser-excited states, and can also determine quenching coefficients with background gases. O, N, and H densities decay with different rates in the plasma effluent with increasing axial distance from the nozzle. Therefore, ratios of reactive species densities change with distance, which could be useful for tailoring species densities for applications. By investigating the reaction kinetics, we have identified important consumption pathways for these species.

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