Abstract Submitted
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Number density and temperatures of excited species in a plasma-assisted flame.[1] JEAN-BAPTISTE PERRIN-TERRIN, NICOLAS MINESI, VICTORIEN BLANCHARD, CHRISTOPHE LAUX, Laboratoire EM2C, CentraleSupelec, CNRS, Universite Paris-Saclay — Nanosecond Repetitively Pulsed (NRP) discharges can be used to stabilize lean flames with a low power budget. In this work, a lean premixed methane-air flame (power: 13.6 kW, equivalence ratio: 0.8) is stabilized by NRP discharges at 20 kHz. In this application, the influence of the discharge on the combustion chemistry is mainly driven by (i) the temperature and (ii) N_2 excited states (e.g. two-step ultrafast dissociation of oxygen). The plasma temperature can be determined from the rotational temperature of excited species, but this measurement relies on the quenching rate which are rarely known at high temperatures. To assess the validity of the temperature measurements, N_2^+(B), N_2(B), and N_2(C) rotational temperatures were determined. Within uncertainties, they are found to be equal. Then, we performed absolute optical emission spectroscopy of N_2(B-A), N_2(C-B), and N_2^+(B-X) to quantify the number densities of N_2(B), N_2(C), and N_2^+(B). They correspond to previous results with the same discharge in preheated air, despite the different gas composition. Also, using Stark broadening of the H_α line, the electron number density is found to increase up to approximately 10^{16} cm^{-3} ($\approx 1\%$ of ionization).

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