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Mechanism of flame stabilization by Nanosecond Repetitively Pulsed Discharges CHRISTOPHE LAUX, GABI STANCU, FARAH KADDOURI, DAVID PAI, GUILLAUME PILLA, DEANNA LACOSTE, Ecole Centrale Paris — The stabilization of lean combustible mixtures, which burn at lower flame temperatures than stoichiometric mixtures and thus produce lesser amounts of thermal nitric oxides, is a crucial issue for the design of the next generation of internal combustion and aircraft engines. In recent years, nanosecond repetitively pulsed discharges have been shown to be highly effective, energy efficient techniques for these applications. Stabilization has been attributed to a combination of thermal and chemical effects produced by the discharge. However, the mechanisms for heat or active species production have not been fully understood. To this end, we have performed time-resolved measurements of temperature and species concentrations in an atmospheric pressure air plasma discharge produced by nanosecond repetitive pulses, using advanced techniques such as Cavity Ring-Down Spectroscopy (CRDS), Two-Photon Laser Induced Fluorescence (TALIF) or quantitative emission spectroscopy. The results show that nanosecond discharges at atmospheric pressure can dissociate up to 50% of molecular oxygen in less than 50 ns. Time-resolved electric measurements are also presented to estimate the efficiency of energy deposition by this process. This ultrafast mechanism has many potential applications, from plasma assisted combustion to materials synthesis.

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