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Rotational CARS Temperature Measurements in Nanosecond Pulse Discharge Plasmas YVETTE ZUZEEK, KEISUKE TAKASHIMA, IGOR ADAMOVICH, WALTER LEMPERT, Ohio State University — Time-resolved and spatially resolved temperatures in repetitively pulsed nanosecond discharges in air and ethylene-air mixtures have been measured by purely rotational Coherent Anti-Stokes Raman Specroscopy (CARS). The experiments have been done in a capacitively coupled plane-to-plane discharge and in an atmospheric pressure near-surface Dielectric Barrier Discharge (DBD), both powered by repetitive nanosecond duration voltage pulses. Gated ICCD camera images demonstrated that the capacitively coupled discharge plasma remains diffuse and stable, with no sign of arc filaments. Comparison of the experimental results with plasma chemical kinetic modeling calculations shows good agreement. The results demonstrate that the rate of heating in the fuel-air plasma is significantly more rapid compared to the one in the air plasma. Kinetic model analysis shows that this occurs due to exothermic reactions of fuel with radical species generated in the plasma, such as O atoms. The present results provide additional insight into kinetics of hydrocarbon fuel oxidation in low-temperature plasmas and into the mechanism of localized heating of air flows by nanosecond DBD discharges.

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