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Laminar lean premixed methane/air combustion near the lean flammability limit using nanosecond repetitive pulsed discharge plasmas MOON SOO BAK, Stanford University, HYUNGROK DO, University of Notre Dame, MARK G. MUNGAL, Santa Clara University, MARK A. CAPPELLI, Stanford University — Gas chromatographic and temperature measurements have been carried out to investigate the extent of premixed methane/air combustion with the application of nanosecond repetitive pulsed discharges around the lean flammability limit for laminar flows. The results show that the discharges lead to the complete combustion when the equivalence ratio is above 0.54, but when the ratio is below the limit, the combustion is quenched at the downstream flow. To investigate the kinetics in detail, 2-D simulations of plasma-induced combustion have been conducted for methane/air mixtures at below and above the lean flammability limit. The simulations reveal that methane is mostly combusted in the discharge region since the discharge repetition timescale is much shorter than the species diffusion and advection timescales, and so the discharge serves more as a heat and radical source rather than a small combustor, to flame hold near the lean flammability limit.

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