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Effect of energetic electrons on combustion of premixed burner flame

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In many studies of plasma-assisted combustion, authors superpose discharges onto flames to control combustion reactions. This work is motivated by more fundamental point of view. The standpoint of this work is that flames themselves are already plasmas. We irradiated microwave power onto premixed burner flame with the intention of heating electrons in it. The microwave power was limited below the threshold for a discharge. We obtained the enhancement of burning velocity by the irradiation of the microwave power, which was understood by the shortening of the flame length. At the same time, we observed the increases in the optical emission intensities of OH and CH radicals. Despite the increases in the optical emission intensities, the optical emission spectra of OH and CH were not affected by the microwave irradiation, indicating that the enhancement of the burning velocity was not attributed to the increase in the gas temperature. On the other hand, we observed significant increase in the optical emission intensity of the second positive system of molecular nitrogen, which is a clear evidence for electron heating in the premixed burner flame. Therefore, it is considered that the enhancement of the burning velocity is obtained by nonequilibrium combustion chemistry which is driven by energetic electrons. By irradiating pulsed microwave power, we examined the time constants for the increases and decreases in the optical emission intensities of N_2, OH, CH, and continuum radiation.