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Simultaneous measurements of OH(A) and OH(X) radicals in microwave argon plasma assisted combustion of methane/air mixtures using optical emission spectroscopy and cavity ringdown spectroscopy[1]

WEI WU, CHUJI WANG, Mississippi State University, LASER SPECTROSCOPY AND PLASMA TEAM — We developed a new plasma assisted combustion system employing a continuous atmospheric argon microwave plasma jet to enhance combustion of methane/air mixtures in different fuel equivalence ratios (φ). The combustor has three distinct reaction zones of pure plasma zone, the hybrid plasma-flame zone and pure flame zone which were well defined by their emission spectra. Optical emission spectroscopy (OES) was used to exam the excited species including OH(A) and results showed that OH(A) intensities gradually increased in plasma zone and rapidly increased in hybrid zone and then dramatically decreased to a very low level in flame zone. In addition to OES, pulsed cavity ringdown spectroscopy (CRDS) was utilized to measure the absolute number density of OH(X) in the flame zone at $\varphi = 0.51$, 0.87, 1.10 and 1.45. Different OH(X) number densities and density profiles were observed comparing rich and lean combustions. At $\varphi = 0.51$, the OH(X, V" = 0, J" = 0.5) number density increased from 2.29×10^{15} molecule cm^{-3} at the combustor nozzle to maximum 3.13×10^{5} molecule cm^{-3} at 2 mm downstream, and then gradually decreased to the lowest detectable level of 0.12×10^{15} molecule cm^{-3} in the far downstream.

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