Assessing NOx Emission from Hydrogen-Enriched Natural Gas in Oxygen-Enriched Conditions

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In this study, a multi-slot burner was utilized to replicate a flame similar to that of an industrial-scale natural gas turbine combustion system. The burner's outer side was used to introduce air, while natural gas and hydrogen were introduced through the inner side. The objective was to investigate the combustion characteristics of different natural gas composition ratios at various hydrogen flow rates and velocities, aiming to achieve a hydrogen addition level of 30%. The experiment was conducted under oxygen-enriched conditions of 25-30% in the air to improve combustion efficiency and reduce nitrogen oxide emissions.

To study the dynamic behavior of the unstable flame in this research, CCD camera was used to capture its images. We conducted sensitivity analysis to evaluate the influence of hydrogen addition on flame length and width. Additionally, a two-color pyrometry method was employed to measure the flame temperature and understand the temperature distribution of hydrogen diffusion within the natural gas flame while keeping the overall combustion flow field unaffected. To effectively control the post-combustion emission of nitrogen oxides, we employed planar laser-induced fluorescence (PLIF) to investigate the effect of hydrogen addition on exhaust gas. The CH free radical produced during fuel cracking at high temperatures serves as a nitrogen oxide precursor, while OH free radicals are linked to nitrogen oxide emissions. The primary goal is to identify the ideal fuel mixture ratio and provide relevant adjustment parameters to significantly reduce nitrogen oxide emissions.

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