Characteristics of Laminar Premixed H2/CO/CH4/Air Opposed-jet Flames

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Abstract

Extensive fossil fuel consumptions have resulted in rapid fuel depletion as well as atmospheric and environmental pollutions. In order to reduce these impacts, two alternatives are currently considered: either to improve the combustion efficiency with considerable reductions in the pollutant emissions into the atmosphere or more significantly, to replace fossil fuel usage as much as possible with environmentally friendly, clean and renewable energy sources [1]. Among the various renewable energy sources, the use of gasified biomass that contains a mixture of carbon monoxide, hydrogen and methane, together with carbon dioxide and nitrogen, can be more versatile and attractive. It becomes essential, therefore, to develop combustion techniques that can burn the gasified biomass or low-grade syngas effectively and to understand chemical and physical properties of flames for such kind of fuels. Since the combustion characteristics of blended fuels may differ substantially from those of single-component fuels, therefore, the detailed investigations of flame structures and chemical kinetics of blended fuels are of vital importance. Literature survey indicates that no detailed investigation on the characteristics of H2/CO/CH4/air flames has been reported. Therefore, in the present study, the premixed H2/CO/CH4/air flames are studied to delineate its burning phenomena, flame structures, and chemical kinetics. The combustion characteristics of the stoichiometric, premixed H2/CO/CH4/air opposed-jet flames are experimentally and numerically investigated. Results show that the predicted flame temperatures and their spatial distributions are in good agreement with the measured data. The calculated laminar burning velocity indicates that the maximum value occur at the condition of 90% CO－10% CH4 and 94% CO－6% CH4 for 10% and 20% of H2 additions, respectively. Finally, we found that the reaction OH + CO H + CO2 plays an important role in H2/CO/CH4/air flames.

Keyword：Blended fuel, Chemical structure, Laminar flame speed