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Rate Ratio Asymptotic Analysis of the Influence of Hydrogen on the Structure and Mechanisms of Extinction of Methane Flames in Laminar Nonpremixed Flows KALYANASUNDARAM SESHADRI, Department of Mechanical and Aerospace Engineering, University of California at San Diego, XUESONG BAI, Division of Fluid Mechanics, Department of Energy Sciences, Lund University, Sweden, FORMAN WILLIAMS, Department of Mechanical and Aerospace Engineering, University of California at San Diego — Rate-ratio asymptotic analysis is carried out to elucidate the influence of hydrogen on the structure and mechanisms of extinction of methane flames in laminar nonpremixed flows. Steady, axisymmetric, laminar flow of two counter-flowing streams toward a stagnation plane is considered. One stream is made up of a mixture of methane, hydrogen, and nitrogen. The other stream is made up of a mixture of oxygen, and nitrogen. A reduced four-step chemical kinetic mechanism is employed. Chemical reactions are presumed to take place in a thin reaction zone that is established in the vicinity of the stagnation plane. On either side of this thin reaction zone, the flow field is inert. These inert regions are called the outer structure. The outer structure is analyzed first. It gives the matching conditions that is required in the analysis of the reaction zone. In the thin reaction zone chemical reactions are presumed to take place in two layers–an inner layer and an oxidation layer. In the inner layer methane is consumed and hydrogen and carbon monoxide are formed. In the oxidation layer oxygen, carbon monoxide and hydrogen are consumed. Critical conditions of extinction are predicted and are compared with experimental data and with results of numerical computation.

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