

MAE Praxair Seminar

Local Extinction in Diffusion Flame Sheets

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Local extinction can occur in nonpremixed flame sheets when spatial or temporal variations in the velocity, such as from turbulence, cause local fuel and air mixing rates to exceed the reaction rate allowed by the chemical kinetics. These extinguished holes in the reaction sheet can grow leading to global extinction or close via flame edge propagation. Recent experimental and numerical research on flame hole formation and edge dynamics will be presented. A co-annular burner has been designed to enable detailed study of the extinction process and flame hole propagation by stabilizing the local extinction point in a steady laminar flame. Numerical simulations of this 2-D flame have been performed using both simple global chemistry and detailed kinetics. The global chemistry simulations show that a higher scalar dissipation rate is required for extinction as compared to a stagnation flame. These simulations also show how the recession velocity of an extinguished flame hole depends on the local velocity and temperature field. The detailed kinetics simulations are used to assess the changes in fuel conversion pathways that occur through extinction. These simulations are compared to measurements of the temperature profile through extinction using line-imaging Raman scattering spectroscopy and to measurements of the hydroxyl and formaldehyde concentrations using planar laser-induced fluorescence.

Bio

Dr. Michael Renfro is an Assistant Professor and Director of Graduate Studies in the Mechanical Engineering Department at the University of Connecticut. He received his B.S. in Mechanical Engineering from the University of Tennessee, Knoxville in 1995 and his M.S. and Ph.D. degrees from Purdue University in 1997 and 2000, respectively. Prof. Renfro's research is in the area of optical diagnostics applied to power production technology, particularly combustion and fuel cell systems. Current research focuses on the development and use of laser-based measurement tools to study flame stability and propagation; ignition and extinction; turbulent flame statistics and numerical simulation validation; and sensor development for high temperature fluid systems. He is an NSF CAREER award recipient and has published over 30 journal and 50 conference papers.

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Seminar 3:30 pm – 4:30 pm