

SWATHI REDDY SHETTY, SINAN DEMIR, and V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV, 26505. Dynamics and Morphology of Premixed Flame Propagation in Channels: Effects of the Lewis Number and Thermal Boundary Conditions.

Equidiffusive combustion is a model, which is widely employed in analytical and computational studies, including those on premixed flame acceleration. However, realistic combustible mixtures are oftentimes far from the stoichiometry, being thereby strongly non-equidiffusive and thus requiring extra analyses. The present work addresses this demand by means of the computational simulations of the basic fully-compressible hydrodynamic and combustion equations. Specifically, here we focus on the non-equidiffusive flames at various thermal boundary conditions, including adiabatic or isothermal walls of the channels. A detailed parametric study is performed, with the key parameters of the problem being the Lewis number, Le , taken in the range $0.2 \leq Le \leq 2.0$, the thermal expansion factor Θ , being $5 \leq \Theta \leq 8$, and the flame propagation Reynolds number, $Re = R/PrL_f$, where L_f is the thermal flame thickness and Pr the Prandtl number. We used Re in the range $5 \leq Re \leq 30$. It is shown that while $\Theta \sim 8$ flames tend to accelerate exponentially in channel with adiabatic, nonslip walls; acceleration moderates to a linear trend for $\Theta \sim 5$. Moreover, with the isothermal walls, acceleration moderates (with hot walls) or even terminates (with cold walls). Furthermore, it is found that a non-unity Le influences the flame dynamics notably in both adiabatic and isothermal channels. Namely, $Le < 1$ flames get extra strong corrugation and thereby spread much faster than equidiffusive ones. In contrast, $Le > 1$ flames are thickened and propagate slower.

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