Kim, J.; **Chung, S. H.**; **Ahn, K. Y.**; **Kim, J. S.**

Simulation of a diffusion flame in turbulent mixing layer by the flame hole dynamics model with level-set method. (English) Zbl 1121.80320

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Summary: The partial quenching structure of diffusion flames, arising from the phenomenon of turbulent flame lift off, is investigated in a turbulent mixing layer by the method of flame hole dynamics. Modification of the flame hole dynamics by including the level-set method is specifically aimed to properly take into account the effect of slow flame-edge response near the crossover scalar dissipation rate at which the edge propagation speed vanishes. Simulating the flame hole dynamics with the level-set method results in two major improvements. The first improvement is observed in stabilizing lifted turbulent diffusion flames. The three necessary conditions for lifted stabilization are proposed and numerically tested to show that rapid variation of the edge propagation speed near the crossover scalar dissipation rate helps lifted stabilization. Secondly, an improvement in the statistical properties of the stationary turbulence reacting state is observed in that (1) the lift-off height is found to be higher because of the streamwise flow pushing the turbulent edge front to the downstream direction and (2) the partial burning probability, conditioned with the scalar dissipation rate, exhibits a realistic smooth transition across the crossover scalar dissipation rate.

MSC:

80A25 Combustion
80M25 Other numerical methods (thermodynamics) (MSC2010)
76F25 Turbulent transport, mixing

Keywords:

flame hole dynamics; flame edge; level set method; lifted stabilization

Full Text: DOI

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