

Chemical explosive mode analysis for a lifted ammonia jet flame in highly preheated and highly diluted air

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Chemical Explosive Mode Analysis (CEMA) [1] was performed to investigate the results of a two-dimensional numerical simulation, aiming to reveal the flame structure and stabilization mechanism of a lifted ammonia jet flame in highly preheated and highly diluted air. The target case was selected from simulations without any turbulence or turbulent combustion models, simulating a flame formed by injecting ammonia through fuel inlet (diameter: $D = 1.0$ mm) into air preheated to 1473 K and diluted to oxygen concentration of 6% at pressure of 1 atm. Figure 1 shows the two-dimensional distributions of temperature and the maximum eigenvalue of the Jacobian matrix of chemical reactions. As shown in Fig. 1(a), a flame base with a temperature exceeding 1600 K is observed at $x = 10D$ from the ammonia inlet at $(x, y) = (0, 0)$, indicating the formation of a lifted flame. In Fig. 1(b), a region with positive eigenvalues of the Jacobian matrix extends from the ammonia inlet to the flame base, suggesting the presence of a Chemical Explosive Mode (CEM) and indicating that the mixture is locally ignitable in the lifted region. Furthermore, relatively small positive eigenvalues are observed downstream of the flame base, which correspond to the flame front of the diffusion flame. In addition to the eigenvalue analysis, spatial distributions of the Damköhler number and Flame Index (FI) are also examined to further understand the flame structure and stabilization mechanism of the lifted ammonia jet flame in highly preheated and highly diluted air.

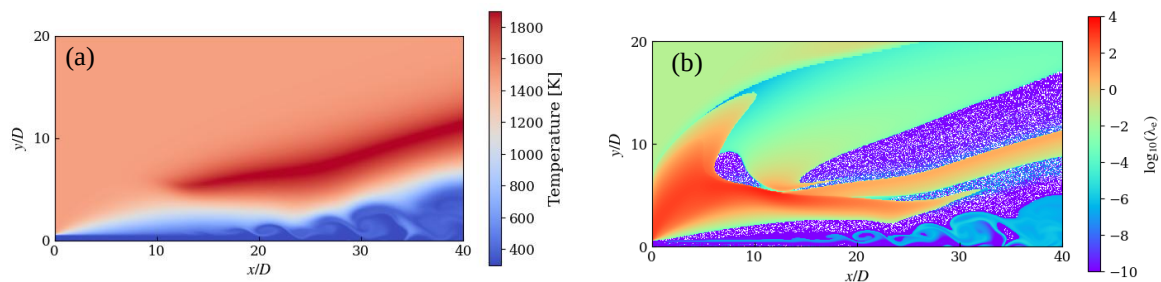


Fig. 1 Two-dimensional distribution of temperature and maximum eigenvalue of a lifted ammonia jet flame in highly preheated and highly diluted air.

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References

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