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A Computational Study on Chemical Characteristics of Bluff-body-stabilized Lean Premixed Flames[1] YU JEONG KIM, WONSIK SONG, FRANCISCO E. HERNNDEZ PREZ, King Abdullah University of Science and Technology (KAUST), BOK JIK LEE, Seoul National University, HONG G. IM, King Abdullah University of Science and Technology (KAUST), KAUST TEAM
— Bluff-body flame holders have been used to achieve stable combustion by recirculating hot product gases behind the holders in premixed reacting flow systems under highly unstable conditions. Despite assisting to improve combustion stability, holders also induce instabilities to flames and flow fields such as vortex shedding and blow-off. In the present study, high-fidelity direct numerical simulations are conducted to investigate flame dynamics behind a bluff-body in lean premixed mixtures and to understand the flame stabilization mechanism, in particular under hydrodynamic instabilities. A three-dimensional rectangular channel with a square-section bluff-body flame holder is selected as configuration. Several distinct flame instabilities are identified as the blow-off limit is approached. The sequence of key physical mechanisms, such as extinction and re-ignition, and combustion and chemical characteristics of the flames are also examined using the combined approach of computational singular perturbation and tangential stretching rate.

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