



DNS of freely-propagating lean hydrogen-ammonia premixed flames at elevated pressures: physical insights and modeling implications

Francisco E. Hernández-Pérez*, Hong G. Im

*Lead presenter: francisco.hernandezperez.1@kaust.edu.sa

King Abdullah University of Science and Technology, Saudi Arabia

Ammonia (NH_3), hydrogen (H_2) and their blends are promising energy carriers for decarbonizing power generation and transportation. To facilitate their adoption, fundamental understanding on their burning characteristics at different turbulent and pressure conditions is needed. In this study, direct numerical simulations (DNS) of freely-propagating turbulent premixed flames are considered for H_2 -air and $\text{NH}_3/\text{H}_2/\text{N}_2$ -air lean mixtures from 1 up to 10 atm, so as to gain physical insights into their propagation and structural characteristics, which are also affected by thermal-diffusive imbalances leading to the presence of thermal-diffusive instabilities. The flame speed enhancement, changes in heat release rate distribution, and variations in the conditionally-averaged flame structure with increasing pressure are all examined, emphasizing the role of the highly diffusive H_2 . Furthermore, implications for modeling such flames using flamelet-based approaches will be discussed.