Mechanisms performance for H_2/air burner-stabilized flames at various pressures

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The kinetic mechanism of hydrogen combustion is the most investigated combustion system. This is due to extreme importance of the mechanism for combustion processes, i.e. it is present as a submechanism in all mechanisms for hydrocarbon combustion systems. In spite of the progress made in understanding of the kinetics of hydrogen combustion there is a demand for further investigation of the detailed aspects of the flame-wall interaction under elevated pressure and under conditions of different wall and gas temperatures, local equivalence ratios etc.

The burner stabilized flame configuration can be efficiently used to study different aspects of chemical kinetics by varying the stand-off distance, pressure, temperature of the burner and mixture compositions. Moreover, the analysis of the unsteady dynamics of the burner stabilized flames can give a deep insight into transient processes in flames.

In the present work, a flat porous plug burner flame configuration is revisited. A hydrogen/air combustion system is considered with detailed molecular transport including thermo-diffusion and with 8 different chemical reaction mechanisms. Detailed numerical investigations are performed to single out the role of chemical kinetics on the loss of stability and on the dynamics of the flame oscillations. The results obtained for the burner stabilized flames are compared with the corresponding data for freely propagating deflagration waves. As a main outcome, it was found/demonstrated that the results of critical values, e.g. critical mass flow rate, weighted frequency of oscillations and blow-off velocity, with increasing the pressure scatter almost randomly. Thus, these parameters can be considered as independent and can be used to improve and to validate the mechanisms of chemical kinetics for the unsteady dynamics.