List of Tables

List of Figures

release rate (HRR) contours are shown at 0.7s, 0.9s, and 1.8s. Time is measured from the instant when the flame is at the burner rim. Syngas composition is 95%CO-5%H_2 with 51.8% N_2 dilution.

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Figure 11: Flame liftoff height versus N_2 dilution for five different syngas mixtures with CO mole fraction varying from 95% to 50%. The transition height at which the base structure changes from double flame to triple flame is indicated by a doted line. Fig. 11b shows the zoomed view of Fig. 11a at lower liftoff heights.

Figure 12: Flame liftoff height versus N_2 dilution for three different syngas mixtures with CO mole fraction varying from 95% to 70% and for two inflow temperatures of 298K and 473K.

Table 1: Properties at the triple point of lifted flames for different syngas compositions. Properties include the syngas composition in terms of CO (rest being H_2), fuel mixtue composition at the nozzle, liftoff height (L_h), axial velocity at the triple point (U_h), local (maximum) axial velocity upstream of the triple point (U_{max}), and computed laminar flame speed (S_L) for the given fuel mixture at equivalence ratio of unity.

	Fuel Molar Composition						
CO%	N_2	H_2	CO	L_h	U_h	U_{max}	S_L (473 K)
95	0.518	0.024	0.457	24.7	0.50	0.65	0.48
90	0.626	0.037	0.336	25.0	0.50	0.73	0.48
70	0.710	0.087	0.203	29.0	0.60	0.83	0.53
50	0.756	0.122	0.122	37.5	0.72	0.93	0.52

Table 2: Effect of syngas composition (specified in terms of CO and H2 mole fractions) and temperature on N_2 dilution (mole fraction) required for flame liftoff and blowout.

Temperature	CO	0.95	0.90	0.70	0.60	0.50
	H_2	0.05	0.10	0.30	0.40	0.50
T=298K	N_2- liftoff	0.30	0.44	0.60	0.64	0.68
	N_2-blowout	0.60	0.66	0.71	0.73	0.74
T=473K	N_2-liftoff	0.38	0.49	0.65	0.68	0.72
	N_2-blowout	0.59	0.66	0.73	0.75	0.76

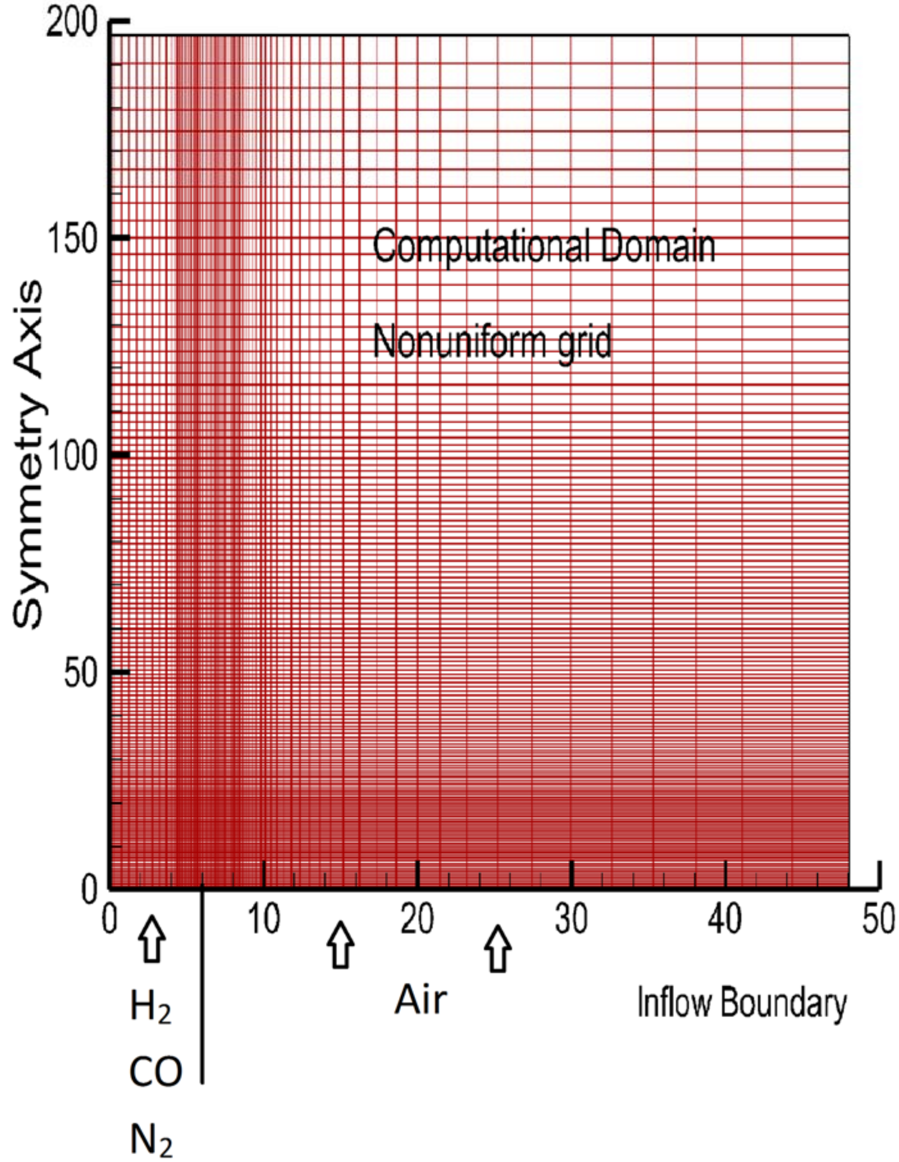


Figure 1: A schematic of the computational domain including the grid distribution and boundary conditions.

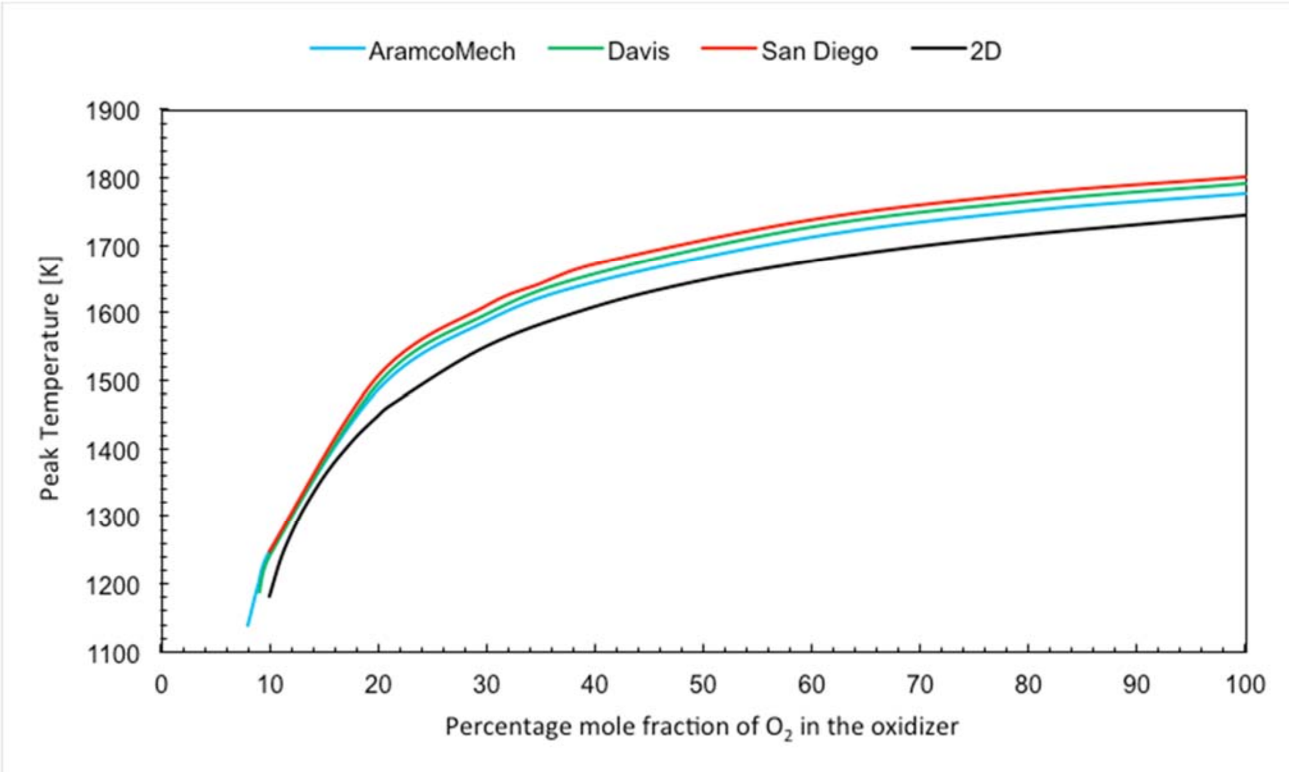


Figure 2: Effect of O_2 mole fraction in the oxidizer stream on the flame temperature corresponding to the extinction of opposed-jet syngas nonpremixed flames at a strain rate of 150 s^{-1}.

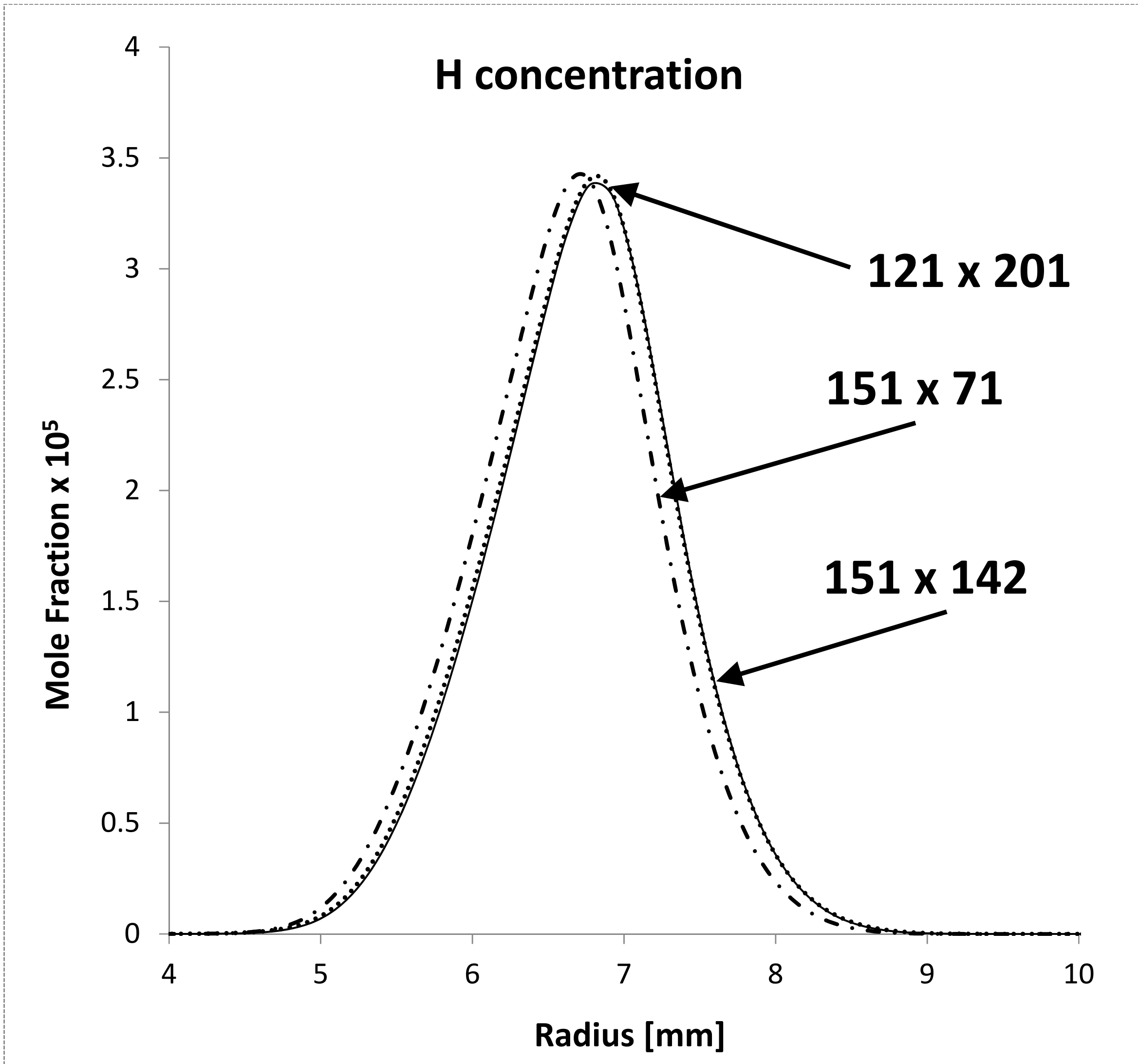


Figure 3: Radial profiles of H radical in a lifted syngas flame simulated using three different grids, **151x71, 151x142, and 121x201**. The flame is stabilized at 4mm from the burner rim. The syngas composition is 70%CO-30%H_2.

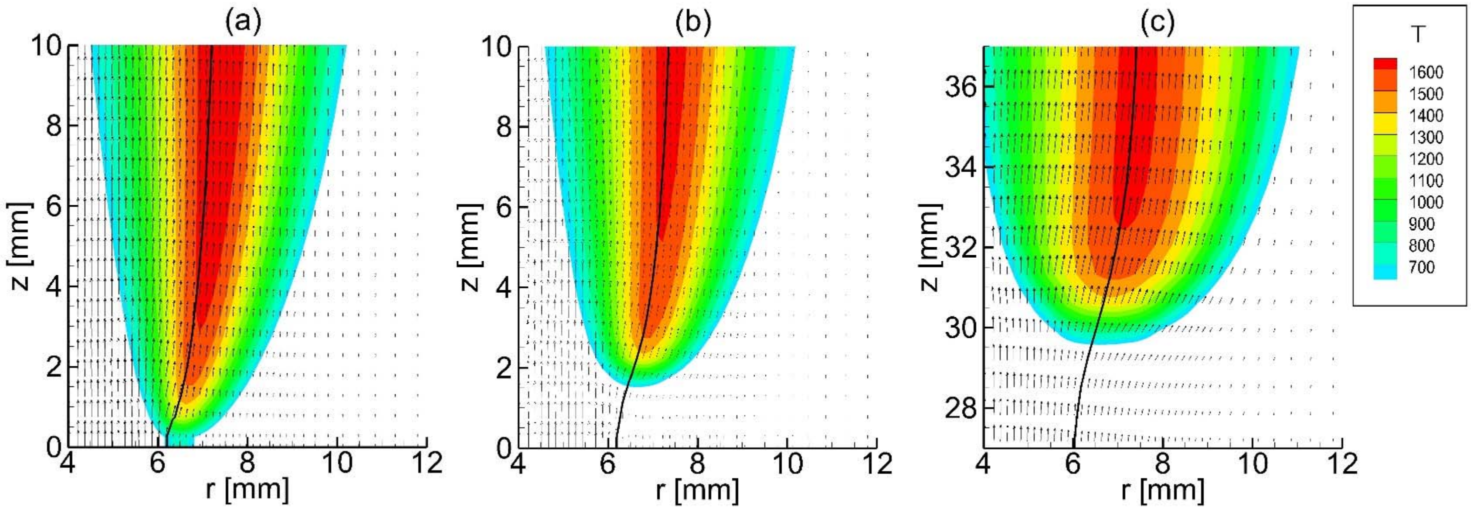


Figure 4: Iso-temperature contours and velocity vectors for three representative syngas diffusion flames with 65% (a), 68% (b), and 71% (c) N2 dilution in the fuel jet. The fuel and air jet velocities are 1.2 m/s and 0.2 m/s, respectively, and temperature is 473K. The stoichiometric mixture fraction (ξ_s) line is also shown in each figure.

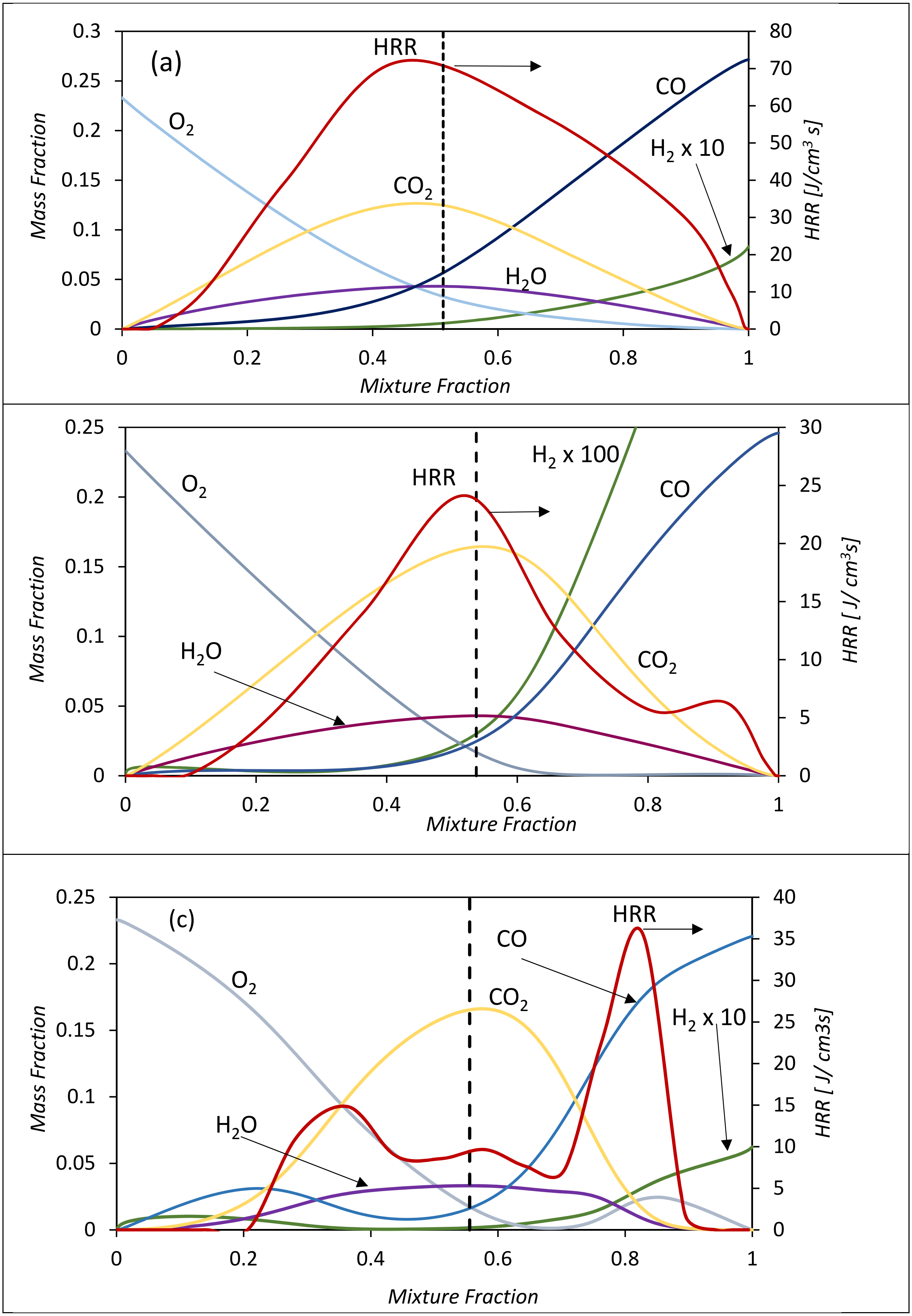

(a)
HRR
CO
O2
H2 x 10
CO2
H2O
Mass Fraction
HRR [J/cm3 s]
Mixture Fraction
0.3
0.25
0.2
0.15
0.1
0.05
0
80
70
60
50
40
30
20
10
0.2
0.4
0.6
0.8
1
H2 x 100
O2
HRR
CO
H2O
CO2
Mass Fraction
HRR [J/ cm3s]
Mixture Fraction
25
15
5
(c)
HRR
CO
O2
CO2
H2 x 10
H2O
Mass Fraction
HRR [J/ cm3s]
Mixture Fraction
40
35

Figure 5: State relationships in terms of HRR and species mass fractions with respect to mixture fraction for the three flames shown in Fig. 4. Vertical line indicates the ξ_s value.

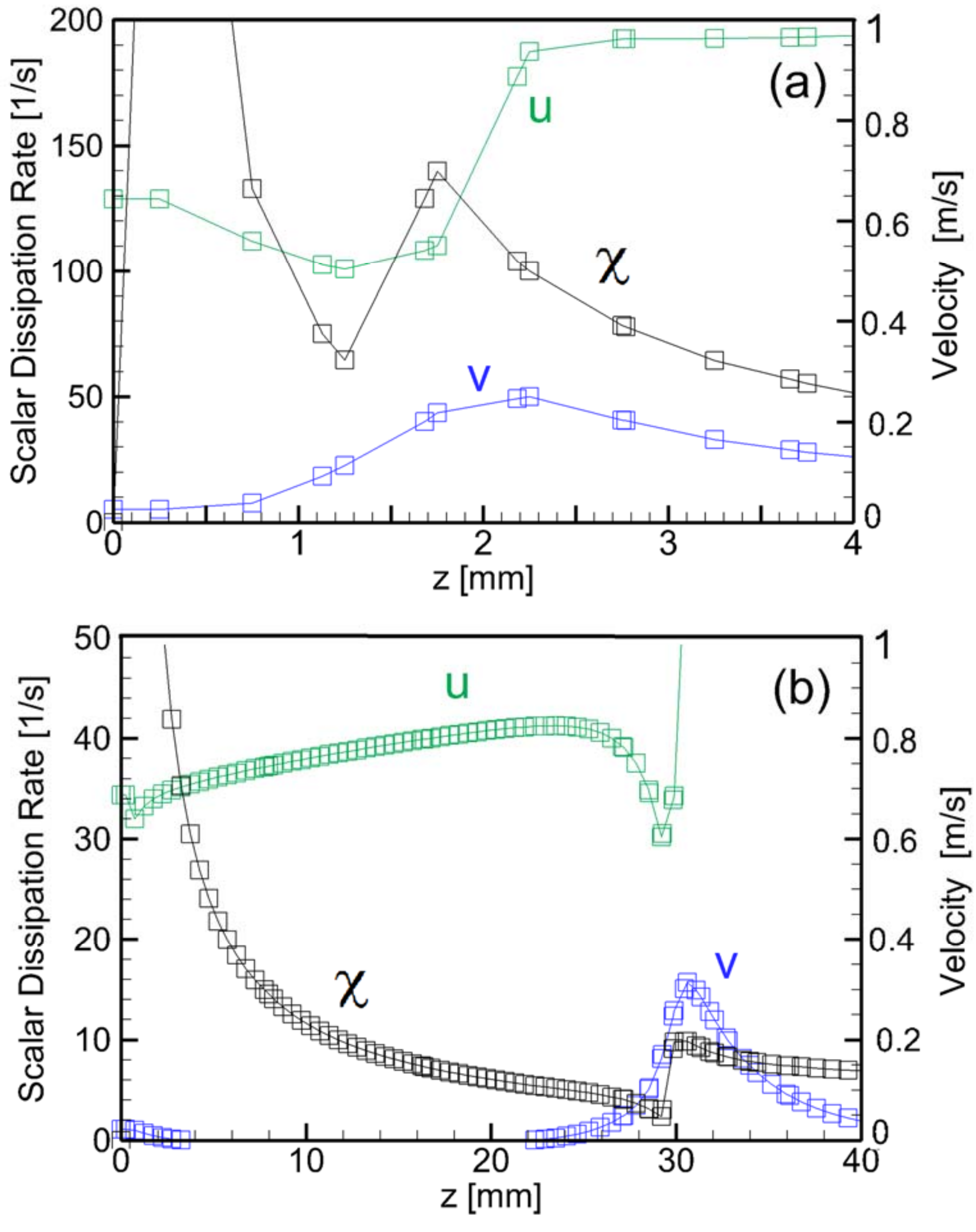


Figure 6: Scalar dissipation rate (χ), axial velocity (u) and radial velocity (v) plotted versus axial distance along the stoichiometric mixture fraction line for the two lifted flames shown in Fig. 4.

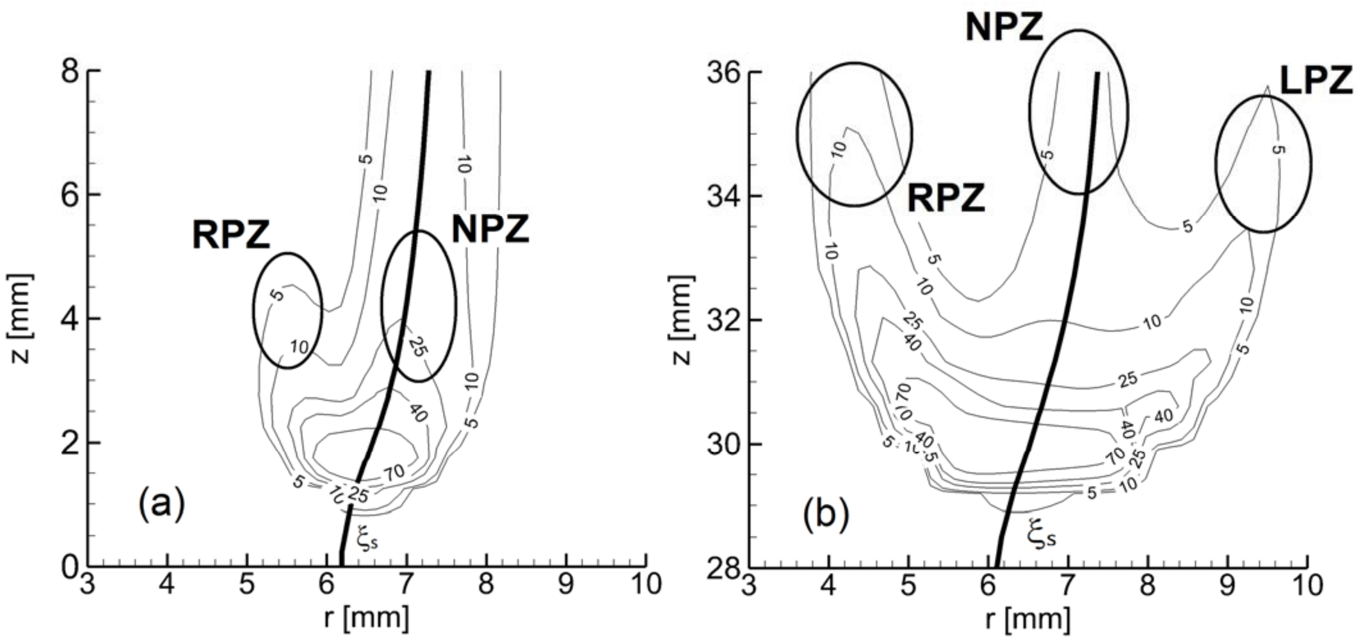


Figure 7: Volumetric heat release rate (HRR) contours for the two lifted flames shown in Fig. 4 with 68% N_2 (a) and 71% N_2 (b) dilution.

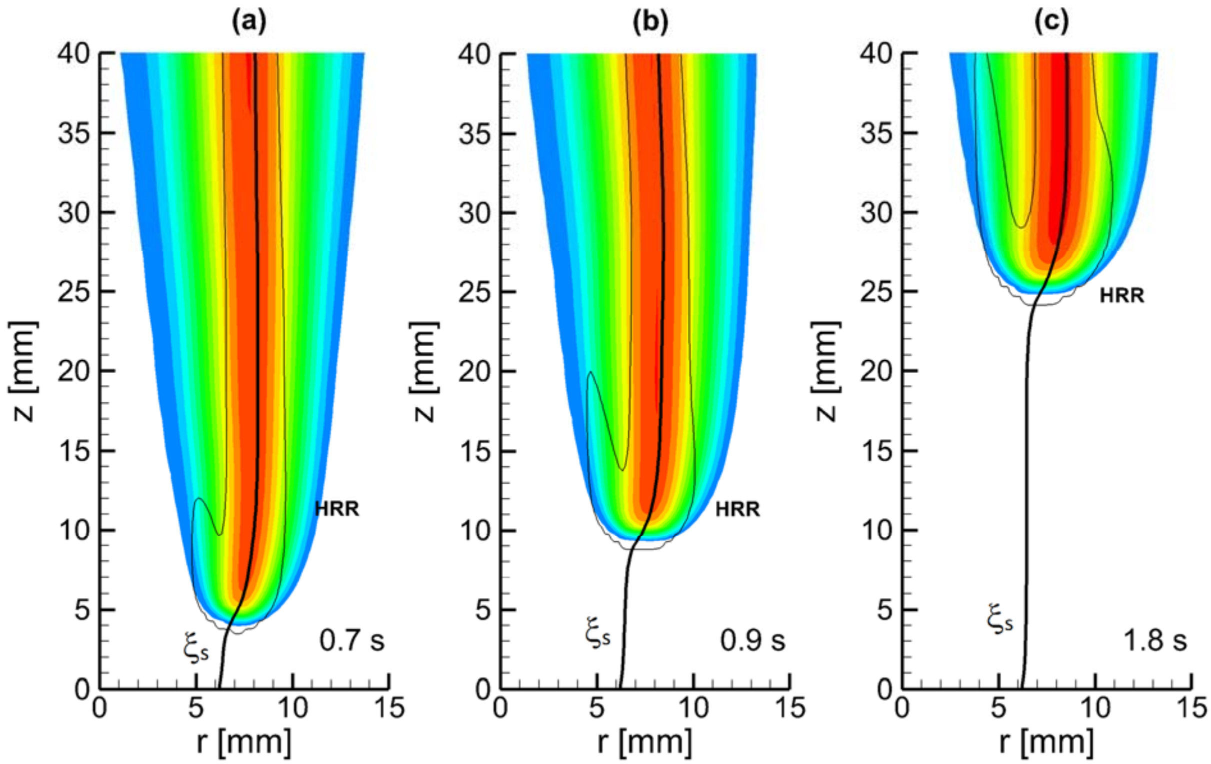


Figure 8: Temporal evolution of a flame during its propagation along the stoichiometric mixture fraction line. Instantaneous images in terms of temperature and heat release rate (HRR) contours are shown at 0.7s, 0.9s, and 1.8s. Time is measured from the instant when the flame is at the burner rim. Syngas composition is 95%CO-5%H_2 with 51.8% N_2 dilution.

(a) t=0.9s **(b) t=1.8s**

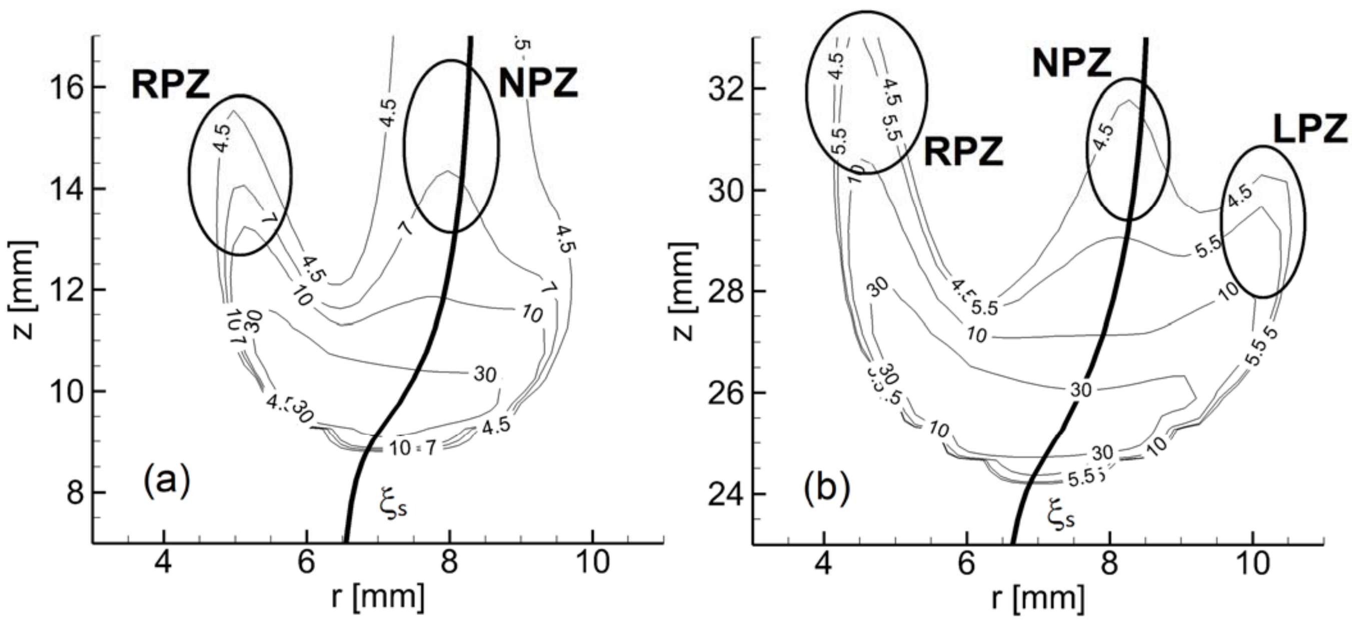
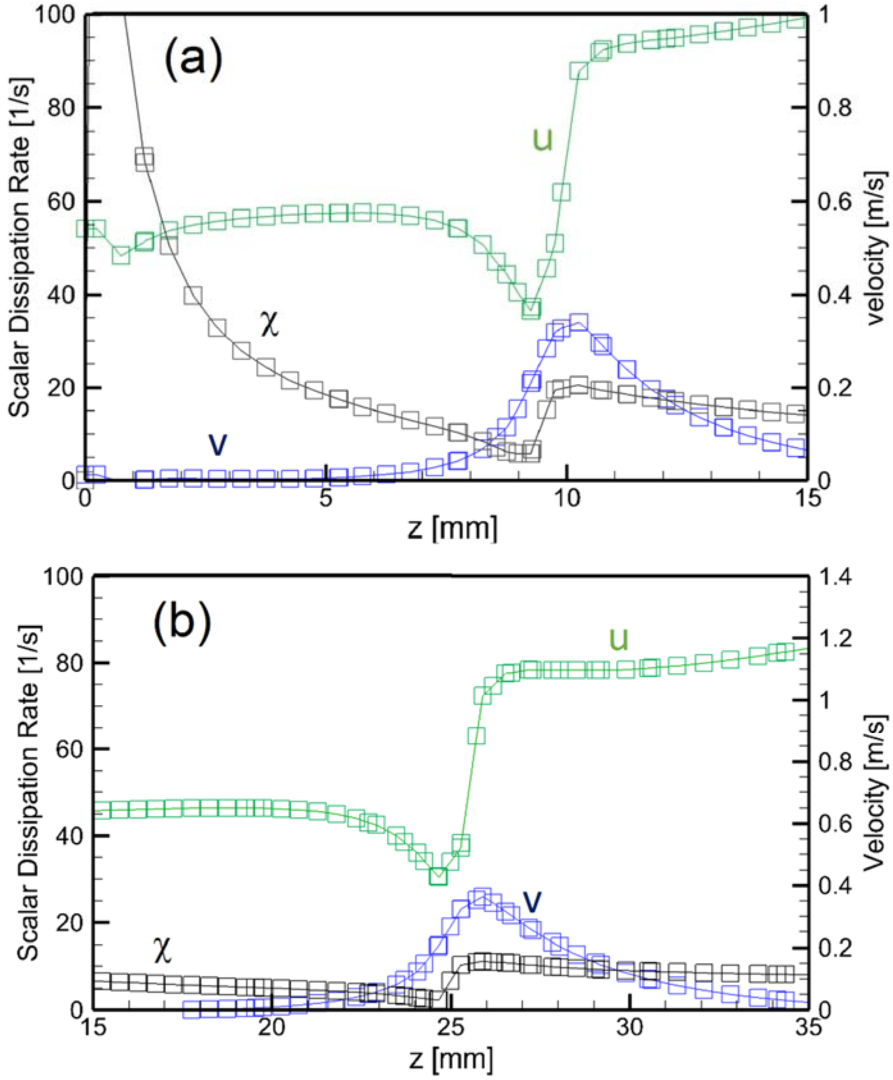


Figure 9: Volumetric heat release rate (HRR) contours corresponding to the instantaneous flames shown in Fig. 5 at 0.9s, and 1.8s.



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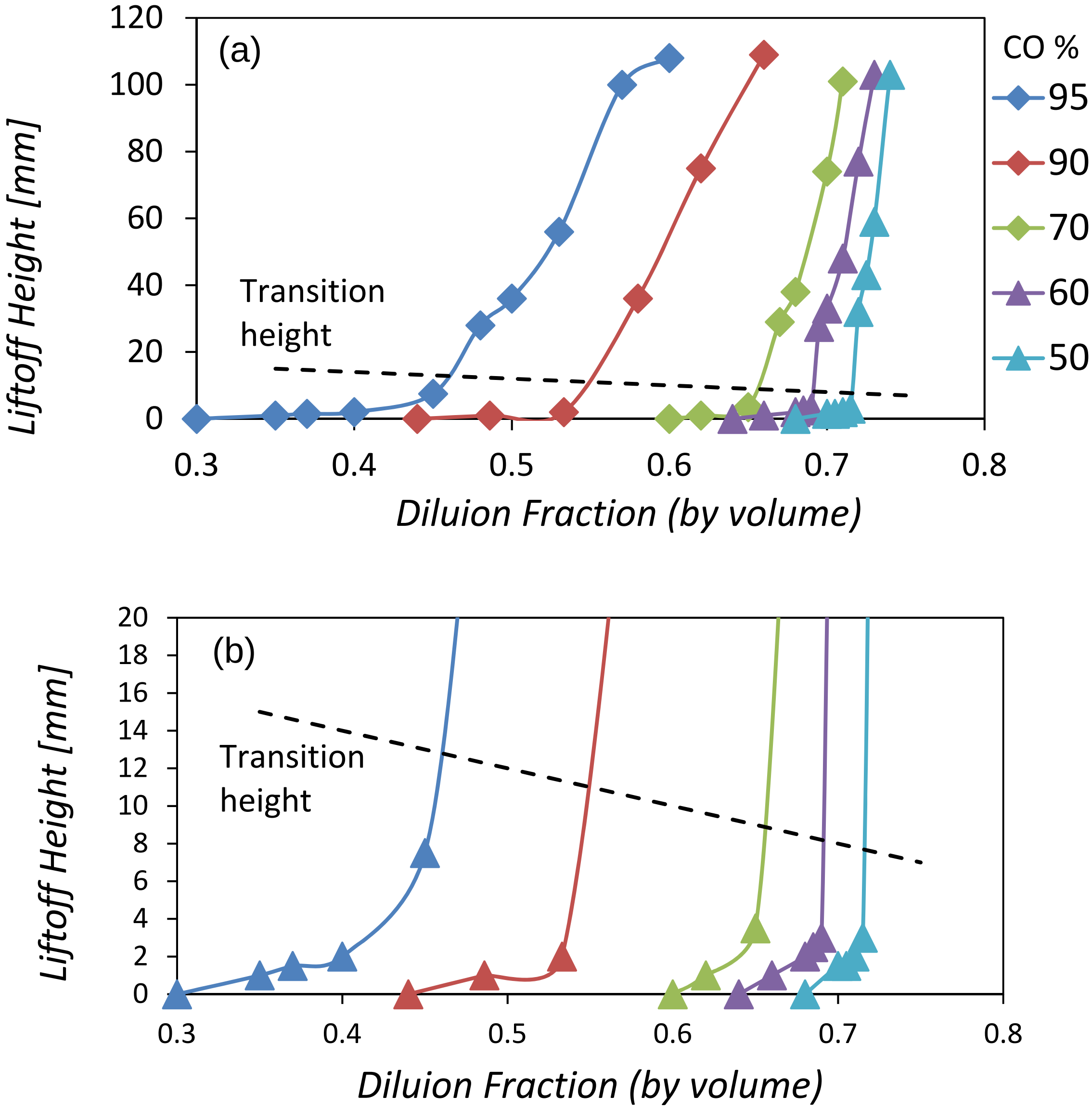

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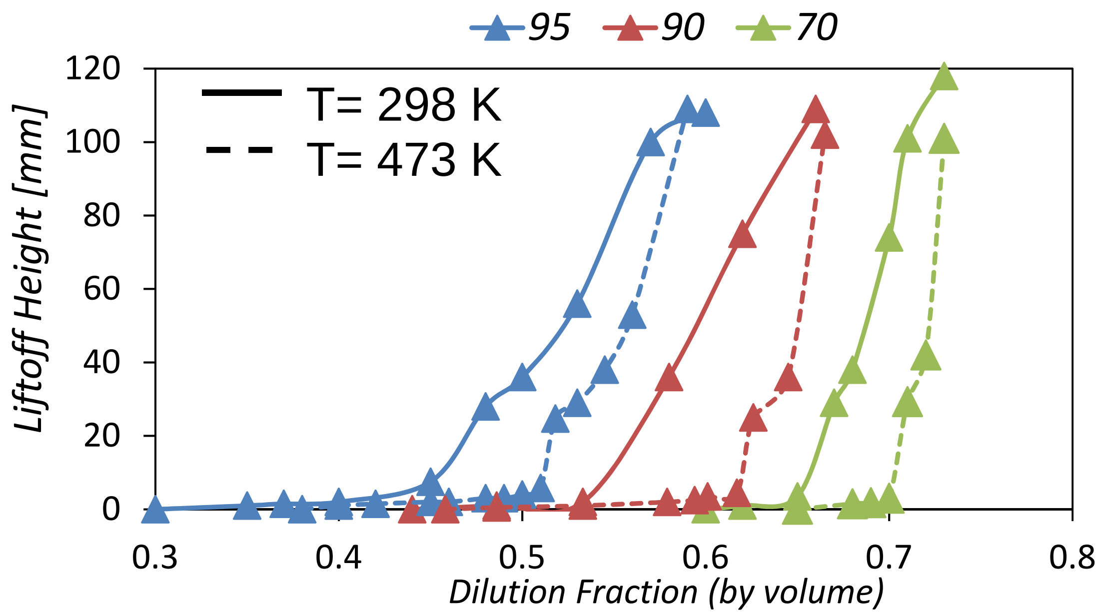

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