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Supporting document list:

1. The numerical simulations for the flow field validation in the SP-JSR
2. Description of the experimental setup
3. **Fig. S1.** (a) Schematic of the geometry of the SP-JSR jet arrangement. (b) Velocity distribution of the simulation at 800 K and 10 atm with fixed jet velocity of 40m/s for SP-JSR (left) and the OCI JSR (right) in a CH_4/air mixture. (c) The spatial cuts through the velocity field of the SP-JSR (left) and the OCI JSR (right). (d) Temporal evolutions of CH_4 mole fractions for the calculations of the mean flow residence time in the SP-JSR (left) and the OCI JSR (right).
4. **Fig. S2**. Temperature distribution of the SP-JSR
5. **Fig. S3. (a)** Temperature evolutions of C_3H_8, CO, CO_2, CH_2O, and C_2H_4 in the oxidation of 0.2%C_3H_8/13%O_2/86.8%N_2 with a fixed residence time of 0.4s at 10 atm. **(b)** Temperature evolutions of DME, CO, CO_2, CH_2O, and C_2H_4 in the oxidation of 0.2%DME/13%O_2/86.8%N_2 with a fixed residence time of 0.4s at 10 atm.
6. **Fig. S4.** Temperature evolution of the fuel mole fraction, n-C_4H_{10} by using Bahrini'e model and Li's model under the experimental conditions of case 1-3 in Table 1 of the main content.
7. **Fig. S5** Sensitivity analysis for *n*-butane without CO_2 addition at 740 K at 10 atm by using Healy's model.
8. **Fig. S6.** Sensitivity analyses for CO_2 in case 3 at 800 K and by using Healy's model.
9. **Table S1**. Experimental conditions of propane oxidation at 10 atm.
10. **Table S2.** Updated reactions in Healy's model