Flow Reactor Studies of Surrogate Jet Fuel Reaction Kinetics

C. T. Bowman, A. Bardos and S. Banerjee
Mechanical Engineering, Stanford University

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- Project Objectives
- Experimental Techniques
- Application to Fuel Kinetics Studies
- Future Directions: Flow Reactor Research

Sponsor: AFOSR/USC
Long-Term Stanford Program Objectives

- Build an accurate, multi-target, multi-species experimental database for combustion of practical jet fuels and surrogates utilizing a flow reactor and shock tubes.

- Collaboratively develop, evaluate and refine detailed kinetic mechanisms for single-component fuels, multi-component surrogate blends, and practical fuels to establish predictive capabilities for the kinetics of current and future jet fuels.
Experimental Conditions

- Initial temperatures: 1000 – 1300K
- Pressures: 1 – 20 atm
- Initial n-dodecane: 200 – 1000 ppmv
- Stoichiometry: \( \Phi \sim 0.2 - 2.0 \)
- Residence times: 20 – 100 msec
Major Species Profiles

- Comparison of data and JetSurf 0.2 simulations
- Duplicate runs and different species analyzers demonstrate experimental repeatability
- Measured reaction time scales are shorter than model predictions
Minor Species Profiles

- Comparison of data and Jet Surf 0.2 simulations
- Initial stages of reaction are dominated by formation of smaller hydrocarbon species and hydrogen
- Removal of these minor species is faster than predicted by JetSurf 0.2

$P = 1 \text{ atm}$
$T = 1187 \text{ K}$
$X_{\text{dodecane}} = 261 \text{ ppm}$
$\phi = 0.56$
Carbon Balance

Propene and 1-butene observed, but not yet quantified

- measured species

P = 1 atm
T = 1187 K
\( X_{\text{dodecane}} = 261 \text{ ppm} \)
\( \phi = 0.56 \)

\[ \frac{C_{\text{out}}}{C_{\text{in}}} \]

Time / ms
Accomplishments/Future Work

• Initial experiments conducted at temperatures intermediate between the Drexel flow reactor and Stanford shock tube.

• Comparison of data and model results shows a discrepancy in measured and computed time scales.

• Data from all three experiments provide targets for improvements in JetSurf.

• Flow reactor conditions will be expanded to higher and lower temperatures and to elevated pressures.