Summary of Flame Chemistry Discussion Session at the 1st Flame Chemistry and Transport Workshop

28-29 July 2012
Warsaw, Poland

Chairs:
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The Discussions Moved in the Direction of Trying to Understand the Major Roles and Directions with Regard to Flame Chemistry

Validation of Flame Chemistry Through Well Defined Platforms: The Intermediate Users of the Chemistry

What are the Major Burner Platforms?

1. Flat Flame/McKenna Burner
2. Counterflow Burner
3. Spherically Propagating Flame
4. Heat Flux Burner
5. Micro Tube/Reactor Flame
6. "Hencken" Type Burners
7. Others?

Challenges

Do these platforms provide the detail and quantification needed?

Can they produce all of the information that is sought?

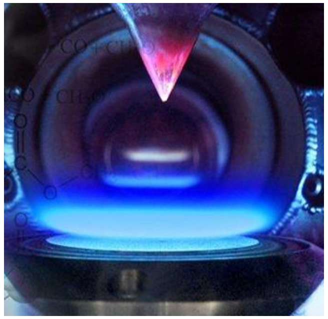
-Appropriate pressures and temperatures?

-1-D, steady?

-Optical and probe access?

Three Major Types of Platforms Used for Fundamental Flame Studies – Their Strengths and Weaknesses

1. Flat Flame Burner



-P≈0.03-1 atm
-molecular beam mass spectrometry measurements
-thickened flame zone for better spatial measurements
-how to clearly define B.C.'s, especially when using probes
-losses to burner surface (heat and radicals)
-higher pressures?

2. Counterflow Burner

-P≈0.5-5 (10?) atm
-ignition, extinction, flame speed measurements
-good optical access
-B.C. problems under certain conditions
-speciation measurements?
-higher pressures?

3. Spherically Propagating Flame

-P≈0.5-100 atm
-flame speed measurements
-limited to flame speed and structure measurements

Other Relevant Areas of Discussion

Diagnostics

Quantification of new diagnostic techniques

Intrusive vs. non-intrusive measurements, especially at high pressure

- -spatial resolution problems?
- -time scale of measurement and quenching dependence

Transport and Thermo-Chemistry at High Pressure

Challenge of transport parameters of large intermediate species

Can we pull upon rocket community (high P and T)?

Flames provide a means of validation → how can diagnostics help?

Turbulence?

What about turbulence and flame chemistry interaction?

Should this be tackled at this point?

Defining Questions of Discussion

1. Do the current platforms provide data under relevant conditions (high pressure with and without turbulence) with high enough fidelity?

2. Can we think about developing new platforms differently than what was thought of 20-50 years ago because of the advancement of diagnostic techniques?

We Find That There is Not a Lack of Data, But Rather a Lack of Clearly Defined and Quantitative Experimental Data

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How Can We Change?

The Way Forward - Two Paths:

1. Extend current techniques for higher pressure with and without turbulence and careful attention paid to quantification, systematic and measurement uncertainties, application of advanced diagnostics, etc.

2. Develop new "standardized" burner systems for high pressure flame studies
   -similar to how Sandia developed Turbulent Non-premixed Flames (TNF) library
   -clearly define boundary conditions
   -different types of burners to cover range of measurements
   -start at 1 atm and refine for higher pressures
   -heating and/or dilution at high pressure to thicken flame for better spatial resolution?
   -some intermediate between a flow reactor and flame regime?
   -1-D and steady

The combustion and diagnostics fields have advanced to a point of allowing us to "reinvent" how we think about experiments and their use for development and validation of combustion chemistry.