Ammonia Combustion Technology Group Meeting
November 7, 2023 1:00 pm EST - 3:00 pm EST

Original Agenda:

1. Introductory remarks (1:00 pm EST)
2. RTX Presentation by Paul Papas (1:10 pm EST)
3. RTX Q&A (1:30 pm EST)
4. GTI Energy Presentation by John Vega (1:40 pm EST)
5. GTI Q&A (2:00 pm EST)
6. ANL Presentation by Sreenath Gupta (2:10 pm EST)
7. ANL Q&A (2:30 PM EST)
8. Open Discussion (2:40 PM EST)
9. Closing remarks (by 2:55 pm EST)

Meeting Notes:

RTX, Paul Papas

- UConn counterflow flame experiments for extinction strain rate
- High-pressure staged reactor rig
- Chemical reactor network modeling
- Future - UConn turbulent flame speed rig, RTRC high-pressure staged reactor

Q&A

- Max residence time in RTRC rig?
  - Higher than 20 or 30 msec
- Jackie Chen - have you looked at differences in extinction strain rate in twin flame vs single strained flame; are you going to look at tubular flames, curvature stretch?
  - Don't have plans to look at another configuration for curvature effects
  - Currently with counterflow just looking at twin configuration, and will look at non-premixed later
  - Main concern now is to look at gas-turbine-relevant conditions
- Thomas Sattelmayer - question on reactor modeling, concerns that mixing in model is far from reality of mixing; poor mixing could contribute to higher NO
  - Will look at sensitivity of time scale of second stage; need long residence time in first stage to reach equilibrium - front end needs much higher residence time than typical combustor
  - Will also do CFD in near future
- Robert Steele - question about PFR1 residence time

GTI Energy, John Vega & Georgia Tech, Wenting Sun

- IDT and NO cross sections of NH3/H2 mixtures up to 20 bar
- Georgia Tech - Hencken burner, NH2/NH LIF
  - Higher pressure, higher temperature & higher residence time in rich stage help keep NO low
- CRAFT Tech turbulent premixed flame modeling
- Q&A
  - Paul Papas - for Wenting, how did he calibrate LIF to make quantitative
    - They are not quantitative, concentrations are proportional to LIF signal

    - Clint Bedick - are LIF measurements at same axial location?
        - Yes, because species are only produced in narrow region of flame
    - Mark Freeman - question about gas analyzer and sampling conditioning
        - CAI off-the-shelf analyzer, has different stacks, combination of chemiluminescence and FTIR measurement. Water in gas phase and no water knock out.
        - Intermediate species difficult to measure because they quench
    - Jackie Chen - in models, are you considering wall temperature, ammonia slip
        - No wall effect (wall is adiabatic) so no ammonia slip in idealized model. Get mostly H2 in second stage, not NH3. But in reality that would be likely.

Argonne National Lab, Sreenath Gupta

- Goal is to design scalable, low-cost, low-power, fuel preconditioning system
- CFD modeling of Purdue injector
- Q&A
    - Clint Bedick - are you considering lifetime of these catalysts?
        - Ni catalyst is cheapest and should last 40-50 years. Don't know durability of novel catalysts. Not much poisoning because you don't have carbon in the fuel stream.
    - Paul Glaser - Do catalysts ever see air, for instance during shut down or start up?
        - Don't expect the catalyst to see air
    - Rob Steele - how did you pick 80 bar?
        - Injection pressure should be greater than 60 bar (stationary GT combustor pressure). 80 bar is sufficiently above that pressure.
        - Paul Glaser - trend is towards increasing pressure ratio but would also want it suitable to other gas turbines at lower end of range
        - Clint Bedick - is it sensitive to pressure in the 80 bar range?
    - Bihter Padak - Any bench scale conversion data for your catalyst?
        - Those are proprietary.
    - Bihter Padak - how does the N2 from cracking affect the combustor?
        - Actually could be beneficial for the combustor that Purdue is using.