Experimental and Numerical Investigation of Ablation Kinetics

Research Objectives

- Both parties have extensive prior experience working with charring ablators, as well as a variety of other thermal protection system (TPS) materials.
- A partnership between these groups provides a unique opportunity to improve the state of the art in both experimental diagnostics and numerical simulation.
- UVM will develop and advance novel measurement techniques characterizing pyrolysis and ablation phenomena.
- UMich will utilize an already developed flow model framework of the UVM 30 kW ICP Torch Facility with UVM data to advance numerical techniques.

Research Team:

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Approach

- Develop novel sample holder for quasi-steady ablation and pyrolysis experiments.
- Perform LIF, PLIF, DLAS and emission measurements of key BL pyrolysis gas species in UVM 30 kW ICP.
- Use UVM expertise to extract key species reaction rates from gradients measured spectroscopically within the boundary layer.
- Use UMich numerical capability to simulate above experimental physical processes.
- Compare experimental and numerical results to assess accuracy of the physical models and to suggest improvements in them as needed.

Potential Impact

- Provide benchmark data sets required to construct and validate pyrolysis gas chemistry models.
  - Such data sets are not currently available.
- Increase the accuracy of the gas-phase chemistry models embedded in NASA ablation codes.
  - This will result in higher fidelity simulations of ablator performance and ablative TPS sizing.
- Successful implementation of such measurement techniques in the UVM 30 kW ICP Torch Facility will likely lead to their development for the NASA Arc Jet Facilities.