

Bridging Experiments and Simulations: Stagnation Flow Reactor Studies on Vitreous Carbon Ablation



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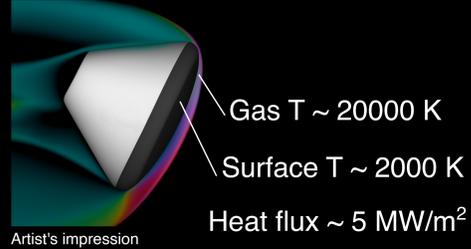
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Context

Thermal Protection Systems (TPS) are required to survive extreme conditions at re-entry

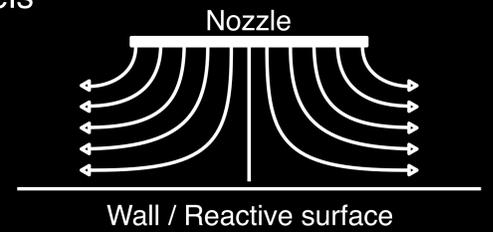


Vitreous carbon has been studied as a material representative of actual heat shield ablative materials



The **Air-Carbon Ablation (ACA)** model is a surface chemistry model with 20 reactions and 3 adsorbed species

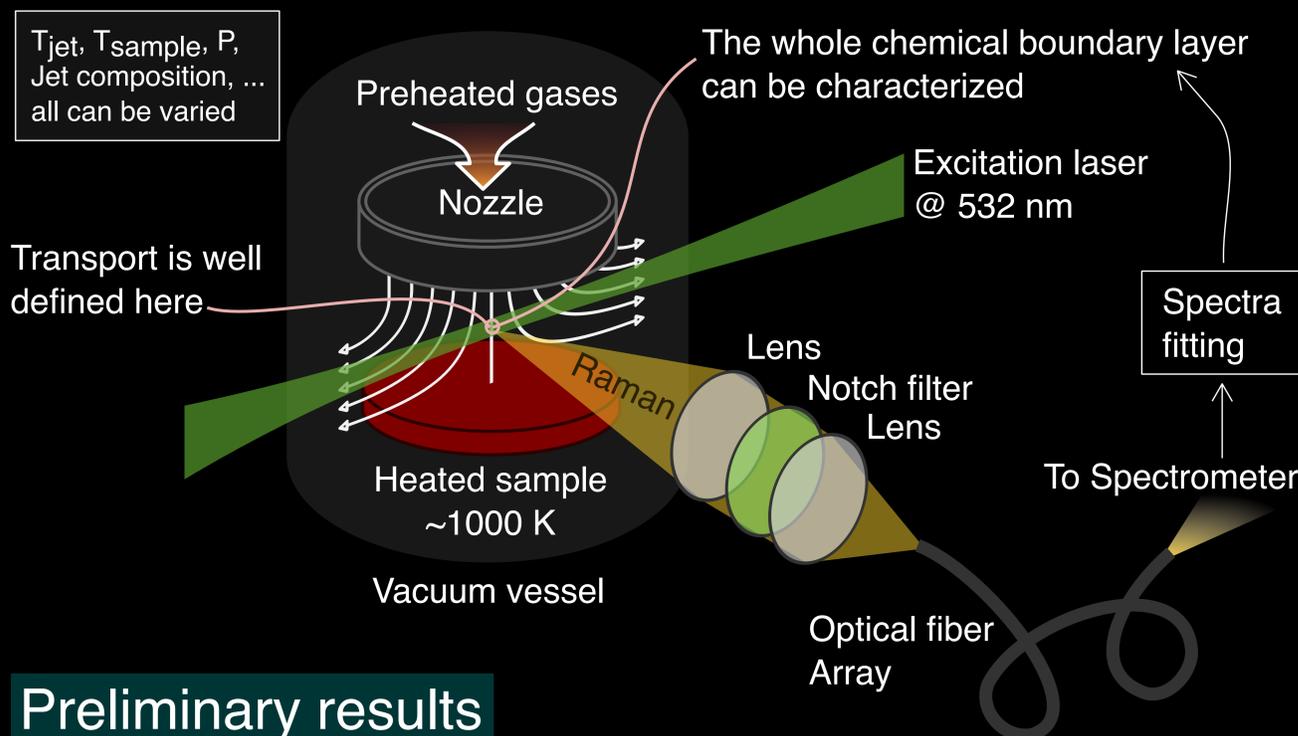
We propose experiments based on an **impinging jet configuration** for material testing and validation of chemical kinetics models



Project goals

1. Develop **spectroscopy-based** framework for material testing
2. Start with studying **vitreous carbon**, for which **models** already exists
3. Study materials by focusing on **gas-phase measurements**

Experimental setup



Numerical simulations

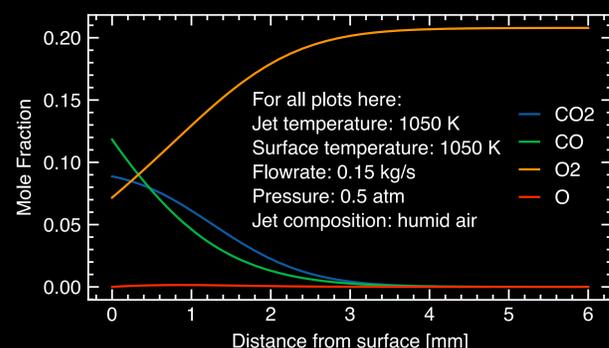
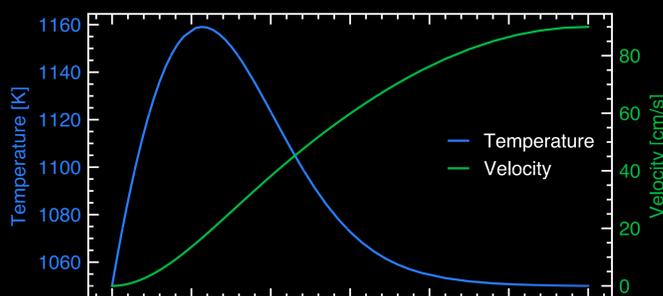
Reactor: 1D impinging jet



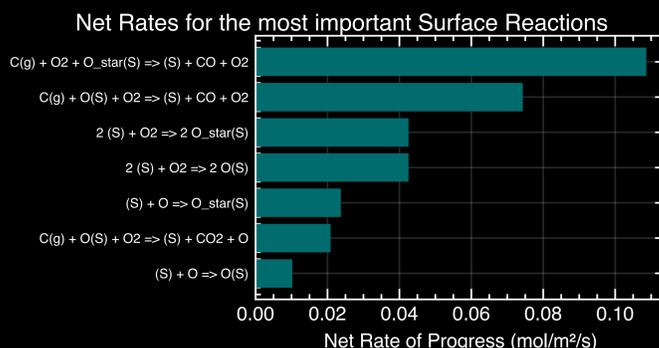
Gas phase	GRI Mech 3.0
Surface phase	ACA Model
Bulk solid carbon phase	

Preliminary results

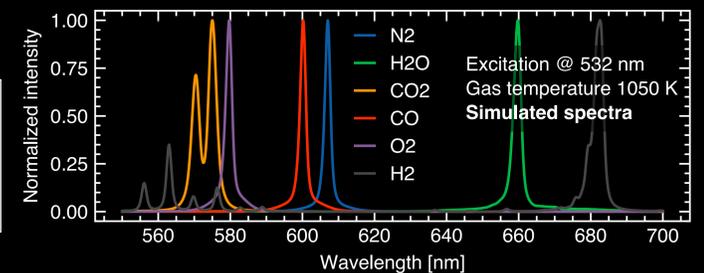
Numerical simulations of a chemically reactive stagnation flow (impinging jet)



Scan to access interactive chemical kinetics simulations based on the ACA model

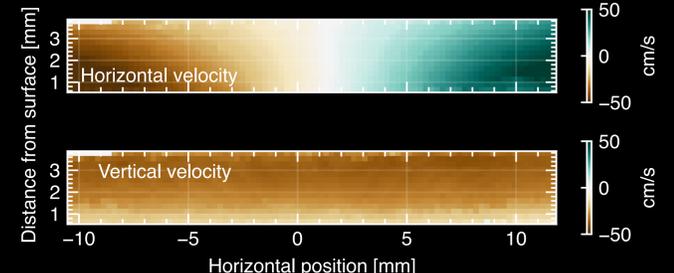


Example of spontaneous Raman scattering



Flowfield measurements - PIV

They need to match with the simulations!



Planned work

1. Measure chemical boundary layers to validate/refine the ACA model
2. Extend the same procedure to other relevant materials
3. [Long term] Introduce plasmas for adding excited species and additional thermal loading

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References

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