Dedicated to mixing, vaporization, and combustion of hypergols

Developed for MMH/NTO compatibility

Designed with support from DoD, industry, Purdue fire protection engineers and industrial hygienists

Recent experiments:

- Ignition and combustion experiments with unlike doublet electromechanically driven injection system in 360° optically accessible combustion chamber
- Viscosity measurements at rocket injection conditions (for gels & suspensions in liquids)
- Drop size and OH distribution measurement with MMH/air diffusion flame
- Drop size and temperature measurements under NTO environments
- Time resolved IR and UV spectrometry of MMH/nitric acid
- Development of reaction kinetic sets and liquid to ignition CFD models
- Dynamic meshing, run time balancing, and phase tracking in OpenFoam based models of hypergolic ignition

### MAJOR EQUIPMENT

- 1300 CFM ventilation system with 3 fume hoods and a portable canopy hood
- Ignition/combustion setup with µm and µs injection resolution at up to 120 ft/s injection velocity
- Agilent Cary 680 FTIR with ATR spectroscopy
- Streak camera coupled UV spectrometer for 200 nm to 900 nm sweeps over 100 ns to 30 ms at up to 40 ps resolution
- Resodyn LABRAM mixer, 500 g mixing capacity
- 5kHz OH PLIF laser diagnostic capability
- Dedicated LABView based data acquisition and control
- MMH and NO₂ gas analyzers (Dräger Pac III and Interscan 4000)
- Capillary rheometer capable of shear rate up to 10⁶ s⁻¹

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Hypergolic Propellants Lab

https://engineering.purdue.edu/Hypergol/
Dedicated to design, development, and characterization of hydrogen storage systems and materials

Research supporting industry, DoD partners, and national and international laboratories

Recent experiments:
- Storage of hydrogen gas in high pressure metal hydrides and chemical hydrides (automotive and aerospace applications)
- Development of metal hydride heat pumps for stationary heat recovery
- Magnesium hydride characterization
- H₂ storage in cryogenic sorbent materials
- In-situ thermal property measurement
- Hydride phase field modeling

In Situ Thermal Property Measurement
- Designed for operation at up to 630 bar H₂ gas
- Wide sample size range
- Study enhancement of metal hydride conductivity with polymers, metals, and carbon nanotubes

In-situ MgH₂ Characterization:
Modular hydride reactor system with:
- Optical access (visible and IR)
- Bed force and expansion measurements

Metal & Chemical Hydride Reactions
- Multiple kilogram scale hydrogen storage systems at pressures up to 410 bar; remotely controlled
- Analytical and CFD models of the filling process match experimental results

Volumetric Gas Absorption (Sievert) System
- Hydrogen absorption up to 700 bar
- Pressure-composition isotherms (PCI) and kinetics of H₂ storage materials
- Rated from -30°C and 80°C using thermoelectrics

Major sponsors: General Motors, DoE, DoD, Industrial Technology Research Institute (ITRI) of Taiwan