High Pressure Hydrogen Storage Systems

Bulk Hydrogen Storage System
- 22 ft³ of 6000 psi hydrogen storage
- Dual stage compressor
- Sized for propulsion and automotive applications
- Remotely controlled

High Pressure Metal Hydride Testing Facility
- Multiple kilogram scale hydrogen storage systems
- System rated to 410 bar; remotely controlled
- Storage systems designed and successfully tested to fill hydrogen within 5 min
- Analytical and CFD models of the filling process that accurately match with the experimental results
- 10 kW chiller (max. flow rate 60 liters/min from 0 to 30°C)

Glovebox Workstation
- 6 port glovebox
- Argon atmosphere maintained at < 0.1 ppm H₂O and < 0.1 ppm O₂
- 1.5 m³ of working space

Storage of Hydrogen Gas in High Pressure Metal Hydrides
- Multiple kilogram scale hydrogen storage systems
- System rated to 70 bar & 77 K
- High instrumentation channel capability

Hydrogen Storage in Cryogenic Sorbent Materials
- Multiple kilogram scale hydrogen storage system
- System rated and operated at 70 bar & 77 K

Research in collaboration with General Motors
**High Pressure Sievert System**

- Characterize hydrogen storage materials at pressures and temperatures expected for vehicle operation
- Study metal hydrides (TiCrMn and LaNi₅)
- Ongoing project to study adsorbent materials at room temperature and high pressure

**SYSTEM SUMMARY**

- Hydrogen absorption up to 700 bar H₂ gas
- Operates between -30°C and 80°C using computer-controller thermoelectric coolers
- Verified with LaNi₅, a well-known hydrogen storage material

**In Situ Thermal Property Measurement**

- Measure thermal conductivity, thermal diffusivity, and volumetric specific heat of powders, pellets, and composite materials via transient heating methods (plane source and hot wire methods).
- Knowledge of these properties is critical for the utilization of solid-state materials for hydrogen storage.

**SYSTEM SUMMARY**

- Designed for operation at up to 630 bar H₂ gas
- Wide sample size range
- Precise measurement of thermal conductivity from insulators to electronic conductors
- Study enhancement of metal hydride conductivity with polymers, metals, and carbon nanotubes

**Metal hydride-carbon nanotube composite**

Research in collaboration with General Motors

Prof. Timothée Pourpoint, timothee@purdue.edu (765) 4949423
Prof. Timothy Fisher, tsfisher@purdue.edu (765) 494 5627

http://engineering.purdue.edu/H2Lab
Measure hydrogen yield and kinetics of chemical hydrides and derivatives at 1/10\textsuperscript{th} gram scale, including thermolysis and hydrolysis of:

- Ammonia Borane (NH\textsubscript{3}BH\textsubscript{3}, AB)
- Water and Ionic Liquid based AB slurries
- Sodium borohydride, NaBH\textsubscript{4}

Heated bath reactor for thermolysis & hydrothermolysis of chemical hydrides

**Multiple Gram Reactor**

- Analysis of industrial scale-up with a multi-gram pellet reactor
- Quantification of reaction yield and kinetics
- Demonstration on a mobile platform, fueling a hydrogen internal combustion engine
- Ammonia sequestration for fuel cell applications

Above: Multi-gram thermolysis reactor
Below: H\textsubscript{2} yield rates in stainless-steel & glass reactors. Temperatures refer to heater set point.

Research in collaboration with the US Department of Energy

Prof. Jay Gore, gore@purdue.edu
Prof. Timothée Pourpoint, timothee@purdue.edu (765) 494 9423