



Hydrogen transport in yttrium hydride under asymmetric heat

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Changing the World's Energy Future

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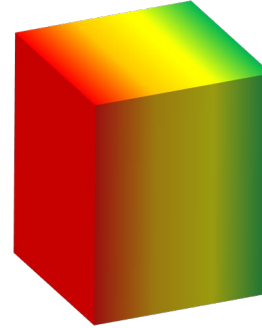
Hydrogen transport in yttrium hydride under asymmetric heat

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Background

- Hydrogen diffusion in metals is driven by:
 - A hydrogen **concentration gradient**:
$$-D\nabla c$$
 - A **temperature gradient**:
$$-D \frac{Q^*c}{RT^2} \nabla T$$
- Thermal diffusion (Soret effect) is often neglected because:
 - Assumed uniform temperature.
 - The Soret coefficient is unknown (experiments are difficult).
- The need to consider the Soret effect:
 - Any hydrogen situation where there is a temperature gradient.
 - Any pin or tube e.g. hydrate moderator
 - Fusion plasma facing surfaces.



Diffusion model

$$J_{dif} = -D\nabla c - D \frac{Q^*c}{RT^2} \nabla T$$

$D[m^2s^{-1}]$ = diffusivity

$c[m^{-3}]$ = dissolved Q atom concentration in metal

$Q^*[J mol(Q_2)^{-1}, or J m^3] =$ Soret coefficient

$R = 8.3145 \times 10^{-3} kJ mol^{-1}K^{-1}$

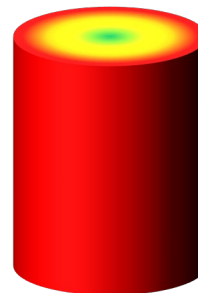
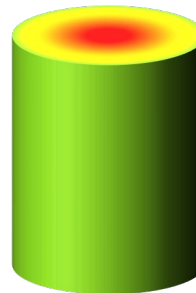
$T[K]$ = temperature

Experiments are difficult

- Imposing a temperature gradient causes the hydrogen to redistribute.
- Releasing the gradient will cause the hydrogen to redistribute, again.
- Possible solutions.**
 - Assess the hydrogen distribution while a temperature gradient is imposed.

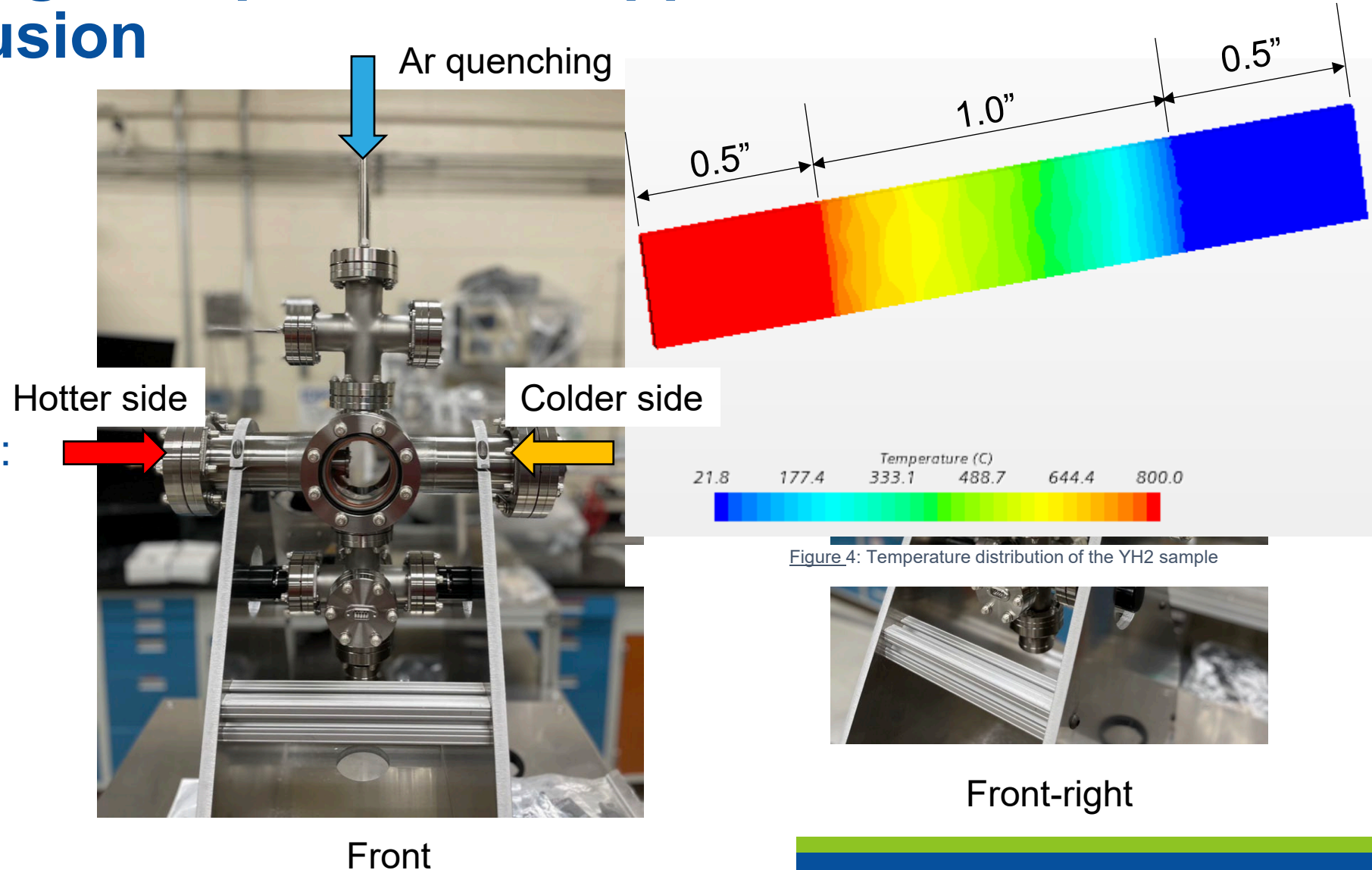


Quench the sample.



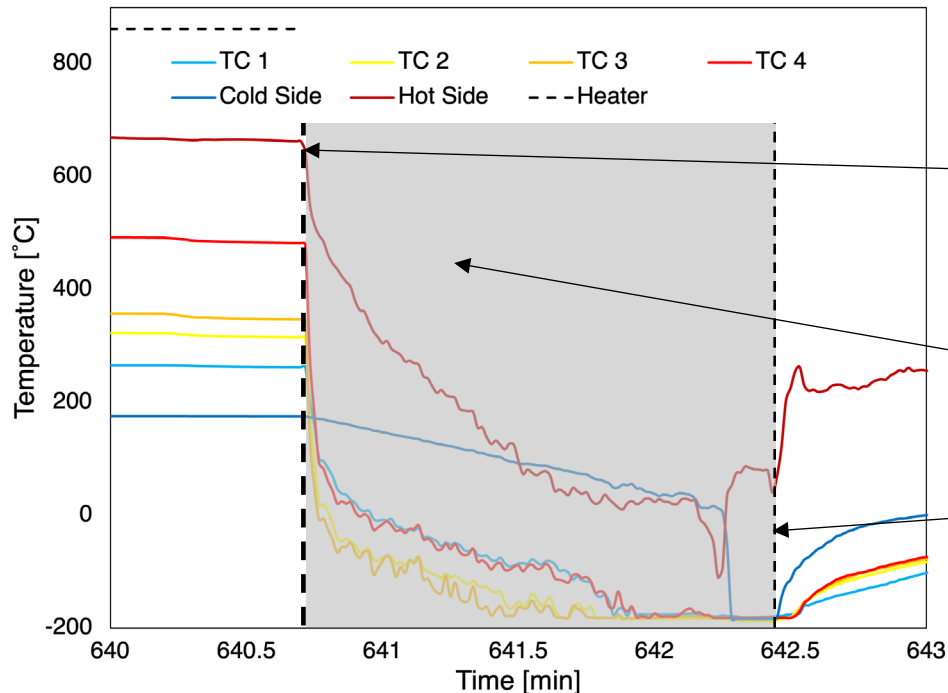
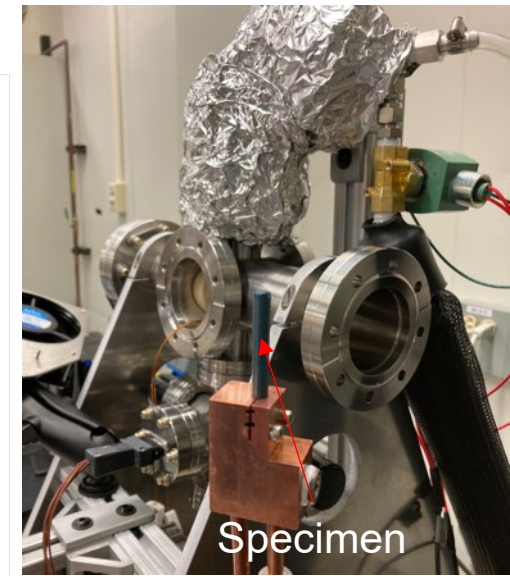
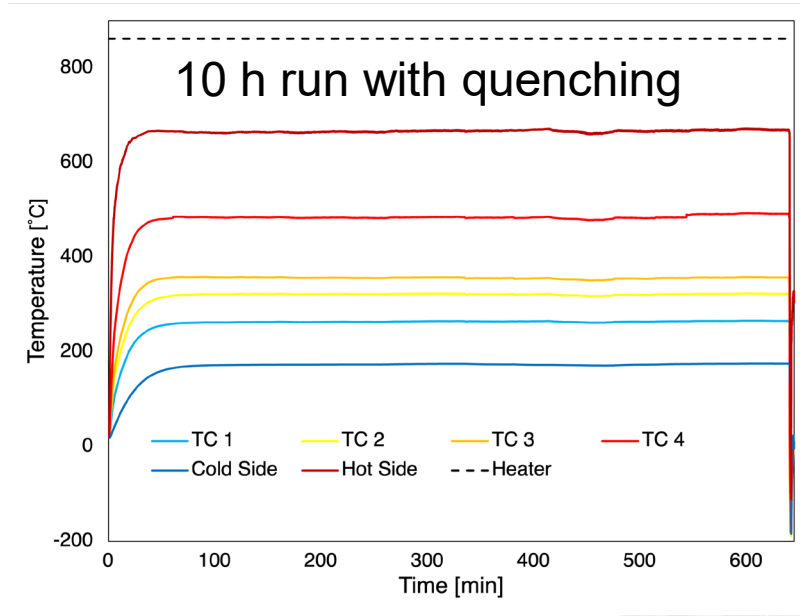
HEATD Hydrogen Experimental Apparatus for Thermal Diffusion

- Hotter side temperature:
 - Heater is able to reach closer to 1000°C.
 - Planned: ~900°C
- Colder side temperature:
 - Heater is able to reach closer to 1000°C.
 - Can range from RT to close to hot side temperature



Current status and Experiments of HEATD

- Successful set up of system
- Successful heating for 1h, 10h, 100h and subsequently liquid Ar quenching



Liquid Ar quenching starts, Heater off

Quenching and specimen disassembly

Specimen is out quenching is stopped

