Fed. funding:	$1.6M
Length	24 mo.

A Novel Hollow Fiber Membrane Reactor For High Purity H_2 Generation From Thermal Catalytic NH_3 Decomposition

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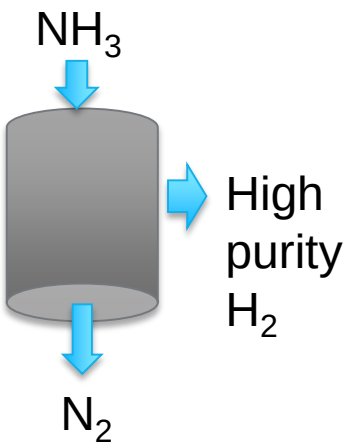
Project Vision

We are solving the challenge of high purity H_2 production from NH_3 decomposition by designing a novel, self-sustained hollow fiber membrane reactor running at <450 ^oC.



Project Impact

The technology, if successful, is expected to solve H_2 transportation and storage problems by using NH_3 as an effective H_2 carrier for PEM fuel cell application, and may open potential markets utilizing H_2 as a fuel.

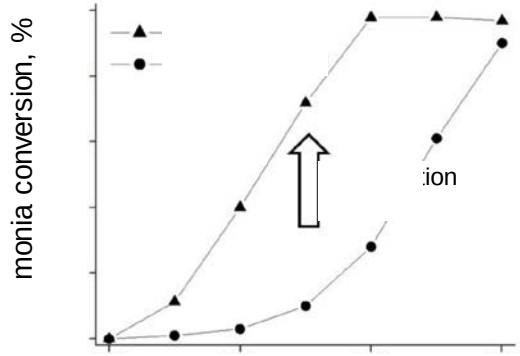
Innovation and Objectives

Innovation

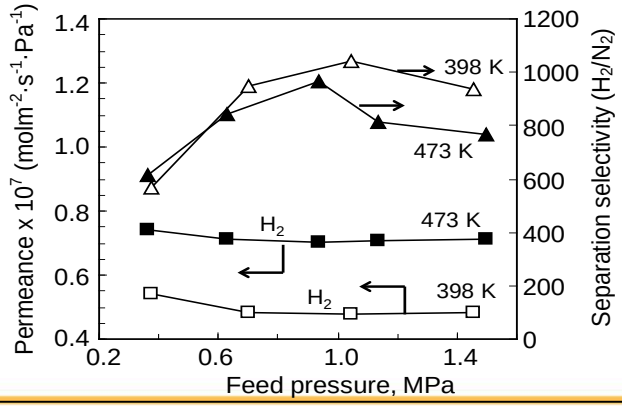
Novel membrane reactor:

- Lower cost and active Ru-based catalysts
- Highly selective H_2 membranes
- High packing-density hollow fibers.

Catalysts



Membrane



Task outline, technical objectives

Component Development and proof-of-concept:

- Ru-based catalyst development (USC and GTI; Q1-Q6)
- H_2 selective membrane (RPI and GTI; Q1-Q6)
- Equilibrium reaction shifting (RPI; Q5-Q6)
- Mini membrane reactor: (GTI; Q3-Q7)

Tech-to-Market strategy

- Develop technology from TRL-2 to TRL-5
- Fabricate modular system, and minimize manufacturing and scalability risks
- Secure IP, and identify next phase funding
- Solicit industrial partners assisting in the future development and value creation
- Anticipated first markets: 2024

Innovation and Objectives

Project history

- Prior collaboration between YU (PI) and LI (co-PI) on three DOE (ARPA-E or NETL) projects
- Ru-based catalyst developed in Lauterbach's group
- H_2 selective membranes developed by YU (PI)
- Experience/expertise on high-temperature membrane reactors of LI (co-PI)

Proposed targets

Metric	State of the Art	Proposed
Size	7.5 L H_2/min	10 L H_2/min
Temperature	480-660 ^oC	350-450 ^oC
H_2 generation rate, g H_2/h/cm^3	0.126	>0.15
H_2 purity	~25%	>99%
Cost of H_2 delivered at 30 bar	N/A	<$4.5/kg

Anticipated challenges

- Membrane permeance and selectivity: ultrathin molecular layer deposition (MLD) coatings will be used
- NH_3 <100 ppb level in product: a H^+ form ion exchange resin or commercial adsorbent may be used

Desirable partnerships

- **Current phase** (4/2017-3/2019): ceramic membrane company Media and Process Technology Inc. (MPT)
- **Prototype** (4/2019-9/2020): MPT
- **Demonstration phase** (10/2020-10/2023): MPT and Engineering Companies (e.g. EPIC System)