H_2RECO$_2$VERY

Los Alamos NATIONAL LABORATORY

Advanced Membranes to recover lost hydrogen and remove carbon dioxide from the dominant hydrogen production process

TECHNOLOGY SNAPSHOT

Publication date: May 17, 2023 LAUR#: LA-UR-23-25324

APPLICATION AREA

Sector: Climate and Energy Transition

Area: Hydrogen Futures

Industry: Oil and Gas

Market: Steam methane reform (SMR)

PARTNERSHIP OPPORTUNITIES

Los Alamos is interested in establishing partnerships with hydrogen producers for pilot-scale demonstration of the technology.

- [X] Cooperative Agreement
- [X] License
- [ ] Tech Assistance
- [X] Start-up Opportunity

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TECHNOLOGY READINESS LEVEL: 4

Validated (functionality) in lab research

IP information

Patent Number: 10,071,345, additional patent pending (S167623)

OVERVIEW

Climate change is a significant threat to the planet. Hydrogen (H_2) as a substitute to existing energy sources is one valuable solution to combat climate change. Steam methane reform (SMR) is currently the dominant H_2 production process. However, there is an opportunity to make this process more efficient and profitable. During production, approximately 25% (2.5 MT/year) H_2 goes into the waste stream representing ~$25B in lost annual revenue. The process also emits 95M tons of uncaptured CO_2 representing further missed revenue potential.

H_2RECO$_2$VERY was developed with this exact problem. This advanced membrane can recover almost all the H_2 currently lost, increasing profits for producers. It can also capture close to all of CO_2 currently emitted, which can be sequestered or to sold to meet industrial demand. In short, H_2RECO$_2$VERY makes H_2 manufacturing more efficient and profitable. Los Alamos has a prototype which recovers H_2 and removes CO_2 efficiently at lab scale and is seeking an industrial partner for pilot-scale demonstration

ADVANTAGES

- ☑ Recovers nearly 100% of H_2 from lost/waste H_2 stream
- ☑ Recovers close to all of CO_2 emissions
- ☑ Modular retrofit to existing SMR Process
- ☑ Significant potential to scale up
- ☑ Tunable structural and physical properties allow the process to impact H2 production from Methane Pyrolysis

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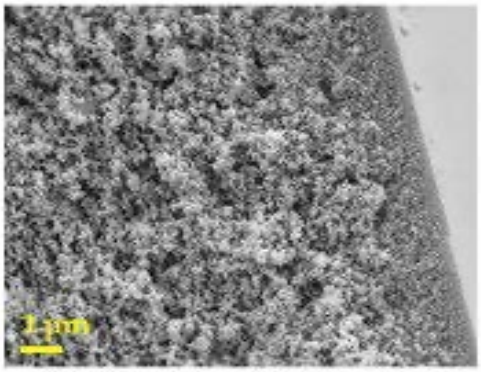

TECHNOLOGY DESCRIPTION

The advanced membrane technology developed at Los alamos is comprised of carbon molecular sieve hollow fiber membranes which feature a highly tunable structural and physical properties that can efficiently recover H_2 and CO_2 from tail (or waste) streams from the dominant hydrogen process – SMR. As H_2 and CO_2 pass through the membrane, the membrane construct allows H_2 only to pass through to be filtered on one side. CO_2 is collected on the other side. The unique carbon membranes can significantly increase H_2 production and decrease CO_2 pollution.

MARKET APPLICATIONS

This technology is ideal for energy companies currently producing hydrogen via SMR. The membranes are encased into modules and the module system is retrofit into the waste stream of existing SMR processes. The global hydrogen generation market size is expected to surpass $219.2 billion (USD) by 2030 and the carbon capture market is projected to reach US $35 billion by 2032.

Existing SMR plants are the initial target for H_2RECO_2VERY; however, with major government and private investment in hydrogen technologies this is just the beginning. This membrane technology can be fine-tuned to support next generation hydrogen production processes - methane pyrolysis - among other applications including biomass and waste gasification, green hydrogen geological storage, H_2 recovery plants and carbon capture at hydrogen plants.

NEXT STEPS

This technology has been evaluated in the lab under simulated process-relevant conditions. Los Alamos has an MVP which efficiently recovers H_2 and removes CO_2 at lab scale. Los Alamos is seeking commercial partners to further develop various process prototypes from pre-pilot to full pilot scale development and implementation.

SELECTED PUBLICATIONS

R.P. Singh, G.J. Dahe, K.W. Dudeck, K.A. Berchtold, Macrovoid-free high performance polybenzimidazole hollow fiber membranes for elevated temperature H2/CO2 separations, International Journal of Hydrogen Energy, 45 (2020) 27331-27345.

R.P. Singh, G.J. Dahe, K.W. Dudeck, C.F. Welch, K.A. Berchtold, High Temperature Polybenzimidazole Hollow Fiber Membranes for Hydrogen Separation and Carbon Dioxide Capture from Synthesis Gas, Energy Procedia, 63 (2014) 153-159.

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