Chemically-Stable Ceramic/Metal Composite Membrane for Hydrogen Separation (2014-099)

Novel composite decreases costs and improves the chemical stability of hydrogen permeation membranes.

Market Overview

This ceramic-metal composite membrane demonstrates excellent hydrogen permeation flux to facilitate high performance in hydrogen separation. The global hydrogen generation market has been valued at $115 Billion as of 2017 and expected to rise to $154 billion by 2022. This growth is influenced by hydrogen's use as a fuel source and other applications in the petrochemical, pharmaceutical, and chemical manufacturing industries. Currently, major issues with the process of hydrogen separation involve the cost and stability associated with separation membranes, which generally use expensive metals such as palladium and nickel. Clemson University researchers have developed a method to fabricate high-performance hydrogen permeation membranes that maintain expected mechanical strength, but also retain excellent chemical stability. These improvements allow for higher operating temperatures and more efficient hydrogen, decreasing overall costs.

Technical Summary

Hydrogen permeation membranes have applications in hydrogen production and separation. Membrane-based hydrogen separation is currently realized by Palladium-based membranes that are expensive and cannot be used in the high-temperature processes (800 °C) where hydrogen is produced. This technology entails a method for fabricating high-performance hydrogen permeation membranes that have excellent chemical stability in this temperature range. The M-BZYT membranes show excellent, high-hydrogen permeation flux and chemical stability in H2O, CO2, H2S and other contaminants while maintaining expected mechanical strength on par with traditional Palladium-based membranes. Active BZY powders and metal powders are mixed, pressed, and sintered to obtain dense composite membranes.

Application

Hydrogen Separation and Production Fertilizers; petroleum

Development Stage

Lab Bench Prototype

Advantages

- Ceramic/metal membrane possess novel composition, increasing mechanical strength of the composite.
- Retains mechanical and chemical stability at high temperatures, making it more desirable than currently available commercial membranes.
- Does not require Palladium or other heavy metals, reducing capital and energy costs in hydrogen production.

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Utility	United States	14/678,372	9,687,775	2014-099	Dr. Kyle Brinkman Dr. Fanglin Chen Dr. Shumin Fang

About the Inventor

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Dr. Kyle Brinkman earned his Ph.D. in Materials Science and Engineering from the Swiss Federal Institute of Technology. Prior to coming to Clemson Dr. Brinkman was a postdoctoral fellow with the Japanese Society for the Promotion of Science and worked as a Principal Engineer for the Department of Energy Savannah River National Laboratory. Dr. Brinkman has been the co-P.I or P.I on over $5 million in sponsored research and has authored or co-authored over 100 peer-reviewed technical publications and government reports. He currently also serves as an Adjunct Professor at the University of South Carolina and serves as Materials Advantage faculty advisor for Clemson undergraduates. His research focuses on development of ceramics, fuel cells, energy materials, interfacial engineering, and crystalline materials for nuclear waste immobilization.

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