the ENERGY lab

PROJECT FACTS

Fuels

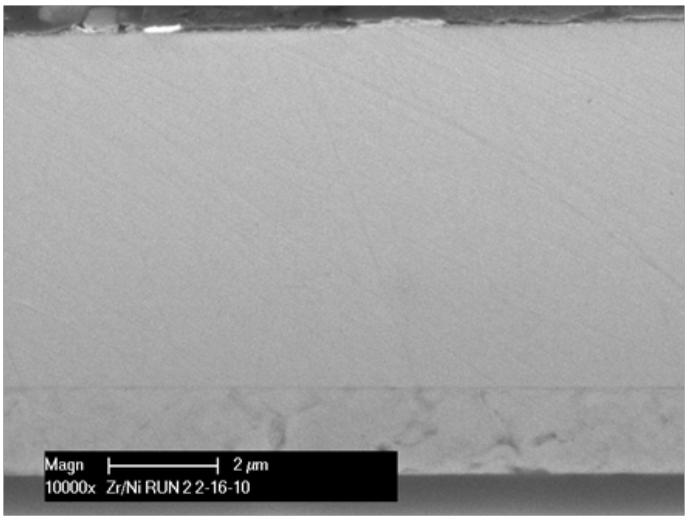
Amorphous Alloy Membranes for High Temperature Hydrogen Separations

Background

Coal and biomass are readily available in the United States and can be mixed for thermal processing to produce hydrogen and power. The produced hydrogen can be sent directly to a fuel cell for highly efficient and environmentally clean power generation. For coal and biomass to become economically viable sources of hydrogen, more efficient production processes need to be developed. To meet this need, the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) is sponsoring research and development in high-performance thin alloy membranes that have the potential to separate hydrogen efficiently.

Project Description

Investigators from Southwestern Research Institute (SwRI), Georgia Institute of Technology (GT) and Western Research Institute (WRI), together with NETL, will conduct a research and development project to fabricate and test amorphous alloy membranes for high temperature hydrogen separations. The design of the membrane system will rely on advanced theoretical modeling to optimize membrane performance. This project will increase membrane performance



Cross Section of an amorphous NiZr thin film membrane deposited by magnetron sputtering. (Courtesy of Kent Coulter, SwRI)

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PARTNERS

Georgia Institute of Technology
Western Research Institute

PROJECT DURATION

Start Date
10/1/2009

End Date
9/30/2012

COST

Total Project Value
$999,736

DOE/Non-DOE Share
$799,786 / $199,950

and efficiency and reduce cost, all of which will result in important progress being made toward the production of affordable, environmentally clean hydrogen from coal-derived synthesis gas.

Project tasks include:

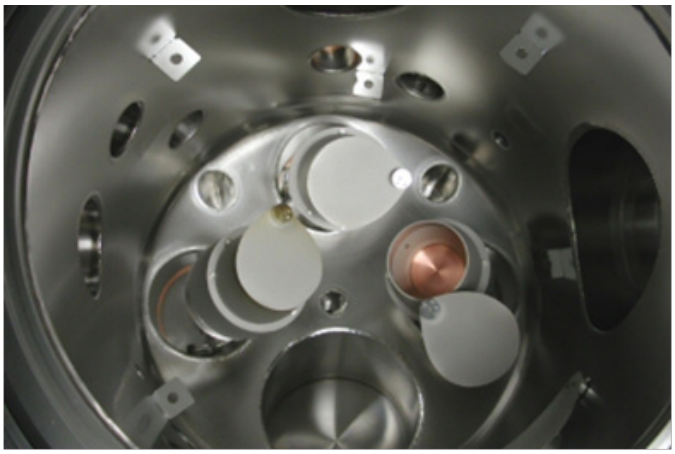
- Materials modeling and composition selection using recent theoretical density modeling conducted at GT.
- Fabrication of high-performance alloy membranes.
- Membrane testing and evaluation to confirm design composition and structure and to assess promising membranes under DOE-specified test conditions.

Goals and Objectives

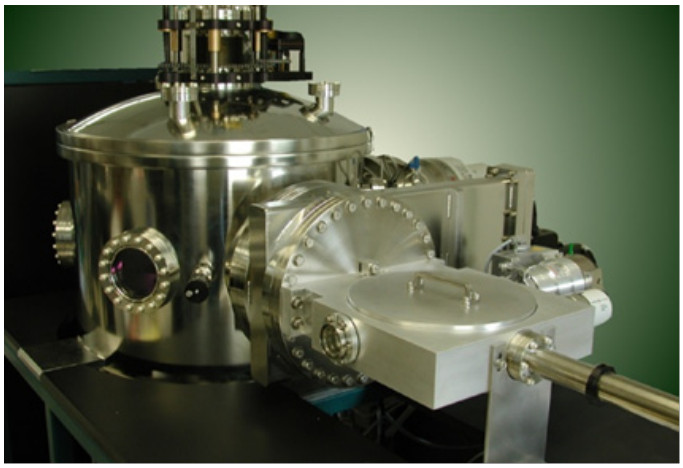
The objectives of this project are to model, fabricate, and test thin film amorphous zirconium-nickel alloy membranes for hydrogen separation from coal-derived synthesis gas. The materials selected for this project will not include platinum group metals.

Benefits

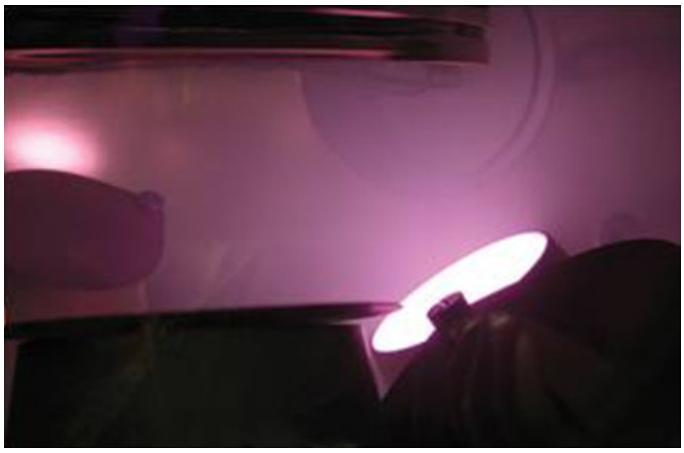
There is growing industrial interest in the use of synthetic membranes for gas and liquid separations. Many of the most effective and efficient membranes currently available utilize expensive and rare platinum group metals. Using metals other than those from the platinum group will help avoid the high cost and risk associated with procuring platinum group metals. This work will increase understanding of factors such as pore size and surface chemistry that control the transport of small molecules in different types of separation membranes. These composite membranes will provide a means to achieve U.S. DOE 2015 hydrogen separation performance goals for flux, selectivity, cost, and chemical and mechanical durability. Achieving these goals will bring affordable, environmentally sound hydrogen supplies closer to reality, increase domestic energy independence, and could significantly alter the way energy is produced in the United States.



Inside view of Magnetron Sputterer, showing sputtering material portals. (Courtesy of Kent Coulter, SwRI)



Outside view of Magnetron Sputterer (Courtesy of Kent Coulter, SwRI)



Magnetron sputter deposition of NiZr alloys. (Courtesy of Kent Coulter, SwRI)