PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

VISION 21

06/2000

SEPARATING HYDROGEN FROM INDUSTRIAL GASES IN AN INEXPENSIVE, ENVIRONMENTALLY BENIGN PROCESS

PRIMARY PARTNER

Eltron Research, Incorporated
Boulder, CO

TOTAL ESTIMATED COST

$2,175,000

COST SHARING

DOE	$1,740,000
Non-DOE	$435,000

WEB SITE

www.netl.doe.gov

Description

Eltron Research and partners will develop an environmentally benign, inexpensive technology for separating hydrogen from gas mixtures produced in industrial processes, such as coal gasification. Although methods already exist or are under development for separation of hydrogen from multi-component gas streams, these methods—which include pressure swing adsorption, porous membranes, methanation, nitrogen wash, and palladium membranes—are either expensive or produce low-purity hydrogen.

The hydrogen separation technology that is the subject of this Vision 21 project is based on non-porous ceramic membranes. In this approach, the hydrogen-containing gas mixture (for example, a syngas consisting of CO_2, CO, and H_2) is passed across the membrane surface where hydrogen is catalytically oxidized. The protons and electrons generated are incorporated into the membrane material lattice and conducted to the reduction surface on the other side of the membrane where the reverse reduction reaction occurs to produce pure hydrogen.

Goals

The primary technical challenges in this project will be to optimize the composition and microstructure of the ceramic membrane materials for proton/electron conduction and stability, and develop dense membrane structures that enable a hydrogen separation rate in excess of 10 ml/min/cm^2. Other aspects of this developing technology that will be addressed include catalysis, ceramic processing methods, and separation unit design.

Benefits

Conduction of protons and electrons across the ceramic membrane is driven by a concentration or partial pressure gradient, and no external circuitry or applied potential is required. Other benefits of this approach are:

1. Since the membrane is non-porous, only hydrogen is transported through the membrane, resulting in a high-purity hydrogen product.
2. The membrane operates at elevated temperatures that integrate well with other Vision 21 technology modules.
3. In addition to hydrogen separation, the ceramic membrane technology can be used to facilitate numerous chemical processing applications.
4. The membrane materials are inexpensive and the system design is inherently simple and economical.

NETL

Separating Hydrogen from Industrial Gases in an Inexpensive, Environmentally Benign Process

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PROJECT PARTNERS

Chevron Chemical Company
Richmond, CA

Coors Ceramics Company
Golden, CO

Sud Chemie, Incorporated
Louisville, KY

McDermott International/ Babcock & Wilcox
Alliance, OH

Argonne National Laboratory
Argonne, IL

Oak Ridge National Laboratory
Oak Ridge, TN

Milestones

Initiate Project	October 2000
Develop and Select Dense Proton-Conducting Membrane Composition and Structure	September 2001
Fabricate Supported Thin-Film Membrane Structures	September 2001
Design, Construct, and Test a Laboratory Scale High Pressure Hydrogen Separation Unit	September 2002
Develop a Sub-Engineering Scale Prototype Hydrogen Separation Unit and Test Performance	September 2003
Develop Strategy for Technology Scale Up	September 2003

Tubular Hydrogen Transport Membrane Configuration Being Developed at Eltron for Spontaneous Hydrogen Separation from IGCC Derived Syngas Feedstreams