II.C.2 Scale-Up of Microporous Inorganic Hydrogen-Separation Membrane

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Objectives

- Produce ultra-pure hydrogen fuel, at 99.999% purity.
- Ensure 90% carbon capture through field tests at Southern Company's Power Systems Development Facility and Eastman Chemicals Kingsport facility during the summer of 2007. Pall Corporation is Oak Ridge's commercial partner in this project, and will have increasing input as the membranes approach commercial readiness.

Introduction

Part of the vision of a hydrogen economy is the production of hydrogen from coal, due to its low cost and abundance in the U.S. A critical part of this process is to separate the hydrogen from carbon dioxide, resulting in a pure clean fuel (hydrogen) stream, and a separate carbon dioxide stream ready for sequestration. Membranes able to perform this separation at warm temperatures promise to cost less than conventional separation technology, and increase the efficiency of the separation process. The Oak Ridge National Laboratory nanoporous membrane technology has already been proven to separate hydrogen from CO_2 in lab-scale tests, at a flux and purity expected to be commercially competitive.

Approach

The proposed approach is to scale-up the technology, and refine the membrane choices to suit DOE's program objectives:

1. To produce ultra-pure hydrogen fuel at 99.999% purity.
2. To ensure 90% carbon capture.

The end goal of the approach is to design an optimal system configuration using Oak Ridge's experimental data and NETL system analysis, and to demonstrate this system at Southern Company's Power Systems Development Facility and Eastman Chemicals Kingsport facility during the summer of 2007. The demonstration will include separation of both clean shifted syngas and raw shifted syngas, both coal-derived. To prepare for the demonstration, materials compatibility and flow tests will be conducted on selected membranes using simulated shifted syngas, at conditions specified by program goals and the system analysis. Flow tests using simulated raw shifted syngas are expected to be performed at NETL, where equipment to perform these tests already exists. Pall Corporation is Oak Ridge's commercial partner in this project, and will have increasing input as the membranes approach commercial readiness.

Accomplishments

- Initiated planning discussions with Tennessee Eastman on hydrogen separation membrane testing.
- Initiated pilot-scale fabrication tests for one-meter long hydrogen membrane elements.
- Incorporated results of AR Materials Program work on refinement of processing parameters for pore size and pore size distribution control.
- Initiated membrane fabrication for test modules.
- Completed support tube laboratory compatibility tests for use with clean syngas.
- Completed update of the project plan, including status of work planned to have been completed on the previous project plan.

Future Directions

- Demonstrate application of membrane layers to one meter long tubular supports.
- Complete characterization of membranes before and after laboratory tests using test gases free of contaminants.