VI.D.8 A Radically New Method for Hydrogen Storage in Hollow Glass Microspheres

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Subcontractors:
MoSci Corp, Rolla, MO
Savannah River National Laboratory, Aiken, South Carolina

Start Date: April 16, 2005
Projected End Date: April 30, 2009

Objectives

This project is aimed toward the development of a radically new method for hydrogen storage in hollow glass microspheres (HGMS), which will provide the technology for a safe, inexpensive, non-toxic method for transportation needs for the hydrogen economy. The primary goals of this study will be to demonstrate that the:

- HGMS of the desired composition and quality can be produced
- HGMS can be filled to sufficient pressure to meet the DOE goals
- The photo-induced diffusion effect can be used to release hydrogen at a sufficient rate for transportation applications
- This technology can be demonstrated at the "bench-top" level

Technical Barriers

This project addresses the following technical barriers from the Hydrogen Storage section of the Hydrogen, Fuel Cells and Infrastructure Technologies (HFCIT) Program Multi-Year Research, Development and Demonstration (RD&D) Plan:

- A. Cost
- B. Weight and Volume

Technical Targets

This project will help to meet the DOE technical targets as outlined in the March 2005 version of the HFCIT Multi-Year RD&D Plan by exploring a novel approach for hydrogen storage in HGMS which will provide the technology for a safe, inexpensive, non-toxic method for transportation needs for the hydrogen economy.

Approach

The primary goal of this project is to demonstrate that a working hydrogen storage and delivery device can be produced using the newly discovered phenomenon of photo-enhanced hydrogen diffusion in glasses. A basic scientific study will provide an understanding of the mechanism(s) which lead to photo-enhanced hydrogen diffusion in glasses. This information will be used to optimize the application of photo-enhanced hydrogen diffusion in glasses to a working device.

Accomplishment of these goals will require development of the technology necessary to produce HGMS of the desired composition and quality in sufficient quantities to provide proof-of-concept of the storage method. It will also be necessary to determine the parameters necessary for filling the HGMS with high pressure hydrogen and monitor their behavior during repeated filling to high pressures.

Accomplishments

The authorized start date for this project was April 16, 2005. Since that time, we hired the personnel at Alfred (students) and initiated the work.

Task 1: Construction has begun on a "drop tower" for the production of HGMS. Preliminary tests of a torch method for production of HGMS have also been initiated. The torch results for a soda-lime-silica test glass produced good solid spheres, but a very small yield (approximately 2%) of hollow spheres.

Tasks 2 and 3: Since these tasks are sequential and can only be initiated after a sufficient supply of HGMS has been produced, work has not yet begun on these tasks. These results are in accord with the original schedule.

Task 4: Selection of glasses for study is underway. An iron-doped commercial soda-lime-silica glass has been melted.

Future Directions

Task 1: Testing of the ability to produce HGMS using the drop tower will begin. Testing of the torch method for producing HGMS will continue. Efforts will be made to incorporate more "blowing agent" in the frit to enhance formation of hollow spheres. The kinetics testing apparatus will be tested at low pressures.

Task 2: Once a cooperative research and development agreement is in place with SRNL, they will fill existing commercial, undoped HGMS with high pressures of hydrogen to test their ability to produce the needed test samples. If they are able to produce such samples, the filled HGMS will be shipped to Alfred for preliminary outgassing studies to test our kinetics measurement facility.

Task 3: Not scheduled to begin until year three of the project.

Task 4: Additional glasses of varying compositions will be melted. Study of the effect of other dopants on photo-enhanced outgassing will begin.