

IV.G.6 Center for Hydrogen Storage Research at Delaware State University*

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Projected End Date: June 30, 2009

*Congressionally directed project

Technical Targets

This project is conducting fundamental studies of alanates and mixed alanates. Insights gained from these studies will be applied toward the design and synthesis of hydrogen storage materials that meet DOE's 2010 goal of 6 weight percent hydrogen storage for the system. The project will also include a study of destabilized hydrides. The following table summarizes the targets.

Storage Parameter	Units	Target
System Gravimetric Capacity: Usable, specific-energy from H ₂ (net useful energy/max system mass)	kWh/kg	1.5
System Volumetric Capacity: Usable energy density from H ₂ (net useful energy/max system volume)	kWh/L	1.2
Storage system cost (& fuel cost)	\$/kWh	6

Approach

The materials to be used for this research will be prepared and characterized by several methods. The hydrides will be made by first ball milling the raw materials and then directly combining them with hydrogen in a Sieverts apparatus. X-ray powder diffraction will be used to confirm the formation of product and to determine phase purity. Each material will be combined with a catalyst in order to improve the overall hydriding characteristics.

The hydriding characteristics of the materials will be determined via thermal gravimetric analysis (TGA). This will give us a quick estimate of the thermal desorption characteristics of each material. All analyses will be done under an argon atmosphere to prevent them from reacting with air and moisture. Pressure-concentration-temperature isotherms will be constructed in order to determine the dependence of absorption capacity on pressure. Kinetic measurements will be done to determine the overall reaction rates and reaction mechanism. Cycling measurements will be done to determine the stability of the materials when subjected to repeated hydrogenation and dehydrogenation cycles.

Accomplishments

The project is due to start in July 2006. Some preliminary measurements have begun but there are no results to report at this time.

Objectives

1. Establish a Center for Hydrogen Storage Research at Delaware State University for the preparation and characterization of selected complex metal hydrides and the determination of their suitability for hydrogen storage.
2. Develop methods for the synthesis, characterization, and modeling of complex hydrides using NaAlH₄ as a model system.
3. Identify the most promising types of complex hydrides and demonstrate the optimum temperature/pressure range and sorption kinetics of the hydrides under a variety of conditions. Determine their cyclic stability and develop improved sorption catalysts.
4. Extend the studies to include destabilized complex hydrides.

Technical Barriers

This project addresses the following technical barriers taken from the Hydrogen Storage section (3.3.4.2) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- (A) System Weight and Volume
- (D) Durability/Operability
- (E) Charging/Discharging Rates