



## The Hydrogen Sponge – A Solar-Powered Hydrogen Generation and Storage Device

The U.S. Navy seeks to commercialize through license agreements and collaborative research and development agreements a **non-fossil fuel means for the generation, safe storage, and recovery of hydrogen gas for use in fuel cell and hydrogen based technologies.**

### Background

Greenhouse gas emissions from fossil fuels attribute to 83% of our nation's air pollution\*, and the demand for fossil fuels is increasing as worldwide reserves are decreasing. It is widely believed that hydrogen gas is an ideal replacement for fossil fuels, but currently, hydrogen gas is either produced from fossil fuel-powered commercial processes, or captured as a byproduct from natural gas and petroleum conversion. Both processes contribute significantly to global carbon emissions. Current methods for safely storing hydrogen gas also require fossil fuel energy; and most storage methods pose an explosive hazard to the end user because the stored hydrogen gas is highly compressed.

### The Technology

SSC Pacific has developed a **solar powered "Hydrogen Sponge" that generates and safely stores hydrogen gas for use in fuel cell and hydrogen based technologies without the use of fossil fuel energy.** It consists of a modified version of a standard solar cell mated with a uniquely designed silicon substrate. The substrate consists of precisely engineered micro-chambers that provide both a micro-structure for electrodes, and reservoirs for the collection and safe storage of hydrogen gas. **The micro-chambers allow hydrogen gas to be safely stored without the need for compression.**

When the Hydrogen Sponge is placed in sunlight and seawater, it uses solar powered water electrolysis to generate and safely store hydrogen gas in its substrate micro-chambers for later use, transport, or long term storage. The hydrogen is then released by increasing pressure in the micro-chambers through mechanical, electrical, or thermal means. **In theory, a 9 inch array of mated solar cells and substrate micro-chambers could generate 2.5 joules of useable power each second.** This number could be increased by stacking multiple wafers, creating various arrays, increasing the micro-chamber size, or engineering more micro-chambers per square inch on a wafer.

### Key Benefits

- Eliminates the need for fossil fuels to generate and store hydrogen gas
- Could be engineered for use in any device that can utilize hydrogen gas to generate electricity (such as homes, vehicles, power generating stations, electronics, etc.)
- Provides a wide range of possibilities for storage volumes
- Does not require exotic metals/materials in manufacturing
- Works in simple seawater (or any ionic fluid) and sunlight
- Is self-contained and reusable

### Development Status

- Patent Pending Navy Case Number 99707: The Solar Powered System for Generation and Storage of Hydrogen Using Substrate Microstructures
- DoD 5000 Technology Readiness Level 2: Technology concept and/or application formulated

**For more information on technology transfer, please contact us at (619) 553-2778 or email [ssc\\_pac\\_t2@navy.mil](mailto:ssc_pac_t2@navy.mil)**

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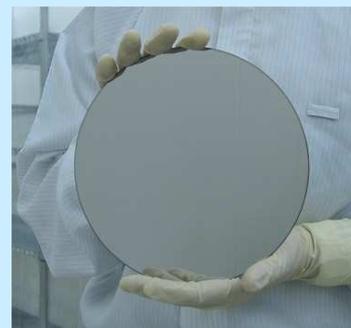
\* According to the 2009 US Greenhouse Gas Inventory Report by the Environmental Protection Agency



Current hydrogen gas production facilities rely on fossil fuel energy, further contributing to global carbon emissions



Photovoltaic cells offer a green source of energy for hydrogen gas generation



A newly developed silicon substrate fabrication process provides the micro-structure needed to generate and safely store hydrogen

Space and Naval Warfare Systems Center Pacific (SSC Pacific) is the U.S. Navy's research, development, test and evaluation, engineering and fleet support center for command, control, communication, computers, intelligence, surveillance, and reconnaissance. <http://enterprise.spawar.navy.mil/techtransfer>