Hydrogen Gas Sensor for Use With Hydrogen Storage Vessels

Hydrogen Storage and Safety

U.S. Department of Energy

Energy Efficiency and Renewable Energy Program

Oak Ridge National Laboratory

UT-BATTELLE

Transportation

FOR THE 21ST CENTURY

Background

Before hydrogen-based alternative fuel technologies can be adopted into widespread use, viable hydrogen gas sensors must be developed for detecting the presence of hydrogen leaks during its storage in both stationary and vehicular platforms. The Oak Ridge National Laboratory (ORNL) is creating optical hydrogen sensors that can be developed into feasible commercial sensor systems. The goal is to commercialize a hydrogen-gas sensor for use with high-pressure hydrogen storage tanks (greater than 10,000 pounds per square inch) in automotive applications, while achieving the Department of Energy's technical targets for hydrogen safety sensors in ambient air.

The Technology

The preferred method for detecting hydrogen leaks in storage tanks is to integrate sensors on the external surface of the tanks. This integrated sensor approach has the advantages of incipient leak detection, immunity from false detection due to extraneous chemical sources, environmental ruggedness, and ease of use. ORNL has identified optical phenomena-based gas sensors as excellent candidates for this application. The technologies are mature with a rich history of unique applications.

ORNL is evaluating several entirely new optical hydrogen gas sensing techniques with respect to their effectiveness, potential cost, and reliability. These techniques do not use palladium metal, a limitation for many existing hydrogen sensors. Two of the techniques utilize the principles of hydrogen spectroscopy, either by dissociating hydrogen molecules with photoelectrons or by detecting hydrogen atomic emission through spectroscopy. The dissociative technique is well suited for development as a micro-electromechanical system (MEMS), while the spectroscopy technique can be deployed as an optical fiber sensor.

Another technique being evaluated is based on the fluorescence properties of certain nanometer-scale inorganic materials. Nanoscale compounds and structures have broad applicability as sensing materials because their electronic properties are strongly influenced by their chemical and physical environment. The fluorescence properties of some nanoscale inorganic compounds are affected by the presence of hydrogen gas. This technique can be also be implemented as an optical fiber sensor.

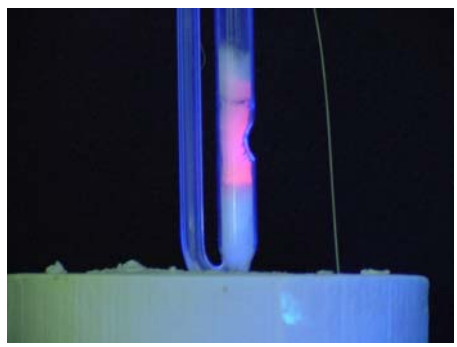
During FY 2003, ORNL will select the most promising sensor technique for application in a prototype system. This system will be tested at ORNL and then demonstrated at facilities provided by a hydrogen tank manufacturer.

Commercialization

ORNL is working in collaboration with manufacturers of composite tanks to develop plans for transfer and commercialization of this technology application.

Benefits

- Will meet specifications for hydrogen safety sensors in ambient air
- Provides incipient leak detection, immunity from false detection due to extraneous chemical sources, environmental ruggedness, and ease of use for high-pressure hydrogen storage tanks
- Applicable to storage tanks on both vehicular and stationary platforms



Nanoscale inorganic powder fluorescing in broadband UV light in a hydrogen gas test cell.

For more information on how ORNL is helping America remain Competitive in the 21st century, please contact:

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Success Story

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