

On the Feasibility and Characteristics of Hydrogen Fuel-Cell Vessels

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With Dr. Leonard E. Klebanoff

Principal Scientist, Sandia National Labs

Abstract

This talk will describe the physical and safety properties of hydrogen fuel, proton-exchange membrane (PEM) fuel cells, and examine the feasibility and characteristics of zero-emission hydrogen fuel-cell vessels. The physical and combustion properties of gaseous and liquid hydrogen will be compared to those of natural gas and liquified natural gas (LNG), which have already started to be used in ferry applications in Scandinavia. PEM fuel cells will be described with their thermal efficiencies compared to diesel engine technology. The feasibility of using hydrogen fuel cells to power a high-speed passenger ferry (nicknamed the SF-BREEZE) will be presented. Recent results for the design and performance of a hydrogen fuel-cell research vessel (named the Zero-V) will also be discussed. The equivalent CO₂ and criteria (i.e. smog) pollutant emissions associated with hydrogen fuel production and delivery will be presented, to better understand the “well-to-waves” emissions associated with hydrogen fuel-cell vessel technology.



Dr. Leonard E. Klebanoff

Biography

Dr. Lennie Klebanoff was born in Washington D.C., and raised in nearby Bethesda Maryland. He earned his B.S. in Chemistry and M.S. in Organic Chemistry from Bucknell University, Lewisburg PA. He earned his Ph.D. in Physical Chemistry from the University of California-Berkeley. After Berkeley, Dr. Klebanoff worked as a “post-doc” for the National Bureau of Standards (now NIST), using spin-polarized electron scattering to study the surface magnetism of nickel and how it is influenced by chemisorbed species.

From 1987–1997, he was a Professor of Chemistry at Lehigh University, Bethlehem, PA. There, he developed the technique of Spin-Resolved X-ray Photoelectron Spectroscopy (SRXPS), and used it to examine the spin-dependence of core-level photoelectric transitions from ferromagnetic surfaces and films. At Lehigh, he eventually attained the rank of Full Professor of Chemistry with tenure.

He returned to the Bay area in 1997, taking a position at Sandia National Laboratories in Livermore, CA. He was appointed the Environmental Team Leader for the Extreme Ultraviolet Lithography (EUVL) program, a large collaboration between the three Bay Area national laboratories and a consortium of semiconductor companies near San Jose including Intel, Motorola and AMD. By 2003, his interest began to take him into the alternative energy arena, where he served with State of California officials to develop the Governor’s Blueprint for a Hydrogen Highway in California.

In 2006 Dr. Klebanoff was named the Director of the US DOE Metal Hydride Center of Excellence (MHCoE), an 18-institution center funded by the DOE Office of Energy Efficiency and Renewable Energy (EERE) to advance the science of solid-state storage of hydrogen using metal hydrides. He also served as the Sandia technical lead in this MHCoE effort. After completing his five-year tenure as the MHCoE Director he continued his hydrogen-related work in Fuel Cell Market Transformation. Today he continues his work in the EUVL field, solving problems in EUV-induced optics contamination, and continues further work in hydrogen storage and fuel cell market transformation sponsored by the U.S. Department of Energy and the U.S. Department of Transportation’s Maritime Administration (MARAD). His most recent activity has been focused on evaluating the feasibility of hydrogen fuel cell vessels, both in public applications such as ferries, but also in ocean going research vessels. Lennie has written over 100 scientific papers, and has 29 patents (filed and issued).



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