Maximum Range Hydrogen Vehicles with Safe and Rapidly Refuelable Cryogenic Pressure Vessels

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With Guest Lecturer Dr. Salvador Aceves

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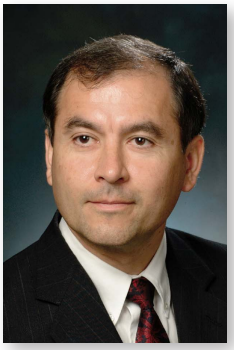

Dr. Salvador Aceves

Cryogenic pressure vessels are composed of a high-pressure inner vessel made of carbon-fiber-coated metal (similar to those used for storage of compressed gas), a vacuum space filled with numerous sheets of highly reflective metalized plastic (for high-performance thermal insulation), and a metallic outer jacket. Cryogenic pressure vessels operate at low temperature (down to 20 K) and are designed for high pressure (350 bar). H2 density at these conditions is considerably higher (~2x) than for compressed H2, resulting in high capacity systems that store hydrogen at the maximum system density achievable. High H2 storage density also reduces the amount of expensive materials (carbon fiber and metal) necessary to store any given amount of H2, resulting in cost-effective systems that minimize ownership cost. Liquid hydrogen pumping enables rapid (5 minute) refueling. Finally, cryogenic pressure vessels have compelling safety advantages: outer vacuum jacket provides secondary protection and containment, and cryogenic hydrogen has low expansion energy compared to compressed gas.

Topics for this seminar will include:

- Description of cryogenic pressure vessels composition and challenges
- Exploring the possibilities and capabilities of long range hydrogen vehicles

Abridged Biography:

Salvador Aceves is the group leader for Energy Conversion and Storage at Lawrence Livermore National Laboratory. During 21 years at LLNL, Salvador has researched diverse applications of thermodynamics and heat transfer to the transportation sector: analysis of electric and hybrid vehicles, hydrogen engines, and thermal and chemical kinetic analysis of combustion in engines. The concept of storing hydrogen in cryogenic pressurized vessels originated in 1996 when Salvador's modeling demonstrated that they would solve the fundamental problem of cryogenic hydrogen storage: high fuel venting rates. Salvador's group has built cryogenic vessel prototypes that have demonstrated the highest volumetric and gravimetric hydrogen storage performance. They also demonstrated the longest driving distance on a single hydrogen tank (650 miles).