proached 100 percent. Long-term tests were conducted to demonstrate continuous production of hydrogen without loss of reactor efficiency. Chemical analyses of the reaction products revealed that generation of hydrogen through decomposition of methane is accompanied by a combination of cracking, oligomerization, and aromatization reactions, which tend to minimize the formation of elemental carbon. Further research is planned to refine understanding of these reactions and to determine whether and how they might be exploited.

Self-Deployable Membrane Structures

These support structures can be used as portable shelters, camping tents, and thermal insulation.

NASA's Jet Propulsion Laboratory, Pasadena, California

Currently existing approaches for deployment of large, ultra-lightweight gossamer structures in space rely typically upon electromechanical mechanisms and mechanically expandable or inflatable booms for deployment and to maintain them in a fully deployed, operational configuration. These support structures, with the associated deployment mechanisms, launch restraints, inflation systems, and controls, can comprise more than 90 percent of the total mass budget. In addition, they significantly increase the stowage volume, cost, and complexity.

A CHEM (cold hibernated elastic memory) membrane structure without any deployable mechanism and support booms/structure is deployed by using shape memory and elastic recovery. The use of CHEM micro-foams reinforced with carbon nanotubes is considered for thin-membrane structure applications. In this advanced structural concept, the CHEM membrane structure is warmed up to allow packaging and stowing prior to launch, and then cooled to induce hibernation of the internal restoring forces. In space, the membrane remembers its original shape and size when warmed up. After the internal restoring forces deploy the structure, it is then cooled to achieve rigidization. For this type of structure, the solar radiation could be utilized as the heat energy used for deployment and space ambient temperature for rigidization.

The overall simplicity of the CHEM self-deployable membrane is one of its greatest assets. In present approaches to space-deployable structures, the stowage and deployment are difficult and challenging, and introduce a significant risk, heavy mass, and high cost. Simple procedures provided by CHEM membrane greatly simplify the overall end-to-end process for designing, fabricating, deploying, and rigidizing large structures. The CHEM membrane avoids the complexities associated with other methods for deploying and rigidizing structures by eliminating deployable booms, deployment mechanisms, and inflation and control systems that can use up the majority of the mass budget.

In addition, highly integrated multifunctional CHEM membranes with embedded thin-film electronics, sensors, actuators, and power sources could be used to perform other spacecraft functions such as a communication, navigation, science gathering, and power generation.

This advanced membrane concept represents the introduction of a new generation of self-deployable structures.

This technology will introduce a new paradigm for defining configurations for space-based structures and for defining future mission architectures. It will provide new standards for fabricating, stowing, deploying, and rigidizing large deployable structures in a simple, straightforward process.

A number of deployable structures are used for space robotics and other support deployable structures for solar sails, telecommunication, power, sensing, thermal control, impact, and radiation protection systems. A self-deployable membrane structure could be used on some of these space applications with a big improvement.

Although the space community is the major beneficiary, potential commercial applications are foreseen for this technology. It could be applied to deployable shelters, storage places, and camping tents. Other potential applications are seen in self-deployable house construction, thermal insulation, automotive, packaging, and biomedical.

Reactivation of a Tin-Oxide-Containing Catalyst

This technique extends the lifetime of a catalyst in a laser discharge.

Langley Research Center, Hampton, Virginia

The electrons in electric-discharge CO_2 lasers cause dissociation of some CO_2 into O_2 and CO, and attach themselves to electronegative molecules such as O_2, forming negative O_2 ions, as well as larger negative ion clusters by collisions with CO or other molecules. The decrease in CO_2 concentration due to dissociation into CO and O_2 will reduce the average repetitively pulsed or continuous wave laser power, even if no disruptive negative ion instabilities occur. Accordingly, it is the primary object of this invention to extend the lifetime of a catalyst used to combine the CO and O_2 products formed in a laser discharge.

A promising low-temperature catalyst for combining CO and O_2 is platinum

on tin oxide (Pt/SnO_2). First, the catalyst is pretreated by a standard procedure. The pretreatment is considered complete when no measurable quantity of CO_2 is given off by the catalyst. After this standard pretreatment, the catalyst is ready for its low-temperature use in the sealed, high-energy, pulsed CO_2 laser. However, after about 3,000 minutes of operation, the activity of the catalyst begins to slowly diminish. When the catalyst experiences diminished activity during exposure to the circulating gas stream inside or external to the laser, the heated zone surrounding the catalyst is raised to a temperature between 100 and 400 °C. A temperature of 225 °C was experimentally found to provide an adequate temperature for reactivation. During this period, the catalyst is still exposed to the circulating gas inside or external to the laser.

This constant heating and exposing the catalyst to the laser gas mixture is maintained for an hour. After heating and exposing for an appropriate amount of time, the heated zone around the catalyst is allowed to return to the nominal operating temperature of the CO_2 laser. This temperature normally resides in the range of 23 to 100 °C.

Catalyst activity can be measured as the percentage conversion of CO to CO_2. In the specific embodiment described above, the initial steady-state conversion percentage was 70 percent. After four days, this conversion percentage decreased to 67 percent. No decrease in activity is acceptable because the catalyst must maintain its activity for long periods of time. After being subjected to the reactivation process of the present invention, the conversion percentage rose to 77 percent. Such a reactivation not only returned the catalyst to its initial steady state but resulted in a 10-percent improvement over the initial steady state value.