Project HC-11: Hydrogen storage in microspheres

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Background

The most common methods of storing hydrogen are the high-pressure storage of gaseous hydrogen and the storage of liquid hydrogen under cryogenic conditions. Problems arising from the heavy weight, voluminous high-pressure containers or the vapor losses of cryogenic tanks restrict range and duration for both space and terrestrial applications.

One very interesting and promising alternative concept is the storage of gaseous hydrogen in tiny hollow spheres, e.g., made of glass. The interior volume of these so-called microspheres can be filled with hydrogen up to pressures of 100 MPa. In combination with very thin walls of the spheres a relatively high storage density can be achieved.

Project Plan

The results of an extensive theoretical study about hydrogen storage in commercial microspheres showed advantageous safety and handling properties as well as storage densities of 5 to 10 weight-%. Charging and discharging such commercially available microspheres with hydrogen experimentally verified the study results and showed that the theoretical storage densities are realistic.

In order to extend the benefit of hydrogen storage in microspheres, mainly the following two characteristics have to be improved:

- The charging and discharging technology has to be simplified
- The tensile strength of the spheres' material should be increased.

Both tasks are presently under investigation. Various different charging / discharging techniques were identified and will be analyzed within 2004. Theoretically, the use of materials with significantly higher tensile strength values (e.g. quartz) makes storage densities of > 20 weight-% possible. The availability of microspheres with more suitable material properties, especially tensile strength, is presently being investigated.