

Storage of Hydrogen as Clathrate Hydrate

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For a number of reasons, it is expected that in the near future hydrogen will be the main source of fuel in the automotive sector. For that purpose, storage of hydrogen at acceptably favorable conditions and with a high energy density is a prerequisite. Recently, the gas hydrate of hydrogen has been discovered. It was established that this gas hydrate is stable only at extreme conditions, i.e., at temperatures below ambient the equilibrium pressure of the hydrogen hydrate is as high as 2300 bar. However, using so-called gas hydrate promoters, it turned out to be possible to have hydrogen hydrate stable at pressures below 100 bar. This finding has been recognized as a candidate solution for hydrogen storage. It also has been discovered that the accepted idea of single-occupancy of the cavities in the gas hydrate structure does not apply for hydrogen hydrate as double and even quadruple occupancy has been established, which means that the energy density of hydrogen hydrate is relatively high. This contribution reports on the phase behavior of hydrogen gas hydrates in presence of certain selected promoters.

[1] L.J. Florusse, C.J. Peters, J. Schoonman, K.C. Hester, C.A. Koh, S.F. Dec, K.N. Marsh and E.D. Sloan, Stable low-pressure hydrogen clusters stored in a binary clathrate hydrate, *Science* **306**, 469-471 (2004).