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Activities of the Core

Mar. 1, 2019	The 30th HU-ACE Steering Committee Meeting
Mar. 6, 2019	Region, Environment and Energy Symposium (co-organization)
Mar. 7, 2019	The 73rd Hiroshima University Biomass Evening Seminar (co-organization)
Mar. 13, 2019	Collaboration meeting with BALITTAS, Indonesia
Mar. 14, 2019	The 2nd Joint Workshop with BALITTAS, Indonesia
Mar. 27, 2019	The 31st HU-ACE Steering Committee Meeting
Mar. 28, 2019	Symposium “Lecture: Learning biofuels from fundamentals” (co-organization)

Collaboration meeting and the 2nd Joint Workshop with BALITTAS, Indonesia

On Mar. 13th, Prof. Matsumura, Prof. Nakashimada, and Prof. Tajima from HU-ACE visited the Sweetener and Fiber Crops Research Institute (BALITTAS), Malang, Indonesia, with whom the Graduate School of Advanced Science of Matter, Hiroshima University has MOU of department level, and had a collaboration meeting. A joint workshop was also held on Mar. 14th. At the workshop, we introduced each other's research contents and discussed the possibility of joint research.

Related information

The 3rd International Symposium on Fuels and Energy (ISFE2019) will be held on Jul. 8-10, 2019 in Higashi-Hiroshima City. The chair will be Prof. Keiya Nishida and the secretariats are Prof. Yutaka Nakashimada and Prof. Takahisa Tajima. Official announcement will be made later, but please secure your schedule.

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Research Topics

No. 6

Hydrogen Compressor using Hydrogen Storage Alloys

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Research field: Engineering, material engineering, functional materials
Keyword: Inorganic hydrogen storage materials, hydrogen storage alloys, secondary battery materials, energy conversion, energy carrier

Abstract

Background In the hydrogen society led by fuel cell vehicle, 70MPa high pressure hydrogen tank is adopted as the on-board hydrogen tank. As a result, several steps of mechanical compressors are installed and operated at the hydrogen filling station. However, since a conventional mechanical compressor involves the problem of hydrogen embrittlement and large energy consumption, cost reduction associated with operation has become a major issue.

Methods In this study, we focus on the thermodynamic properties of hydrogen storage alloys. A hydrogen storage alloy usually releases heat corresponding to the standard enthalpy of formation of hydride produced by hydrogenation. On the other hand, it is necessary to input the same amount of heat in order to achieve dehydrogenated state. At this time, since hydrogen moves from a solid state to a gas state, high pressure can be generated by raising the temperature, as in the general "boiling phenomenon". Because the change in temperature leads to “exponential-like” change of pressure, a relatively small change in temperature is able to produce a large change in pressure. In this research, we focus on hydrogen storage alloys with different thermodynamic stability (different enthalpy change), and the following cycles were tried to pressurize hydrogen: storing hydrogen at room temperature to low pressure type alloy → temperature rise → high pressure gas generation around 20 MPa to store hydrogen at room temperature to high pressure type alloy → temperature rise → high pressure gas generation around 80 MPa.

Results As shown in Fig. 1, hydrogen was introduced into the low pressure reaction vessel at a pressure of 10 MPa at 23 °C . Thereafter, by raising the temperature to 125 °C, a pressure of 20 Mpa was obtained. Using this pressure, hydrogen was introduced into the high-pressure reaction vessel, and the temperature was raised to 189 °C, and a high pressure of 80 MPa was successfully obtained. It is to be noted that hydrogen storage alloys exposed to high-temperature and high-pressure hydrogen gas was found to lead to deterioration by disproportionation [1, 2], and performance improvement against this phenomenon is needed for practical use.

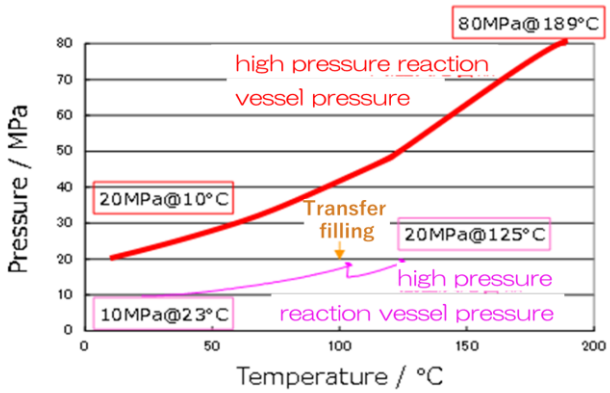

Fig. 1 Demonstration test results at HyTReC

References

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2. Selvaraj, S. et al., “Study of cyclic performance of V-Ti-Cr alloys employed for hydrogen compressor”, Int. J. Hydrogen Energy, 43, 2881-2889 (2018)