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Activities of the Core

Sept. 9, 2021	The 24th Biomass Project Research Center Symposium(co-organized)
Sept. 16, 2021	Professor Nishida gave the invited lecture "Optical Measurement of Fuel Spray --Fuel Air Mixture Formation and Wall-Impinging Spray Fuel Film Formation-" at the "International Symposium (online) Optical Diagnostics of Combustion Systems".
Sept. 16, 2021	The 63rd HU-ACE Steering Committee Meeting
Sept. 29, 2021	The 3rd Hiroshima University Biomass Premium Evening Seminar (co-organized)

HU-ACE Symposium “High efficiency power generation using the recovery of ammonia from biomass and hydrogen conversion” was held.

On September 9, 2021, HU-ACE Symposium “High efficiency power generation using the recovery of ammonia from biomass and hydrogen conversion” was held online. After the greetings from the head of HU-ACE, Prof. Yukihiko Matsumura, 5 presentations were given by Prof. Yutaka Nakashimada, Prof. Takayuki Ichikawa, Prof. Wookyung Kim, and Prof. Keiya Nishida. The recent research progress on the regional circular livestock system based on large improvement of power generation efficiency using ammonia derived from livestock waste, which was supported by the environment research and technology development fund of the environmental restoration and conservation agency of Japan, was also reported. We would like to thank all of you who contributed to the symposium, especially the members of HU-ACE. We are confident that this symposium will help the development of the regional circular livestock system.

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Member Introduction No.32

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Research Field： Material science
Keyword ：Energy storage and conversion/ Hydrogen storage materials/ Hydrogen compressor

Abstract

Background

Realization of hydrogen energy society provides solutions to problems in renewable energy main power sources and brings hope for a new evolution of the current energy storage system and human beings' lifestyles. The development of novel hydrogen storage materials and the expansion of their application are important to prompt the construction of a new hydrogen energy society. Hydrogen compression is important in hydrogen transportation and usage, and plays a significant role in the process of hydrogen energy industrial development. Various hydrogen storage materials used for hydrogen compressors are being investigated for hydrogen compression efficiency and cyclic durability.

Methods

Different hydrogen storage alloys such as BCC, AB type alloys were thermochemically compressed at different conditions (extreme temperature and pressure) to evaluate their material performance. Boundary conditions were defined for stable and degraded hydrogen compression performance. Hydrogen compression efficiency and cyclic durability were studied to clarify the best compression behavior for practical applications. Structural and morphology characterization was utilized for the identification of phase changes caused by extreme operating conditions. Thus, the mechanism for unexpected disproportionation and degradation that happened in the hydrogen compression process was clarified, which provides guidance for safety-conscious hydrogen compression application.

Results

Hydrogen storage performance of a model system $V_{20}Ti_{32}Cr_{48}$ alloy (BCC) is shown in figures (a) and (b) after 25 hydrogen compression cycles. The influence of two important parameters, i.e. hydrogen content and temperature, were investigated individually. The disproportionation of the $V_{20}Ti_{32}Cr_{48}$ alloy during the hydrogen compressor cycle test occurred at temperatures higher than 200° C and 75% H_2 content of the total capacity under the initial conditions. A clear and obvious boundary condition between disproportionation and keeping the initial phase intact was defined as shown in Fig. (c). We expect that the methodology used to determine the boundary operation condition can be treated as a general method to ensure that hydrogen storage alloys are used safely and efficiently in hydrogen compressor applications.

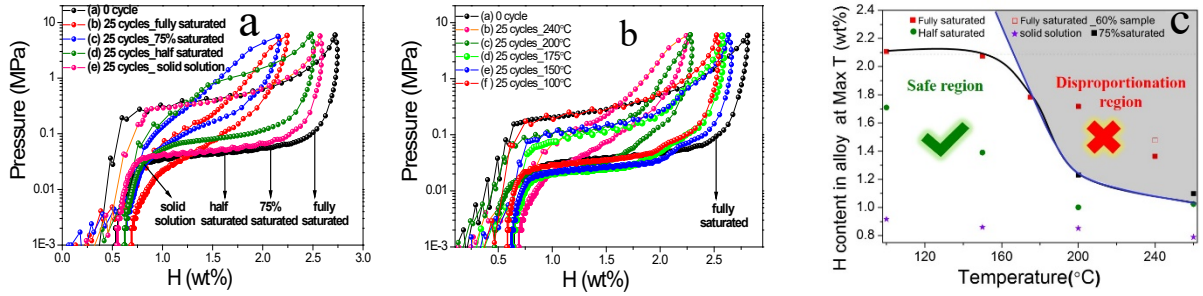

Figure: PCI curves of $V_{20}Ti_{32}Cr_{48}$ at RT before and after 25 cycles of compressor test with: (a) different hydrogen content and (b) at different temperature; (c) H content remained in the alloy at achieved max temperature.

References

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