The 22nd Meeting of Japan CF-Research Society

JCF22 ABSTRACTS

March 5, 2022

(Online meeting)

Japan CF-Research Society

Program of JCF22 Meeting

Japan CF-Research Society

Supported by The Thermal & Electric Energy Technology Foundation

Date: March 5, 2022
Place: (Online)
Paper presentation: Oral presentation 20 min. + Discussion 5 min.
Language: English or Japanese
Book of Abstract: Only available at JCF home page (http://jcfrs.org/)

March 5 (Sat), 2022

10:00-10:10 **Opening Address** S. Narita (Iwate University)

Session-1 *Chair: S. Narita (Iwate University)*

10:10-10:35 **JCF22-1** Y. Mori et al. (Technova Inc.)
New MHE Experiments by D-System

10:35-11:00 **JCF22-2** M. Hasegawa et al. (Technova Inc.)
Characteristics of Excess Power Generation in MHE Experiments by D-System

11:00-11:25 **JCF22-3** H. Miura
Computer Simulation on the Metal Hydride Band Gaps of Pd, Ni and Cu Metal Lattices

11:30-12:00 **JCF Annual Meeting**

12:00-13:00 **Break**

Session-2 *Chair: M. Kishida (Kyushu U)*

13:00-13:25 **JCF22-4** Y. Iwamura et al. (Tohoku University)
Energy Generation using Nano-sized Multilayer Metal Composites with Hydrogen Gas; Intentional Induction of Heat Burst Phenomenon

13:25-13:50 **JCF22-5** T. Itoh et al. (Tohoku University/CLEAN PLANET Inc.)
Optical Observation of Spontaneous Heat Burst Phenomena during Hydrogen Desorption from Nano-sized Metal composite

13:50-14:15 **JCF22-6** T. Kobayashi (Waseda University)
Heat generation of metal composite powder caused by the pulse flow of hydrogen gas

14:15-14:30 **Break**

Session-3 *Chair: Y. Iwamura (Tohoku University)*

14:30-14:55 **JCF22-7** M. Kishida (Kyushu University)

Effects of Heat of Hydrogen Absorption and Heat of Alloy Phase Transition on Sustained Heat Generation from Palladium-Nickel-Zirconium Alloys in Hydrogen

14:55-15:20 **JCF22-8** S. Narita (Iwate University)

Recent Progress of Deuterium/Hydrogen Desorption Experiment Using Pd-Ni Sample

15:20-16:00 **Panel Discussion**

Adjourn

New MHE Experiments by D-System

Yutaka Mori[1], Akito Takahashi[1], Masahiko Hasegawa[1], Joji Hachisuka[1], Yuichi Furuyama[2]

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We have studied the so-called AHE (anomalous heat effect) by calorimetry of our C-system[1)]. The C-system was designed to make accurate detection of excess thermal power larger than several W/kg-sample. By our latest data with significant increase of excess thermal power of the MHE (nano-metal hydrogen energy) experiment, we have met to needs for improving the system. Especially in cases of observing 200W/kg-sample level excess power evolution using re-calcined PNZ- and CNZ-type MHE powder-samples[2)], we have found some drawbacks in calorimetry with the C-system.

In our new system (D-system), we have made the following improvements:

a) Heat recovery system to cover higher temperature conditions as over 500°C of hydrogen gas condition of reaction chamber
b) Increase detection points of heat sensors
c) Reaction chamber assembly with high temperature-tight performance

One drawback of the C-system was due to the problem that calorimetry inaccuracy became very large (underestimation) when coolant oil temperature reached at boiling point (ca. 350°C). In the D-system, we use the heat recovery by radiation heat transfer from the surface of reaction chamber settled in outer vacuum chamber. As a result, we can operate H-gas feeding runs with MHE sample powder to extend for much higher temperature conditions. We can take characteristic AHE data of excess thermal power with additional key data as evolution of H/Ni loading ratio. Characteristic feature of latest AHE data will be shown by another paper in this JCF22 meeting[3)].

References:

1) Akira Kitamura, Akito Takahashi, Koh Takahashi, Reiko Seto, Takeshi Hatano,Yasuhiro Iwamura, Takehiko Itoh, Jirohta Kasagi, Masanori Nakamura, Masanobu Uchimura, Hidekazu Takahashi, Shunsuke Sumitomo, Tatsumi Hioki, Tomoyoshi Motohiro, Yuichi Furuyama, Masahiro Kishida, Hideki Matsune; **Comparison of excess heat evolution from zirconia-supported Pd-Ni nanocomposite samples with different Pd/Ni ratio under exposure to hydrogen isotope gases, Proc. JCF18, 2018**
2) Akito Takahash, Hiroyuki Ido, Atsushi Hattori, Reiko Seto, Atsushi Kamei, Joji Hachisuka, Toyoshi Yokose, Yutaka Mori, Akira Taniike, Yuichi Furuyama; **Latest Progress in Research on AHE and Circumstantial NuclearEvidence by Interaction of Nano-Metal and H(D)-Gas, J. Condensed Matter Nucl. Sci. 33 (2020) 14–32**
3) Masahiko Hasegawa, Akito Takahashi, Yutaka Mori, Joji Hachisuka, Yuichi Furuyama; **Characteristics of Excess Power Generation in MHE Experiments by D-System**, this meeting

This is abstract to paper for JCF22 Meeting, Tokyo, Mar.5-6, 2022

Characteristics of Excess Power Generation in MHE Experiments by D-System

Masahiko Hasegawa[1], Akito Takahashi[1], Yutaka Mori[1], Joji Hachisuka[1], Yuichi Furuyama[2]

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By using our new experimental system (called D-system[1)]) of MHE (nano-metal hydrogen energy) reaction, it became to be able to measure and to evaluate more clearly the anomalous heat effect (AHE) by the elevated temperature interaction of nano-composite metal sample and hydrogen-gas. Two new characteristics of AHE excess power by the MHE reaction are reported in this paper.

The first one is that the evolutional generation of excess thermal power level (25-35W) is largely dependent on the dynamic absorption rate of hydrogen (H/Ni loading ratio) in MHE sample-material (CNZ9; Cu_1Ni_7/zirconia, 140-150g by repeated calcination). After exceeding the turning point of H/Ni=1.0 (nominal value), excess thermal power was started to increase steeply, and a few days later it started to decrease at the near full H/Ni loading ratio (H/Ni>>1.0) dependent on condition of the MHE sample-material under elevated temperature (highest temperature amid RC was over 900 °C). H/Ni loading ratio was estimated by calculating the decrease of hydrogen pressure in the reaction chamber (RC) and in the reservoir tank, (Pr) and (Ps) respectively. The characteristics of H/Ni evolution shows that the absorption of hydrogen on the T-sites of the FCC lattice of Ni nano-islands in the MHE sample-material is important factor for the AHE excess thermal power generation in 200W/kg-sample level. And this is also the experimental evidence of the reported absorption mechanism of hydrogen into the Ni nano-meso-catalyst islands[2,3)].

The second one of new findings is that the AHE power level can be re-activated from the low-active state under the near full H-absorption rate (nominal value of H/Ni =3.5 locally is conceived). The control/trigger method is by the operation of the hydrogen-gas valve of RC to be closed for a few hours and then to be re-opened. This control of triggering re-activation is repeatable for many times with significant excess power increase (10-15 W in present actual runs) lasting a day or so per each triggering.

The conceived mechanism of the phenomena is that the feeding of hydrogen-gas with pressure difference would be some stimulus toward the MHE reaction sites (SNHs[2)]) on the surface of Cu-Ni nano-islands, and this first phase of on-surface MHE reactions makes the enough heat energy to desorb some part of the absorbed hydrogens at T-sites, so that the desorbed hydrogen makes the rapid increase (burst) of Pr. Even after some ten second of peak of Pr, the increase of temperatures of MHE sample-material zone were continued for a day with slowly decaying mode by increasing H/Ni ratio (recovering), suggesting that MHE reactions are taking place at T-sites by 4H/TSC formation from 4 protons of O-sites[2,3)]. The re-activated MHE reaction rates were slowly decreased and the H/Ni loading was also returned to the previous full saturation level (nominal local value of 3.5) before the reactivating valve operation and the temperatures of MHE sample-material in the RC also returned to the previous semi-equilibrium temperatures with low level AHE power (several watts in this study) at SNHs, which is long lasting bias.

References:

1) Yutaka Mori, Akito Takahashi, Masahiko Hasegawa, Joji Hachisuka, Yuichi Furuyama; New MHE Experiments by D-System, JCF-22 Meeting (this meeting), 2022
2) Akito Takahashi; Physics of Cold Fusion by TSC Theory, J. Condensed Matt. Nucl. Sci., 12, 191-198, 2013
3) See also: (PDF) MHE nuclear-like thermal power generation and guiding TSC theory (researchgate.net)

This is abstract to paper for JCF22 Meeting, Tokyo, March.5-6, 2022

Computer Simulation on the Metal Hydride Band Gaps of Pd, Ni and Cu Metal Lattices

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It has been recently reported by Parkhomov that if thermal electrons with energy larger than about 0.5 eV in metals produce electron neutrino pairs, and if the produced electron neutrinos have energy about 0.1 eV, they could cause Low Energy Nuclear Reaction (LENR). On the other hand, the electronic band and the electronic density of states (DOS) of many metal hydrides have been investigated that the Fermi level of palladium hydride (PdH) shifts to the direction of high energy of the electronic band, and some rare earth metal hydrides transit into insulators. Therefore, if H atoms enter metals such as Pd and the Fermi level shifts to the direction of high energy of the electronic band, and even if it is temporary, the semiconductor like band gaps of about 0.5 to 1.0 eV are generated, electrons which transit from the conduction band to the valence band of the band gaps could replace the thermal electrons in the idea of LENR by Parkhomov.

In order to confirm these band gaps occur, the electronic band and the electronic DOS of face centered cubic (FCC) metal lattices such as Pd, Ni and Cu metals, and as a comparison with these metals, those of Pt, Ag, Au and Al metals and others were investigated by using ABINIT, the first principle molecular dynamics method with a personal computer. As a result, it was confirmed that the metal hydride band gaps of Pd, Ni and Cu metal lattices occurred with gap energy of 0.5 to 1.0 eV across the Fermi level.

However, photons are mostly produced by electron transition from the conduction band to the valence band of the band gaps, and the probabilities of electron neutrino pair production by a weak interaction are very small. Therefore, as a future issue, in order for LENR to occur by neutrino pair production from these band gaps, some amplification mechanism of electron transition will be necessary. Fortunately, the electron neutrinos would be produced in small energy of about 0.1 eV and then their wave functions would spread so widely that they could interact with many objects to cause LENR. As the possible LENR process, it is assumed that a produced anti-electron neutrino, an electron and a proton (quark) of H atom will interact with the weak interaction and collide all together as “a pseudo-neutron” on another nucleus such as a lattice metal nucleus.

Energy Generation using Nano-sized Multilayer Metal Composites with Hydrogen Gas; Intentional Induction of Heat Burst Phenomenon

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An innovative heat generation method using Ni based nano-sized metal multilayer thin films with hydrogen has been developed by our team [1]-[2]. Anomalously large heat generation was induced by heating up the metal multilayer thin film that absorbed hydrogen gas in advance. Two nano-sized metal multilayer composite samples, which were composed of Ni and Cu thin films on bulk Ni (25mm×25mm×0.1mm), were placed in a vacuum chamber. These samples were fabricated by Ar ion beam or magnetron sputtering method. After baking of the samples, H_2 gas was introduced into the chamber and the Ni based multilayer thin films started to absorb H_2 gas. Typically, after about 15 hours, H_2 gas was evacuated and simultaneously the samples were heated up by the ceramic heater up to 500~900°C. The evacuation and heating process trigger heat generation reactions. Up to now, the value of averaged released energy evaluated with total amount of absorbed hydrogen reached as high as 21 keV/H, which was too high to be explained by known chemical reactions [1].

Surface temperatures on nano-sized multilayer metal composites and centre temperature in the ceramic heater were simultaneously measured by two radiation thermometers looking at both surfaces (A and B) of the samples and a thermocouple (Tc) embedded in the ceramic heater as shown in Fig.1(a). In JCF21, we reported that spontaneous heat burst phenomena were observed [2]. In this study, we present that we succeeded in intentionally inducing such a heat burst phenomenon. An example of intentional induction of a heat burst induced by the perturbation of input electrical power is demonstrated in Fig.1(b). If no heat burst is generated, it is normal for the surface temperatures A, B and Tc to return to original values when the input power is reduced and then returned to the original input power. However, in this case, the surface temperatures A, B, and Tc have all increased significantly. Furthermore, the increases in surface A and B temperatures were larger and steeper than that of thermocouple Tc. It would indicate that heat burst reactions were induced by the perturbation of input power at the surface A and B and then their energy propagated to the Tc. Considering that the pressure in the chamber is less than 10^{-5} Pa, the energy released in this heat burst cannot be explained by any known chemical reactions such as hydrogen combustion. This phenomenon has been observed frequently, although it depends on the state of sample. At present, we assume that the temperature distribution change due to the perturbation of the input power and hydrogen diffusion and concentration are involved in intentional induction of heat burst phenomenon.

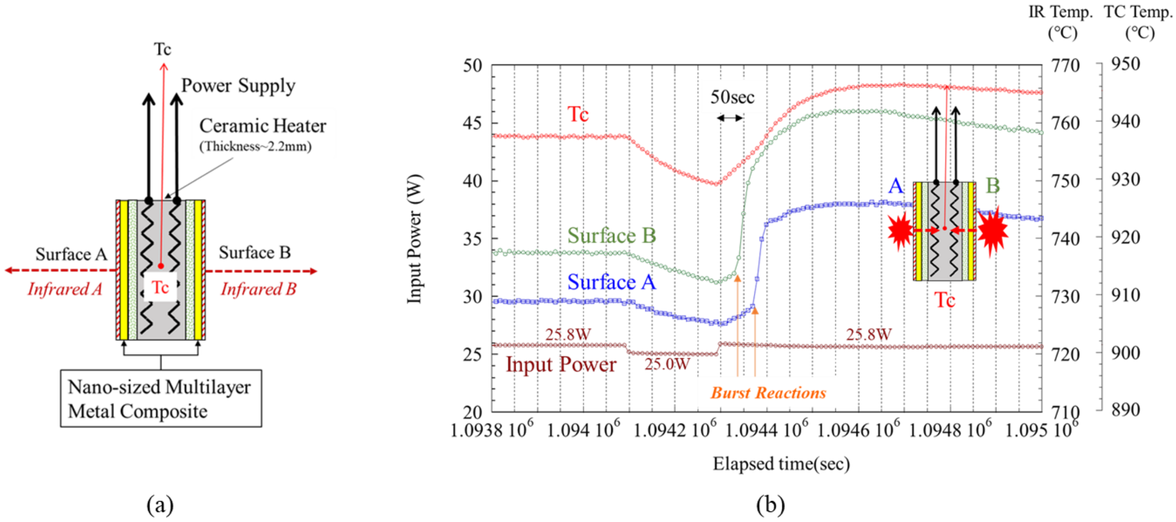

Figure 1. Intentional Induction of Heat Burst Phenomenon; (a) Measurement of Tc and surface temperature A and B, (b) Heat burst phenomena induced by intentional perturbation of input electrical power.

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Optical Observation of Spontaneous Heat Burst Phenomena during Hydrogen Desorption from Nano-sized Metal composite

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We have been conducting research on anomalous excess heat (AEH) generation phenomena using hydrogen and nano-sized metal composite. Up to the present, we succeeded in observing the AEH that cannot be explained by the chemical reaction [1,2]. In addition, we often observed heat burst phenomena, in which the temperature of the heater suddenly rises [2]. Observing this phenomenon in detail is one of the ways to understand the mechanism of the AEH production. Recently, experiments have been conducted by adding light radiation to temperature measurement [3]. In the present work, we report on the latest results measured by a group of photodetectors. The sample mainly examined is a Ni/Cu nano multilayer film which is deposited on Ni substrates by sputtering.

The experimental process is as follows. First, two films are fixed on both sides of a ceramic heater in a sample holder installed in the vacuum chamber (Fig.1). Next, the samples are sufficiently baked out in a vacuum, and then H_2 gas is introduced into the chamber to 200 Pa, the heater temperature is kept at 250 C for about 15 hours to allow the samples to absorb hydrogen. Finally, we heat the samples up and keep the heater input power constant, while evacuating the chamber to release hydrogen from the samples: This induces the AEH generation.

In the experiment, the heater temperature was continuously measured together with the light radiation emitted from the surface of the sample. Attempted was the simultaneous detection of light radiations when the heat burst occurred. Used photodetectors are TMHK-CLE1350 (wavelength 3-5.5 μm) for mid-IR, an FTIR spectrometer Hamamatsu C15511 (1.5-2.5 μm) for near-IR, and a spectroscope Hamamatsu C10027 (0.3-0.9 μm) for visible light (Fig.1).

In our experiments, we observed many sudden heat generations. Fig.2 shows the occurrence of typical heat bursts between 60 and 80 hours: a plot of the temperature and radiant intensities as a function of elapsed time. Red, green, brown and light-blue lines are heater temperature, radiant intensities measured in mid-IR, in near-IR and in visible light, respectively. At time 77.6 hours, sudden increase is clearly seen in every line and they are temporally synchronized, even though the heater input power is constant. This suggests that there is sudden energy generation in the sample, part of it is dissipated quickly by radiation from the surface and is partly propagated to the inside as to rise the heater temperature.

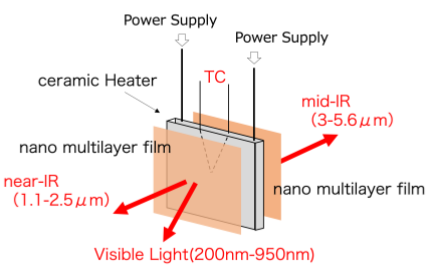

Fig.1 Schematic of components around Nano-sized Multilayer film

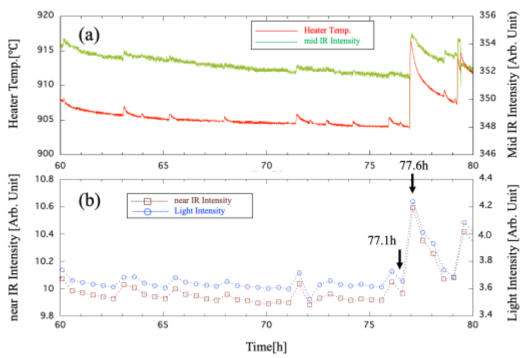

Fig2. Typical heat bursts occurring spontaneously

References
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Heat generation of metal composite powder caused by the pulse flow of hydrogen gas

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Anomalous heat generation in exposure of metal powder (Ni or Pd) to hydrogen (or deuterium) gas was observed in previous research [1,2]. Anomalous effect in hydrogen (or deuterium) gas absorption by mixed oxides of Pd and Zr is also reported [3]. In our previous report, we developed a reaction system with small chamber (Fig. 1) and conducted the fundamental experiment of the anomalous heat effect. About 10 K of temperature increase was observed when hydrogen gas is absorbed by Pd-Ni-Zr composite powder at about 500 K. [4] In this report, we conducted the experiments of anomalous heat generation (absorption of hydrogen gas by Pd-Ni-Zr composite powder [5]) with the pulse flow [6] of hydrogen gas. As a result, about 30 K of temperature rise was observed (Fig. 2). In addition, the tendency was observed that temperature rise during experiment is increased than that of the experiments without the pulse flow.

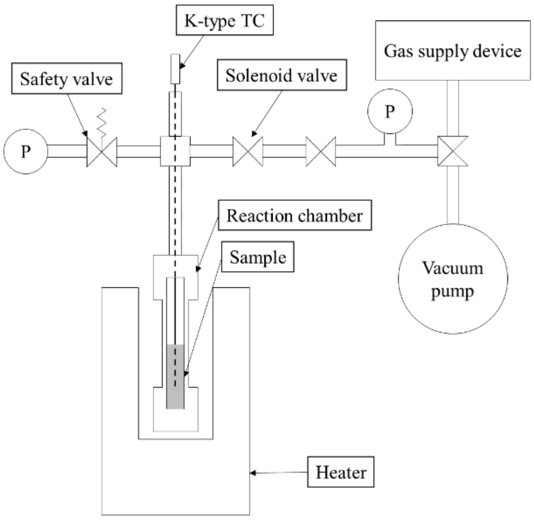

Fig.1. Reaction system

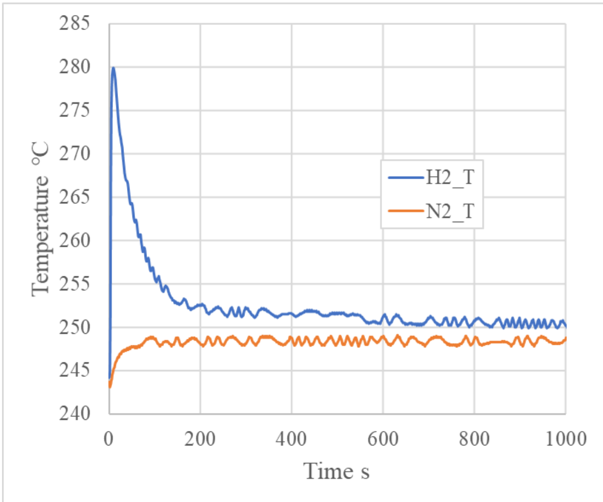

Fig. 2. Experimental result

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Effects of Heat of Hydrogen Absorption and Heat of Alloy Phase Transition on sustained Heat Generation from Palladium-Nickel-Zirconium Alloys in Hydrogen

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It has been reported that anomalous heat different from hydrogen absorption heat is maintained for several weeks when hydrogen or deuterium gas is in contact with some metal alloys. The total amount of heat is so large that it cannot be explained by only chemical reactions [1]. It is very important to clarify the mechanism of such anomalous heat generation, but it is also important to clarify the effect of known heat generation on that heat generation. In this study, we examined the alloy phase state, hydrogen storage behavior, and sustained heat generation behavior of palladium-nickel-zirconium (PNZ) and nickel-zirconium (NZ) alloys to clarify the effects of hydrogen absorption and alloy phase transition heat on sustained heat generation.

The alloy samples were fine powders provided by Nissan Motor Co., Ltd. The molar compositions of the samples were Pd:Ni:Zr = 1:7:15 and Ni:Zr = 7:15. The alloy phases were determined by X-ray diffraction method using Ultima IV diffractometer (Rigaku). Hydrogen storage and release behavior was measured by temperature-programmed reaction method (TPR) using a BELCAT-B analyzer (Microtrac MRB) equipped with a quadrupole mass spectrometer (QMS). The exothermic/endothermic behavior was evaluated by differential scanning calorimetry (DSC) using a PT-1600H calorimeter (Linseis) with a controllable gas atmosphere. In the DSC measurement, 100 mg of the sample was heated to a specified temperature at 5 ºC/min and held at that temperature for 4 hours. The sample was measured under both hydrogen and inert gas atmospheres, and the difference in heat flow between the two was determined to be the heat output generated by the sample.

The PNZ sample absorbed hydrogen at around 100 °C in diluted hydrogen and slowly depleted hydrogen from 250 °C to 800 °C. The exothermic behavior of the sample was examined in hydrogen, and heat generation was observed when the sample was held at a certain temperature between 300 and 500°C, and the heat output did not decay during the measurement time. The temperature dependence and hydrogen partial pressure dependence of the heat generation indicated that the PNZ sample generates a sustained heat during hydrogen desorption.

Next, the stability of $NiZr_2$, the main alloy phase of PNZ, at 200 °C and 400 °C was compared, and it was found to be more unstable at 200 °C. The phase change is considered to be due to an amorphization of the $NiZr_2$ phase. However, no sustained heat generation was observed at that temperature (200 °C). Therefore, the sustained heat generation is not due to the change in the alloy phase.

In the presentation, the difference in heat generation behavior between the PNZ and NZ samples will be also reported.

Reference

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Recent Progress of Deuterium/Hydrogen Desorption Experiment Using Pd-Ni Sample

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We have conducted deuterium absorption and desorption experiments using Pd-base metal complex samples, which were fabricated by depositing a metal membrane, such as Ni, Ag, Ti, and Zr, onto a Pd foil. In particular, for the sample of Pd coated with Ni membrane, we have observed a short-period intermittent fluctuation in temperature, which might indicate that a prompt deuterium diffusion occurred bidirectionally between the Pd foil and the membrane [1-3]. Although we have attempted to derive the amount of heat generated during the experiment, a quantitative and precise method for analyzing it has not been established, and we have not obtained any results indicating that excess heat was significantly generated. However, the exothermic behavior we have observed, and the associated peculiar migration and densification of deuterium at the Pd-Ni interface, may be related to the excess heat generation phenomenon reported in other experiments [4,5].

We have recently modified the experimental conditions for more accurate temperature measurement and better reproducibility. With the method of holding the sample in the past experiments, the temperature measurements were sometimes affected by deforming of the sample during deuterium desorption. Then, we have made a new sample holder designed to hold the sample and the thermocouple firmly. In the experiments using the holder, short-period intermittent heat generation phenomena have been observed with good reproducibility. In addition, temperature measurement had been done only with a thermocouple, which was easily affected by the contact condition of the sample and did not have sufficient time response to temperature changes. An infrared radiation thermometer has been recently implemented for precise measurement of the temperature with high time response of ~0.1 s. We have been conducting quantitative evaluation of excess heat obtained from the experiments with this modified apparatus. Moreover, we have recently started experiments with hydrogen. A phenomenon similar to that observed in deuterium experiment, that is, short-period intermittent heat generation, has been observed even with hydrogen.

References

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