The 23rd Meeting of Japan CF-Research Society

JCF23 ABSTRACTS

March 4~5, 2023

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Japan CF-Research Society

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Japan CF-Research Society

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Date:	March 4 & 5, 2023
Place:	Waseda University, Faculty of Science and Engineering 3-4-1 Ookubo, Shinjuku, Tokyo **Building 62W 1F. 大会議室 (Main meeting room)**
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 4 (Sat), 2023

Registration 12:00 - 13:00 **at Building 62W 1F. 大会議室 (Main meeting room)**

13:00-13:10 **Opening Address** Ken Naitoh (Waseda University)

Session-1 *Chair: T. Itoh (Tohoku University)*

13:10-13:35 **JCF23-1** Hideo Kozima (Cold Fusion Research Lab.)
The Cold Fusion Phenomenon and the ARPA-E Project 2022 of DOE: A Facet of the Sociology of Modern Science

13:35-14:00 **JCF23-2** Kazuo Ooyama (Ooyama Power Inc.)
Theory of Nuclear Fusion Chain Reactions in Metal Crystals

14:00-14:25 **JCF23-3** Kazuo Oyama (Ooyama Power Inc.)
Experiments without Nuclear Reaction

14:25-14:40 **Break**

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

14:40-15:05 **JCF23-4** Tomonori Takahashi, Takehiko Itoh, Yasuhiro Iwamura, Shinobu Yamauchi and Jirohta Kasagi (CLEAN PLANET Inc./Tohoku University)
Gas analysis by a quadrupole mass spectrometer during anomalous heat generation observed in the interaction of Ni-based nano-multilayer metal composite and hydrogen gas

15:05-15:30 **JCF23-5** S Yamauchi, Takehiko Itoh, Yasuhiro Iwamura, Tomonori Takahashi and Jirohta Kasagi (CLEAN PLANET Inc./Tohoku University)
Elemental analysis towards the clarification of anomalous heat generation phenomena observed in the interaction of Ni- based nano-multilayer metal composite and hydrogen gas

15:30-15:55 **JCF23-6** Takehiko Itoh, Yoshinobu Shibasaki, Jirohta Kasagi Tomonori Takahashi, Shinobu Yamauchi and Yasuhiro Iwamura (Tohoku University/CLEAN PLANET Inc.)

Photon Radiation Analysis for Heat Burst Phenomena during Hydrogen Desorption from Nano-sized Metal composite

16:00-17:00 **JCF Annual Meeting**

March 5 (Sun), 2023

Session-3 *Chair: S. Narita (Iwate University)*

9:30-9:55 **JCF23-7** Shunji Tsuji-Iio (Tokyo Institute of Technology)

Replication experiments on nuclear transmutation induced by deuterium permeation through Pd/CaO multilayer film

9:55-10:20 **JCF23-8** Akito Takahashi, Masahiko Hasegawa, Yutaka Mori, Yuichi Furuyama, Tomoya Yamauchi, Masato Kanasaki (Technova, Kobe/Kobe University)

Rising Characteristics of MHE Power with CNZ Material

10:20-10:35 **Break**

Session-4 *Chair: Y. Iwamura (Tohoku University)*

10:35-11:00 **JCF23-9** Yuta Toba, Ken Naitoh Tomotaka Kobayashi, Daiki Okada, Ryuki Nakagawa (Waseda University)

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

11:00-11:25 **JCF23-10** Tomotaka Kobayashi, Ken Naitoh, Daiki Okada, Ryuki Nakagawa, Yuta Toba, Masaharu Uchiumi, Daisuke Nakata (Waseda University & Muroran Institute of Technology)

Fundamental experiments of anomalous heat effect in metal composite powder exposed to pulsed high-pressure hydrogen gas

11:25-11:50 **JCF23-11** Nagayuki Yanagidate, Tomo Nemoto, Sora Komukai, Aiko Shoji, Shinya Narita (Iwate University)

Heat Measurement in Hydrogen Desorption Experiment Using Pd-Ni Sample

The Cold Fusion Phenomenon and the ARPA-E Project 2022 of DOE: A Facet of the Sociology of Modern Science

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A sociological perspective for the Development of the Cold Fusion Phenomenon (CFP) or the LENR is given in relation to the ARPA-E Project 2022 (referred as "Project" in this paper, hereafter) proposed by DOE, USA on September 13, 2022. Brief summary of characteristics of the experimental data obtained in the CFP closely related to the requirement of the Project is given in relation to the character of the Project. The nature of modern science strongly bound to the social requirement rather than the scientific value itself is discussed using this case as a typical example.

The most important characteristics of the CFP in relation to the Project are the qualitative reproducibility observed and confirmed in the cold fusion materials: The lack of quantitative reproducibility in the CFP, one of the main targets against the CFP raised at first by Huizenga in his book, has been an obstacle to understand the CFP as a part of modern science. The characteristics related to the qualitative reproducibility have been analyzed and explained by the laws of complexity in systems with nonlinear interactions between components. The direct appearance of the laws of complexity in physics is a very rare case and it is explained why the science of the CFP is not easily reconciled with the commonsense of the modern science governed by the quantitative reproducibility common in simple systems.

The requirement of the Project includes "A key goal of the Exploratory Topic (ET)" which asks "the convincing empirical evidence of nuclear reactions in an LENR experiment and publication of the evidence in a top-tier peer-reviewed research journal." The requirements have long been shown in contradiction to the attitude of the research journals for about 30 years. It is, therefore, very difficult to attain the requirement by the sudden change of the attitude of the research journals by several new experimental data.

It is concluded that the object of the Project is too difficult to attain in the asked period of 30 months due to the nature of the CFP even if the Project is able to stimulate recognition of the importance of the qualitative reproducibility ubiquitous in many-body systems.

Theory of Nuclear Fusion Chain Reactions in Metal Crystals

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We presented the nuclear reaction mechanism of cold fusion in ``Nuclear Fusion Mechanism in Metal Crystals [1]'' and predicted the involvement of ^{6}Li. Among these reactions, the "Nuclear Fusion Chain Reaction", which is responsible for the generation of "Heat after Death [2]", is important for the utilization of nuclear energy [3]. In a previous paper, they found evidence that 6Li was produced as an intermediate product of "postmortem heat" [3]. In addition, the creation and startup of the reactor was announced in "Start-up of Metal Crystal Confinement Fusion Reactor [3]". However, it seems that the theory has been evaluated as having some imperfections, and it seems that we have not yet accepted what we have achieved.

There are many unexplained phenomena in the invisible world of nuclear physics. For example, discrepancies between shielding energies in metals and theoretical values, reasons for particle generation by trinuclear fusion in metals, elucidation of reaction cross sections of neutrons with low-mass nuclei, reasons for excessive DD and DT fusion cross sections and so on. Investigating into the reasons why these have not been clarified, we found that the cause was that the shape of the nuclear potential, which was tentatively established in Yukawa's meson theory paper in 1935 [4], was left undiscussed. Therefore, by correcting the shape of the nuclear force potential to match the measured value of the nuclear reaction cross section, the theory of nuclear fusion chain reaction in metal crystals was completed.

There are new points about the experiment including the correction of the phase diagram of the Pd-Li system, which are summarized here including the correction of the interpretation of the experimental results.

References

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Experiments without Nuclear Reaction

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CF (Cold Fusion) research began in 1989, when Ponds et al. reported abnormal heat generation in the electrolysis of heavy water. However, since no solid theory has been established, researchers tend to think that the fever they do not understand is CF. However, since no solid theory has been established, researchers tend to think that the fever they do not understand is CF. Furthermore, since there are mixed experimental reports of errors and fabrications, we have lost direction in CF research and are stuck in a stalemate. The purpose of this lecture is to avoid misleading future researchers by presenting past experiments and information that we believe do not have nuclear reactions.

In 1994, Sergio Focardi reported experimental results that heat is generated from the temperature difference for the same heating in the Ni-hydrogen (H) system [1]. A. Rossi proposed joint research to him and later obtained patents as a chemical reactor in various countries [2]. Rossi sells the patent to investors around the world as the cold fusion reactor patents. He called it E-cat and had Giuseppe Levi and others create Lugano Report [3] in which heat generation and nuclide transmutation were observed, and published it on the Internet. We invalidated Rossi's Japanese patent [4], believing that the E-Cat would mislead CF research. In the process, Rossi promised that "the LENR was concluded to be unrealizable."

In 1999, Arata et al. announced that they confirmed the generation of excess heat and He from Pd nanopowder [5]. On May 22, 2008, Arata gave a lecture on the generation of excess heat and He from samples of ZrO2Pd and ZrNiPd alloys, and conducted a public experiment [6]. After that, Arata et al. reported experimental results for two types of nanopowder ZrO_2Pd35 and $ZrO_2Ni30Pd5$, significantly modifying the former data from previous ones and the latter reportedly produced more excess heat and He [7]. However, the figure presented in this paper as evidence that He was produced is evidence that He is not produced.

References

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Gas analysis by a quadrupole mass spectrometer during anomalous heat generation observed in the interaction of Ni-based nano-multilayer metal composite and hydrogen gas.

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Our team at Tohoku University have been conducted fundamental research to develop a new energy source using anomalous heat generated by Condensed Matter Nuclear Reactions.

As for anomalous heat, it was reported that heat generations beyond 100eV/H or D were observed during NEDO project [1]. The anomalous heat was obtained by heating nano-sized particles, such as CuNiZr-O_X or PdNiZrO-O_X, up to 200~300℃ with D_2 or H_2 gas. On the other hand, transmutation reaction of Cs into Pr induced by D_2 gas permeation through nano-sized Pd and CaO multilayer composite was reported [2].

Based on these papers, a new type of excess heat experiment was developed using nano-sized metal multilayer composites and hydrogen gas, resulting in the observation of excess heat [3]. In this experiment, gas analysis using a Quadrupole mass spectrometer (Q-mass) was performed on the gas released when the sample was heated to find out if there is a correlation with heat generation. Q-mass was installed near the TMP of the exhaust pipe and installed in a position where the generated gas could be detected without interfering with the chamber during the heat generation experiment.

As an evaluation method for gas analysis, the peak intensity of Ar was used as a standard. Attention was paid here to the magnitude of the difference between the peak intensities for the Ar peaks of the major atmospheric components and those during heat generation experiments the thermal evaluation experiment.

As a result, the O_2 peak intensity showed a fairly specific intensity ratio to the standard Ar peak ratio. This is an anomalously strong peak that cannot be explained simply by air leak or contamination adhesion. It may suggest the possibility that O_2 gas was generated from the sample for unknown, not specified reason.

In the future, we plan to evaluate the relationship between the heat generation mechanism and gas generation by proceeding with gas analysis of samples that generate a larger amount of excess heat.

References

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Elemental analysis towards the clarification of anomalous heat generation phenomena observed in the interaction of Ni- based nano-multilayer metal composite and hydrogen gas

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Previous results by our group demonstrated nano-sized metal multilayer composites on Ni substrate and hydrogen gas induced heat bursts and excess energy generation [1]-[3]. To understand the mechanism of this anomalous heat generation, it is essential to investigate the samples which produced excess energy in our experiments. Thus, we performed analysis of the samples after having performed the experiment, using Scanning Electron Microscopy (SEM)/ Energy Dispersive X-ray spectroscopy (EDX) and Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) to evaluate the morphology and chemical composition on the sample surface where such heat bursts may have occurred.

First, the specimens were observed under SEM/EDX (JSM-6500F, JEOL), then specific regions with common characteristics were identified in the samples that produced excess heat energy in the experiment. These areas were selected as measure points for performing TOF-SIMS (TOF.SIMS 5, ION-TOF GmbH) analysis.

The morphological observations using SEM showed the presence of some clumps in the middle of crystal gains in a Ni substance. EDX data indicated that Ni was the major element in the surface components, whereas the clumps contained higher O ratios (at% >10) than the matrices (at% <1). Furthermore, the presence of O was confirmed by ion maps from TOF-SIMS as high-intensity region of O at the measurement points where the clumps were observed densely. This area rich in O can be attributed to the existence of many clumps. Meanwhile, O was not found at the points of the less clumps in the same heat-producing specimen. Regarding a quantitative evaluation of O element, the depth profile obtained from TOF-SIMS revealed that intensity of O is also higher in the region of numerous clumps compared to the area of less clumps. As regards the amount of excess energy of each sample, the value gained from specimen observed numerous clumps was higher than the value gained from the sample which had less clumps.

These findings might imply that the existence and distribution of regions with high concentration of O indicates some phenomenon which is related to the production of anomalous heat energy. As for the process of forming the clumps rich in O element, the mechanism remains to be clarified. Nevertheless, it might be an important factor in understanding this phenomenon of energy generation. Further investigation will be necessary to arrive at a definitive conclusion of this study.

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Photon Radiation Analysis for 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 have observed the AEH that cannot be explained by the chemical reaction [1,2,3].

The sample used in our experiments is a Cu/Ni/CaO nano-sized multilayer film, which was deposited using magnetron sputtering. Oure experimental process is as follows. First, we fix the two nano-sized multilayer films on both sides of a ceramic heater in a sample holder installed in the vacuum chamber. After sufficiently baking the sample in vacuum, we introduce H_2 gas into the chamber for hydrogen absorption into the sample. The hydrogen pressure is 250 Pa, the sample temperature is maintained at about 300°C for 15 hours. 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 these experiments, 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.

In recent experiments, as reported at JCF22, optical measurements have been added to temperature measurement [4,5]. We measured the heater temperature continuously together with the photon radiation emitted from the surface of the sample. Attempted was the simultaneous detection of photon radiations when the heat burst occurred. We used photodetectors; 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.

As reported in [5], we find that the visible, near-infrared, and mid-infrared radiant intensities increase synchronously with the occurrence of heat bursts. Analysing the photon radiation intensity spectrum in a wide energy range is important in considering reaction mechanisms such as hot spot formation [6]. Analysis of the spectrum during heat bursts has revealed the following: In normal thermal radiation, the observed spectrum is consistent with the one calculated by the gray-body radiation model. On the other hand, the spectrum at the time of the heat burst shows a slight difference from the gray-body radiation spectrum in high energy region (near infrared to visible light region). Details of the results and analysis will be reported.

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Replication experiments on nuclear transmutation induced by deuterium permeation through Pd/CaO multilayer film

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The nuclear transmutation from Cs to Pr induced by deuterium permeation through a Pd/CaO multilayer film has been reported [1]. We conducted its replication experiments employing RF sputtering to form Pd/CaO multilayer films and Cs was deposited on the surface by electro-chemical method. D_2 gas bellow 130 kPa down to around 80 kPa was permeated for several days keeping the film temperature around 120°C to 140°C.

Elemental analysis was made utilizing TOF-SIMS (Time of Flight Secondary Ion Mass Spectroscopy) with mass resolution of 11,000@29u (FWHM) and EDX (Energy Dispersive X-ray Spectroscopy). Thereby we found the following points,

a) The number of CaO layers or its width are not important parameters, so that the presence of a CaO layer near the surface is a key to induce nuclear trans- mutation.
b) The nuclear transmutation to Pr was observed even the deposited Cs and the Pd/CaO multilayer were placed at the down-stream, i.e., pumping side.
c) The presence of $^{40}Ca^{44}CaF_3$ at 140.9133 m/e may interfere the quantification of the amount of Pr at 140.9077 when mass analysis with low resolution such as a quadrupole mass spectrometer employed by Hioki *et al.* [2].

In addition to the misidentification of $^{40}Ca_2O$ as ^{96}Mo revealed by TOF-SIMS analysis [3], we could not confirm ^{137}Ba to ^{149}Sm nor ^{138}Ba to ^{150}Sm, ^{137}Ba had not been enriched beforehand in contrast to the reported case [4] though. D_2 gas permeation through a W-deposited Pd/CaO multilayer film did not produce elements just below 190 such as ^{190}Pt or ^{190}Os claimed by Iwamura *et al.*[5], neither.

Newly found candidates of nuclear transmutation by TOF-SIMS analysis will be presented at the meeting if they are confirmed by EDX analysis.

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Rising Characteristics of MHE Power with CNZ Material

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Our R&D aim is to increase and continue longer the excess thermal power (Wex) by the anomalous heat effect (AHE) through clarifying the mechanism of MHE (nano-metal hydrogen energy) reaction. In the previous report, we reported that the close correlation between AHE power level and the absorption loading ratio of hydrogen (H/Ni) in the reaction material. After exceeding the turning point of H/Ni=1.0 (nominal value), Wex 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. The characteristics of H/Ni evolution shows that the absorption of hydrogen on the T-sites from the O-sites in the FCC lattice of Ni nano-islands in the MHE sample-material under elevated temperature over 300 degree C is important factor for the AHE excess thermal power generation in 200W/kg-sample level.

Two types of MHE reaction sites in the MHE sample-material were reported. The first one is O-site and T-site that are the hydrogen absorption sites in the FCC lattice of nano scale island of Ni. The second one is on the SNHs[2)] on the surface of Cu-Ni nano-islands. The AHE of level (25-35W) is mainly dependent on the dynamic evolution of H/Ni in MHE sample-material (in this case CNZ9; Cu_1Ni_7/zirconia, 140-150g by repeated calcination). The conceived mechanism of MHE are dynamic cluster of 4H/TSC formation at T-sites, by phonon excitation movement of 4 protons of surrounding O-sites[2,3)]. The largest Wex phase of MHE reactions are taking place at T-sites.

The whole MHE reactions are rather complex phenomena in the reactor. Hydrogen (H2) gas, which are around the sample material as fuel substance for the MHE reaction, are changing from gas molecule to hydrogen atom at the SNHs and absorbed in O-sites and finally absorbed in T-sites in the Ni lattice. These processes exceed with several endothermic and exothermic reaction through the absorption of hydrogen and desorption in chemical process.

Several factors and methods are under investigation in our R&D to increase and prolonger Wex. This time, the beginning rise-up phase after start of heating are analysed about hydrogen absorption and starting dynamics of MHE reaction along with temperature rise-up, in order to investigate better condition of the MHE reaction enhancement.

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Heat generation of metal composite powder caused by the various 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 conducted the experiments of anomalous heat generation (absorption of hydrogen gas by Pd-Ni-Zr composite powder [4]) with the pulse flow [5, 6] of hydrogen gas generated by a solenoid valve using a small reaction chamber, while having a short pipe from solenoid valve to chamber of 325 mm (Fig.1). In this report, we conducted experiments by extending the pipeline length from the solenoid valve to the small reaction chamber, due to 2.5 times longer pipe length optimized (825 mm). Hydrogen gas is absorbed in about 530K and 0.5MPa by Pd-Ni-Zr composite powder with pulse flow. Then, about 60K of temperature rise was observed for the longer pipe, whereas being temperature rise of about 50 K without extending the pipe length. (Fig. 2) The temperature rise is increased by 16% due to 2.53 times longer pipe length.

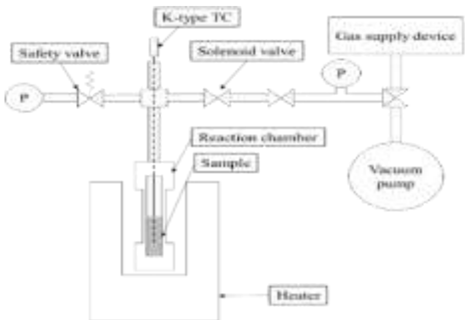

Fig.1. Reaction system

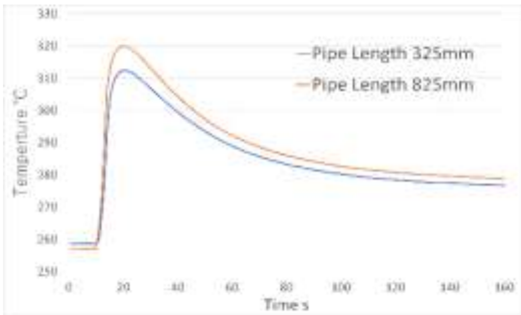

Fig.2. Experimental result

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Fundamental experiments of anomalous heat effect in metal composite powder exposed to pulsed high-pressure hydrogen gas

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Anomalous heat generation was observed in several patterns. For example, Miley reported anomalous heat in the electrolysis using nickel film (Miley and Patterson, *J. New Energy*, 1996), Arata reported anomalous heat generation in the exposure of metal powder (nickel or palladium) to hydrogen (or deuterium) gas (Arata and Zhang, *J. High Temp. Soc.*, 2008), and Kitamura reported anomalous effects in hydrogen (or deuterium) gas absorption by mixed oxides of palladium and zirconium (Kitamura et al., *Physics Letters A*, 2009). We have developed a reaction system with a small chamber (Fig. 1) and have conducted some fundamental experiments to evaluate the anomalous heat in the hydrogen gas absorption of metal powder (especially under the rapid pressure increase). In our previous report, we conducted experiments on low-pressure (< 1 MPaG) hydrogen gas absorption by Pd-Ni-Zr composite powder (PNZ10r, provided by Technova Inc.) with pulsed flow generated by the solenoid valve. In the experiment under the condition of 240 °C of initial temperature and 0.8 MPaG of the hydrogen gas pressure, 35 K of temperature rise was observed and 48.4 J, 5.38 W of heat generation was estimated (Kobayashi et al., *ICCF-24*, 2022). In addition, the positive correlations between the temperature rise and both initial temperature and hydrogen gas pressure were observed in past experiments (Kobayashi et al., *J. Condensed Matter Nucl. Sci.*, 2022). In this report, we develop a reaction system for experiments with high-pressure hydrogen gas (Fig. 2) and conduct a fundamental experiment of hydrogen gas absorption with Pd-Ni-Zr composite powder (PNZ10r) to obtain a larger temperature rise. The reaction system for experiments with high-pressure hydrogen gas pulsed is designed to operate at 10 MPaG and cleared the airtightness test at 9.5 MPaG. In the experiment conducted under the condition of 300 °C of initial temperature and 8 MPaG of the hydrogen gas, over 150 K of temperature rise is observed. Moreover, influence of small amount of oxygen gas included in reaction chamber initially on temperature raise is also tested.

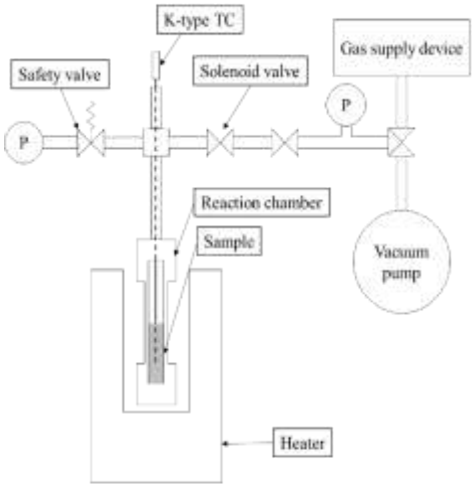

Fig. 1. Reaction system for experiments with low-pressure hydrogen gas

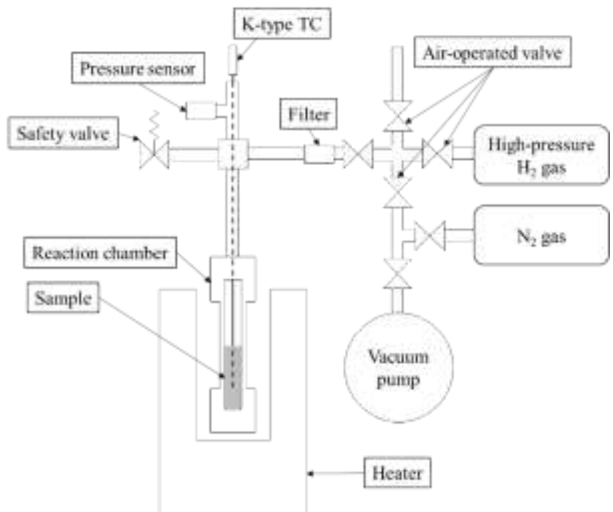

Fig. 2. Reaction system for experiments with high-pressure hydrogen gas

Heat Measurement in Hydrogen Desorption Experiment Using Pd-Ni Sample

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It has been reported by some groups that excess heat was observed in the hydrogen absorption and desorption processes with metal composite samples such as Cu-Ni [1.2]. Besides, we have conducted hydrogen (H) or deuterium (D) absorption/desorption experiments using a sample of Pd foil coated with Ni membrane with fine-structure of their interface. Then, we observe strange thermal behaviors such as short-period fluctuation of the temperature or bust-like heat generation [3,4]. These phenomena are supposed to be due to specific properties of the sample materials and hydrogen diffusion at the Pd-Ni interface, which may be relevant knowledges to clarify a condition to induce low-energy nuclear reaction in condensed matter.

In our previous desorption experiments, constant current was applied to stimulate H/D diffusion by the Joule heating. In the condition, variation in the sample resistance during the desorption process affected significantly evaluating the amount of heat generated from the temperature measurement. Then, a constant power supply system was newly developed and conducted the desorption experiments with it, which is expected to make the excess heat measurement more precise.

In present paper, we report the recent results in a modified experimental system.

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