The 19th Meeting of Japan CF-Research Society

JCF19 ABSTRACTS

November 9-10, 2018

Iwate University, Ginga Hall

Japan CF-Research Society

Program of JCF19 Meeting

Japan CF-Research Society

Date: November 9-10, 2018
Place: Iwate University, Ginga Hall, Morioka, Japan
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/)

November 9 (Fri), 2018

12:00-13:00 **Registration**

13:00-13:10 **Opening Address** S. Narita (Iwate U.)

Session-1 *Chair: K. Tanabe (Kyoto U.)*

13:10-13:35 **JCF19-1** Y. Sato et al. (Kyushu U.)
Verification of anomalous heat detected by differential scanning calorimetry from Palladium-Nickel-Zirconium alloy in hydrogen flow

13:35-14:00 **JCF19-2** I. Imoto et al. (Kyushu U.)
Anomalous Heat Observed in New Binary Metal System under Hydrogen Stream

14:00-14:25 **JCF19-3** Y. Iwamura et al. (Tohoku U.)
Trial to Reproduce Coincident Burst Increase Events of Pressure and Gas Temperature during Heat Generation Experiments using Metal Nanocomposites and Hydrogen Gas

14:25-14:45 **Break**

Session-2 *Chair: S. Narita (Iwate U.)*

14:45-15:10 **JCF19-4** A. Takahashi et al. (Technova Inc.)
Repeated Calcination and AHE by PNZ6 Sample

15:10-15:35 **JCF19-5** T. Yokose et al. (Kobe U.)
Anomalous Heat Burst by CNZ7 Sample and H-Gas

15:35-16:00 **JCF19-6** K. Tanabe (Kyoto U.)
Theoretical Investigation of Plasmonic Field Enhancement at Oxide/Metal Interfaces

16:00-16:25 **JCF19-7** K. Ooyama (Ooyama Power Inc.)
Li Quantity Suitable for Nuclear Fusion Mechanism

16:25-16:50 **JCF19-8** H. Miura
Computer Simulation Approaches to Hydrogen Cohesion inside the Metal Surface

17:00-17:30 **JCF Annual Meeting**

18:30-20:30 **Reception**

November 10 (Sat), 2018

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

9:30 - 9:55 **JCF19-9** S. Ono et al. (Kyoto U.)
Direct Joule Heating of D-Loaded Pd Plates in Vacuum II

9:55 -10:20 **JCF19-10** M. Endo et al. (Iwate U.)
Thermal property of Pd-Zr and Pd-Ni-Zr complex samplesin deuterium diffusion process

10:20 -10:45 **JCF19-11** S. Kikuchi et al. (Iwate U.)
Search for nuclear phenomena in deuterium discharge experiment
using Pd/PdO cathode

10:45-11:00 **Break**

Session-4 *Chair: H. Numata*

11:00-11:25 **JCF19-12** K. Tsuchiya (NIT, Tokyo College)
A theoretical study on the possible change of the phonon dispersion relation due to the nuclear reaction in two-dimensional lattice

11:25-11:50 **JCF19-13** H. Kozima et al. (Cold Fusion Research Lab.)
Characteristics of the Nuclear Reactions in the Cold Fusion Phenomenon

11:50-12:15 **JCF19-14** H. Kozima (Cold Fusion Research Lab.)
Inductive Logic and Meta-analysis in the Cold Fusion Research

12:15-13:30 **Lunch**

Session-5 *Chair: K.Tsuchiya (NIT, Tokyo College)*

13:30-13:55 **JCF19-15** H. Kozima (Cold Fusion Research Lab.)

Development of the Solid State-Nuclear Physics (SSNP)

13:55-14:20 **JCF19-16** H. Numata

Microstructure of surface and interior of Pd rod electrode duringlong-term electrolysis in 0.1 M LiOD

14:20-14:45 **JCF19-17** K. Ooyama (Ooyama Power Inc.)

Nuclear Fusion Mechanism in Pd Cathode

Adjourn

Verification of anomalous heat detected by differential scanning calorimetry from Palladium-Nickel-Zirconium alloy in hydrogen flow

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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 at a temperature of 200-300ºC. The total amount of the heat is so large that it cannot be explained by only chemical reaction [1,2]. However, not only the mechanism of such anomalous heat generation but also the condition under which the phenomenon occurs has not been revealed. To clarify the condition, it is important to evaluate the anomalous heat from a small amount of metal alloy sample.

In this work, we examined the anomalous heat generation from a small amount of palladium-nickel-zirconium alloy (PNZ) by differential scanning calorimetry (DSC) under various conditions, which is aimed to clarify the condition under which the anomalous heat is generated and to verify abnormality of the phenomenon.

The DSC (Linseis PT1600H) measurements were conducted as follows. 100 mg of PNZ sample (provided by Nissan Motor Co.,Ltd.) was heated at 5 °C/min to a predetermined temperature and then kept at that temperature for more than 4 h, during which the heat behavior of the sample was measured by DSC. In that manner, a sample was measured in both hydrogen and helium, and the difference of the heat flow between them was determined as the heat generation derived from hydrogen.

As a result, nickel or zirconia sample which is a component of PNZ showed no difference in the heat flow between hydrogen and helium. On the other hand, in case of PNZ, the heat flow in hydrogen was significantly larger than that in helium, and the difference was maintained throughout the measurement time (4-24 h). This result indicates that PNZ continuously emitted the heat derived from hydrogen at a constant temperature. Such heat generation was observed at more than 250 °C and the maximum heat flow was obtained around 400 °C. The heat flow of PNZ became smaller as the hydrogen pressure increased from 1 to 2 atm. By evaluating the hydrogen absorption / desorption behavior on PNZ with a temperature-programmed-reduction apparatus, it was found that hydrogen was desorbed slightly from PNZ under the same condition as the continuous heat generation was observed. These results reveal that the heat continuously generated from PNZ in hydrogen at more than 250 °C cannot be explained by conventional science.

Acknowledgments

A part of this work is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

Reference

[1] Y. Iwamura *et al.*, “Anomalous Heat Generation Experiments Using Metal Nanocomposites and Hydrogen Isotope Gas”, *12th Int. Workshop on Anomalies in Hydrogen Loaded Metals,* Costigliole d'Asti (AT), Italy,5-9 June 2017.

[2] A. Kitamura *et al.*, “Excess heat evolution from nanocomposite samples under exposure to hydrogen isotope gases”, *International Journal of Hydrogen Energy,* **43**(33), 16187-16200 (2018).

Anomalous Heat Observed in New Binary Metal System under Hydrogen Stream

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In recent years, it has been reported that anomalous heat different from hydrogen absorption heat is detected when some metal alloys are heated to 200-300 °C in deuterium or hydrogen. Since the anomalous heat generation lasts over several weeks, the total calorific value becomes extremely large. Such anomalous heat has been observed in metal alloy samples such as Pd-Ni-Zr, Cu-Ni-Zr, and Cu-Ni -Si [1, 2]. In order to utilize such anomalous heat industrially, it is important to find a new material showing greater output of the anomalous heat.

In this study, for the purpose of finding a new metal system which causes the anomalous heat generation, we examined the exothermal / endothermal behavior of several systems composed of binary metals based on Ni, Al, Ti and so on by using a differential scanning calorimeter (DSC) in hydrogen flow.

In the experiment, 20 mg each of two kinds of commercially available metal powders were weighed, physically mixed, and then set to DSC. For pretreatment in DSC, the mixed sample was pre-heated to 750 °C in hydrogen flow, and cooled to room temperature. During this pretreatment, aluminum was melted above 660.3°C of melting point, and then solidified with other metal powders below the melting point. For measurement, the sample was heated to a predetermined temperature (300 to 800 °C) at 5 °C/min and kept constant for 2 hours at that temperature, during which the heat behavior of the sample was measured by DSC. A mixed sample was measured both in hydrogen and helium, and the difference in the heat flow between them was regarded as exothermal / endothermal heat derived from hydrogen.

As a result, we found for the first time that a binary system composed of Ni and Al powders generates anomalous heat at 500-800 °C. The maximum of the exothermal heat flow was about 180 mW/g which was very large compared with 20 mW/g (450 °C) obtained with the same DSC apparatus for Pd-Ni-Zr sample. This sample was repeatedly evaluated, resulted in high reproducibility with respect to anomalous heat generation.

The binary system composed of Ti and Al powders also generated anomalous heat at 700 °C as well as Ni-Al system.

Reference

[1] Y. Iwamura *et al*., "Anomalous Heat Generation Experiments Using Metal Nanocomposites and Hydrogen Isotope Gas", *12th Int. Workshop on Anomalies in Hydrogen Loaded Metals,* Costigliole d'Asti (AT), Italy,5-9 June 2017.

[2] A. Kitamura *et al.*, "Excess heat evolution from nanocomposite samples under exposure to hydrogen isotope gases", *International Journal of Hydrogen Energy,* **43**(33), 16187-16200 (2018).

Trial to Reproduce Coincident Burst Increase Events of Pressure and Gas Temperature during Heat Generation Experiments using Metal Nanocomposites and Hydrogen Gas

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Collaborative research between Technova Inc., Nissan Motor Co. Ltd., Kobe Univ., Kyushu Univ., Nagoya Univ. and Tohoku Univ. was done from Oct. 2015 to Oct. 2017 [1]-[2]. In this collaboration work, heat generations far beyond 10eV/H or D were observed, which could not be explained by any known chemical process, and qualitative experimental reproducibility was confirmed.

During the collaborative work, we found very interesting coincident burst-like increase events of the pressure of reaction chamber and gas temperature for 2 samples, which suggested sudden energy releases in the reaction chamber. These events were observed under a specific experimental condition. Usually a sheath heater (W_1) wound spirally on the outer surface of the reaction chamber and a cartridge heater (W_2) located at the central axis of the reaction chamber were applied to heat up the sample [1]-[2]. However, this burst-like events were observed under the condition that the cartridge heater (W_2) located at the centre was shut down and the sample was $CuNi_7Zr_{15}$-O_x nanocomposites with H_2 gas.

After the period of collaborative research, we tried to replicate the phenomena using re-oxidized $CuNi_7Zr_{15}$-Ox sample. The sample (CNZ5sR) was prepared by oxidizing already used $CuNi_7Zr_{15}$-Ox sample (CNZ5s) in the air for 180H at 450℃. Coincident increase events were successfully replicated using CNZ5sR under similar experimental conditions. Gamma rays were monitored during the experiment using a Ge detector, however, no significant signals above background level were detected. The correlation between gas temperature and excess power will be discussed. Preliminary ICP-MS analysis for gases in the reaction chamber will be also presented.

Reference

[1] A. Kitamura et.al, "Excess heat evolution from nanocomposite samples under exposure to hydrogen isotope gases", *International Journal of Hydrogen Energy* **43** (2018) 16187-16200.
[2] Y. Iwamura et.al, "Anomalous Heat Effects Induced by Metal Nanocomposites and Hydrogen Gas", *Proc. of ICCF-21*, 3-8, June 2018, For-Collins, CO, USA, to be published.

Acknowledgement

The authors would like to acknowledge A. Kitamura, A. Takahashi, K. Takahashi, R. Seto, T. Hatano, T. Hioki, T. Motohiro, M. Nakamura, M. Uchimura, H. Takahashi, S. Sumitomo, Y. Furuyama, M. Kishida, H. Matsune, for their significant contributions to the collaborative research. The authors would like to appreciate H. Yoshino, S. Hirano, M. Ise and M. Hattori for their assistances.

Repeated Calcination and AHE by PNZ6 Sample

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Repeatability of anomalous heat effect (AHE) by the interaction of nano-composite PNZ6 (Pd_1Ni_{10}/zirconia) sample[1,2] and D-gas at ca. 300 degree C RC (reaction chamber) condition was studied by making repeated calcination of sample after D-charging experimental runs. D-loading ratios (D/Ni) at room temperature changed as 3.5, 0.8 and 0.08 for the virgin, second and third calcined PNZ6 sample, respectively with big decrease of integrated heat. AHE at elevated temperature was repeated with 7-11 W level by re-calcination and excess power was sustained for several weeks. Large increase (over 100 deg C cf. blank run) of local temperatures was observed by the #1-2 run with the third calcined sample PNZ6rr. It is equivalent to excess power of 55 W in the local zone along central line of RC. Strange oscillatory change of TC4 temperature at gas-inlet/outlet point of RC and much increased inside temperatures by 4 RTDs were recorded in #1-2 run of PNZ6rr sample.

We make summary as: Re-calcination is effective to change D-loading at room temperature; namely to drastically small absorption of D. After third calcination, PNZ6rr sample gave significant (ca. 100 deg C) temperature rise in local RC zone and sustainable excess heat over 10W for weeks. Oxygen content increased to ca. 20% in weight for PNZ6rr by the third calcination. Low oxidized sample PNZ10 (under trial for AHE scale-up) with poor control of fat melt-span ribbon thickness may be treated by re-calcination after use and we may try retest, for confirming possible enhancement of AHE.

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) 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; **Excess heat evolution from nanocomposite samples under exposure to hydrogen isotope gases, Int. J. Hydrogen Energy, 43** (2018) 16187-16200

This is abstract to paper for JCF19 Meeting, Iwate University, Nov.9-10, 2018

Anomalous Heat Burst by CNZ7 Sample and H-Gas

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Repeatability of anomalous heat effect (AHE) by the interaction of nano-composite CNZ (Cu_1Ni_7/zirconia) sample[1,2,] and H-gas at 200- 300 degree C RC (reaction chamber) condition was studied. In this paper, we report a large heat burst (ca. 100 W peak) event by CNZ7 sample (ca. 1kg, Cu_1Ni_7/Zirconia) and H-gas interaction under elevated temperature.

CNZ7 sample was made by calcination (450 deg C x 60hr) of melt-spun ribbons. CNZ7 sample of 1137g with 1mm diameter zirconia filler of 439g was set in the reaction chamber (500 cc) of Kobe-U MHE calorimetry system[2]. The sample was first baked at round 300-500 degree C of RC temperatures (monitoring by 4 RTDs) for a week and cooled down to room temperature (25 deg C). The #1-1 RT (room temperature) run with H-gas feed was done in a day to have H-loading ratio of 0.35 H/Ni and heat of ca.20Wx2hrs (ca.150 kJ). Next run #1-2 under elevated temperature was started with [W1, W2] =[120, 80] W heating condition and 18.4 cc/min of coolant-oil flow rate. After ca. 90 min of ET-run start, we suddenly observed large heat burst event; Temperature at about middle height (by RTD4) of RC increased from 210 deg C to 475 deg C. And ca. 110 W peak-heat power by coolant-oil outlet temperature (TC2) of 350 degree C (increased from 237 deg C) with ca. 0.8 MPa pulse increase of RC gas-pressure. The pulse pressure increase, which occurred after rapid rise of RTD4 temperature, was quickly transferred to ca. 3700 cc H-gas storage chamber (SC) at room temperature. Pressure increase in SC was 0.17 MPa by the event, which corresponded ca. 0.19 H/Ni decrease from sample; namely desorption of H-gas from the sample. The heat burst occurred before the H-gas desorption. Total released heat by the burst was ca. 300 kJ. Strange oscillatory behavior of TC4 (at RC gas outlet) was observed, which looks corresponding to the Iwamura observation[1] of frequent heat and pressure spikes observed by CNZ5 and CNZ6 samples, as well as similar oscillatory fluctuation of TC4 temperature in #1-2 run of PNZ6rr sample (Takahashi et al, this meeting). Water formation (by H_2 + O) in RC did not seem to occur, due to transferred H-gas to SC at room temperature (if H_2O vapor moved to SC, it should condensate to liquid at 25 deg C to decrease SC pressure). Amount of spent H-atoms by the heat burst event was therefore very much smaller than 0.54 mole H-transferred, namely invisibly small to suggest non-chemical nuclear-like reactions. Specific heat seems very much larger than 5.6 eV/H-transferred.

After the heat burst event, small (2-3 W) excess power level sustained for a day. Then we increased the H-gas pressure of SC to ca. 1.0MPa to feed to RC with [120, 80] W heating condition; we then started to observe rather slow H-absorption with significant endothermic condition. After saturation of H/Ni ratio, we increase RC temperature for seeking sustaining excess thermal power.

References:

1) Yasuhiro,Iwamura, Takehiko Itoh, Jirohta Kasagi, Akira Kitamura, Akito Takahashi, Koh Takahashi; **Replication Experiments at Tohoku University on Anomalous Heat Generation Using Nickel-Based Binary Nanocomposites and Hydrogen Isotope Gas, Proc. ICCF20, JCMNS 24, 191-202, 2017**
2) 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; **Excess heat evolution from nanocomposite samples under exposure to hydrogen isotope gases, Int. J. Hydrogen Energy,** 43 **(2018) 16187-16200**

This is abstract to paper for JCF19 Meeting at Iwate University, Nov.9-10, 2018

Theoretical Investigation of Plasmonic Field Enhancement at Oxide/Metal Interfaces

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The power density supplied to deuterium-metal systems is a key to initiate the nuclear reaction. We previously proposed and analyzed the electromagnetic energy focusing effect around metal nanoparticles and nanoshells [1] and planar metal surfaces [2] to significantly increase the reaction probability. However, a number of experimental studies for condensed-matter fusion have been conducted also with oxide materials [3], not solely with metals. Such oxides have been experimentally adopted mainly as mechanical supporting media for micro/nano metal particulate aggregates, as proton/deuteron-diffusion-barrier layers, or as proton/deuteron-conducting electrolytes. In the present work, we calculated the plasmonic field enhancement at planar metal/oxide interfaces and around metal nanoparticles embedded in oxides.

We calculate the field enhancement factors, which are the intensity ratios of the fields around the object to those in the absence of the object (metals in this case), or the original incident fields, for planer metal/oxide interfaces and for spherical metal nanoparticles in oxide media. These calculations, based on the classical electromagnetic field theory, show quantitatively how much energy can be concentrated from the incident optical or electric power. The methods used to calculate the field enhancement factors are described in Refs. 1, 2, and 4.

We have found that a certain degree of enhancement is available for commonly used material combinations in the field of condensed-matter nuclear fusion, and use of Ag, Al, Au, and Cu would particularly provide significantly larger enhancement. This electromagnetic boosting effect may have unknowingly benefited the experiments reported so far, particularly for the electrolysis-type ones, and its active utilization by proper material and structure choices can improve condensed-matter fusion systems further.

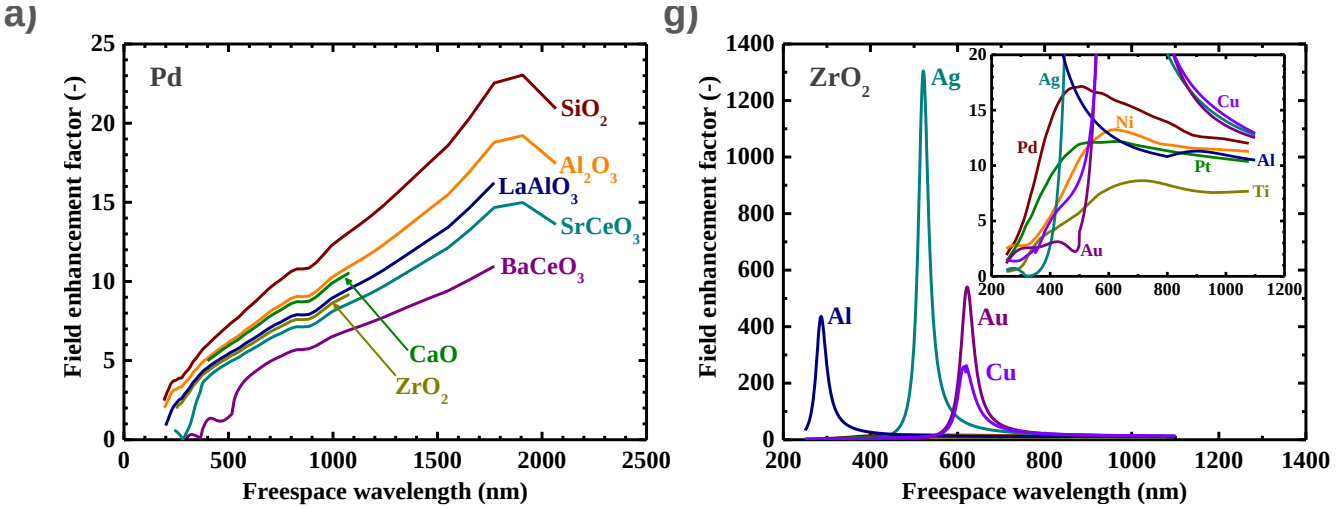

Fig. 1 Electromagnetic field enhancement factors (left) at planar Pd/oxide interfaces and (right) around metal nanoparticles embedded in ZrO_2.

[1] K. Tanabe, *JCF-16*, #12 (2015) / *J. Cond. Matter Nucl. Sci.* **24**, 296 (2017).

[2] K. Tanabe, *ICCF-21*, N-3 (2018) / *J. Cond. Matter Nucl. Sci.*, in press.

[3] T. Mizuno et al, *Fusion Technol.* **29**, 385 (1996) / A. Kitamura et al, *J. Cond. Matter Nucl. Sci.* **24**, 202 (2017).

[4] K. Tanabe, *J. Phys. Chem. C* **112**, 15721 (2008).

Li Quantity Suitable for Nuclear Fusion Mechanism

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The cold fusion experiments that have been announced so far in the actual nuclear reaction are classified into "Ignition Reaction" and "Combustion Reaction" of "Nuclear Fusion Mechanism in Metal Crystal" which the author published at JCF 18-10. In "Generation of Excessive Heat of the Pd Cathode by electrolysis of heavy water (hereinafter referred to as Electrolytic Experiment)", a slight excess heat accompanied by generation of neutrons, which occurs during electrolysis, is an "Ignition Reaction" and a large excess heat generated after the end of electrolysis, is "Combustion Reaction".

The author searched the past literature for Pd cathodic analysis data which will be evidence of these nuclear reactions, and found a report of Makoto Okamoto et al. [1]. In this report, there are written that neutrons are detected during electrolysis from "Pd cathode sample with greatly fluctuating electrolytic voltage" and T is detected in the SIMS analysis data of the sample. These are evidence of the occurrence of "Ignition Reaction ". And in the SIMS analytical data of "Pd cathode sample loaded with a constant electrolytic voltage", it is shown that ^{6}Li was produced and the D content was low. The ^{6}Li is evidence of the occurrence of "Combustion Reaction", and the fact that D is small is evidence showing the history of fever.

This "Combustion Reaction" is the nuclear fusion chain reaction in which D is used as a fuel and ^{4}He is the final product, which is the future energy of mankind. In order for "Combustion Reaction" to occur, both D and Li concentrations must be appropriate, however, the both concentrations are unknown. Therefore, the author made a sample for comparison doped with ^{6}Li ions and performed SIMS analysis. Based on this data, I estimated the ^{6}Li concentration of the part of Okamoto et al 's Pd cathode sample where active reaction occurred. The ^{6}Li concentration is an important value as the initial setting concentration at the time of reproducing experimental samples of "Combustion Reaction".

References

[1] Mutuhiro Nakada, Takehiro Kusunoki, Makoto Okamoto and Osamu Odawara "A Role of Lithium for the Neutron Emission in Heavy Water Electrolysis" Ikegami, H., ed. Third International Conference on Cold Fusion(1992), "Frontiers of Cold Fusion". 1993, Universal Academy Press, Inc., Tokyo

Computer Simulation Approaches to Hydrogen Cohesion inside the Metal Surface

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Some phenomena have been recently reported that various elements seem to be generated under vibratory agitation of pure water or aqueous chloride solutions slightly added heavy water by palladium plating (Pd) vibration blades. This would be possibly considered that the high density water cage cluster formed by the collapse of spherical micro-bubble near the Pd plating surface of vibration blade collides against it to cause cohesion of hydrogen (H) and deuterium (D) atoms which compose the high density water cage cluster inside it. When the high density water cage cluster collides against the surface of vibration blade with small colliding energy in the pure water or aqueous chloride solutions, only one H/D atom or ion could be considered approximately to collide against the surface of vibration blade. This would be nearly equivalent to the motion of H/D atom or ion of electrolysis or H/D gas permeation, and H/D atom or ion would diffuse or cohere inside the metal surface in the almost same way in both cases. On the other hand, when the high density water cage cluster collides against the surface of vibration blade with large colliding energy, H/D atoms and O atoms which compose the high density water cage cluster or metal atom which bonds it would collide against the surface of vibration blade one after another due to the force of surrounding water molecules which flow into the collapsing bubble. This would be expected for H/D atoms to squeeze into the metal surface and to cause cohesion of H/D atoms or ions. Then we are carrying out the computer simulations of EMS (Effective Screening Medium) method applying a voltage on the surface of Pd metal or other metals adsorbed by H atom on the analogy of the electrolysis, and other computer simulations of MD (Molecular Dynamics) method increasing a pressure on H molecules near the surface of Pd metal or other metals on the analogy of the H/D gas permeation. These methods perform in a computer simulation program Quantum Espresso (opEn-Source Package for Research in Electronic Structure, Simulation, and Optimization) for the calculation of electronic-structure properties within Density-Functional Theory (DFT). The computer simulation for the cohesion of H/D atoms or ions inside the metal surface would be carried out on the expansion of those for gas permeation. However, the cohesion of H/D atoms or ions which squeeze into the metal surface would have to be more condensed in other processes of nuclear reaction to cause the generation of element that is nuclear transmutation.

Direct Joule Heating of D-Loaded Pd Plates in Vacuum II

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A gas-phase experimental research in quest of condensed-matter fusion is underway by using multilayered deuterium-containing Pd plates. In our experiment, we in particular directly apply a bias voltage across the Pd sample to provide a current injection through Pd, to stimulate the nuclear reaction by Joule heating, also anticipating strong electrodiffusion or electromigration, in addition to the conventional deuterium diffusion induced by pressure/mass-concentration and thermal gradients.

Our experimental setup is a stainless-steel-made, gas-phase reactor system including a deuterium-loading chamber, an electron-beam deposition chamber, and a reaction-analysis chamber [1,2]. A high-resolution small-amu quadrupole mass spectrometer, two gas proportional neutron detectors, and a Geiger-Mueller detector for α, β, and γ rays are equipped to the facility. We first annealed a Pd plate with a dimension of 3 cm × 3 cm × 1 mm at 1000ºC for 10 hours in an external furnace in a nitrogen atmosphere for crystallization and surface degreasing. Then we brought the Pd plate into the electron-beam deposition chamber via a pre-evacuation chamber. A Au film with a thickness of 100 nm was deposited on one side of the Pd plate, as a low-contact-resistance electrode as well as a capping layer to induce single-directional deuterium diffusion and desorption for the ease of analyses. We then transferred the Pd plate to the deuterium-loading chamber. After filling the chamber with D_2 gas up to 760 Torr, we left the Pd plate for 5-10 hours at room temperature in order for the Pd plate to absorb deuterium asymptotically to the equilibrium. Finally, we transferred the Pd plate to the reaction-analysis chamber inside the cluster high-vacuum system with no ambient exposure. In the reaction-analysis chamber, a W needle electrode and a *K*-type thermocouple contacted the surface of Au-deposited side of the Pd plate. Electric current was then injected through the W needle to the Pd plate.

Previously we reported anomalous temporal behaviors of heat generation that are inconsistent with known physical chemistry principles, and neutron emission from the samples temporally coincident with the abrupt temperature increase [3,4]. We present further analyses of our reaction system in the meeting.

The authors would like to thank Eiichi Yamaguchi and Hideki Tanaka of Kyoto University, Takehiko Itoh of Tohoku University, and Shinji Kai of Tanaka Kikinzoku Kogyo K.K. for discussions. This work was financially supported, in part, by the Thermal & Electric Energy Technology Foundation.

[1] E. Yamaguchi and H. Sugiura, *Proc. ICCF-7*, 420 (1998).
[2] H. Sugiura and E. Yamaguchi, *Proc. ICCF-7*, 366 (1998).
[3] Y. Kitagawa et al, *JCF-18*, #1 (2017).
[4] Y. Kitagawa et al, *ICCF-21*, K-3 (2018).

Thermal property of Pd-Zr and Pd-Ni-Zr complex samples in deuterium diffusion process

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In deuterium absorption / desorption process for of nanocomposite of Pd-Ni-Zr, anomalous heat evolution, which can not be explained by chemical reaction, has been observed [1, 2]. In addition, we have conducted a deuterium absorption and desorption experiment using Pd-based metal complex samples, which were fabricated by depositing a metal membrane, such as Ni, Ag, Ti, and Zr, onto the Pd foil. Then, we observe an anomalous heat behavior in the desorption process [3, 4]. These phenomena are supposed to be caused by the unique properties of deuterium diffusion in the complex metals with sub-micron/nano-scaled fine structure. Moreover, the anomalous phenomenon has been supposed resulting from a condensed matter nuclear reaction, and a specific sample condition in the experiments might be essentially important for triggering the reaction. In this paper, we report the updated results for testing Pd-Ni-Zr complex samples.

In the desorption experiment, the Pd-Ni-Zr sample loaded with deuterium was heated by supplying electric current to stimulate deuterium out-diffusion from the sample. The sample temperature, the pressure in the chamber, the current and bias applied to the sample were monitored during the experiment. We observed the temperature changed simultaneously with the bias applied for some runs. For the Pd-Ni-Zr sample with fine structure interface, we observed a continuous short-period fluctuation of the sample which was not correlated with the pressure behavior. It is possible that deuterium diffusion from Pd to Ni and from the Ni to Pd occurred frequently in this period and that endothermic and exothermic phenomena associated with the heat of solution repeatedly occurred owing to deuterium transport between the two metal

We also estimated the heat balance from the temperature behavior considering the possible exothermic and endothermic processes in the deuterium diffusion, and no significant excess heat was observed. In addition, we have made more precise analysis for the sample structure using a TEM, since it has been claimed that the scale of the sample structure significantly depends on the generation of the excess heat. Besides the thermal analysis, we have measured the hydrogen diffusion velocity of the metal membrane for Ni and Pd-Ni complex

Reference

[1] A.Kitamura et al., Proc. of JCF16 (2016) 1.
[2] A.Kitamura et al., J. Condensed Matter Nuclear Science, 24 (2017) 202.
[3] S.Narita et al., Proc. of JCF17 (2017) 28.
[4] Y.Sato et al., Proc of JCF18, *in press*.

Search for nuclear phenomena in deuterium discharge experiment using Pd/PdO cathode

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We have observed possible nuclear products, which suggests occurrence of a low energy nuclear reaction, in deuterium discharge using a Pd based metal complex cathode [1]. A.G. Lipson et al. observed charged particle emission in the deuterium discharge with Pd/PdO cathode [2]. Besides, it has been reported that anomalous heat evolution is observed in deuterium desorption experiment with nano-particles of binary or ternary metal complex [3]. These phenomena could be attributed to a specific properties of metal complex material as well as fine structure of the sample. Considering these experimental results, we have tested Pd/PdO sample with a fine-structured interface as a cathode in deuterium discharge and searched for nuclear products on the sample surface.

In this experiment, we prepared Pd/PdO sample in the following procedure. On the Pd substrate (10mm x 10mm x 0.1mm in size, >99.95% in purity), nano-structure were formed by Ar^{+} beam sputtering. Then, an oxide film was formed on the surface by annealing at 800 degC in the air. The fabricated sample was put into the discharge cell as the cathode. The stainless anode was used and the gap distance between the electrodes was set to be ~10mm. After evacuating the cell to $<10^{-2}$ Torr, the deuterium gas is supplied until inside pressure became 1000 Pa. Then, DC voltage was applied to expose the Pd/PdO sample to discharge in which the voltage and current were typically ~400 V and ~2 mA, respectively. The discharge experiment was continued for 3 hours. After discharge, the element composition of the cathode was analyzed by TOF-SIMS and searched for newly produced elements as well as anomaly in isotopic abundance for the elements detected. As the result, we found signals on the mass of 51 and 55, which were not supposed to be contaminants from the environment. These might be an evidence of occurrence of a nuclear reaction.

[1] H.Ougida et al. Proc. of JCF11 (2011) 23.
[2] A.G.Lipson et al. proc of ICCF 12 (2005) 26.
[3] A.Kitamura et al., Proc. of JCF16 (2016) 1.

A theoretical study on the possible change of the phonon dispersion relation due to the nuclear reaction in two-dimensional lattice

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Abstract

In our previous works, we considered the change of phonon dispersion relations due to the nuclear reaction by assuming ions and impurities arranged in one dimension [1, 2]. In those studies, we considered the structure changes of crystals due to the nuclear reactions, and estimated their effects to the phonon dispersion relations. However, in one-dimensional lattices, it is unlikely that a collision of two impurities will happen, because there is a host ion between two impurities.

In this study, we used two-dimensional models and estimated the nuclear reactions in solids. If some impurity ions get closer through the lattice gaps and nuclear reactions occur , the structures of the crystal will change and it makes changes of phonon dispersion relations. We tried to show the method how to find the change of phonon dispersion relation due to the nuclear reaction in solid.

References

1. K. Tsuchiya, ”A theoretical study on the possible change of the phonon dispersion relation due to the nuclear reaction in solid”, proceedings of JCF9, p80.
2. K. Tsuchiya, “A theoretical study on the possible change of the phonon dispersion relation due to the nuclear reaction in solid II”, proceedings of JCF10, p59

JCF19, Kozima-1 (November 9 – 10, 2018, Morioka, Iwate, Japan)

Characteristics of the Nuclear Reactions in the Cold Fusion Phenomenon

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Abstract

The cold fusion phenomenon is characterized by nuclear reactions in CF materials, materials including hydrogen isotopes (H or/and D) with a high concentration, with no mechanisms to accelerate particles in them. First of all, we would like to notice that the CF materials are not confined to deuterium but also protium systems and classified roughly into two groups; (1) metallic materials include transition-metal hydrides (e.g. NiH_x, AuH_x) and deuterides (e.g. PdD_x, TiD_x), and hydrogen graphite (HC_x), and (2) hydrocarbons including XLPE (cross-linked polyethylene) and microorganisms including bacteria, microbial cultures and biological tissues or organs.

Looking for the common cause of nuclear reactions in these CF materials, we have to notice the characteristics of the nuclear reactions in the CFP different from the nuclear reaction observed in nuclear physics in free space. In free space, the energy difference between the initial and the final states, generally more than a few MeV, is carried out by a particle or two. The amount of this energy difference is about eight orders of magnitude larger than the thermal energy of the particles in the CF material. Therefore, it is difficult to consider the participation of environment in the nuclear reactions in the CFP.

Nuclear reactions in the CFP show, in general, no emission of high energy photons which should be observed if emitted despite of the existence of CF materials surrounding the site where the reaction occurs. Furthermore, the most wonderful events in the CFP is the generation of new elements with changes of the proton number Z and/or nucleon number A from those of preexisting elements in the system. We have given a self-consistent unified explanation of various events in the CFP hitherto in our books and papers. In this paper, we concentrate our investigation on the nuclear transmutations with large shifts of the proton number Z and the nucleon number A revealed by recent experimental data sets to illustrate the peculiarity of the CFP and to show again the ability of the TNCF model and the ND model to give consistent explanation of various events in the CFP. It should be noticed that the investigation of the premises assumed in the models have shown the decisive role of the nuclear interaction between neutrons in lattice nuclei and protons/deuterons at interstitial sites which is discussed elsewhere.

JCF19 Kozima-2 (November 9 – 10, 2018, Morioka, Iwate, Japan)

Inductive Logic and Meta-analysis in the Cold Fusion Research

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Abstract

The cold fusion phenomenon (CFP) had been a wonderful and inexplicable phenomenon where occur nuclear reactions in materials composed of host elements and hydrogen isotopes (CF materials) at near-room temperature environment without any specific acceleration mechanism. The variety of the experimental data has been also mysterious to understand it in the traditional solid-state physics and the nuclear physics. To understand the complex experimental data obtained in the CFP consistently, we have to depend on the phenomenological approach with a model and then on the quantum mechanics to investigate the premises assumed in the model. We have presented a successful model (the TNCF model) for the CFP and the quantal analysis of the model has revealed participation of neutrons in the nuclear reactions in the CF materials.

Looking back to the methodology used in the explanation of the CFP by the TNCF model, we notice now that there are resemblance of the logic in the explanation of the CFP to the meta-analysis and more widely to the inductive reasoning prevalent in natural history before the science revolution in 17^{th} century.

It is valuable to point out the use of the meta-analysis in astronomy in 18^{th} century and in such complex situations in the medical science where they call the analysis “EBM” (evidence based medicine) or “Systematic Review” in modern medicine. The analysis of the data sets in the CFP performed in our phenomenological approach could be classified into the meta-analysis. It is also noticed that the logic used in our explanation of the CFP by the TNCF model is classified into the inductive rather than the deductive logic prevalent among the modern science developed after 17^{th} century when the Newtonian mechanics was established. In a complex system where the nonlinear dynamics governs the behavior of component particles of the system and complexity is ubiquitous, we are not able to prepare exactly the same microscopic state for a sample using even the same macroscopic experimental conditions and therefore not able to predict the effect in the system from the macroscopic initial condition. The ordinary concept of the analysis and the deductive logic fail to give a definite image and a definite history of the system. It is emphasized that the cold fusion phenomenon is just the case we have to depend on the meta-analysis and the inductive logic to describe the development of the system.

JCF19 Kozima-3 (November 9 – 10, 2018, Morioka, Iwate, Japan)

Development of the Solid State-Nuclear Physics (SSNP)

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Abstract

Investigation of the cold fusion phenomenon (CFP) for about 30 years since its discovery in PdD_x by M. Fleischmann et al. in 1989 has revealed existence of nuclear reactions in specific solids at near room-temperature without any mechanism of acceleration for particles in the system. The diverse and complex experimental data, obtained in CF materials including hydrogen isotopes (H or/and D) with high concentration, have been riddles for almost all scientists. The facts observed in this field, however, suggest existence of new mechanisms for nuclear reactions in such solids (CF materials) as transition-metal hydrides and deuterides, hydrogen graphite, XLPE (cross-linked polyethylene) and microorganisms. The new mechanisms for the CFP should be a fundamental element of a new physics in between solid state physics (condensed matter physics) and nuclear physics, which we may call the solid state-nuclear physics (SSNP).

We have developed a phenomenological approach with a model (TNCF Model) to the CFP to understand the complex data sets as a whole obtained in this field. The approach has been successful to give a unified interpretation for the CFP and suggests an outline of the SSNP where neutrons in the CF materials play a key role for the realization of the nuclear reactions resulting in the CFP.

In the phenomenological approach to the CFP, we used unintentionally the inductive logic and the meta-analysis of the experimental data which are not popular in modern physical sciences developed in these 300 years since the establishment of the physics based on the Newtonian mechanics, which was effectively applied to the simple systems with the linear interaction between particles. For such a system as the CF materials where nonlinear interactions govern the behavior of component particles, the inductive logic should be used and the meta-analysis is necessary to treat experimental data.

The fundamental premises assumed in the TNCF model have been explained by a new mechanism for interactions among host elements and interstitial hydrogen isotopes explained by quantum mechanics. Thus, the CFP have opened a gate to the SSNP in which the nuclear interaction between neutrons in lattice nuclei and interstitial protons/deuterons induces a new state of neutrons and they play the reading part to realize the nuclear reactions resulting in the CFP which is a new phenomenon of SSNP.

Microstructure of surface and interior of Pd rod electrode during long-term electrolysis in 0.1 *M* LiOD

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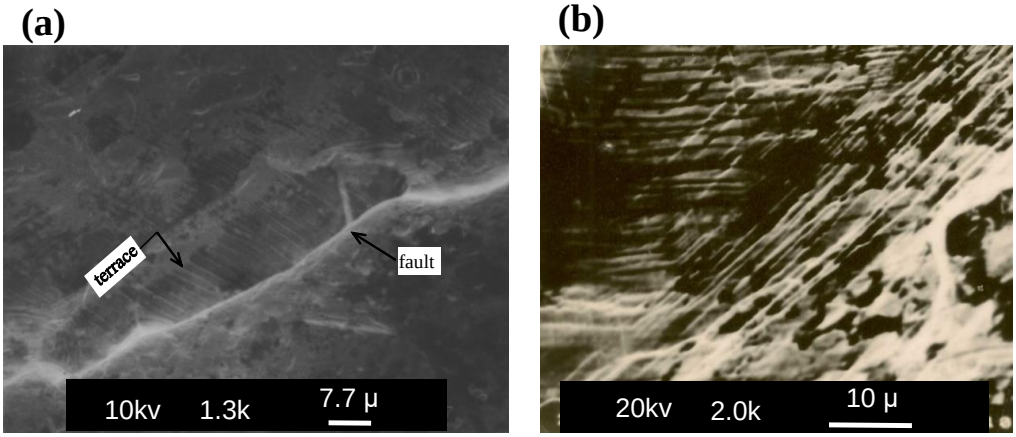
Cold fusion experiments at ambient temperatures have been conducted by electrolysis of heavy water on a Pd electrode and on other stable metals, e.g., Ni. Long-term electrolysis for well annealed thick Pd rod (9.0 mm ϕ) in 0.1 *M* LiOD was performed [1]. Microscopic observation of post-electrolysis Pd showed that long-term electrolysis did not resulted in any cracking but surface voids, two long faults: (a), voids arranged in a straight line and double slip: (b), as shown below in Fig. (a) and (b). To improve the reproducibility of cold fusion experiments the phase-change and microstructural change of Pd electrode during H absorption (i.e., loading) are of interest, particularly with respect to the microstructural changes underneath the sample surface.

There has been existed requisite aspect that the H loaded Pd metal mechanically behaves like that of unloaded one. In former study, comparison of the morphology of deformed sample of usual tensile test (H unloaded) and the surface morphology of the postelectrolysis Pd electrode was reported [2]. In this study we focus the mechanical properties, i.e., Young's modulus [3] and the parameter of work hardening et al. derived from the stress-strain curve during H absorption. Furthermore, the microstructural changes under H absorption will be presented with reference to a stress applied sample, irrespective of H loaded or unloaded.



References

1) H. Numata et al.: Proc. Conf. Science of Cold Fusion, Vol.33, pp.71, T.BRESSANI et al. eds., SIF, Bologna, Italy (1991)
2) H. Numata: Proc. JCF17, pp.32 (2005)
3) H. Numata an M. Fukuhara: Fusion Technol., **31** (1997)300

Nuclear Fusion Mechanism in Pd Cathode

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Here, the author will explain the mechanism of "Generation of Excess Heat of Pd Cathode by electrolysis of heavy water (hereinafter referred to as Electrolytic Experiment)" based on "Nuclear Fusion Mechanism in Metal Crystal" which the author published at JCF 18-10. However, I omit a lot of the part written in JCF 18-10, mainly on commentary on the part unique to "Electrolytic Experiment" and additional commentary on the binary nucleus.

In “Electrolysis Experiment”, there are two kinds of excess heat, one is a slight excess heat with the occurrence of neutrons generated during electrolysis, and the other is a large excess heat generated after the end of electrolysis, so-called "Heat after Death".

The former heat generation corresponds to "Ignition Reaction" and is due to sporadic nuclear fusion due to tunnel effect due to deformation of Pd containing a large amount of D. The latter heat generation corresponds to "Combustion Reaction", which is a nuclear fusion chain reaction in which D is used as a fuel and ^{4}He is the final product.

Since LiOD D_2O is used as an electrolytic solution in "Electrolytic Experiment", Li solid-dissolves from the surface of the Pd cathode. This solid-solved Li is involved in the activation of the "Combustion Reaction", while the intermediate product due to the "Combustion Reaction" is ^{6}Li, whereas 92.5% of Li in nature is ^{7}Li. The presence of ^{7}Li inhibits the chain reaction and produces neutrons. Therefore, it is desirable to use ^{6}LiOD D_2O as the electrolytic solution.

And for "Combustion Reaction" to occur, both D and ^{6}Li concentrations must be appropriate. Since D becomes excessive during electrolysis, "Combustion Reaction" does not occur. After completion of the electrolysis, D is released from the surface of the Pd cathode and the D concentration decreases, so that the appropriate portion of the D concentration is sequentially moved toward the inside of the Pd cathode from the surface. At this time, "Combustion Reaction" may be activated only when the D concentration of the appropriate Li concentration portion is appropriate. That is, although the Pd cathode is large as a sample, the time and place for starting the "Combustion Reaction" is limited. However, if "Combustion Reaction" is started, ^{6}Li is generated, so that the place where "Combustion Reaction" occurs will spread to the inside of the Pd cathode and a large heat generation will be obtained.

References

[1] Kazuo Ooyama, " Nuclear Fusion Mechanism in Metal Clistal" JCF18-10 (2017)

[2] S. Tsuruga, T. Itoh, Y. Iwamura, "Recent advances in transmutation experiments induced by deuterium permeation using Nano-Structured Pd/CaO/Pd Multilayer Thin Film" Proc. JCF14, pp14-25(2013)