The 11th Meeting of Japan CF-Research Society

JCF11 ABSTRACTS

December 11-12, 2010

Morioka, Iwate

Japan CF-Research Society

Program of JCF11 Meeting

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Date: December 11-12, 2010
Place: Ichiyu-Kaikan, Fuculty of Engineering, Iwate University, 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/

December 11 (Sat.), 2010

12:00-13:00 **Registration**
13:00-13:10 **Opening Address** (H. Yamada, Iwate U.)

Experiment-1 (Chairman: H. Numata, Tokyo Institute of Tech.)

13:10-13:35 **JCF11-1** K. Tsuchiya (Tokyo T. N. C. T.) et al. : Heat Generation from the Palladium Deuteride
13:35-14:00 **JCF11-2** Y. Suzuki et al. (Iwate U.) : Energetic Charged Particle from Multi-layered Pd Sample by Deuterium and Hydrogen Permeation
14:00-14:25 **JCF11-3** Y. Miyoshi (Kobe U.) et al. : Effect of Forced Oxidization on Hydrogen Isotope Absorption/Adsorption Characteristics of Pd·Zr Oxide Compounds
14:25-14:50 **JCF11-4** H. Sakoh (Kobe U.) et al. : Hydrogen Isotope Absorption/Adsorption Characteristics of Ni·Pd Binary Nano-particles

-----**break** (15 min)-----

Theory-1 (Chairman: K. Tsuchiya, Tokyo T. N. C. T.)

15:05-15:30 **JCF11-5** A. Takahashi (Technova Inc.) et al. : Mesoscopic Catalyst and D-Cluster Fusion
15:30-15:55 **JCF11-6** S. Wakamatsu : Hypothesis Regarding the Mechanism of the Nuclear Reaction Observed in Hydrogen Formation Process
15:55-16:20 **JCF11-7** H. Kozima (CF Res. Lab.) et al. : Brief Explanation of Experimental Data Set on Excess Heat and Nuclear Transmutation in Multiplly Nanocoated Ni Wire

16:20-17:00 **JCF Annual Meeting**

17:30-19:30 **Reception**

December 12 (Sun.), 2010

Experiment-2 (Chairman: A. Takahashi, Technova Inc.)

10:00-10:25 **JCF11-8** H. Ougida et al. (Iwate U.) : Search for Nuclear Phenomena in Deuterium Irradiation to Nano-structured Metal under Glow Discharge

10:25-10:50 **JCF11-9** M. Kawashima et al. (Iwate U.) : Search for Nuclear Phenomena in Deuterium Desorption Process with Multi-layered Metal Complex

10:50-11:15 **JCF11-10** S. Narita et al. (Iwate U.) : Systematic Uncertainties of Isotopic Abundance Measured by TOF-SIMS

11:15-11:40 **JCF11-11** H. Yamada et al. (Iwate U.) : Detection of Energetic Charged Particle from Thin Metal Cathode in Light and Heavy Water Electrolysis Using CR39

-----**lunch** (11:40-13:00)-----

Theory-2 (Chairman: A. Kitamura, Kobe U.)

13:00-13:25 **JCF11-12** Kozima (CF Res. Lab.) : Localization of Nuclear Reactions in the Cold Fusion Phenomenon

13:25-13:50 **JCF11-13** H. Numata (Tokyo Institute of Tech.) : Numerical Simulation of the Motion of Cascade Vortices under Beneath of the Electrode Surface

13:50-14:15 **JCF11-14** H. Kozima (CF Res. Lab.) : Neutron Emission in the Cold Fusion Phenomenon

Adjourn

Heat generation from the Palladium deuteride

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Abstract

It is reported by Baranowski [1] that the enthalpy of Pd hydride was positive when H/Pd>0.85. This means that hydrogen desorption process of highly concentrated Pd hydride corresponds to the exothermal reaction. In our recent deuterium loading to metallic Pd powder, we have found that the sample generates a lot of heat when D/Pd=0.5 at the deuterium desorption process. In this region, it should be the endothermic reaction. Therefore, we consider that it cannot be explained by usual chemical reactions.

References

1. B.Baranowski, Hydrogen in Metals Ⅱ (Springer-Verlag, Topics in Applied Physics 29) p157

Energetic Charged Particle from Multi-layered Pd Sample by Deuterium and Hydrogen Permeation

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We have been studied low energy nuclear reaction(LENR) for Hydrogen permeation method using TOF-SIMS.[1)] These results suggested that the low energy nuclear reaction occurs in hydrogen system as well as in deuterium system. On the other side, record on plastic track detector such as CR39 has been also preferably used in investigating the LENR for light water electrolysis, because of giving direct evidence of the phenomena.[2)] However, there has been no report of detecting charged particle using CR39 by gas permeation method even though deuterium system.

In the present investigation, we have performed a test for D_2 and H_2 gas permeation with multi-layered Pd foil sample for detection of energetic charged particle using CR39. The Pd foil sample consisted of five couples of CaO and Pd thin films on a base Pd foil of $0.1 \times 12.5 \times 12.5$ mm in size. The piece had small amount of Cs or Li on its uppermost surfaces by electrochemical method. The sample was set up into a holder placed between an upper and lower stream chambers. D_2 or H_2 gas was introduced into the upper chamber with the pressure 0.2 or 1 MPa, followed by evacuation of lower stream chamber. The gas moved downstream passing through the sample at 70 ℃ by difference of pressure. The CR39 was placed opposite above the Pd sample at the distance of 3 mm in the upper chamber. After the D_2 or H_2 gas permeation for 14 days, the CR39 was taken out and etched in 5N NaOH solutions for 8h at 70 ℃. After the etching, The surface of the CR39 were scanned to count and measure of the etch pits using a digital microscope system (KEYENCE VHX-200). As the results, we occasionally observed more etch pits on the area of CR39 facing directly Pd sample than these on other area covered by the metal foil. There was no excess etch pits observed when Pd samples without multi-layer and added element were used. The result suggests the possibility that a charged particle is emitted from Pd sample during H_2 gas permeation process and strongly indicates the LENR for this hydrogen system as well as deuterium system.

1) H. Yamada et al., Elemental Analysis on Pd-foil after Hydrogen Permeation at Room Temperature by TOF-SIMS, Proceedings of the 5th Meeting of Japan CF research Society, pp. 69-73(2003)
2) H. Yamada et al., Detection of Energetic Charged Particle from Thin Ni Cathode in Shortened Li2SO4/H2O Electrolysis Using Track Detector CR39 Proceedings of the 10th Meeting of Japan CF research Society, pp. 41-45(2010)

Effect of Forced Oxidization on Hydrogen Isotope Absorption/Adsorption Characteristics of Pd·Zr Oxide Compounds

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In order to confirm heat and ^{4}He generation by deuterium (D) absorption in nano-sized Pd powders reported by Arata and Zhang [1], we established a twin absorption system for simultaneous D_2 and H_2 gas absorption experiments using Pd micronized particles and oxide composites of nano-sized Pd and Zr [2]. In the present work, two kinds of samples are tested; the Pd·Zr oxide composite "PZ" and a Pd·Ni·Zr oxide composite "PNZ", both supplied by Santoku Corporation.

The as-received samples are oxidized to some extent. To investigate the effect of oxidization on sorption (absorption and/or adsorption) rate and heat release rate, we applied forced de-oxidization and forced oxidization (to make 5-10% PdO or NiO) to the samples. Oxidization was made at 473 K or 573 K in oxygen gas at a pressure of 0.3 MPa(a), while de-oxidization was made at 573 K in D_2 (H_2) gas at a pressure of 0.3 - 0.5 MPa(a). The D_2 (H_2) absorption runs have revealed the following facts for the 1st phase [2, 3], where predominant heat evolution associated with hydrogen isotope sorption proceeds;

1. Forced de-oxidization of the PZ and PNZ samples gave greatly reduced D (H) sorption rate (loading ratio; D(H)/M value) and heat release rate compared to very large values for as-received samples, which were recovered significantly by forced oxidization.
2. Time-resolved measurements have been applied to the PZ samples to reveal existence of sub-phases, 1a and 1b. In the 1a-phase, the anomalously large heat evolution proceeds under relatively low pressure below 3 kPa, while relatively small amount of heat is generated in the 1b-phase under relatively high pressure (3 – 10 kPa) with significant isotope dependence. Oxygen incorporation is necessary for the 1a-phase to appear.
3. Time-resolved specific sorption energy, or differential heat of hydrogen uptake, $\eta_D(t)$ ($\eta_H(t)$), defined as the output energy per one hydrogen isotope atom absorbed/adsorbed is very large; η_D (η_H) ≈ 1.33 eV/D (1.15 eV/H) for the 1a-phase, and η_D (η_H) ≈ 0.47 eV/D (η_H ≈ 0.41 eV/H) for the 1b-phase, respectively, as averaged values in their intervals.

[1] Y. Arata and Y. Zhang: The special report on research project for creation of new energy, J. High Temperature Society, 2008, No. 1.
[2] T. Nohmi, Y. Sasaki, T. Yamaguchi, A. Taniike, A. Kitamura, A. Takahashi, R. Seto and Y. Fujita; Proc. ICCF14, Washington DC, 2008, paper 15.
[3] A. Kitamura, Y. Miyoshi H. Sakoh, A. Taniike, A. Takahashi, R. Seto and Y. Fujita; submitted to Journal of Condensed Matter Nuclear Science.

Hydrogen isotope absorption/adsorption characteristics of Ni·Pd binary nano-particles

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In order to confirm heat and ^{4}He generation by deuterium (D) absorption in nano-sized Pd powders reported by Arata and Zhang [1], we used a twin absorption system for D_2 or H_2 gas absorption experiments using oxide nano-composites of Pd, Ni and Zr.[2] The sample powders used in the present work are Ni·Pd binary nanoparticles dispersed in ZrO_2 holder-flakes (PNZ2B) which were provided by B. Ahern.

Observed loading ratio, D(H)/[Pd·Ni] ≈ 3.3 (3.3), and specific heat release, E_1 ≈ 2.0 (1.8) eV/atom-[Pd·Ni], in the first phase of as-received PNZ2B runs were both very large. The latter is converted to hydridation energy, $Q_{D(H)}$ ≈ 0.55 (0.50) eV/atom-D(H), which is, however, considered to include reduction energy, since the as-received PNZ2B sample is considered to be partly oxidized.

To investigate the effect of oxidization on absorption rate and heat release rate, we compared runs with the sample after forced de-oxidization and the sample after forced oxidization to control oxygen amount. Oxidation was made at 473 K or 573 K, while de-oxidation was made at 573 K. In the case of de-oxidation, D(H)/[Pd·Ni], E_1 and $Q_{D(H)}$ exceeded 2.0 (2.0), 1.5 eV/atom-[Pd·Ni] and 0.5 eV/atom-D(H), respectively. In the case of oxidation, the loading ratio and $Q_{D(H)}$ were as large as those for the as-received samples. In addition, we observed anomalous change of gas pressure in the beginning of the first phase, which we infer to be due to the effect of surface NiO_2 layer.

We have defined the dynamic (time-dependent) hydridation energy $\eta_{D(H)}$. Averaged values of η_D and η_H were 0.61 and 0.55, respectively. Although the isotope effect of about 11% is rather moderate, time variation of η_D showed sometimes much larger values than η_H, which suggests the existence of heat component of nuclear origin. A phenomenological modeling and discussions on the role of the PdO surface layer on the nano-particle core of Pd and/or Ni as well as a possible mechanism relating the anomalous heat component found in the present work to a nuclear origin will be found in another presentation [3].

[1] Y. Arata and Y. Zhang; The special report on research project for creation of new energy; J. High Temperature Society, 2008, No. 1.
[2] A. Kitamura, Y. Miyoshi, H. Sakoh, A. Taniike, A. Takahashi, R. Seto and Y. Fujita; Time resolved measurements of loading ratios and heat evolution in D_2 (and H_2)-Pd·Zr mixed oxide systems; to be published in J. Condensed Matter Nucl. Sci.
[3] T. Takahashi, A. Kitamura, Y. Miyoshi, H. Sakoh, A. Taniike, R. Seto and Y. Fujita; Mesoscopic Catalyst and D-Cluster Fusion; to be presented in this Meeting.

Mesoscopic Catalyst and D-Cluster Fusion

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Very rapid MD(H)x over-full loading (x>1) under near "zero pressure" of D(H)-gas and anomalously large released heat (0.6-2.0 eV/D(H)) in Phase-I period are reproducibly observed for Pd/ZrO_2 (PZ) and $Pd/Ni/ZrO_2$ (PNZ) samples. By the forced oxidization (several % PdO or MO formation) of used PZ and PNZ samples, surprising recovery of performances on loading ratio (x>1) and heat release level (0.9-1.5eV/D(H)) has been repeatedly observed, by our group[1-3]. To study dynamics of D(H)-sorption (adsorption/absorption), time-dependent measurements of evolutions for D(H)/M ratios and η-values (energy per a D(H)-sorption) have provided interesting data with very large dynamic isotope effects, which suggests some "nuclear effects". We propose and discuss mechanisms to answer why such "chemical + nuclear" anomalies take place in "mesoscopic" particles confined in nano-metal-oxides. Special roles of PdO surface layer and add-atoms of Pd on Ni nano-core are modeled to scope the generation of surface sub-nano-holes (SNH). SNH may trap D(H)-clusters on surface with deep adsorption potential, providing seeds of 4D/TSC-induced 4d fusion (23.8MeV/^{4}He-product). It enhances D(H)-diffusion into Pd (and Ni nano-core of binary alloy) lattice sites of nano-particle, and at the end of Phase-I realizes the x>1 state with "very deep (1.5-1.8eV for PZ and about 0.6eV for PNZ)" global potential for trapping (GPT) of *mesoscopic catalyst* which generates anomalous chemical heat for D(H)-gas absorption at room temperature. In GPT there holds local shrunken Bloch potentials for PdD(H) or $NiD_3(H_3)$ lattice to induce the non-linearly coupled D(H)-oscillation mode that enhances very much the dynamic TSC (tetrahedral symmetric condensate; transitory Bose-Einstein-Condensate) formation probability inside the nano-particle. Binary-metal nano-particle with incomplete-shell/core, dispersed in ceramics supporter flake, is promising for providing very large (x>3.0) loading and long lasting high level heat-power in repeatable use. (*Note: abstract for JCF11 Meeting, 11-12 December, 2010, Morioka, Japan*)

1) A. Kitamura, T. Nohmi, Y. Sasaki, A. Taniike, A. Takahashi, R. Seto, Y. Fujita: *Physics Letters A*, 373 (2009) 3109-3112

2) Akira Kitamura, Akito Takahashi, Yu Sasaki, Yuki Miyoshi, Akira Taniike, Reiko Seto and Yushi Fujita: "Heat Evolution from Pd Nanopowders Exposed to High-Pressure Hydrogen Isotopes and Associated Radiation Measurements", J. Marwan Ed., *LENR Information Sorcebook*, American Institute of Physics, 2010, in press (shifted to JCMNS publication, 2010-2011)

3) Akira Kitamura, Akito Takahashi, Yu Sasaki, Yuki Miyoshi, Akira Taniike, Reiko Seto and Yushi Fujita: "Anomalous Heat Evolution in Charging of Pd Powders with Hydrogen Isotopes", J. Marwan Ed., *LENR NET Sourcebook Vol.3*, American Chemical Society, to be published in 2010 (cancelled and the paper was submitted to JCMNS, October 2010)

4) A.Takahashi, A. Kitamura, Y. Sasaki, Y. Miyoshi, A. Taniike, R. Seto and Y. Fujita**:** Role of PdO Surface-Coating in CMNE D(H)-Gas Loading Experiments, Proceedings of 9th Workshop on Anomalies in D(H)-loaded Metals, 16-19 September 2010, Siena, Italy (also submittal to JCMNS)

Hypothesis regarding the mechanism of the nuclear reaction observed in hydrogen formation process

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The purpose of this paper is to show the theoretical possibility of the mechanism concerning a certain reaction seemed to be a nuclear reaction which has been observed in the process of hydrogen formation, and to present one hypothesis with which we can elucidate the phenomena. With this reaction, the phenomena were observed, as if oxygen had fissioned into nitrogen, carbon and hydrogen. And excess heat is also recognized. It is very difficult to elucidate the phenomena to find out the type of nuclear reaction employed and the aspect of energy balance. After the theoretical study, I have found the way to elucidate the possibilities of above-mentioned nuclear reaction by employing combination of the several types of nuclear reaction. As the information about the experiment is, to my regret, not yet on public, I did not quote them. As this reaction experiment was done in the Intect Holding Corporation. I am not in a position to certify the result of experiment. The purpose of this paper is, therefore, not to introduce the experimental results, but, to present a theoretical hypothesis with which you can elucidate the phenomena in case when such experimental results were obtained.

The outline of hypothesis is as follows. As the mass exchange among the concerned elements and the gamma ray is observed with the reaction, it suggests that it is the nuclear reaction. If oxygen fissions into nitrogen and hydrogen, in addition when, nitrogen fissions into carbon and hydrogen, the above-mentioned nuclear reaction may happen. However, the necessary energy must be supplied in order for the reactions to be achieved, as this is the nuclear endoergic reaction, by way of whichever kinds of catalytic nuclear reactions. When scale of the energy which is necessary for the nuclear endoergic reaction is considered, we must accept the simultaneous or preceded occurring of nuclear exoergic reaction with which the necessary energy is obtained for it. We can consider that the difference of the amounts of energy between the exoergic reaction and the endoergic one will come out to excess heat.

When we have an assumption of electron capture of the plural times and a neutron emission and beta disintegration of the plural times concerning the nuclear endoergic reaction, we can develop a theory that says that an atom with smaller atomic mass by one and a hydrogen atom can be formed. When it applies this to the oxygen atom, the formation of nitrogen and hydrogen is elucidated. When it applies this to nitrogen atom, the formation of carbon and hydrogen is elucidated. Consecutively, when this is repeated, is possible the fact that it applies to helium formation.

Furthermore, presently the concrete experimental result is not obtained concerning the nuclear exoergic reaction. When the sorts of the concerned reaction product with atomic mass number between oxygen and the nickel are verified, we expect to get the clue for the elucidation of nuclear exoergic reaction. The nuclear reaction of aggregate might take place. These nuclear reactions, stabilizing in the circumstances of low temperature and low pressure, are worthwhile to pay attention to. Important is the fact that these nuclear reactions are able to avoid the nuclear burst, as the energy obtained from the nuclear exoergic reaction is to be absorbed by the nuclear endoergic reaction after the energy consumption in the meanwhile in need. In addition, this reaction becomes chemical-reaction rate-controlling, also the point which becomes control of the reaction possible is important with the supply restriction of the chemical substance.

References

1. Y. Ishikawa *Japanese laid-open disclosure public patent bulletin 2010-006677*
2. Y. Ishikawa *Japanese laid-open disclosure public patent bulletin 2010-131553*

Brief Explanation of Experimental Data Set on Excess Heat and Nuclear Transmutation in Multiplly Nanocoated Ni Wire

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Abstract

Experimental data of excess heat generation and nuclear transmutation obtained in Ni wire multiplly nano-coated with Pd and a compound of B, Sr, Ba and Th at up to 900 degC have been analyzed using the TNCF model.

The Ni wire is 50 μ m of diameter and 82 cm long. The coating has been made by Pd and the compound about 50 times resulting in a surface layer of about one μ m thick. The maximum excess energy $Q_{\max}$ is 1800 W/g of the Ni wire. There have occurred various nuclear transmutations. Most notable results are enumerated as follows. (1) Elements Ti, Cr, Co, As, Ir, and Tl have increased. (2) B, Sr, Pd and Ba have decreased. (3) Fe and Ni have not showed remarkable change. (4) In the case of B, Sr and Ba, the rates of the decrease are larger for lighter isotopes. (5) $^{10}_{5}$B/$^{11}_{5}$B ratio decreased over 14%. (6) $^{105}_{46}$Pd decreased about 5% and $^{102}_{46}$Pd increased about 9%.

These data have been analyzed using the TNCF model successively applied for explanation of various experimental data sets in these 15 years. We can estimate the parameter of the model $n_{\rm n}$ using the data for $^{10}_{5}$B and $^{105}_{46}$Pd as follows; $n_{\rm n} = 1.3 \times 10^{9}$ cm^{-3} (by the decrease of $^{10}_{5}$B) and $n_{\rm n} = 2.5 \times 10^{11}$ cm^{-3} (by the decrease of $^{105}_{46}$Pd). These values show the situation in the experiment belong the range of fairly large value of the parameter where we can expect the nuclear reactions by a single neutron and also a n-p cluster.

The excess heat generation of 1800 W/g at its maximum has been investigated using the value of $n_{\rm n}$ estimated above and a formula for the excess energy is induced. Assuming the surface layer of 1 μ m thick is made of Pd only, for illustrative object, we have obtained $Q_{\rm av}$ about 1% of the observed maximum one. If the average value of the excess energy is about 10% of the maximum, the discrepancy is about an order of magnitude. If we know the correct composition of the surface layer, the calculated value of $Q_{\rm av}$ will increase a little.

The nuclear transmutation of several elements confirmed by the experiment is qualitatively explained assuming the single neutron absorption by elements in the surface layer. Decrease of Ru might be explained by single *n-p* cluster absorption.

Search for Nuclear Phenomena in Deuterium Irradiation to Nano-structured Metal under Glow Discharge

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We have performed the discharge experiment in deuterium atmosphere, and observed the events recognized as transmutation and particle emission. It is suggested that the low energy nuclear reaction (LENR) can occur on the surface of the cathode metal by irradiating deuterium atoms with electric field. Besides the discharge method, it is well known that the selective nuclear transformation (e.g. $_{55}Cs \rightarrow _{59}Pr$) can be induced by permeation of deuterium through multi-layered thin Pd/CaO films. In addition, it has been recently claimed that the LENR can be induced effectively in the deuterium absorption and desorption for the nano-particles. These results suggest that the properties of nano-structured metal help the trigger efficiency of LENR enhance and it is important to understand the deuterium behavior in such materials for clarifying the mechanism of LENR. In this study, we conducted the DC glow discharge in deuterium atmosphere using nano-structured film cathode, and searched for the nuclear phenomena.

In the experiment we examined the following multi-layered samples; (i) Cs-deposited Pd/CaO complex and (ii) thin Pd film deposited on Cu foil. For sample (i), the Pd layer with the thickness of 40 nm was formed on the Pd foil (10 mm x 10 mm x 0.1mm), then 5 nm CaO and 40 nm Pd layers was formed. For sample (ii), Pd layer with the thickness of ~500 nm was deposited on the Cu foil (10 mm x 10 mm x 0.1 mm). 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 ~10 mm. After evacuating the cell to $<10^{-2}$ Torr, the deuterium gas is supplied until inside pressure became 1 Torr. Then, DC voltage was applied to expose the multi-layered sample to discharge in which the voltage and the current were typically ~500 V and ~2 mA, respectively. We tried to detect charged particles emitted during the discharge by some pieces of CR-39 detectors placed surrounds the cathode. After discharge, the element composition of the cathode was analyzed by TOF-SIM and ICP-MS and searched for newly produced elements as well as anomaly in isotopic abundance for the elements detected. We have precisely investigated the possible nuclear events by analyzing tracks recorded on CR-39 and elemental analysis as well as the variety of the results for each sample type.

Search for Nuclear Phenomena in Deuterium Desorption Process with Multi-layered Metal Complex

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Charged particle emission and anomalous heat evolution have been observed in deuterium loading/unloading process with multi-layered metal sample. These phenomena were supposed to be attributed to a low energy nuclear reaction in condensed matter.

In our past researches, we have observed phenomena considered to be excess heat and charged particle emission in deuterium out-diffusion from multi-layered Au/Pd/CaO and Pd/CaO/Pd/Au samples [1,2]. MHI group has demonstrated that the selective transmutation can be induced effectively in deuterium permeation with multi-layered Pd/CaO complex [3]. Considering these results, in this study, we performed deuterium desorption experiment with MHI-type Pd/CaO sample, and investigated the nuclear phenomena induced.

The Pd foil sample (0.1×10.0×10.0mm) was washed by acetone and aqua regia followed by being annealed at 900℃ for 10 hours. After annealing, the surface contaminants were removed by aqua regia again. Then, the Pd and CaO layers were deposited onto the surface of the foil by Ar ion beam sputtering. The multi-layered sample was loaded with deuterium being exposed to 5 atm D_2 gas for 20 hours. The D/Pd ratio was typically 0.6-0.7. After loading, D loaded sample was set into the evacuated chamber (~10^{-4} Pa) and applied the DC current (8 A) to stimulate the deuterium diffusion. The surface temperatures of the sample and the inside pressure of the chamber were monitored continuously for 24 hours. The currents and voltages applied to the sample were also recorded. The CR-39 detectors were set in the chamber for detecting charged particles.

In this paper, we present the deuterium desorption behavior for MHI-type Pd/CaO multi-layered sample and considerable nuclear phenomena induced in the process.

Reference

1. S.Narita et al., Proc of JCF10 (2010) 36.
2. S.Narita et al., Proc of JCF10 (2008) 5.
3. Y.Iwamura et al. Jpn. J. Appl. Phys. 41 (2002) 4642.

Systematic Uncertainties of Isotopic Abundance Measured by TOF-SIMS

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In the condensed matter nuclear science (CMNS), the anomaly in the isotopic abundances on the sample is often referred to as the evidence of nuclear transmutation. The time-of-flight secondary ion mass spectrometry (TOF-SIMS) is one of the methods to measure the isotope composition and it is popularly used in the CMNS experiments. In deuterium permeation experiment by MHI group, the transmutation from Sr to Mo isotopes was investigated. They found that the ratios of the signals on the masses corresponding to Mo isotopes were quite similar to natural isotopic abundances of Sr which were deposited onto the sample surface. This result was considered to be an evidence of the selective transmutation from Sr to Mo [1]. Omori et al. has found that the abundance of Pd isotopes on the surface layers of Pd cathode can change from natural abundance in the light water critical electrolysis [2]. This may also indicate the occurrence of nuclear transmutation. TOF-SIMS was used in these experiments to determine the isotopic abundances. In general, TOF-SIMS is capable of analyzing all the elements including their isotopes as well as good sensitivity for detecting a small amount of elements on the sample with a high mass resolution. However, it is known that appreciable changes in natural isotopic composition can occur at near-surface layer of the sample due to various effects such as surface sputtering, surface scattering, thermo diffusion by external source, and so on [3]. Therefore, it is quite important to make out the uncertainties in the TOF-SIMS measurement for the signal intensity of specified isotopes to justify the results of the low energy nuclear transmutation.

In this study, we measured the isotopic abundance for some types of metal foil with various surface conditions using TOF-SIMS. We also prepared the Pd sample loaded and unloaded with deuterium, and analyzed the surface isotopic composition. Then, the varieties of the isotopic abundances were evaluated for those samples and the uncertainties in the measurements were discussed quantitatively.

References

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Detection of Energetic Charged Particle from Thin Metal Cathode in Light and Heavy Water Electrolysis Using CR39

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We have been studied low energy nuclear reaction (LENR) for Li_2SO_4/H_2O electrolysis with thin Ni cathode using CR39 [1]. Comparing with the results for blank experiments, a marked increasing number of etch pit has been observed on the CR39 chips after the electrolysis. The results suggested the emission of an energetic charged particle penetrating through the Ni cathode during the electrolysis. The emitting particles would be protons having a constant energy of ~3 MeV. The result strongly indicates the low energy nuclear reaction for the hydrogen system.

In the present investigation, we have investigated the energetic charged particle for light water electrolysis with Au filml cathode and for heavy water electrolysis with Ni film cathode. The CR39 was set as being closely contacted with the cathode of 5 μ m thickness Ni or 2.5 μ m thickness Au film. These thin metal films formed the bottom of the test cell in 0.1 M Li_2SO_4 light or heavy water solution. The volume of solution was 8.5 cc. The anode was 155mm length and ϕ 0.5 mm Pt wire, which formed a spiral of ϕ ~5 mm. The distance between the tip of anode and the Ni cathode was ~10 mm. This construction can minimize the energy loss of charged particle through the thin metal cathode and maximize the detecting efficiency of emitting particle. The electrolysis time was ~20 min by constant DC ~20 mA and ~6 V application. The short detecting time of 20 min have an advantage of minimizing the noise from the environment. The CR39 used was cut into 30×30 mm in size just before the electrolysis. The etching time of CR-39 surface by 5 M NaOH was 7h.

Comparing with the case for blank tests, we have occasionally observed a marked increasing number of etch pit on CR-39 only after the electrolysis. The emitting particle seems to have energy range of the order of MeV. The result strongly indicates the LENR for these electrolysis systems.

1) H. Yamada et al., Detection of Energetic Charged Particle from Thin Ni Cathode in Shortened Li_2SO_4/H_2O Electrolysis Using Track Detector CR-39, Proceedings of the 10th Meeting of Japan CF Research Society, pp. 41-45 (2010)

Localization of Nuclear Reactions in the Cold Fusion Phenomenon

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Abstract

One of the characteristics of the cold fusion phenomenon (CFP), i.e. low energy nuclear reactions in solids with high density hydrogen isotopes at near room-temperature in ambient radiations, is the localization of nuclear reactions relevant to the phenomenon. The earliest data sets showing the localization of nuclear reactions were given by Iyengar and Srinivasan (1989, 1990) for product tritium localized in spots (fraction of a millimeter or less in size) at surfaces of a Ti sample and Morrey et al. (1990) for $^{4}_{2}$He in surface layers of Pd with a width of about 25 μm. Okamoto et al. (1994) observed nuclear transmutation of minor elements in surface layers of Pd samples, especially $^{27}_{13}$Al into $^{28}_{14}$Si, in a layer of about 2 μm. Miley et al. (1996) observed various transmutation products, especially transmutation of $^{A}_{28}$Ni isotopes, in the thin Ni layer of width about 0.1 μm in a protium system. Mizuno et al. (1996) also observed similar nuclear transmutations in PdD_x and AuH_x systems. Iwamura et al. (2002, 2005) observed transmutations of Sr, Cs and Ba into Mo, Pr and Sm, respectively, in/on a Pd surface layer of thickness about 100 A. Furthermore, the second product was confirmed its spatial localization with a diametrical size of about 100 μm. Thus, we know that the reaction products of the CFP are localized in regions at surface layers about a few μm in width of massive CF materials and also in thin CF materials with layer structures of widths less than one μm.

The confinement of nuclear reactions in surface/boundary layers of a few μm might be a characteristic of the CFP in protium and deuterium systems. This characteristic of the CFP is explained by the structure of a CF material composed of (1) a host material composed of a metal and a hydrogen isotope and (2) a guest material including agents for the CFP on the surface of the former. The localization of nuclear reactions in the guest material in spot-like regions is another characteristic showing nuclear reactions between the agent (such specific nuclei as alien nuclei (Li, Sr, Cs) or the irregularity of atomic arrays). These characteristics of localized nuclear reactions are investigated quantum mechanically using properties of nucleus and proton/deuteron wavefunctions in the CF material.

Numerical simulation of the motion of cascade vortices under beneath of the electrode surface

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Abstract:

During long-term electrolysis for well annealed thick Pd rod (9.0 mmΦ) in 0.1M LiOD, vortex pattern was observed [1-2]. The morphology of the postelectrolysis electrodes revealed the two long faults without any cracks on the surface. N-cycle model was proposed[3-4] where the vortex threads move under beneath of the surface to understand the CF phenomenon. Further the vortex threads were realized as the continuous flow of hypothetical particles mass from a vessel to a neighboring one in the Scavenger process.

In our last work[5], two continued vortex patterns on the postelectrolysis Pd rod successfully obtained from Lattice Gas Cellular Automata numerical simulation of the motion of the hypothetical particles mass flow. During the experiment it was inferred that the vortex thread (cascade of n-vortices) move under the influence of structural inhomogeneity, e.g. tunnel and coagulated precipitates existing in the subsurface layer of the electrode.

In this study, the other numerical simulation method: numerical simulation using discretization method is applied for the analysis of 3D motion of the hypothetical particles mass as a function of magnetic field and the matrix inhomogeneity.

References

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Neutron Emission in the Cold Fusion Phenomenon

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Abstract

The physics of the cold fusion phenomenon (CFP), i.e. low energy nuclear reactions in solids including high density hydrogen isotopes at near room-temperature in ambient radiations, has not yet been given appropriate explanations irrespective of abundant experimental data obtained in these more than twenty years. We focus on the nature of neutrons from cold fusion (CF) materials observed in these years to investigate mechanisms relevant to nuclear reactions responsible to the neutron emission. In the data sets by Jones et al. (1989), Shani et al. (1989), Takahashi et al. (1990, 1991), Bressani et al. (1991, 1992), and Okamoto et al. (1993) obtained in the early stage of this field, we point out the energy spectrum of the emitted neutrons extends more than about 7 MeV in consistent with recent observation of neutrons with more than 9.6 MeV by Szpak et al. (2008). The data by De Ninno et al. (1989) shows the bifurcation aspects of the CFP as pointed out by us (1999). The neutron vs. tritium ratio N_n/N_t of about 10^{-6} to 10^{-9} observed by Srinivasan et al. (1990) accords with our model ($\approx 10^{-7}$) and is a manifestation of the mechanism relevant to the nuclear reactions simultaneously generating triton and neutron in the CF materials.

The neutron energy spectra extending up to about 10 MeV and the existence of the CFP in protium systems exclude the *d-d* fusion from fundamental nuclear reactions responsible to events in this phenomenon. We have presented therefore a phenomenological model with a single adjustable parameter that is able to give explanation of the experimental facts depicted above qualitatively and sometimes semi-quantitatively.

In this paper, we give explanation of the characteristics of the neutron emission, existence of neutrons with energies up to 10 MeV, the bifurcation of temporal evolution and N_n/N_t ratio of the order of 10^{-6} to 10^{-9}, using concepts developed in the phenomenological explanation of events in the CFP as results of complexity in the CF materials composed of agents (nuclear species) interacting nonlinearly.