The 15th Meeting of Japan CF-Research Society

JCF15 ABSTRACTS

November 1-2, 2014

Hokkaido Citizens Activites Promotion Center

KADERU 2.7, Sapporo

Japan CF-Research Society

Program of JCF15 Meeting

Japan CF-Research Society

Date:	November 1-2, 2014
Place:	Hokkaido Citizens Activites Promotion Center KADERU 2.7, Sapporo, Japan
Paper presentation:	Oral presentation 20 min. (Review: 25min) + Discussion 5 min.
Language:	English or Japanese
Book of Abstract:	Only available at JCF home page (http://jcfrs.org/)

November 1 (Sat.), 2014

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

13:00-13:10 **Opening Address** T. Mizuno (Hydrogen Eng. A&D Co.)

Experiment-1 Chairman; Y. Iwamura (Mitsubishi H. I.)

13:10-13:45 **JCF15-1** Kitamura et al. (Technova Inc., Kobe U.)

Comparison of some Ni-based nano-composite samples with respect to excess heat evolution under exposure to hydrogen isotope gas

13:45-14:10 **JCF15-2** H.Kudo et al. (Iwate U.)

Deuterium adsorption test using Pd-Ni and Pd-Ag multi-layered samples.

14:10-14:45 **JCF15-3** T. Mizuno et al. (Hydrogen Eng. A&D Co.)

Analysis of Heat Generation using Pd and Ni Fine Wires

14:45-15:00 **Break**

Theory-1 Chairman; S.Narita (Iwate U.)

15:00-15:35 **JCF15-4** A. Takahashi (Technova Inc.)

Background for Condensed Cluster Fusion

15:35-16:00 **JCF15-5** K.Tsuchiya (NIT, Tokyo College)

Convergence Aspect of the Self-consistent Calculations for Quantum States of Charged Bose Particles in Solids

16:00-17:30 **JCF Annual Meeting**

18:00-20:00 **Reception**

November 2 (Sun), 2014

Experiment-2 Chairman; T. Mizuno (Hydrogen Eng. A&D Co.)

10:00-10:25 **JCF15-6** C. Nishimura et al. (National Institute for Materials Science)
Deuterium and hydrogen permeation of Pd-Ag and V-Ni alloy membranes with multi-layered CaO/Pd

10:25-10:50 **JCF15-7** Y. Iwamura et al. (Mitsubishi H. I.)
Increase of Transmutation Products by Electrochemical Deuterium Permeation through Nano-Structured Pd Multilayer Thin Film

10:50-11:05 **Break**

Theory-2 Chairman; K.Tsuchiya (NIT, Tokyo College)

11:05-11:30 **JCF15-8** H. Miura
Computer Simulation of Hydrogen Phonon States in Palladium Metal

11:30-12:05 **JCF15-9** A. Takahashi (Technova Inc.)
Is Gamma-Less Transmutation Possible? -The Case of Metal plus TSC and BOLEP-

12:05-13:30 **Lunch**

Free Discussion Chairman; K.Tsuchiya (NIT, Tokyo College)

13:30-15:00 Free Discussion

Adjourn

Comparison of some Ni-based nano-composite samples with respect to excess heat evolution under exposure to hydrogen isotope gas

A. Kitamura*[1,2], A. Takahashi[1,3], R. Seto[1], Y. Fujita[1], A. Taniike[2] and Y. Furuyama[2]
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We have been studying phenomena of anomalous heat evolution from hydrogen-isotope-loaded nano-composite metal-oxide samples at room temperature using a twin absorption system, A_1A_2 [1, 2] and at elevated temperatures using scaled-up system C_1 with a ten-times larger reaction chamber equipped with a flow calorimeter using an oil coolant with a boiling point of 390 °C [3, 4].

The samples tested in the A_1A_2 system were mainly Pd-based and Ni-based nano-composites supported by or mixed with zirconia; Pd/ZrO_2 ("PZ"), $Pd_{0.08}Ni_{0.35}/ZrO_2$ ("PNZ"), $Pd_{0.04}Ni_{0.29}/ZrO_2$ ("PNZ2B"), Ni/ZrO_2 ("NZ"), $Cu_{0.081}Ni_{0.36}/ZrO_2$ ("CNZ") and $Cu_{0.21}Ni_{0.21}/ZrO_2$ ("CNZII"), and have shown effectiveness of metal-oxide nano-composites for production of anomalously large hydrogen uptake and associated heat. These experiments were also effective to make an inference that surface adatoms of the minor component have a catalytic effect to enable hydrogen absorption of the host atom and enhanced release of absorption energy. The A_1A_2 system was also used for samples Pd/SiO_2 ("PS") and $Pd_{0.011}Ni_{0.062}/SiO_2$ ("PNS") to reveal effectiveness of meso-porous silica for an supporter of nano-composite particles.

The purpose of the fabrication of the C_1 system was to make precise measurements for Ni-based samples at elevated temperatures using the oil flow calorimetry. The results of the absorption runs with $Cu_{0.02}Ni_{0.083}/SiO_2$ (CNS) and $Cu_{0.076}Ni_{0.36}/ZrO_2$ (CNZ4) are described in ref's. [3] and [4], respectively, to show some excess heat characteristics yielding 30 - 100 eV/atom-Ni and 5 W/g-Ni, respectively.

To confirm the interesting characteristics of the CNS sample, a sample of similar composition, $Cu_{0.011}Ni_{0.077}/SiO_2$ (CNS2), containing much larger amount (12 g) of Ni was synthesized in our laboratory using meso-porous silica supplied by Admatechs Co. Ltd., and hydrogen absorption runs were performed at various temperatures from R.T. up to 350 °C to show long-lasting excess temperature which would correspond to an excess power of 13 W at around 300 °C, an excess energy of 10 keV/atom-H and 1 keV/M, where M denotes a Ni or Cu atom. These values will be discussed in comparison with the results of the $NiO/Ni\text{-}Al_2O_3$ (NN) and $Pd_{0.016}Ni_{0.070}/SiO_2\text{-}Al_2O_3$ (PNS) samples.

[1] Akira Kitamura, Takayoshi Nohmi, Yu Sasaki, Akira Taniike, Akito Takahashi, Reiko Seto, Yushi Fujita; Physics Letters A, **373** (2009) 3109-3112.
[2] A. Kitamura, Y. Miyoshi, H. Sakoh, A. Taniike, A. Takahashi, R. Seto and Y. Fujita; J. Condensed Matter Nucl. Sci. **5** (2011) 42-51.
[3] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike, Y. Furuyama; to be published in Proc. ICCF18; J. Condensed Matter Nucl. Sci.
[4] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike, Y. Furuyama; Proc. JCF14 (2014) 1-13.

Deuterium adsorption test using Pd-Ni and Pd-Ag multi-layered samples.

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Anomalous heat evolution have been observed in deuterium desorption experiment with Pd-Ni binary nano-particles [1]. In the experiments, the phenomenon could be attributed to the fine-structure of the sample as well as a specific property of Ni in deuterium diffusion. Considering the experimental result, we performed deuterium desorption experiment using multi-layered Pd-Ni complex sample and investigated thermal and deuterium diffusion behavior. We also examined the multi-layered sample with fine-structured surface and investigated the deuterium diffusion in dependence of the surface condition.

The thermal behavior in deuterium desorption from the metal depends on heat of hydrogen (deuterium) dissolution. In general, metals are classified into exothermic and endothermic absorbers of hydrogen, and Ag as well as Ni are classified as an endothermic absorber. If deuterium diffusion in the interface region of the binary metals is a significant factor to determine its thermal dynamics, we may expect the similar behavior for a Pd-Ag binary metal to Pd-Ni one. Then, we also tested a multi-layered Pd-Ag complex in this study.

In the experiment, these samples were fabricated by depositing thin metal layer of Ni or Ag onto a Pd foil substrate by Ar ion beam sputtering. For some samples, nanoscale fine-structured surface was formed by etching with aqua regia or Ar ion beam. The sample fabricated was loaded with deuterium being exposed to 5 atm D_2 gas for 24 h. After loading, the sample was set into an evacuated chamber (~10^{-4} Pa) and applied DC current to stimulate deuterium out-diffusion. The surface temperatures of the sample and the inside pressure of the chamber were monitored continuously for 24 h.

In this paper, we report the thermal behavior in deuterium desorption for various sample conditions and show an assumption of a peculiar process of deuterium diffusion in Pd-Ni or Pd-Ag binary metals.

Reference

[1] H.Sakoh *et al.*, Proc of JCF13 (2013) 214.

Analysis of Heat Generation using Pd and Ni Fine Wires

Tadahiko Mizuno and Hideki Yoshino
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Abstract

During the MIT meeting in March 2014, we reported excess heat of 75watt (COP=1.9) and excess energy of 108MJ for over 1 month. After the meeting, we made a few modifications to the reactor. We replaced the original ceramic heater with a new ceramic heater with an embedded thermocouple, capable of producing a higher heat output. We also rearranged the equipment inside the reactor by changing the placement of the electrodes and by improving the reactor vessel. Additionally, we modified the reactor by adding a water cooling device around the reactor which absorbs the heat generated allowing us to measure excess heat more accurately.

The following reactant gas and reactive metals were used during the tests of the improved reactor:

1. Reactant gas: pure D_2 gas at 10^{-2}～ 300 Pa
2. Reactive metals:
   a. Ni wire mesh: (0.15mmφ), s300 x 300mm, 23 g
   b. Pd wire: (i) (0.2mmφ) x1000mm, 1.14g, (ii) (1mmφ) x300mm, 2.82g, (iii) total weight = 3.96g

In addition,

3. Temperature of the heater: 300 ～ 800°C
4. Measured data: temperature, gas pressure, gas component and radiation

During the tests with the improved reactor, excess heat generation was observed when deuterium gas was present. We observed that when D_2 gas pressure was high, excess heat was generated consistently. Hydrogen isotopes (light and heavy hydrogen) were the reactants. Hydrogen isotopes reacted when they were on the metal surface (or in the vicinity of the metal surface), which generated excess heat.

In these tests, nano metal particles acted as a catalyst, causing hydrogen to react and generate heat. Based on the calibration value, these heat generations ranged from 10% to 70% of the input power. Approximately 4g of palladium was used as a catalyst in some tests, and approximately 23g of nickel was used in the other tests. Based on the total energy output with the palladium (4g), power density was approximately 5 watts per gram. With the nickel (23g), power density was approximately 1 watt per gram. These power densities are comparable to that of a nuclear reactor fuel.

Background for Condensed Cluster Fusion

Akio Takahashi
Technova Inc., Tokyo Japan
Professor Emeritus, Osaka University

To explain anomalous excess heat phenomena in metal-D(H) systems, the condensed cluster fusion (CCF) theory has been proposed and elaborated[1-8] since 1989. This paper presents the latest status of CCF theory development. The outline of paper is as follows:

1) Classical mechanics and free particle fusion
2) Fusion rate theory for trapped D(H) particles
   2-1) Strong interaction rate
   2-2) Condensation dynamics of D(H)-clusters
3) Final state interaction and nuclear products
4) Sites for Platonic D(H) cluster formation on/in condensed matter

[1] Akito Takahashi: The basics of deuteron cluster dynamics as shown by Langevin equation, American Chemical Society *LENRSB (Low Energy Nuclear Reaction Source Book)* 2 (2009) 193-217
[2] Akito Takahashi and Norio Yabuuchi: Study on 4D/TSC condensation motion by non-linear Langevin equation, American Chemical Society *LENRSB* 1 (2008) 57-83
[3] Akito Takahashi: Physics of Cold Fusion by TSC Theory, *J. Physical Science and Application*, 3(3) (2013) 191-198
[4] Akito Takahashi: JCMNS, Vol.1, 62-85 (2007)
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[6] Akito Takahashi: Nuclear Products of Cold Fusion by TSC Theory, Proc. ICCF18, to be published in JCMNS (see http://vixra.org/abs/1309.0072 also)
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[8] A. Takahashi, D. Rocha: D(H)-cluster Langevin code and some calculated results, Proc. JCF14, to be published in 2014 (see preprint at http://vixra.org/abs/1401.0202)

Convergence Aspect of the Self-consistent Calculations for Quantum States of Charged Bose Particles in Solids

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Abstract

In our previous works [1,2], we proposed the method to calculate the quantum states of the charged bosons trapped in the ion trap in order to investigate the nuclear reactions in solids. These studies consist of the self-consistent calculations. They are done by obtaining the numerical solutions for the Schrödinger's and the Poisson's equations alternately. However, the self-consistencies were not always adequate. In this study, we try to show the reasons for the bad convergence in iterative calculations.

References

1. Ken-ichi Tsuchiya," A Self-Consistent Iterative Calculation for the Two Species of Charged Bosons Related to the Nuclear Reactions in Solids", Journal of Condensed Matter Nuclear Science, Vol.13, pp.594-602
2. Ken-ichi TSUCHIYA, Aska OKUZUNI, Aiko WATANABE, "The Quantum States of the System Including Two Species of Charged Bosons In Ion Traps Ⅲ", Proc. of JCF14, pp.161-167

Deuterium and hydrogen permeation of Pd-Ag and V-Ni alloy membranes with multi-layered CaO/Pd

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Abstract

The purpose of this research was to clarify how the deuterium permeates the composite membranes, and elucidate the relations between deuterium permeation path and position where transmutation occurred. Surface of deuterium-permeated composite membranes was analyzed and possibility of the generation of new elements was examined.

Deuterium and hydrogen permeation characteristics were investigated using an ordinary gas permeation technique, in the temperature range of 343-573 K. Applied gas pressure was 0.1MPa, and the permeated side of the sample was vacuum pumped. Pd-25Ag alloy and V-15Ni alloy were selected as the substrate of the composite membranes, both of which are known as typical membrane materials for hydrogen purification with a high permeation flux. Surfaces of electrochemically deuterium-permeated samples were analyzed by SIMS and ICP-MS.

Deuterium permeability of Pd-25Ag sample with multi-layered CaO/Pd was about 2×10^{-9} mol D_2 $m^{-1}s^{-1}Pa^{-1/2}$ above 473 K. V-15Ni sample with multi-layered CaO/Pd showed lower permeability than that of Pd-25Ag, the value was about 4×10^{-10} mol D_2 $m^{-1}s^{-1}Pa^{-1/2}$ at 473 K. Without multi-layered CaO/Pd condition, V-15Ni sample shows higher hydrogen permeability than Pd-25Ag. So, oxidation before and during sputtering procedure must be the reason for the low deuterium permeability.

Peaks of Mass number 139, 140, 141, 142 were clearly observed in deuterium-permeated samples with ^{133}Cs implantation. Peak of mass number 190 was observed in deuterium-permeated samples with W implantation.

This research was supported by a “Grant in Aid” for Scientific Research, 22560744.

Increase of Transmutation Products by Electrochemical Deuterium Permeation through Nano-Structured Pd Multilayer Thin Film

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Low energy nuclear transmutation reactions have been observed in nano-structured Pd multilayer thin film which are composed of Pd and CaO thin film and Pd substrate, induced by D_2 gas permeation[1]-[2]. Replication experiments have been successfully performed by some researchers and Toyota R&D center published almost complete replication experiments on the transmutation of Cs into Pr last year [3].

Increase of transmutation products is important issue to apply this deuterium permeation transmutation phenomenon to practical use. This phenomenon would be used as an innovative nuclear transmutation method for radioactive waste or a new energy source if we could solve many problems for commercialization. We have been trying to increase the amount of transmutation products for these years [4].

The following factors are assumed to be important for inducing deuterium permeation transmutation.

(1) Local Deuteron Density

(2) Electronic Structure

Based on this assumption, we applied an electrochemical method to increase the local deuteron density near the surface of the nano-structured Pd multilayer film. Transmutation products were increased up to ~1$\mu g/cm^2$ by this approach, although the amount of products varies widely depending on the experimental condition.

Now we are performing another type of electrochemical permeation experiments. Recent experimental methods gave us increased transmutation products and new implications on Deuterium Permeation Induced Transmutation.

References

[1] Y. Iwamura, M. Sakano and T. Itoh, Jpn. J. Appl. Phys. 2002, 41, 4642-4648.
[2] Y. Iwamura et al., J. Condensed Matter Nucl. Sci. 4, 2011, 132–144.
[3] T.Hioki et.al, Jpn. J. Appl. Phys. 52, 2013,107301.
[4] Y.Iwamura et al., J. Condensed Matter Nucl. Sci. 13, 2014, 242-252.

Computer Simulation of Hydrogen Phonon States in Palladium Metal

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In order to examine which kind of conditions cause more than one deuterium (D) or hydrogen (H) to gather in condensed matter such as palladium (Pd) metal for nuclear fusion or nuclear transmutation, we simulated the H phonon states in Pd metal using a quantum molecular dynamics on a personal computer. We computed the phonon energy and the displacements of generic atoms of the bulk Pd metal by a computer simulation program within Density Functional Theory based on the local density approximation using pseudo-potentials and a plane-wave basis.

Computations were done on the lattice of host Pd atoms with occluded H atoms in a quarter or all O sites. The periodic boundary conditions were imposed on the computing 1x1x1 lattice of conventional cubic unit cell composed by four Pd atoms with or without one vacancy or one impurity atom such as calcium (Ca).

We investigated the phonon energies and the displacements of H atoms at Gamma, X, M and R-point in the reciprocal phonon wave-vector space. We observed the phonon energies and the H atom displacements of the phonon modes relate with H atoms were greater than those of the phonon modes relate with host Pd atoms and became much greater with a vacancy. To get more accurate results, the computations with lattice defects such as vacancies and impurity atoms have to be done in larger computing cell, and then we are trying to simulate on the 2x2x2 conventional one.

Is Gamma-Less Transmutation Possible?
-The Case of Metal plus TSC and BOLEP-

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Is Iwamura 'Transmutation' a real nuclear reaction? It is mystery with unknown theoretical mechanism. Transmutation of ^{133}Cs by A-8 & Z-4 increase by 4D/TSC capture should damp its ^{141}Pr* nuclear excitation energy of intermediate compound nucleus by mass defect (about 50 MeV) by some electro-magnetic transition. But how does it go without emitting high energy gamma-rays? Is the BOLEP (burst of low energy photons) as proposed for ^{8}Be* after 4D/TDC fusion applicable to the Iwamura transmutation?

M(metal-nucleus) + 4D/TSC fusion may take place with much higher rate than M + 4H/TSC reaction, because of 'very long' life time (a few ms or more) of ^{8}Be* cf. a few fs life of 4H/TSC-minimum: ratio is $10^{-3}/10^{-15} = 10^{12}$: and <W> value is much larger too. (This may explain why 'transmutation by H-gas was not observed by Iwamura.)

Damping very high-energy (ca. 50 MeV) excitation of compound nucleus of metal plus 4D/TSC-min (^{8}Be*) by the BOLEP mechanism might be a possibility. Very high spin rotation/vibration mode of 2-alpha-halo state of intermediate excited nucleus is a candidate model (see Fig.1).

However, the model is very speculative and is yet to study more detailed possible transition channels

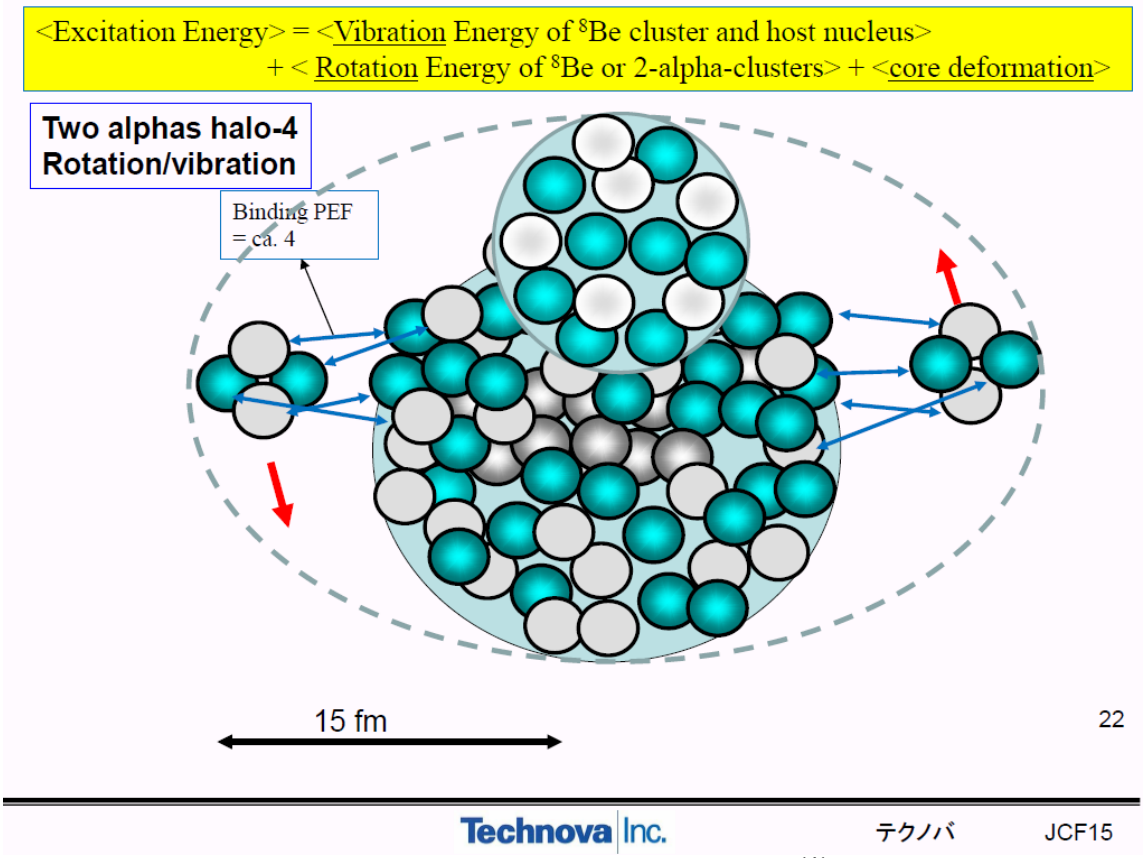

Fig.1: Very highly excited state of intermediate compound nucleus ^{141}Pr* by 4D/TSC capture to ^{133}Cs