The 9th Meeting of Japan CF-Research Society

# JCF9 ABSTRACTS

March 28-29, 2009

Shizuoka-ken Sangyo Keizai Kaikan

Japan CF-Research Society

# Program of JCF9 Meeting

**(Japan CF-Research Society)**

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**Date: March 28-29, 2009**

**Place: Shizuoka-ken Sangyo Keizai Kaikan** (Tel. 054-273-4330, Fax: 054-273-4331), 44-1 Outemachi, Aoi-ku, Shizuoka, 420-0853, Japan

**Paper presentation: Oral presentation 20 min. + Discussion 5 min.**

**Language= English or Japanese**

**Book of Abstract: Only available at JCF home page;**

http://dragon.elc.iwate-u.ac.jp/jcf/index.html

**March 27 (Sat. ), 2009 (at The 1st Conference Room)**

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

13:00-13:10 **Opening Address** (H. Kozima, CF Res. Lab.)

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

13:10-13:35 **JCF9-1** T. Jang et al. (Yokohama National U.): Gas and Heat Balance during Plasma Electrolysis (2)

13:35-14:00 **JCF9-2** J.S. Gao et al. (Toyota Central R & D Labs.): Investigation of Nuclear Transmutation of Sr into Mo Using $D_2$ Permeation through Pd Foil

14:00-14:25 **JCF9-3** S. Narita et al. (Iwate U.): Characterizing Deuterium Absorption/ Desorption Behavior with Multi-layered Pd

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

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

14:40-15:05 **JCF9-4** N. Yabuuchi (High Sci. Res. Lab.): Principle of Condensation for Nuclear Fusion

15:05-15:30 **JCF9-5** T. Nagashima et al. (Tokyo Metropolitan U.): Computer Simulation of Classical Dynamics Version of TSC Model

15:30-15:55 **JCF9-6** H. Kozima (CF Res. Lab.) et al.: Investigation of the Cold Fusion Phenomenon in the Surface Region of Hydrogen Non-occlusive Metal Catalysts; W, Pt, and Au

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

**Experiment-2** (Chairman: S. Narita, Iwate U.)

16:10-16:35 **JCF9-7** A. Kitamura (Kobe U.) et al.: CMNS Research Progressing in Kobe University –Deuterium Permeation and Absorption–

16:35-17:00 **JCF9-8** Y. Sasaki (Kobe U.) et al.: Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution (I) Results of absorption experiments using Pd powders

17:00-17:25 **JCF9-9** A. Takahashi (Technova Inc.) et al.: Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution (II) Discussions on Experimental Results and Underlying Physics

17:25-18:10 **JCF Annual Meeting**

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

**March 28 (Sun. ), 2009 (at The 1st Conference Room)**

**Theory-2** (Chairman: S. Sasabe, Tokyo Metropolitan U.)

10:00-10:25 **JCF9-10** N. D. Cook (Kansai U.): Quantitative Prediction of the Changes in Palladium Isotopes Due to Electrolysis

10:25-10:50 **JCF9-11** H. Miura: Condensation of Hydrogen or Heavy Hydrogen in Metal by Formation of Vacancy-Hydrogen Cluster or Vacancy-Heavy Hydrogen Cluster

10:50-11:15 **JCF9-12** H. Yamamoto: An Explanation of High Helium Concentration in Chupadera Mesa in New Mexico by Hydrogen-fusion

11:15-11:40 **JCF9-13** A. Takahashi (Technova Inc.): Neutron Spectra in CMNS –Back to the Past –

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

**Experiment-3** (Chairman: A. Kitamura, Kobe U.)

13:00-13:25 **JCF9-14** Y. Toriyabe et al. (Tohoku U.): High Energy Charged Particle Detection during Gas Permeation Experiment Using a Newly Developed Detector System

13:25-13:50 **JCF9-15** T. Mizuno (Hokkaido U.) et al. Heat Generation by Hydrogenation of Carbon Hydride

13:50-14:15 **JCF9-16** H. Yamada et al. (Iwate U.): Producing Elements of Mass Number 137 and 141 by Deuterium Permeation in Double Multi-layered Pd Samples with Cs Deposition

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

**Theory-3** (Chairman: M. Fukuhara, Tohoku U.)

14:30-14:55 **JCF9-17** H. Numata (Tokyo Institute of Tech.) et al.: Numerical Simulation of Vortex Pattern Appeared on Electrode Surface after Long Term Electrolysis of Well Annealed Thick Pd Rod in 0.1M LiOD: Open Boundary Condition

14:55-15:20 **JCF9-18** K. Tsuchiya (Tokyo N. C. T.): A Theoretical Study on the Possible Change of the Phonon Dispersion Relation Due to the Nuclear Reaction in Solid

15:20-15:45 **JCF9-19** H. Kozima (CF Res. Lab.): Non-localized Proton/Deuteron Wavefunctions and Neutron Bands in Transition-metal Hydrides/Deuterides

**Adjourn**

# GAS AND HEAT BALANCE DURING PLASMA ELECTROLYSIS (2)

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Plasma electrolysis is an unconventional electrolysis which glow discharge occurs at an electrode surface. During the process, excess gas which exceeded the theorectical gas generation calculated from Faraday`s law was produced during an electrolysis with plasma.[1] In addition, not only the excess gas but also the excess heat was produced during the electrolysis with plasma.[2-3] These reports suggest a new method for the production of hydrogen and energy. In the past experiments, we have reported that excess gas was produced during electrolysis with plasma. In this study, the energy balance and mass balance was measured accurately using the flow calorimetry from 26 to 50°C.

$Na_2CO_3$ light water solution was used as an electrolyte, and an anode was a platinum mesh (99.99% purity, 55meshs) with 20 mm diameter of a cylindrical shape. A cathode was a tungsten rod (Φ 1.0 mm, 99.95% purity), and placed at the center of the cylindrical anode. The electrolysis was conducted at a constant voltage of 110 V, and a flow rate of the electrolyte was fixed between 720 and 887$cm^3$ $min^{-1}$ to maintain no more than the temperature difference of 5°C between the inlet and the outlet of the electrolyte. The temperature was measured by Pt resistance thermometers. Mixed gas of hydrogen and oxygen which were generated during electrolysis was collected in a reservoir, and measured the rate of the gas generation by a gas flowmeter. The concentration of the electrolyte was 0.2moldm$^{-3}$, and temperature was 26 ― 50°C.

Figure 1 shows the dependence of gas and energy balance on the temperature. The excess gas was observed at all experiment in the range from 10% to 35%. The gas balance decreased with the increase of the temperature. In contrast, the energy balance increased with the temperature of electrolyte. The excess energy was observed at 38 and 50°C, and the amount of the excess reached up to 10%.

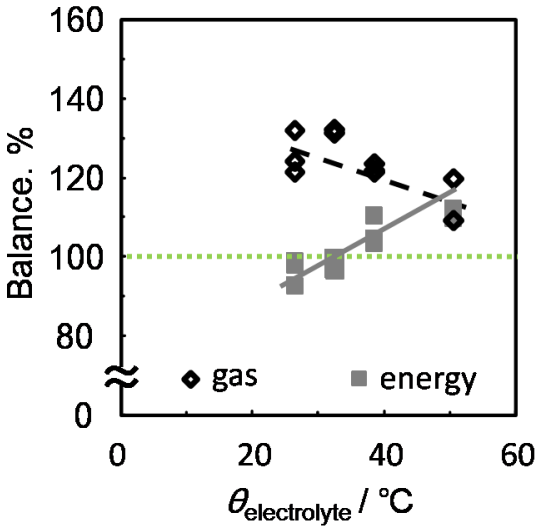


Fig. 1 Dependence of gas and heat balance on temperature of $Na_2CO_3$ solution at 110V.

1) S. K. Sengupta, O. P. Singh, *J. Electroanal. Chem.*, **369**, 113 (1994).
2) T. Mizuno, T. Ohmori, T. Akimoto, A. Takahashi, *Jpn J. Appl. Phys.*, **39**, 6055 (2000).
3) T. Mizuno, T. Akimoto, K. Azumi, T. Ohmori, *Jpn J. Appl. Phys.*, **44**, 396 (2005).

# Investigation of Nuclear Transmutation of Sr into Mo Using $D_2$ Permeation through Pd Foil

**Junsi Gao, Tatsumi Hioki, Naoko Takahashi, Shogo Hibi, Atsushi Murase and Tomoyoshi Motohiro**

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Recent years, the cold (or low energy) nuclear transmutation has been paid to attention, because it implies **a** revolution in our understanding of the nuclear reaction, a fundamental breakthrough in science. Practical application, even a new supply of cheap, clean energy, is of great importance. Therefore, it is very significant to investigate the realization possibility of the low-energy nuclear transmutation for a new application and a new scientific field.

Based on the progresses of the first stage [1] where we developed a new method for eliminating sulfur and obtained the high permeation rate, we carried out the two kinds of experiments relevant to the cold nuclear transmutation. First, we investigated element conversion from Sr to Mo in a pure Pd system; second, we investigated the same element conversion in the multi-layer Pd system. For the pure Pd system, the as-purchased Pd foil was first annealed in a vacuum chamber and air furnace, then, Sr ions were implanted into it, and finally, the $D_2$ permeation through it was performed for about 10 days. In the case of multi-layer transmutation, CaO/Pd multi-layer was deposited on the Pd foil which was annealed as the same procedures as in the pure Pd system, then Sr ion implantation and the $D_2$ permeation were carried out to it. In addition, for the permeated samples, we carried out a post annealing, i.e. annealing the samples in air after $D_2$ permeation.

The permeated samples were evaluated after the post annealing using XPS method. The results have been summarized as follows. (1) Because sulfur has a very intense peak at around S 2s which overlaps that of Mo 3d, in spite of very small amount of sulfur, we can't analyze the spectrum of Mo 3d even if it exists. Thus, we have firstly established the method of eliminating sulfur after $D_2$ permeation, and demonstrated the three characteristics of the standard spectrum of Mo 3d, that is , the main peak position, the difference of the binding energies ($\Delta E$) of 3.13 eV and the ratio of 3/2 of two peaks Mo $3d_{5/2}$ and $3d_{3/2}$.

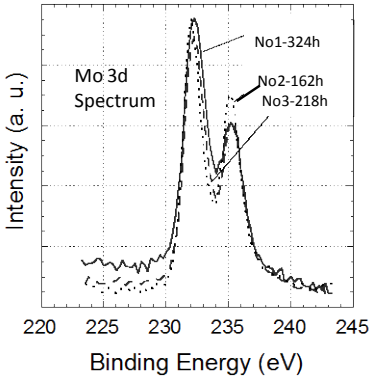


Fig.1. Mo 3d spectra of samples No.1~3.

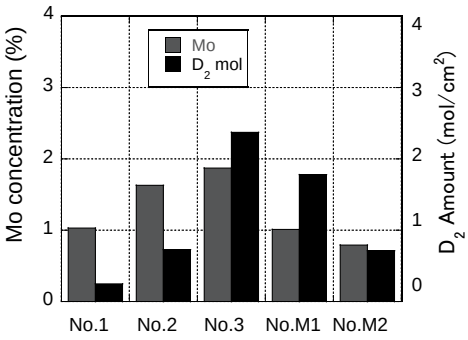


Fig. 2. The dependence of the detected Mo amount on the permeated $D_2$ amount which was scaled in the unit of a mole.

(2) According to the characteristics of Mo 3d, we first detected Mo on the surface of sample No.1 (pure Pd system) after the post annealing. Subsequently, we prepared two samples No.2 and No.3 according to the same procedures as those of sample No.1, and we also detected Mo on the surfaces of these two samples. Figure 1 shows the Mo 3d spectra of these three samples. In addition, we prepared two multi-layer-samples (No.M1 and No.M2), and detected Mo on the surface of them after the post annealing. But one of them was detected Mo before the $D_2$ permeation, which should be considered as the Mo contamination on the sample.

(3) We have found that the changes in total amount of the permeated $D_2$ gas are in agreement with the changes of the detected Mo amounts for Sr-pure Pd samples, as shown in Fig. 2. This tendency was also observed for the multi-layer samples.

Finally, we investigated the possibility of getting mixed Mo contaminations into samples in the processes, including the vacuum annealing, air annealing, ion implantation and permeation, the results of which are also presented on JCF-9.

Reference:

[1] Junsi Gao, Tatsumi Hioki, Naoko Takahashi and Tomoyoshi Motohiro, JCF-8, Nov.29, 2008, Kyoto.

# Characterizing deuterium absorption/desorption behavior with multi-layered Pd

S. Narita†, H. Yamada, Y. Fukuda, H. Nagai, T. Takahashi, S. Hiyama, J. Narumi, T. Murakami

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In deuterium diffusion process with multi-layered or hetero-structured Pd foil, observation of nuclear phenomena such as transmutation, heat evolution and radiations have been reported in various experiments. A selective transmutation has been found in permeation of D through thin-layered Pd/CaO complex by Iwamura *et al.* [1]. Yamaguchi *et al.* observed excess heat and helium production in controlled deuterium diffusion from the hetero-structured Au/Pd/MnO sample [2]. Lipson *et al.* also reported charged particle emissions in deuterium diffusion from Pd/PdO sample [3]. They also found the deuterium desorption rate can be enhanced. Now it is widely recognized that a specified property of the multi-layered structure plays an important role to induce condensed matter nuclear reaction (CMNS), and understanding the deuterium dynamics in such sample may lead us to clarify the mechanism of CMNS.

We have investigated the deuterium absorbing and desorbing behavior with surface coated Pd foil. In this study, we tested Pd/Au, Pd/CaO, Au/Pd/CaO, Pd/Pd samples which were prepared by depositing Au, CaO, Pd layer by Ar beam sputtering onto the surface of Pd substrate, respectively. The deuterium loading capability and time-resolved desorption behavior were investigated for each sample. We found that the loading ratio has a dependence on the type of coating material as well as its thickness. During the gas desorption process, a heat evolution simultaneously with explosive gas release from the sample was sometimes observed. A significant number of tracks was also recorded on CR-39 detector with the events. These phenomena strongly suggest the occurrence of the nuclear reaction, and it may be associated with a peculiar behavior of deuterium desorption led by unique sample structure.

In this paper, we report the characteristics of the deuterium absorption and diffusion behavior followed by nuclear phenomena for various types of multi-layered sample. Then, we will discuss the trigger condition to induce nuclear reaction in terms of the deuterium motion.

**References**

1. Y. Iwamura *et al.*, Jpn. J. Appl. Phys. 41 (2002) 4642.
2. E. Yamaguchi *et al.*, Jpn. J. Appl. Phys. 29 (1990) L666.
3. A.G. Lipson *et al.*, Proc of ICCF12 (2006) 293.

# Principle of Condensation for Nuclear Fusion

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The auther thought about the style that arranged neutrons and deuterons for the atomic nucleus Structure of the regular hexahedron to COLD FUSION magazine in 1996. This time I arranged heavy electron and deuterons for the atomic nucleus structure of the same regular hexahedron and thought about nuclear fusion. May thory of key to this is found in the thinking of Einstein, Kepler, and Descartes, as well as in the Pythagorean theorem as it relates to Platonic solids and in the theory of dissipation described in *Self-Organization in Non-Equilibrium Systems* by Gregoire Nicolis and Ilya Prigogine. Of course, the heavy electrons posited in nuclear theory and Brian Josephson's theories of superconductivity are also essential.

Namely, just as carbon$_{60}$ ($C_{60}$) is actually produced in a vacuum, as Ilya Prigogine held, the deuterons and heavy electrons occluded within a hydrogen-occluding alloy are taken to be arranged in a Platonic structure by the self-organization that is termed "Form" in philosophy. Accordingly, it has been learned, the heavy electrons and deuterons come to exert repulsion and attraction in just the right combination, with attraction that is 0.84 times larger than repulsion constantly being exerted, and the electrons and deuterons condense toward the center. When I express this principle by an equation ,F=0.84 F. Further, it is also understood that when a heavy electron and a deuteron collide, the heavy electron assumes an observed state, and so it becomes a point and the wave packet of the electron becomes no impediment to condensation. It is moreover understood that, just as an atom and electrons are subject to being bound by centrifugal force and attraction and move in orbits that describe a Bohr radius, the heavy electron and deuteron in Platonic space are also bound by repulsion and attraction and move in collision orbits, and so calculation according to classical theories based on determinism was carried out with reference to Ehrenfest's theorem. Accordingly, two deuterons must overcome the Coulomb barrier with movement energy of 15.0 x $10^6$ [eV],30.0MeV in total, colliding and experiencing fusion. This spot is 5.29fm from the center point. Deuteron two of kinetic energy 30.0MeV collide when I calculate and consume energy of9.9MeV. Compound nucleus helium and the compound nucleus helium of the other side collide in kenetic energy 20.1 MeV of a composed collision at the center point and compose activated beryllium and return to helium again. The mass defect energy by this nuclear fusion process is 47.6MeV.When I express it in an equation.

$$^2D+^2D+^2D+^2D \rightarrow {}^4H^*e_2 + {}^4H^*e_2 \rightarrow {}^8Be^*_4 \rightarrow {}^4He_2 + {}^4He_2 + 47.6MeV \quad (1)$$

The use of Platonic structures to describe molecular structure in college chemistry textbooks is now commonplace, with fullerenes being the most well-known examples of modified Platonic structures. In the field of celestial dynamics as well, the physical cosmology of Platonic solids announced by Dr. Jeffrey Weeks in 2004 is in the process of being proven. Accordingly, it is now understood that the structures of elementary particles, atomic nuclei, molecules, and celestial mechanics are fundamentally Platonic solids, and as Descartes and Euler's formula of V + F - E = 2 for regular polyhedra suggest, the number 2 is the phase-invariable quantity for the world's structure. In particular, V corresponds to point-mass number, F to field, and E to nuclear force, electromagnetic force, and gravity.

# Computer Simulation of Classical Dynamics Version of TSC Model

**Takayuki Nagashima and Keisuke Okabe,**
**Shigeru Sasabe** *)

**Department of Science & Technology, Tokyo Metropolitan University,**
**1-1 Minami Osawa, Hachioji, Tokyo, 192-0397 Japan**

Classical dynamics version of TSC model [1] is examined. We use the computer simulation to investigate the motions of electrons and deuterons.
It is found that Tetrahedral Symmetric Condensate succeeds in some cases, or fails in other cases for the nuclear fusion.
The condensation for realizing the nuclear fusion requires the exact symmetry.

[1] A. Takahashi, N. Yabuuchi; Brief Review on Fusion Rate of Bosonized Condensates Part Ⅱ: EQPET/TSC Model, Proc. 7th Meeting of JCF Reserch Society, pp63-70 (2006).

*) E-Mail: s-sasabe@tmu.ac.jp

*JCF9* (March 29 – 30, 2009, Shizuoka, Shizuoka, Japan)

# Investigation of the Cold Fusion Phenomenon in the Surface Region of Hydrogen Non-occlusive Metal Catalysts; W, Pt, and Au

Hideo Kozima[*] and Tadahiko Mizuno[**]

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Experimental data sets of the cold fusion phenomenon (CFP) obtained in the contact catalysts W, Pt and Au are investigated from a point of view common to whole data of the CFP in various systems performed in almost twenty years after its discovery. These metals do not occlude hydrogen isotopes and give us precious information about mechanisms facilitating formation of a matter for the CFP (cf-matter). On the other hand, recent knowledge of calalytic action at the surface has shown existence of "subsurface" hydrogen states in Ti, Ni, Zr, Nb, Ru, Pd, Pt and others. Furthermore, in the case of Pt, there are seven or eight types of adsorbed hydrogen, half of which refer to hydrogen adsorbed on the external surface, and the remainder refers to hydrogen incorporated in different forms at dislocations, grain boundaries, or inclusions [1]. Therefore, we have to consider the CFP more carefully taking into our consideration concrete knowledge of hydrogen states in the surface region of CF materials.

Thus, the recent knowledge of contact catalysts shed light on atomic processes necessary to form the cf-matter and also on nuclear processes to realize the nuclear transmutation and other events accompanying excess energy production in the CFP. The former may have a close relation with the mechanism of catalysis which has not enough been explored yet.

Experimental data sets on the nuclear transmutation in the metals, W, Pt and Au, have confirmed the stability effects in the generation of new nuclides discovered by us with some characteristic modifications by the characteristics of experimental systems. This is an evidence of collective nature of nuclear reactions in these metals suggesting formation of the cf-matter in the surface region of the samples. This knowledge obtained in the CFP and the facts obtained in the catalysis investigation give strong support to our phenomenological approach to the CFP based on the experimental data sets including hydrogen occluding and non-occluding transition metals.

[1] R. Birch, *Chemical Physics of Solids and their Surfaces*, *Vol. 8*, pp. 1 – 17 (1980).

JCF9 abstract

**CMNS Research Progressing in Kobe University -Deuterium Permeation and Absorption–**

A. Kitamura[1*], T. Yamaguchi[1], T. Nohmi[1], Y. Sasaki[1], Y. Miyoshi[1],
A. Taniike[1], Y. Furuyama[1], and A. Takahashi[2]
[1]Division of Marine Engineering, Graduate School of Maritime Sciences, Kobe University;
Higashinada-ku, Kobe 6580022, Japan; *kitamura@maritime.kobe-u.ac.jp
[2]Professor Emeritus, Osaka University

Experimental studies on condensed matter nuclear science (CMNS) ongoing in Kobe University are reviewed. One is the subject of nuclear transmutation during forced permeation of deuterium (D) through a multi-layered film of X/CaO/Pd, with X being an element to be transmuted, *e.g.*, $^{133}$Cs transmuted to $^{141}$Pr, $^{88}$Sr to $^{96}$Mo, *etc*., which was originally claimed by Iwamura *et al.*[1]. In addition to the modified version of the sample exposure system with reversed flow direction installed at a beam line of a tandem electrostatic accelerator 5SDH-2, a stand-alone D permeation system was used to examine the phenomenon by *in-situ* or *ex-situ* PIXE/ERD analysis, respectively.

Using Sr as the element X, more than ten samples having a variety of multi-layer structure have been examined. The PIXE spectra have shown that three out of fourteen samples had increased areal densities of Mo in exchange for decreased those of Sr after D permeation with integrated flow rates up to 2 - $20\times10^{22}$ cm$^{-2}$. However, the $K_\alpha$-$K_\beta$ X-ray peaks in the spectra were too small to give sufficiently high reliability to the identification of the peaks, and to deduce definite conclusion of transmutation. It should be noted, nonetheless, that almost all samples with exception of only one had decreased areal densities of Sr after D permeation.

Tungsten was also tested as the element X. Assuming the regularity in transmutation that (atomic number, mass number) increase by (4, 8), we expected production of radioactive nuclei $^{191}$Pt ($T_{1/2}$ = 2.86 d) from $^{183}$W. An NaI(Tl) scintillation probe and a HPGe detector were employed to detect 0.538-MeV gamma rays from $^{191}$Pt. The result of the measurement for the first sample has shown that the areal density of $^{191}$Pt is smaller than $10^7$ cm$^{-2}$, if any.

The second subject is to confirm heat and $^4$He generation by D absorption in nano-sized Pd powders reported by Arata and Zhang [2], and to investigate the underlying physics. We have installed a twin system to perform calorimetry during $D_2$ or $H_2$ absorption by micronized powders of Si, Pd, Pd-black, and Pd-Zr oxide compounds. The research is performed as a joint research program with Technova Inc., and is described in detail in the following two presentations [3, 4].

[1] *Y. Iwamura, M. Sakano and T. Itoh; Jpn. J. Appl. Phys. 41 (2002) 4642-4650.*
[2] *Y. Arata and Y. Zhang; The special report on research project for creation of new energy, J. High Temperature Soc., No. 1, 2008.*
[3] *Y. Sasaki, A. Kitamura, T. Nohmi, T. Yamaguchi, A. Taniike, A. Takahashi, R. Seto, and Y. Fujita; Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution, (I) Results of absorption experiments using Pd powders, (this meeting).*
[4] *A.Takahashi, A. Kitamura, T. Nohmi, Y. Sasaki, Y. Miyoshi, A. Taniike, R. Seto, and Y. Fujita; Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution, (II) Discussions on Experimental Results and Underlying Physics, (this meeting).*

**Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution**

(I) Results of absorption experiments using Pd powders

Y. Sasaki[1*], A. Kitamura[1], T. Nohmi[1], Y. Miyoshi[1], A. Taniike[1],

A. Takahashi[2], R. Seto[2], and Y. Fujita[2]

[1]Division of Marine Engineering, Graduate School of Maritime Sciences, Kobe University;

Higashinada-ku, Kobe 6580022, Japan; *088w508w@stu.kobe-u.ac.jp

[2]Technova Inc.

To confirm heat and $^4$He generation by deuterium (D) absorption in nano-sized Pd powders reported by Arata and Zhang [1], and to investigate the underlying physics, we have installed a twin system of double structured vessels to perform flow calorimetry during $D_2$ or $H_2$ absorption by a variety of micronized Pd samples. The inner reaction vessels contain sample powders of Si, Pd, Pd-black, or Pd-Zr oxide compounds, and have calorimetry arrangement, *i.e.*, coolant pipes and thermocouples on the outer surfaces. The inner vessels are located in the outer chambers which are evacuated for thermal insulation. We can perform $D_2$ and $H_2$ absorption runs for two samples at the same time under the same environmental condition. Nuclear diagnostic tools, a 2"×2" NaI(Tl) scintillation probe and a neutron dose-rate meter, are also provided around the system.

The first-stage experiments are described in detail in ref. [2]. The evolution of pressure and temperature after introduction of 1-MPa $D_2/H_2$ gas was divided into two phases. In the first phase, during which the pressure was kept well below 10 kPa, the D (H) loading ratio of D/Pd (H/Pd) and the specific output energy reached 0.85 (0.78) and 0.54±0.10 (0.45±0.08) kJ/g-Pd, respectively, for the Pd-black, which were about 2 – 3 times greater than those for the 0.1-μm$\phi$-Pd powder. Moreover, when $D_2$ gas was used with Pd-black, apparent excess heat production in the second phase was implied, although temperature oscillations and drift were too large to confirm the result.

Then in the second stage, the system was modified to improve the accuracy: The heat capacity of the reaction vessel was decreased, while increasing the mass of the test sample, to minimize the time constant of the calorimeter and maximize the sensitivity.

First, repeated use of the Pd-black samples after one or more cycles of D (H) absorption-degassing has revealed the Pd-black powder stuck with each other to become larger micro-particles without nanoscale structure. Next, nano-sized powders of mixed Pd and Zr oxides fabricated by Santoku Cooperation, Kobe, Japan, have been used to reveal their interesting and exciting characteristics, which is discussed in detail in the succeeding presentation [3].

[1] *Y. Arata, et al.: The special report on research project for creation of new energy, J. High Temperature Society, No. 1. 2008.*

[2] *T. Nohmi, Y. Sasaki, T. Yamaguchi, Taniike, A. Kitamura, A. Takahashi, R. Seto, and Y. Fujita: Basic research on condensed matter nuclear reaction using Pd powders charged with high density deuterium, Proc. ICCF14 (Washington DC, Aug. 10-15, 2008).*

[3] *A.Takahashi, A. Kitamura, T. Nohmi, Y. Sasaki,Y. Miyoshi, A. Taniike, R. Seto, and Y. Fujita: Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution (II) Discussions on Experimental Results and Underlying Physics, (this meeting).*

JCF9 Takahashi2 abstract

**Deuterium Gas Charging Experiments with Pd Powders for Excess Heat Evolution**

**(II) Discussions on Experimental Results and Underlying Physics**

A.Takahashi[1*], A. Kitamura[2], T. Nohmi[2], Y. Sasaki[2],

Y. Miyoshi[2], A. Taniike[2], R. Seto[1], and Y. Fujita[1]

[1]Technova Inc. *akito@sutv.zaq.ne.jp

[2](Division of Marine Engineering, Graduate School of Maritime Sciences, Kobe University)

Our experimental results [*Ref-1*] obtained for Pd/PdO/$ZrO_2$ nano-composite samples under the joint research of Kobe University and Technova Inc. in the 2008 fiscal year are summarized as:

1) Arata-Zhang's excess heat result demonstrated in May 2008 was replicated quantitatively.
2) For Pd/PdO/$ZrO_2$ powders (produced by Santoku Co. , Kobe Japan):
   2-1) D-gas charge in the 1st phase (zero pressure interval) gave 20~90 % excess heat than H-gas charge.
   2-2) In the 2nd phase of pressure rise (finally up to 1MPa), significant excess heat (about 2 kJ/g-Pd) for D-gas charge was observed, while near zero level excess heat for H-gas charge was observed.
3) No increase of neutron counts was seen, nor increase of gamma-ray counts.
4) D/Pd loading ratio in the end of 1st phase was 1.0, while H/Pd ratio was about 0.8-0.9.
5) Released energy per D or H-atom in the 1st phase was 1.7-1.8eV or 1.0-1.6eV respectively for D or H. These specific values are anomalously large, compared with known values of 0.5eV and 0.2eV per D or H respectively for surface-adsorption and lattice-absorption of hydrogen gas into bulk Pd metal.
6) After evacuation, used Santoku sample retains 100 times more deuterium than Pd-black sample, seen by degassing data by baking up to 574 K.
7) In repeated run with used sample after #1, we can expect further steady excess heat. We observed similar effect as "heat after death" after evacuation of reaction chamber in the end of run.

For the 1st phase, we discuss the underlying surface and nano-particle physics in views of the enhanced surface adsorption potential by fractal sub-nano-scale trapping points on nano-Pd particle, the diffusion to inner shallower Bloch potential of regular Pd lattice, and the drastic mesoscopic and isotopic effect of surface and lattice rearrangement of nano-Pd particle by full D(H)-absorption to make deeper D(H) trapping potentials of surface adsorption (about 2eV for D) and intermediate surface state trapping.

We add discussions on the 2nd phase where we observed long lasting significant excess heat only for D-charging, in the view of possible 4D/TSC model type "condensed cluster fusion reaction" to produce excess heat and $^4$He particles by preferred 4D fusion without neutrons and gamma rays.

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# Quantitative Prediction of the Changes in Palladium Isotopes Due to Electrolysis

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Together with heat production, Mizuno (1998) reported significant changes in the abundance of palladium isotopes following electrolysis. Specifically, the changes in natural abundance for Pd102, Pd104, Pd105, Pd106, Pd108 and Pd110 were, respectively, +3.0, +6.0, -2.2, -6.3, -5.7 and +5.2% after electrolysis in a deuterium bath. Isotopic changes are clearly nuclear effects, but the cause of the various increases and decreases depending on isotopic number has remained unexplained. In a numerical simulation of transmutation at the surface of the palladium cathode, I show that all of the palladium isotopes were ***equally*** involved in the transmutation process (Cook, 2008). That is, starting with one million palladium nuclei on the cathode surface, a "loss" of ~89% of all isotopes (i.e., with transmutation to various end-products) results in the isotopic abundances reported by Mizuno. I conclude that, whatever the physical mechanism that allows deuterons to enter into the palladium nucleus (e.g., Takahashi, 2007), ***all nuclei*** on the surface of the cathode are susceptible to transmutation. In other words, there are no "special" palladium isotopes that are responsible for the Mizuno results. The "big puzzle" in low-energy nuclear reaction research that remains unsolved is therefore how deuterons are shielded from the nuclear Coulomb charge.

# Condensation of Hydrogen or Heavy Hydrogen in Metal by Formation of Vacancy–Hydrogen Cluster or Vacancy–Heavy Hydrogen Cluster

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Interaction between hydrogen and vacancies within various metals has been studied systematically in relation to wall materials of thermonuclear fusion reactors. From those results we found out that the binding energy between hydrogen and a vacancy forming a vacancy–hydrogen cluster is smaller than that of hydrogen bound to a usual interstitial site of lattice, and that the thermal equilibrium concentration of vacancy–hydrogen clusters increases rapidly as the hydrogen concentration in a metal becomes larger to some extent. Since diffusion of impurity atoms in a metal usually takes place through vacancies, it is possible that the probability of diffusion of ions such as alkali or alkaline–earth metal ions and also $H^+/D^+$ ions permeating into the host metal increases, when the concentration of vacancy–hydrogen clusters or vacancy–heavy hydrogen clusters increases.

On the other hand, when ions diffuse in a metal, the surrounding lattices in which $H^+/D^+$ ions are self–trapping would be distorted, and then the repulsion potential barrier of the metal lattice would be affected. Studies on the tensile stress on metals of body centered cubic lattice such as Fe showed us that the potential bottom of the interstitial site where hydrogen is self–trapping moves in the direction of the next one, and then hydrogen occupies it. Those would be similarly realized to the case of reduction of internal pressure replaced with the tensile stress. When an ion such as alkali or alkaline–earth metal ion and also $H^+/D^+$ ion permeating into the host metal hops–into T site or a vacancy and hops–out again, the potential bottom of O sites where $H^+/D^+$ ions are weakly bound as the vacancy–hydrogen cluster or vacancy–heavy hydrogen cluster would move in the direction of T site or a vacancy, and then cluster $H^+/D^+$ ions could move there and condense together.

The crystal structure of the host metal of face centered cubic lattice such as Pd, where the cluster $H^+/D^+$ ions should condense into T site or a vacancy and should occur nuclear reactions, would be the structure where vacancy–hydrogen clusters or vacancy–heavy hydrogen clusters are located in the surrounding lattices of the tetrahedron of the host metal atoms centering on the T site. One of those crystal structures is the periodic pattern of the basic structure that has a vacancy replaced with one of the vertixes of the triangle section of octahedron which are cut off four vertex portions of the large regular tetrahedron circumscribed with the regular tetrahedron of the host metal atoms (partial ratio of vacancies: 0.5/4).

# An Explanation of High Helium Concentration in Chupadera Mesa in New Mexico by Hydrogen-fusion

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Key words: helium concentration, helium isotope ratio, hydrogen fusion, geo-fusion, earthquake, faults

## Introduction

Helium is contained in natural gases and its concentration varies from nearly zero to 8%(mole percent). Helium concentration of the most of natural gas wells in USA is below 0.3%, but some in New Mexico which are located on the densely distributed fault zones contain as much as 8% of helium. Interestingly, helium content increases with proximity to the faults (1). It is commonly perceived that $^4$He is generated by radiogenic decay of uranium and thorium and $^3$He is mostly primordial and derived from the mantle. S. Jones proposed geo-fusion of deuterium in condensed matter within the earth (2). In this case outcomes are tritium and $^3$He ($^4$He is negligible). The author proposed earthquakes are caused by hydrogen fusion whose outcomes are both $^3$He and $^4$He (3). The helium isotope ratio ($^3$He/$^4$He) is a good tool to determine the origin of helium. The atmospheric isotope ratio, *Ra* is $1.4\times10^{-6}$. The helium isotope ratio of the most of natural gas wells in USA is under 0.08*Ra* but Chupadera Mesa in New Mexico has 0.515*Ra*, about 6 times higher (4). This suggests part of helium was derived from the mantle or geo-fusion or earthquakes caused by hydrogen fusion.

## Fusion of hydrogen dissociated from water under the ground

R.L. Mills has reported that atomic hydrogen can generate energy somewhat between chemical reaction and nuclear reaction by lowering the electron orbit from the ground state to lower state (5). According to Mills, hydrogen atoms can achieve lower states than ground state by a resonant collision with a nearby atom or combination of atoms having the capability to absorb the energy to effect the transition, namely, an integer multiple of the potential energy of the electron at atomic hydrogen, m*27.2 eV (m is an integer) . He named this shrunken hydrogen atom hydrino and claims that this hydrino can be a catalyst to shrink other hydrinos to further lower states. He named this reaction the BlackLight Process.

The Earth's crust is divided into several separate solid plates. Subduction occurs when two plates collide and the edge of one dives beneath the other. The crust contains water and when it contacts with metals such as iron, atomic hydrogen will be produced according to the following reaction.

$3Fe + 4H_2O = 8H + Fe_3O_4$, where H designates atomic hydrogen.

Once atomic hydrogen is produced and if there is no heat sink at the collision point, just a collision of atomic hydrogen, for instance, H + H = $H_2$ (molecular hydrogen) wouldn't take place but just elastically repulse each other. This suggests that high pressure atomic hydrogen gas will build up under the ground. As is shown below, a simultaneous collision of 3 atomic hydrogen is the BlackLight Process because the ionization energy of hydrogen is 13.6eV and the sum of the ionization energy of 2 hydrogen is 27.2eV.

H + H + H = [Hn=1/2] + 2 p+ 2 e

p designates proton and [Hn=1/2] designates a hydrogen whose electron orbit is shrunken to 1/2 the radius of a normal one and these will be shrunken further to lower orbits as reaction continues. It can be postulated that if containing vessels are tight enough as is the case of the underground, well shrunken hydrinos which have a relatively small Coulomb barrier can fuse each other resulting in the generation of mainly $^4$He and a fraction of $^3$He.

## An explanation of helium concentration in New Mexico

Helium generated by radiogenic decay of uranium and thorium in granite migrates with other gases. But it is very difficult to find out the mechanism how helium content increases. The fact that helium content increases with proximity to the faults strongly suggests that dense helium at the fault was first made and then propagated. The coincident of the densely distributed faults and high helium concentration in Chupadera Mesa in New Mexico indicates helium was made in the event of earthquakes by hydrogen fusion. Rather high helium isotope ratio ($^3$He/$^4$He) of 0.515*Ra* is due to the unburned $^3$He in the event of earthquakes.

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# Neutron Spectra in CMNS
## - Back to the Past –

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The recent SPAWAR claim on $^{12}C(n,n')3\alpha$ detection (Naturwissenschaften 2008) due to 14 MeV neutrons by D-T reaction in $D_2O$/Pd co-deposition cell reminds our old discussion on observed neutron spectra from CMNS/CF cells in the past.

Structure or shape of neutron spectra should give important (decisive) evidences on underlying physical mechanisms on possible deuteron-related nuclear fusions in PdDx systems.

$^{12}C(n,n')3\alpha$ reaction has threshold at 6.18MeV of incident neutron energy.

Explanation by secondary d-t reaction after d+d fusion is not plausible, as yield of d+t reaction by 1MeV triton slowing down in PdDx matter is on the order of $10^{-5}$ ,

Here : d + d → p(3.015MeV) + t (1.005MeV)+ 4.02MeV for conventional fusion.

One $^{12}C(n,n')3\alpha$ event needs about 100 fluence of 14MeV neutrons into CR39 track detector. This should correspond to $10^7$ neutrons of 2.45MeV by d+d reactions: This is easily to be detected, but has never been observed so.

[Case-1]: If "Dream" of the **"d+d to $^4$He + lattice energy (23.8MeV)"** were taking place, the doping tritons make "d+t to $^5$He + lattice energy" reactions, in the same path and,

- $^5$He → n(0.716MeV) + $^4$He(0.179MeV)

**14 MeV neutrons are not major products**, but **low energy neutrons (0.716 MeV)** should be detected with micro-curie/cc-$D_2O$ T-doping.

[Case-2]: Our **4D/TSC fusion model** predicts 23.8MeV/$^4$He energy deposit in PdDx lattice as major product. **Minor products of triton and higher energy neutrons** are predicted as,

- $^8$Be*(47.6MeV) → t(LT.16.2MeV) + $^5$Li(Ex) + (28.7MeV – Ex)
- $^8$Be*(47.6MeV) → n**(LT.25.1MeV)** + $^7$Be*(Ex) + (28.7MeV – Ex)

**(3D+T)/TSC** makes $^9$Be*(43.01MeV) intermediate compound state.

- $^9$Be*(43.01MeV) → $^4$He(22.53MeV) + $^5$He(18.01MeV)
- $^5$He → n + $^4$He + 0.895MeV (for $^5$He at rest)

**Neutron energy appears in 0.41 to 6.79 MeV (emitted from moving $^5$He break-up)**

- $^9$Be*(43.01MeV) → n + $^8$Be*(Ex) + (41.36MeV- Ex)

This emits neutrons in 0-36.75 MeV region.

We recall our past measurements of neutron spectra from CF-electrolysis experiments to be discussed under the above prediction.

# High energy charged particle detection during gas permeation experiment using a newly developed detector system

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Charged particle detection is most sensitive method to verify condensed matter nuclear reactions. A CR-39 track detector has been frequently used for electrolysis and desorption experiments.[1-3] However, the detector cannot give a time profile of the reaction rate, and it is difficult to get good energy calibration as well as particle identification. Furthermore, background events caused by cosmic rays and natural radio isotopes cannot be easily suppressed. In order to overcome the disadvantages, we have developed a new detector system suitable for gas permeation experiment.

An experimental setup is a similar one originally reported by the Mitsubishi Heavy Industry group for selective nuclear transmutation from Cs to Pr.[4] Although the mechanism of the transmutation has been unknown, we expect any kind of charged particle emissions spilled out through the transmutation process. We cannot use a Si surface barrier detector (SSB) in a D2 gas atmosphere because a thin p-type oxidation layer is easily reduced and the detector loses its resolution. Thus a measurement aiming at clear identification of several MeV $\alpha$ particles with a Si $\Delta$E-E counter telescope in a permeation chamber is abandoned.

We have examined various scintillation detectors and found that Cerium doped Yttrium Aluminum Perovskite ($YAlO_3$ : YAP(Ce)) is the best for the present purpose because of its good chemical stability and little dependence of light yield on the temperature. Finally, we made a scintillator phoswich consisting of the YAP(Ce) and a plastic scintillator (BC444); lights emitted in both scintillators are detected with the same photomultiplier tube. Using a difference of electrical pulse shape, one may discriminate a light emitted in the YAP(Ce) from that in the BC444. Hence, the phoswich can serve for particle identification and to decrease background events. Furthermore, in order to reduce background events more, a permeation chamber in which the phoswich detector is placed is surrounded by plastic detectors serving for vetoing cosmic rays. We applied pulse shape discrimination (PSD) technique to identify very rare events. All pulse shapes from the photomultiplier tube were recorded by a digital storage oscilloscope for off-line analyses after the experiment. Consequently, this system can identify very low reaction rate events (3 counts / day) for a several-MeV range.

By using this new detector system, we examined several samples. The measurements were carried out under $D_2$ gas permeation. Background events were measured with the same apparatus but with $H_2$ gas permeation as well as vacuum conditions. From some of the sample we observed high energy events during $D_2$ gas permeation. Although counts are few, PSD analysis provides high reliability for charged particle identification. We consider that the events detected at 20-30 MeV are candidates for emitted charged particles, most likely to be alpha particles.

In the presentation, we will report on our detection system in detail, and discuss on the results of the permeation, especially for energy spectra at a higher energy region.

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# Heat Generation by Hydrogenation of Carbon Hydride

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## Abstract

When phenanthrene (a heavy oil fraction) in hydrogen gas is subjected to high pressure and high temperature in a reactor with a metal catalyzer (a platinum screen), there occurs a markedly anomalous reaction. It produces excess heat and weak radiation, specifically x-rays and gamma-rays. After the experiment, almost all phenanthrene and hydrogen gas remain in the same condition they were initially. There are few reaction products such as other chemical compounds. However, the formation enthalpies for these compounds are all negative. The heat generation sometimes reaches 0.1 kW and has continued for several hours. There is a reasonably significant correspondence between the heat generation and the gamma emission. We have confirmed the same result with high reproducibility by controlling temperature and pressure. The anomalous energy generation cannot be the product of a conventional chemical reaction for the following reasons: At these temperatures, hydrogenation reactions are endothermic, not exothermic. The total heat release far exceeded any known chemical reaction with this mass of reactants. There is virtually no chemical fuel in the cell. There were few chemical reaction products. The components and chemical species in the cell including phenanthrene and hydrogen gas remained essentially as they were when experiment began, except that the platinum screen was coated with carbon. Gamma emissions are characteristic of a nuclear reaction. The reaction is reliably triggered by raising temperatures above the threshold temperature of ~600°C and the hydrogen pressures above 70 atm. It can be quenched by lowering the temperature inside the cell below ~600°C. When the necessary conditions are achieved, generation of heat is observed with high reproducibility. However, the amount of heat generated is not stable. Only a small amount of reactant is consumed during the experiment, presumably by conventional chemical reactions. We conclude the following: Anomalous heat generation was confirmed during heating of phenanthrene in high pressure of $H_2$ gas. Sporadic gamma emission was confirmed during high temperature experiment. A weak correlation was observed between heat and gamma ray emissions.

# Producing Elements of Mass Number 137 and 141 by Deuterium Permeation in Double Multi-layered Pd Samples with Cs Deposition

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Deuterium and hydrogen permeation experiments have an advantage of minimizing contamination to the permeation sample, which is preferably used in investigating small amount of elements. We have observed an anomalous count peak at mass number 137 by a deuterium permeation experiment [1, 2, 3]. In this present investigation, we prepared several types of multi-layered Pd pieces. The typical one consisted of five couples of CaO and Pd thin films on a base Pd foil of 0.1x12.5x12.5 mm in size. The piece had small amount of Cs on its uppermost surfaces. Two pieces of them formed a double multi-layered Pd test sample, in which the Cs was sandwiched between the two pieces. Elemental analysis on the surface with Cs was performed after deuterium permeation experiment and for control samples using TOF-SIMS.

The TOF-SIMS has revealed a marked count peaks at specific mass numbers in spectra after deuterium permeation at 70℃, only when the multilayered Pd piece had a small amount of Cs. The marked peak at mass number 137 has been observed on the multi-layered Pd piece. Furthermore, a relatively high count peak was seen at mass number 141 only when Cs was deposited. The substance with mass number 137 and 141 could be $^{137}$La and $^{141}$Pr, respectively. The substance with mass number 137 might be $^{137}$Ba. These elements would be produced during deuterium permeation by some nuclear transmutation occurring between the two multi-layered Pd pieces. The results suggest that consisting of CaO/Pd thin films on Pd foil contribute to induce production of such elements. This would imply a transmutation of 4 mass number increasing before $^{141}$Pr production [4].

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# Numerical simulation of vortex pattern appeared on electrode surface after long term electrolysis of well annealed thick Pd rod in 0.1M LiOD: Open boundary condition

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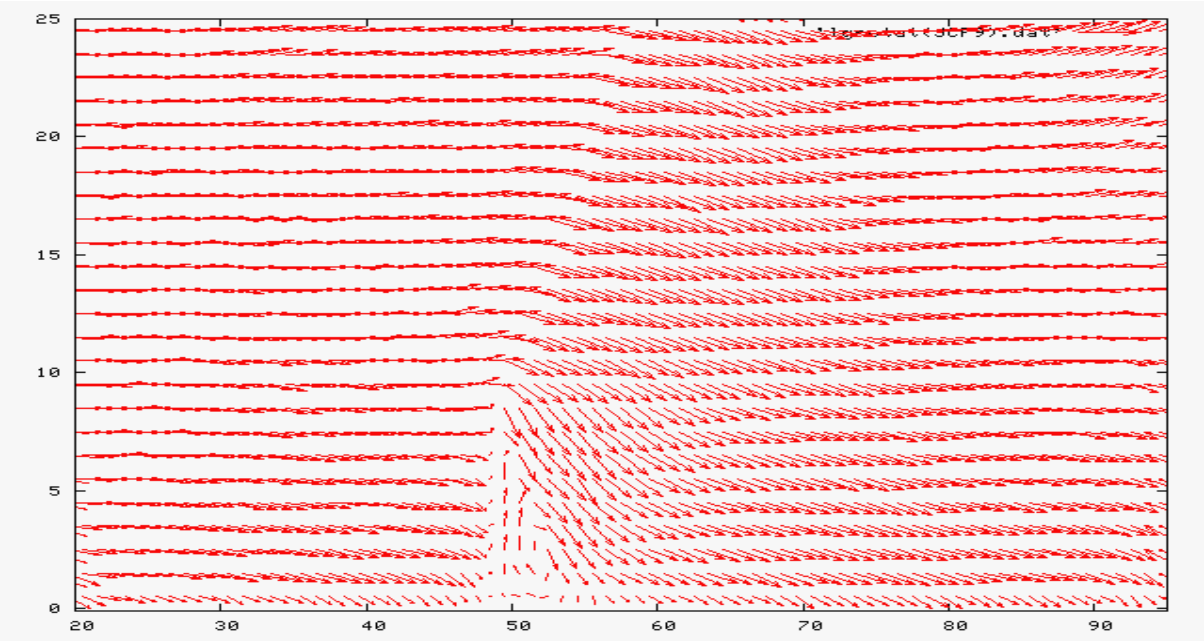
During long term electrolysis for well annealed thick Pd rod (9.0 mm dia.) in 0.1M LiOD vortex patterns were observed [1-2]. The morphology of the postelectrolysis electrodes revealed that there were appeared two long faults and several vortices on the surface. This vortex pattern was proved that the hypothetical particles mass flow coincidently through the electrode surface/electrolyte interface using Lattice Gas Cellular Automata (LGCA) numerical simulation method [3-4] ; the cascade model of vortices was proposed for simulating vortex patterns [5], however there still remained ambiguous with respect to the nature of moving particles. Our computer simulation is focused on analyzing the dynamic behaviors of these vortices and vortex threads in relation with the peculiarities observed during cold fusion experiments. It is importantly known that the conditions, i.e., boundary conditions are well satisfied for the physical conditions in the experiments performed. In this paper recent progress of PC resources (Linux platform and vectorization of program) will be presented.  Further two open boundary conditions as outflow one are compared numerically in a two-dimensional flow using LGCA method. Figure shows a vortex behind a flat plate (t = 20000 step) in the downstream (upper pressure left: inflow side and lower pressure right: outflow side); the outflow boundary condition was adopted in ghost cells adjacent to the inflow and outflow boundaries where the corresponding pressures were controlled by particle generation and disappearance conditions. The other boundary condition for the outflow boundary condition will be discussed.

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# A theoretical study on the possible change of the phonon dispersion relation due to the nuclear reaction in solid.

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**Abstract**

The phonon dispersion relation depends on the structure of the solid and the interaction between the ions in the solid [1,2]. Therefore, if the structure and interactions are changed, the dispersion curves should be changed accordingly. In this study, the phonon dispersion relation of the palladium deuteride was analyzed from the one-dimensional lattice with two ions per primitive cell. In this model, heavy ions and light ions are distributed alternatively along a line and harmonic interactions between the neighboring ions are assumed. Well known solutions of this problem are given in the textbooks [1,2]. It is a very simple model but it can give suggestive results for the replacements of the light ions. In this case heavy and light ions correspond to Pd ion and deuteron, respectively. And replacements mean nuclear reactions. We can apply this discussion to the Raman observation of the palladium deuterides [3,4].

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# Non-localized Proton/Deuteron Wavefunctions and Neutron Bands in Transition-metal Hydrides/Deuterides

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## Abstract

Using knowledge about hydrogen/deuterium wave functions in transition metals obtained in solid-state physics and in chemistry of catalysis, we discuss quantal bases of the neutron band mediated by non-local proton/deuteron wavefunctions [1, 2] introduced in the phenomenological explanation of the cold fusion phenomenon (CFP).

The non-local wavefunctions of protons/deuterons have been used successfully to understand characteristics of the hydrogen diffusion in *bcc* transition metals. It is assumed protons/deuterons form bands in their excited states which contribute diffusion in specific manner to explain the experimental data, especially in niobium where are plenty of experimental data sets. The *fcc* transition metals are, on the other hand, have different characteristics from those of *bcc* ones suggesting more diffuse wavefunctions for the protons/deuterons in them.

About the CFP, the *bcc* transition metals are ineffective to show it in contrast to the fact that it is observed in the *fcc* transition metals. We had concluded that the higher non-locality of the wavefunctions in the latter makes it possible to mediate the neutron bands in *fcc* transition-metal hydrides/deuterides to induce the CFP.

On the other hand, the knowledge about the hydrogen effects in catalysis has shown that it is necessary to assume the non-local hydrogen wavefunctions on and in the surface to explain the experimental data. The CFP observed in the hydrogen non-occlusive metals, W, Pt, and Au should has close relation with this behavior of the protons on the surface region.

Thus, the idea of the neutron band mediated by non-local proton/deuteron wavefunctions introduced into our phenomenological explanations of the CFP has strong supports from knowledge of diffusion behavior in metals and hydrogen effects on catalysis on and in the surface region.

A preliminary calculation of matrix elements related with the neutron bands mediated by the non-local proton/deuteron wavefunctions will be given.

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