The 16th Meeting of Japan CF-Research Society

JCF16 ABSTRACTS

December 11-12, 2015

Kyoto University, Higashi-Ichijokan

Japan CF-Research Society

Program of JCF16 Meeting

Japan CF-Research Society

Date:	December 11-12, 2015
Place:	Kyoto University Higashi-Ichijokan, Kyoto, Japan
Paper presentation:	Oral presentation 20 min. (Review: 35 min) + Discussion 5 min.
Language:	English or Japanese
Book of Abstract:	Only available at JCF home page (http://jcfrs.org/)

December 11 (Fri), 2015

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

13:00-13:10 **Opening Address** E. Yamaguchi (Kyoto U.)

Session-1 *Chairman: Y. Iwamura (Tohoku U.)*

13:10-13:35 **JCF16-1** A. Kitamura et al. (Technova Inc., Kobe U.)
Heat evolution from zirconia-supported Ni-based nano-composite samples under exposure to hydrogen isotope gas

13:35-14:00 **JCF16-2** T. Hioki et al. (Nagoya U.)
Stability of Nano-Pd Particles Dispersed in Mesoporous Silicas under Hydrogen Atmosphere

14:00-14:25 **JCF16-3** T. Mizuno et al. (Hydrogen Eng. A&D Co.)
Thermophysical analysis of anomalous heat generation (AHG) reaction between metal and hydrogen

14:25-14:50 **JCF16-4** S. Kataoka et al. (Iwate U.)
Deuterium desorption experiments using multi-layered metal samples with fine-structured surface

14:50-15:10 ***Break***

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

15:10-15:35 **JCF16-5** T. Itoh et al. (Tohoku U., CLEAN PLANET Inc.)
Anomalous Heat Generation Experiments at Condensed Matter Nuclear Reaction Division of Tohoku University

15:35-16:00 **JCF16-6** Y. Iwamura et al. (Tohoku U.)
Preliminary Results on Identification of Pr by Rutherford Backscattering Spectrometry and Transmutation of Pd using Deuterium Gas Permeation Method through Nano-Structured Pd Multilayer Thin Film

16:00-16:25 **JCF16-7** N. D. Cook (Kansai U.)
A Hypothesis Concerning the Connection Between the "Mössbauer Effect" and the "Rossi Effect"

16:25-17:05 **JCF16-8** A. Takahashi (Technova Inc., Osaka U.)
Chaotic End-State Oscillation of 4H/TSC and WS Fusion

17:15-17:45 **JCF Annual Meeting**

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

December 12 (Sat), 2015

Session-3 *Chairman: A. Kitamura (Technova Inc., Kobe U.)*

9:30 - 9:55 **JCF16-9** K. Tanabe (Kyoto U.)
A Chemical Approach to Model the Deuterium Dynamics and Heat Generation on Palladium

9:55 -10:20 **JCF16-10** K. Tsuchiya (NIT, Tokyo College)
Convergence Aspect of the Self-consistent Calculations for Quantum States of Charged Bose Particles in Solids II

10:20 -10:45 **JCF16-11** H. Miura
Computer Simulation of Hydrogen Phonon States in Face Centered Cubic Lattice Metals

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

Session-4 *Chairman: H. Numata*

11:00-11:25 **JCF16-12** K. Tanabe (Kyoto U.)
Laser- and Plasmon-Enhanced Condensed Matter Nuclear Fusion: Proposals and Analysis

11:25-11:50 **JCF16-13** H. Kozima (Cold Fusion Research Lab.)
From the History of CF Research – A Review of the Typical Papers in the Cold Fusion Phenomenon –

11:50-12:15 **JCF16-14** H. Kozima (Cold Fusion Research Lab.)
The Cold Fusion Phenomenon and Neutrons in Solids

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

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

13:30-13:55 **JCF16-15** H. Numata
Advanced LGCA simulation for cascade vortices underbeneath of the electrode surface

13:55-14:20 **JCF16-16** T. Sawada (Nihon U.)
What is the nuclear active environment of the cold fusion

14:20-14:45 **JCF16-17** H. Kozima (Cold Fusion Research Lab.)
Nuclear Transmutations in Polyethylene (XLPE) Films and Water Tree Generation in Them (2)

14:45-15:10 **JCF16-18** H. Kozima (Cold Fusion Research Lab.)
Biotransmutation as a Cold Fusion Phenomenon

Adjourn

Heat evolution from zirconia-supported Ni-based nano-composite samples under exposure to hydrogen isotope gas

A. Kitamura*[1,2], E. Marano[4], A. Takahashi[1,3], R. Seto[1],
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Ni-based nano-composites supported by zirconia, $Pd_{0.044}Ni_{0.31}/ZrO_2$ ("PNZt") and $Cu_{0.044}Ni_{0.31}/ZrO_2$ ("CNZt"), were fabricated in Department of Chemistry, University of Torino. Absorption runs for these samples were performed in Graduate School of Maritime Sciences, Kobe University, using the scaled-up system C_1 with a 500-cc chamber equipped with a flow calorimeter with an oil coolant with a boiling point of 390 °C [1 - 3]. The net amount of Ni was 6.4 g in the PNZt sample, and 9.2 g in the CNZt. In addition, STEM/EDS analyses before and after the absorption runs were made using the facility in CSREA (Center for Supports to Research and Education Activities), Kobe University.

Anomalously large absorption / adsorption (sorption) energy of $(1.6\pm0.2)\times10^{1}$ eV/atom-Pd or (2.3±0.9) eV/atom-D in the initial phase of the #1 run with D_2 at room temperature was observed. If Ni is taken into account as the absorbent element, a rather plausible value of 2.0±0.3 eV/atom-M (M stands for both Pd and Ni) is obtained, which means that Pd atoms act as a catalyser for deuterium absorption of Ni. The large sorption energy was repeatable with about $(6 - 9)\times10^{-1}$ eV/atom-M in D-PNZt#2 through H-PNZt#4 runs.

In the elevated temperature (200 – 300 °C) phases, on the other hand, excess temperature of 15 – 16 °C corresponding to conservatively evaluated excess power of 11 – 12 W (or 1.3 - 1.5 W/g-Ni) was recorded repeatedly in both PNZt and CNZt sample runs with both H and D. The detailed description including the result of the STEM/EDS characterization will be given in the presentation.

[1] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike, Y. Furuyama; Proc. JCF14 (2014) 1-13.
[2] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike, Y. Furuyama; J. Condensed Matter Nucl. Sci. 15 (2015) 231-239.
[3] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike, Y. Furuyama; Proc. JCF15 (2015) 1-19.

Stability of Nano-Pd Particles Dispersed in Mesoporous Silicas under Hydrogen Atmosphere

Yoshiki Ichikawa[1,] Tatsumi Hioki[2], Noriaki Sugimoto[3], Akihisa Ichiki[2]
and Tomoyoshi Motohiro [1,2,3]

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The behavior of hydrogen isotopes in metals, particularly in Pd, Ni, and their alloys, has been of great interest concerning the low energy nuclear effects in condensed matter as well as from the perspective of modern demand of renewable energy. It has been believed that a high amount of deuterium, D/Pd > 0.88, is required to be loaded in Pd to generate excess heat effect with the electrochemical loading technique. The hydrogen absorption properties in bulk metals and alloys have been studied extensively. In the gas charging technique, the D/Pd value for bulk Pd does not exceed 0.88 in the normal conditions of gas pressure up to about a few 10 MPa. The use of nano-sized Pd particles has attracted attention because nano-sized Pd particles are believed to be able to absorb much larger amount of hydrogen than bulk Pd. However, hydrogen absorption properties of nano-sized metallic particles has not yet been cleared well. Some literatures on Pd reported that nano-sized materials can absorb hydrogen more than bulk materials [1], and some others reported opposite [2]. A reason of these contradictory results is considered to arise from the fact that the particle size of nanoscale materials generally become bigger upon exposure to hydrogen. It is therefore important to suppress the grain growth of metal particles associated with exposure to hydrogen to clarify their hydrogen absorption property.

In this study, we prepared meso-porous silicas (MPS) with a pore size of 1.8nm dispersed with a variety of Pd concentration. In these systems, some Pd particles are expected to occupy the space inside the pore of MPS and these particles are expected hard to grow upon exposure to hydrogen. The pore size of MPS is controllable, and the effect of pore size on the growth of Pd particles with exposure to hydrogen can be examined. In the hydrogen loading process, heat of absorption is generated and it causes the growth of the nano-particles.

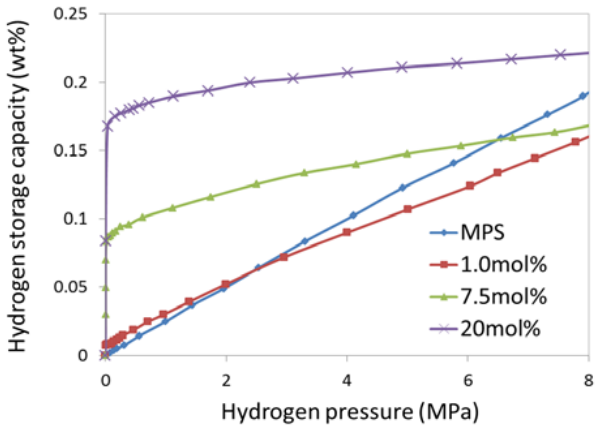

Fig.1 Hydrogen storage capacity vs hydrogen pressure

Results of hydrogen absorption capacity for some samples of MPS doped with different concentration of Pd are shown in Fig.1. The hydrogen absorption capacity at a pressure close to zero arises from the Pd particles and the capacity at 8MPa arises from both the Pd particles and the matrix of MPS. From the value near zero pressure, it was found that the H/Pd value was dependent on the concentration and different from the bulk value: in the samples of higher Pd concentration, the H/Pd value was similar to the bulk value and in the samples of lower concentrations, the H/Pd value was about 0.4 which was significantly lower than the Pd bulk value.

References

[1] S. Kishore et al., J. Alloys Compd. 389**,** 234-242 (2005).
[2] M. Yamauchi and H. Kitagawa, Synthetic Metals, 153, 353-356 (2005).

Thermophysical analysis of anomalous heat generation (AHG) reaction between metal and hydrogen

Tadahiko Mizuno (HEAD Co.) Hideki Yoshino (C. P. Company LTD.)

We have developed a strict method of measurement and analysis to confirm AHG between hydrogen and metal. The factors involved in the energy analysis are electricity, mass (heat capacity), thermal conductivity, mechanical and thermal radiation. These contribute the most to heat analysis and can be easily estimated using matrix equations to calculate unknown quantities. We describe the results of the AHG experiment and the methods of thermal calibration within the framework of our chosen measurement system.

To confirm AHG, we elected four factors that contribute to positive heat values: input power, ambient temperature, temperature of the reaction system, and pump temperature. For simplicity, we neglected heat losses from radiation or evaporation of the recirculating water. We estimated that an even larger heat generation would result from incorporating these heat losses into the calculation. The observed value of ratio of heat out and input (H_{out}/H_{in}) was less than unity for the plasma discharge test. The value of excess heat could be estimated from the input energy that was consumed by the chemical reaction during the plasma discharge.

We can compare the AHG test with the calibration and to obtain the mathematically proven that abnormal heat was produced because the correlation coefficient R of the calibration data was very high as 0.9996. We limit out focus to the range of input was from 40 to 50 W; there are 10 calibration data sets and 20 AHG data sets in this range. We use Welch's *t*-test to compare the average value of the H_{out}/H_{in} for the experimental tests with the calibrations to determine whether there is a statistically significant difference between the two results.

Null hypothesis: H_0, the average value of H_{out}/H_{in} is equal for the test and control data sets.

Alternative hypothesis: H_1, the average value of H_{out}/H_{in} for the test data set than is larger than that for the control data set.

From the significant difference test results, when it is the critical region 1%, the P-value (one side) is many orders of magnitude smaller than 0.01, and the *t*-value is much larger (10.81) than the *t*-boundary value. Further, we reject the null hypothesis; the average value of the test data is greater than the calibration data with 99% accuracy.

We confirmed the occurrence of AHG through experiments and mathematical analysis. We measured excess heat was 10 W at input was 40 W; we estimated that the specific AHG was 0.3 W/g **(**on the basis of the mass of the Ni reacting material) and 30 mW/cm (on the basis of the surface area of Ni). This excess heat generation was calculated by a rigorous thermal analysis. Until now, AHG was confirmed due to its low experimental reproducibility and disagreement with theory; however, this study definitively confirmed AHG. This finding is a significant advancement with important ramifications. Further research is needed to elucidate the theory and mechanisms underlying this phenomenon. Varying different parameters, such as the reactant gas, we will be able to develop methods for controlling the process and harnessing the phenomenon for practical applications. We plan to conduct even stricter thermal analyses in the future and to broaden the scope of parameters evaluated.

Deuterium desorption experiments using multi-layered metal samples with fine-structured surface

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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 property of Ni in deuterium diffusion. Considering the specific conditions of the experiment, we performed deuterium desorption experiments using multi-layered Pd-Ni complex samples and investigated the thermal and deuterium diffusion behavior. In the experiment, samples with a fine-structured interface of two metals were examined to investigate the dependence of the deuterium desorption behaviors on the surface condition, and we have observed curious behavior of sample temperature in the deuterium desorption process [2].

In general, metals are classified into exothermic and endothermic absorbers of hydrogen. Ni as well as Ag, Au, Pt, and Cu are classified as endothermic absorbers. If deuterium diffusion in the interface region of the binary metals has a significant effect on the thermal dynamics, we may expect similar behavior for a binary metal of Pd and an endothermic metal. Then, we have tested a multi-layered Pd-Ag complex and checked if the same phenomenon was observed. On the other hand, Ti is classified as an exothermic absorber, and a Pd-Ti multi-layered sample may show different thermal behavior in deuterium diffusion.

In this paper, we report the thermal behavior in deuterium desorption for the Pd-Ni, Pd-Ag, and Pd-Ti multi-layered sample, and discuss the association with deuterium diffusion process and thermal dynamics for each sample, systematically.

Reference

[1] A.Kitamura *et al.*, Proc of JCF15 (2015) 1.
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Anomalous Heat Generation Experiments at Condensed Matter Nuclear Reaction Division of Tohoku University

Takehiko Itoh[1,3], Yasuhiro Iwamura[1], Jirohta Kasagi[1], Tadahiko Mizuno[2], Hideki Yoshino[3], Masanao Hattori[3] and Hidetoshi Kikunaga[1]

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A new division devoted to Condensed Matter Nuclear Reaction (CMNR) established at the Research Center for Electron Photon Science of Tohoku University in April, 2015. For the study on anomalous heat generation, an experimental apparatus introduced in our lab was based on the experimental device and method developed by Mizuno [1]-[2].

His experimental process is as follows. First, Ni metal was heated under vacuum condition and D_2 gas was introduced into the chamber. The Ni mesh was subjected to the plasma discharge and cooled down. This process was repeated 4 or 5 times to create the nano–structured Ni surface. After this activation process, D_2 gas, at about 100~300 Pa, was introduced at 200^{o}C, and then excess heat generation was observed.

We have already set up the experimental apparatus and carried out some calibration runs. Now we are in the stage of fabrication of nano‑structured Ni surface. Status of current experiments will be presented at JCF16.

Presently, we are planning to develop a new method for anomalous heat generation based on both Mizuno's method and our transmutation method which was induced by gas permeation [3]-[5]. It is very important to measure precisely the released heat precisely as well as to evaluate correct input power. We would like to develop a precise heat evaluation apparatus for energy generation by FY2016. The new method for anomalous heat generation will be developed using it.

References

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[3] Y. Iwamura, T. Itoh and S.Tsuruga, *Current Science*, Vol. 108, NO. 4, p.628-632, 2015.
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[5] Y. Iwamura, T. Itoh, N. Gotoh and I. Toyoda, *Fusion Technology*, Vol.33, p.476-492, 1998.

Preliminary Results on Identification of Pr by Rutherford Backscattering Spectrometry and Transmutation of Pd using Deuterium Gas Permeation Method through Nano-Structured Pd Multilayer Thin Film

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Condensed matter nuclear transmutation reactions induced by D_2 gas permeation have been reported by MHI group [1]-[4] for nano-structured Pd multilayer film composed of Pd and CaO thin film and Pd substrate. Those so far observed are of Cs into Pr, of Ba into Sm, and of W into Pt. Although replication experiments were also reported by other groups [5]-[7], the phenomenon has not yet be understood completely up to now. Therefore, more experimental evidence for the occurrence of nuclear transmutation is required.

Transmutation of Cs into Pr was observed by XPS（X-ray Photoelectron Spectroscopy), ICP-MS（Inductively Coupled Plasma Mass Spectrometry), XRF（X-ray Fluorescence analysis), SIMS（Secondary Ion Mass Spectrometry) and TOF-SIMS（Time of Flight Secondary Ion Mass Spectrometry)[1]-[4]. XPS and XRF are the analysis methods utilizing the information of an electron orbit of an element. ICP-MS, SIMS and TOF-SIMS are analysis techniques for identifying the mass number of an element.

In the present work, we applied RBS (Rutherford Backscattering Spectrometry), for the first time, to the D_2 permeated Pd multilayer thin film on which Pr was detected by ICP-MS. Since RBS is based on a different principle from the above analysis methods, effects of chemical bonding and compound spices for identification of Pr are completely negligible.

The first experiment was performed at MALT (Micro Analysis Laboratory, Tandem accelerator,The University of Tokyo) and the second experiment was done at CYRIC (Cyclotron and Radioisotope Center, Tohoku University). Due to the shortage of beam time, only preliminary data could be obtained. However, they suggest the existence of Pr on the D_2 permeated Pd sample. Thus, we are now planning the third and fourth RBS experiments to obtain more convincing results.

The other work is on the transmutation experiments using stable isotopes. Final target isotopes in ImPACT program are ^{107}Pd, ^{135}Cs, ^{79}Se, ^{93}Zr. We observed some indications on the transmutation of stable Pd, although further study is required.

This work was funded by ImPACT Program of Council for Science,Technology and Innovation (Cabinet Office, Government of Japan). Program name is “Reduction and Resource Recycle of High Level Radioactive Wastes with Nuclear Transmutation”[8].

References

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[8] http://www.jst.go.jp/impact/en/program08.html

A Hypothesis Concerning the Connection Between the "Mössbauer Effect" and the "Rossi Effect"

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In order to explain the "anomalous heat" generated by Andrea Rossi's E-Cat (the "Rossi Effect"), I propose a mechanism based on the Mössbauer Effect and involving gamma ray resonances among nuclei. I hypothesize that the emission of gamma rays from low-lying excited-states of Mössbauer isotopes (e.g., ^{57}Fe, ^{61}Ni and ^{183}W, that are contained in the E-Cat "fuel") can induce resonances at relatively high-energies in non-Mössbauer isotopes (e.g., ^{27}Al, ^{55}Mn, ^{58}Ni, ^{60}Ni, and ^{62}Ni) as a consequence of the overlap of transition energies at much higher nuclear levels. Resonances at energy levels higher than those of the Mössbauer Effect itself lead to a cascade of gamma emissions, as the excited states of the resonating non-Mössbauer nuclei de-excite through multiple steps leading toward their ground-states. Significant heat production is a consequence of the kinetic energy of the gamma emissions.

The hypothesis consists of three distinct parts: The Mössbauer Effect (i) itself is a well-known phenomenon in which one isotope (a Mössbauer isotope with a low-lying excited-state) emits a gamma ray to excite an identical Mössbauer isotope to the same excited-state with no loss of energy. It is known to provide a link between quantum events and macroscopic physics. The Expanded Mössbauer Effect (ii) is a generalization of the Mössbauer Effect to include the gamma ray resonance between a Mössbauer isotope and a non-Mössbauer isotope that, by chance, exhibit transition energies between nuclear levels of (nearly) identical magnitude to one another (<180 keV), but at very different nuclear level energies (<180 keV vs. several MeV). It is a hypothetical resonance phenomenon, but is related to the known phenomenon of "induced gamma emission" (IGE or "stimulated gamma emission"). Although IGE contains no "new physics" of unknown character, it awaits confirmation in the context of LENR. Finally, the so-called Rossi Effect (iii) is the generation of heat due to the de-excitation of non-Mössbauer isotopes from their relatively-high excited-states to their ground-states through a cascade of low-level gamma ray emissions (generally <100 keV) following the "selection rules" for isomer decays that are well established in nuclear structure physics. The generation of heat through the kinetic energy imparted by the gamma radiation in the E-Cat device is the mechanism through which initially low-energy Mössbauer quantum events are transformed into the heat of macroscopic classical physics.

Chaotic End-State Oscillation of 4H/TSC and WS Fusion

Akito Takahashi

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What is nuclear mechanism of AHE (anomalous heat effect) by Ni-H systems? The WS fusion of 4H/TSC_condensation/collapse is a candidate model[1]. To enhance WS fusion rate, life time of collapsed state is of key factor: more than 1.0E-15 s (1 fs) is expected.

The 4H/TSC collapse should stop at Rpp = 2.4 fm due to hard core of proton. What happens after that? Oscillation? Effective life time? Simulation study has been done by the D(H)-cluster Langevin code. Various conditions were tried for the end-stage of collapse motion:

1) Time dependent pseudo-potential for TSC trapping
2) Fix-up of Rpp >= 2.4 fm
3) Taking relativistic effect for electron state (imitating so called DDL component)

Near Stable Oscillations (may last > 1fs) were found for 4H/TSC with Vs1(m, 1.41) potentials for a wide band of parameters (BA, SGDL, AW).

An example of simulation is shown in Figure-1 below.

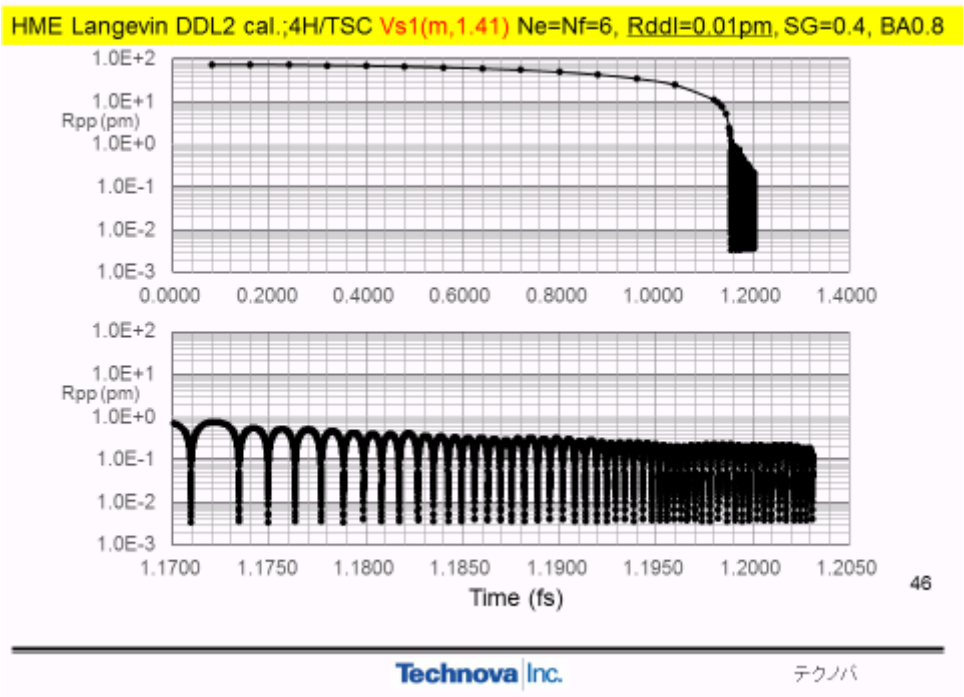

Fig.1: Simulation of 4H/TSC condensation/collapse motion with DDL effect

1) Akito Takahashi: Physics of Cold Fusion by TSC Theory, J. Phys. Sci. Application, 3(3) (2013) 191-198

A Chemical Approach to Model the Deuterium Dynamics and Heat Generation on Palladium

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We model the dynamics of H and D adsorbed on Pd nanoparticles including the heat generation induced by the chemical adsorption and desorption, as well as Pd-catalyzed reactions. The model of the time-evolution of the Pd surface and inner coverage by H and D is formulated by simplifying the phenomenon of adsorption and desorption of the gas molecules on and in the Pd nanoparticles. In this study, we model the experimental results of H_2 and D_2 injection into a composite material containing Pd nanoparticles reported in Ref. 1. A Langmuir-type adsorption–desorption mechanism is assumed. We adopt the most commonly accepted two-body D–D nuclear fusion reaction [2,3]. Our series of formulations is summarized as a set of differential equations describing the H/D storage filling factor ξ_a and temperature T evolutions:

$$\frac{d\xi_a(t)}{dt} = \ _a\{k-\xi_a(\ )\}\{J+\xi_a\ (t)\}k_d\xi_a\ t \qquad \frac{dT(t)}{dt} = h_{a-d}\frac{d\xi_a(t)}{dt} + h_{reac}(T)\{\xi_a(t)\}^2 - h_{diss}\{T(t)-T_0\}$$

k_a and k_d are the adsorption-and-absorption and desorption rate constants, respectively. J_{in} is the H_2 or D_2 gas injection flow rate into the reactor chamber. $h_{a\text{-}d}$, h_{reac}, and h_{diss} are coefficients for the heat generation or dissipation by the chemical adsorption and desorption, D_2 nuclear reaction and conductive heat dissipation.

Our model calculation well reproduces both the experimental P and T results with a single set of fitting parameters as seen in the Figures, and the nontrivial P and T behaviors are explained in terms of ξ_a, as the details will be discussed in the conference. This model provides a basis in the field of solid-state fusion for the evaluation and optimization of the operational performance with respect to the system structures and reaction conditions.

We would like to thank Arata Research and Development Center, Osaka University for their suggestion on the importance of a formulation of their experimental results.

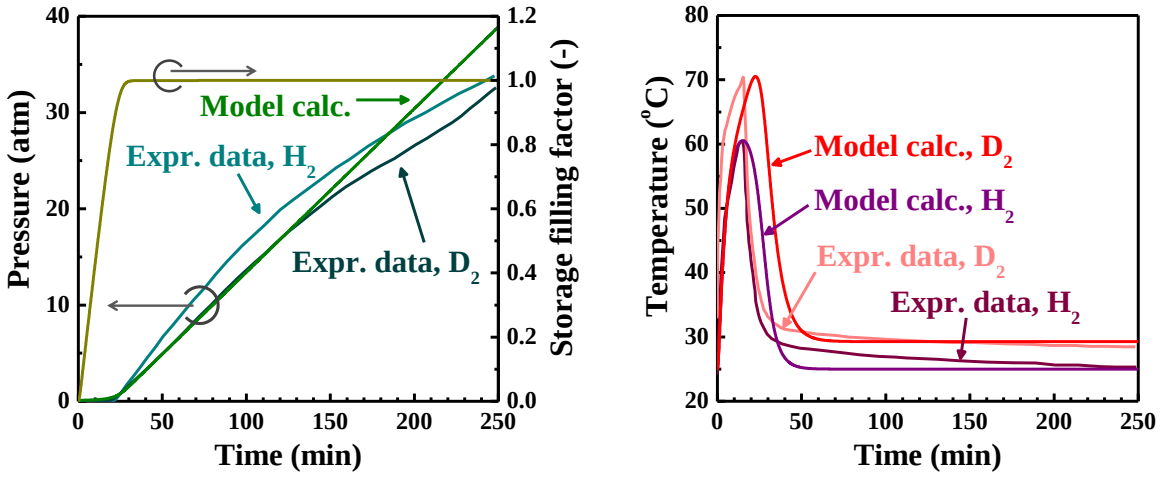

Fig. Experimental and calculated time-evolution of the (left) pressure and (right) temperature for the H_2-Pd and D_2-Pd systems.

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

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Abstract

In our previous works [1-3], we proposed the theoretical methods in order to investigate the nuclear reactions between charged bose particles in solids by using self-consistent calculations. Especially in ref.3, we showed that the rapid convergences were obtained for the case of strong trapping potentials of ion traps.

In this study, we explain the relations between the real stable sites in solids and the bottoms of ion traps with spherical symmetry.

References

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3. Ken-ichi TSUCHIYA and Sommy KOUNLAVONG, "Convergence Aspect of the Self-consistent Calculations for Quantum States of Charged Bose Particles in Solids", Proc. of JCF15, pp.91-99

Computer Simulation of Hydrogen Phonon States in Face Centered Cubic Lattice Metals

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We simulated the hydrogen (H) phonon states in face centered cubic (FCC) lattice metals such as nickel (Ni), palladium (Pd), cupper (Cu) and so on by using a quantum molecular dynamics on personal computers, in order to examine what conditions gather H or deuterium (D) atoms in condensed matter like a Pd metal to cause nuclear fusion or nuclear transmutation.

We used a computer simulation program based on Density Functional Theory of the local density approximation using a plane-wave basis and pseudo-potentials. We calculated the phonon energy of the bulk FCC lattice metals of the conventional 1x1x1 cubic unit cell, being imposed periodic boundary conditions. The lattice was perfect composed of four atoms of one kind of FCC lattice metals or defective with a vacancy, and it occluded H atoms on all O sites or all/half T sites with or without an impurity atom such as H, lithium (Li), potassium (Na) and so on.

We investigated the phonon energies at Gamma, X, M and R-point in the reciprocal phonon wave-vector space. In the last study, we have observed that the Pd metal lattice has zero phonon energy at Gamma-point and negative square phonon energy at X, M or R-point. It shows us the Pd metal lattice might be nearly structurally stable for the phonon vibration when it occludes H atoms not only on all O sites or all/half T sites but also on those around the vacancy. Especially even when impurity H atom enters an O site or impurity Li atom enters an O site or vacancy, the Pd metal lattice with occluded four H atoms on the half T sites is nearly structurally stable for the phonon vibration. In this time, we observed that among the perfect metals the Ni metal behaved most similarly to the Pd metal in the phonon vibration. On the other hand, among the defective metals with too much 1/4 vacancies of lattice atoms all the other FCC lattice metals like Ni and Cu looked to behave similarly to the Pd metal lattice in the phonon vibration. We will study whether these four H (D) atoms occluded on the half T sites in the defective Pd, Ni or Cu metal and Ni alloy or Cu alloy with fewer vacancies would proceed to the condensation to cause nuclear fusion or nuclear transmutation.

Laser- and Plasmon-Enhanced Condensed-Matter Nuclear Fusion: Proposal and Analysis

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We propose and numerically investigate a scheme to provide high-density optical or electromagnetic energy to fusion-fuel materials. The incident electric power onto Pd samples in liquid and gaseous systems reported has been generally around 1 W/cm^2 or less. Semiconductor or solid-state (e.g., YAG) lasers, on the other hand, are able to strike power densities several orders of magnitude greater. This approach aims an initial local ignition of nuclear fusion reaction enabling the generated heat there to trigger subsequent reactions throughout the fuel material. Moreover, the plasmonic field enhancement effect induced by metal nanoparticles can concentrate the incident optical energy even further, as follows. The top figures show field enhancement factors, the local energy ratio between the cases with and without the object, around spherical metal nanoparticles calculated under the quasistatic-limit approximation valid for subwavelength-scale particulates. Nanoparticles of Pd etc. thus concentrate optical or electromagnetic energy in their vicinity like antennae. The bottom figures show field enhancement factors for Ag/SiO_2 nanoshells, concentric spherical particles with SiO_2 cores and Ag shells, on shell-to-core diameter ratio *f*. We can take the advantage of such gigantic energy concentration and resonant-frequency tunability with *f*, for instance by simply coating fuel materials with metal nanoshells. Note that this metal-nanoparticle/shell-induced energy concentration scheme is applicable not only with lasers but also for electrolysis-type fusion, since the electromagnetic field enhancement is equivalent for both systems.

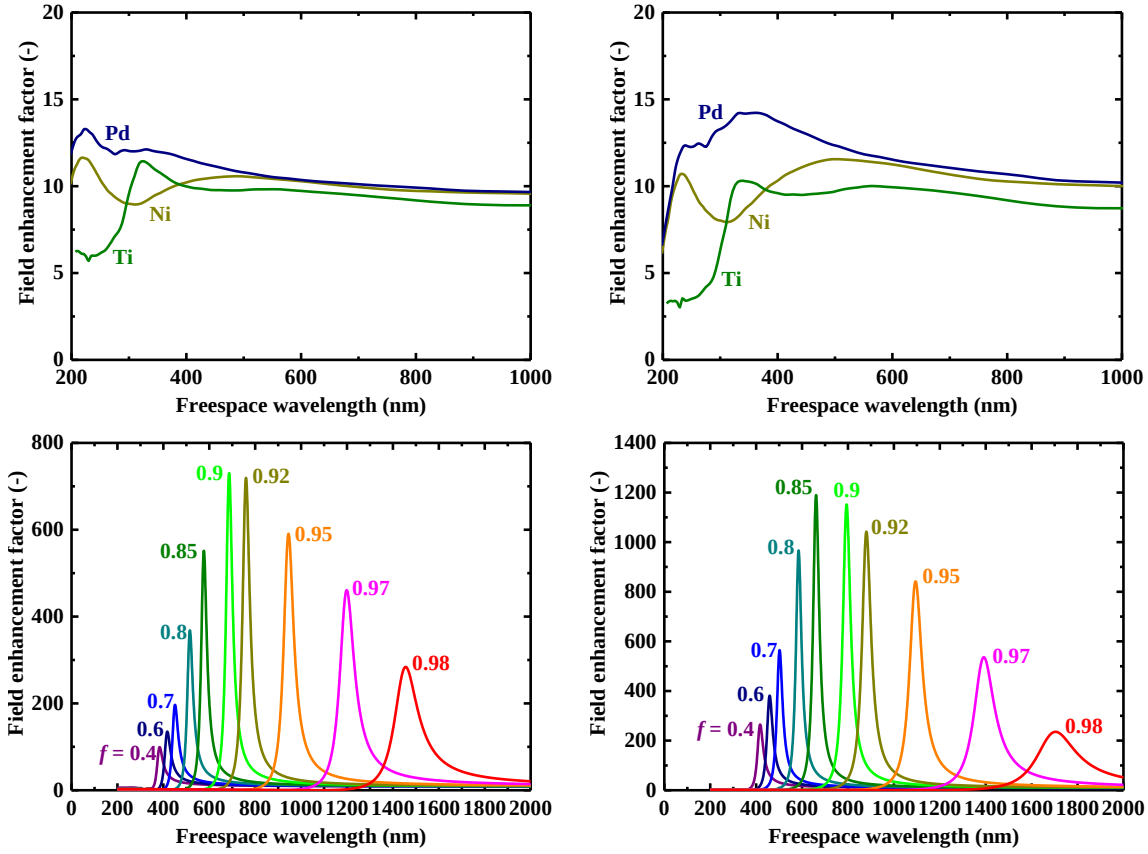

Fig. Field enhancement factors of (top) metal nanoparticles and (bottom) Ag/SiO_2 nanoshells in (left) D_2 and (right) D_2O.

From the History of CF Research – A Review of the Typical Papers in the Cold Fusion Phenomenon –

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Abstract

The investigation of the cold fusion phenomenon (CFP) has lasted more than a quarter of a century after 1989 when it was discovered without remarkable success in innovation of the paradigm of modern science. Recent trend of the CF research seems shifting to the application of the CFP leaving the fundamental problem how to explain this curious phenomenon consistently in the frame of modern physics. We have tried to investigate the CFP in accordance with the common sense of modern science established mainly in 20th century. To do so, we emphasized importance of communication with other scientists working in the established fields of science. The communication has been given several times in the history, especially in the case of the investigations of the CFP by committees in the DOE as discussed in our papers[1)]. Another point we would like to emphasize and to give a review in this paper is a big regard for the past experimental results piled up in these more than 25 years. The first measurement of the energy spectrum of neutrons was performed by S.E. Jones et al. (1989). On the detection of $^{4}_{2}$He**,** we have to consider the work by Morrey et al. (1990). The first data of nuclear transmutation in a protium system was obtained by R.T. Bush and R.D. Eagleton (1993, 1994). The most extensive measurement of excess energy was performed by M.C.N. McKubre et al. (1993, 1994). M. Okamoto et al. (1994) determined the localized nuclear reactions in the CFP for the first time. There are several astonishing data sets on the nuclear transmutations (NTs) in such systems very different from the main CF materials (transition-metal hydrides and deuterides) as carbon-hydrogen systems including hydrogen graphite, XLPE and microbial cultures. To give a unified explanation of them, we have to investigate them correctly and contemplate sincerely.

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The Cold Fusion Phenomenon and Neutrons in Solids

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Abstract

The cold fusion phenomenon (CFP) has been investigated for more than a quarter of a century after its discovery by Fleischmann et al. in 1989. Looking into the various products of the CFP, it is clear that there are nuclear reactions in the CF materials (PdD_x, NiH_x, CH_x, etc.) with no acceleration mechanisms. We have tried to get overall perspective of the CFP using a phenomenological model (TNCF model) based on several premises referring to the experimental facts[1)]. The TNCF model has been successful to give qualitative and sometimes quantitative explanations to the numerical relations between data of observables with appropriate values of the single adjustable parameter n_n, the density of quasi-stable neutrons assumed in CF materials. Then, the origin of the trapped neutrons in CF materials has been contemplated to give a quantum mechanical foundation to the model[2)]. In the process of this contemplation, the ideas of the neutron band in the CF materials have been developed[1)] by the quasi-free neutron model and by the tight-binding neutron model. The concept of the former model is used in the ultra-cold neutron physics[3)] even if the neutrons in the band decay with the life-time of 889 ±3 s. It is shown in this paper that the neutrons in the latter model are free from the beta decay and are the candidate for the trapped neutrons in the TNCF model.

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Advanced LGCA simulation for cascade vortices underbeneath of the electrode surface

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Abstract: During long-term electrolysis for well annealed thick Pd rod (9.0 mm Φ) 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 underbeneath 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. So far, we have succeeded in obtaining, though not precise a vortex pattern and their cascade [5]. Meanwhile, we have developed a PC simulator which elucidates the physical rule underlying the CF phenomenon through the simulation of the motion of the hypothetical particles mass flow.

Up to now, we have done the following PC simulation;

- Single vortex and two vortices patterns formed by 2D Lattice Gas Cellular Automata (LGCA) simulation where PC simulation was performed using C on Linux
- Evaluate the magnitude of magnetic field at adhered babbles on the electrified Pd surface
- Significant property of cyclonic vorticity [6]

In this study, we have learned more robust and/or net compatible PC languages Java and C# on Windows, instead of C. First, we use Java to C# conversion soft 'Sharpen' (plugin to Eclipse 5.4) followed by an adjustment of automatically converted stuff.

The converted C# program is primitive one; evolving a vortex in 2D space, then further work will be devoted to simulate a real phenomenon. For this purpose numerous obstacles are regularly distributed in a rectangular domain. Under such circumstance the flow of the hypothetical particles mass would be appeared in a planed pattern; many continued vortices (vortex threads).

The progress of PC simulation work and unsolved issues will be presented.

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What is the nuclear active environment of the cold fusion

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In the big bang theory, it is believed that the magnetic monopoles are produced abundantly. However because of the rapid expansion of the space, the monopole density decreases rapidly, and so today the monopoles are the rare particle. We shall consider the nuclear physics in the external magnetic Coulomb field produced by the magnetic mono poles. Because of the charge quantization condition of Dirac *ee/ħc=1/4, in which $*e^2/\hbar c=137/4$ is the magnetic counterpart of the fine structure constant $e^2/\hbar c=1/137$. The additional interaction term of the deuteron in the magnetic Coulomb field is $H'=\kappa\,(e/2m)\,*e/r^2$ whose strength is the order of the strong interaction. The binding energy B of the ground state of the d- *e system is B=2.3 MeV., and the wave function is the hedge-hog type, in which spin of the deuteron points outward spherically.

When two deuterons are trapped by the same magnetic monopole whose orbital radius is several fm. , the deuterons must fuse to become more stable He(4). Since the spin of He(4) is zero, it cannot be trapped by the monopole. It must simply leave the monopole. This is simplest nuclear cold fusion. Another important consequence of the nuclear reaction is that the channels d + d →t+p and d + d → He(4)+n are closed energetically. This is because the energy level of the d+d+*e level is 2(B - 2.2MeV.) in which 2.2 MeV. is the binding energy of n and p, and B=-2.2MeV. is the binding energy of d+*e. So the lowest binding of d+d+*e system is 2. (B - 2.2) MeV.=9.0 MeV. On the other hand the binding energies of the t and He(3) are 7.7 MeV. And 6.5 MeV. Respectively. Therefore it is energetically impossible to transit to t+p or He(3)+n channels from the ground state of *e+d+d.

Nuclear Transmutations in Polyethylene (XLPE) Films and Water Tree Generation in Them (2)

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Abstract

The cold fusion phenomenon (CFP) includes various events predicting nuclear reactions in such various materials (CF materials) as PdD_x , NiH_x and XLPE containing a lot of hydrogen isotopes H or/and D. The CF materials include such astonishing materials as biological systems and the polyethylenes, which is the material we investigate in this paper. As we have investigated before[1,2], Kumazawa et al. detected various new elements in the XLPE (crosslinked polyethylene) films dipped in aqueous electrolytic solutions with and without application of high-frequency electric field. The experimental data had been explained by us using the TNCF model consistently with other data of nuclear transmutations observed in CF materials with transition metals. In the investigation of the cause of gamma rays observed in XLPE experiments, Kumazawa et al.[3] determined the origins of the gamma rays as nuclei ^{214}Pb and ^{214}Bi. Using the TNCF model, we could explain the new data obtained by Kumazawa et al.[3] in accordance with our explanation[1,2] of former data obtained by them.

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Biotransmutation as a Cold Fusion Phenomenon

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Abstract

The nuclear transmutations in biological systems (biotransmutations) have been investigated for more than two centuries as reviewed in several books[1,2]. Recently, the investigation of the biotransmutations made a great progress in the direction to determine the microscopic origin of the nuclear reactions in the biological system where is apparently no mechanism to accelerate charged particles up to enough energies to cause fusion reactions of nucleons. Vysotskii et al.[3] have shown not only the biotransmutation but also the decay-time shortening of radioactive nuclides in systems including microbial cultures: There are data sets showing (1) production of $^{57}_{26}$Fe from $^{55}_{25}$Mn and also (2) acceleration of the decays of radioactive nuclei $^{157}_{55}$Cs, $^{140}_{56}$Ba and $^{140}_{57}$La in several bacterial cultures. To solve the riddle of nuclear reactions occurring in biological systems, there had been proposed the TNCF model which was applied successfully to various events in the cold fusion phenomenon (CFP) including the Carbon-Hydrogen systems[4]. In this paper, we have reexamined the data of biotransmutation and decay-time shortening of radioactive nuclides in microbial cultures from molecular levels to investigate nuclear reactions between participating nuclei in the system. It is shown that the TNCF model is applicable also to this phenomenon.

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