The 14th Meeting of Japan CF-Research Society

JCF14 ABSTRACTS

December 7-8, 2013

Tokyo Institute of Technology

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Program of JCF14 Meeting

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Date: December 7-8, 2013

Place: South 8 Build. , O-okayama Campus, Tokyo Institute of Technology, Tokyo Japan

Paper presentation: Oral presentation 20 min. (Review: 25min) + Discussion 5 min.

Language: English or Japanese

Book of Abstract: Only available at JCF home page (http://jcfrs.org/)

December 7 (Sat.), 2013

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

13:00-13:10 **Opening Address** H. Numata (Tokyo Institute of Tech.)

Experiment-1 Chairman; T. Mizuno (Hydrogen Eng. A&D Co.)

13:10-13:35 **JCF14-1** A. Kitamura et al. (Technova Inc., Kobe U.)
Study on Anomalous Heat Evolution from H-Ni Nanoparticle System at Elevated Temperature with Mass-Flow Calorimetry

13:35-14:00 **JCF14-2** S. Tsuruga et al. (Mitsubishi H. I.)
Recent Advances in Deuterium Permeation Induced Transmutation Experiments using Nano-Structured Pd/CaO/Pd Multilayer Thin Film

14:00-14:25 **JCF14-3** T. Takahashi et al. (Iwate U.)
Deuterium permeation experiment using Pd/Ni multi-layered sample

14:25-14:40 **Break**

Theory-1 Chairman; N. D. Cook (Kansai U.)

14:40-15:05 **JCF14-4** T. Sawada (Nihon U.)
Relation between the magnetic monopole and NAE of the nuclear cold fusion

15:05-15:30 **JCF14-5** H. Kozima et al. (CF Res. Lab.)
Atomic Nucleus and Neutron —Nuclear Physics Revisited with the Viewpoint of the Cold Fusion Phenomenon

15:30-15:55 **JCF14-6** H. Kozima (CF Res. Lab.)
Nuclear Transmutation in Actinoid Hydrides and Deuterides

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

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

December 8 (Sun), 2013

Experiment-2 Chairman; Y. Iwamura (Mitsubishi H. I.)

10:00-10:25 **JCF14-7** X.F. Wang et al. (Arata R&D Center, Hydrogen Eng. A&D Co.)
Synthesis of nano-Pd particles in Y-Zeolite pores by ultrasonic irradiation

10:25-10:50 **JCF14-8** H. Yamada et al. (Iwate U.)
Impressive Increase in Number of Etch Pit occasionally Produced on CR-39 in Light and Heavy Water Electrolysis Using Ni Film Cathode

Theory-2 Chairman; K.Tsuchiya (Tokyo National College of Tech.)

10:50-11:20 **JCF14-9** A. Takahashi et al. (Technova Inc.)
D(H)-Cluster Langevin Code and Some Calculated Results

11:20-11:45 **JCF14-10** H. Miura
Computer Simulation of Hydrogen States near T site in Ni and Pt Metals

11:45-12:10 **JCF14-11** H. Numata (Tokyo Institute of Tech.)
Numerical simulation of vortex appeared on electrode surface under long term evolution of deuterium in 0.1M LiOD －Vortex formation locally, triggered by cylindrical pillar current initiation

12:10-13:30 **Lunch**

Theory-3 Chairman; E. Yamaguchi (Doshisya U.)

13:30-13:55 **JCF14-12** K. Tsuchiya et al. (Tokyo National College of Tech.)
The quantum states of the system including two species of charged bosons in ion traps Ⅲ

13:55-14:25 **JCF14-13** E. Igari et al. (Hydrogen Eng. A&D Co.)
Discussion about the quality of the experiments in cold fusion

14:25-14:50 **JCF14-14** N. D. Cook (Kansai U.)
Transmutation of Palladium and Nickel Isotopes

14:50-15:15 **JCF14-15** H. Kozima (CF Res. Lab.)
Nuclear Transmutations (NTs) in Cold Fusion Phenomenon (CFP) and Nuclear Physics

15:15-15:40 **JCF14-16** H. Kozima (CF Res. Lab.)
The Cold Fusion Phenomenon － What is It?

Adjourn

Study on Anomalous Heat Evolution from H-Ni Nanoparticle System at Elevated Temperature with Mass-Flow Calorimetry

A. Kitamura [1, 2], A. Takahashi [1, 3], R. Seto [1], Y. Fujita [1], A. Taniike [2] and Y. Furuyama [2]
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We have been studying phenomena of anomalous heat evolution from hydrogen-isotope-loaded nano-composite samples at elevated temperatures as well as at room temperature using a twin absorption system [1, 2]. Recent experiments used Ni-based nano-composite samples; $Pd_{0.08}Ni_{0.35}/ZrO_2$ ("PNZ"), Ni/ZrO_2 ("NZ"), $Cu_{0.081}Ni_{0.36}/ZrO_2$ ("CNZ") and $Cu_{0.21}Ni_{0.21}/ZrO_2$ ("CNZII"). The results of measurements were/will be published in [3], [4] and [5], respectively, and the time-dependent data have been re-analyzed in [6] by A. Takahashi for speculating heat releasing mechanisms during the several-week-lasted phase of D(H)-loading into the nano-composite samples. As has been shown there, a lot of interesting, even astonishing, features are involved; burst-like heat release with anomalously high values of differential heat of sorption (η) reaching ca. 600 eV/atom-H, large values of integrated heat reaching ca. 800 eV/atom-Ni from the CNZ sample absorbing H, and abrupt desorption with absorbed energy of 50 - 80 eV/atom-Ni observed almost exclusively in the first 573-K run for each sample.

To confirm the interesting phenomena, repeated measurements with improved signal-to-noise ratio are required. Since the easiest way for this is to increase the sample amount, we have fabricated a reaction chamber with a ten-times-larger volume than that used earlier. Another important improvement is a mass flow calorimetry applied to the system using an oil coolant with a boiling point of 390 deg-C. The calibration of the calorimeter using commercially available alumina and the first application to a sample $Cu_{0.0071}Ni_{0.03}/SiO_2$ ("CNS") have been described in [7]. It has been rather plausible to ascribe the observed temperature increase to the excess power from the sample. It is, however, also true that the increased amount has been too small to deny all other factors which could affect the temperature.

In the present work, a 300-gram sample of Ni-based nano-composite, $Cu_{0.076}Ni_{0.36}/ZrO_2$ ("CNZIV"), with much greater amount of Ni, is used. We will show the hydrogen absorbing characteristics at various conditions with temperatures even higher than 400 deg-C.

[1] Akira Kitamura, Yuki Miyoshi, Akira Taniike, Akito Takahashi, Reiko Seto and Yushi Fujita; J. Condensed Matter Nucl. Sci. **4** (2011) 56-68.
[2] Y. Miyoshi, H. Sakoh, A. Taniike, A. Kitamura, A. Takahashi, R. Seto and Y. Fujita; J. Condensed Matter Nucl. Sci. **10** (2013) 46-62.
[3] Y. Miyoshi, H. Sakoh, A. Taniike, A. Kitamura, A. Takahashi, R. Seto and Y. Fujita; Proc. JCF12 (2012) 1-9.
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[6] A. Takahashi, A. Kitamura, A. Taniike, Y. Furuyama, R. Seto, Y. Fujita, T. Murota, T. Tahara; to be published in Proc. ICCF18.
[7] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike, Y. Furuyama; to be published in Proc. ICCF18.

Recent Advances in Deuterium Permeation Induced Transmutation Experiments using Nano-Structured Pd/CaO/Pd Multilayer Thin Film

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Permeation induced transmutation reactions, which we originally found in the nano-structured Pd multilayer film composed of Pd and CaO thin film and Pd substrate [1], have been observed in our laboratory and other research institutes[2]-[4]. Recently, Toyota R&D centre reported almost complete replication experiments on the transmutation of Cs into Pr at ICCF-17[2]. We observed transmutation reactions of Cs into Pr, Ba into Sm, W into Pt up to now. Especially, transmutation of Cs into Pr has been confirmed by "in-situ" measurements using x-ray fluorescence spectrometry (XRF) at SPring-8 in Japan [5].

Experimental data that indicates the presence of transmutation have been accumulated and the underlying mechanism for inducing low energy transmutation reactions is gradually becoming clear, although systematic experimental study is still insufficient. The permeation induced transmutation technology would be expected as an innovative nuclear transmutation method for radioactive waste and a new energy source if we would be able to increase the amount of transmutation products.

We have been trying to increase the amount of transmutation products these years for the practical application. The following factors are assumed to be important for inducing deuterium permeation transmutation.

1) Local Deuteron Density
2) Electronic Structure

Based on this assumption, we applied an electrochemical method to increase the local deuteron density near the surface of the nano-structured Pd multilayer film. We also tried to increase the transmutation products by changing surface electronic state. These recent experimental methods gave us increased transmutation products, gamma-ray emissions, and new implications on Deuterium Permeation Induced Transmutation.

References

[1] Y. Iwamura, M.Sakano and T.Itoh, "Elemental Analysis of Pd Complexes: Effects of D2 Gas Permeation", Japanese Journal of Applied Physics, Vol.41, (2002) pp. 4642-4650.
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Deuterium permeation experiment using Pd/Ni multi-layered sample

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One of the outstanding reports in a study of low energy nuclear reaction in condensed matter, is observing a transmutation phenomenon in deuterium permeation using Pd/CaO multi-layered complex by MHI group. Especially, a selective transmutation from 133Cs, which is deposited onto the sample surface, to 141Cs was found and it has been verified by various methods. In this experiment, the multi-layered sample structure, especially for containing nano-scaled thin Pd membrane and CaO layer with a lower work function is supposed to be a key for triggering the reaction [1,2].

Besides, anomalous heat evolution was found in deuterium loading/unloading experiment with Pd-Ni binary nano-particles by Kobe-Technova group [3]. In the experiment, a fine-structure of the sample as well as a specific properties of Ni in deuterium loading might be related to the anomalous phenomenon.

Considering these results, we performed deuterium permeation experiment using Pd-Ni multi-layered sample and examined occurrence of nuclear transmutation reactions.

In the experiment, we fabricated *Pd*/Pd/*Ni*/*Pd* multi-layered sample by depositing Pd and Ni membrane onto a Pd foil by Ar ion beam sputtering, followed by depositing Cs onto the sample surface by electrolysis. Then, deuterium permeation experiment was carried out with the sample for a week. After permeation experiment, a composition of the sample was analyzed by Time-of-Flight Secondary-Ion-Mass-Spectrometer (TOF-SIMS). In this paper, we discuss a possibility of occurrence of transmutation reactions.

References

[1] Y. Iwamura *et al.* Jpn. J. Appl. Phys. 41 (2002) 4642.
[2] Y. Iwamura et al. Proc of JCF13 (2013)196.
[3] H. Sakoh *et al.*, Proc of JCF11 (2011)16 .

Relation between the magnetic monopole and NAE of the nuclear cold fusion

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The Maxwell equations are not symmetric with respect to the interchange of the electric and the magnetic objects. We can restore such symmetry by adding the terms of the magnetic charge density *ρ and its current density *i at appropriate places. Once we modify the Maxwell equations, we can consider a system in which a particle with the electric charge Q and another particle with magnetic charge *Q coexist. A novel property of such a system is the appearance of the extra angular momentum (*QQ/c)**ŝ** in addition to the ordinary orbital angular momentum （m **v X r**） , where **ŝ** is the unit vector connecting the two particles. If we remember that in the quantum theory a component of the angular momentum can assume only the integer multiple of ħ/2, we obtain the charge quantization condition of Dirac: $*QQ/\hbar c = n/2 \ \ with \ \ n = 0, \pm 1, \pm 2 \cdots$ (D). From this condition, we can firstly understand why the electric charge Q appearing in Nature is discrete. Because if we substitute the magnetic charge *Q by *e in equation(D), where *e is the smallest magnetic charge, the charge quantization condition (D) becomes $Q = (\hbar c / 2 * e) n \ \ with \ \ n = 0, \pm 1, \pm 2 \cdots$, and this equation indicates not only the discreteness but also the equality of electric charges of proton and the electron for example, up to sign. Secondly we can determine $*e^2/\hbar c$, the magnetic counterpart of the fine structure constant, from equation (D) and the value of the fine structure constant $e^2/\hbar c=1/137$. It turns out $*e^2/\hbar c=137/4$, which means that the interaction between the monopoles is super-strong. Since *ee/ħc = 1/2, the interaction potential of a nucleon with magnetic moment κ (e/2m) and the magnetic monopole *e is $V(r) = -\kappa (*e\, e / 2m\hbar c)(\vec{\sigma} \cdot \vec{r}) F(r) / r^3$, where F(r) is the nucleon form factor. The calculations of the binding energies of the ground states of the nucleon-monopole system are straightforward. If the nuclear potential between the proton and the neutron is given, we can estimate the binding energy of the deuteron-monopole system by applying the variation calculation. It turns out that the binding energy of the ground state is E=2.5 MeV. If we consider a system where two deuterons form a bound state with the same magnetic monopole, it must transit to a more stable stateα- particle. Since the spin of theαis zero, it must simply be emitted. So it enables us to construct the nuclear fusion reactor which operates at ordinary temperature, when the magnetic monopole is available. In addition comments on the Parisi-Wu formalism (Langevin form) of the quantum theory will also be given briefly.

Atomic Nucleus and Neutron — Nuclear Physics Revisited with the Viewpoint of the Cold Fusion Phenomenon

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Abstract

Nuclear reactions induced by thermal neutrons are reviewed in respect of new interest caused by the cold fusion phenomenon (CFP) where observed emergence of new elements and new nuclides in solids composed of host elements and hydrogen isotopes (cf-materials) at near room temperature without specific acceleration mechanisms. Nuclear physics developed in the 20th century has investigated mainly isolated nuclei and nucleons with temporal interaction between them and incidentally nuclear matters of high density neutrons in relation to the existence of the neutron star. On the other hand, the experimental data sets obtained in the CFP as a whole have suggested realization of a specific state (cf-matter) in cf-materials where occur nuclear reactions similar to those occurring at high energy regions considered in nuclear physics and in neutron star matter. Examining nuclear reactions investigated in nuclear physics, we have noticed several new features of neutron-nuclear interaction not taken up by now for explanation of extraordinary results obtained in the CFP. One of the interesting features is the nature of the boundary layer between a nucleus and a surrounding neutron matter. Increase of the ratio (n_o/n_i) of neutron densities of the outside neutron matter n_o and that of the inside nucleus n_i makes the energy of the boundary layer small resulting in the decrease of the barrier height for alpha-decay and finally in the increase of decay probability (or the shortening of decay time). Another feature is a possibility of fission of nuclei with medium proton number Z by simultaneous absorption of several neutrons which is applicable to explanation of nuclear transmutations in the CFP. It is well known that the fission reaction of nuclei with small Z (e.g. ${}^{6}_{3}$Li and ${}^{10}_{5}$B) and large Z (${}^{235}_{92}$U and ${}^{239}_{94}$Pu) are induced by absorption of a neutron. Instability of a compound nucleus with a medium Z formed by absorption of a neutron is not enough to induce the fission of the nucleus. However, simultaneous absorption of several neutrons by a nucleus suggested in the CFP has given us a hint to investigate a possible fission of medium Z nuclei by this mechanism.

Nuclear Transmutation in Actinoid Hydrides and Deuterides

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Abstract

Nuclear transmutations observed in the cold fusion phenomenon (CFP) have attracted attention from various points of view. The sense of wonder in the CFP is based on the common sense that events occurring in a nucleus are isolated from the drama played in the world of atoms without little exceptional effects like Knight shift in NMR, change of K-capture probability by environment and Moessbauer effect connecting weakly between two world

As have been revealed by many experimental data sets observed in the CFP, there are various events showing occurrence of nuclear reactions in materials composed of host elements and hydrogen isotopes (protium or/and deuterium) with a comparable ratio to the host (cf-materials). In the events of nuclear reactions observed in the CFP, one of the most interesting is the nuclear transmutations of nuclei with several decay channels (including radioactive nuclei such as $^{235}_{92}U$ and $^{231}_{90}Th$) which show a gigantic shortening of the decay time compared to that observed in free space.

We have used a model (TNCF model) to give a successful explanation for various events in the CFP from excess energy generation to emissions of charged particles and neutron. The assumption of the existence of the "trapped neutron" has been replaced by formation of a new state (cf-matter) composed of quasi-free neutrons and a little protons and electrons to neutralize it as a whole in the quantal investigation of premises of the TNCF model. The experimental data sets on the nuclear transmutation of radioactive nuclei include many details of the measurements and give us materials for their analysis if we can use them properly. Using our model in addition to knowledge of nuclear physics on the interaction of a nucleus and neutron sea (corresponding to the cf-matter in our model), we have given a unified and consistent explanation of the decay-time shortening observed in uranium (and thorium) hydrides and deuterides prepared by implantation thorough glow discharge or by absorption through electrolysis.

Synthesis of nano-Pd particles in Y-Zeolite pores by ultrasonic irradiation

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Abstract

In Cold Fusion research, metal nanoparticles have been attracting attention as reaction medium. The method of synthesis of nano-Pd particles is reported in this paper, which is to irradiate the 35kHz ultrasonic waves on $PdCl_2$-zeolite solution. The reaction equation is considered to be as below. Nano Pd particles are synthesized in the Y-zeolite(SiO_2/Al_2O_3, Na_2O (wt%): 4) pores with pores size 0.8nm. Scanning electron microscope (SEM), Energy Dispersive X-ray Spectroscopy (EDS / EDX), transmission Electron Microscope (TEM) are applied to confirm the size and components of the particles. The size of nano Pd particles produced in the zeolite pores (by SEM, EDS analysis) is suppressed to below 0.8nm i.e. the pores size of Y-zeolite (by TEM analysis).

Reaction equation :

$PdCl_2 \rightarrow Pd^{2+} + 2Cl^-$

$H_2O \rightarrow {}^{-}OH + H^+$ (sonolysis)

$(CH_3)_2CHOH + {}^{-}OH(H^+) \rightarrow (CH_3)_2 \cdot {}^{-}C(OH) + H_2O(H^+)$ (pyrolysis radicals)

$Pd^{2+} + 2(CH_3)_2{}^{-}C(OH) + 2H^+ \rightarrow\rightarrow Pd + 2(CH_3)_2C(OH) + 2H^+$

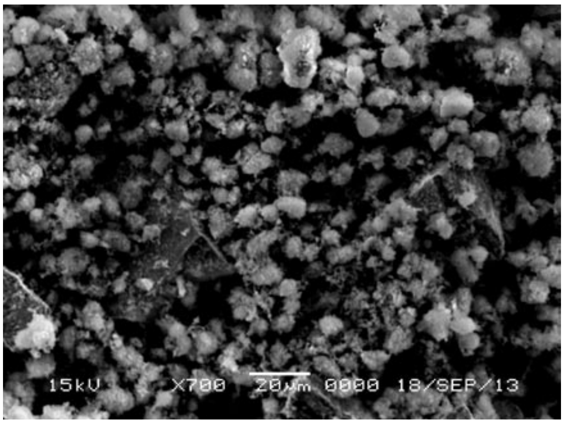

Fig.1.a Pd- Y zeolite SEM analysis X700

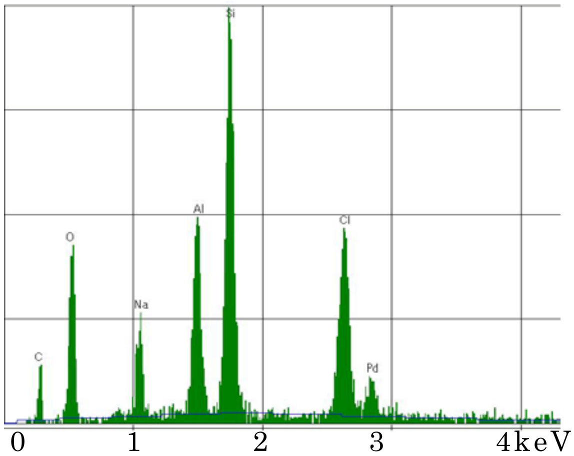

Fig.1.b Pd- Y zeolite EDS analysis

Figure 1.b is the EDS component analysis data of the particles as shown in figure 1.a. The results show that Pd element is obviously detected on the surface of the particles.

Impressive Increase in Number of Etch Pit occasionally Produced on CR-39 in Light and Heavy Water Electrolysis Using Ni Film Cathode

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The plastic track detector has become a popular method to detect energetic charged particles in low energy nuclear reaction (LENR) studies especially in electrolysis experiments. In these studies, the evidence of the reaction is in the form of nuclear damage trails made visible by etching of the plastic chips. Many studies have been performed on light and heavy water electrolysis using the plastic track detector and the generations of charged particle emission during the electrolysis have been reported.

However, there still exist technical complexities in using plastic detector in electrolysis experiment. In the previous studies, there have been a thin layer of electrolyte and/or a solid film between the cathode electrode and the plastic detector. Such construction could cause a considerable decrease in the energy of the charged particle emitted from the cathode.

In this present study, electrolysis of D_2O and H_2O solutions is carried out under several DC current patterns using a Ni film cathode. A chip of the plastic track detector CR-39 is positioned just under the Ni film cathode to limit energy decrease; a CR-39 chip of 30×30 mm in size is set in close contact with the rear surface of the cathode film. This construction avoids chemical attack on the chip by ions generated by the electrochemical reactions on the Ni film cathode. The present technique is simple but capable of detecting energetic charged particles produced on the cathode during electrolysis with higher efficiency. Using the present technique, we have studied energetic charged particle emission from the metal film cathodes for light and heavy water electrolysis [1-4]. An impressive increasing in number of etch pit is occasionally observed for both D_2O and H_2O solutions.

The primary purpose of this study is to establish a simple technique producing new convincing evidence that a nuclear reaction as LENR could accompany both heavy and light water electrolysis.

1) H. Yamada et al., Proceedings of the 10th Meeting of Japan CF Research Society, pp. 41-45 (2010)
2) H. Yamada et al., Proceedings of the 11th Meeting of Japan CF Research Society, pp. 41-46 (2011)
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4) H. Aizawa et.al. J. Condensed Matter Nucl. Sci. 12 (2013) in press

D(H)-Cluster Langevin Code and Some Calculated Results

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Time dependent motion of deuterium (or protium) cluster is calculable by a computer code based on the quantum-mechanical Langevin equation [1, 2]. Especially the dynamics analyses of a three body d-e-d or p-e-p, a 5-body d-e-d-e-d or p-e-p-e-p (namely $D3^+$ or $H3^+$ ionic molecule) and a 8-body d-e-d-e-d-e- d-e (4D) or p-e-p-e-p-e-p-e (4H) cluster under the Platonic symmetry (TSC: tetrahedral symmetric condensate) are important to understand the underlying mechanisms of condensed matter nuclear reactions aka cold fusion [3]. The dynamic analysis is quite applicable to investigate time-dependent behavior of the three body system of d-muon-d after sticking of muon to a d-e-d molecule. The QM langevin method is also applicable for much larger cluster under the Platonic symmetry, such as 6D(H), 8D(H), 12D(H) and 20D(H) clusters.

We have made a generalized Cluster Langevin Code revised from the original crude one [1, 2]. We show some typical calculations of 1) dynamic motion going to the ground state, for systems having ground state eigen-values (namely steady molecules), 2) collapsing motion going to several-tens or smaller fm size transitory condensates which may cause very enhanced multi-body nuclear interactions by strong (for D) or weak (for H) boson exchange (namely multi-body fusion), and 3) oscillation motion of EQPET clusters with electron Cooper pair and quadruplet [1, 2].

A muonic d-μ-d system converged in 8.3 fs to its ground state with the inter-nuclear d-d distance of 800 fm (0.8 pm) after 90 oscillations from a d-e-d state with 138 pm d-d distance of the electronic $D2^+$ molecule ground state. A 4D(H)/TSC cluster collapses to the "nuclear interaction size" (20 fm to 4 fm) in 1-2 fs variant to the adoption of different type of trapping potential functions (Vs2 or Vs1 potential), always. The Rhombic dodecahedron of 6D(2-) and the Rhombic triacontahedron 20D(8+) may collapse into the nuclear interaction size. Some other examples are also shown, including two-body Coulombic scattering at higher d(p) incident kinetic energy. A list of BASIC program of the Cluster Langevin code is given in Appendix of full paper and in ppt presentation, respectively.

[1] Akito Takahashi: The basics of deuteron cluster dynamics as shown by Langevin equation, American Chemical Society LENRSB (Low Energy Nuclear Reaction Source Book) 2 (2009) 193-217

[2] Akito Takahashi and Norio Yabuuchi: Study on 4D/TSC condensation motion by non-linear Langevin equation, American Chemical Society LENRSB 1 (2008) 57-83

[3] Akito Takahashi: Physics of Cold Fusion by TSC Theory, J. Physical Science and Application, 3(3) (2013) 191-198

Computer Simulation of Hydrogen States near T site in Ni and Pt Metals

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We simulated the hydrogen (H) states in nickel (Ni) and platinum (Pt) metals using a quantum molecular dynamics on a personal computer to compare with our previous computer simulation in palladium (Pd) metal [1]. We calculated the total energy, charge density and electronic structure of the host bulk metal by a computer simulation program within Density Functional Theory based on the local density approximation using pseudo-potentials and a plane-wave basis in the same method with the previous simulation.

Calculations were done about four H atoms located near a T site of Ni and Pt metals filled with H atoms in all O sites deforming the tetrahedron surrounding the T site. The periodic boundary conditions were imposed on the computing 2x2x2 super cell of 28 Ni or Pt atoms and four vacancies next to some O sites.

We investigated the differences between the total energy with an impurity atom of H or alkali/alkaline-earth metal entered into the T site of Ni or Pt metal lattice and the total energy without it. In the previous case of Pd metal we have observed Li and Ca atoms could move from O sites to T sites under the small lattice deformation such as atomic vibration at room temperature, and the Li atom could hop out from the T site pushed by weak force and the Ca atom could hop out by strong force. It have seemed that the Li atom could draw four H/D atoms (applying the result to deuterium atoms) surrounding the tetrahedron and leave them to cause mostly nuclear transmutation/fusion, and the Ca atom could draw for D atoms and leave them to cause mostly nuclear transmutation. This time, in the case of Ni metal we observed the only Li atom could carry out the same role of it within the previous Pd metal case, and in another case of Pt metal Mg atom added to Li atom could carry out the same role of Li atom and further the Ca atom could do the same role of it within the Pd metal case respectively.

From these three simulations, we could find different impurity atoms cause the condensation of four H atoms in different metals. Then we made another attempt to check the combinations of metals and impurity atoms to cause the condensation of four H atoms.

References

1) H. Miura, Computer Simulation of Hydrogen States near T site in Pd Metal, Proc. of 13th Meeting of Japan CF Research Society, p. 108 (2012)

Numerical simulation of vortex appeared on electrode surface under long term evolution of deuterium in 0.1M LiOD －Vortex formation locally, triggered by cylindrical pillar current initiation

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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 underneath 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]. Mean while we noted that the magnetic configuration underneath of the surface layer plays an important role in the simulation of the motion of the hypothetical particles mass flow. In the last paper [6], there were evaluated the distributions of the electrode potentials and magnetic flux densities in an electrolyte and bubbles adhered on an electrode. However, there have been unverified with respect to those structures and solid-state properties of the sub-surface layer.

Alternatively, we have conducted PC computer simulation works (3D motion of the hypothetical particles mass). In the framework we had encountered the obstacle which might make our work continuation difficult. On this occasion we went back to the original N-cycle model that was old and, thus overlooked conceptual model, although that model has included very useful hint for modeling of PC computer simulation. When the study focuses the existing triggering (N-cycle model is composed of four sequential processes: in-taking and compression — triggering (the CF reaction) — scavenging); more appropriate model is established in shedding a new light on the numerical simulation of the motion of the hypothetical particles mass.

In this study, we report unsuccessful trial and solved preliminary results using discretization method.

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The quantum states of the system including two species of charged bosons in ion traps Ⅲ

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In our previous work, we reported the new method how to perform the numerical calculations for the problem on the mixtures of the positively charged bosons in ion traps, which was proposed by Kim et al. [1]. Our formulas for the calculations were defined as the iterative process to determine the electro-static potential W_i and the charge density $n_i = |\psi_i|^2$ based on the Poisson and Schrödinger equations, respectively. They are written as

$$W_i(\boldsymbol{r}) = \int G(\boldsymbol{r} - \boldsymbol{r}') \left[\frac{e^2}{\varepsilon_0} Z_i \left\{ Z_i n_i(\boldsymbol{r}') + Z_j n_j(\boldsymbol{r}') \right\} + k^2 W_i(\boldsymbol{r}') \right] d\boldsymbol{r}' , \qquad (1)$$

and

$$\left\{ -\frac{\hbar^2}{2m_i} \nabla^2 + V_i(\boldsymbol{r}) + W_i(\boldsymbol{r}) \right\} \psi_i(\mathrm{r}) = \mu_i \psi_i(\mathbf{r}) , \qquad (2)$$

where G, Z_i, Vi and μ_i mean Green's function of Helmholtz equation, charge of the particle, harmonic potential and chemical potential, respectively. However, the equations for two bosons were linked together and it was not easy to find convergences.

In eq.(2), the chemical potential should be selected to give damped solution at large $|\boldsymbol{r}|$. In the previous work, it was done by finding a node at large $|\boldsymbol{r}|$. In this work, it has done by finding an asymptotic solution for harmonic potential. This improved the convergence in iterative process. We will discuss the possibility of nuclear reaction between the charged bosons in ion traps by using the self-consistent distribution of the particles.

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Discussion about the quality of the experiments in cold fusion

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After the announcement of the Cold Fusion by Fleischmann and Pons in 1989, there has been great debate between the deniers and the believers of the science of cold fusion phenomena. The debate continues to this day after two decades since the announcement. In other sciences, this situation is rare typically due to the fact that experiments are either reproducible or not. In this particular situation, the poor reproducibility of the experiment has been a major issue. As a result, the truth about whether or not cold fusion is even possible has been questioned. The purpose of this paper is to clarify why this unique situation occurred.

We divide the process of experiment into four phases to analyze why "poor reproducibility" occurred. (1)Setting up the hypothesis, (2) Planning of experimental design, (3) Implementation of the experiment and (4) Verification of experiment. We would like to discuss what the problems have been in each phase.

We interviewed the scholars in the field of Cold Fusion and found that the following problems have occurred in the four phases. (1) Hypotheses: There have been a number of hypotheses. Therefore, it has been difficult to get specific, measurable feed back. What one believes theoretical plays outs quite differently in experimental form. (2) Experimental design: Each experiment may appear to have been carried out under the same conditions. However, variations appeared in the experimental results. It is possible that there were unknown conditions in metal, gas, and other components. Such unknown conditions might have not been considered in the experimental design. (3) Implementation of the experiment: Preventing the dispersion of the gas such as nano-structure of the metal as well as the gas such as hydrogen is very difficult. Hence, it has been difficult to control the experiment perfectly. (4) Verification of experiment: There has been some uncertainty about the various hypothesis and experimental conditions. It is difficult to write specifically about all the experimental conditions in the papers. Therefore, reproducing the experiments have been difficult for other researchers.

In this study, we focused on the quality of the "implementation of experiment". In particular, we analyzed the prototype of the venture companies outside of Japan. We looked at the photos and the data of the prototype. We also analyzed the structure of the prototype, material, gas, and the method of heat measurement from the photos. We came to the conclusion that the results and outputs that the company claims are quite different from what they appear to be. Moreover, the data and the information which contained a lot of noise were announced without peer-reviews.

In conclusion, "the lack of clear hypothesis", "difficulty in controlling the experimental conditions" and "uncertainty of information" led to the current controversy of Cold Fusion. It is important to solve these problems in order for the society of Cold Fusion to be in the main stream of the scientific society.

Transmutation of Palladium and Nickel Isotopes

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Over the past 20 years, the transmutation of various nuclear species has been reported in many LENR experiments (Storms, 2007). Of particular interest have been the isotopic changes reported by Tadahiko Mizuno of Hokkaido University. Here, I present the results of computer simulations of the isotopic transmutations found by Mizuno on the surface of electrodes made of pure Palladium (Mizuno, 1998) and in an SUS304 alloy consisting of Nickel, Iron and Chromium (Mizuno, 2013).

The main assumption underlying the simulation is that the nuclear transmutations detected at hotspots were due to the gradual ***depletion*** of the metals on the surface of the electrodes. In other words, the isotopic changes were ***solely*** a consequence of the disappearance of isotopes on the electrode surface due to LENR (possibly fusion or fission reactions, leading to the accumulation of other atomic species on the electrodes and to a depletion of the original metals). The simulation was undertaken to determine the levels of depletion of the various isotopes that would result in a change from the known natural abundances to the post-experimental abundances, as reported by Mizuno.

The final percentages of the various isotopes of palladium, nickel, iron and chromium were easily reproduced in the simulations by adjusting the levels of depletion per isotope, but the significance of the simulation lies not in the "success" of reproducing the experimental data, but in specifically the levels of isotopic depletion required to reproduce the data. In the case of Palladium electrodes, all of the stable isotopes of Palladium were strongly (70~90%) depleted. In the case of the SUS304 alloy, all of the isotopes of Iron, Chromium and Nickel were strongly depleted, ***with the exception of*** ^{61}***Ni.*** With a depletion rate of only 10% for this isotope in the simulation, there was a notable absence of its participation in the LENR reactions. This unanticipated result of the simulation is of interest because researchers at Defkalion Ltd. recently reported (2013) that excess heat was consistently produced using their own Nickel-Hydrogen LENR system when mono-isotopic Nickel species were used, with the sole ***exception*** of ^{61}Ni.

Although the underlying mechanisms remain uncertain, it is thought that the ***independent*** replication of the non-participation of ^{61}Ni in the production of excess heat in two distinct LENR systems is a strong indication of nuclear involvement. It is, moreover, noteworthy that the "anomalous" isotopic changes reported by Mizuno since the 1990s are easily explained by means of the depletion simulations, and clearly indicate that the relative increases and decreases in various isotopes are a consequence of ***minor*** differences in the levels of their depletion during the LENR effect. Further study of such isotopic changes and the characterization of new isotopic species deposited in the electrodes would be worthwhile.

Nuclear Transmutations (NTs) in Cold Fusion Phenomenon (CFP) and Nuclear Physics

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Abstract

Vast experimental data sets of nuclear transmutation in the cold fusion phenomenon (CFP) in solids with deuterium and protium (cf-materials) are investigated from the phenomenological point of view in terms of our model (TNCF model) with a single adjustable parameter, using the recent knowledge of nuclear physics on the interaction of a nucleus and neutrons. The nuclear transmutations (NTs) in the CFP are classified into four groups; 1) Nuclear transmutation by absorption (NT_A), 2) Nuclear transmutation by decay (NT_D), 3) Nuclear transmutation by fission (NT_F), and 4) Nuclear transmutation by transformation (NT_T). The mechanisms of these NTs have a common factor, absorption of a neutron or a nucleon cluster from a surrounding cf-matter (corresponding to neutron sea considered in nuclear physics), figured out in our investigation of the fundamental premises of the TNCF model. In addition to this common factor in their mechanisms of the NTs, there had been additional assumptions in the case of NT_D and NT_F; a) In the case of NT_D, it was necessary to assume the decay-time shortening of compound nuclei formed by absorption of neutrons, and b) In the case of NT_F, it was necessary to assume the fission of the compound nuclei. In this paper, the possibility of these assumptions assumed in the analyses of experimental data sets has been positively explained by the analysis of the interaction of a nucleus and neutron sea given in another paper presented at this Conference.

In the investigation of the CFP, we have given explanations of several features of the NTs in the CFP before; i) The relation of frequency of occurrence N_{NT} to that of other events such as excess energy generation N_Q, ii) Local nature of nuclear reactions in the CFP, and iii) quantitative explanations of nuclear transmutations in Pd and Ni alloys. In addition to these investigations, we have given the theoretical explanation of the decay-time shortening as explained above using the TNCF model.

Thus, the unified explanation of many events in the CFP based on the TNCF model, including the nuclear transmutations given in this paper and other events such as emissions of charged particles and neutrons given in former works, suggests that the "trapped neutrons" or the cf-matter in cf-materials assumed in our model has substantial meaning in the solid-state nuclear physics.

The Cold Fusion Phenomenon – What is It?

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Abstract

Present status of the cold fusion (CF) research is reviewed from our point of view to make this field a common heritage of modern science. Various events observed in this field specified by a generic name "cold fusion phenomenon (CFP)" are investigated as a whole from a point of view using a phenomenological model with a parameter (TNCF model) based on the whole experimental facts obtained in materials composed of various host solids and hydrogen isotopes not only deuterium but also protium (cf-materials). A parameter n_n is assumed to be the density of the quasi-stable trapped neutrons (cf-matter) formed in the cf-material. Events used to construct the model include generation of excess energy, emissions of neutrons and charged particles, generation of tritium and helium, and the nuclear transmutation at boundary regions of materials. Numerical relations between numbers of complex events are explained by the model. Empirical laws found for observables have been used to discuss the cold fusion phenomenon as a complexity thus explaining irreproducibility and sporadicity of events as fundamental natures of the cold fusion phenomenon. Bases of premises assumed in the model, especially the trapped neutrons, have been investigated quantum mechanically. A possible mechanism of an indirect nuclear interaction between lattice nuclei mediated by interstitial hydrogen isotopes (super-nuclear interaction) was proposed. The neutron bands formed by this super-nuclear interaction contribute to formation of the trapped neutrons and further the cf-matter. Recent knowledge in nuclear physics and solid state physics is used to give some predictions of possible experiments not known until now. The copper (Cu) is a metal that show high mobility of hydrogen isotopes at higher temperature than 450 °C and the nucleus has neutron energy levels at around evaporation level (zero level). These characteristics suffice a necessary condition for formation of the neutron bands by the super-nuclear interaction between lattice nuclei at higher temperatures than 450 °C. So, we may be able to obtain positive data for the CFP in CuH_x and/or CuD_x there. Possible applications of the CFP are proposed. Though the answer to the question "What is the CFP" is not given at present, we have many materials to solve this riddle in near future.