

The 4th Meeting of Japan CF-Research Society

JCF4 ABSTRACTS

October 17-18, 2002

at Iwate University

Japan CF-Research Society

<http://www.eng.osaka-u.ac.jp/nuc/03/nuc03web/JCF/>

Program of JCF4 Meeting

(Japan CF-Research Society)

Date and Place: October 17-18, 2002, at Memorial Hall Ichiyu Kaikan, Iwate University, Morioka, Japan

Paper presentation: oral presentation 15 min.+ discussion 5 min.,

language = English or Japanese

Book of abstract: to be distributed at site, also to be available at JCF home page

Proceedings paper: format = A4, 5 pages limit, 9 point letter (sample will be shown),

Dead line = November 30 (to be sent to Prof. Yamada, Iwate U.)

October 17(THU), 2002

13:00-13:30 **Registration**

13:30-13:40 **Opening Address** (H. Yamada, Iwate.U.)

Electrolysis-1 (chairman: T. Mizuno, Hokkaido U.)

13:40-14:00 **JCF4-1** H. Numata (Tokyo Inst. Tech.): Performance of calorimeter and thermal behavior of deuterated metals in 0.1M LiOD

14:00-14:20 **JCF4-2** H. Inoue et al. (Yokohama N.U.): HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING FLOW CELL (III)

14:20-14:40 **JCF4-3** T. Sato et al. (Iwate U.): Analysis of Production Elements on Pd Surface after Light Water Electrolysis

14:40-15:00 **JCF4-4** S. Sasaki et al. (Iwate U.): Nuclear Reaction Occurring in Light Water Electrolysis on Gold and Cobalt Cathode Electrode

15:00-15:20 **JCF4-5** F. Celani et al. (INFN-LNF): Unexpected detection of new elements in electrolytic experiments with deuterated ethyl-alcohol, Pd wire, Sr and Hg salts

---break (20 min)---

Theory-1 (chairman: T. Sawada, Nihon U.)

15:40-16:00 **JCF4-6** H. Yamamoto: Another Explanation of Pipe Rupture Incident at Hamaoka Nuclear Power Station Unit-1 from View Point of Cold Fusion

16:00-16:20 **JCF4-7** M. Ohta et al. (Osaka U.): Analysis on neutron induced fission of ^{235}U by SCS model

16:20-16:40 **JCF4-8** M. Fukuhara (Toshiba Tungaloy): Possible Nuclear Transmutation of Nitrogen in Atmosphere of Earth

16:40-17:00 **JCF4-9** H. Kozima (Portland State U.): Neutron Drops and Production of Larger Mass-Number Nuclides in Cold Fusion Phenomenon (CFP)

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

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

October 18(FRI), 2002

Electrolysis-2 (chairman: K. Ota, Yokohama N.U.)

9:00-9:20 **JCF4-10** T. Ohmori et al. (Hokkaido U.): Positive and negative excess heat evolution and

corresponding new element production in light water electrolysis at high current density on palladium electrodes

9:20-9:40 **JCF4-11** T. Mizuno et al. (Hokkaido U.): Confirmation of anomalous hydrogen generation by plasma electrolysis

9:40-10:00 **JCF4-12** M. Matsunaka et al. (Osaka U.): Studies of Photon Source for Multi Photon Induced Fission under Plasma Electrolysis

10:00-10:20 **JCF4-13** T. Ohya et al. (Osaka U.): Studies of neutron emission by alternate electrolysis of heavy and light water with loading of deuterium into palladium

10:20-10:40 **JCF4-14** T. Hanawa : Problems in Calorimetry of Submerged Carbon Arc

--- break (20 min) ---

Beam and Gas Phase Exp.-1 (chairman: H. Yamada, Iwate U.)

11:00-11:20 **JCF4-15** M. Miyamoto et al. (Kobe M.M.U.): Reaction yield enhancement under deuterium ion irradiation of deuterated Au/Pd samples

11:20-11:40 **JCF4-16** T. Itoh et al. (Mitsubishi H.I.): Observation of Low Energy Nuclear Reaction Induced by D₂ Gas Permeation through Pd Complex(1)

11:40-12:00 **JCF4-17** S. Sakai et al. (Mitsubishi H.I.): Observation of Low Energy Nuclear Reaction Induced by D₂ Gas Permeation through Pd Complex(2)

--- lunch (12:00-13:30) ---

Beam and Gas Phase Exp.-2 (chairman: A. Kitamura, Kobe M.M.U.)

13:30-13:50 **JCF4-18** H. Onodera et al. (Iwate U.): Analysis of Nuclear Products in Hydrogen Penetration through Palladium

13:50-14:10 **JCF4-19** N. Tanaka et al. (Iwate U.): Observation of Heat Evolution with Palladium Hydride in the Evacuated Chamber

14:10-14:30 **JCF4-20** N. Sato et al. (Iwate U.): Gamma Ray Measurement and Surface Analysis on Deuterated and Hydrated Palladium Electrodes under DC Glow-like Discharge

--- break (20 min) ---

Theory-2 (chairman: H. Kozima, Portland State U.)

14:50-15:10 **JCF4-21** A. Takahashi (Osaka U.): DRASTIC ENHANCEMENT OF D-CLUSTER FUSION BY ELECTRONIC QUASI-PARTICLE SCREENING

15:10-15:30 **JCF4-22** A. Takahashi et al. (Osaka U.): Mass-8-and-Charge-4 Increased Transmutation by Octahedral Resonance Fusion Model

15:30-15:50 **JCF4-23** N. Yabuuchi (High Sci. Res. Lab.): Nuclear fusion and the structure of nuclei

15:50-16:10 **JCF4-24** K. Tsuchiya (Tokyo N.C.T.): A Possible Model for the Nuclear Reactions in Metal Vacancy Induced by Bose-Einstein Condensation

16:10-16:30 **JCF4-25** T. Sawada (Nihon U.): Rational basis of the nuclear fusion reaction at very low energy

16:30-16:50 **JCF4-26** M. Ban: Composition of 1/ f amplitudes electron wave and a work of one dimension of lattice

Adjourn.

JCF4-1

Performance of calorimeter and thermal behavior of deuterated metals in 0.1M LiOD

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From material science and electrochemical aspects our research interest has been focused on the physico-chemical properties of deuterated Pd, which in turn are throwing the light on understanding the characteristics of Pd-D system. In the first experiment the electrolytic cell was just inserted into water thermostat whose temperature was readily affected by a room temperature variation during long-term deuterium absorption. In this study more stepped up cell, flow calorimetry apparatus, neutron measurement system and data acquisition system have been constructed to collect more accurate data.

Experimental set-up

Electrolytic cell: transparent quartz, water jacketed double wall, plugged by silicone rubber stopper where three electrodes holders, inlet or outlet ports for electrolyte exhausted, evolved gas release and Pt resistance thermometer are mounted. Electrolyte content is 130ml.

Electrode material: Pd, Ni and Ir Thermostat enveloping cell: see Figure

Preliminary results of flow calorimeter: thermostat performance

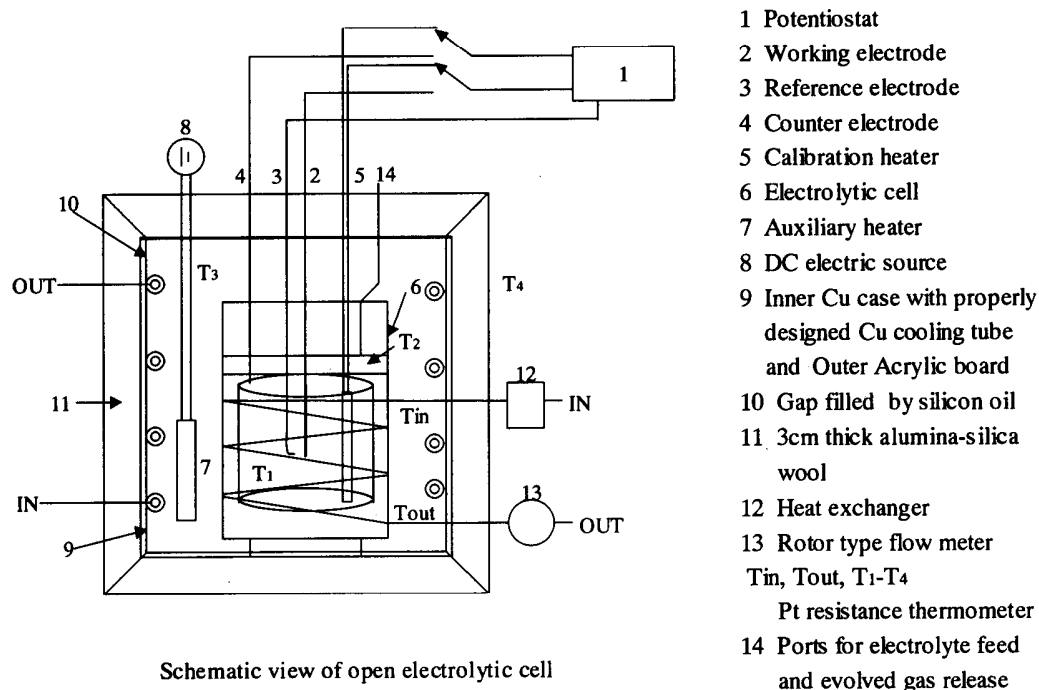
With tap water cooling through the heat exchanger the cell temperature variation(cycle/day) was within ± 0.075 C and more frequent fluctuation within ± 0.01 C

With tap water cooling not through the heat exchanger was within ± 0.15 C

Neutron detection system: 2 systems (NE213 liquid scintillation and ^3He counters; 50dia.x15 long, 4atm)

Data acquisition system of electrochemical measurement and flow calorimetry experiment: LabVIEW6.1, for neutron count rate measurement: values resisted/analyzed: BASIC program

It is noted that motor driven equipments (stirrer, water circulation for cooling) were rejected and miscellaneous electrostatic noise shielding for apparatus and noise cut trans for electricity were adopted to eliminate electric noise. The discussion of the calorimeter performance and the data concerned with electrochemical and neutron measurements are presented at the meeting.



Schematic view of open electrolytic cell

HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING FLOW CELL (III)

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We reported clear excess heat during light water electrolysis at ICCF9 in Beijing. In order to confirm these results, we have conducted heat measurement, separately, using the improved cell with insulator. Figure.1 shows the schematic drawings of a new type cell. The electrode beads were put in the central part of the cell as cathode. They were Ni rods($\phi 1\text{mm} \times 2\text{mm}$), Ni beads($\phi 1\text{mm}$) or Al_2O_3 beads($\phi 1\text{mm}$), with Pd thin film on the surface which was formed by sputtering or chemical plating. Electrolyte was $1\text{M Li}_2\text{SO}_4\text{-H}_2\text{O}$ or $0.5\text{M K}_2\text{CO}_3\text{-H}_2\text{O}$, and it was circulated through the cell. Electrolysis was performed with constant current ($\sim 1\text{A}$). During electrolysis the electrode beads were pressed with suitable pressure. With the treatment the cell voltage was stabilized and the oxidation of electrode was suppressed. The accuracy of measurements was improved considerably. The output energy was obtained by summing the energy used for the temperature rise of electrolyte (W_1) and the energy used for the water electrolysis reaction (W_2). The heat balance (HB) was obtained by dividing them by the input energy (W_0). Figure.2 shows a typical result. In this case 2% excess was obtained. In several experiments, small excess heat (less than 5%) was observed. However, we have not observed a clear excess heat (20% or more) during these runs.

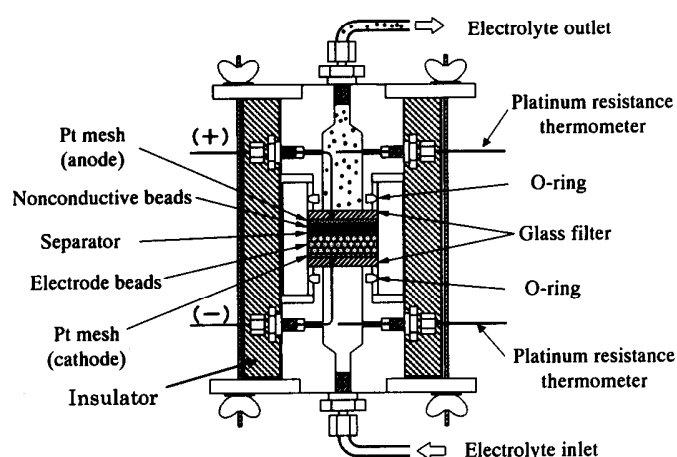


Fig.1 Electrolytic cell

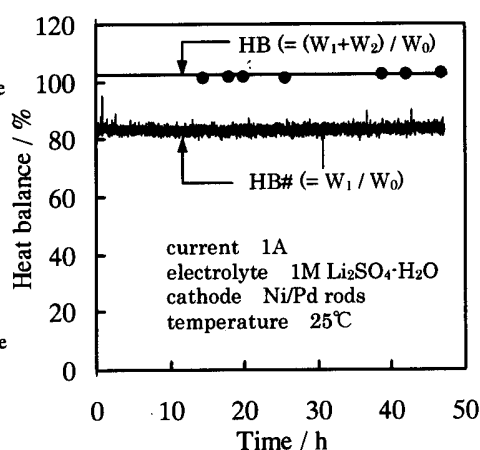


Fig.2 Heat balance

Analysis of Production Elements on Pd Surface after Light Water Electrolysis

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ABSTRACT

Various elements have been observed on several metallic cathode after light water electrolysis. It is thought that those elements may have been formed in a certain nuclear reaction on the surfaces. In this study, paying attention to avoid contamination which can be introduced during Pd sample preparation and during experiment, light water electrolysis carried out to analyze surface composition of Pd cathode after the electrolysis. The cells used for the experiment were made of the quartz and of polyethylene. These have a cylindrical shape with volume capacity of 200 and 550 cm³, respectively. A Pd foil of 0.1×5×10mm as the cathode and an 80-mesh Pt net as the anode were employed for this experiment. The electrolyte solution was 0.5 M sodium sulfate solution. The volume of electrolyte solution was 150-500cm³. The electrolysis was carried out for 14-30 days at a constant direct current 0.5 Amps. The constituting elements on the Pd electrode after electrolysis were identified by means of time-of-flight secondary ion mass spectrometry (TOF-SIMS). The SIMS measurement was carried out by Ga⁺ ion irradiation. The spectrometry was also performed after 10s sputter cleaning of the Pd surface with the Ga⁺ ion.

Most of elements observed in this study are those which have already been observed using Au cathode; Li, B, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn and Pb commonly observed by TOF-SIMS on the surface of Pd and Au cathode. Of particular interest is that considerable amount of Ba was observed using Pd cathode. Such elements detection suggests that a transmutation takes place on the surface of metallic cathode.

Nuclear Reaction Occurring in Light Water Electrolysis on Gold and Cobalt Cathode Electrode

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ABSTRACT

The nuclear transmutation reactions have been investigated by the electrolysis of light water with Au electrode and of heavy water with Pd electrode. In this experiment, two electrolytic cells made of quartz and polyethylene were used. The advantage of using polyethylene cell is that there are fewer possibilities for the electrolyte to be contaminated during electrolysis. These cells have a cylindrical shape with volume capacity of 200 cm³ and 500 cm³, respectively. Au and Co foils of 0.1×0.5×10 mm as the cathode and a 80-mesh Pt net as the anode were employed for the test. The electrolyte was 0.5 M sodium sulfate solution. The volume of electrolyte solution was ~ 150 cm³ for both cells. The electrolysis usually carried out for 14 days at a constant DC current of 0.5 Amps. Elements composition of the surface of cathode sample with and without electrolysis was analyzed by TOF-SIMS. The SIMS measurement was carried out by Ga⁺ ion irradiation. The spectrometry was also performed after 10s sputter cleaning of the cathode surface with the Ga⁺ ion.

The several common elements were observed for Au and Co cathodes as the result of SIMS analysis ; B, Mg, Al, K, Ca, Cr, Mn, Fe, Ni, Cu and Zn were detected from both the metal cathodes. The elements observed after electrolysis indicates that a nuclear reaction took place on the cathode surface.

Unexpected detection of new elements in electrolytic experiments with deuterated ethyl-alcohol, Pd wire, Sr and Hg salts.

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We have recently analysed, by ICP-MS instrument, several Pd wires and "after electrolysis powder" (see following details about), in order to test if some new elements are present, hopefully with an isotopic composition different from natural one. The analysis have been performed by a high resolution ICP-MS instrument (by YOGOKAWA Analytical Systems) specially calibrated at "low power plasma" in order to reduce the counts of fake signals due to interference of "peak sum" i.e. M/e (the true element to be detected) plus Ar, H, C, N, O, Cl and the usual M/2e and 2M/e. Obviously, the drawback of such kind of set-up is the complete loss of elements at low concentrations. The instrument is located at the, well known, Laboratories of "Centro Sviluppo Materiali" and we used, usually, such Laboratories as an external check of our results (double blind procedure) or specific chemical analysis (i.e. we pay for the work performed). Only very recently some Researcher decided to join our experimental activity because some problematic of their interest. The electrolyte we used was quite unusual, even in the framework of Cold Fusion studies. As reported in the recent papers published from us at ICCF8 and ICCF9, we used an electrolyte and experimental set up as following:

- heavy ethyl alcohol (C_2H_5OD) and heavy water (D_2O) mixture (typ. 93:7); volume about 750cc
- $SrCl_2$ or $SrCO_3 + DCl$, 10^{-4} moles
- $HgCl_2$, typ. $2-3 \times 10^{-6}$ moles
- D_2SO_4 , typ. 10^{-6} moles
- $Ba(OH)_2$, 10^{-6} moles, if necessary
- Pd, cathode, wire (long 60cm, diameter 0.05mm), U shaped to fulfil the borosilicate glass beaker "FORTUNA" (long 40cm, diameter about 5cm);
- Pt, anode, wire (long 60 cm, diameter 0.5mm);
- electrolytic current density at cathode: $10mA/cm^2$;
- Anode-cathode distance: about 5cm;
- AC current density along the cathode: $1000A/cm^2$ at 10kHz, square wave;

- Minimum cell temperature $24^\circ C$, cooling because flow calorimetry measurements (distilled water) at $0.2ml/s$.

The main solution, C_2H_5OD and D_2O are carefully, twice, vacuum distilled and, in situ, on line 100nm PTFE filtered in order to:

- strongly reduce the amount of unwanted salts usually dissolved in such heavy liquids;
- "eliminate" the bacteria, two new species (*Ralstonia detusculanense* and *Stenotrophomonas detusculanense*), discovered from us since 1999 (Ref. 1, 2) and we experienced can affect negatively the deuterium loading (Ref. 3), specially when the usual $LiOD$ (added to D_2O as electrolyte) is used at low concentrations ($0.001M$) or even not used at all.

We would like to notify that we performed, during a typical 2 weeks experimental run, several low-current ($2mA/cm^2$ for about 2 hours, finally $10mA/cm^2$ for about 10 minutes when the R/Ro value was as low as 1.1) anodic stripping in order to keep under control excessive coating of Pd surface by $SrSO_4$ salt and/or too much tick Hg-Pd amalgam.

Only recently we realised, by comparison of the results of SEM analysis of Pd surface (made at Pirelli Labs, the wire diameter is reduced from 0.05mm up to about 0.045mm) and the semi-quantitative (by ICP-MS) evaluation of Pd found in the "black powder" dissolved in the solution after the experiment is finished that, for some up to now unknown reason, the hydroalcoholic (Ref. 4) solution is very aggressive to Pd and even Pt surface. In other words, up to 10-20 % of total Pd wire mass is dissolved, and was found as a not soluble "black powder" in the solution. The previous effect, from the point of view of detection of new elements, is quite lucky because, if we suppose that the reactions happen mainly at the surface of Pd electrode, we "strip off" exactly this portion of the wire: the signal/noise ratio is maximised. In other words, the surface of Pd is the signal, the bulk is the noise. In short, we detected in the "black powder" of 2 experiments (over 13 analysed, 3 blanks included), that get interesting mean value of deuterium overloading ($R/Ro < 1.7$) for enough long time (several hours), measurable amounts of Molybdenum atoms (of the order of 8×10^{14} in experiment #10 and 3×10^{14} in experiment #11; detection limit 10^{12}).

The isotopic composition for powder coming from experiment #10 was quite similar to natural one except isotope 92 (expected 17.2%, measured 9.3%). The isotopic composition of experiment #11 was completely different from natural one: for almost all isotopes the relative difference was of the order of +50% and reached a value as large as 330% for isotope 100 (expected 9.6%, measured 31.5%); obviously, we considered also the possibility of peak sum due to ^{88}Sr and ^{12}C and discarded such effect. It is interesting to notify the experiment #11 was the same that give both excess heat and anomalous tritium production as reported in our paper at ICCF9.

The results look similar, for at least about Mo production and some anomalies in isotopic composition, to what reported from Y. Iwamura and co-workers of Mitsubishi Heavy Industries, (paper published by Japanese Journal of Applied Physics, Vol.41 July 2002, pp.4642-4650; a recent and very detailed paper presented at ICCF9) when they used a very sophisticated multi-layer of Pd-CaO-Pd-Sr and allowed flowing of deuterium gas for 2 weeks. They reported, in a qualitatively reproducible way, "transmutation" of Strontium at the surface into Molybdenum and moreover a large isotope increase at

mass 96 (according to them due to the effect of Sr at mass 88, 82.6% isotopic abundance + mass 8). Anyway, it is necessary to understand the reason of different "peaking" of isotopic differences between the experiments.

Moreover, there is some indication of large, (in experiment #10 was $9.7 \cdot 10^{15}$ and in experiment #11 was $2.9 \cdot 10^{15}$, in both accounting only for mass 48) Titanium "production", perhaps due to Pd fission as suggested from A. Takahashi and co-workers at Osaka University in a paper published by JJAP Vol.40 (2001), pp.7031-7046. Up to now, the results of analysis show a very large increase of mass that can be ascribed to Ti but with very weak isotopic anomaly. The work of analysis, and other experiments, are in progress and at the Workshop we will report the latest results.

ACKNOWLEDGEMENTS

We would like to notify that Dr. Naoto Asami and Prof. Kazuaki Matsui, now at Institute of Applied Energy of Tokyo (Japan), were the first people that realised about NON-inorganic pollution of heavy water during Cold Fusion experiments (NHE Project, 1999, Sapporo, Japan). Their observations were for us starting points for further analysis and stimulated us to strong changing of experimental set-up.

We are indebted to Prof. Piergiorgio Sona at CESI (Milan, Italy) because very long stimulating discussions and "warnings" about our, unusual, experimental set-up and electrolytes.

We deeply thank Prof. Akio Takahashi, (Osaka University, Japan), because useful suggestions and criticism related to the experimental set-up and unvaluable help on the analysis about the new elements that seem have been discovered.

REFERENCE

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- [2] D'Agostaro, G.A.F., Celani, F.J.V.A., (...) and Nakamura, M.: National Centre Biology Information: LOCUS: AF280434; 535 bp DNA linear BCT 19-JAN-2002 DEFINITION: *Stenotrophomonas detusculanensis*; ORGANISM: *Stenotrophomonas detusculanensis* Bacteria; Proteobacteria; gamma subdivision; Xanthomonas group; Stenotrophomonas. Submitted (20-JUN-2000) <http://www.ncbi.nlm.nih.gov>
- [3] F. Celani, A. Spallone et al.: "HIGH HYDROGEN LOADING INTO THIN PALLADIUM WIRES THROUGH PRECIPITATE OF ALKALINE-EARTH CARBONATE ON THE SURFACE OF CATHODE: EVIDENCE OF NEW PHASES IN THE Pd-H SYSTEM AND UNEXPECTED PROBLEMS DUE TO BACTERIA CONTAMINATION IN THE HEAVY WATER", Proceedings of the "8th International Conference on Cold Fusion", Lerici, Italy 21-26 May 2000; - Conf. Proc. Vol. 70 pg 181-190 Edited by F. Scaramuzzi; Compositori- SIF, Bologna, 2000; Italy. ISBN 88-7794-256-8

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Another Explanation of Pipe Rupture Incident at Hamaoka Nuclear Power Station Unit-1 from View Point of Cold Fusion

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Key words: hydrogen explosion, high concentration of hydrogen and oxygen, Hydrino

Introduction

An extraordinary powerful explosion took place at the Hamaoka nuclear power station unit-1 of Chubu Electric Power Company in Nov. 2001, resulting in a pipe rupture of the steam condensation line of the residual heat removal system. The cause of the incident is said to be hydrogen explosion, namely, combustion of stoichiometric mixture of hydrogen and oxygen accumulated in the residual heat removal system. Intensive research works have been carried out to reconstruct this strange combustion phenomenon and the final report was published. A close examination of this report suggests that high concentration of hydrogen and oxygen on noble metals at high temperature brought out so-called cold fusion.

Hydrino hypothesis

Dr. Randle Mills demonstrated that hydrogen atoms can achieve lower states than ground state by a resonant collision with a near by 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 atomic hydrogen, $m \times 27.2\text{eV}$ ($m=\text{integer}$) (1).

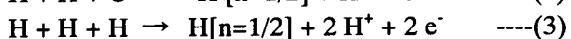
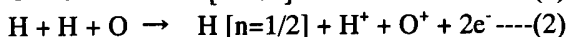
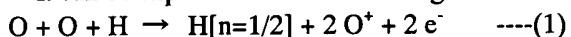
He named this shrunken hydrogen atom "Hydrino" and claims that this Hydrino can be a catalyst to shrink other hydrinos to further lower states. He succeeded in generating energy somewhat between chemical and nuclear reaction using water vapor plasma based on his hypothesis.

A catalytic role of atomic oxygen

The author postulated that atomic oxygen can be a good catalyst for "hydrinos" production because ionization energy of hydrogen and oxygen is very close as is shown below(2,3).

Hydrogen =13.598 eV, Oxygen =13.618 eV

It can be expected that the following reactions can take place:



$\text{H}[n=1/2]$ designates a hydrogen whose electron orbit is shrunken to 1/2 the radius of a normal one and these will be shrunken further as reaction continues.

Mechanism of anomalous explosion at the Hamaoka Nuclear Power Station

The investigation report the Chubu Electric Power made heavily relies on the simulated calculation in which the initial condition of gas contents in the pipe doesn't reflect the measured one. High concentration of hydrogen and oxygen on noble metals at high temperature is an ideal condition for initiation of cold fusion and this paper will give another explanation of the mechanism of anomalous combustion at the Hamaoka Nuclear Power Station from the view point of cold fusion.

Reference

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- (2) Yamamoto, H., Explanation of Anomalous Combustion of Brown's Gas using Dr. Mills' Hydrino Theory, SAE1999-01-3325
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Analysis on neutron induced fission of ^{235}U by SCS model

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[Keywords] U-235, neutron, fission, selective channel scission model, channel-dependent fission barrier

We have analyzed the nuclear transmutation of W, Au and Pd by multi-photon induced fission (MPIF) and selective channel scission (SCS) models. In the process of this analysis, the evaluation of calculation method of SCS model, in particular effective scission distance, is needed. Then, we have analyzed famous neutron-induced fission of ^{235}U to evaluate and to improve SCS model and have discussed the correspondence to multimodal random-neck rupture model.

The reason why the mass-distribution of fission product (FP) yield from thermal neutron fission of ^{235}U has two humps could be almost understood by SCS model in previous paper [1]. It is known that the FP yields from $n+^{235}\text{U}$ reaction are changed for incident neutron energies. To analyze this change of valley part of FP yield we improved the calculation method of SCS model. Treating the information of fission potential by one parameter η , that is the parameter concerning effective scission distance, the optimum data set of η is obtained to fit the mass-distribution of FP yields from neutron-induced fission of ^{235}U by thermal, 1 MeV and 14 MeV neutrons.

The FP yields for thermal, 1 MeV and 14 MeV were calculated by SCS model and compared to the experimental data. These analytical results were able to explain the incident neutron energy dependence for neutron-induced fission of ^{235}U . Fig.1 shows the consistence of SCS analysis for Z-A distribution of FP yield from thermal neutron fission of ^{235}U . And the correspondence to multimodal random-neck rupture model was understood. But in this analysis, the definition of the parameter η is different from the one in previous analysis [1] because of one parameter fitting. This correspondence will be discussed. These improvements will be applied to the analysis of nuclear transmutation phenomena.

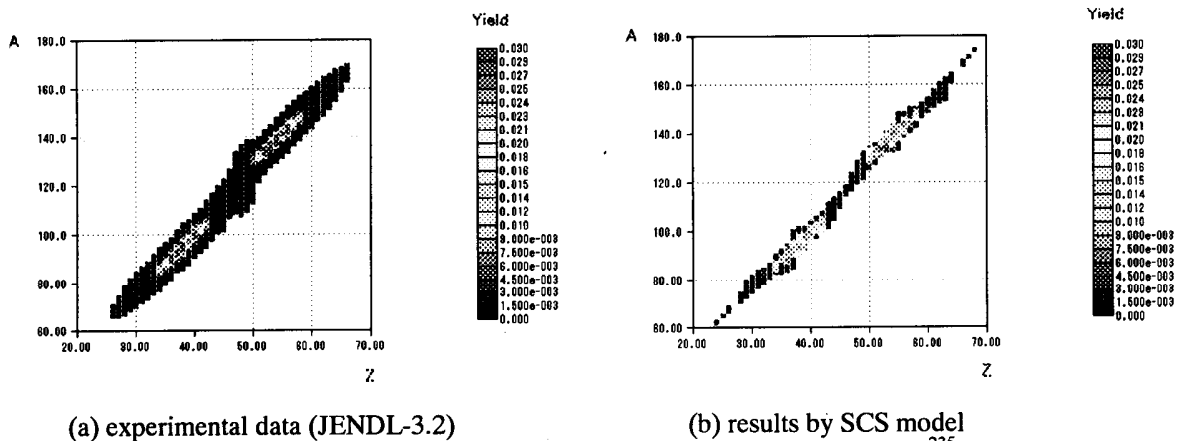


Fig. 1: fission product yields of thermal neutron induced fission of ^{235}U .

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Possible Nuclear Transmutation of Nitrogen in Atmosphere of Earth⁽¹⁾

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Toshiba Tungaloy

When we note a nitrogen composition of the atmosphere in all solar planets and their sixty-one satellites, we find that the nitrogen composition of these planets and satellites is considerably low (~6%) with exception of the Earth, Titan and Triton. On the other hand, the nitrogen composition of the Earth is extremely large (78%). The nitrogen amount of Titan and Triton would be less than 2- and 5x10⁻⁶% of the Earth one, respectively. Since solar interior rocky planets had formed by accretion of solid planetesimals in the same region of the developing solar system at almost the same time,⁽²⁾ we cannot imagine that abundance of nitrogen is derived from the planetesimals with abundance of nitrogen as the secondary atmosphere, after primary, captured atmosphere was released. Notwithstanding the consensus, a significant question for the origin of abundance of nitrogen has not been entirely resolved, and has been overlooked.

When we note carefully the variation of various atmospheric gases on the Earth's history, we find that the decrease in carbon dioxide composition is accompanied by a gradual accumulation of nitrogen into the atmosphere in Archean era (3.8 to 2.5 billion years ago), before the generation of atmospheric oxygen derived from photosynthetic activity by organic matters from around 2 billion years ago. The disappearance means formation of rocks and mantles containing carbon dioxide due to weathering of igneous rocks. The main parts of carbonaceous rocks are widespread at or near the Earth's surface. Thus, consumption of the carbon dioxide, *i.e.*, formation of carbonates, seems to correlate with formation of nitrogen.

Here we note a possibility of nuclear transmutation between carbon and oxygen atoms in carbonate crystals to form nitrogen under high pressure and temperature. The endothermic nuclear transmutation due to two-body confinement of carbon and oxygen nuclei in carbonate MgCO₃ lattice of mantle in Archean era (3.8 to 2.5 billion years ago) was explained by attraction effect (32% shrinkage) thanks to catalysis of neutral pions derived from electron emission,



based on neutral pion catalyzed fusion,⁽³⁾



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Neutron Drops and Production of Larger Mass-Number Nuclides in Cold Fusion Phenomenon (CFP)

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Production of the larger mass-number nuclides in the cold fusion phenomenon (CFP), i.e. nuclear reactions and accompanying events occurring in solids with high densities of hydrogen isotopes in ambient radiation, is investigated from a point of view based on neutron drops formed in the boundary region of materials used in experiments where new nuclides with larger mass numbers than nuclides preexisted in the system were observed.

The neutron drops are formed in the boundary region where neutron Bloch waves in the neutron conduction and valence bands in samples are reflected and where a large density of neutrons is formed by the local coherence of neutron waves with similar energies but different wave number vectors. The large density neutrons in the region results in a state with neutron drops including neutrons and a few protons imbedded in a thin background neutron gas, as shown by numerical simulations in the neutron star matter problem worked out in the early 1970's.

Existence of lattice nuclei in the CF matter such as PdH or PdD that are absent in the neutron star matter makes a difference in the two cases. Qualitative discussion on the effects of these lattice nuclei is given in favor of formation of neutron drops in CFP that makes the appearance of CFP rather complex than the case of neutron star matter.

Existence of neutron drops and surrounding thin neutron gas gives large effects on the lattice nuclei and minor nuclei in CF matters through the mutual interaction: 1) These nuclei absorb either one neutron, several neutron or a cluster of neutrons and protons to form new nuclides that give nuclear transmutations by decay (NT_D), by fission (NT_F) or by pure absorption stabilizing without change of nucleon and proton numbers (NT_A). 2) The NT_F includes productions of tritium, helium-4 and other light nuclei besides production of medium nucleon number nuclides facilitated by fission-barrier lowering. 3) The mutual interaction induces decay-time shortening of unstable nuclides formed through the interaction resulting in gamma-less nuclear reactions in CF materials.

The experimental data sets of NT_D (R.T. Bush (1992), Okamoto et al. (1994), Dash et al. (1994), R.T. Bush and Eagleton (1994), Savvatimova et al. (1994), Yamada et al. (1996), Passell (1996)), NT_F (Bockris and Minevski (1995), Miley et al. (1996), Mizuno et al. (1996), Ohmori et al. (1997), Yamada et al. (2002)) and NT_A (Miguet and Dash (1995), Kopecek and Dash (1996), Warner and Dash (2000), Yamada et al. (2002), Iwamura et al. (2002)) and decay-time shortening (R.T. Bush (1992, ^{40}K), Savvatimova et al. (1994, ^{107}Pd), Dash et al. (2002, ^{238}U)) are evidences of these reactions only explained by the assumed mutual interaction between pre-existing nuclides and formed neutron drops in the surface layers of CF matters.

Positive and negative excess heat evolution and corresponding new element production in the light water electrolysis at high current density on palladium electrodes.

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In the present study we investigated the excess heat evolution and the identification and isotopic distribution of the new product elements in the light water electrolysis at a high current density on palladium electrodes. Two types of the electrodes were used: one is no treated palladium sheet and the other is palladium sheet scraped its surface with a cleaned Pyrex-glass fragment. The excess heat evolution and the way in which the new elements are produced depended strongly on the surface treatment of the palladium electrode. The results were listed in Table 1.

It can be summarized as follows:

1. For no scraped electrodes, in general, the positive excess heat evolution was observed. Fe is a common major product element in this case.
2. For scraped electrodes the situation is much more complicated. One group generates positive excess heat for which the major product element is Fe, the other group generates both positive and negative excess heats for which the major product element is Pt however Fe is also observed as minor product element, and the remaining one electrode generates only negative excess heat for which the product

Table 1

Sample No.	Treatmmment	Excess heat	Product elements
106	Scrape	from -3 to +3 W	Pt (major), Fe (small)
108	Scrape	from -5 to -2 W	Pt(major)
113	Scrape	from -2 to +3 W	Pt (major), Fe (small)
114	No Scrape	from 2 to 7 W	Fe(major), Zn,K,Sn,Cd (small)
115	Scrape	from -3 to +1 W	K (major), Pt (small)
116	No Scrape	from -2 to +4 W	K, Fe (major), Cu,Zn, Sn (small)
117	Scrape	from 1 to 5 W	K(major), Fe, Zn (small)
118	No Scrape	from 3 to 11 W	Zn,Fe,K(major), Hg,Cd,Sn (small)
120	Scrape	from 0 to 6 W	Fe, K (major), Tl, Sn (small)
121	Scrape	from 4 to 12 W	Fe (major), Tl Zn, Ca (small)
122	No scrape	from 5 to 25 W ^{*)}	Fe, K(major), Zn,,Sn,Cd,Pb (small)

*) This heat was observed only in the critical electrolysis.

element is Pt alone.

These results show that the nuclear transmutation occurring on palladium is strongly dependent on the surface layer condition of this material, the characteristics of which is considered to be the cause of the poor reproducibility of the results of excess heat measurements tried so far by a number of researchers. However there is an unambiguous tendency that when positive excess heat is evolved the masses of main product elements are smaller than Pd while when negative excess heat is evolved the mass of the main product elements are larger than Pd.

The isotopic distribution of Pd atoms in the surface layers of the electrode material was strongly deviated from its natural isotopic distribution. Figure 1 shows one example of the isotopic distribution of Pd of a scraped electrode after the electrolysis (electrode 108). It is noted that the isotopic content of ^{108}Pd is significantly increased in particular in relatively deep layers. Such an isotopic deviation was also observed for the new product elements, e.g. Pt, Hg, Fe, etc.

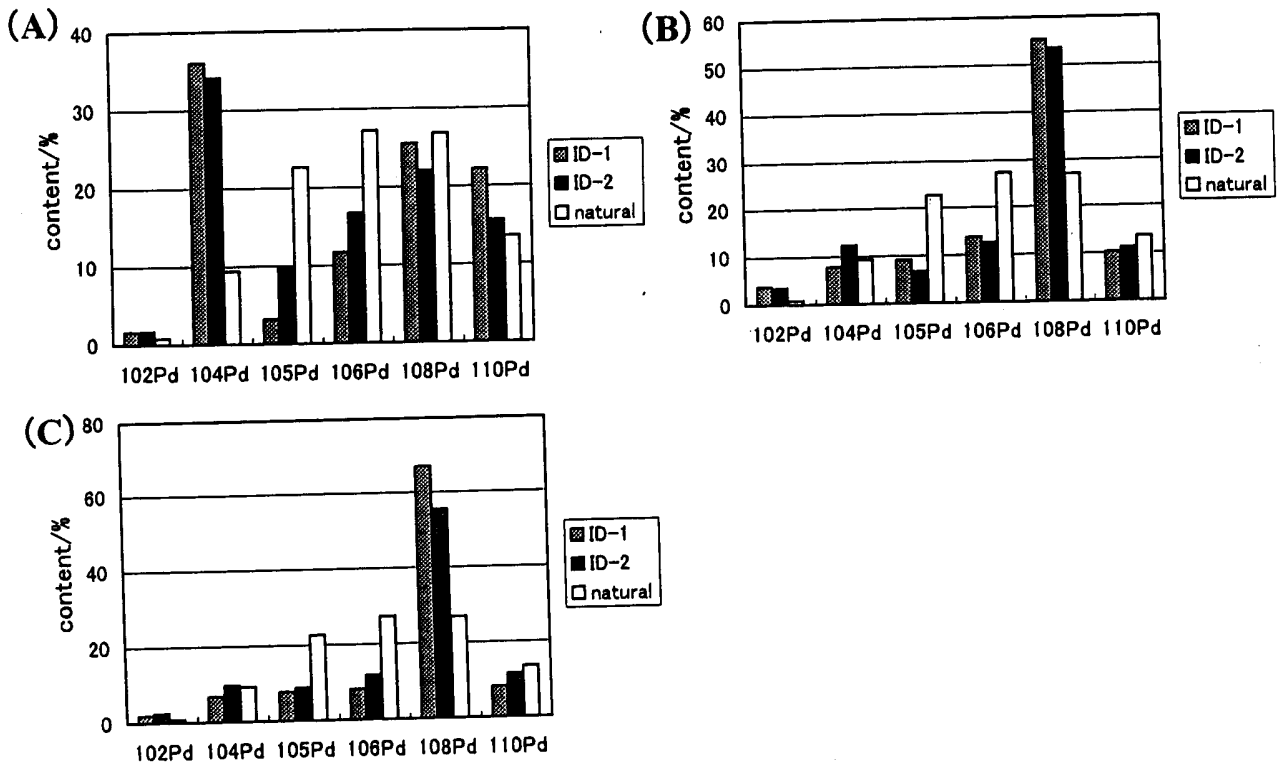


Figure 1.

Isotopic content of Pd on the surface layers of the electrode after the electrolysis of a Pd (scraped) electrode (electrode 108) in 0.5 M $\text{K}_2\text{CO}_3/\text{H}_2\text{O}$ solution measured at different two parts of the electrode (ID-1 and ID-2 bars) by means of ToF-SIMS. Sputtering time: (A) 0, (B) 30 sec, (C) 120 sec. (natural bar) means natural isotopic abundance of each isotope of palladium.

Confirmation of anomalous hydrogen generation by plasma electrolysis

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Abstract

We have already reported the anomalous heat generation during plasma electrolysis. Some researchers have attempted to replicate the phenomenon; however, it was difficult to generate the large excess heat. Usually, the Plasma State could be easily started if the input voltage had been increased up to 140V at rather high temperature electrolysis cell by adding an electrolyte. They are tending the input voltage upward to very high something like several hundred Volts. But they have observed no excess heat even if the input voltage was kept several hundred volts. At the moment so much vapor and the hydrogen gas would be released from the cell. It is difficult to calibrate the exact heat balance. Especially, heat release and the gas release are complicated and difficult. Here, we can show the anomalous hydrogen gas generation during the plasma electrolysis. At the same time the gas bring the excess heat out of the measurement system. We are going to point out the heat measurement during the plasma electrolysis. It is very important to replicate the excess heat and other product during the electrolysis.

The amount of hydrogen and the oxygen generated by electrolysis is under the Faraday's law, and the volume of these gas are $0.116\text{cc}/Q$ for hydrogen and $0.0581\text{cc}/Q$ for Oxygen at the standard condition. Of course, this yield might be changed from the law for the case of electrolysis at a high temperature because the direct pyrolysis process can be occurred. However, it can not be occurred in the case at the usual condition because the pyrolysis process is predominantly at the temperature exceeds to 1000°C . The gas mixture of hydrogen and steam are formed on the surface of the cathode electrode when a plasma is formed if electrolysis is taken by high input voltage up to 100V in an aqueous solutions. The generation of hydrogen, which exceeds the Faraday law, is observed when the conditions such as temperature, current density, input Voltage and electrode surface are suitable. The condition of the over unity generation of hydrogen gas is still under studying, then also the controlling is difficult, and the report of claim of the observation for the excess hydrogen is very few.

Studies of Photon Source for Multi Photon Induced Fission under Plasma Electrolysis

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[Keywords] plasma electrolysis, multi-photon absorption, photo fission, x-ray burst

1. Introduction

There are many reports that excess heat and nuclear transmutation were observed by CF experiments¹⁾. To explain the observed results, the Multi Photon Induced Fission / Selective Channel Scission (MPIF/SCS) model was proposed²⁾. This model supposes the existence of intense bursts of photons with energy less than 5MeV, which induce nuclear collective excitation of cathode metal nuclei by multi-photon absorption to lead to fission channel. For example, we require photon source emitting random bursts of 1-100 keV photons (X-ray region) in short pulse (less than 10^{-9} s) with very high peak flux (more than 10^{28} photons $\text{cm}^{-2} \text{s}^{-1}$). We have thought that the plasma region produced by electric discharge in electrolyte may provide such photon source due to the mechanism similar to X-ray laser generation, and then excite cathode metal nuclei to make them fission. The aim of present work is to search such X-ray bursts from plasma electrolysis experiments.

2. Experiment

The plasma electrolysis was conducted on the tungsten cathode in $\text{K}_2\text{CO}_3/\text{H}_2\text{O}$ electrolyte. The anode is made of nickel mesh, and the electrolytic cell is made of glass.

The measuring instruments were set up for detecting X-ray emission and for spectroscopy of light under electric discharge. A HPGe semiconductor detector was used for detecting X-ray, and a monochromator was used for spectroscopy of visible light.

3. Results

In this work, we measured X-rays and gamma rays during plasma electrolysis, and observed continuous spectrum in 10-50 keV region. The origin of most count might be electromagnetic noise from thin plasma layer formed around the tungsten cathode. But there were other possibilities that X-rays from speculated photon source and bremsstrahlung X-rays from scission fragments were buried under noise spectrum. Identification of X-ray is under way using the filter technique. We report here experimental results about measurement of X-rays and spectra of light emission.

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Studies of neutron emission by alternate electrolysis of heavy and light water with loading of deuterium into palladium

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[Keywords] neutron, He-3 counter, NE213 detector, alternate electrolysis, D₂O, H₂O

Introduction:

Repeated events of neutron burst emission were reported by Mizuno et al [1]. Their treatment was that at first Pd cathode was electrolyzed in heavy water cell to absorb deuterium and then the Pd cathode was transferred to light water cell to make alternate electrolysis.

In this work, we have also performed a replication experiment of alternate electrolysis of deuterium/hydrogen system with palladium cathode. We call these the electrolysis series experiments. To know D(H)-loading ratio reflecting results of electrolysis series, we measured cathode resistance. We call these experiments the resistance measurement series.

Experiments:

For the setting-up of the electrolysis series experiments, Pd wire was used as the cathode. Sample cathode was welded to Ni lead wire which was covered with a teflon tube. And a Ni wire was used as anode. The electrodes were set with a silicon lid. The electrolytes were K₂CO₃-D₂O solution and K₂CO₃-H₂O solution. At first the silicon lid was equipped with heavy water cell. After several hours electrolysis, a silicon lid set-up was transferred to light water cell. To measure neutrons, we used a He-3 counter and an NE213 detector.

On resistance measurement series setting, we constructed four-terminal network with a miliohmmeter.

Results:

By the electrolysis series experiments, during electrolyses in light water cell, we observed neutron count rates a little increased on He-3 counter. It is suggestive that electrolysis voltage change stimulates neutron emission as Mizuno reported [1].

By the resistance measurement series, we observed that resistance ratio curves sometimes formed oscillatory projections.

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PROBLEMS IN CALORIMETRY OF SUBMERGED CARBON ARC

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Thermal energy produced by carbon arc in water was measured by the calorimeter presented in JCF3. Larger heat loss through the carbon rod was to be estimated by measuring temperatures of two points located outside and inside of the vessel, however, this scheme had to be abandoned due to the fact that the outside temperature was much higher than inside at arc-on state; Energy loss at arc-on and that at arc-off are nominated as dynamic loss (DL) and static loss (SL), respectively, hereafter. At present, measurement of DL seems to be impossible, however, G obtained without DL gives us interesting information as follows:

- (1) G has considerable temperature dependence.
- (2) G has values of over unity in a wide temperature range often accompanied with under unity values at around room temperature and at around 90 °C.
- (3) The highest value of $G = 2.6$ was obtained at around 50 °C.

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JCF4-15 Reaction yield enhancement under deuterium ion irradiation of dueterated Au/Pd samples

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Three-body reactions of low energy deuterons/deuterium(D), *i.e.*, $DD(d,^4\text{He})pn$, $DD(d,^4\text{He})d$ and $DD(d,^3\text{He})t$, have been claimed to take place with great enhancements in metal deuterides. Nuclear transmutations in a variety of samples have also been reported from many laboratories. The latter include experiments on forced permeation of D through a multilayered film of Pd and Cs. These observations suggest that the density and mobility of D in metals is one of the most important parameters for occurrence of the apparently anomalous phenomena.

We try to control the D transmission current and density in Pd under ion beam irradiation. One side of the sample exposed to vacuum is irradiated with low energy atomic/molecular ion beams of D, while the other side is exposed to D_2 gas at variable pressures.

A Pd sample coated with a 22nm-thick gold layer (Au/Pd) is irradiated with 15-keV D_2^+ after deuterium loading by exposure to D_2 gas at a pressure of 1.0×10^5 Pa. Figure 1 shows the reaction yield enhancement; the evolution of the normalized yield $Y_n = Y_m/Y_c$ for the $D(d,p)T$ reaction during 15-keV D_2^+ irradiation of the Au/Pd sample up to a fluence of $1.9 \times 10^{19} \text{ cm}^{-2}$, where Y_m and Y_c are the measured yield and that calculated with the TRIM85N code, respectively.

The Au/Pd sample has been subjected to elastic recoil detection analysis (ERDA) and Rutherford backscattering spectroscopy (RBS) to clarify the deuterium density in the Au/Pd sample reaching $3.5 \times 10^{22} \text{ cm}^{-2}$ corresponding to a composition $PdD_{0.5}$ and formation of a mixed layer of Au and Pd. This suggests that the Au/Pd layer not only contributes to maintain high D density under irradiation but also induces enhancement of the reaction cross section.

We have also examined clustering effect of the irradiation beam by comparing the yield under irradiation of the sample with 26-keV D_2^+ and 13-keV D^+ ions up to a D fluence of $6.4 \times 10^{17} \text{ cm}^{-2}$ under the same condition. The Y_n in the former case 10 times greater than that in the latter case has been observed, which suggests that the enhancement of the reaction cross section depends on the density of the projectile.

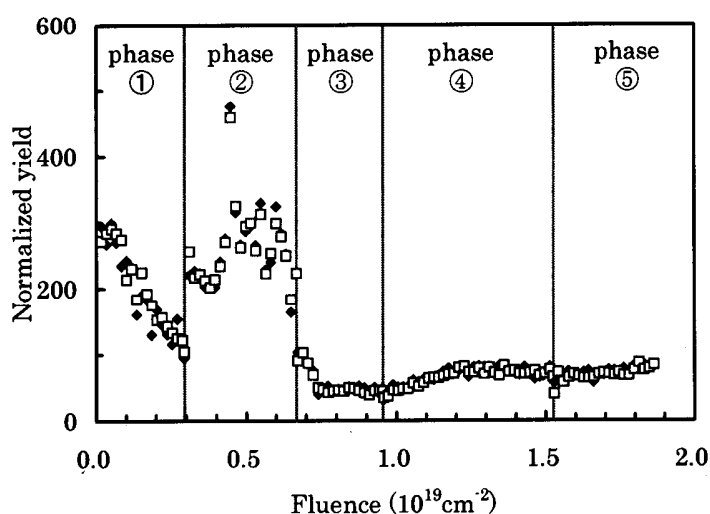


Fig.1. Evolution of the normalized yield Y_n of $D(d,p)T$ protons from a deuterated Au/Pd sample under irradiation of 15-keV D_2^+ ions.

**Observation of Low Energy Nuclear Reaction
Induced by D₂ Gas Permeation through Pd Complex(1)
- Confirmation of Nuclear Products using XANES and TOF-SIMS -**

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Keywords: Cs, Sr, Pr, Mo, Pd, Transmutation, XPS, XANES, TOF-SIMS

We have already reported on observation of low energy nuclear reactions induced by D₂ gas permeation through Pd complexes, which consist of a thin Pd layer, alternating CaO and Pd layers and bulk Pd⁽¹⁻⁴⁾. The Pd complex was located in a vacuum chamber and the elemental analysis was performed using an X-ray photoelectron spectroscopy (XPS) apparatus mounted on the chamber. When Cs was added on the surface of a Pd complex, Pr emerged on the surface while Cs decreased after the Pd complex was subjected to D₂ gas permeation at 343K and 1atm for about one week. In the case of adding Sr on the surface, Mo emerged on the surface while the added Sr decreased after D₂ permeation for about two weeks⁽¹⁻⁴⁾.

In order to confirm that the elements observed by XPS are Pr and Mo by another analysis methods, we performed the following analysis. (1) X-ray absorption near edge structure (XANES), (2)TOF-SIMS, (3)ICP-MS.

First, we examined the sample after experiments using XANES. We use beam line BL-9A(for Pr analysis) and BL-12C(for Mo analysis) of KEK(High energy Accelerator Research Organization) and detected Pr L_{III}-edge absorption and Mo K-edge. We identify the elements on the sample as Pr and Mo certainly.

The next analysis is TOF-SIMS. We investigate the sample of Cs transmutation experiments by TOF-SIMS device (TRIFTTM II ;ULVAC-PHI). We detected the element of ¹⁴¹Pr and confirm Pr exist on the sample by TOF-SIMS analysis. We, furthermore, perform analysis of Pr distribution on the surface. The result shows that Pr distributed almost uniformly.

In addition, we analyzed amounts of products of Pr by ICP-MS and obtained the data that Pr existed more than 1 ng. Details will be presented in next paper. It can be said that these results clearly indicate that the products on the surface are Pr.

Since these analysis support strongly that Pr and Mo exists on the surface of the sample after experiments, we confirm more certainly the results that Cs transmuted into Pr and Sr into Mo.

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**Observation of Low Energy Nuclear Reaction
Induced by D₂ Gas Permeation through Pd Complex(2)
- Quantitative Analysis of Pr using ICP-MS -**

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Keywords: Cs, Pr, Pd, Transmutation, XPS, ICP-MS

We have already reported on observation of low energy nuclear reactions induced by D₂ gas permeation through Pd complexes, which consist of a thin Pd layer, alternating CaO and Pd layers and bulk Pd⁽¹⁻⁴⁾. Experimental procedure is as follows. We added Cs on the surface of Pd complex by applying electric field in 1mM CsNO₃ solution. The sample was located in a vacuum chamber and the elemental analysis was performed using an X-ray photoelectron spectroscopy (XPS) apparatus mounted on the chamber. In the report, we presented that Pr emerged on the surface while Cs decreased after the Pd complex was subjected to D₂ gas permeation at 343K and 1atm for about one week⁽¹⁻⁴⁾.

In order to estimate amounts of nuclear products Pr, we performed ICP-MS analysis. ICP-MS analysis has advantage in terms of quantitative analysis and high sensitivity, though it is destruction test. We used the following procedures in this analysis. First, we melt the sample with 10N-HNO₃ (Tama-Pure; TAMA KAGAKU co.) and make solution that contains elements – Pr, Cs, Pd, etc.- on the surface of the test piece. Next, we introduced the solution into ICP-MS device; (SPQ9000; SEIKO) and analyze amount of Pr.

We carried out about 30 times experiments and examined samples after experiments. Pr was detected in all samples. Reproducibility of these experiments is very good. We, further, obtained the data that amounts of Pr are from 1 to 50 ng. Each data exceeds detection limit (0.1ng) and Pr signal of ICP-MS has significant intensity. Of course, we checked background samples on which Cs was added, however, that were not subjected to D₂ permeation. It was found that Pr did not exist in the samples. We performed a comparative experiment using H₂ gas for a Pd complex test piece and did not detect Pr. This results shows that deuterium is necessary for observation of this phenomena and agree with previous report^(1,2). In concluding, these results strongly support that Cs transmuted into Pr induced by D₂ gas permeation.

[REFERENCE]

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Analysis of Nuclear Products in Hydrogen Penetration through Palladium

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Mitsubishi group has reported observation of elements production in deuterium permeation experiment with a multilayer palladium (Pd) film [1]. They showed a certain rule of nuclear transmutation, that is, 8 mass number and 4 atomic number increase in the process. This method has an advantage of minimizing contamination to the sample, which is preferably used in investigating small amount of elements. We performed the similar method to theirs using hydrogen with Pd plate and searched for nuclear products as a result of the low energy nuclear reaction.

The Pd plate sample (0.1x12.5x12.5mm or 0.3x12.5x12.5mm) was washed by aqua regia and set into the holder placed between the upper and lower stream chambers. Hydrogen gas was introduced into the upper chamber with the pressure up to 1-10 atm, and it moved downstream passing through Pd plate. In the former system, the sample surface of the lower stream side faced on the atmosphere. Now, we modified the lower stream chamber to be evacuated. This modification prevented the sample from being contaminated from the atmosphere. After a certain term (1-2 weeks), the sample was taken out and the gas remained in the sample was unloaded. The sample surface was analyzed by Time-of-Flight Mass spectroscopy (TOF-SIMS) and compared the composition of the elements on the sample before and after experiment. We found ^{56}Fe and ^{63}Cu only after experiment. These elements could be produced during the experiment. Anomaly in isotopic distribution has been also claimed in several experiments, so, we investigated it for the elements detected.

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Observation of Heat Evolution with Palladium Hydride in the Evacuated Chamber

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[Abstract]

The controlled gas out-diffusion in the evacuated chamber was performed using palladium (Pd) hydride. We prepared the square Pd plate sample ($0.3 \times 12.5 \times 12.5$ mm or $0.1 \times 12.5 \times 12.5$ mm). It was washed by aqua regia. After that, one side of the Pd surface was covered with MnOx or Au film by sputtering ($200\text{\AA} \sim 800\text{\AA}$ thickness). The hydrogen gas was loaded to the sample under 10 atm pressure for 72 hours. The loading ratio (H/Pd) was measured to be about 0.7 typically. The sample was set into the stainless steel vacuum chamber, then it was evacuated to 10^{-4} Pa. The sample was supplied a constant current (about 4A) by a DC power supplier. During the experiment, temperature of the surface of the sample was measured by thermocouple. The gas in the chamber was analyzed by a quadrupole mass spectrometer system (Q-mass). Current, voltage, and pressure in the chamber were observed simultaneously. The experiment continued for about 100 hours for 0.3mm thickness sample, and about 24 hours for 0.1mm thickness sample.

Anomalous heat evolution was observed after 2~3 hours of flowing current. Since the current showed a constant, temperature rises were not due to Joule heat. At the same time, the pressure in the chamber showed explosive release of the gas. The composition of released gas was analyzed by Q-mass. It showed increase of ion currents for mass number 1, 2, and 3 on the gas diffusing. Each mass number should correspond to H, H_2/D , and $^3\text{He}/\text{HD}/\text{T}$ respectively. The ion current for mass number 3 showed larger increase than that for other two signals. Therefore it was not originated from only HD but also T and/or ^3He . It was possible that T and/or ^3He were produced concurrently with the heat evolution.

In this experiment we purposed of clarifying the mechanism of heat evolution by changing the film material and the combination of the thickness of sample and film. We will also discuss about the nuclear products by analysis of the sample surface.

Gamma Ray Measurement and Surface Analysis on Deuterated and Hydrated Palladium Electrodes under DC Glow-like Discharge.

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Abstract

The possibility of inducing nuclear reactions at low temperature has been investigated by electric discharge for several years. The discharge cell made by Pyrex glass was employed in this study. Two adapters and a valve were jointed to the upper part of the cell. An Au foil was used as the anode and a rectangular palladium foil as the cathode. The cathode was supported by an Au wire with a quartz cylinder surrounding it to avoid any movement of the samples during the experiments. The gap distance between two electrodes was 10 mm. The advantage of using Pyrex glass material compared with metal is that there are fewer possibilities for palladium samples to be contaminated during the sputtering process by glow-like discharge. The samples were exposed to discharge of 2-4 mA, voltage 4000-7000 V, pressure ~1 atm for a duration time of 60 min.

A NaI scintillation counter was used to detect the gamma ray emitted from the samples. In the gamma ray measurement, signals which are different from the background was observed in 4 runs out of total 13 runs for deuterium-palladium system. For deuterium-palladium system, the peaks in the gamma ray spectrum corresponds to 227 keV, 105 keV and 150 keV, 73 keV and 118 keV, 170 keV. To the contrary, such signals were not observed in hydrogen-palladium system for total 12 runs. The glow-like discharge experiment in air at 1 atm also did not show any peaks in the gamma ray spectrum.

The surface composition of palladium cathode was analyzed before and after DC glow-like discharge experiments by TOF-SIMS. For deuterium-palladium system, a change of isotopic distribution of Mg was observed on the surface of discharge side even though the change was observed at one area out of three detection areas. Moreover, a peak in the gamma ray spectrum, corresponding to 227 keV, had been observed using this palladium sample before the TOF-SIMS analysis.

The gamma ray radiation during deuterium-palladium system experiments indicates the possibility of a nuclear reaction.

DRASTIC ENHANCEMENT OF D-CLUSTER FUSION BY ELECTRONIC QUASI-PARTICLE SCREENING

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To explain major claims of "cold fusion" experiments e.g., He-4 generation in correlation with excess heat and transmutation¹⁾ with increases of mass 8 and Z (atomic number) 4, we have proposed the tetrahedral (TRF) and octahedral resonance fusion (ORF) model of deuterons in lattice dynamics²⁾. Under the transient condensation of deuterons in focal points of PdDx lattice, *bosonization* of electrons in very short time interval (few ps) was assumed²⁾ due to strong phonon-electron coupling via PdDx ($x>1$) lattice plasma oscillation to form quasi-particles, $e^*(2,2)$:Cooper pair and (4,4):quadru-coupling, which could drastically enhance d-d (2D), 3D, 4D and 8D fusion rates. A quantitative discussion is given in this paper.

For dde^* and dde^*e^* molecular states, screened potentials were calculated by solving Schroedinger equation with Coulomb + nuclear potential. Born-Oppenheimer approximation was applied, and shielded potential as a function of inter-nuclear (d-d) distance was obtained by variation method. Results for dde^- : $e^*(1,1)$, heavy electron $e^*(2,1)$ and Cooper pair $e^*(2,2)$ are shown in Fig.1 and barrier penetration probabilities (BF) for a d-d pair in condensing D-cluster were estimated. Transient deep potential hole (~ 180 eV by Cooper pair and ~ 1.8 keV by quadru-coupling) strongly attracts and condensates D-clusters (4 deuterons for TRF and 8 deuterons for ORF) within 80 fm domain. By assuming that more than two electrons per each deuteron were squeezing at focal points, approximate BF-values were obtained for 2D, 3D, 4D and 8D multi-body fusion in condensation, assuming superposition of cascade processes of two-body reactions in very short time interval less than 1 fs.

Resonant behavior of strong interaction in multi-body fusion reaction was modeled²⁾ based on the three-dimensional geometrical symmetry of charged pion exchange between two deuterons for 3D, 4D and 8D(equilateral octahedron)-

cluster fusion. Effective S-values for 3D, 4D and 8D resonance fusion were then empirically estimated by extrapolating known S-values of H-D, D-D and D-T fusion reactions.

Approximate orders of fusion rates were then obtained for 2D, 3D, 4D and 8D fusion, for cases of bare (no electrons), e^- (electron), e^* (Cooper pair) and e^* (quadru-coupling). Typical results of calculated fusion rates (per cluster) are shown in Table-1.

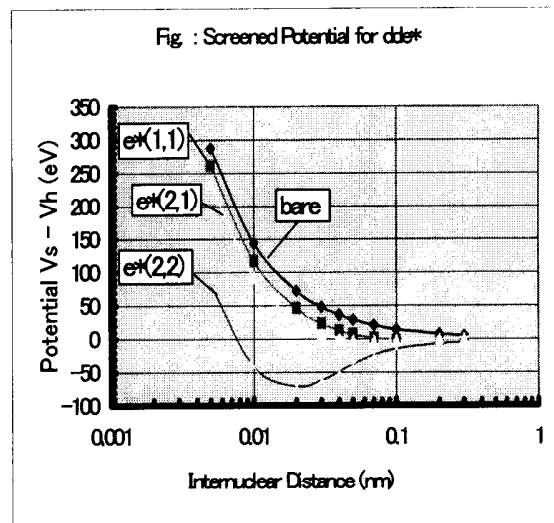


Fig. 1: Screened potential for dde^*

Table-1: Fusion Rate (FR) for D-cluster

(m/m _e , Z)	FR: 2D (f/s/cl)	FR: 3D (f/s/cl)	FR: 4D (f/s/cl)	FR: 8D (f/s/cl)
(1,1)	1E-137	1E-193	1E-252	1E-499
(2,2)	1E-20	1E-17	1E-17	1E-29
(4,4)	1E-16	1E-11	1E-9	1E-13

It is shown that 4D fusion reaction rates could exceed 10^{11} f/s/cc (1W/cc) level, assuming time-averaged cluster density of 10^{20} cl/cm³ level, with the existence of quadru-coupling and produce major product of ⁴He, with significant high energy ⁸Be by 8D fusion. We conclude that *generation of superconductivity-condition (quasi-particles) is key to CF phenomena.*

1) Y. Iwamura, et al: paper to ICCF9, and July 2002 issue of Jpn. J.Appl. Phys., 7A

2) A. Takahashi: Tetrahedral and octahedral resonance fusion under transient condensation of deuterons at lattice focal points, Proc. ICCF9, May 19-23, 2002, Beijing China

Mass-8-and-Charge-4 Increased Transmutation by Octahedral Resonance Fusion Model

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The Mitsubishi H. I. Group has reported¹⁾ extraordinary transmutation results, namely production of mass-8-and-charge(atomic number)-4 increased elements (Mo-96 and Pr-141) from Sr-88 and Cs-133 thin zone on Pd/CaO/Pd multi-layered film under deuterium permeation. By applying Takahashi's theoretical model^{2,3)} of tetrahedral (TRF) and octahedral resonance fusion (ORF) with transient quasi-particle e^* (Cooper pair and quadru-coupling) generation in PdDx lattice dynamics, we attempt to explain the underlying physics of the observation.

The CaO layer (100 nm thick) is considered to make significant gap of Fermi levels in the interface region between CaO and thin (40 nm) Pd layer on which about 2 nm thin test sample (Sr or Cs) zone was made. Constant D-flow from sample zone to backing thick (0.1 mm) Pd zone would continue to satisfy overloading (PdDx, $x > 1$) condition in the thin surface zone of Pd, where local superconductivity condition generating e^* can be expected due to strong phonon-electron (Pd 4d shell) coupling by D-plasma oscillation (about 10^{14} s⁻¹ frequency), in transient dynamics of D-cluster condensation at t- or o-sites²⁾. Celani reported⁴⁾ anomalous reduction of resistance of Pd-wire under overloading PdDx condition, and we conceive that was the occurrence of superconductivity.

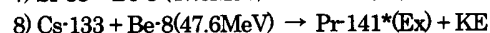
Very deep (-180 eV by Cooper pair and -1800 eV by quadru-coupling) transient potential holes, born by the generation of e^* , strongly attract electrons and D-clusters (4D for TRF and 8D for ORF). At the case of more than two e^* generation per 8D cluster, 8D cluster can condense within 80 fm domain where quantum mechanical tunneling interaction of simultaneous multi-body fusion²⁾ may be drastically enhanced in competition of the following reactions;

- 0) $2D \rightarrow n + {}^3\text{He} + 3.25\text{MeV}, p + T + 4.02\text{MeV}$
- 1) $3D \rightarrow \text{Li-6}^* \rightarrow t + \text{He-3} + 9.5\text{MeV}$
- 2) $4D \rightarrow \text{Be-8}^* \rightarrow 2\text{xHe-4} + 47.6\text{MeV}$
- 3) $5D \rightarrow \text{B-10}^* (53.7\text{MeV})$
- 4) $6D \rightarrow \text{C-12}^* (75.73\text{MeV})$
- 5) $7D \rightarrow \text{N-14}^* (89.08\text{MeV})$
- 6) $8D \rightarrow \text{O-16}^* (109.84\text{MeV}) \rightarrow 2\text{xBe-8} + 95.2\text{MeV}$

Because of resonant strong interaction by

3-dimensionally symmetric pion exchange²⁾ for TRF and ORF process, 2D, 3D, 4D and 8D fusion reactions are selectively enhanced. Especially with the existence of plural quadru-coupling $e^*(4,4)$ quasi-particles, 8D fusion process can be winner of the competition and generate very high energy Be-8 particles (47.6MeV).

Be-8 particles with 47.6 MeV high kinetic energy make easy secondary capture (fusion) reaction with existing heavy nuclei as Sr-88 or Cs-133, due to large contact surface of Be-8 deformed nucleus and Sr or Cs nucleus for high energy fusion process, as



Considering a liquid drop like character of above collision processes, the very high kinetic energy of Be-8 may be transferred to kinetic energy (KE) of Mo-96 or Pr-141, which may be deposited to lattice phonon energy by heavy particle slowing down process, without hard X- or gamma-ray radiation.

The process is illustrated in Fig.1;

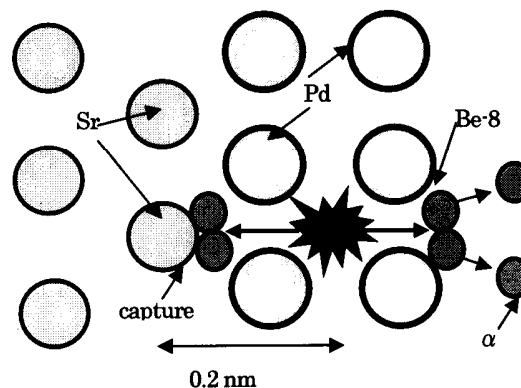


Fig.1: What happens near interface

1)Y. Iwamura, et al: observation of low energy nuclear reactions by D₂ gas permeation through Pd complexes, Proc. ICCF9, May 19-23, 2002, Beijing, China; also see Jpn. J. Appl. Phys., July issue 2002, 7A

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Nuclear fusion and the structure of nuclei

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Key words: nuclear fusion, nuclear structure, proton repulsion, tunnel effect, analogical existence, molecular crystalline structure, atomic structure

In studying the mechanisms of nuclear fusion, there are external and internal factors, and at academic conferences the author has proposed that collisions due to superconductivity and Einsteinian Bose contraction in cracks are an external factor. Internal factors are thought to lie in the structure of the atomic nucleus, as is also propounded in this paper.

Before we had knowledge of nuclear bonds, we knew of atomic bonds and molecular bonds. The author has long considered nuclear bonds on analogy with atomic and molecular bonds.

Molecules form crystals through bonds between atoms, and when the configuration of such a crystal is one of Plato's regular polyhedrons, it exhibits strength and stability. It was hypothesized by Matthias Brack that the configuration of bonds between atoms due to electron bonds were Plato's regular polyhedrons. As the author announced in Cold Fusion in 1996, it is believed that the structure of the nucleus is formed by nucleon bonds, and that the configurations thereof are Plato's regular polyhedrons.

These three stages of areas of existence can be said to have energy levels and a regular-polyhedron structure in common. As long as there is no vacancy in the energy levels, then no matter how bonding is attempted, even if the tunnel effect is large, the structure does not accept it, and so no bonding occurs.

For nuclear bonds as well, vacancies naturally occur in nucleons, and when in order to form a polyhedral structure it is necessary to fill such a vacancy with a nucleon from another nucleus, nuclear bonding readily takes place. That is to say, when the polyhedral structure breaks down, the unstable nucleus pulls a nucleon from another nucleus into the vacancy, forming a bond. This force that pulls a nucleon into a nucleon hole overcomes the Coulomb barrier. It is, in reality, what is known as the tunnel effect.

**A Possible Model for the Nuclear Reactions in Metal Vacancy
Induced by Bose-Einstein Condensation**

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It is known that deuterons are trapped in metal vacancy. This means that Bose-Einstein condensation (BEC) will happen at the vacancy deuterons complex, because deuterons can be regarded as bosons. If it happens, deuterons are condensed and nuclear reactions may be induced in metal vacancy. In this work, we made a possible model for the nuclear reactions in metal vacancy induced by BEC.

The quantum states of deuterons in metal vacancy can be estimated by using the equivalent linear two-body (ELTB) method, which is based on the approximate reduction of many-boson problem through the variational principle. We applied Kim's method¹⁾ to this problem and get ELTB ground state wave function numerically. The harmonic potentials are used for this problem, because deuterons are confined in spherical vacancy. This is same with Kim's problem for the bosons confined in an ion trap device.

The ELTB ground state wave function gives the nuclear reaction rate R , the number density n of deuterons condensed in a vacancy and the transition temperature T_c of BEC. If the temperature of the system is lower than T_c , BEC happens and the nuclear reaction is induced whose reaction rate is R . In this work, they were calculated as a function of the number of deuterons trapped in a vacancy. We also estimated the case of deuterons in combined vacancies, which is called as void.

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Rational basis of the nuclear fusion reaction at very low energy

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One of the most important achievements in science in 20th century is the discovery of the quantum mechanics and its extension to the quantum field theory. With these theories, we can compute various quantities which can be compared with experiments. For example, in the Lamb shift of the hydrogen-like atom or in the anomalous magnetic moment of the electron (or of the muon), the agreements of the theory and experiment are very high; 7 to 8 digits. Since the limit of the domains of applicability of these theories are 100GeV. or more, and the characteristic energy of the nuclear reaction is around 10MeV., the nuclear fusion reaction, which we are considering, must be understood in framework of the quantum theory. Therefore it is not acceptable to alter the quantum principle in order to explain a single phenomenon.

One of the important and useful feature of the quantum mechanics is that two phenomena, whose characteristic wave lengths (or the energies) differ by several order of magnitude, can not interfere. Therefore arguments that nuclear reaction may be changed drastically in lattice, need careful check before we believe in such conclusions, because the characteristic wave lengths of the nuclear and the atomic systems are 1 fm. and 1\AA , respectively.

When we try to obtain information on a given system, the fundamental equations alone are not sufficient but we must specify the constituent matter of the system. For example, when we describe the hydrogen atom we must choose the proton and the electron as the ingredient matter, on the other hand to describe the deuteron, the constituent matters are the neutron and proton. Although the form of the fundamental law is established already, we can consider varieties of systems by choosing various ingredient matters. Usually the choice of the novel ingredients leads to surprising results. For example, when the ingredient matters are the strings or the super-strings, by applying the quantum field theory we obtain the equation of the gravitational field, which had been known in the general theory of relativity.

Because the existence of the magnetic monopole can explain the discreteness of the electric charge and equality of the electric charges of proton and the electron (up to sign), the monopoles are wanted for a long time. In the talk, I propose to consider a system whose ingredient matters are magnetic monopole and hadrons (including nuclei). In this novel system, super strong magnetic Coulomb field produced by the monopole attracts the nuclei with large anomalous magnetic moment such as n, p, d, ^3H and ^3He , and form the bound states, then such states decay into the monopole and ^4He . What is important is that the energy level, the wave function of the bound state, the decay rate and the rate of the formation of the bound state from the surrounding deuterons, can be calculated from the standard rule of the quantum mechanics or the quantum field theory unambiguously and uniquely.

In the talk, we shall also consider the problem of the nuclear transmutation, in which a nucleus changes Z and A largely by absorbing the surrounding small nuclei such as p and d. It is interesting to consider why the same nucleus absorbs surrounding matter repeatedly and why the protons are absorbed more effectively than the deuterons.

Composition of $1/f$ amplitudes electron wave and a work of one dimension of lattice

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When there is an electric current, lining up of a deuterium atom named a pearl chain phenomenon is generated. A line of deuterium atoms is generated naturally in Kohji Kamada, yoshio Katano, Nariaki Ookubo, Isao Yoshizawa, "Anomalous Heat Evolution of Deuteron Implanted Al upon Electron Bombardment 4th "ICCF8, Proc. 8th Int. Conf. on Cold Fusion, Italy, 21-26, May. 2000, and there is the doubt that it does resonance of electron wave powerfully, and it cause the generation of heat.

The pearl chain phenomenon that happened in deuterium may let what is called cold fusion be successful by phase change from crystallization to polycrystal phase with an opportunity.

It is considered to be a cold fusion phenomenon with the generation of heat, but a principle is wrong with a traditional atomic energy theory. Latent heat was actualized so that there was a work the same as crystal lattice in standing wave of electron wave when the grating constant changed, and equilibrium maintenance of quantum nature got up with it as an opportunity, and mass and a conversion phenomenon of heat got up.

When an electric current produces it, a pearl chain phenomenon can get up with a trap of light pressure by standing wave of a laser beam, and matter wave of crystallization lets an atom surely stand in line. There is power to let an atom stand in line in $1/f$ electron wave. I have finished assembling a hypothesis about this phenomenon.

Cold cathode ray occurring from the electrode includes $1/f$ noise current. The noise is a phenomenon of resonance of electron wave. An existing electronic wave does resonance of $1/f$ characteristic between electrodes of direct current electric circuit of cold cathode lay and makes lattice line-like composition standing wave, and an atom is settled in a lattice, and shape makes a pearl chain. Electrons go through composition standing wave with tunneling and rais $1/f$ noise. Electron is soliton electron wave propagating a lattice.

It is considered to be well type potential barrier between electrode pairs of a diode. Then standing wave of electron wave is created between electrodes. The amplitude of standing wave except low degree and product of frequency are constant value. A lot of potential barrier stands in line at an equal interval that standing wave is composed in a well. Electrons goes through it by tunnel resonance to potential barrier line. The resonance produces a generation of heat phenomenon with a pearl chain.

Reasons for Establishing the Japan CF-Research Society

This society shall be called (in Japanese) "the CF Research Society" and (in English) "the Japan CF-Research society," abbreviated (in both cases) JCF. CF stands for Condensed-matter (solid state) Fusion, Coherently-induced Fusion, or Cold Fusion. All the terms refer to a nuclear reaction inside a solid state body. The term CF is also meant, in the broader sense, to include the science and technology associated with the phenomenon. The main goal of the society is to investigate the nuclear reactions that occur in the solid-state and, ultimately, to develop techniques to extract useable energy from these reactions.

We do not think it is necessary for us to reiterate the reasons why associations of this type play such a important role in promoting sound development in science and technology. We have long been concerned that cold fusion, like any other area of science, needs an organization to collect and disseminate data and promote general interest in the field. Despite this pressing need however, no organization like the CF research society has been formed until now, for two main reasons: First, because the existence of the so-called cold fusion reaction has not been widely recognized, and very few scientists and researchers concentrate on it as their main occupation. Second, because cold fusion research requires an interdisciplinary, multidisciplinary approach involving scientists for many different fields, who would not normally meet together or form a society.

In recent years, a great deal of experimental data has indicated that new phenomena exist, which originate in condensed (solid-state) matter when various physical and chemical conditions are satisfied, giving rise to, for example, coherently induced nuclear fusion. This process is intrinsically different from the nuclear reactions heretofore discovered, which are random rather than coherent processes. CF has characteristics peculiar to the solid-state environment. It has given rise to an effusion of new discoveries in physics, chemistry, material science and nuclear engineering. Cold fusion research crosses traditional academic domains and requires an interdisciplinary approach, so we hope that researchers from many fields will join us in these efforts. It is hoped that opening up the field will be the most significant outcome of the establishment of this CF Research Society. Another significant goal of the Society is to enhance Japan's role as a focal point of research in this area, and to act as a clearing house for international cooperation and information exchange.

(The CF society is an unofficial organization, without legal standing.)

March 29, 1999

Activity of JCF

1. Name of the Society: CF(Nuclear Reaction in Solid)-Research Society for Japanese.
English name is Japan CF-research Society(JCF).

2. Aims: contribute to science and technology development by studying CF phenomena,
exchange information between JCF members and organize meeting for CF-research.

3. Activities:

- (1) Studies on works in CF-research field.
- (2) Information exchange between members and foreign activities.
- (3) Organize and implement meetings and conferences.
- (4) Publish reports
- (5) Collect academic materials(papers and documents) on CF-research.
- (6) Others

4. Members:

- (1) Member(Normal): CF-researchers and related person
- (2) Cooperational Member: Company and organization which financially assist JCF
- (3) Fellow: Senior researcher who made great contribution to JCF and has been selected by JCF

5. Fee:

- (1) Registration fee: 10,000 yen for member(free for student)
- (2) Annual fee: 5,000 yen for member(2,000 yen for student)
- (3) Fund by Cooperational Member: 50,000 yen per stock

6. Directors:

Chief-in-Directors(one), Vice-Chief-in-Directors(one or two), Directors(several for meeting, publication, information-exchange and finance) and Senior Consultant Members

7. Fields:

consists of combined fields interdisciplinarily and multidisciplinarily in the following fields;
nuclear physics, fusion science, radiation physics, condensed-matter physics, surface and catalysis science, metallurgy, hydrogen science, electro-chemistry, calorimetry, accelerator and beam science, laser science, nuclear and quantum science and engineering, molecular dynamics, acoustics, etc.

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