「 第 2 回 CF(固体内核反応) 研究会」

予稿集

JCF2 ABSTRACTS

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CF(固体内核反応) 研究会

Japan CF-Research Society

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Program of JCF2 Meeting, October 21-22, 2000, at Academic Exchange Hall, Hokkaido University, Sapporo, Japan

October 21, 2000

9:00	**Opening Address**
9:10	**Electrolysis: Light Water** (chairman: K. Ota, Yokohama N.U.)
9:10-9:35	**JCF2-1** M. Fujii et al. (Yokohama N.U.): HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING METAL RODS CATHODE
9:35-10:00	**JCF2-2** R. Notoya (Hokkaido U.): Gamma-spectra Observation during Electrolysis in a System of K2CO3 Light Water Solution/Pt Electrodes
10:00-10:25	**JCF2-3** H. Yamada et al. (Iwate U.): Low Excess Heat Evolution and Impurities Production in Light Water Electrolysis
--- **break** (15 min) ---	
10:40	**Electrolysis: Heavy Water** (chairman: T. Mizuno, Hokkaido U.)
10:40-11:05	**JCF2-4** K. Yabuta et al. (Osaka U.): Measurement of excess heat and nuclear products by using a closed D_2O electrolysis system
11:05-11:30	**JCF2-5** H. Kudo et al. (Yokohama N.U.): Precise heat measurement of D_2O electrolysis
11:30-11:55	**JCF2-6** H. Numata (Tokyo Inst. Tech.): In situ Potentiometric, Resistance, and Dilatometric Measurements of Palladium Electrodes During Repeated Electrochemical Hydrogen Absorption
--- **lunch** (11:55-13:30) ---	
13:30	**Electrolysis: Plasma State** (chairman: H. Yamada, Iwate U.)
13:30-13:55	**JCF2-7** T. Ohishi et al. (Osaka U.): Studies on Nuclear-Reaction-in-Solid Using Plasma Electrolysis
13:55-14:20	**JCF2-8** T. Mizuno et al. (Hokkaido U.): Heat and other products induced by plasma electrolysis
14:20-14:45	**JCF2-9** T. Ohmori et al. (Hokkaido U.): The Nuclear Transmutation Induced by a Plasma Electrolysis in Light Water Using Tungsten and Rhenium Electrode
--- **break** (15 min) ---	
15:00	**Theory-1** (chairman: E. Yamaguchi, 21st C.E.P.R)
15:00-15:25	**JCF2-10** A. Takahashi et al. (Osaka U.): POSSIBILITY OF FISSION-PRODUCTS BY MULTI-PHOTON EXCITATION PROCESS FOR A>100 NUCLEI
15:25-15:50	**JCF2-11** M. Ohta et al. (Osaka U.): Analysis on fission of W, Au and U by LEPF/SCF model
15:50-16:15	**JCF2-12** N. Yabuuchi (Inst. High-Sci. Res.): Fusion and Fission in metal
16:15-16:40	**JCF2-13** M. Ohta et al. (Osaka U. and CFRL): Possible Explanation of He-4 Production in Pd/D_{2} System by TNCF Model
16:40-17:10	**JCF Annual Meeting**
18:00-20:00	**Reception**

October 22, 2000

9:00 **Gas and Vacuum Phase Exp.** (chairman: T. Ohmori, Hokkaido U.)

9:00-9:25 **JCF2-14** A. Arapi et al. (Iwate U.): Nuclear Reaction In Deuterated Palladium Electrodes Under DC Glow Discharge.

9:25-9:50 **JCF2-15** S. Narita et al. (Iwate U.): Detection for Nuclear Products in Palladium Deuteride/Hydride in the Evacuated Chamber

9:50-10:15 **JCF2-16** T. Itoh et al. (Mitsubishi H.I.): ANALYSIS OF NUCLEAR PRODUCTS OBTAINED BY CONTINUOUS DIFFUSION OF DEUTERIUM THROUGH MULTI-LAYER PALLADIUM CONTAINING LOW WORK FUNCTION MATERIAL

10:15-10:40 **JCF2-17** M. Sakano et al. (Mitsubishi H.I.): TIME DEPENDENCE OF NUCLEAR PRODUCTS INDUCED BY CONTINUOUS DIFFUSION OF DEUTERIUM THROUGH MULTI-LAYER PALLADIUM CONTAINING LOW WORK FUNCTION MATERIAL

10:40-11:05 **JCF2-18** T. Hanawa (Osaka U., Emeritus): Effect of Water in Biological Nuclear Transmutation

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

Special Talk: (chairman: A. Takahashi, Osaka U.)

11:20-12:00 **JCF2-19** F. Celani (INFN-LNF): Problems related to presence of new specific bacteria (genere Ralstonia and Strenotrophomonas) into D2O interesting with overloading of deuterium into Pd by electrolytic procedures

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

13:30 **Beam Solid Interaction** (chairman: A. Kitamura, Kobe M.M.U.)

13:30-13:55 **JCF2-20** S. Uneme et al. (Osaka U.): STUDIES OF NUCLEAR-REACTIONS-IN-SOLID IN TITANIUM-DEUTERIDE UNDER ION BEAM IMPLANTATION -Experiments with deuteron beam implantation-

13:55-14:20 **JCF2-21** Y. Katayama et al. (Osaka U.): STUDIES OF NUCLEAR-REACTIONS-IN-SOLID IN TITANIUM-DEUTERIDE UNDER ION IMPLANTATION- II -Experiments with proton beam implantation-

14:20-14:45 **JCF2-22** T. Hayashi et al. (Osaka U.): Charged-Particle Spectroscopy with Decreasing Pileup of D-D Reactions for Titanium Deuteride under Deuteron Implantation

14:45-15:10 **JCF2-23** H. Mori et al. (Osaka U.): STUDIES OF NUCLEAR REACTIONS IN SOLIDS UNDER ELECTRON BEAM IRRADIATION TO METAL DEUTERIDE

--- **break** (10 min) ---

15:20 **Theory-2** (chairman: Y. Iwamura, Mitsubishi H.I.)

15:20-15:45 **JCF2-24** K. Tsuchiya (Tokyo N.C.T.): Effects of the Bose-Einstein Condensation to the Nuclear Reaction in Solids

15:45-16:10 **JCF2-25** H. Yamamoto: A Catalytic Role of Atomic Oxygen on Anomalous Heat Generation Induced in Proton Conductive Ceramics under Hydrogen Atmosphere

16:10-16:35 **JCF2-26** H. Kubota: ON THE POSSIBILITY OF NUCLEAR FORCE ATTENUATION BY THE ELECTRIC FIELD IN THE NUCLEAR TRANSMUTATION REACTION

16:35-17:00 **JCF2-27** T. Sawada (Nihon U.): Catalyzer of the nuclear cold fusion reaction

Adjourn.

JCF2-1

HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING METAL RODS CATHODE

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1.Introduction

More than 10 years has past since the first announcement of the cold fusion by Fleischmann and Pons[1]. Many reports claimed excess heat. However, the amount of excess was very small and the reproducibity was very poor in most of the reports. Patterson[2] claimed that he observed large excess heat with high reproducibity during electrolysis using multi layer beads electrode in light water solution. In this stady we aimed to measured the heat balance during electrolysis in light water solution using Ni,Pd and Ti rods

2.Experimental

The electrolysis cell was made of acrylic resin. Ni rods(2mm ϕ ×2mm, 12g), Pd rods(1mm ϕ × 2mm, 520 pieces) and Ti rods(1mm ϕ ×2mm, 520 pieces) for cathode was used in electrolysis. Anode was Pt mesh anode(3cm ϕ , 55mesh), and electrolyte was 1MLi_2SO_4-H_2O solution. The electrolyte was circulated in this system. The temperature of the electrolyte was kept at 20℃ at the inlet of the cell and the flow rate of the electrolyte was fixed at 10ml/min or 45ml/min. The electrolysis was conducted at a constant current. The current was increase by 0.1A every other day from 0.5 to 1.0A during the run. The same electrode was used repeatedly. In order to estimate the amount of the recombination of H_2 and O_2, the current efficiency was measured using a gas flow meter of soap membrane.

3.Result and discussion

As shown in Table1, the average heat balance is more than 1.0 in most cases. However we could not confirm the excess heat, considering the distribution of the data, and the calibration of the cell efficiency. Since we could not observe the large excess heat in our system as reported by Patterson et al. We will try to measure the heat balance precisely, using the insulated vessel that has triple walls to keep constant temperature in the vessel .

Table1. Heat balance of electrolysis in Li_2SO_4–H_2O solution

Run Number	Cathode Electrode	Cell Current(A)	Cell Voltage(V)	HB_{AVE}
R5	Ni	0.5～ 1.0	10.6～27.2	1.02
R6	Ni	0.5～ 1.0	7.1～20.7	1.01
R7	Ni	0.5～ 1.0	8.1～16.9	1.00
R8	Ni	0.5～ 1.0	11.3～20.8	1.02
R10	Pd	0.5～ 1.0	9.6～ 18.8	1.03
R11	Pd	0.5～ 1.0	9.6～ 25.9	0.99
R12	Pd	0.5～ 3.0	9.2～ 38.0	1.01
R13	Pd	0.5～ 3.0	6.5～ 36.2	1.01
R14	Ti	0.5～ 1.0	18.3～ 35.2	1.02
R15	Pd	0.5～ 1.0	18.7～ 33.8	1.03

4.Reference

1) M.Fleischmann, S.Pons et al, J.Electroanal. Chem.,289,293(1989)
2) James A.Patterson, U.S.Patent, 5318675

JCF2-2

"Gamma-spectra Observation during Electrolysis in a System of K2CO3 Light Water Solution/Pt Electrodes"

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The findings of the gamma-ray radiating species obtained by electrolysis provided one of the plainist evidences of the cold nuclear transmutation (CNT). Owing to many efforts with this method, the scheme of some reactions of CNT has been elucidated. For the last several years, the author also had found some gamma-ray radiating species as the products of CNT in some electrolysis systems. In a electrolysis system of K2CO3 light water solution, the peaks attributed to K(40), K(42), K(43), Ti(44), Ca(49), Sc(49), the positron annihilation and moreover the neutron capture by proton have been observed during electrolysis by use of a platinized platinum mesh cathode and a platinum wire anode. A reaction network of CNT, which will be deduced on the basis of this result, will be shown in this report. Recently, new gamma peaks appeared on the spectrum only observed during electrolysis. Their assignment will be also mentioned in the report on JFC-2.

Low Excess Heat Evolution and Impurities Production in Light Water Electrolysis

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ABSTRACT

Three electrolytic cells made of quartz with a brass or a polyethylene flange were used. These have a cylindrical shape with volume capacity of 100cm^3(Cell A), 200cm^3(Cell B) and 500cm^3(Cell C). The brass flange was plated with gold in 10 μm thickness. A couple of rectangular shape working electrodes of 0.1 × 5 × 10 mm with gap spacing of 10mm were set in Cell A for excess heat measurement test. A platinum anode electrode was used in this test. The counter cathode electrode was a nickel, nickel scraped and nickel-plated iron. A larger nickel-plated cathode of 0.1 × 10 × 10mm was also used together with a same size platinum anode. The electrolyte solution was 0.5 M sodium carbonate solution. The volume of electrolyte solution was 40cm^3. Cell voltage and the increments of electrolyte solution temperature were monitored by a personal computer. Cell B and C were used only for transmutation experiment; a gold electrode of 0.1 × 5 × 10mm as a cathode and a 80-mesh platinum net as a anode were employed for the test. The electrolyte solution was 0.5 M sodium sulfate solution. The volume of electrolyte solution was 150-200cm^3 for Cell B and 500cm^3 for Cell B. Both the electrolytes were prepared from Merck Sprapur Reagents. The electrolysis was carried out for 7-30 days using Cell A at a constant current 0.5-1 Amps and 3 months using Cell C at a constant current 0.5 Amps. The constituting elements on the gold electrode after electrolysis were identified by means of Time-of-Flight Secondary Ion Mass Spectrometry(TOF-SIMS) and Electron Probe Microanalysis(EPMA). Their isotopic compositions were surveyed by TOF-SIMS. The SIMS measurement was carried out by Ga+ ion irradiation.

No excess power was measured for nickel cathode. However, excess power levels of up to 10% was measured for scraped nickel cathode and nickel-plated cathode. The highest excess power level of 10% was observed in a test using nickel-plated cathode of 0.1 × 10 × 10mm. Marked increase in

counts for mass number 64, 66, 67, 68 and 70, which correspond to zinc, were observed on the gold cathode after electrolysis. The isotopic composition of mass number 67, probably corresponds to ^{67}Zn, was increased to 15% from 4% of its natural value. Increase in counts of nickel was also observed by SIMS, however, no change in its national isotopic composition was seen. EPMA have also showed an increase in the amount of zinc as well as nickel for the same gold cathode after SIMS.

JCF2-4

Measurement of excess heat and nuclear products by using a closed D_2O electrolysis system

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Keyword: ^4He, Q-mass analysis, excess heat,

Abstract

In a series of experiments, on- line measurement of correlation between time variation of excess heat, D/Pd and neutrons were performed with a closed D_2O electrolysis system. After electrolysis, quantitative measurements of ^4He amount in the upper cell gas and the electrolyzed cathode were performed with a high resolution Q-mass (quadrupole mass spectrometer). In some experiments, significant amount of ^4He atoms($\sim 10^{16}$) was detected both in the upper-cell gas and the gas released from the electrolyzed palladium cathode(1). Since leakage of ^4He from air into the mass analysis system was estimated to be very little, detected amount of ^4He should be produced by kind of some nuclear reaction. Considering that the applied heating temperature of the cathode in the released gas analysis was low (about 350℃), observed ^4He atoms might have been released from the interracial layer between surface coating zone and palladium zone. No meaningful amount of neutrons exceeding background level was detected in this series of experiment. It seemed that there was no correlation between ^4He-generation and neutron emission.

Density of deuterium near the surface of cathode might be a key factor to induce some coherent nuclear reactions between deuterons under dynamic conditions of electrolysis (2),(3). To investigate the deuteron distribution near the surface, electrolyzed cathodes were analyzed with NRA (nuclear reaction analysis) by using the D (d,p) reaction.

Reference

1) Y. Isobe et al.: *Proceeding of ICCF-8*(Lerici, Italy, May, 2000)(to be published)
2) A. Takahashi et al.: *Fusion Technology*, **25**, PP.71-85 (1995)
3) A. Takahashi et al.: *Physics Letters* A **255**, 89 (1999)

JCF2-5

Precise heat measurement of D_2O electrolysis

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1.Introduction

In order to confirm the small excess heat, it is important to establish a precise heat measurement system owing to cold fusion phenomenon. We have been developing two types of flow calorimetry systems. One is the Yokohama type calorimeter, the other is the NHE type calorimeter that originally designed by the NHE project (Japanese cold fusion project) which uses the vacuum insulation around the electrolysis cell.

2.Experiment

The Yokohama type cell has triple walls to keep constant temperature in the vessel. The NHE type cell was a closed cell with recombiner. Electrolytic cell is thermally insulated by vacuum. The cooling water excluding the air flows from top to bottom along the wall of the inner cell. The heat recovery was measured by the temperature difference of cooling water. The electrolysis was carried out at a constant current and the total input power was fixed using a joule heater. The electrolyte was 1M LiOD-D_2O solution.

3.Results and discussion

Figure 1 shows the comparison of the Yokohama type cell and the NHE type cell. The heat recovery are 91.5±0.8% and 99.01±0.34%, respectively. We obtained 99% heat recovery using the improved NHE type calorimeter and have almost established the absolute measurement of the heat during electrolysis. Figure 2 shows the dependence of the temperature difference on the input power. The linear relationships is clearly observed. Considering the slope of the line and the sensitivity of the thermometer (0.01℃), we can measure a small heat of 30 mW.

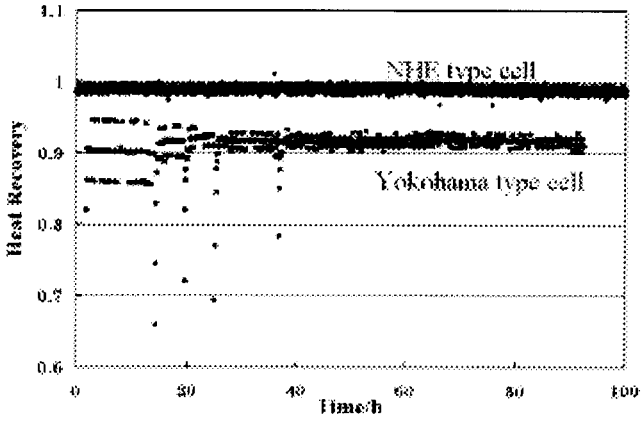

Fig.1 Heat recovery of Yokohama type cell and NHE type cell

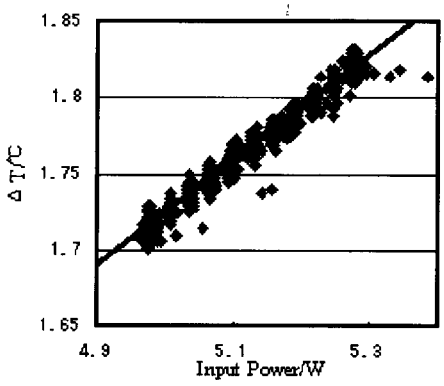

Fig.2 Dependence of the temperature difference on input power

JCF2-6

In situ Potentiometric, Resistance, and Dilatometric Measurements of Palladium Electrodes During Repeated Electrochemical Hydrogen Absorption

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Key words: electrolytic hydrogen absorption, resistance measurement, dilatometry, void, Pd, phase transformation

I. Abstract

Among many metal-hydrogen alloys Pd is particularly known as an easily absorbing and dissolving metal, however, repetition of absorption and desorption alters the microstructure more or less. Therefore, the loading behavior is influenced not only by electrode materials, and electrolytes but also by electrolysis methods.

In this study, the electrochemical behavior, the dilation and resistance of the Pd electrode have been measured *in situ* using a computer controlled potentiostat connected to the measurement devices. These measurements were made with respect to the microstructural changes induced by hydrogen absorption-desorption cycles in the Pd electrode.

The physicochemical properties of the Pd-H system were studied by *in situ* potentiometric, resistance and dilatometric measurements under in each of the two applied pulse modes, A and C repeated hydrogen absorption and desorption. Potential, resistance ratio and an increase in dilation($\Delta l/lo$) was measured simultaneously after equilibrium of hydrogen with the Pd electrode was attained. During the continuous absorption structural phase transition($\alpha \rightarrow \beta$) and void formation occurred and the values of the H/Pd ratio in the limiting α phase, in that of $\alpha+\beta$ phase coexistence, and in the transition and the β+voids coexistence regions are consistent with those obtained from the Pd-H isotherm at 40°C. Hydrogen absorption caused the dilation, from the slope of which the molar volume was obtained as 0.64(α phase) and 0.40($\alpha+\beta$ phase)cm^3mol^{-1}. The resistance increased in proportion to the H/Pd ratio and was kept constant at 1.7~1.8 over R_{tr}.

For the first absorption through the β phase($>\beta_{min}$) the electrode potential shifted with an increase in dilation, which suggests nonequilibrium PdH_{2-x} precipitation followed by conversion to the β phase and void formation. Although there was a remarkable lack of any repetition number dependence of the values of the limiting resistance and potential corresponding to the $\alpha+\beta$ and β+void coexistence, the onset of the β phase, β_{min}, increased as the repetition number increased. The volumetric ratio for an increase in the H/Pd ratio corresponds to the absorption in high density defect areas surrounding voids. During repeated absorption and desorption in C applied pulse mode the apparent molar volumes of the $\alpha+\beta$ phase coexistence shows that the absorption proceeds inhomogenously, in contrast to the case of the first absorption in A applied pulse mode.

Acknowledgment This work was supported by the New Hydrogen Energy Project, NEDO and the Institute of Applied Energy, Japan.

Reference H.Numata, " Nuclear Reaction Study In Condensed Matter No.1", Chapter 4, pp.124(1999) Kougakusha.

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Studies on Nuclear-Reaction-in-Solid Using Plasma Electrolysis

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Keywords: Nuclear Reaction in Solid, Glow-Discharge in Electrolyte, Pd (Pd-Rh Alloy)

There have been some reports claiming nuclear reactions (nuclear transmutation) in cathodes during electrolysis under A.C. (direct current) glow discharge condition[1]. Our study has intended in that some nuclear reaction would be induced by the interaction of electrode and plasma during the direct or alternative current plasma discharge, using Pd-Rh (95:05) alloy (or pure-Pd) electrodes, in alkali heavy (or light) water solution. To confirm the nuclear phenomenon in the site, we have measured characteristic X-rays ($K_{\alpha,\beta}$-rays) of Pd, bremsstrahlung X-rays of charged particles and neutrons that were expected to arise in case where nuclear reaction happened in Pd metal. And we have also measured light spectra under the electric discharge for the study of atomic excited states under plasma discharge.

The system of electrolysis was of open-cell type. We made use of grass cells and A.C. or D.C. power supply. Electrodes of foreground runs at D.C. discharge have been Pd-cathodes (Hollow type) and Pt-mesh-anodes, and those for A.C. discharge have been Pd-electrodes (Hollow type). For electrolyte we have employed 0.5(mol/l) K_2CO_3 - D_2O solution for both cases. For control (background) runs at D.C. and A.C. discharges, Ni electrode of identical shapes were adopted and electrolyte of 0.5(mol/l) K_2CO_3 - H_2O solution was also adopted. The measuring instruments were set up by using a NE213-organic liquid scintillator (NE213) to detect neutrons and two cadmium-telluride detectors (CdTe) to detect characteristic and bremsstrahlung X-rays, both of which signals were analyzed by multi-channel-analyzers (MCA) and multi-parameter-multi channel-analyzers (MPMCA). For a spectrophotometry of light under electric discharge we used a monochromater.

In a series of experiments, signals from CdTe-detectors were contained in high noise level. To decrease this noise level, the rise-time discrimination method was employed to separate true signals from noise signals. With this technique, spectra which were regarded to be bremsstrahlung X-rays from Pd electrodes were observed during the direct current electric discharge using hollow cathodes of parallel dual Pd-Rh alloy sheets (flat boards type). And we will report some experimental results used hollow electrodes (cathodes), thermoionic emission activity of which is higher than that of electrode of parallel dual flat board.

Reference:

1) T. Ohmori and T. Mizuno, Researches of Nuclear Reactions in Solid (No.1) (In Japanese), p.159~246, Kogakusya Co. Ltd. (1999)

Heat and other products induced by plasma electrolysis

Tadahiko Mizuno, Tadayoshi Ohmori, Tadashi Akimoto (Hokkaido University), and Akito Takahashi (Osaka University)

KEYWORDS: plasma electrolysis, photo fission, excess heat, fission product

Summary

Plasma was formed on the electrode surface in a liquid electrolyte when a metal cathode was polarized high voltage electrolysis in the solution. When a liquid electrolyte is polarized at high-voltage (70~500 V), it gives rise to an electric discharge and plasma state(123). We measured the output heat and input electric power in real time by a method that combined open cell isoperibolic calorimetry and flow calorimetry(4). During the plasma electrolysis a large amounts of excess heat are sometimes confirmed. The heat can exceed input substantially, and in some cases by up to 200 percent of input power(5). At the same time, anomalous elements were detected in the electrolyte and on the electrode surface(6).

Takahashi(7) hypothesizes a nuclear reaction that can be induced by photon activation on the cathode element. We have attempted to explain the experimental results by the mechanism that produces the no radioactive materials and or weak radio emission. Here, we applied the same discussion that would be taken in Pd and Au electrodes for the case of W electrode. We have recognized that the distribution for their reaction product showed clearly one or two peaks that consisted the mass number around 52 for the case of Pd and 64 and 120 for Au.

Above discussion can be held essentially for the metal electrode. One peak is the major element from 40 to 65 and the others are from 100 to 120 for Tungsten electrode. The total generated amount of element for excess heat evolved was calibrated as the order of mg. Then the total excess heat was calculated as the order of $10^{6\text{-}7}$J from the products. Meanwhile, the total excess heat during plasma electrolysis was typically estimated as 10^5 J; it seems that the value was several orders less than the calculation value. In the case, we have to calculate the excess heat from the weight loss between reacted and produced materials. The result can be explained the excess heat evolution during the plasma electrolysis. We can conclude that the photo-fission mechanism well explains the amount of excess heat and the distribution of the element generation during the electrochemical treatment.

References:

1, A. Hickling and M.D. Ingram, Trans. Faraday Soc., 60 (1964) 783.
2, C. S. Taylor, Trans. Electrochem. Soc., 47 (1925) 301.
3, Herbert H. Kellogg, J. Electrochem. Soc., 97 (1950) 133.
4, T. Mizuno, T. Akimoto and T. Ohmori, J. New Energy, 3 (1999) 33.
5, T.Mizuno, T. Ohmori, T. Akimoto and A. Takahashi, Jpn. J. App. Phys., 10 (2000) in printing.
6, T. Ohmori and T. Mizuno, Infinite Energy, 5 (1999) 34.
7, A. Takahashi, M. Ohta and T. Mizuno, submitted to Fusion Technology, April 2000.

JCF2-9

The Nuclear Transmutation Induced by a Plasma Electrolysis in Light Water Using Tungsten and Rhenium Electrode

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Abstract

When a tungsten or a rhenium cathode was electrolyzed at high power, it incandesced and emitted an intense reddish-purple glow and radio frequency (RF) electromagnetic waves. This phenomenon is now referred to "plasma electrolysis". This phenomenon occurred at current densities above 4 A/cm^2. This state continues as long as the plasma electrolysis condition is maintained. The temperature of the solution just before the initiation of incandescence was 80 to 85℃. After the initiation, the temperature increased sharply and reached the boiling point within 80 seconds.

The excess heats evolved during the electrolysis were between 60 to 140 watts for tungsten (31 samples) and between 75 to 130 watts for rhenium (14 samples). Energy efficiency was mainly in the range of 180 to 200 %.

After the plasma electrolysis, remarkable anomalous structure were found on the electrode surface. The tungsten layers near the electrode surface have melted. This indicates the temperature may have risen up to 3400℃ or more. In addition, some crater- like structures were formed. For tungsten electrode some foreign elements, *i.e.* iron, chromium, and carbon were locally concentrated at the center parts of the craters where the contents of iron and chromium were estimated at 67.4 and 16.9 at. %, respectively. The content of W was only 7.8 at. %. Besides iron, chromium, and carbon, several percents of nickel and small amounts of lead (0.6 at. %) and rhenium (0.3 at. %) were detected. The distribution of iron, chromium and carbon is completely overlapping. On the electrode surface of rhenium after the electrolysis numerous rhombic pits showing traces of micro explosions were formed. Some foreign elements, zinc, copper, iron, etc., were identified.

POSSIBILITY OF FISSION-PRODUCTS BY MULTI-PHOTON EXCITATION PROCESS FOR A>100 NUCLEI

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Tadahiko Mizuno
Department of Quantum Energy Engineering, Hokkaido University

[Keywords] low energy photo-fission, A>100 nuclei, multi-photon absorption, liquid drop model, selective channel scission, radiation-less products

Energy release by nuclear fission is possible in principle for A>90 nuclei due to positive Q-values to scissions. A low energy photo-fission (LEPF)model was proposed[1,2] by supposing that nuclear collective excitation by multi-photon absorption could exceed some of lowest band fission-barriers (LBFB) for many Q>0 scission channels which were modeled to have own different fission barriers. It is known that nuclear excitation by low-energy neutron (or proton or deuteron) absorption can exceed LBFB only for ^{233}U, ^{235}U, ^{237}Np ^{239}Pu and some minor actinides to induce fission. The present theory however proposes that multi-photon absorption process can induce selective channel fission (SCF) for A>100 nuclei to liberate nuclear energy.

It is known that low-lying excited states of nucleus (A>100) are in collective states by rotation and/or vibration of deformed nucleus (e.g., dipole or quadrupole states). If the multi-photon absorption process (E1 or E2 process) under very high photon flux of 1-100 keV (X-ray region) can excite nucleus collectively, starting from low-lying states (0.1-0.5 MeV) and pumping up to high collective excited states (namely very deformed states of liquid drop) with nuclear excited energy over LBFB (7-20MeV), binary scission events will be opened for SCF channels. High photon flux with 1-100keV can be expected in such conditions as QED photons via solid plasma oscillation and coherently induced deuteron fusion processes of metal-hydrides[2], plasma electrolyses[3], gas-glow-discharge[4] or X-lay laser irradiation, etc.. We can expect that neutron and gamma-ray emission by the excitation process will be suppressed since the excitation energy goes to

collective deformation of total nucleus and thus the local energy concentration to a single nucleon has very small probability.

This work discusses on possible photon sources in metal-hydrides, SCF analysis based on the rotating-liquid-drop model and radiation-less fission products for LEPF of Pd (A=102-110), to be compared with some of experimental results claiming transmuted nuclear products without significant radiation but with quite non-natural isotopic ratios[4-6]. Application of the present theory to other elements, i.e., tungsten, gold and uranium isotopes is presented in a separate paper[7] of this meeting.

Results of the LEPF/SCF theory for Pd-isotopes have shown consistent agreements with experimental claims[4,5,6] for mass- and element-distributions of fission products, non-natural isotopic ratios and minor radio-isotope products. Major transmuted (fission) products for LEPF of Pd-natural are Fe, Cr, Ti, Ca, Ni, Mn, V, Ar, S, Zn, Sr, O, Sc, Cu, Ga, Ge, K, Si, etc., in the order of yield strength. Naturally non-abundant isotopes like ^{44}Ca, ^{46}Ca, ^{48}Ca, ^{49}Ti, ^{50}Ti, ^{54}Cr, ^{57}Fe, ^{58}Fe, and so on, are significantly produced.

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JCF2-11

Analysis on fission of W, Au and U by LEPF/SCF model

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[Keywords] low energy photo-fission, selective channel fission, liquid drop model

Nuclear Transmutation (fission) of Pd cathodes has been reported by many researchers. To explain this phenomena low energy photo fission (LEPF) model was proposed at ICCF8[1]. Because of positive Q-value, fission of Pd is possible in principle. This model supposed that low energy multi-photon excitation induces Selective channel fission (SCF). If this excitation exceeds lowest band fission barrier (LBFB), SCF channels are opened. The possible photon source and the analysis of Pd case will be presented by A. Takahashi in this meeting[3].

It is well known that mass distribution of fission products of U by low energy neutron absorption shows two peaks. SCF analysis based on liquid drop model is applied to this low energy neutron absorption. Tunnel fission probability is estimated using the WKB formula[2]. Analysis by this theory shows two peaks of mass distributions of fission products and shows qualitative agreements with experimental results. And mass distribution of fission products of U by high energy neutron absorption will be discussed.

Recently, nuclear transmutation of W and Au in electrolysis experiments was reported. Fe, Zn, Ca etc. are observed as main products. Applications of LEPF/SCF theory to W and Au cases will be also reported.

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Fusion and fission in metal

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The author has proposed a structure of the atomic nucleus according to Kepler's method of Plato's regular polyhedrons, and has described the fission ratio and magic numbers of uranium. The present paper further discusses the possibility of nuclear fusion and fission within a metallic solid in terms of the Yabuuchi Platonic model. Experimentation by Prof. Brack of Germany has made considerable progress with respect to a Platonic model of atomic structure, and Brack also conjectures that the atomic nucleus has a Platonic structure.

1. Nuclear fusion

Atoms of a super-heavy hydrogen isotope which is a halo atomic nucleus wherein a deuteron has captured a neutron may mutually fuse to $^{4}He_{2}$ having a nucleus with the structure of a regular tetrahedron. The atomic nucleus of super-heavy hydrogen is closest to helium4, having a large radius and little repulsion of shell protons. Because of this, it resonates with the outer surface of the halo atomic nucleus, and is likely to experience fusion.

The following reaction equations 1-(1) through 1-(3) indicate examples of this.

$^{2}H_{1} + {}^{4}H_{1} = {}^{4}He_{2} + {}^{2}n + E$ 1-(1)

$^{3}H_{1} + {}^{5}H_{1}$ 1-(2) Difficult because of the mutual Pauli particles

$^{4}H_{1} + {}^{6}H_{1} = {}^{4}He_{2} + 3{}^{2}n + E$ 1-(3)

The cause of the mutual collisions among the super-heavy hydrogen isotope atoms required for fusion in the foregoing equations 1-(1) through 1-(3) is due to a spark effect in hyperfine vacuum according Drude's theories, or due to contraction in solids according to the Bose and Einstein theory.

In the deuterium-tritium (DT) reaction, the nuclear structure of the tritium atom, whose structure is close to that of a regular tetrahedron, is missing one proton, and so the steady state of this void strongly attempts to acquire a proton from outside and complete its crystalline structure as a regular tetrahedron. Accordingly, the reaction of the proton already existing within the nucleus is surpassed, that is, the proton enters the nucleus due to an overmountain effect (postulated by

author and described later in this paper), then resonates and is acquired. The regular-tetrahedron crystalline structure of a helium nucleus is thereby formed. This, then, is nuclear fusion. Nuclear physics heretofore has neglected the attraction force of nucleon-crystal holes.

2. Nuclear fission

Let us consider $^{104}Pd_{46}$, $^{105}Pd_{46}$, and $^{106}Pd_{46}$.

According to the Yabuuchi Platonic model, the equation for the nuclear structure of $^{104}Pd_{46}$ is as follows:

$^{104}Pd_{46}$ = (T, O, C, I, D) (C) (T, O, C, I, D) 2-(1)

= (2p2n, 3p3n, 4p4n, 6p6n, <u>8p10n</u>) (8n) (2p2n, 3p3n, 4p4n, 6p6n, <u>8p10n</u>)

In this equation, T is a regular tetrahedron having four apices, O is a regular octahedron having six apices, C is a cube having eight apices, I is a regular icosahedron having 12 apices, and D is a regular dodecahedron having 20 apices; n indicates a neutron and p a proton. Each structure to the left and right of (C) is composed of a succession of regular polyhedra inscribed within respective concentric spheres; the sequence, from the center out, is T, O, C, I, and D.

Each regular polyhedron is stable as a crystal of nucleons, with neutrons and protons arrayed in alternation at the apices of this crystal.

Accordingly, each of the two D structures in the $^{104}Pd_{46}$ atom lacks two protons at each apex (and so the two D structures lack a total of four protons), and so the atom, seeking stability, exerts a strong force to absorb protons from outside. This force is stronger than the reaction force of other protons within the nucleus. It is incorrect to refer to this force as a tunnel effect; it should rather be termed an "overmountain" effect, because penetration surmounts the "mountain" posed by the Coulomb barrier. This overmountain force could better be termed a regular-polyhedron nucleon-hole effect when the nucleus is a regular polyhedron, because there are four proton holes at the apices of the nuclear crystal structure of the palladium having a regular-polyhedral structure crystal, and so hydrogen or deuterium protons are absorbed from outside with tremendous force in order to fill these holes. Because these are neutron holes and this absorption force surmounts the "mountain" posed by the Coulomb barrier, it is an overmountain effect. This is the cause of absorption of hydrogen by the nucleus of a palladium atom.

Next is the use of the Yabuuchi Platonic model to represent isotopes of palladium nuclei.

$^{105}Pd_{46}$ = (T, O, C, I, D) (C) (T, O, C, I, D)

= (2p2n, 3p3n, 4p4n, 6p6n, <u>8p+n10n</u>) (8n) (2p2n, 3p3n, 4p4n, 6p6n, <u>8p10n</u>)

$^{106}Pd_{46}$ = (2p2n, 3p3n, 4p4n, 6p6n, 8p+n10n) (8n) (2p2n, 3p3n, 4p4n, 6p6n, 8p+n10n)

$^{108}Pd_{46}$ = (2p2n, 3p3n, 4p4n, 6p6n, 8p+n+n10n) (8n) (2p2n, 3p3n, 4p4n, 6p6n, 8p+n+n10n)

Analysis of the structure reveals that the shells are embedded in the nucleus according to the principle of symmetry.

Next, a nickel atom resembles a palladium atom from which the shells of regular-polyhedron D structure on the left and right and the multiple neutrons 8n bonded thereto have been removed. This is expressed by the following equation.

$^{58}Ni_{28}$ = (T, O, C, I) (T, O, C, I)

= (2p2n, 3p3n, 4p4n, 5p6n) (2p2n, 3p3n, 4p4n, 5p6n)

To complete a stabilized regular-polyhedron nucleon-crystal structure, the atom attempts to absorb protons or neutrons at steady-state locations where protons are lacking. The atom achieves stability when protons are absorbed. When many neutrons are absorbed, however, the balance with the protons is disrupted at the underlined portions, and both palladium and nickel are susceptible to fission at the bond locations. It is understood that a Yabuuchi-Platonic bipolar structure undergoes fission at bond areas, but in the case of a unitary structure, fission cannot readily occur.

In the case of low-temperature fission, palladium stabilizes to T, O, I, C, and so the 8p portion is destroyed, but it is nearly impossible for the atomic number to be reduced by nine or more. For nickel, similarly, it is nearly impossible for the atomic number to be reduced by six or more.

According to Takahashi's hypothesis, the energy required for fission may be a photonuclear reaction. In this case, enormous resonance is required, and it is assumed that emission of protons and neutrons is stopped before fission occurs.

The author believes instead that 5p and 8p attract a large number of neutrons, these neutrons cluster at the bond locations of the 8n and the like, forming the nucleus of a radioactive isotope, disrupting the balance of protons and neutrons and bringing about nuclear fission.

JCF2-13

Possible Explanation of He-4 Production in Pd/D_{2} System by TNCF Model

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Abstract

It is well known now that the cold fusion phenomenon, named at first after supposition of the direct *d* - *d* fusion reaction in solids at room temperature, includes many "events" from the excess heat generation, tritium production, neutron emission to He-4 generation and various nuclear transmutation (NT). This diversity of the events tells us the fundamental cause of the phenomenon should be not the simple *d* - *d* fusion reaction but more complex reactions occurring in solids as a complex system. Therefore, the name "Cold Fusion" should be interpreted as "nuclear reactions and accompanied events in solids including high density hydrogen isotopes".

In the line outlined above, experimental data showing generation of He-4 from Pd sheet - D_{2} gas system observed by E. Botta et al. are analyzed by the TNCF model. The proposed mechanism of He-4 generation is not the direct *d* - *d* reaction but the reactions between the trapped neutron and a Pd isotope, *n* - ^{A}Pd reactions, with a supplemental assumption, decrease of threshold energies for (n, α) reactions of ^{A}Pd in solids. The arbitrary parameter *n*_{n}, the density of the trapped neutrons, of the model is determined to be about 10^{12} cm^{-3} consistent with values determined in analyses of data in various events in the cold fusion phenomenon. The analysis of this data set is consistent with our analysis of neutron energy spectra observed by the same group in similar systems of Ti - D_{2} and Pd - D_{2}.

The recent experimental data sets on the nuclear transmutation show clearly existence of decay time shortening and induced nuclear fission in the system with the presence of thermal neutrons. The analysis given in this work shows also reality of alpha decay of compound nucleus, ^{A+1}Pd* in this case, induced by the trapped neutron with thermal energy in the cold fusion materials.

From these analyses of the events in the cold fusion phenomenon, it is deduced an interesting feature of the neutron-induced nuclear reactions: Change of branching ratios of decay channels occurs depending on experimental conditions. In the cases we have treated, *n* - Pd reaction results in 1) Zn in Pd wire up to 40 ¥% in one year, 2) Ag in Pd and 3) He-4 in Pd - D_{2} gas system although expected Ru is not searched.

JCF2-14

Nuclear Reaction In Deuterated Palladium Electrodes Under DC Glow Discharge.

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Introduction.

"The nuclear reaction in solid" is reaction that occur under certain condition in supersaturated metal hydrides (metals with a lot of hydrogen or heavy hydrogen dissolved in them). It is the reaction, in which protium or deuterium nuclei absorbed in solid, undergo nuclear transmutation and produce nuclear products (particles generated in the reaction) and excess heat at above room temperature. These reactions follow after successful loading of the metals by an hydrogen isotopes. For this case several methods are used. Using the base metals as a cathode in a glow discharge with deuterium gas, and having deuterium absorbed in metals is employed in our laboratory.

Experiment.

To confirm the nuclear reaction phenomena in solid a DC glow discharge with deuterium as gas-working was applied. The installation is provided with a set of instruments to register the follow parameters : current, voltage, gas - working pressure (discharge parameters varied respectively : current 2~6mA , voltage 600~2000V and pressure 3~20Torr). Discharge duration time was 1 hour and palladium plate was used as cathode while the other electrode was brass covered with golden foil. Au was also used as cathode holder. Before experiments the samples were treated by aqua-regia (about one hundred seconds) to remove the surface impurities, and after that were set in vacuum chamber filled with deuterium gas. The vacuum system , using rotary - pump, achieved vacuum at the required pressure for evaquation of the gas to the chamber. The vacuum cell made by brass and capacity of 80cc was used as discharge chamber. A NaI scintillation counter was set near the cell to register gamma-ray emission. The elemental and isotopic composition at the surface of cathode material was investigate by " Secondary Ion Mass Spectrometer " (SIMS). Radioactive isotopes appearing in cathode before and after experiments were analyzed by autoradiography. The emulsion can be exposed in case of autoradiography by moving charged particles.

Results and Discussion.

Gamma-ray emission spectrum peaks were observed during experiments. In contrast with low discharge parameters (3Torr, 600 ~700V), high pressure and voltage (15 ~ 20Torr , 1000 ~ 2000V) showed sometimes peaks above background spectrum. 57.01keV, 69.22keV, 109.94keV, and 175.17keV peaks were obtained. The emulsion was exposed when both blank and experiment samples were autoradiographed. Anywhere the results showed that after experiments the emulsion was partly disappeared. This fact, may be related to an unloading process as a results of very strong discharge. "Secondary Ion Mass Spectrometer" (SIMS) was sometimes done before and after experiments.

The concentration of the isotopic elements depends on counts intensity. High counts intensity of the elements and low counts intensity of the primary ion (Ga) are proportional to concentration of the elements. The SIMS spectrums showed that iron (56) seemed to be increased, comparing with blank samples, and chromium (52) was appeared. It is important to emphasize the fact that both elements appeared in sputtering zone as well as in bombardment zone. (In the first stage Fe(56)' counts intensity was 185000 while in sputtering zone was 279000 counts. Cr(52)' counts intensity148000 while in sputtering zone was 298000 counts). The fact that the concentration of iron and chromium increased in second stage, showed that may be some nuclear transmutation reactions took place in and inside (in very thin layer) on the cathode's surface. However nuclear transmutation is difficult proof for nuclear reaction in solid because impurities are always really possibility.

Detection for Nuclear Products in Palladium Deuteride/Hydride in the Evacuated Chamber

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Abstract

The controlled out-diffusion method was employed to induce a nuclear reaction in a palladium (Pd) plate with MnOx film. The rectangular Pd plate sample (0.3 × 12.5 × 25mm) was prepared by the following procedure. After washing and annealing, a side of the sample was coated with MnOx film of 20-40nm thickness by sputtering, followed by loading deuterium or hydrogen gas. The loading ratio of deuterium or hydrogen was measured to be approximately $0.6 \sim 0.7$. The sample was then set into the stainless-steel vacuum chamber and supplied a constant current DC power. Temperature of the surface of the sample was measured by thermocouple during the experiment. A quadrupole mass spectrometer (QMAS) was employed for mass spectrometry of the gas in the chamber. The time-resolved mass spectra for Pd deuteride revealed tritium production. Similar time behaviors of mass number 1-4 and 6 in the spectra was also observed for Pd hydride.

After the experiment, the sample was autoradiographed to detect γ and X-ray photons and charged particles using monochromatic negative film. The autoradiograph for the almost all Pd samples showed blackening parts on the film. This indicated β and/or X-ray was radiated from the Pd sample.

The surface of the Pd hydrides was investigated by Time-of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) and compared the composition before and after the experiment. There were considerable increases in counts for some elements for some samples.

These results suggested that possible nuclear reaction occurred in this experiment.

ANALYSIS OF NUCLEAR PRODUCTS OBTAINED BY CONTINUOUS DIFFUSION OF DEUTERIUM THROUGH MULTI-LAYER PALLADIUM CONTAINING LOW WORK FUNCTION MATERIAL

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Our experimental results so far let us to assume that necessary conditions to induce low energy nuclear reactions in the metal-deuterium system are as follows; (i) existence of a low work function material near the Pd surface, (ii)enough diffusion flux of deuterium, (iii) high D/Pd on the Pd surface.

Two kinds of experimental methods have been developed to meet with the assumption. One is the method of using the diffusion of D_2 gas, and the other utilizing electrolysis of D_2O. Common feature between these methods is to cause continuous diffusion of deuterium through a multi-layer Pd sheet that contains low work function material (CaO, TiC, Y_2O_3, etc..). Experimental results on D_2 gas diffusion method is presented in the other paper of JCF-2.

The feature of the electrolysis type of apparatus is that much larger reaction rate is possible because D/Pd on the Pd surface is larger than that of D_2 gas diffusion type of apparatus. We can estimate excess heat and radiation with this type of apparatus, although element and mass analysis of the Pd sample become possible after the end of an experiment.

Excess heat and nuclear products were observed for almost all the cases we tried using the multi-layer Pd. Isotopic composition of the obtained product were often different from natural abundance. In this paper, Fe and Si products are described.

$^{57}Fe/^{56}Fe$ isotope anomaly was presented in ICCF-7. At that time, the authors estimate the isotopic composition of a product by SIMS. In order to confirm the anomaly, TOF-SIMS(Time of flight SIMS) was applied to the sample. As a result, TOF-SIMS analysis also showed high $^{57}Fe/^{56}Fe$. Therefore, Fe isotope ratio anomaly was confirmed by both SIMS and SIMS.

Large excess heat more than input power was often obtained. As excess heat increased, the amount of nuclear products increased. We have an example that the amounts of the Si reaches to 0.057g. In order to evaluate Si contamination, we made a list of candidates of contamination source; solution, multi-layer Pd, Pt anode, Ni cooling pipe, Polypropylene and Teflon in the experimental apparatus. Maximum quantity of Si contaminants was estimated at 0.023g, which is smaller than that of obtained Si powder.

The isotope ratios of detected Si powder were analyzed by ICP-MS(Inductively Coupled Plasma Mass Spectrometry) . ^{29}Si of detected Si powder is smaller than Si standard solution. The isotopic composition of Si powder detected in the apparatus after an experiment was different from natural Si abundance.

JCF2-17

TIME DEPENDENCE OF NUCLEAR PRODUCTS INDUCED BY CONTINUOUS DIFFUSION OF DEUTERIUM THROUGH MULTI-LAYER PALLADIUM CONTAINING LOW WORK FUNCTION MATERIAL

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We have been studying on low energy nuclear reactions observed in the metal-deuterium system based on the following assumptions. Necessary conditions to induce nuclear reactions are (i) existence of a low work function material near the Pd surface, (ii)enough diffusion flux of deuterium, (iii) high D/Pd on the Pd surface.

In order to meet with the assumptions, we have developed a new experimental method using the diffusion of D_2 gas through a multi-layer Pd in a vacuum chamber. The first feature of this method is to cause continuous diffusion of deuterium through a multi-layer Pd sheet that contains low work function material (CaO, TiC, Y_2O_3, etc..) The second feature of the D_2 gas diffusion method is that it can analyze the surface of a Pd sample by XPS (X-ray Photoelectron Spectroscopy) WITHOUT taking it out of the apparatus. Therefore it is possible to avoid contamination onto the Pd sample from outer environment. This newly developed apparatus can provide the data of time dependence of detected nuclear products.

The apparatus consists of two vacuum chambers, a X-ray gun and electrostatic analyzer for XPS , a mass spectrometer and a Ge semiconductor detector. One chamber is fulfilled with D_2 gas, and the other chamber is evacuated by a turbo molecular pump. These two chambers are divided by a multi-layer Pd which composed of Pd thin film(400 angstrom), low work function layer(typically CaO; 1000 angstrom) and Pd sheet(25mmX25mmX0.1mm). Procedure of an experiment is as follows. At first, the surface of a multi-layer Pd in the vacuum chamber is analyzed by XPS to confirm that surface of the Pd sample is clean. Next, D_2 gas is fulfilled into a chamber and deuterium atoms diffuse from the D_2 side chamber to the vacuum side chamber. At this moment nuclear reaction occur on the multi-layer Pd containing low work function material. After certain period(from 2days to 1 week) of deuterium diffusion through the Pd sample, the D_2 side chamber is evacuated and the surface of the Pd sample is analyzed by XPS in the chamber without taking out of it. The new elements which did not exit on the Pd sample at the beginning of the experiment can be detected. In case of obtaining time dependence of the products, the process mentioned above should be repeated.

We detected Mg, Si, S on the Pd sample after deuterium diffusion through it. C on the Pd sample decreased, which existed at the beginning of the experiment. Mg once increased and decreased at the end of the experiment. Si and S increased monotonously. Furthermore isotopic compositions of Mg, Si, S were different from natural abundance' s according to the results of SIMS(Secondary Ion Mass Spectroscopy). It might be possible to make an interpretation that C was transmuted to Mg, Si, S, and the result is consistent with the EINR(Electron-Induced Nuclear Reaction) model that we proposed [Y.Iwamura et al, *Fusion Technol.*, **33**, 476(1998)] . We confirmed that no change of C and no other elements on the Pd sample was observed in a blank experiment, and that qualitative reproducibility was obtained.

Effect of Water in Biological Nuclear Transmutation

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In the present study, the highest purity water produced in Osaka Univ. was applied in culturing a yeast Saccuromyces cereviciae IFO 0234 instead of distilled water used in the previous works[1], which revealed the existence of microbiological nuclear transmutation. The negative results obtained in this study suggest the crucial role of water in biological systems.

EXPERIMENTAL

Water--- Resistivity: >18.2 MΩ cm, TOC: <1 ppb, Particulate (>7x10-8m): <1/ml, Silica: <1 ppb, Bacteria (live): <1/litter, B: ppt.

Sample--- Yeast was cultured in nutrient solutions: (1) perfect composition, (2) devoid of K, (3) devoid of Ca.

Experimental analysis--- Dried and powdered yeast was pressed to a tablet, which was subjected to X-ray spectrometric analysis using energy dispersive fluorescence analyzer (SEIKO SEA2001)

RESULTS

Sample (1), control, showed full elements expected, but no generation of K in sample (2) and of Ca in (3) were observed. At present, we can present only the result.

REFERENCE of Effect of Water

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JCF2-19

Problems related to presence of new specific bacteria (genere Ralstonia and Strenotrophomonas) into D2O interesting with overloading of deuterium into Pd by electrolytic procedures

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A new procedure has been developed at INFN-Frascati Laboratory in order to achieve a very high Hydrogen (H) or Deuterium (D) electrolytic loading into a long (30cm) and thin (0.05mm) Palladium (Pd) wire: the technique consists in the addition of a very small amount (some tens of micromoles) of alkaline-earth elements into a very diluted acidic solution (pH-5).

Because of enhancing pH values around the cathode, due to electrolytic current, carbonate are able to precipitate onto the cathode's surface forming a thin layer which strongly increases the Pd loading. Moreover, proper computer simulations have been developed in order to find out the proper working conditions for the carbonates precipitation.

Usually, at proper loading values, few micromoles of Hg (as HgCl2) are added to the solution in order to reduce the problem of cracking of Pd surface due to H or D absorption.

Loading results using H (i.e. bi-distilled light water) were excellent (R/Ro<1.2, i.e. H/Pd->1) and fully reproducible. Similar results, adopting the same procedure, were obtained in other two well equipped and experienced Laboratories (PIRELLI, Italy; SRII, USA). Among other, the evidence of a new phase in the Pd-H system was inferred from the basis of the variation of thermal resistivity coefficient of the Pd wire as a function of the H/Pd ratio.

Less satisfactory results were obtained for D (D/Pd about 0.85; no excess heat detected) because of inorganic and organic contamination usually present in ordinary, reactor-grade (99.97% isotopic purity) heavy water.

A peculiar procedure to purify heavy water, developed at INFN-LNF has permitted to achieve interesting loading, up to D/Pd-0.97, for several days and evidence of localized overheating of Pd wire, i.e. "excess heat" when the D is properly "moved" inside Pd wire. Main drawbacks of purification procedure are its long time consuming and sensitivity to ambient humidity: it is necessary over a week to purify 1.5 liters of heavy water.

We have discovered that the poor results, obtained with the commercial heavy water we used, were due also to the presence, fully unexpected, of (at least) two kinds of new Bacteria living in that unusual environment. We named such bacteria (Ralstonia and Stenotrophomonas genera) Detusculanense specie.

Up to now, we understood that such bacteria are "dangerous" to overloading procedure because: "metabolize" the proper salts used for polsoning the cathode surface, are easy to be attached at cathode surface and even able to "produce" molecular D (or H) using CO2 and visible light.

STUDIES OF NUCLEAR-REACTIONS-IN-SOLID IN TITANIUM-DEUTERIDE UNDER ION BEAM IMPLANTATION

-Experiments with deuteron beam implantation-

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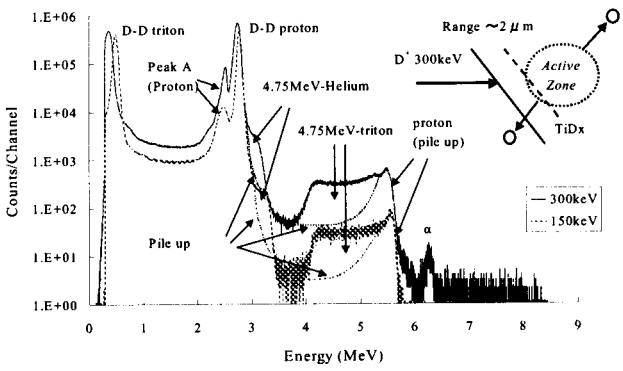
Up to now, the charged-particles which suggest multi-body fusion have been observed, by implantation of deuteron beam to titanium deuteride (TiDx). Unique D-D proton which is considered the charged-particle emitted in the same coherent process in TiDx as multi-body fusion has been observed. To identify these charged-particles, we tried coincidence measurement using thin foil sample.

Fig.1 shows the charged-particle spectra emitted from TiDx sample under the implantation of 150 and 300 keV deuteron beam. The shoulder measured at about 3.3MeV at high energy side of D-D proton's peak was assigned to be helium in the present work. And, the peak measured at about 4.1MeV in the low energy side overlapping D-D proton pile up region was also identified to triton. Energies of charged-particles by impurity-reactions do not correspond to the energies of these peaks. Considering one of the branch of 3D multi-body fusion, 3D → t(4.75MeV)+^{3}He(4.75MeV), these peaks can be explained. It was reported that the multi-body reaction was enhanced by transitional condition which was induced beyond the range of deuteron beam (active zone)[(1)].



Charged-particle spectra observed by the Ek detector with the 300 and 150-keV deuteron beam.

Peak A is measured at lower side of D-D proton peak (by 100-200 keV). It is known that peak A is proton in the present work from energies loss value using screening foil. ^{12}C(d,p)^{13}C reaction is a considerable impurity reaction. But energy dependence of peak A differs from that of the ^{12}C(d,p)^{13}C reaction. So, we speculate that the peak A will be unique D-D proton produced by the same coherent reaction process in TiDx as multi-body 3D fusion.

Ref.[(1)]A.Takahashi et al : Fusion Technology, 1998, Nov, Vol34

JCF2-21

STUDIES OF NUCLEAR-REACTIONS-IN-SOLID IN TITANIUM-DEUTERIDE UNDER ION IMPLANTATION- II

-Experiments with proton beam implantation-

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The high energetic charged-particles have been observed by implantation of proton beam to titanium deuteride(TiDx).Considering the thickness of the screening foil which is fixed in front of the detector, we thought these charged-particles are protons. If these particles are protons, these suggest multi-body fusion{H+D+D→p(19.1MeV)+ α (4.77MeV)}. To identify these charged-particles, we tried coincidence measurement. Emission of such high energy protons are not known in all the two-body reactions and in three-body reactions except the above one.

Fig.1 shows the charged-particle spectrum emitted from TiDx sample under the implantation of 300keV proton beam. The detector observed charged-particles which were emitted from TiDx sample and lost their energy in the Ti layer of 1300 μ m which contained the thickness of the sample and the screening foil . In this case, the proton which has the energy of 19.1MeV is observed at the energy of 2.7MeV. So, the observed broad peak in 2～3.5MeV of spectrum in Fig.1 may suggest the possibility of the emission of

that 19.1MeV proton

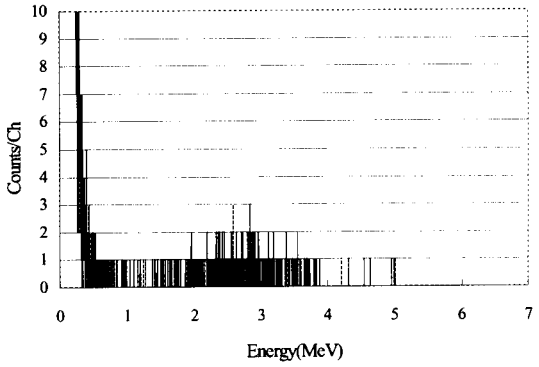

Fig.1 Charged-particle spectrum emitted from TiDx sample implanted with 300keV-proton

It is reported that multi-body reaction occurs beyond the range of incident beam (active zone)[1], and kinetic energy near zero. So the 180° symmetrically coincidence measurement is proper, and we set two detectors at the front and the back-side of TiDx sample. Fig.2 shows two dimensional charged-particle spectrum emitted from TiDx sample under the implantation of 300keV proton beam. Considering the range of proton beam, the thickness of screening foil and the thickness of sample, this spectrum suggests the possibility of the multi-body reaction{H+D+D→p(19.1MeV)+ α (4.77MeV)}, as we explain the detail.

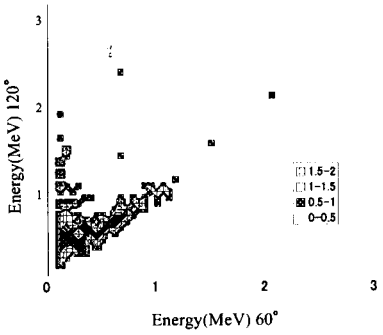

Fig.2 Two dimensional charged-particle spectrum emitted from TiDx sample implanted with 300keV-proton

Ref.(1) A.Takahashi et al :Fusion Technology,1998,Nov,Vol134

JCF2-22

Charged-Particle Spectroscopy with Decreasing Pileup of D-D Reactions for Titanium Deuteride under Deuteron Implantation

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Multibody fusion were observed under low-energy D^+ ion beam implantation with titanium-deuteride (TiDx). But we could not estimate the unique charged-particle spectrum exactly because of pileups of D-D reactions. In order to evaluate spectrum precisely, we tried pileup-reduction -measurement of D-D reactions.

The rise time of pileup signal is longer than single event signal. So we can distinguish between pileup signal and normal signal by difference of rise time. Fig.1 shows the measured charged particle spectra emitted from a TiDx sample under the 300keV deuteron implantation. The spectrum was greatly improved by the reduction technique of pileups of D-D protons and D-D tritons.

When two and more charged particles go into detector at the same time, the rise time of the signal is almost equal to that of single event signal. So, we can't distinguish between pileup signal and normal signal in this case. Therefore, we thought that Peak A was caused by such signals, which D-D protons went into the detector exactly at the same time with D-D tritons. And, Peak B was caused by D-D protons and D-D protons with the same mechanism.

However, pileups were fully decreased in the range of 4-5MeV and over 6.5MeV in Fig.1. Especially alpha-particle peak by $^{14}N(d,\alpha_1)^{12}C$ can be confirmed clearly. It was reported that the reaction rate ratio (R_{3D}/R_{2D}) between two-deuteron (D+D) and three-deuteron (D+D+D) fusions was about 10^{-30},which was a typical value for cascade reactions in random process.[1] In case of considering that signals in the range of 4-5MeV in Fig.1 are some of charged-particles emitted by a branch of 3D multi-body fusion, 3D→t(4.75MeV)+He(4.75MeV), the reaction rate ratio (R_{3D}/R_{2D}) is about 10^{-6}. So, 3D multi-body fusion rate would be greatly enhanced than the random theory rate 10^{-30}.

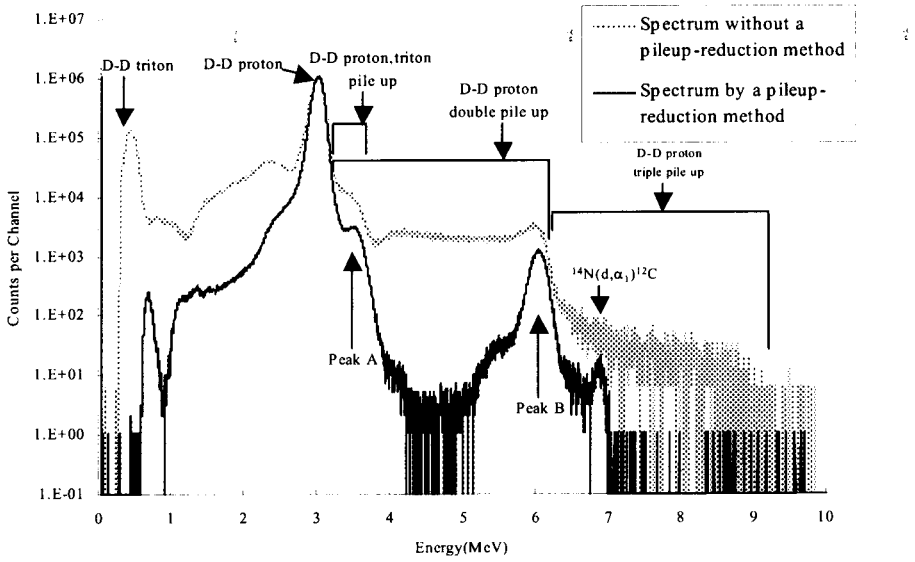

Fig.1 Charged-particle spectra emitted from TiDx sample implanted with deuteron-beam

Ref.[1]A.Takahashi at al : Anomalous enhancement of three-body deuteron fusion in titanium-deuteride with low-energy D^+ beam implantation,1998,Nov,Vol34

JCF2-23

STUDIES OF NUCLEAR REACTIONS IN SOLIDS UNDER ELECTRON BEAM IRRADIATION TO METAL DEUTERIDE

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Keywords : nuclear reactions in solids, electron beam, PdDx

It is said that the excitation of harmonic oscillation and diffusion of deuterons in a metal lattice are important factors to generate nuclear reactions in solids. [1,2] Such conditions may be attainable only on some dynamic processes, not in equilibrium state. The purpose of this experiment is to make disturbed situation by stimulating highly D-loaded metals (titanium-deuteride, TiDx or palladium-deuteride, PdDx) with electron beam irradiation and to induce nuclear reactions in solids.

Figure 1 shows the experimental setup. The electron beam was produced with an electron gun of which beam energy, beam current and beam diameter are about 3 keV, 1μA and 1mm respectively. Two SSBDs for charged particle and two CdTe detectors for X-rays were attached to a vacuum chamber keeping about 5×10^{-6} Pa. In several runs, a lithium drifted silicon detector (Si (Li)) for low energy X-rays and a HPGe detector for γ-rays were also set up. Pre-D-loaded Ti (TiDx: x~1.5, by gas loading method) or Pd (PdDx: x~0.7, by electrolysis method) was used as a target. Surface of PdDx was coated with copper layer (~0.05 μm) by electroplating method after D-loading by electrolysis (150 mA/cm^2, 8 hours), for making blocking-layer to prevent loaded deuterium releasing out.

Figure 2 shows energy spectra measured with twin CdTe detectors under electron beam irradiation to PdDx. Bumps from 10 keV to 20 keV are recognized in the both of spectra. Counts from 10 keV to 20 keV in the both of spectra were about 24 times as much as background. Counts above 20 keV also increased about 5 times comparing with background. Since electron beam energy was 3 keV, these are not bremsstrahlung x-rays of incident electrons. There are some possibilities that these spectra are responses of bremsstrahlung x-rays by slowing down of generated charged particles, of scattered γ-rays by Compton effect, or some pumped-up photons in the system.

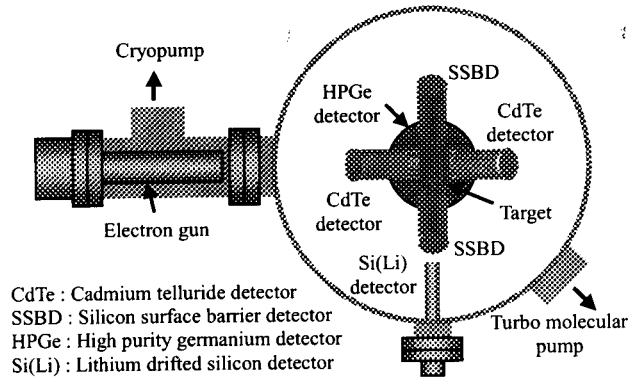

Fig.1 Schematic view of the experimental set up

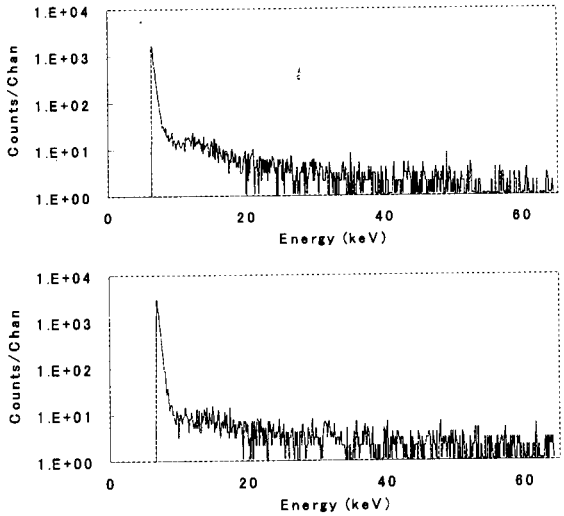

Fig.2 Energy spectra under electron irradiation to PdDx measured with CdTe detectors
(Measurement time: 5000sec, Beam current 1μA)

References

[1] Akito Tkahashi et al., Fusion Technology, 19 (1991) pp.380-390
[2] Akito Tkahashi et al., Fusion Technology, 27 (1995) pp.71-85

Effects of the Bose-Einstein Condensation to the Nuclear Reaction in Solids

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Since deuterium in palladium can be regarded as bosons, Bose-Einstein condensation may happen if the temperature is lower than critical temperature Tc that depends on the density of the deuterium. For high-density system, this condition is satisfied at room temperature and many deuterium atoms begin to occupy the ground state. On this occasion, its energy is transferred to the deuterium atoms in high-energy states. This may lead to the cold fusion through the quantum tunneling effect. In this study, tunneling effect enhanced by Bose-Einstein condensation is discussed by using Peng's theory.[1]

Reference

1. Peng Kuangding and Chen Shanna, Proceedings of ICCF6 Vol.1 p337

JCF2-25

A Catalytic Role of Atomic Oxygen on Anomalous Heat Generation Induced in Proton Conductive Ceramics under Hydrogen Atmosphere

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There are several scientists who claim that an electron with lower energy states than the ground electronic state is possible in the hydrogen atom. According Dr. Randlle Mills(1), one of these scientists, it is postulated that hydrogen atoms can achieve these lower states by a resonant collision with a near by atom or combination of atoms having the capability to absorb the energy to effect the transition as is shown in Fig 1.

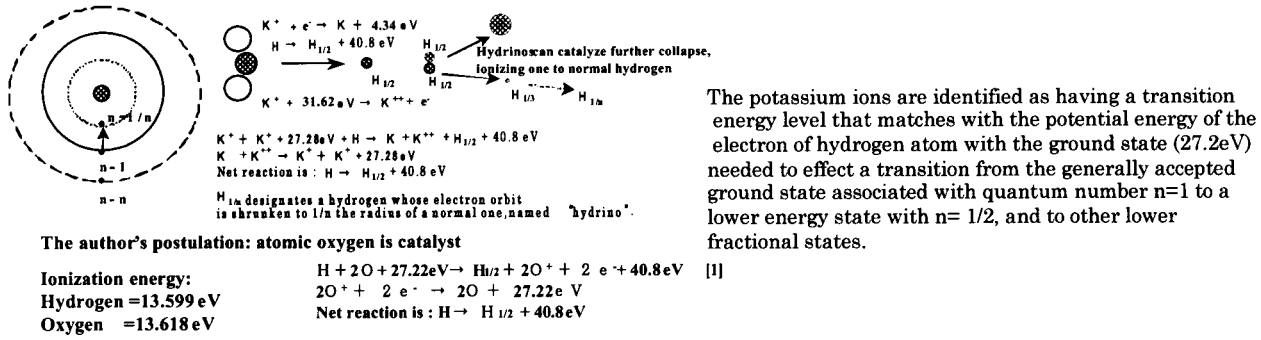

Fig 1 Mechanism of "hydrino " generation and energy release by Dr. Mills and the author

The author postulated that 2 atomic oxygen could play the same function as potassium ions as is also shown in Fig 1.

It had been shown that this postulation could be applied to the explanation of several anomalous combustion phenomena that cannot be explained by current theories(2).

This paper explains that atomic oxygen can play the same catalytic role on anomalous heat generation induced in proton conductive ceramics under hydrogen atomosphere

When certain proton conductive ceramics such Sr(Ce,Nb,Y)O3 or La0.95AlO3 with palladium or gold plating are heated and electrolyzed in deuterium, anomalous heat generation has been observed(3). The cause of proton conductivity in these ceramics is said to be due to oxygen vacancies expressed as $V_O^{\cdot\cdot}$ .When such ceramics as Sr(Ce,Nb,Y)O3 or La0.95AlO3 are heated in the oxygen rich atmosphere, $V_O^{\cdot\cdot}$s absorb oxygen and turn into oxygen ions $O_O^{\times}$ and electric holes $h^{\cdot}$ as is expressed in Fig2.

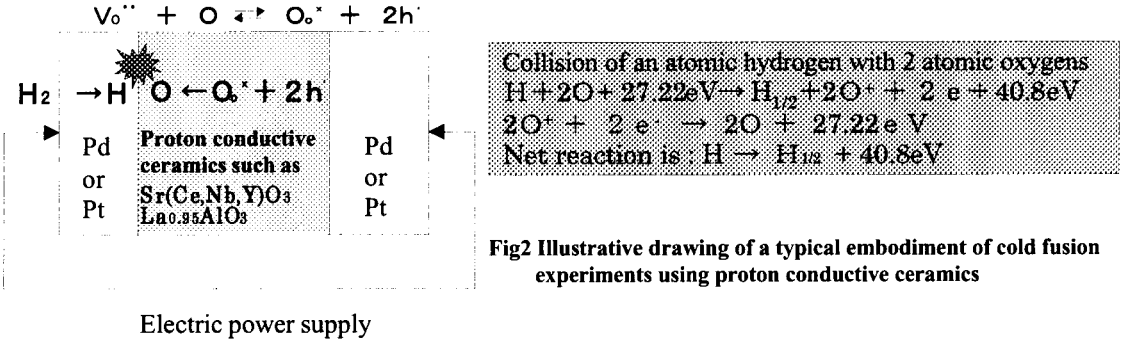

Fig2 Illustrative drawing of a typical embodiment of cold fusion experiments using proton conductive ceramics

In the case of experiments above mentioned, the test layout can be simplified as shown in -Fig 2. When electric field or thermal fluctuation is applied, it can be expected that collision of atomic hydrogen with oxygen at the joint face would take place, resulting in the generation of anomalous heat and nuclear transmutation.

REFERENCE

(1) Mills,R. The Grand Unified Theory of Classical Quantum Mechanics, Blacklight Power Inc., 1999
(2) Hiroshi Yamamoto Explanation of Anomalous Combustion of Brown s Gas using Dr. Mills' Hydrino Theory SAE1999-01-3325
(3) Biberian, J., " Electrolysis of LaAlO3 Single Crystals and Ceramics in a Deuteriated Atmosphere , Proceedings of 7th International Conference on Cold Fusion,1998

ON THE POSSIBILITY OF NUCLEAR FORCE ATTENUATION BY THE ELECTRIC FIELD IN THE NUCLEAR TRANSMUTATION REACTION

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In the experiment of the nuclear reaction in the solid, it has been confirmed that reaction product of various types occurs by the nuclear transmutation. In the meantime, though the announcement number is little, the nuclear transmutation experiment has also been carried out ten of year in all over the world since the front.

Next common point was found, when it tried to examine these experiments and nuclear transmutation experiment by present nuclear reaction in the solid.

1. The sum of the number of proton and neutron which constitutes the atomic nucleus before nuclear transmutation is equal to the sum after the reaction of the number of proton and neutron.
2. The atomic number is equal to each sum in before and behind of the reaction.
3 That electric fields such as the discharge are used for the experiment.
4. Being a reaction in the short time very much.
5. That the product material quality after the reaction is not having composition on the earth.

I tried to make next hypothesis in order to explain these phenomena.

The meson which is linking proton and neutron in the atomic nucleus in "strong force" of the nuclear force the original work which the meson has in the effect of electric fields such as the discharge is not possible, and it seems to reconstitute various atoms by the atomic nucleus becoming temporarily the rose only in the very short time, and proton and neutron in the atomic nucleus randomly sticking, when the effect of electric fields such as the discharge disappeared afterwards, to some extent.

This the reaction product which consists of the element of various types is formed in great numbers, and moreover, the fact of the ratio of the natural isotope element on the earth agrees with the consistency.

And, the the sum of the number of proton and neutron is also made on description in before and behind of the nuclear transmutation reaction.
In addition, it is similar in the atomic number.

Catalyzer of the nuclear cold fusion reaction[1]

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Abstract

It is shown that Dirac's magnetic monopole can play the role of the catalyzer of the nuclear fusion reactions. A short review of the magnetic monopole is given, which leads to the charge quantization condition of Dirac. After introducing the monopole harmonics $Y_{q,\ell,m}(\theta,\phi)$ of Wu and Yang, which is a generalization of the ordinary spherical harmonics $Y_{\ell,m}$ and is necessary in the description of the quantum mechanics of the charge-monopole system, it is shown that a charged particle of spin zero, such as He^4, cannot form a bound state with the monopole.

By making Pauli approximation of the Dirac equation in the external monopole field, we obtain an equation which is suitable for our treatment of the nucleus-monopole system. In general, light nucleus with anomalous magnetic moment can form bound states with a monopole. A table of the energy levels of such bound states is given. Although in the fusion reaction the repulsive Coulomb barrier is an obstacle, once a nucleus form a bound state with a monopole, the second nucleus can easily approach to the bound system, because the barrier is largely reduced. In the best situation the height of the barrier is reduced to 17 keV..

Finally a mechanism, in which a magnetic monopole is trapped by the crystal of atoms with the magnetic moment of a few Bohr magneton, is explained.

[1]詳しくは小島英夫氏の CFRL News (www:mars.dti.ne.jp/ kunihito/cf-lab/indexhtml) にシリーズで掲載している「Cold fusion へのメッセージ (沢田哲雄)」を見てください。この essay は3部からなっていて、その第一部と第2部は5月号と6月号 (No.12 and No.13) に載っています。 また第3部は8月号か9月号 (No.15 or No.16) に掲載される予定です。

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:
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7. Fields:
consists of combined fields interdisciplinarily and multidisciplinarily in the following fields;
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