The 3rd Meeting of Japan CF-Research Society

JCF3 ABSTRACTS

October 25-26, 2001

at Yokohama National University

Japan CF-Research Society

http://fomcane.nucl.eng.osaka-u.ac.jp/jcf/

Program of JCF3 Meeting, October 25-26, 2001, at University Hall, Yokohama National University, Yokohama, Japan

October 25, 2001

9:00-9:50	**Registration**
9:50	**Opening Address** (K. Ota, Yokohama N.U.)
10:00	**Electrolysis: Light and Heavy Water** (chairman: A. Takahashi, Osaka U.)
10:00-10:25	**JCF3-1** H. Yamada et al. (Iwate U.): Nuclear Transmutation by Light Water Electrolysis with Palladium Cathode
10:25-10:50	**JCF3-2** M. Fujii et al. (Yokohama N.U.): HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING Pd RODS AND Pd/Ni RODS CATHODE
10:50-11:15	**JCF3-3** Y. Isobe et al. (Osaka U.): Study of Nuclear Reactions in Metal-Deuteride by Closed-Type D_2O Electrolysis
11:15-11:40	**JCF3-4** T. Mizuno et al. (Hokkaido U.): Neutron and Heat Generation from a Palladium Electrode by Alternate Absorption Treatment of Deuterium and Hydrogen

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

11:40-12:15	**JCF3-5** F. Celani et al. (INFN-LNF): Electrochemical H-D loading of Palladium wires by hydro-alcoholic electrolytes related to the new discovered *Ralstonia* bacteria into heavy water.

---**lunch** (12:15-14:00) ---

14:00	**Electrolysis: Plasma State** (chairman: T. Itoh, Mitsubishi H.I.)
14:00-14:25	**JCF3-6** T. Ohmori et al. (Hokkaido U.): Nuclear Transmutation from ^{39}K to ^{41}K in the Plasma Electrolysis on Re in K_2CO_3/H_2O and D_2O Solutions
14:25-14:50	**JCF3-7** M. Matsunaka et al. (Osaka U.): Studies of Photon Source for Multi Photon Induced Fission under Plasma Electrolysis
14:50-15:15	**JCF3-8** T. Hanawa (Osaka U., Emeritus): Calorimetry of Submerged Carbon Arc.

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

15:25	**Theory-1** (chairman: K. Ota, Yokohama N.U.)
15:25-15:50	**JCF3-9** T. Sawada (Nihon U.): Implications of ^4He dominance in $d+d$ reactions
15:50-16:15	**JCF3-10** T. Sawada (Nihon U.): Proposal to identify the 'nuclear active state'
16:15-16:40	**JCF3-11** H. Yamamoto: A Study on Anomalous Characteristics of Gasses Generated by under-water electric arc discharge with carbon electrodes
16:40-17:05	**JCF3-12** N. Yabuuchi (High Scientific Research Laboratry): Possibility of Nuclear Fusion in Solid
17:05-17:35	**JCF Annual Meeting**
18:00-20:00	**Reception**

October 26, 2001

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

9:00-9:25 **JCF3-13** A. Arapi et al. (Iwate U.): Generation of the new elements and isotopic changes on deuterated palladium electrodes under DC glow discharge.

9:25-9:50 **JCF3-14** S. Narita et al. (Iwate U.): Anomalous Heat Effect for Palladium Hydride in Gas Out-diffusion Method

9:50-10:15 **JCF3-15** T. Itoh et al. (Mitsubishi H.I.): Observation of low energy nuclear reaction induced by D_2 gas permeation through the multilayer Pd film(1) -Transmutation of Cs into Pr-

10:15-10:40 **JCF3-16** M. Sakano et al. (Mitsubishi H.I.): Observation of low energy nuclear reaction induced by D_2 gas permeation through the multilayer Pd film(2) -Transmutation of Sr to Mo-

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

10:50 **Theory-2** (chairman: T. Ohmori, Hokkaido U.)

10:50-11:15 **JCF3-17** M. Fukuhara: Neutral Pion-Catalysed Fusion in Palladium Lattice

11:15-11:40 **JCF3-18** K. Tsuchiya (Tokyo N.C.T.): Effects of the Bose-Einstein Condensation to the Nuclear Reaction in Solids II

11:40-12:05 **JCF3-19** A. Takahashi et al. (Osaka U.): Cold Fusion and Clean Fission

12:05-12:30 **JCF3-20** M. Ohta et al. (Osaka U.): Analysis on fission in U-235 by SCS Model

--- **lunch** (12:30-14:30) ---

14:30 **Beam Solid Interaction** (chairman: H. Yamada, Iwate U.)

14:30-14:55 **JCF3-21** K. Kamada (The Wakasa-wan Energy Reserch Center): Heating of Deuteron Implanted Al on Electron Bombardment and its Possible Relation to "Cold Fusion" Experiment

14:55-15:20 **JCF3-22** T. Hayashi et al. (Osaka U.): STUDIES OF NUCLEAR REACTIONS IN SOLIDS IN TITANIUM DEUTERIDE UNDER DEUTRON BEAM IRRADIATION

15:20-15:45 **JCF3-23** Y. Katayama et al. (Osaka U.): STUDIES OF NUCLEAR-REACTIONS-IN-SOLID IN TITANIUM-DEUTERIDE UNDER ION INPLANTWTION-III
-Experiments with proton and Si^{3+} beam implantation-

15:45-16:10 **JCF3-24** T. Dairaku et al. (Osaka U.): Analysis of Charged-Particle-Spectra Obtained under the Implantation of Ion Beam to TiD, TiDH and TiH

16:10-16:35 **JCF3-25** H. Mori et al. (Osaka U.): STUDIES OF NUCLEAR REACTIONS IN SOLIDS UNDER ELECTRON BEAM IRRADIATION TO METAL DEUTERIDE

Adjourn. (JCF4 will be held at Iwate U.)

JCF3-1

Nuclear Transmutation by Light Water Electrolysis with Palladium Cathode

Hiroshi Yamada, Yoshikazu Fujii, Taketoshi Sato, Shigeo Sasaki,
Shinya Narita and Tadayoshi Omori

Faculty of Engineering, Iwate University, Morioka 020-8551 Japan
Catalysis Research Center, Hokkaido University, Sapporo 060-0811, Japan

ABSTRACT

Two electrolytic cells made of quartz with a polyethylene flange were used. These have a cylindrical shape with volume capacity of 100cm^3(Cell A) and 200cm^3(Cell B). 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 palladium plate. 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 was used only for transmutation experiment; a palladium 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 was 0.5 M sodium sulfate solution. The volume of electrolyte solution was 150 - 200cm^3 for Cell B. Both the electrolytes were prepared from Merck Sprapur Reagents. The electrolysis was carried out for more than 7 days using Cell B at a constant current 0.5 Amps. The constituting elements on the palladium electrode after electrolysis were identified by means of Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS). Their isotopic compositions were surveyed by TOF-SIMS. The SIMS measurement was carried out by Ga+ ion irradiation.

Excess power levels of up to 9% was measured with palladium cathode for every run using the Cell A. Marked increase in counts for mass number 7, 10-11, 24-26, 27, 39-41, 40-44, 50-53, 55, 54-57, 59, 58-62, 63-65, 64-68 and 130-138 were observed on the palladium cathode after electrolysis. These correspond to Li, B, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn and Ba, respectively. These elements except Ba have been observed for the test with gold cathode under similar electrolysis condition. Barium production would suggest that the transmutation process with palladium cathode involves a different channel from the process with gold cathode.

JCF3-2

HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING Pd RODS AND Pd/Ni RODS CATHODE

○ M.Fujii, S.Mitsushima, N.Kamiya and K.Ota

Depertmant of Energy and Safety Engineering, Yokohama National University

79-5 Tokiwadai Hodogaya-ku, Yokohama 240-3501 JAPAN

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 claimed that he observed large excess heat with high reproducibity during electrolysis using multi layer beads electrode in light water solution[2)~4)]. In this study, we aimed to measured the heat balance during electrolysis in light water solution using Pd and Pd coated Ni(Pd/Ni) rods.

2. Experimental

Pd rod and Pd coated Ni rod for cathode was used in electrolysis. Anode was Pt mesh, and electrolyte was 1M Li_2SO_4 light water solution. The electrolysis was conducted at 0.5～2A constant current, mostly 1A constant current. The electrolyte was circulated in this system. The flow rate of electrolyte was fixed at about 40 ml/min. The gas that was generated during electrolysis was collected in reserver. The flow rate of gas was measured using a soap membrane flow meter in order to correct the heat balance.

3. Result & discussion

In this report, we will show the result of the heat balance of 19 runs those using Pd rods or Pd/Ni rods for cathode. Table.1 shows the summary of those results. Among these 19 runs, we could not see any excess

Table.1 Heat balance of electrolysis in 1M Li_2SO_4-H_2O using Pd rods and Pd/Ni rods for cathode.

No	Time(h)	Cathode	Cell Voltage(V)	HB	Corrected HB	Corrected HB_{AVE}
1	24.25	Pd	8.8～10.7	1.10～1.52	1.26～1.65	
2	75.75	Pd	13.2～15.4	0.74～1.15	0.84～1.25	1.03
3	239.9	Pd/Ni	6.3～11.3	1.12～1.83	1.34～1.96	
4	30	Pd	10.5～12.2	0.75～1.02	0.87～1.15	1.06
5	72.6	Pd/Ni	6.3～11.4	0.89～1.57	1.25～1.49	
6	126.9	Pd	9.8～11.8	0.75～0.99	0.87～1.13	1.05
7※	50	Pd/Ni	7.5～9.9	1.13～1.85	1.32～2.00	
	20.05		8.3～10.9	1.05～1.22	1.20～1.36	
	24.05		4.7～4.9	0.84～1.34	1.15～1.64	
	29.2		5.9～6.4	1.04～1.25	1.28～1.50	
8	55.75	Pd/Ni	8.1～11.8	0.76～1.00	0.93～1.15	1.03

※ Cell current is 0.5～2.0A. In the other experiment, cell current is 1A

No	Time(h)	Cathode	Cell Voltage(V)	HB	Corrected HB	Corrected HB_{AVE}
9	25.6	Pd/Ni	10.9～12.0	0.84～0.99	0.97～1.12	1.05
10	81.5	Pd/Ni	10.0～12.3	0.76～1.02	0.90～1.16	1.02
11	33.2	Pd/Ni	12.5～15.9	0.77～0.99	0.88～1.09	1.00
12	20.3	Pd/Ni	12.7～16.0	0.72～0.98	0.81～1.10	0.93
13	43.35	Pd/Ni	14.9～20.5	0.83～1.09	0.92～1.19	1.02
14	76.5	Pd/Ni	9.3～12.0	0.74～1.10	0.89～1.23	1.03
15	77.2	Pd/Ni	9.4～10.9	0.77～1.03	0.91～1.17	1.03
16	74.65	Pd/Ni	9.1～10.9	0.76～1.09	0.91～1.24	1.03
17※※	73.3	Pd/Ni	7.3～8.5	0.80～0.92	0.99～1.10	1.04
18※※	52.2	Pd/Ni	6.4～7.1	0.82～0.87	1.04～1.09	1.07
19	54.1	Pd/Ni	7.2～8.3	0.85～0.89	1.03～1.07	1.05

※※ Cell current is 0.8A. In the other experiment, cell current is 1A.

heat only at 1 runs that used Pd/Ni rods. Figure.1 show the trend of heat balance. The heat balance dose not change significantly. The average heat balance was 0.93 that means no excess heat.

We could see small excess heat (less than 10%) at 14 runs. The excess ratio was between 2 ～5% of input power. However we can not confirm this excess, considering the error limit of our measuring system. Figure.2 shows typical trend of these runs. The average heat balance was 1.03.

We detected large excess heat (more than 25% excess) at 4 runs. In these cases, we got the excess heat even without the correction of current efficiency (energy of products). Figure.3 shows the trend of the excess heat. We got a maximum excess heat of 100 % at the beginning of electrolysis. This excess was the largest in this study. The excess heat decreased after that. The trend of the cell voltage was the same.

In this study, we observed clear excess heat using Pd/Ni or Pd rods at 4 runs. However, most of runs showed the small excess or no excess. At this stage, we cannot clarity the difference. Further study is needed to elucidate the excess heat.

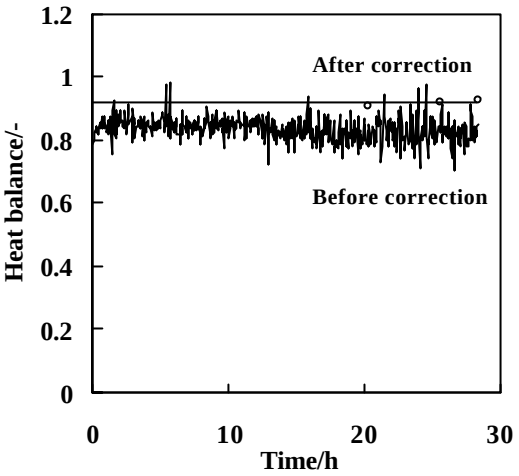

Fig.1 Heat balance of electrolysis in 1M Li_2SO_4-H_2O solution using Pd/Ni rods cathode.

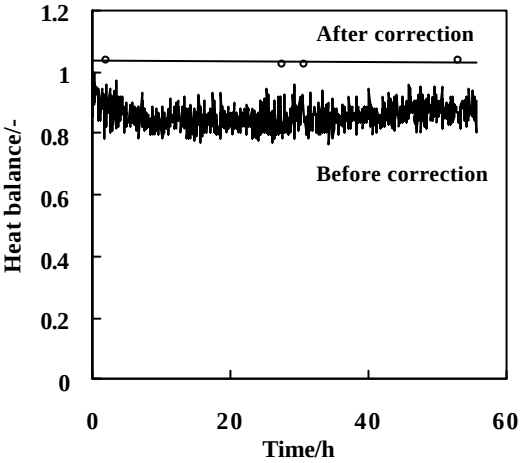

Fig.2 Heat balance of electrolysis in 1M Li_2SO_4-H_2O solution using Pd/Ni rods cathode.

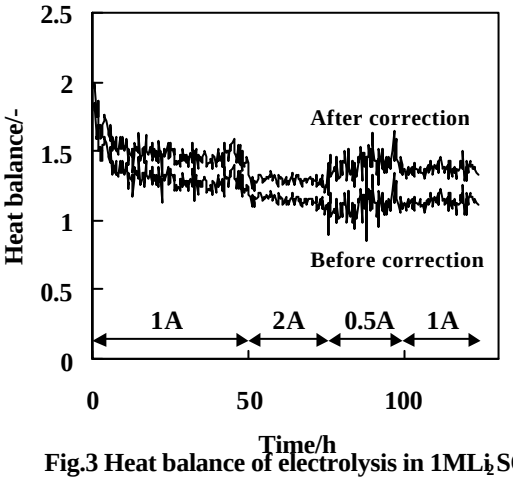

Fig.3 Heat balance of electrolysis in 1MLi_2SO_4-H_2O solution using Pd/Ni rods cathode.

4. References

1) M.Fleischmann, S.Pons et al, J.Electroanal. Chem.,286,293(1989)
2) James A.Patterson, U.S.Patent, 5318675
3) G.H.Miley et al, Proc.ICCF6, 629(1996)
4) D.Cravens, Proc.ICCF4, 79(1995)
5) M.Fujii, S.Mitsushima,N.Kamiya, K.Ota, JCF2 Abstracts(2000)

Study on Nuclear Reactions in Metal-Deuteride by Closed-Type D_2O Electrolysis

Yuji Isobe, Kahou Yabuta, Satoshi Ueda and Akito Takahashi

Department of Nuclear Engineering, Graduate School of Engineering, Osaka University, Yamadaoka 2-1, Suita, Osaka 565-0871

E-mail: yisobe@newjapan.nucl.eng.osaka-u.ac.jp

In order to induce nuclear reactions in metal-deuteride, electrolysis experiments with a closed type vessel and palladium cathodes have been performed. Significant amounts of ^{4}He generation have been detected in several experiments. However, strong emissions of neutron were not detected during that experiments. Electrolyses with a new vessel are also under way. This vessel has two windows to measure emissions of X-rays during electrolyses. The results of electrolysis with this new vessel are also reported.

Introduction

Many kinds of experiments have been performed by many researchers in order to induce nuclear reactions in metal-deuterides [1]. Several groups have claimed that significant amounts of ^{4}He were generated during the electrolyses of D_2O with Pd-cathodes. Excess heat generations were also obtained in some of them [2]. In our laboratory, investigation of this phenomenon has been done by electrolyzing D_2O with a Pd-cathode in a closed type vessel [3]. Generation of ^{4}He was observed in several times without strong emission of neutrons [4]. In order to search the origin of this ^{4}He, a new electrolytic vessel, with which X-rays could be measured, was designed. If this ^{4}He is an ash of some kind of nuclear fusion reactions, the ^{4}He-particles should be emitted with initial kinetic energies, which should be lost during the slowing down of particles in metals with emitting bremsstrahlung X-rays. If the kinetic energies of the particles are high enough (over several MeV), characteristic X-rays of the host-metals may be also emitted. Therefore, spectroscopic detection of X-rays can be an important evidence to estimate the origin of this ^{4}He-generation. Moreover, if compound nuclei are produced just after some kinds of deuteron fusion reactions, there is a possibility that it may releases its excited energy by emitting hard γ-rays or by sharing the energy to many QED-photons. These QED-photons may be detected as a strong burst. Results of the recent experiments and of experiments with the new vessel are reported here.

Experimental Setup

Figure 1 shows a schematic view of the new electrolytic vessel and the measurement system. The vessel was made from stainless steel and its inner wall is coated with Teflon layer. It has two windows of tempered glass (20 mm diameter and 5 mm thickness). Contamination of ^{4}He through the window is small enough to be neglected. A CdTe detector is set in front of this window to measure X-rays and γ-rays. An NE213- and a ^{3}He- detector are employed for neutron detection. Loading ratio (D / Pd) is also measured on-line. The analysis of ^{4}He is done off-line with a QMS. The gas accumulated in the vessel was sent to a

QMS after electrolysis. The gas trapped inside the cathode was also analyzed by heating up the electrolyzed cathode. The maximum temperature of the heating was about 470 degree centigrade.

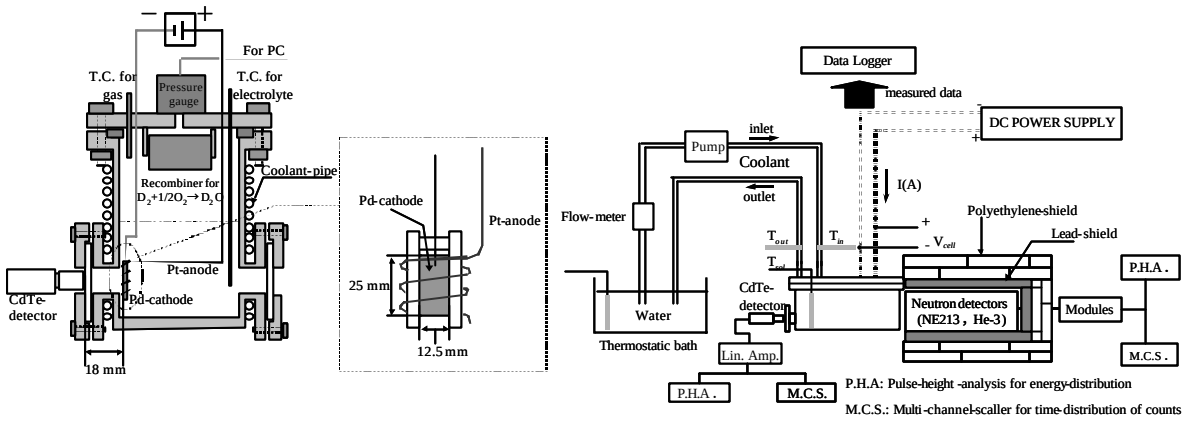

Fig. 1 Schematic view of the electrolytic vessel and the measurement system

Results

In several times, generations of significant amount of ^{4}He were observed. However, strong emissions of neutrons were not detected during these experiments. In one of the experiments, an increase of ^{4}He of 4.6×10^{16} atoms was detected. In the same run, the amount of ^{4}He detected in the inside-gas of Pd-cathode was 8.1×10^{16} atoms. This amount of ^{4}He cannot be explained by the contamination of atmospheric ^{4}He. It is conceived that the origin of this ^{4}He is by some nuclear reactions. Experiments with the new electrolysis vessel are under way.

<References>

[1] Proc. of 8th Int. Conf. Cold Fusion (Italian Physical Society, Conf. 70, Bologna, 2001)

[2] Y. Arata and Y.C. Zhan: Jpn. J. Apply. Phys. 38 (1999) L774

[3] S. Ueda, Y. Yasuda and A. Takahashi: Proc. of 7th Int. Conf. Cold Fusion (ENECO, Vancouver, 1998) P. 398

[4] Y. isobe, S. Uneme, K. Yabuta, H. Mori, T. Omote, S. Ueda, K. Ochiai, H. Miyamaru and A. Takahashi: Proc. of 8th Int. Conf. Cold Fusion (Italian Physical Society, Conf. 70, Bologna, 2001) p. 17

Neutron and Heat Generation from a Palladium Electrode by Alternate Absorption Treatment of Deuterium and Hydrogen

Word¥JCF3 9 7

Tadahiko Mizuno, Tadashi Akimoto, Tadayoshi Ohmori [1], Akito Takahashi [2]

Division of Quantum Energy Engineering, Graduate School of Engineering, Hokkaido University, Kita 13 Nishi 8, Kita-ku, Sapporo 060-8628, Japan

[1] Catalysis Research Center, Hokkaido University, Kita 11 Nishi 10, Kita-ku, Sapporo 060, Japan

[2] Department of Nuclear Engineering, Graduate School of Engineering, Osaka University, 2-1Yamadaoka, Suita, Osaka 565-0871, Japan

We observed neutron emissions from palladium after it absorbed deuterium from heavy water followed by hydrogen from light water. The neutron count, the duration of the release and the time of the release after electrolysis was initiated all fluctuated considerably. Neutron emissions were observed in five out of ten test cases. In all previous experiments reported, only heavy water was used, and light water was absorbed only in accidental contamination. Compared to these deuterium results, the neutron count is orders of magnitude higher, and reproducibility is much improved.

Introduction

It has been reported that palladium electrolyzed in heavy water produces excess heat [1]. However, the mechanism remains unknown because research is hampered by poor reproducibility and lack of control. The very existence of the reaction is often called into question. On the other hand, based on several reliable reports of neutrons and other fusion products, many researchers assume that the mechanism involves nuclear fusion; however, many problems remain with this assumption [2-5].

The authors have examined many of the reports available to date of neutrons and heat, and have reached the following conclusions. First, when neutrons and excess heat are observed, they usually appear after electrolysis has continued for a long time. Second, many instances have been reported in which these effects occur after the cell is replenished with new electrolyte. Third, it is known that when electrolysis is used to absorb deuterium into palladium, at first, the electrolyte contains almost pure heavy water but later, it becomes mixed with light water [6]. This substitution occurs because heavy water is hydrophilic, and light water permeates even a nominally closed cell at some stage during the process, gradually diluting the heavy water.

Based on these observations, we conclude that this reaction must require something more than the absorption of deuterium. In particular, after electrolysis has continued for a long time and the heavy water has been replenished, light water is likely to be mixed in the electrolyte. Also, after electrolysis loading has reached a certain point, any hydrogen present in the cell will migrate to the cathode and block the absorption of additional deuterium. In view of these facts, we predict that the reaction cannot occur with deuterium absorption alone, and that it requires certain triggering events.

Experimental

Palladium wire, 99.9% purity, 1 mm in diameter and 3 cm in length, was used as the cathode. Tungsten lead wire, 1.5mm diameter and 150 mm in length, was welded

with the sample electrode. The electrolyte was composed of 100% pure heavy water from Acros Organics, and K2CO3 reagent from Kanto Kagaku Corp., which was 99.5% pure, and was adjusted to 0.2 M concentration. The reagent was heated to 300 ℃ in an electric furnace to evaporate all water in it. The palladium sample was placed in a quartz glass cell containing 100 g of heavy water electrolyte. It was surrounded by a platinum mesh that served as the anode. Electrolysis was performed for three hours. Immediately after that, the palladium cathode was transferred to a light water cell where light hydrogen absorption was performed. At this stage, voltage was 10 V, and current was about 2 A. The light water cell was made of Pyrex, and it was 10 cm diameter and 20 cm high, with a silicon rubber lid. The palladium was introduced through a hole in the lid. The cell was also equipped with a platinum mesh anode in a configuration similar to the heavy water cell. In this phase, voltage was 40 V and current reached a maximum of 8 A; however, because the electrolyte temperature rose rapidly toward its boiling point, current was reduced to 1 A.

Neutrons were measured with three He3 detectors placed 50 cm above and apart from the cell. The detectors were calibrated with a standard Cf252 neutron source (2.58 $\times 10^4$ decay/s). The background count was 0.008 ± 0.003 c/s. The efficiency of the detectors was set at 4×10^{-5} by calibration measurement. To reduce noise, the detectors were covered by an electromagnetic shield. After calibration, neutrons and noise were distinguished by covering one of the detectors with a 0.5-mm-thick Cd film. Neutron emission could be detected by the coincidence method with two of the detectors and the anti-coincidence method with one detector that was covered by the Cd film.

Results

The experiment was performed ten times. A typical result of neutron emission is shown in the Figure. This shows the neutron count rate as well as the input voltage, current, and electrolyte temperature during the run. In this example, voltage was raised to 85 V at 3000 s, and immediately after that, 1 and 2 count rates were observed by the detectors that were not covered by the Cd film. As shown in Figure, 25,800 neutrons were observed to emit from the cathode, with the count rate of 1 c/s. Neutron production peaked when voltage was raised, and 200 s after that, fell to the background level again. During this period, the total neutron count was estimated as 1.57×10^6. In this example, electrolysis in light water continued for a considerable length of time and neutron emission was observed when voltage increased. In another run, neutron emissions were observed immediately after light water electrolysis commenced. Electrolyte temperature was 40 ℃ and input voltage was 40 V. The maximum count rate was 7.7/s, the duration time 20 s and the total neutron count was estimated as 4.38×10^4.

Table shows how differences in electrolysis conditions led to differences in neutron emissions. Column 1 shows sample number and column 2 is electrolyte temperature. When neutron emissions occur, they always occur after increase in voltage, either when electrolysis begins, or later on when voltage is increased to a higher level. Column 3 shows the voltage level before neutron emissions began. Voltage was zero for

samples 1, 2, and 9, meaning they produced neutrons immediately after electrolysis began. Column 4 shows the ending voltage after emissions ceased, or with samples 6 and 7, after a boost failed to produce neutrons. (Sample 3 remained at 25 V during the entire run, with no boost, and failed to produce neutrons.) In some cases we tried raising voltage gradually while in others, we increased it abruptly. Column 5 shows how much time was taken for each sample. Column 6 shows the total voltage increase that trigged an event, or the boost increase that failed to trigger an event, and column 7 shows the rate of increase. For example, with sample 7, we raised voltage from 70 to 90 V over 15 s, a total of 20 V, at the rate of 1.33 V per second, but no emission was detected. Column 8 shows the peak count, column 9 the total counts, and column 10 the duration of the emission event. Column 11 shows the average count rate per second, and column 12 shows the total number of neutrons extrapolated from the count, based on the calibration with the Cf252 neutron source.

It is clear from this table that in five examples, over 100,000 neutrons are observed, which is deemed a significant count. Emission performance was neither predictable nor controllable: neutron counts varied by one order of magnitude, from 10^5 to 10^6, and continued for the duration ranging from 2 to 200 seconds. All emissions had a distinct pattern, namely a peak soon after the emission began, and a gradual decline. From the data in this table, we cannot yet establish a causal connection between neutron emissions and temperature, voltage, or other control parameters, but in samples that did produce neutrons; the degree of the total voltage increase does appear to correlate with the peak, average, and total neutron counts. Higher voltage correlates with higher neutron counts.

Neutron emissions during light water absorption following heavy water absorption are very difficult to explain by the models proposed heretofore, which involve d-d fusion reactions. These other models assume that neutron emissions occur when heavy water alone is absorbed, and the emissions must be accompanied by excess heat and tritium production. The reaction we observed came about after alternating absorption of deuterium followed by hydrogen, and the reaction appeared to be highly reproducible, reliably generating high neutron emissions. We conclude that the models proposed heretofore based upon d-d reactions are inadequate to explain our present results, which involve hydrogen nuclear reactions.

References

1. M. Fleischmann and S. Pons: J. Electroanal. Chem. 261 (1989) 301.
2. A. Takahashi, T. Iida, H. Miyamaru and M. Hukuhara: Fusion Technol. 27 (1991) 71.
3. J. Kasagi, T. Otsuki, K. Ishii and M. Hiraga: J. Phys. Society Jpn. 64 (1995) 777.
4. S. Chubb and T. Chubb: Trans. Fusion Technol. 26 (1994) 414.
5. A. Takahashi: Trans. Fusion Technol. 26 (1994) 451.
6. Y. Torikai: private communication, July 18 (2000).
7. T. Mizuno, T. Ohmori, T. Akimoto and A. Takahashi: Jpn. J. Appl. Phys. 39 (2000) 6055.

Figure: Neutron counts after absorbing deuterium and hydrogen. After 3000 s, electrolysis voltage was raised to 80 V, and neutron emissions suddenly occurred. (Data from sample 4.)

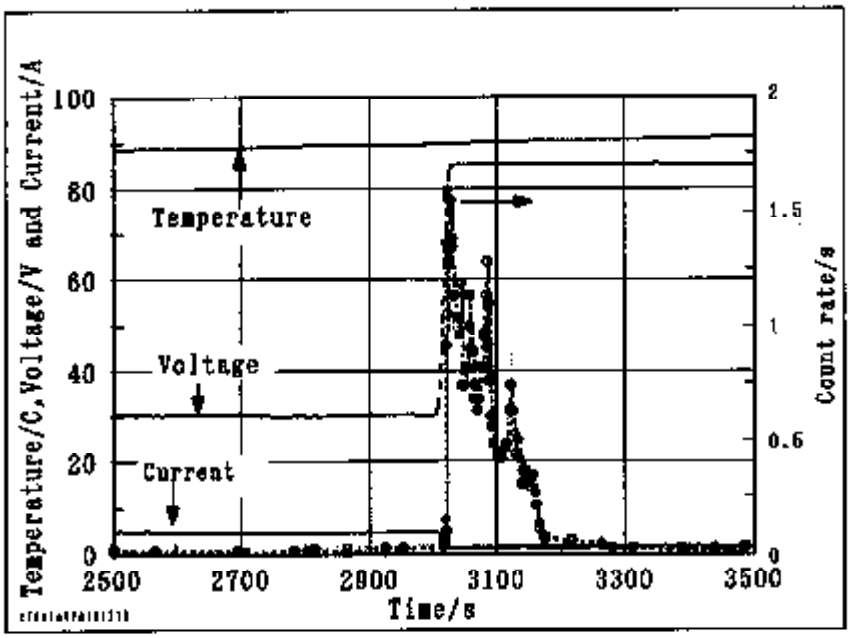

Table: Changes of the factors and neutron emission for various measurements.

Sample No.	Cell Temp. (℃)	Starting Voltage	Ending Voltage	Duration of boost (s)	Voltage Boost (V)	Voltage change (V/s)	Peak Count	Total counts	Duration of Burst (s)	Count rate (c/s)	Total neutron burst
No.1	40	0	40	15	40	2.67	7.70	17	50	0.17	438600
No.2	25	0	30	10	30	3.00	3.08	5	2.6	1.92	129000
No.3	40	0	25	5	25	5.00	0	0		0	0
No.4	90	30	83	20	53	2.65	1.54	61	200	0.305	1573800
No.5	95	50	90	40	40	1.00	0.05	3	100	0.03	77400
No.6	90	40	90	20	50	2.50	0	0		0	0
No.7	90	70	90	15	20	1.33	0	0		0	0
No.8	90	20	90	40	70	1.75	0.910	5	135	0.037	129000
No.9	60	0	0	200	0	0	0.025	5	200	0.025	129000
No.10	80	72	92	15	20	1.33	0.460	1	195	0.005	25800

JCF3-5

Electrochemical H-D loading of Palladium wires by hydro-alcoholic electrolytes related to the new discovered *Ralstonia* bacteria into heavy water.

F. CELANI(1), A.Spallone(1), P.Marini(2), V.DiStefano(2), M.Nakamura(2), A.Mancini(3) G.D'Agostaro (4), E.Righi (1), G.Trenta (1), P.Quercia (5), C. Catena (4).

(1)INFN-LNF, Via E.Fermi 44, 00044 Frascati (Roma), Italy; (2)EURESYS, Via Lero 30, 00129 Roma, Italy; (3)ORIM SrL, Via Concordia 65, 62100 Piediripa (MC), Italy; (4)ENEA-Casaccia, Via Anguillara 301, 00060 Roma, Italy;(5)ASL-RmH, Via E.Fermi1,00044 Frascati (Roma), Italy.

The lack of reproducibility observed in "Cold Fusion" experiments is mainly connected with the difficulty in obtaining loading atomic ratios (D/Pd) close to one. It has been shown in fact that such a high D/Pd ratio, which is considered as a necessary condition for the production of the so called "anomalous heat", is very difficult to be obtained and in particular to be maintained for reasonably long time, except few lucky occasions. In order to solve definitely such a serious problem our group has performed a systematic campaign of experiments, starting from simpler and more economic Pd-H system, aiming to find out a protocol capable to insure a fast and reproducible loading with thin Pd wires, up to a H/Pd ratio close to one.
The protocol, tested successfully in three different Laboratories (Pirelli-Labs, Milan-Italy; Stanford Research Institute International-USA; our Laboratory, in two completely different arrangements of the electrolytic cells), is based (in an acidic environment, pH about 5) on the addition of very small amount (typically 10^{-5}M) of alkaline-heart ions (Strontium seems to be the most effective) to the re-distilled water used for the preparation of the electrolyte.
The use of re-distilled water was found to be a mandatory requirement: it has been found that the impurities normally yet present in the distilled and/or de-ionized water can negatively affect the loading process.
The protocol is based on the following physico-chemical principle:
Strontium ions (as $SrCl_2$) are added to the re-distilled water in such an amount that no precipitation as $SrCO_3$ can occur in the bulk of the electrolyte with the carbonic ions normally dissolved (as H_2CO_3) in water. Strontium carbonate is allowed to precipitate only on the cathodic surface, because of the local alkalinization produced by the flowing of the electrolytic current: it is well known that the solubility of carbonates decreases strongly following to increase of the pH.
In the cathodic process:

$$2H_2O + 2e \rightarrow 2H(ads) + 2OH^-$$

the OH- ions formed on the cathode promote the precipitation of $SrCO_3$.
The atomic Hydrogen adsorbed on the cathodic surface, can either be absorbed into the Pd bulk:

a) H(ads) --> (H)Pd (loading reaction)

or bubbled out as H_2 gas

b) 2H(ads) --> H_2 (parasitic reaction)

The intrinsically catalytic surface of Pd, used as cathode, promotes generally the ***b)*** reaction, deleterious to (H,D) overloading purposes. By using our protocol, viceversa, because of the precipitation on the cathodic surface of a thin layer of $SrCO_3$, the catalytic properties are consistently reduced and the loading reaction ***a)*** turns to be predominant, thus allowing a fast achievement of H/Pd ratio =1.
We have found that the addition of very small amounts of mercuric ions are also effective in maintaining the loading level over a large period of time. Hg, because its ability to form amalgams, is supposed to act as "anti-cracking agent" against Pd damage due to H,D absorption.
When we tried to apply our protocol for D-Pd loading and H_2O was replaced by D_2O, the results in terms of D/Pd were consistently lower, and/or unstable, than those obtained with light water.
The reasons of such an evident failure are essentially:

- The amount of the impurities generally contained in the "as received" heavy water is too large. Foreign inorganic ions, galvanically deposited on the cathode, were found to hinder the formation of the proper $SrCO_3$ layer. Double distillation of D_2O, which is very difficult to be accomplished because of its hygroscopicity (no contact with the atmosphere is required), is a necessary but not sufficient pre-treatment.
- Heavy water contains bacteria that were identified from us at ENEA-Casaccia,. These bacteria belong to two new species, which were also found to form colonies on the cathodhic surface. Therefore, long treatments of the D_2O with $KMnO_4$ (1g/l) at pH of $1 \rightarrow 7 \rightarrow 13 \rightarrow 7$ under nitrogen at 90°C and at 25°C with vacuum, are previously required for a satisfactory sterilisation.

About those two new bacteria, we experienced that one of this, *Ralstonia* species, "metabolizes" several elements including the Hg used in our procedure. Thanking to specific studies, originally needed to understand the behaviour of this bacteria from the point of view of "Cold Fusion" (i.e. the effect of the elements added to electrolytic solution on H,D loading), we experimentally proved that they "absorb" almost any kind of heavy metals (Hg, Pb, Cd, Cr, Ni) included the Uranium, up to concentrations as large as several milli Moles. Just now (september 2001) we are starting-up a specific industrial-research program to optimize the use of this type of bacteria for bio-remediation purposes because some big Companies asked us to utilize it. The beneficial effects of this new bacteria (originally living in heavy water) to polluted environments can be really impressive if all the test-tube experiments will show no side effects. The bacteria as has been registered on June 2000, through the properly devoted International Scientific Institutions (DDBJ-Japan and NCBI-USA), with the name of ***Ralstonia detusculanense***.

Aiming to eliminate wasting time and troublesome pre-treatments, needed to "kill" the bacteria and purify the heavy water from inorganic and organic pollutants, and taking into account that the main controlling parameter of the D-Pd loading seemed to be the ratio between the total amount of the impurities present in the electrolyte and the surface of the cathode, we realised that the problem could be matched from a completely different point of view.
In order to minimise the ratio between the amount of the impurities and the surface of the cathode, two different approaches could be taken into consideration:
1) build up a very thin cell, just around the electrodes (Pd surface about 1 cm^2), thus containing a very small amount of electrolyte (i.e. 50cc) and consequently a negligible amount of impurities;

2) fill the cell currently used in our experiments, whose volume is about 1000 cc, with a new electrolyte prepared by mixing a majority part of suitable organic solvent (i.e. 950 cc) with a minority part (i.e. 50 cc) of heavy water.
In both cases, with respect to the 1000 cc of D_2O, normally used in our tests, the reduction to 50 cc is equivalent to a 20 times reduction of the impurities which could be deposited on the cathodic surface.
The #2 seemed to be extremely more attractive because of its simplicity (no need to build up a new and very delicate cell) and its flexibility (the ratio between the organic solvent and the heavy water can be varied over a large extent).
As far as the choice of the organic solvent is concerned, the following requirements should be satisfied:
- large miscibility with water,
- very small amount of H_2O present as residual impurity (isotopic contamination of H in the D-Pd loading),
- no (or negligible) acid properties (isotopic contamination for partial dissociation and production of H^+ ions),
- boiling point not too far from 100°C.

In relation to the above mentioned requirements, alcohols, ketones, esthers seem to be the most promising solvents.

Experimental results

If the hydro-organic electrolyte could be considered an elegant solution for the problem of the impurities, the proper precipitation of $SrCO_3$ on the surface of the cathode seemed difficult to be accomplished in the new ambient: how to control the concentration of carbonic ions?
Taking into account that the actual concentration, the "activity", of the ions in the hydro-organic electrolyte could be remarkably higher than their nominal concentration (referred to both the components of the liquid phase), we realised that Strontium ions could be precipitated as $SrSO_4$ even though the solubility product of this compound is about 50 times higher than that of $SrCO_3$.
In this case, the $SrSO_4$ precipitation in the hydro-organic ambient could be accomplished simply by controlling the amounts of Sr^{++} and SO_4^{2-} ions added to the electrolyte.
After several tests we found that a suitable electrolyte could be prepared just by using 1000 cc of ethyl alcohol (95% concentration, i.e 50cc is water) and by adding to the hydro-alcoholic solution 20mg of $SrCl_2$, 1-2 cc of H_2SO_4 (0.01M) and 0.5-2 cc of $HgCl_2$ (0.01M).
The electrolysis was started with the following conditions:
Anode: Pt (wire, length 30cm, diameter 200μm); Cathode: Pd (wire, total length 30cm with 2 portions of 15cm, diameter 50μm); electrodes parallel (inter-distance 4cm); Current: 5mA.; Voltage: 20-50V; T=20°C.
The loading rate of the cathode, after 1 day of "conditioning", was surprisingly high: in less than 20 minutes a H/PD ratio very, very close to one (R/Ro = 1.20 !!!) is currently achieved. Our results have been completely reproduced at Pirelli Labs, Italy.
Works are in progress for the application of the new protocol to a D_2O-organic solvent electrolyte. Now we could only anticipate that we observed, although with a not jet optimized experimental set-up, a clear increase of temperature (at external wall of the cell) in respect to H/Pd loading experiments using solutions and experimental protocols that gave a mean (over 15 cm of wire) D/Pd ratio larger 0.95 (by R/Ro resistance measurements).

JCF3-6

Nuclear Transmutation from ^{39}K to ^{41}K in the Plasma Electrolysis on Re in K_2CO_3/H_2O and D_2O Solutions

Tadayoshi Ohmori (Catalysis Research Center, Hokkaido Univ.),
Hiroshi Yamada (Faculty of Engineering, Iwate Univ.),
Shinya Narita (Faculty of Engineering, Iwate Univ.) and
Tadahiko Mizuno (Guraduate School of Engineering Hokkaido Univ.)

ABSTRACT

The plasma electrolysis was conducted on the Re electrode in K_2CO_3/H_2O and K_2CO_3/D_2O solutions. During this electrolysis a significant amount of K atoms were produced on/in the electrode. The isotopic distribution of K atoms analyzed by TOF-SIMS was quite extraordinary, the content of ^{41}K in K notably increasing as compared with its natural value. This result shows that the most of these ^{41}K atoms were nuclear transmutation products possibly from ^{39}K atoms. The amount of ^{41}K atoms produced for period of electrolysis up to 9 minutes in K_2CO_3/H_2O solution reaches ca. 7×10^{15} atom.

In addition, we observed significant amounts of excess energies on all of the Re electrodes used. They are in the range from 87 to 40 W (54 to 30 kJ), which are consistent with those calculated from the amounts of ^{41}K product atoms provided that the excess energy is produced by a reaction, ^{39}K + neutron (or virtual neutron) $\rightarrow$ ^{41}K.

Key words: nuclear transmutation, plasma electrolysis, isotopic distribution, excess energy

JCF3-7

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

Masayuki Matsunaka, Takehiro Murasawa, Ryo Toshima, Hiroki Mori, Yuji Isobe, Masayuki Ohta and Akito Takahashi

Department of Nuclear Engineering, Osaka University

[Keywards] plasma electrolysis, multi-photon absorbtion, photo fission, x-ray burst

1. Introduction

There are many reports that excess heat and nuclear transmutation were observed by CF experiments. To explain this phenomena the Multi Photon Induced Fission / Selective Channel Scission (MPIF/SCS) model was proposed[1]. This model supposes the existence of photon source and nuclear collective excitation of cathode metal nuclei by multi-photon absorbtion. And the photon source is required to emit random bursts of 1-100 keV photons (X-ray region) in short pulse ($< 10^{-9}$ s) with very high peak flux ($> 10^{28}$ photons cm^{-2} s^{-1}). We have thought that plasma produced by electric discharge in electrolyte may provide such photon source to excite cathode metal nuclei and to make them fission, because some of their reports claimed continuous X-ray emission during experiment in addition to excess heat and nuclear transmutation[2,3]. In this work, we have set up experiment to observe speculated X-ray bursts from thin plasma layer formed during the discharge type electrolysis.

2. Experiment

Figure 1 shows experimental setup. A D.C. power supply and open-type glass cell were used to electrolyze K_2CO_3-H_2O electrolyte. Tungsten plates were adopted for both of cathode and anode. They were set parallel. The measuring instruments were set up for detecting X-ray emission and for spectroscopy of light under electric discharge. For detecting X-ray emission, a NaI scintillation detector and two CdTe detectors were used. And for spectroscopic analysis of light, a monochromater was used.

3. Summary

If nuclear transmutaion would occur, it would be possible to predict what elements would be produced by fission of tungsten nuclei. For example, they are Ti, Cr, Fe, Zn, Ge, Zr, Pd, Cd, Te and so on[4]. We report here experimental results about detection of X-ray burst and spectra of light emission, and analytical results which would be compared with model prediction.

[References]

1) A. Takahashi, M. Ohta and T. Mizuno: Jpn. J. Appl. Phys. (to be published)

also see, A. Takahashi, M. Ohta and T. Mizuno: Italian Phys. Soc. Proc. **70** (2000) p.397
2) Y. Iwamura, T. Itoh, N. Gotoh and I. Toyoda: Fusion Technology **33** (1998) 476.
3) H. Fukuoka, T. Ikegawa, K. Kobayashi, and A. Takahashi: Proc. 6th Int. Conf. Cold Fusion, Toya, 1996, p.425.
4) M. Ohta, M. Matsunaka, A. Takahashi and T. Mizuno: JCF2 meeting, Sapporo, 2000.

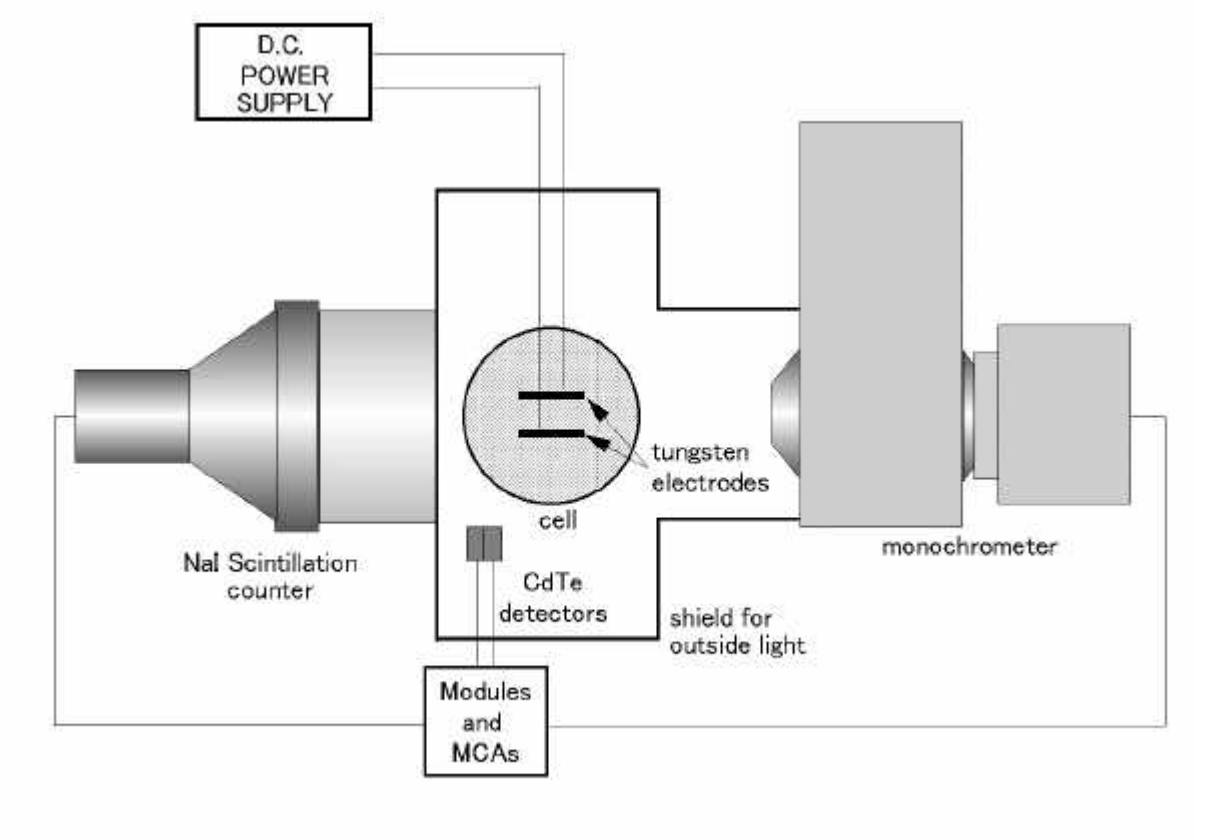

Fig.1 Schematic view of the experimental set up

JCF3-8

Calorimetry of Submerged Carbon Arc.

Teruo Hanawa, Prof. Emeritus of Osaka University*

Studies of nuclear products associated with submerged carbon arc have been reported so far, but not the calorimetric study. Considering the importance of this subject both in physics and in the field of energy, a calorimeter was build up recently. In the present report, design and performance of the apparatus are illustrated and preliminary result will be given.

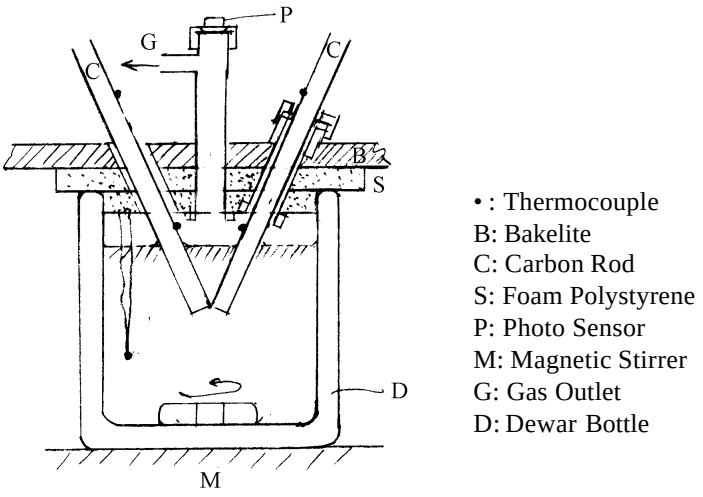

Fig.1: Arc Chamber

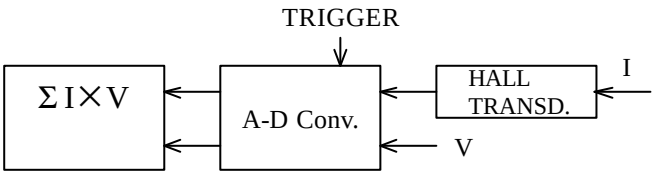

Fig.2: Input Power Integrator

*home: 1-12-3, Kitakasugaoka, Ibaraki, Osaka, 567-0048. Japan

Implications of ^4He dominance in $d+d$ reactions

Tetsuo Sawada
Atomic Energy Research Institute, Nihon University, Tokyo, Japan 1010062

[I] In general, when the Lagrangian of the system is invariant under the space-time displacement, the total energy and momentum are conseved, and the T-matrix has the form $\delta(E_F - E_I)\delta^3(\vec{P}_F - \vec{P}_I)T$. In such a case, reaction from the two-body state to the one-body state such as the reaction $d+d \rightarrow {}^4He$ cannot occur, because the two conservation laws are incompatible. Contrary to other branches of physics, in the nuclear physics it is customary to assume such invariances from the beginning.

On the other hand, if the occurrence of $d+d \rightarrow {}^4He$ is the real one, we must alter the assumption of the invariance of the Lagrangian under the parallel displacement of the coordinate system. We know that if there is an external potential, such an invariance is violated, and the momentum conservation does not exist. In the calculation of the scattering amplitude $f(\vec{k})$ by a given potential $V(r)$, we encounter such a non-conservation. If $\vec{q} = \vec{p}_F - \vec{p}_I$ is the momentum transfer, the amplitude is the Fourier transformation of $V(r)$ in the Born approximation:

$$f(\vec{q}) = -\frac{m}{2\pi\hbar^2}\int \exp[\frac{-i\vec{q}\cdot\vec{r}}{\hbar}]V(r)\, d^3r \quad .$$

When the potential becomes a constant, $f(\vec{q})$ reduces to the delta function $c'\delta^3(\vec{q})$ and the conservation of the momentum exists. However since $V(r)$ and $f(\vec{q})$ are connected by the Fourier transformation, the size Δr of the locality of $V(r)$ and the width Δq of $f(\vec{q})$ are related by the uncertainty relation $\Delta r\, \Delta q \sim \hbar$.

Therefore if the nuclear reaction proceeds under the influence of the external potential, the restriction of the momentum conservation does not exist, and the reaction $d+d \rightarrow {}^4He$ can occur when the spacial dimension Δr of the external potential is sufficiently small. In particular, in order for $d+d \rightarrow {}^4He$ to proceed, the required locality Δr of the external potential is $\Delta r \lesssim \hbar/\sqrt{2M'Q}$, where M' is the mass of ^4He and Q is the Q-value, which is 23.6MeV. in this case. Numerically $\Delta r \lesssim 0.5fm$ namely $\Delta r \lesssim 5\times 10^{-14}cm$.

Since the requirement is that the potential must change appreciably within the scale of 1 fm, the external potential of the atomic origin, whose characteristic size is 1Å, cannot do the job. In a lattice, the 'spread' of $\delta^3(\vec{p}_F)$ due to the uncertainty relation is too small to reach to the point required by the energy conservation: $2M'\delta(p_F^2 - 2M'Q)$. Therefore 'chemically assisted nuclear reaction' is an inadequate terminology.

[II] We have learned that in order for the reaction $d+d \rightarrow {}^4He$ to occur the external field, which varies appreciably within the scale of 1 fm, is necessary. The external potential must be strong enough to compete with the nuclear potential, in order to alter the $d+d$ reactions in vacuum. Moreover it is desirable for the external potential to attract some of the fuel nuclei such as p, n, d, t, and ^3He from the surrounding space and to repel the product particle ^4He. Above all, the source of the introduced external field must not conflict with the fundamental principles of the particle physics.

A candidate which satisfies all the requirements is the magnetic monopole of Dirac. The magnetic monopole is introduced to remedy the duality asymmetry of Maxwell's equations in such a way that the electricity and the magnetism are treated on the same footing. One

of the remarkable properties of the system, which consists of the magnetic charge ${}^*Q$ and the electric charge Q with the separation $\vec{r} = \vec{r}_M - \vec{r}_E$, is that the system has an extra angular momentum $\vec{L}_{extra} = ({}^*QQ/c)\hat{r}$ where $\hat{r} = \vec{r}/r$. We can check this by simply integrating the angular momentum density $\vec{r'} \times (\vec{E}(\vec{r'}) \times \vec{H}(\vec{r'}))/c$ in space.

If we remember that in the quantum theory a component of the angular momentum can assume the half-integer multiple of $\hbar$, we obtain the charge quantization condition of Dirac: ${}^*QQ/\hbar c = n/2$. However Schwinger claims that it can assume only the integer not the half-integer multiple of $\hbar$, because it has the classical correspondence like the orbital angular momentum, and his charge quantization condition is ${}^*QQ/\hbar c = n$. From these conditions, we can understand why the electric charge Q appeared in Nature is discrete. The magnetic counterpart of the fine structure constant $e^2/\hbar c = 1/137.04$ can be evaluated by replacing Q and ${}^*Q$ by their smallest values e and ${}^*e$ respectively and by setting $n = 1$ in those charge quantization conditions. We obtain $({}^*e^2/\hbar c)(e^2/\hbar c) = 1/4$ (Dirac) and $({}^*e^2/\hbar c)(e^2/\hbar c) = 1$ (Schwinger). They are ${}^*e^2/\hbar c = 137.04/4$ (Dirac) and ${}^*e^2/\hbar c = 137.04$ (Schwinger) respectively. Therefore the Coulomb field of the monopole is superstrong.

The quantum machanical treatments of the charge-monopole system had suffered from the singularity of $\vec{A}$, namely from the Dirac string. However in 1976, Wu and Yang found a way to bypass the difficulty by introducing a concept 'eigen-section' instead of 'eigen-function'. We can now freely solve the Schrödinger equation or the Dirac equation in the magnetic Coulomb field. Although the particle of spin zero such as ${}^4He$ cannot form the bound states with the monopole, the nuclei with sufficiently large anomalous magnetic moment can form the bound states. In fact all the small nuclei ($A < 4$) except the deuteron form the bound states. The deuteron is marginal, it can form the bound states with Schwinger's monopole, however it cannot do with Dirac's monopole. We can also use these equations to compute the cross sections and the transition rates as well as the eigen-values and $\psi(\vec{r})$.

One of the remarkable results found with these equations is that when the first nucleus and the monopole form a bound state, it is tightly shielded by an electron, and it is easy for the second nucleus to penetrate and be bounded. More precisely, in the WKB approximation, the penetration factor of the tightly shielded case is around 10^{-8}, whereas for the case of the fusion in the vacuum it is forbiddingly small 10^{-105}, when $Z_1 - Z_2 = 1$. Such a bound state decays to the monopole and the energetic ${}^4He$ when the nuclei are properly selected. Therefore the monopole plays a role of a catalyzer of the fusion reaction.

[III] Finally a few words are necessary concerning the uniqueness of the magnetic monopole as the source of the external field and the sporadic nature of the nuclear fusion reaction at ordinary temperature.

A nucleus has various types of electromagnetic interactions such as electric monopole (charge), magnetic dipole, electric quadrupole and so on as well as the short range nuclear interaction which can respond to the given external field. On the other hand, potentials of the asymptotic form $-C/R^\alpha$ with $\alpha \leq 2$ have the infinitely many bound states of the Rydberg orbits, and which serve to attract nuclei from the surrounding space. If we add such a requirement to the source of the external field, only two cases remain as the candidates (1) a particle with large negative charge, (2) a magnetic monopole. However the former is excluded because ${}^4He$ as well as the small nuclei are attracted. Therefore the magnetic monopole is the unique candidate of the source of the external field.

Since the magnetic monopole is a rare particle, altough its life time is infinity, we must wait for long time until a magnetic monopole comes in and is trapped by the cathode. Once it is trapped, the magnetic monopole plays a role in the fusion reaction as the catalyzer for long period. In order to overcome the sporadic nature in starting the fusion reaction, we must identify the magnetic monopole in the cathode beforehand.

Proposal to identify the 'nuclear active state'

Tetsuo Sawada
Atomic Energy Research Institute, Nihon University, Tokyo, Japan 1010062

[I] Device to detect the magnetic monopole

From the charge quantization condition, the smallest magnetic charge $^*e$ relates to the smallest electric charge e by $^*e = (\hbar c/2e)D$, where $D = 1$ and $D = 2$ are Dirac's quantization and Schwinger's quantization respectively. Since the total magnetic flux ϕ_m outgoing from the monopole is $4\pi\,^*e$, the charge quantization implies

$$\phi_m = \frac{2\pi\hbar c}{e} D \equiv \phi_0 D \quad ,$$

ϕ_0 is the quantum unit of the magnetic flux and is 4.14×10^{-11} Wb or in terms of the Gauss unit $4.14 \times 10^{-7} G\,cm^2$.

Because of the Meisner effect, which says that $\vec{B} = 0$ in the superconductor except for the thin surface region of the depth around 10^{-5} cm, magnetic flux cannot penetrate into the material of the super-conducting state. If we consider a Nb ring of the torus shape in a weak external magnetic field and cool it below $9.15°K$, then the magnetic flux is trapped in the super-conducting ring even after we switch off the external magnetic field. The total trapped flux ϕ does not change in time. However if a magnetic monopole passes through the ring, the trapped flux must increase by $D\phi_0$. The change of the flux by this amount will be used as the signal of the magnetic monopole. It is well known that in general the total magnetic flux trapped by the super-conducting ring must be an integer multiple of ϕ_0, namely $\phi = n\phi_0$, which is obtained from the requirement that the wave function in the ring is a one-valued function. Therefore since D is an integer, the total flux $(n + D)\phi_0$, after a monopole passes through the ring, is consistent with the general requirement $\phi = n'\phi_0$.

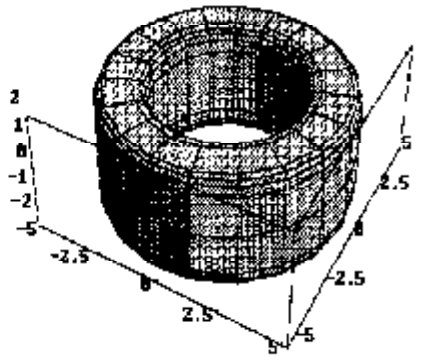

Figure 1: The superconducting torus, with the inner radius $a = 3\,cm$, the outer radius $b = 5\,cm$ and the height $h = 4\,cm$, is shown. When the unit quantum flux ϕ_0 is trapped, the total permanent current circulating the inner surface is $J = 0.046\,\mu A$. Therefore the surface current density is $I = 0.0116\,\mu A/cm$.

In the surface region, there must appear the surface current $\vec{j}$ in order to compensate the abrupt change of $\vec{B}$, the magnitude of which is $B_a = \phi/\pi a^2$ outside and 0 inside of the superconductor, where a is the inner radius of the torus. If we use the equation $\mathrm{rot}\vec{B} = 4\pi\vec{j}/c$ and the continuity of the normal component of $\vec{B}$, it is derived that $\vec{I} = (c/4\pi)(\vec{n} \times \vec{B}_a)$, where $\vec{I}$ is the density of the surface current [A/cm] obtained by integrating $\vec{j}$ to the direction of the depth, and $\vec{n}$ is the unit vector perpendicular to the surface.

In particular, if the cross section of the torus is a rectangular with the height h and the width $(b-a)$, the total permanent current J circulating on the inner surface of radius a of the superconducting torus is Ih, namely $J=(ch/4\pi)(\phi/\pi a^2)$. It is instructive to estimate J for the unit quantum flux ϕ_0 for the typical size of the torus: $a=3$ cm and $h=1$ cm. It turns out $J=0.0116\mu A$. When we search for the monopole in the cosmic ray, the required accuracy of the measurement of the current is around $0.01\mu A$, however when we search for the monopole in a material such as in the cathode, the increase of the trapped magnetic flux can be made $nD\phi_0$ by passing the same material n times through the superconducting ring. In this way we can make the requirement of the accuracy of the measurement of the current less stringent. Finally, when the cross section of the torus is not the rectangular we must determine the coefficient c' of $J=c'\phi$ by the calibration using the pseudo-monopole, which is actually a thin and long magnet.

[II] Why physicists say it is impossible ?

When the two deuterons fuse to become ^4He by the nuclear interaction, it is necessary to penetrate the repulsive Coulomb barrier $V(r)=e^2/r$ in $a<r<b$, where $b=0.53$Å(Bohr radius) and $a=1.4$ fm $(\hbar/m_\pi c)$, because d is shielded by an electron at $r\approx b$ and the nuclear interaction becomes prevalent at $r\approx a$. In the WKB approximation the transmission coefficient T is

$$T=\exp[-2\tau] \quad with \quad \tau=\int_a^b \frac{\sqrt{2\mu(V(x)-E)}}{\hbar}dx \quad ,$$

where μ is the reduced mass and $\mu=M_d/2$ in our case. In the low energy limit $E\to 0$, $\tau=(2c/\hbar)\sqrt{M_d}(\sqrt{b}-\sqrt{a})=120.5$. Therefore the transmission coefficient becomes forbiddingly small: $T=2.0\times 10^{-105}$. This result cannot be improved much even if we consider more complicated routes to ^4He, because in the sub-process, in which two charges come close, nearly the same extremely small factor always appears.

[III] A way to bypass the difficulty

The interaction Hamiltonian of the monopole-dipole system is

$$H_{int}=\frac{^*ec}{2m}(1+\kappa_a)\frac{(\vec{\sigma}\times\hat{r})}{r^2} \quad ,$$

where $\kappa_a e/2m$ is the anomalous magnetic moment. Two remarkable results are obtained from the r^{-2} behavior of the potential. (1) the electron forms the tight shield to the magnetic monopole whose charge density is $\rho(r) \quad (m_e/2\pi)\exp[-2m_e r]/r^2$, (2) the monopole-nucleus system has the infinitely many Rydberg orbits whose energy levels are $E_n=-C_\infty\exp[-2\pi(n-1)/\mu]$ where n is the principal quantum number, C_∞ and μ are parameters. In particular, $C_\infty=576.0eV$, and $\mu=0.845$ for the system of the deuteron and the monopole of $D=2$.

Once the first deuteron forms a composite particle with the monopole, it is easy for the second deuteron to penetrate to the $^*e$-d system because of the tight shield caused by an electron with the shielding radius $r_s=\hbar/2m_e c$, which is $1.93\times 10^{-11}cm$. The transmission coefficient T is estimated by substituting the upper bound b of the WKB integration by r_s rather than the Bohr radius. The result is $\tau \quad 6.68$, therefore $T=1.57\times 10^{-6}$.

Moreover there is an attractive potential $U(r)$ in $r\gtrsim r_s$, which arises from the magnetic monopole-dipole interaction with the depth of several eV.. Since the concentration of deuteron is the Boltzmann factor $\exp[-U(r)/k_B T_D]$ in the classical approximation, we have sufficiently large influx of the deuterons to the neighborhood of the monopole, unless the temperature T_D is not very high. In this way, the magnetic monopole attracts the fuel nuclei from the surrounding space. Therefore we can expect that the nuclear fusion reaction proceeds without being hindered by the repulsive Coulomb barrier.

JCF3-11

A Study on Anomalous Characteristics of Gasses Generated by under-water electric arc discharge with carbon electrodes

Hiroshi Yamamoto
17-5 Fujimi-dai Iwata, Shizuoka- Pref. Japan Zip 438-0088
Tel: 0538-32-4584, e-mail: hughy@aqua.ocn.ne.jp

Key words: under-water electric arc discharge, carbon electrodes, Hydrino, nitrogen.

In the past research of cold fusion, many kinds of electrolysis of water have been done, namely, experiments with many kinds of electrodes and electric power sources.
The voltage applied to the electrodes is getting higher and some researchers tried to raise the voltage to the point where arc discharge takes place. Carbon has been used as an electrode for electric arc discharge in many industrial applications and it is only natural for researchers to come up with an idea to develop devices using under-water electric arc discharge with carbon electrodes.
A couple of companies in USA are just about to introduce this kind of devices to the market, with claims that gasses thus generated have such anomalous characteristics as is listed below.
1 Over-unity of heat valance
2 Unexpected increase of heating value of gasses
3 Appearance of unexpected heavy MS peaks
4 less hydrogen in comparison with oxygen
5 Generation of nitrogen
6 Increased penetration of gasses through substances
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. Dr. Mills named this shrunken hydrogen as Hydrino.
The author postulated that the collision of 2 atomic oxygens with an atomic hydrogen could bring out this phenomenon and showed that this postulation can be applied to the explanation of several anomalous combustion phenomena that cannot be explained by current theories(2).
The author also showed that atomic oxygen can play the same catalytic role on anomalous heat generation induced in proton conductive ceramics under hydrogen atmosphere(3).
This paper describes that
1 Hydrino can be made in under-water electric arc discharge with carbon electrodes
2 Hydrino thus generated can be used to explain anomalous characteristics of evolved gasses as is listed above.

A special emphasis will be placed on the presence of nitrogen.
Researchers involved in the experiments of the under-water electric arc discharge with carbon electrodes attribute the presence of almost 4% of nitrogen in the evolved gasses to contamination of air but the author thinks that the following reaction can explain less hydrogen in comparison with oxygen and also generation of nitrogen.

C_{13} + Hydorino $\rightarrow$ $\mathbf{N}_{14}$

REFERENCES

(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) Hiroshi Yamamoto, "A Catalytic Role of Atomic Oxygen on Anomalous Heat Generation Induced in Proton Conductive Ceramics under Hydrogen Atmosphere", Proceedings of JCF-2,Oct. 2000.

JCF3-12

Possibility of Nuclear Fusion in Solid

Norio Yabuuchi
High Scientific Research Laboratry
204 marusen bill marunouchi tsu city mie-ken JAPAN
e-mail;yabu333@lilac.ocn.ne.jp

coulomb-barrier. resonate. new property of solid

We can not take no notice of classic nuclear physics. For example particular coulomb-barrier and resonate are for those. I state about those ploblems like following.

For a start, mountain of coulomb-barrier get in the way of fusion. A settlement of coulomb-barrier is to create a nucleus having a large radius. Because within nuclear proton is far fromm neutron. It is super hydrogen isotope. For example hydrogen five and six are. After my thory Pf Brack published super-shell like my thory on SCIENTIFIC AMERICAN at 1997.

Second, A settlement of resonate is to fill up a neutron the holl of quantum state. Whithout sure resonate nuclear sure fusion is not.

Recentry at Aoyama callege put forward a new property of solid is cocerned with magnet. Please notice this thory.

JCF3-13

Generation of the new elements and isotopic changes on deuterated palladium electrodes under DC glow discharge.

A.Arapi,Y.Kurisawa,R.Ito,N.Sato,S.Narita and H.Yamada
Faculty of Engineering, Iwate University, Morioka 020-8551 Japan

Abstract

The possibility of inducing nuclear fusion reactions at low temperature in solid state materials has been widely investigated by DC glow discharge experiments for several years. The discharge cell made by Pyrex glass ,two parts of it were jointed together by using silicone grease which kept the vacuum at the required pressure, was employed. Also two adapters and a valve were jointed to the upper part of the cell. Gold foil was used as anode and rectangular Pd plate as discharge cathode. The Pd cathode was supported in the gold wire and quartz cylinder surrounded the wire, to avoid a moving of the samples during discharge experiments. The advantage in using Pyrex glass material for experiment device, comparing with brass one used in the past, consists in the fact that there are less possibilities for palladium samples to be contaminated as a result of the sputtering effect, which takes place during plasma discharge. The experiments were carried out with low discharge parameters and for three different times 30,60,90 minutes. The same device was used for protium - palladium system.

Cathode materials elemental and isotopic structure before and after experiments in low energy ions Glow Discharge were investigated by TOF-SIMS analysis method. Production of new elements, with different atomic mass, and impurities increase were observed. By analyzing experimental results, for deuterium-palladium system, it was found that Be and Ni were produced during experiment. Emphasis is placed on factor that reinforced the conclusion that these elements (Be and Ni) cannot be accounted for by impurities. Almost all nickel's isotopes are introduced on the surface and their isotopic distribution agree the natural abundance. The quantity of presented impurity elements Na, Mg, Al, Ca, K, Mn, after glow discharge has been changed. For elements like Na, Al, Ca, K the peak could be seen in almost every run of experiment. There is no any significant change observed for isotopic distribution, comparing with their natural abundance.

The surface analysis data after experiment showed that ^{63}Cu,^{56}Fe,^{7}Li are presented on the surface(bombardment zone) and inside it (sputtering zone), but while ^{56}Fe and ^{7}Li concentration is greater in sputtering zone than in bombardment one ^{63}Cu concentration seemed to be less. May be copper can be disintegrated due to fission reaction into iron and lithium(*disintregation of the exited copper,generation of iron and lithium*).The suggestion followed by the idea that at first stage copper production reaction occurred on the surface and after that its disintregation was spread inside the surface.Because most of the samples were analysed only in sputtering zone this idea needs further investigation.

The nuclear transmutation reaction possibility in the protium-palladium system is under investigation. The missing of the detected radiation emission during experiments still remains a weak point in our researching.

Reference:Hiroshi Yamada et al.,Fusion technology,39(2001) pp 253-258.

JCF3-14

Anomalous Heat Effect for Palladium Hydride in Gas Out-diffusion Method

S. Narita[1], T. Tateishi[1], H. Monma[1], H. Onodera[1], N. Tanaka[1], H. Yamada[1], M. Baba[1], E. Yamaguchi[1,2]

1) Faculty of Engineering, Iwate University

2) The 21st Century Public Policy Institute

Abstract

The controlled gas out-diffusion method in the evacuated chamber was employed to induce a nuclear reaction for a palladium (Pd) plate. The Pd plate sample ($0.3 \times 12.5 \times 12.5$mm) was prepared by the following procedure. After washing by aqua resia, one of the surface was coated with MnOx film of 20-40nm thickness by sputtering. This layer could control the out-diffusion of the gas from the sample surface. Then, the H_2 gas was loaded to the sample. The loading ratio H/Pd was estimated to be ~ 0.7 typically. After loading the gas, the sample was set into the stainless-steel vacuum chamber. A DC power supply was connected to the sample to flow the constant current ($\sim$ 4A) during the experiment. Temperature of the surface of the sample was measured by thermocouple and a quadrupole mass spectrometer (Q-mass) was used for mass spectrometry of the gas in the chamber.

Previously we had observed the time behavior in temperature for just about 60 minutes. In this experiment, we tried to observe it for much longer period up to $\sim$ 6000 minutes. Significant temperature increases happened after 1300-3000 minutes of flowing DC current in some trials. The Q-mass spectroscopy showed that ion currents for mass number 1, 2, and 3 were increased at the same time. This indicated that the temperature increase was correlated with the gas diffusion. Since the monitored current showed a constant before and after temperature increase, it was not due to Joule heat. Furthermore, the temperature should drop in gas diffusion process since it is endothermic in principle. Considering these facts, the heat generation cannot be explained by the process of known reactions. A correlation between the heat generation and the gas loading ratio was also investigated, however there was no dependence each other. The condition for the reproducibility of the phenomena was still unclear.

The surface of the samples were investigated by Time-of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) before and after experiments. Some elements was detected for the sample only after experiment. Since this method has an advantage of minimizing contamination in the reaction chamber, it was difficult to regard those elements as contamination from the environment. Therefore, it was possible that these elements were produced during the experiments.

JCF3-15

Observation of low energy nuclear reaction induced by D_2 gas permeation through the multilayer Pd film(1) - Transmutation of Cs into Pr -

Takehiko ITOH, Mitsuru SAKANO, Yasuhiro IWAMURA* and Satosi SAKAI

Advanced Technology Research Center, Mitsubishi Heavy Industries, Ltd.
1-8-1, Sachiura, Kanazawa-ku, Yokohama, 236-8515, Japan
*TAKASAGO Research & Development Center, Mitsubishi Heavy Industries, Ltd,
2-1-1 Shinhama Arai-cho, Takasago, Hyogo, 676-8686,Japan

Keywords: Palladium, Cesium, Praseodymium, Transmutarion, X-ray photoelectron spectroscopy

We observed low energy nuclear reaction induced by deuterium permeation through a multilayer Pd film caused by D_2 gas pressure gradient between each sides of the sample. We installed a device of the X-ray Photoelectron Spectroscopy (XPS) in the D_2 gas permeations apparatus[1,2] and carried out element analysis of the nuclear products on the surface of the sample without removing it from the equipment(Fig.1).

The multilayer Pd film is made by Ar ion beam sputtering method[1]. We add Cs on the surface of the thin Pd film by applying electric field in 1mM $CsNO_3$ solution. The multilayer Pd with Cs is introduced into the vacuum chamber. At first, all the vacuum chambers are evacuated with a turbo molecular pump and the sample is heated up to 70°C. As a first step of observation, the surface of a multi-layer Pd in the vacuum chamber is analyzed by XPS to confirm that no other elements on the surface of the sample are detected except the given element(Cs) and Pd. D_2 gas is fulfilled into a chamber to 1atm and deuterium atoms permeate from the D_2 side chamber to the vacuum side chamber. After certain period(from 2 days 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 the XPS in the chamber. The new elements that did not exit on the sample at the beginning of the experiment can be detected. Usually this process is repeated a few times to obtain the data on the time dependence of the given or produced elements.

XPS analysis is performed under the following assumptions; (1) The analyzed region is a circle of 5 mm in diameter and 20 angstrom in depth. The depth corresponds to the average path length of photoelectrons. (2) Atomic number of a detected element is calculated by the ratio of Pd peak intensity and the ionization cross section of the element.

Time dependence of numbers of Cs and Pr atoms is shown in Fig.2. There was no Pr at the beginning of the experiment. The number of Cs decreased and Pr increased as time passed. At 120hours, the number of Pr atoms exceed those of Cs. Reproducibility of these experiments is good. Similar results were obtained in the other cases. We can consider that these experiments are reproduced qualitatively.

It might be possible to make an interpretation that Cs was transmuted to Pr, and the result is consistent with the EINR (Electron-Induced Nuclear Reaction) model[3] that we proposed. We confirmed that no change of Cs and no other elements on the Pd sample were observed in a blank experiment(using H_2 gas), and that qualitative reproducibility was obtained.

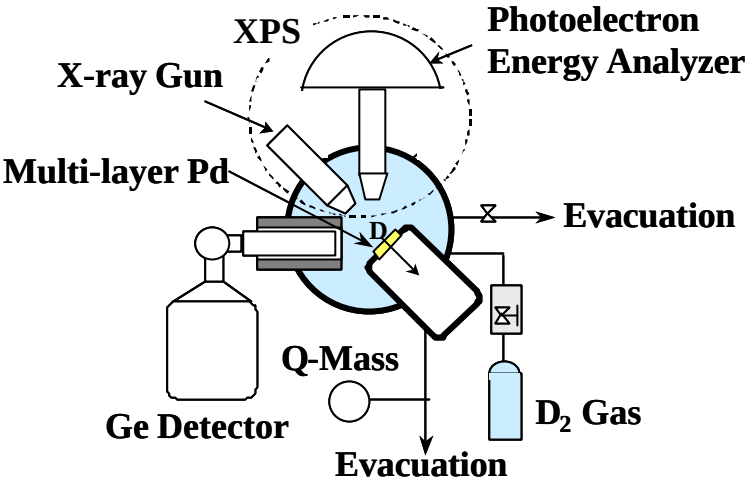

Fig.1 Experimental apparatus

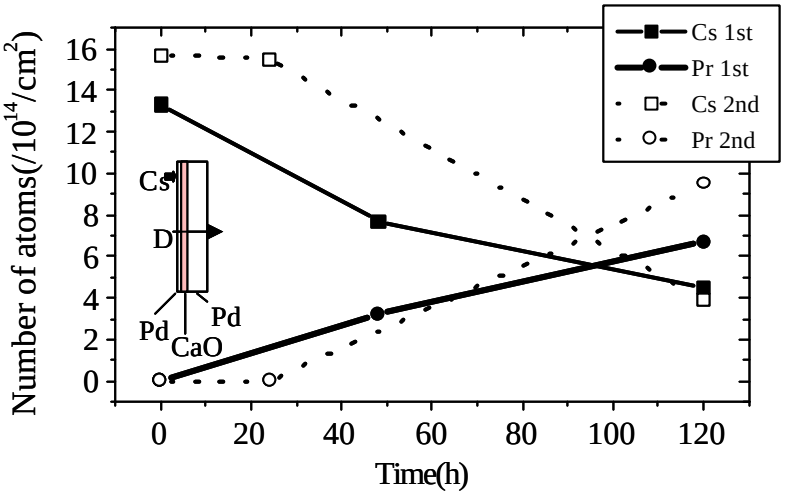

Fig.2 Time dependencs of number of Cs and Pr atoms

[REFERNCE]

(1)Y.Iwamura, T.Itoh, and M.Sakano; Proc.of ICCF-8, Lerici(La Spezia), Italy, May 21-26, 2000, p141

(2) Y.Iwamura, M.Sakano and T.Itoh; Proc.of ISEM-10, Tokyo, Japan, May 13-16, 2001, p383

(3)Y.Iwamura, N.Gotoh, T.Itoh and I.Toyoda; *Fusion Technol.*, **33**, (1998) 476

JCF3-16

Observation of low energy nuclear reaction induced by D_2 gas permeation through the multilayer Pd film(2) - Transmutation of Sr to Mo -

Mitsuru SAKANO, Yasuhiro IWAMURA*, Takehiko ITOH and Satosi SAKAI

Advanced Technology Research Center, Mitsubishi Heavy Industries, Ltd.
1-8-1, Sachiura, Kanazawa-ku, Yokohama, 236-8515, Japan
*TAKASAGO Research & Development Center, Mitsubishi Heavy Industries, Ltd,
2-1-1 Shinhama Arai-cho, Takasago, Hyogo, 676-8686,Japan

Keywords: Palladium, Strontium, Molybdenum, Transmutation, X-ray photoelectron spectroscopy

We observed low energy nuclear reaction induced by deuterium permeation through a multilayer Pd film caused by D_2 gas pressure gradient between each sides of the sample. We installed a device of the X-ray Photoelectron Spectroscopy (XPS) in the D_2 gas permeations apparatus[1,2] and carried out element analysis of the nuclear products on the surface of the sample without removing it from the equipment.

The multilayer Pd film is made by Ar ion beam sputtering method[1]. We add Sr on the surface of the thin Pd film by applying electric field in 1mM $Sr(OD)_2$ solution. The multilayer Pd with Sr is introduced into the vacuum chamber. An Experimental Procedure is similar as a previous report on transmutation of Cs into Pr.

XPS analysis is performed under the following assumptions; (1) The analyzed region is a circle of 5 mm in diameter and 20 angstrom in depth. The depth corresponds to the average path length of photoelectrons. (2) Atomic number of a detected element is calculated by the ratio of Pd peak intensity and the ionization cross section of the element.

Time dependence of numbers of Sr and Mo atoms is shown in Fig.1. There was no Mo at the beginning of the experiment. The number of Sr decreased and Mo increased as time passed. Reproducibility of these experiments is good. Similar results were obtained in the other 2 cases. We can consider that these experiments are reproduced qualitatively.

In order to investigate isotope distribution, the sample after the experiment is analyzed by the secondary ion mass spectrometry (SIMS). Fig.2 shows the isotopic anomaly of Mo. The isotopic distribution of the detected Mo (Fig.2(i)) is different from natural isotopic abundance of Mo (Fig.2(ii)). The characteristic feature of the detected Mo is that mass 96 is largest in the isotopes of Mo for the two cases of the Sr experiments. On the other hand, the major isotope of Sr is mass 88 (Fig.2(iii)). Therefore it is supposed that the next reaction can explain the results of SIMS analysis.

$$^{88}_{38}Sr \rightarrow ^{96}_{42}Mo \qquad (1)$$

It might be possible to make an interpretation that Cs was transmuted to Pr, and the result is consistent with the EINR (Electron-Induced Nuclear Reaction) model[3] that we proposed.We confirmed that no change of Sr and no other elements on the Pd sample were observed in a blank experiment (using H_2 gas), and that qualitative reproducibility was obtained.

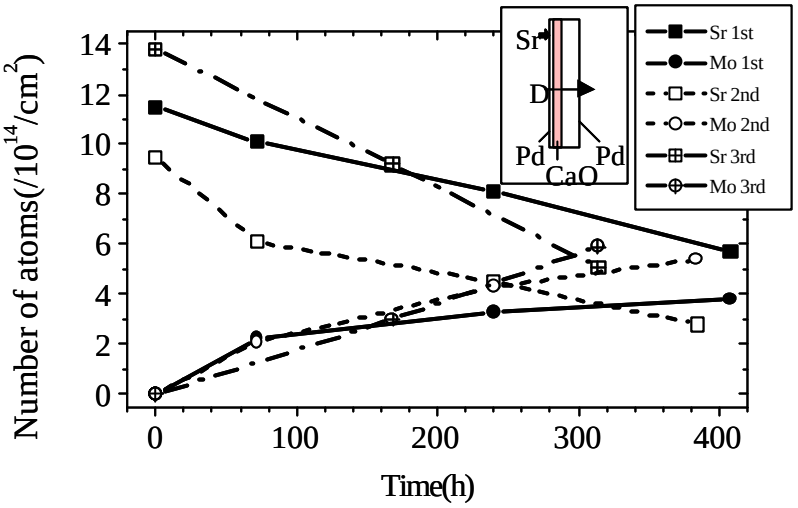

Fig.1 Time dependence of number of Sr and Mo atoms

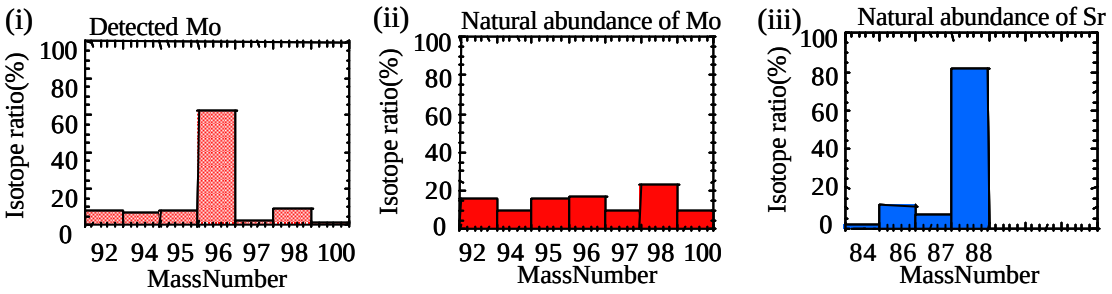

Fig.2 (i) Isotopic composition of Detected Mo, (ii) Natural abundance of Mo, (iii) Natural abundance of Sr

[REFERNCE]

(1)Y.Iwamura, T.Itoh, and M.Sakano; Proc.of ICCF-8, Lerici(La Spezia),Italy May 21-26, 2000,p141
(2) Y.Iwamura, M.Sakano and T.Itoh; Proc.of ISEM-10, Tokyo, Japan, May 13-16, 2001, p383
(3)Y.Iwamura, N.Gotoh, T.Itoh and I.Toyoda; *Fusion Technol.*, **33**, (1998) 476

JCF3-17

Neutral Pion-Catalysed Fusion in Palladium Lattice [1]

Mikio Fukuhara
Toshiba Tungaloy

Abstract

The deuteron is a *np* state whose isospin wave function is antisymmetric, where *n* and *p* are neutron and proton, respectively. In the symmetric meson theory, the nuclear forces are connected with a particular mixture of positive, negative and neutral meson fields. However the first order internuclear force between *n* and *p* in deuteron is mediated by charged pions, π^+ and π^-, and the π^0 has actually nothing to do with the *np* state of the deuteron. In other words, the deuteron is a rare atom which lacks a neutral pion. On the other hand, the helium nucleus is composed of two protons and two neutrons. These four nucleons are combined by the attractive mediation of charged and neutral pions, π^+, π^- and π^0 (Fig.1).

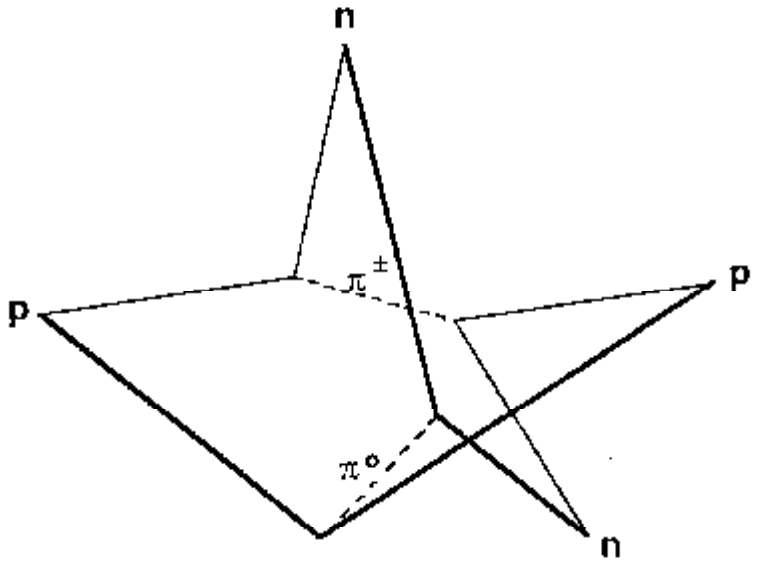

Fig. 1 Schematic representation of two proton-neutron attractions mediated by positively and negatively charged and neutral single pions in helium nucleus. Fine and bold solid lines present attractive mediation by charged and neutral pions, respectively.

Keywords: deuterated palladium, neutral pion-catalysed fusion, excited collective electron

Therefore the formation of the helium nucleus from two deuterons, *i.e.*, fusion, requires necessarily a direct force due to exchange of two neutral pions which do not compose the deuterium nucleus, because the additional nonexchange part by the neutral pion substantially modulates the *n, p* force in helium nucleus. Thus the dynamic interaction of interest is presented by the following nuclear reaction.

$$^2D + ^2D + 2\pi^o = ^4He \qquad (1)$$

The neutral pion in Eq.(1) is provided by a fundamental process which is an electromagnetic interaction;

$$\gamma + \gamma = \pi^o \qquad (2)$$

From isospin symmetry, the photon in Eq.(2) is produced by emission of excited collective electrons derived from the palladium atoms.[2]

$$e \dashrightarrow e^*, \gamma. \qquad (3)$$

From Eqs.(1) - (3), we get the following formula

$$^2D + ^2D + 4e^* = ^4He, \qquad (4)$$

where e^* is an excited electron. The introduction of the neutral pions makes possible to reduce remarkably an internuclear distance between deuterons as if it were catalysis, enhancing fusion rate for helium formation. The dynamic interaction is interpreted as the result of condensation of deuterons into octahedral interstitial sites by electrolysis and contraction of the deuteron octahedra around the Pd^{10-3} atom with the help of the electron-phonon charge-density wave (CDW) coupling.

We estimate the reaction rate for neutral pion-catalised fusion from two deuterons, based on the Born-Oppenheimer approximation. Because the addition of two neutral pions increases the S factor ($=10^6$) by four orders of magnitude over conventional two charged pions,[3] we obtain cross section σ = 46.167 barn, astrophysical S-factor $S = 10^6$ and $E = 1.552 \times 10^{-5}$ keV. Thus we have

$$\sigma = \frac{10^6}{E} \exp\left(\frac{-0.078}{\sqrt{E}}\right), \qquad (5)$$

Refferences

1. M.Fukuhara, Fus.Sci. & Tech.J., to be published.
2. R.P.Feymann,"The Theory of Fundamental Processes",Benjamin/Cummings Publishing Company,p.37, (1961).
3. A.Takahashi,T.Iida,T.Takeuchi and A.Mega,"Excess Heat and Nuclear Products by D_2O/Pd Electrolysis and Multibody Fusion," Int.J.Appl.Electromag. Mater.,3, 221 (1992).

JCF3-18

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

Ken-ichi Tsuchiya
Department of Chemical Science and Engineering,
Tokyo National College of Technology,
1220-2 Kunugida, Hachioji, Tokyo 193-0997
e-mail: tsuchiya@tokyo-ct.ac.jp

Many papers are published in order to explain the nuclear reaction in solids by using Bose-Einstein condensation (BEC), because deuterons in solids can be regarded as Bose particles confined in ion traps. In this work, we estimated the d-d fusion rate as a function of the temperature and the density of the particle by using equivalent linear two-body (ELTB) method [1].

In this problem, the Hamiltonian for the system including N identical charged Bose nuclei confined in harmonic ion trap is written as

$$H = -\frac{\hbar^2}{2m}\sum_{i=1}^{N}\nabla^2 + \frac{1}{2}m\omega^2\sum_{i=1}^{N}\mathbf{r}_i^2 + \sum_{i<j}\frac{e^2}{|\mathbf{r}_i-\mathbf{r}_j|}, \quad (1)$$

where m is the rest mass of the nucleus. By using ELTB method, Y.E.Kim et al.[1] showed the ground state wave function. It is written as

$$\Psi(\mathbf{r}_1,\mathbf{r}_2,.....,\mathbf{r}_N) \approx \Psi(\rho) \quad (2)$$

where

$$\rho = \left(\sum_{i=1}^{N}\mathbf{r}_i^2\right)^{1/2}. \quad (3)$$

They also derived the nucleus-nucleus fusion rate for the case of N charged Bose nuclei confined in an ion trap by assuming high particle density. In this work, their theory is modified by introducing the dependence on the temperature. This can be done by using the well-known formula for the critical temperature of BEC, which is given by

$$T_c = \frac{h^2}{2\pi m k_B}\left(\frac{n}{\zeta(\frac{3}{2})}\right)^{\frac{2}{3}}, \quad (4)$$

where n is the number density of the particle. In ICCF6, Peng Kuangding et al.[2] tried to use this equation for the explanation of the cold fusion in solid. In this work, their theory is also applied to this problem.

References

1. Y.E.Kim and A.L.Zubarev,
"Nuclear Fusion for Bose Nuclei Confined in Ion Trap", Fusion Technology, 37,151(2000)

2. Peng Kuangding and Chen Shanna,
"The Theory of Bose-Einstein Condensation in Finite System for Explanation of Cold Fusion" , Proceedings of ICCF6(1996) Vol.1 p337

JCF3-19

Cold Fusion and Clean Fission

Akito Takahashi[1*], Masayuki Ohta[1] and Tadahiko Mizuno[2]
[1]Osaka University, [2]Hokkaido University
*akito@nucl.eng.osaka-u.ac.jp

Keywords: multi-photon-induced fission, X-ray burst, laser, CF experiments, relation

Introduction: Kinds of speculative relation between multi-photon-induced fission (MPIF) and cold fusion experiments are discussed in this paper. Possible production of radiation-less elements has been analyzed based on the model of selective channel fission (SCF) under the nuclear tandem deformation (E1 + E3) of collective excitation by multi-photon absorption of low energy (<5MeV) photon burst[1,2]. The SCF products (fission products) from the lowest band of fission barriers around the E1 giant resonance may be mostly radiation-less (stable isotopes), isotopic ratios of which can be very different from those of natural elements[1]. Calculated results for mass-, Z- and isotopic distributions have shown intrinsic agreements with observed "transmutation" results for Pd and W by Mizuno[3] and Iwamura[4]. The SCS analysis fits very well with the prediction of two—peaked fission products by ^{235}U + neutron fission[2]. These results suggest the existence of "clean fission", namely radiation-less fission and clean energy-release. However, to induce MPIF, it has been considered[1] that very intense peak flux (>10^{28} p/cm^2/s) of low (0.01 to 5 MeV) energy photon bursts (< ns width) should be required. The hard X-ray bursts induced by peta-watt & fs laser[5] may realize[1] this condition as well as X-ray lasers (10-100 keV region) which are yet to be developed.

Possible generation of that intense bursts of X-rays (or gamma-rays) under the conditions of CF experiments is speculatively discussed in the following.

Pd/D_2O electrolysis: Iwamura[4] has shown the "transmutation" namely fission-like generation of foreign elements with non-natural isotopic ratios for the gas-diffusion type electrolysis with multi-layered Pd-cathode, for D_2O cell. His H_2O cell has however shown only background contamination of natural elements, in much smaller amount. The reason why only heavy water system had the effect may be attributed to the Cold Fusion, namely deuteron-induced coherent fusion such as,

D + D = ^{4}He + 23.8MeV (ca. 1000 QED photons) (1)

D+D+D = ^{4}He(0.24MeV) + d(0.47MeV) + 23.2MeV(ca. 1000 QED photons) (2)

D+D+D+D = 2x^{4}He(0.048MeV) + 47.6MeV(ca. 1000 QED photons) (3)

Since the coherent fusion (1) is thought to be difficult due to the fact that known break-up to n + ^{3}He + 3.25MeV or p + t + 4.02MeV should be predominant even in the solid state

condition, the multi-body coherent interactions [6,7] namely 3D and 4D fusion may be major source of ^{4}He generation and ultra-intense (equivalently 10^{50} p/cm^2/s macroscopic peak flux [1]) short (few fs) bursts of QED-X-rays (10-100 keV region). These bursts of QED-X-rays may be regarded as a kind of gamma-ray laser in sub-nm domain, and can well excite the target nuclei (e.g., Pd) up to the E1 giant resonance energy (15-20 MeV) via multi-photon cascade absorption process, to induce efficiently MPIF for Pd.

Plasma Electrolysis: Mizuno[3] has shown "transmutation" products on tungsten (W) cathodes used in the plasma electrolysis experiments with either H_2O or D_2O. The hydrogen absorption capability of W is small, compared to Pd, so that coherent deuteron fusion which is thought to take place under the over-saturation condition for D in metal lattice may not be induced. Mizuno et al has recently reported (private communication) that they observed the random generation of X-rays over 10 keV region when cathode plasma changed color and excess heat arose. Whenever they found excess heat, they found large amount of "transmuted" elements deposited on W-cathode, while no foreign elements were found when they saw no excess heat.

The cathode plasma seems standing in the electric double layer region in the vicinity of cathode surface, maybe in several nm thin layer. Electric field strength in the thin plasma layer can be very strong as 10^8 to 10^9 V/cm which will make tunnel ionization of inner orbit electrons of Pd and recombination X-ray emission. Supposing the locally strong "non-adiabatic self-phase matching[8]" of field ionization and X-ray re-ionization process under continuously fed electric field by the plasma electrolysis, the cathode plasma condition may be very similar to the condition of X-ray laser[8].

References:

1) A. Takahashi, M.Ohta, T.Mizuno: Production of Stable Isotopes by Selective Channel Photo-Fission of Pd, to be published in Jpn J. Appl. Phys. Also see Proc. ICCF8, Italian Phys. Soc. Conf. Vol.70, pp.397-402 (2000)
2) M.Ohta, M.Matsunaka, A.Takahashi: Analysis of ^{235}U Fission by Selective Channel Scission Model, to be published in Jpn J. Appl. Phys.
3) T. Mizuno, et al. : Jpn J. Appl. Phys., 39, pp.6055-6061 (2000); see also Proc. ICCF8, Italian Phys. Soc. Conf. Vol.70, pp. 75-80 (2000)
4) Y.Iwamura, et al.: Fusion Technology, 33, 476 (1998)
5) T.E.Cowan,et al.: Phys. Rev. Letters, 84, pp.903-906 (2000)
6) A. Takahashi, et al.: Fusion Technology, 27, 71 (1995)
7) A.Takahashi, et al.: Fusion Technology, 26(4T), pp.380-383 (1994)
8) T.Brabec, F.Krausz: Rev. Mod. Phys., 72 (2), pp.545-591(2000)

JCF3-20

Analysis on fission in U-235 by SCS Model

Masayuki Ohta* and Akito Takahashi
Osaka University
* E-mail: mohta@newjapan.nucl.eng.osaka-u.ac.jp

Keywords: selective channel scission, channel dependent fission barrier, clean fission

Abstract

Nuclear transmutations of Pd, W and Au have been analyzed by multi-photon induced fission (MPIF) / selective channel scission (SCS) model. Calculated results for Mass and Z distribution have shown good agreement with experimental results[1]. Isotopic ratio of fission products calculated by SCS model fits well with the experimental results.

And thermal neutron fission in ^{235}U has been also analyzed by SCS model[2]. Fission process that is related with the energy change in the elliptic deformation before scission and Coulomb potential after scission is treated by liquid drop model. Then Channel dependent fission barrier is obtained by the extrapolation to Coulomb potential using effective scission distance R_{eff}; $R_{eff}=\eta(R_1+R_2)$, where R_1 and R_2 are the radius of fission fragment FP1(Z1,A1) and FP2(Z2,A2), respectively. Obtained channel-dependent fission barriers draw two peaks around mass 95 and 140, as shown in Fig.1. It means the answer to the question why the mass-distribution of fission products from thermal neutron fission in ^{235}U makes two peaks. Fig.2 shows the plot of η and the fitting curves. The curves are fitted for three regions of A2-A1. This may suggest the existence of multimode of fission[3]. By now, we cannot obtain the complete expression of R_{eff}. We will improve the expression of R_{eff} to fit with the data of mass distribution of fission products from ^{235}U+n fission.

The products characterizing the total chain yields for the respective mass numbers[4] from thermal neutron fission in ^{235}U around two peaks of mass distribution is mainly stable or pure β-decay isotope. Long-lived γ-emitter is little in these products. If fission can be induced by e.g. photons at lower excitation energy (e.g. about 5 MeV for ^{235}U) than that by neutron (i.e. 6.5 MeV for ^{236}U), very clean fission is possible to induce. And prompt neutron production rate is expected to be less because the prompt neutron emission is much from the fission products around mass 115 and 155.

Reference

1) A. Takahashi et al., “Production of Stable Isotopes by Selective Channel Photo-Fission of Pd”, *Jpn. J. Appl. Phys.* (to be published); Also see *Proc. ICCF8*, 397 (2000).
2) M. Ohta et al., “Analysis of ^{235}U Fission by Selective Channel Scission Model”, *Jpn. J. Appl. Phys.* (to be published).

3) U. Brosa, S. Grossmann and A. Müller, *Phys. Reports*, **197**, **No.4**, 167 (1990).
4) *Reactor Physics Constants ANL-5800 2nd* (United States Atomic Energy Commission, Washington) (1963) p. 6.

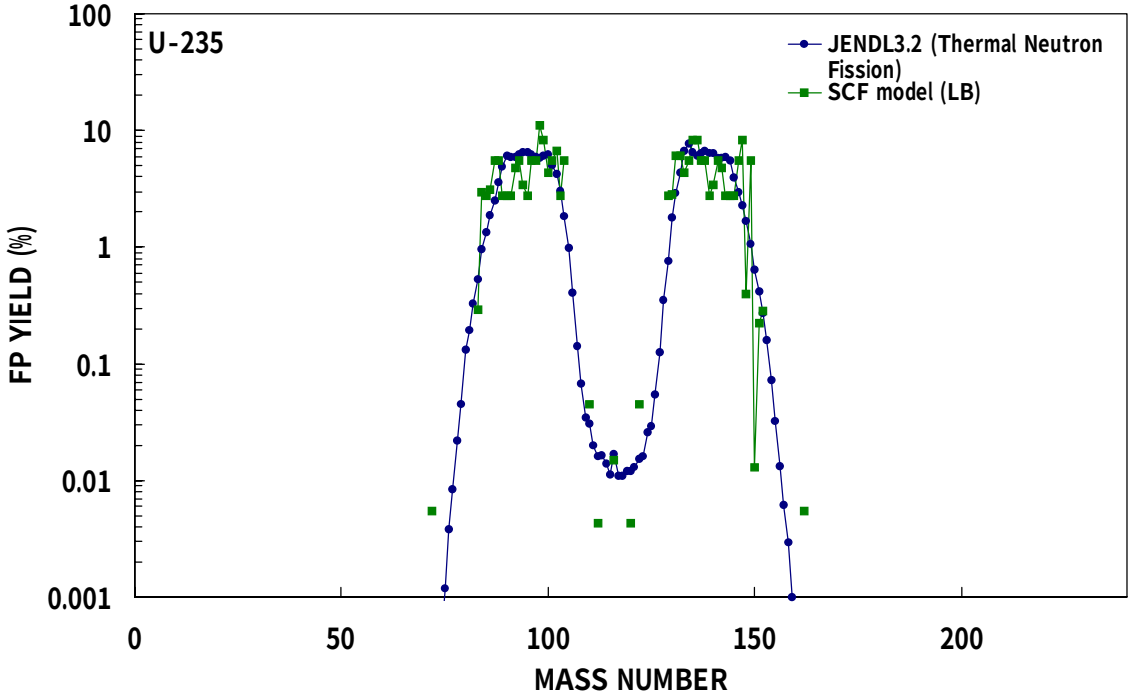

Fig.1: Mass distribution of fission products for thermal neutron fission in ^{235}U

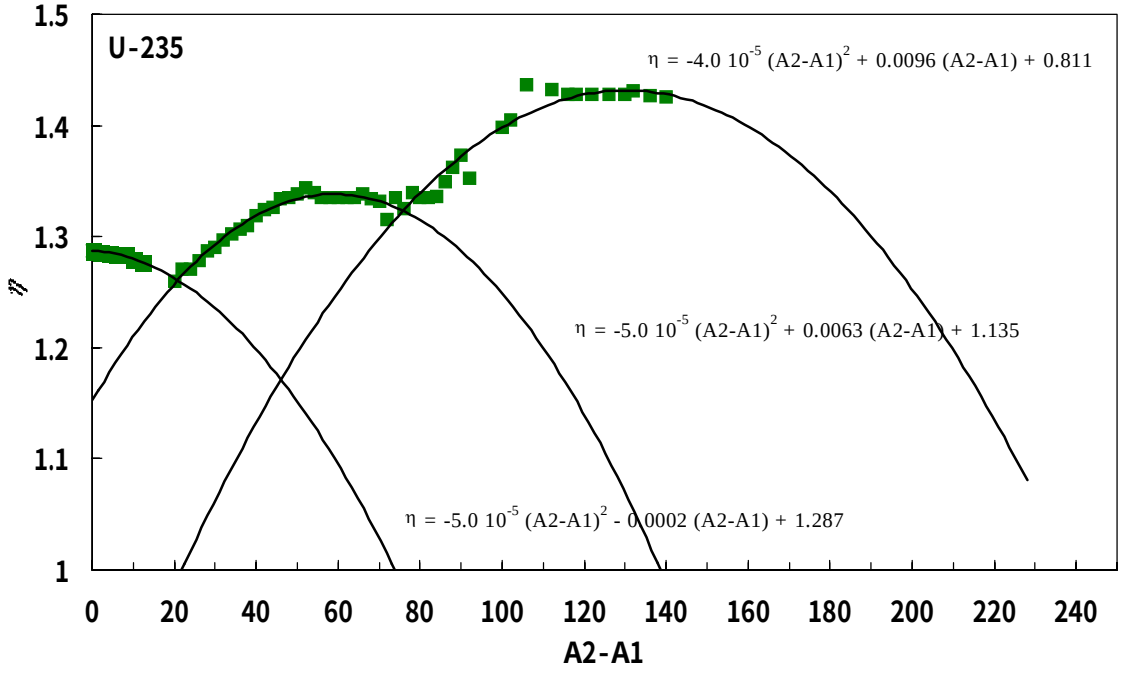

Fig.2: plot of η and fitting curves

JCF3-21

Heating of Deuteron Implanted Al on Electron Bombardment and its Possible Relation to "Cold Fusion" Experiment

Kohji Kamada
The Wakasa-wan EnergyResearch Center
Nagatani, Turuga city,
Fukui-prefecture, 914-0192 Japan.

Key Word ; deuteron implantation, phonon maser, electron bombardment, cold fusion

Abstract

This paper deals with the so-called " phonon maser" due to the level splitting of deuterium imbedded in Al in a strong magnetic field. Since the wave length of the phonon ranges around 0.1 mm, corresponding frequency of the phonon is in the radio frequency range.

The present paper aims at explanation of the anomalous melting of Al surface implanted with deuterium on the irradiation with high energy electron in a transmission electron microscope. After theoretical and/or experimental examinations of several conventional mechanisms, all of them are of classical process and usually conceived by solid state or material scientists, we judged that the phenomenon can not be accounted for by these classical processes, but quantum theoretical mechanism is requisite.

However, the present theory is rather preliminary and qualitative.

In recent investigations of the behaviour of implanted Al, we found a surface melting of the deuteron implanted Al on the high energy electron bombardment in transmission electron microscope. This is an evidence of a heat evolution in deuterium precipitates implanted into the Al sub-surface area. Typical examples of the surface melting are frequently shown in previous papers, which are electron micrograms taken on Al thin foils after the implantation with 15 keV deuterons (1,2,3). The most important feature of this phenomenon is that the melting is observed only in deuteron implanted Al but never observed in hydrogen implanted Al. In spite of the investigation on several conventional mechanisms of the melting, as will be mentioned at the conference, we could not explain the melting under the present experimental conditions.

And we propose here a mechanism which is based on the phonon maser action of deuteron under the magnetic field of about 1.2 tesla in electron microscope.

JCF3-22

STUDIES OF NUCLEAR REACTIONS IN SOLIDS IN TITANIUM DEUTERIDE UNDER DEUTRON BEAM IRRADIATION

T.Hayashi, Y.Katayama, Y.Isobe, T.Dairaku, S.Uneme, A.Takahashi
Department of Nuclear Engineering, Osaka University, 2-1 Yamadaoka, Suita, Osaka, Japan

We observed signature of coherent multibody fusion under low energy deuteron-beam-implantation to titanium deuteride (TiDx). However, up to now, we could not seach the unique charged particle spectrum exactly because of pileup signals of D-D reactions. Therefore, two kings of experiments were carried out. The one is experiment using a ΔE-E counter telescope, the other is measurement with reducing pileup signals of D-D reactions. It was suggested that 3D multibody fusion rate would be enhanced than the random theory rate.

Fig.1 shows the charged particle spectrum emitted from TiDx sample under the implantation of 300keV deuteron beam. Two unique charged particles were observed. We conceive that they are ^{3}He(4.75MeV) and t(4.75MeV) emitted by 3D multibody fusion. The energies of charged particles by the impurity reactions don't correspond to the regions of ^{3}He(4.75MeV) and t(4.75MeV). It was reported that the multibody fusion reaction was enhanced in transitional condition that may be induced beyond the range of deuteron beam (active zone)[(1)]. However, the yield of ^{3}He(4.75MeV) by 3D fusion couldn't be evaluated precisely because the responses of ^{3}He were on the shoulder of D-D protons. By the same reason, the yield of t(4.75MeV) by 3D fusion couldn't be estimated accurately because of pileup signals of D-D protons.

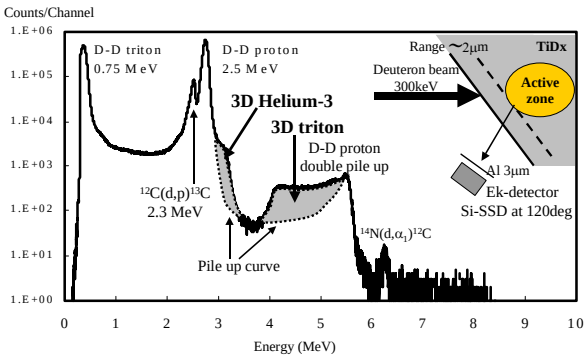

Fig.1 : Charged particle spectrum observed by Ek-detector emitted from TiDx sample implanted with 300-keV deuteron beam

To inspect ^{3}He(4.75MeV) by 3D fusion, experiments with deuteron beam implantation were carried out using a ΔE-E counter telescope. Fig.2 shows the image of the active zone and each energy of ^{3}He and t by 3D fusion. Helium-3 by 3D reaction stops in the ΔE detector, and doesn't reach in the E-detector. Fig.3 shows the charged particle spectra of E(lower Fig.) and ΔE(upper Fig.) detector respectively. The peak measured at about 3.5MeV in spectrum of the ΔE-detector was assigned to be ^{3}He counts by 3D fusion. The ratio of the yield of ^{3}He to that of D-D proton was about 2.2×10^{-4}. Therefore, the ratio of the reaction of 3D to 2D was R_{3D}/R_{2D} $\sim2.2\times10^{-4}$. 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)] Therefore, the reaction ratio of 3D fusion may be strikingly enhanced than that of the random theory. However triton(4.75MeV) by 3D fusion was not valued precisely since pileup responses of D-D protons overlap on the responses of tritons by 3D fusion.

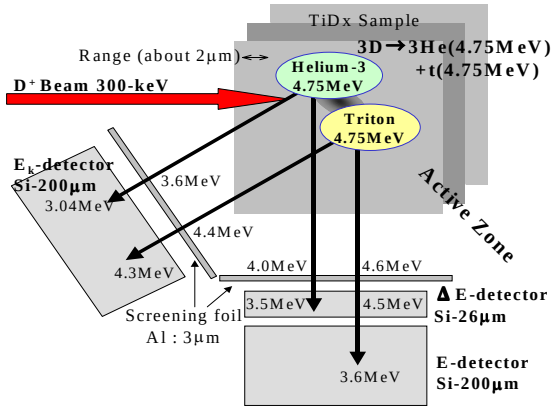

Fig.2 : The image of the active zone

In order to evaluate triton by 3D fusion, a reduction technique of pileup signals of D-D reactions was applied to the experiments of deuteron beam implantation. The rise time of pileup signal is longer than single event signal. Then, we can discriminate between pileup signal and normal signal by difference of rise times. The energy spectra shown in Fig.4 were obtained under the implantation of 300keV deuteron beam to TiDx sample. Charged particle spectra with pileup reduction and without pileup reduction are compared. The spectra were greatly improved by the reduction technique for pileup signals. Pileup signals of D-D reactions were fully decreased in the range above 3.5MeV. Especially the peak of alpha-particle by ^{14}N(d,α$_1$)^{12}C reaction could be confirmed clearly at about 6MeV. The signals in the range of 4-5MeV could

be assigned the component of t(4.75MeV) by 3D reactions. The ratio of the yield of triton counts by 3D fusion to D-D proton counts was about 2.1×10^{-4}, which agreed with reaction rate ratio (R_{3D}/R_{2D}) about 2.2×10^{-4},by the ^{3}He counts(Fig.3. upper).

We have done firstly experiment using a counter telescope of a ΔE-E charged particle spectrometer, and secondly measurement of reducing pileups of D-D reactions. By these two experiments, the ratio of the yield of ^{3}He by 3D fusion to that of D-D proton was nearly equal to ratio of the yield of ^{3}He to that of D-D proton. Therefore 3D multibody fusion rate ($R_{3D}/R_{2D}\sim2\times10^{-4}$) consequently would be greatly enhanced by 10^{26} times referred to the random theory rate 10^{-30}.

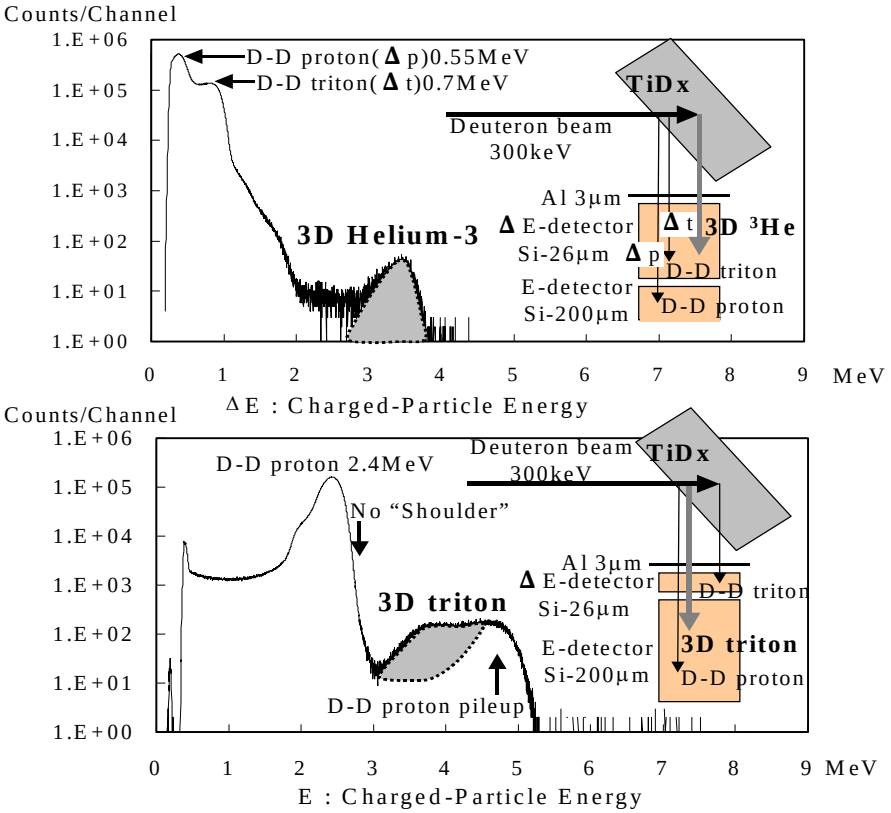

Fig.3 : Charged particle spectra observed by E and ΔE-detector emitted from TiDx sample implanted with 300-keV deuteron beam

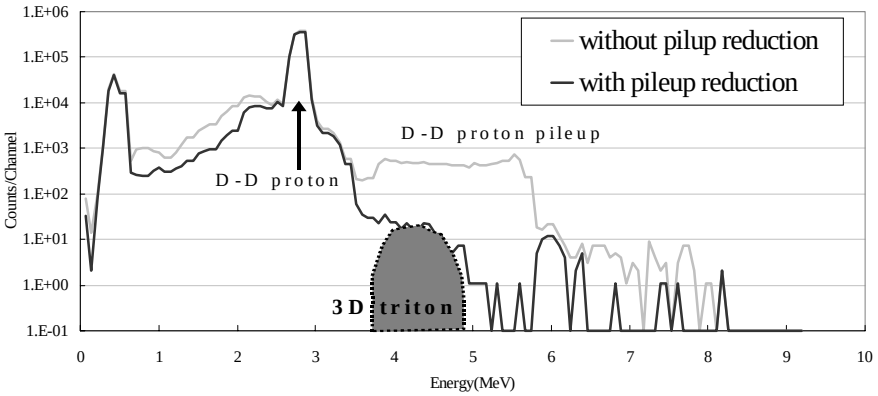

Fig.4 : Charged-particle spectrum observed by Ek-detector emitted from TiDx sample implanted with 300-keV deuteron beam

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

JCF3-23

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

-Experiments with proton and Si^{3+} beam implantation-

Y. Katayama, T. Dairaku, T. Hayashi, Y. Isobe, and A. Takahashi

Department of Nuclear Engineering, Osaka University, 2-1Yamadaoka, Suita, Osaka,565-0871 Japan

We have performed experiments with ion-beam bombarding a titanium-deuteride (TiDx) target in order to obtain the evidence of the multi-body fusion (3-bodies, 4-bodies)[(1)]. Up to now, charged-particles, that are not known in the ordinary beam-target interaction, have been observed in the experiments with deuteron beam[(2)]. However, it is difficult to know whether multi-body fusion includes an incident deuteron (direct multi-body fusion) or multi-body fusion is caused by only deuterons in TiDx (indirect multi-body fusion). Therefore, we made experiments with proton and Si^{3+} beam. In the proton-beam experiments, high energetic charged-particles have been observed. A silicon surface barrier detector (SSBD), which had a screening foil at its front side, was placed at the back side of the TiDx (1mm thickness). We changed the thickness of screening-foils (Al-410 μm, Al-450 μm) in order to identify the high energetic charged-particles. Figures1 and 2 show energy spectra of the high energetic charged-particle emitted from TiDx under the implantation of 300keV-proton. The difference between Figs.1 and 2 indicates that the particles are protons emitted with initial kinetic energy of 17~19MeV. It has

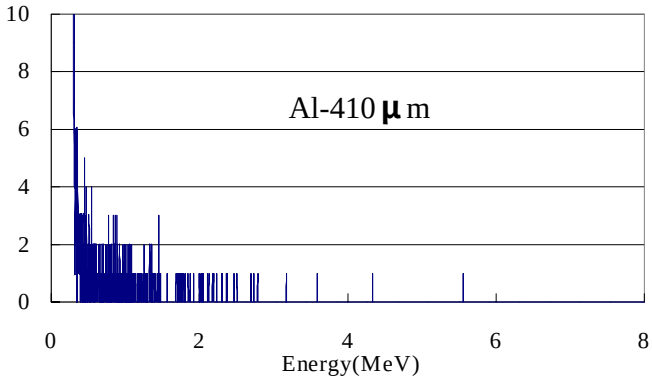

Fig.1 Charged-particle spectrum emitted from TiDx sample impinged by 300keV-proton

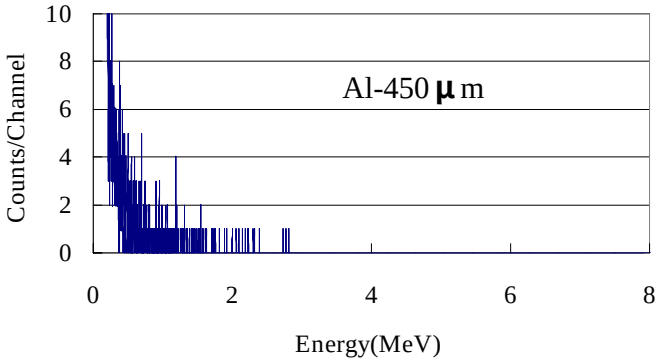

Fig.2 Charged-particle spectrum emitted from TiDx sample impinged by 300keV-proton

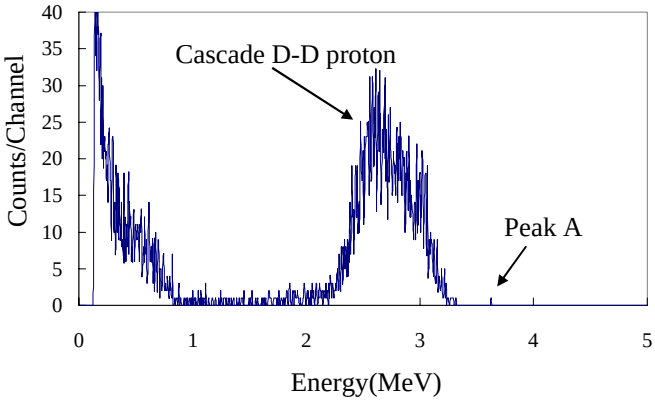

Fig.3 Charged-particle spectrum emitted from TiDx sample bombarded with 4MeV-Si^{3+}

been reported that a possible branch of the multi-body fusion ; H+D+D→ p+α+23.8MeV, can emit protons with 19.1MeV. Therefore this result suggests that the multi-body reaction was induced in the TiDx under bombardment with proton, as direct multi-body fusion, in this case.

As mentioned above, the possibility of direct multi-body fusion was shown, then, we made an experiment with Si^{3+} beam to search the possibility of indirect multi-body fusion. Figure.3 shows energy spectrum of the charged-particles emitted from TiDx under the implantation of 4MeV-Si^{3+} beam. We observed small counts of response around 3.5MeV. In this experimental system, the response beyond the cascade d-d proton peak can not be explained with conventional two-body nuclear reactions under the beam-target interactions. Considering the energy losses of charged particles within the thickness of screening foil (Al-5μm), it was possible to say that the response was of such charged particles by the multi-body reaction as ; D+D+D→t(4.75MeV)+^{3}He(4.75MeV). Although the perfect identification of the particles was not possible because of the statistical problem, the possibility of indirect multi-body fusion was thought to be shown in this result.

References

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

(2)A. Takahashi et al : Physics Letters A225(1999)89~97

JCF3-24

Analysis of Charged-Particle-Spectra Obtained under the Implantation of Ion Beam to TiD, TiDH and TiH

T. Dairaku, Y. Katayama, T. Hayashi, Y. Isobe and A. Takahashi
Department of Nuclear Engineering, Osaka, University, 2-1Yamadaoka, Suita, Osaka, Japan

In order to study multi-body fusion (3-bodies, 4-bodies), ion beam implantation experiments with titanium-deuteride targets have been carried out in our laboratly. And up to now, we have obtained the data that suggest possibilities of multi-body fusion. (1)

Figure 1 shows typical energy spectrum of charged-particle emitted from TiD_x under D^+ beam implantation. Most of the shapes of the spectrum can be explained by the D-D fusion and the reaction of D^+ beam with impurity nuclei. However, there are remained some responses that cannot be explained with the impurity-reactions. To identify unknown peaks and edges, some experiments, changing target-type, thickness of the screening foils and detection angle, have been performed in this study.

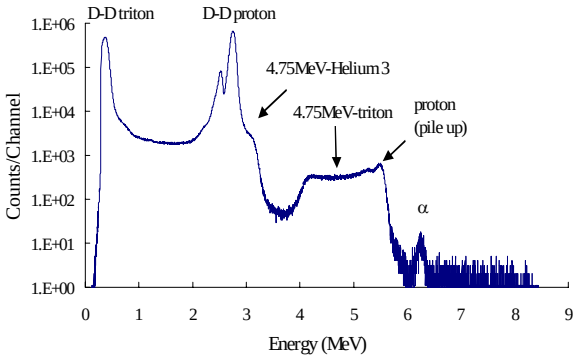

Fig. 1 Charged-particle spectrum at the front side of TiD_x implanted with 300 keV-deutron beam

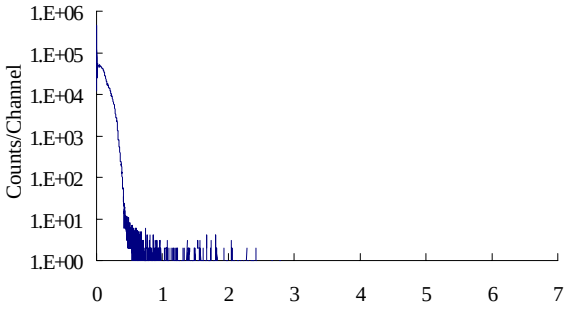

Fig. 2 Charged-particle spectrum at the back-side of TiH_x implanted with 300 keV-deutron beam

Figure 2 shows energy spectrum observed at the back-side of TiH_x under 300keV-D^+ beam implantation. Broad response ranging from 1 MeV to 2.5MeV is recognized on the spectrum. Since the thickness of the target was 1mm, no charged-particle emitted by the impurity-reactions could reach to the detector. If the response is of charged-particle, it suggests that the peculiar reactions (multi-body-fusion), for example $H+D+D \rightarrow p(19.1MeV)+\alpha(4.77MeV)$, were taken place. In order to search this response exactly, we are carrying out the experiment with changing the sorts of beam, target-type and thickness of the screening foils.

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

JCF3-25

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

○Hiroki Mori, Yuji Isobe and Akito Takahashi

Department of Nuclear Engineering, Osaka University

E-mail: mori@newjapan.nucl.eng.osaka-u.ac.jp

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 with some dynamic processes, not in equilibrium state. The purpose of this experiment is to make some 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 were about 3 keV, 5μA and 1mm, respectively. Two CdTe-detectors for X-rays, a lithium drifted silicon detector (Si (Li)) for low energy X-rays and a HPGe detector for γ-rays were attached to a vacuum chamber. The chamber was kept in a vacuum level of about 5×10^{-6} Pa. 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 the D-loading (150 mA/cm^2, 8 hours), in order to attach blocking-layer to keep the deuterium inside the Pd and to make boundary atom layers in different metal interfaces.

In JCF2, we presented that bumps in X-rays spectra from 10 keV to 20 keV were recognized in both of two spectra measured with twin CdTe detectors under electron-beam irradiation to PdDx. In order to confirm that the bumps were definitely X-rays, one of the CdTe detectors was covered with a Zr filter that had absorption the K-shell edge at about 18 keV. Figure 2 shows energy spectra measured under this condition. Differences between foreground and background from 10 keV to 30 keV are recognized, though the differences are smaller than the data of JCF2. The numbers of counts from 10 keV to 30 keV in the both of spectra are larger about 1.25 times, comparing with the background. The numbers of counts above 30 keV are not different from the background. Differences between CdTe1 and CdTe2 are also recognized (Fig.3) in spectra of foreground. The numbers of counts of CdTe1 from 10 keV to 30 keV were about 1.13 times as much as that of CdTe2. We conceive that the cause of the differences was absorption with the Zr filter. There are some possibilities that these spectra are responses of bremsstrahlung X-rays by slowing down of generated charged particles, scattered γ-rays by Compton effect, or some pumped-up photons in the system.

References

[1] Akito Takahashi et al., Fusion Technology, 19 (1991) pp.380-390

[2] Akito Takahashi et al., Fusion Technology, 27 (1995) pp.71-85

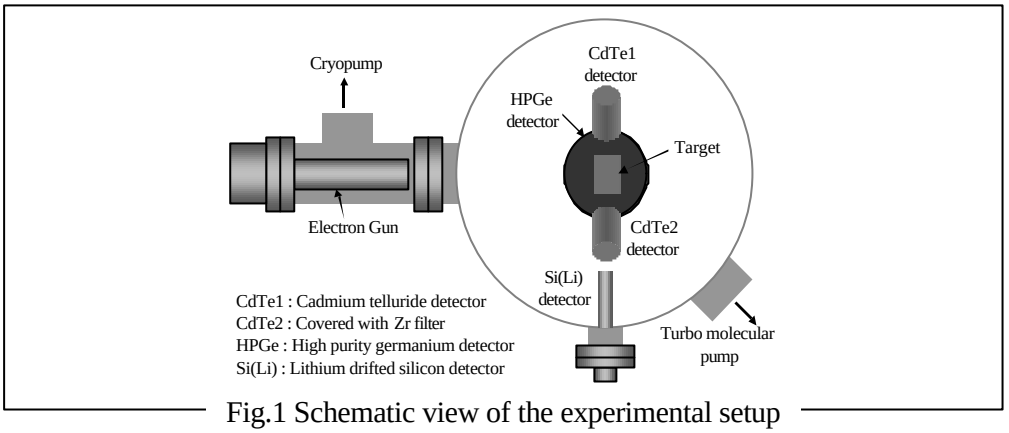

Fig.1 Schematic view of the experimental setup

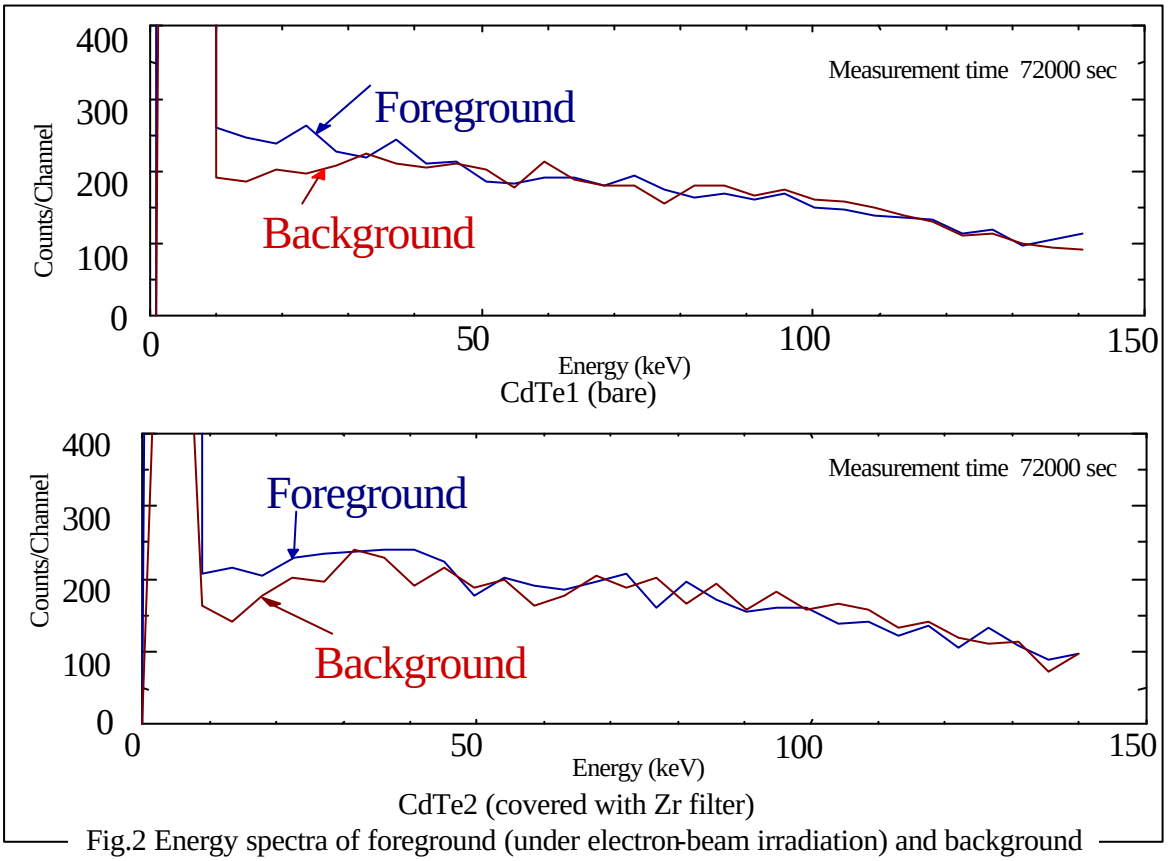

Fig.2 Energy spectra of foreground (under electron-beam irradiation) and background

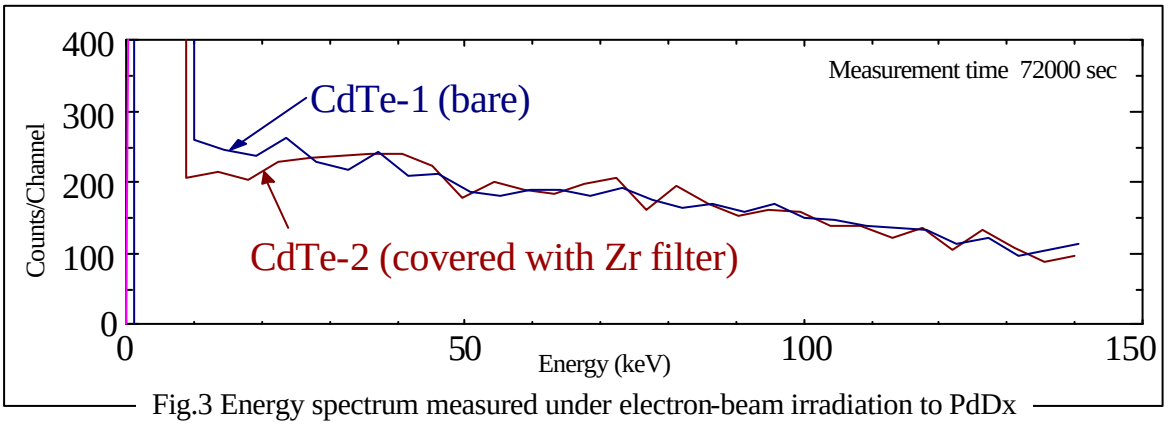

Fig.3 Energy spectrum measured under electron-beam irradiation to PdDx

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, publicaton, 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.

List of Founders

Naoto Asami (IAE)	: asami@iae.or.jp
Yoshiyuki Asaoka (CRIEPI)	: asaoka@criepi.denken.or.jp
Tadashi Akimoto (Hokkaido U.)	:
Yoshiaki Arata (Osaka U.)	: zyuec@crcast.osaka-u.ac.jp
Michio Enyo (Hokkaido U.)	:
Hideo Ikegami (Nagoya U.)	: ikegami@nifs.ac.jp
Shigeru Isagawa (KEK)	:
Yasuhiro Iwamura (MHI)	: iwamura@atrc.mhi.co.jp
Koji Kamata (NIFS)	: kkamada@werc.or.jp
Akira Kitamura (Kobe MM U.)	: kitamura@cc.kshosen.ac.jp
Hisatoki Komaki (K. B. I.)	:
Hideo Kozima (Shizuoka U.)	: cf-lab.kozima@nifty.ne.jp
Takaaki Matsumoto (Hokkaido U.)	:
Kazuaki Matsui (IAE)	: mac@iae.or.jp
Tadahiko Mizuno (Hokkaido U.)	: mizuno@hune.hokudai.ac.jp
Kikujiro Namba (Technova)	:
Reiko Notoya (Hokkaido U.)	: RNOTOYA@cat.hokudai.ac.jp
Hiroo Numata (TIT)	: numata@mtl.titech.ac.jp
Tadayoshi Omori (Hokkaido U.)	: tohmori@pop.cat.hokudai.ac.jp
Kenichiro Ota (Yokohama N. U.)	: ken-ota@ynu.ac.jp
Akito Takahashi (Osaka U.)	: akito@nucl.eng.osaka-u.ac.jp
Ryoji Takahashi (Tokyo U.)	:
Yasuto Takeuchi (Kagoshima U.)	: ytake@ics.kagoshima-u.ac.jp
Norio Yabuuuchi (HSTI)	: yabu333@lilac.ocn.ne.jp
Eiichi Yamaguchi (I21EP)	: ey@21ppi.keidanren.or.jp
Hiroshi Yamada (Iwate U.)	: yamada@dragon.elc.iwate-u.ac.jp
Harumi Yamato (Toshiba)	: yamato@eml.rdc.toshiba.co.jp

Director in 2001

Senior Consultant Members:
Dr. Yoshiaki Arata (Prof. Emeritus, Osaka University)
Dr. Michio Enyo (Prof. Emeritus, Hokkaido University)
Dr. Hideo Ikegami (Prof. Emeritus, Nagoya University)
Dr. Hideo Kozima (Prof. Emetirus, Shizuoka University)

Chief-in-Directors:
Dr. Akito Takahashi (Prof., Osaka University)

Vice-Chief-in-Directors:
Dr. Kenichiro Ota (Prof., Yokohama National University)

Directors:
Dr. Tadahiko Mizuno (Hokkaido University)
Dr. Yasuhiro Iwamura (Mitsubishi Heavy Industry Co.)
Dr. Hiroshi Yamada (Prof., Iwate University)
Dr. Eiichi Yamaguchi (Inst. 21 Century Economy and Polytics)
Dr. Naoto Asami (Inst. Applied Energy)
Dr. Yoshiyuki Asaoka (Central Research Inst. Electric Power Industry)