The 5th Meeting of Japan CF-Research Society

JCF5 ABSTRACTS

December 15-16, 2003

at Kobe University

Japan CF-Research Society

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

Program of JCF5 Meeting

(Japan CF-Research Society)

Date and Place: December 15-16, 2003, at Conference Hall, Academic Exchange Center, Fukae Campus, Kobe University, Kobe, Japan

Paper presentation: oral presentation 25 min.+ discussion 5 min.,

language = English or Japanese

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

December 15 (Mon.), 2003

9:00-9:50   **Registration**

9:50-10:00   **Opening Address** (A. Kitamura, Kobe U.)

Beam (chairman: H. Yamada, Iwate U.)

10:00-10:30   **JCF5-1** T. Minari et al. (Kobe U.): Experiments to Confirm $^7Li(d,n\alpha)^4He$ Reaction Rate Enhancement in Liquid Lithium

10:30-11:00   **JCF5-2** Y. Awa et al. (Kobe U.): D(d,p)t Reaction Rate Enhancement and its Dependence on Target Material under Irradiation of D Ions

11:00-11:30   **JCF5-3** J. Kasagi (Tohoku U.): Screening energy of DD reactions in metals

11:30-12:00   **JCF5-4** A. Takahashi et al. (Osaka U.): Detection of d + alpha channel by 3D fusion

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

Discharge, Laser, Magnetic field, etc. (chairman: A. Takahashi, Osaka U.)

13:00-13:30   **JCF5-5** S. Narita et al. (Iwate U.): Observation of Nuclear Reaction in Glow Discharge Experiment Using Deuterated Palladium Electrode

13:30-14:00   **JCF5-6** F. Celani et al. (INFN-LNF): Measurements of new elements in $Pd-H_2$ thin films

14:00-14:30   **JCF5-7** K. Kamada: Heating of Heavy Water by Acoustic Wave Propagation in Magnetic Field and Phonon Maser Action of Deuteron

14:30-15:00   **JCF5-8** T. Mizuno et al. (Hokkaido U.): Neutron emission from D_2 gas under magnetic field at low temperature

---**break** (30 min) ---

Electrolysis (chairman: Y. Iwamura, Mitsubishi H.I.)

15:30-16:00   **JCF5-9** T. Ohmori et al. (Hokkaido U.): Anomalous Isotopic Distribution of Palladium generated during the Light Water Electrolysis on Palladium and Palladium/Gold Alloy Electrodes and Their Reaction Products

16:00-16:30   **JCF5-10** F. Celani et al. (INFN-LNF): Further tests on composition and isotopic anomalies when Pd thin cathodes are electrolysed in acidic C_2H_5OD/D_2O mixtures added with Th-Hg salts at micromolar concentration.

16:30-17:00   **JCF5-11** T. Aoki et al. (Tsukuba U.): Search for neutrons form palladium cathodes during alternate electrolysis of heavy and light water

17:00-17:30	**JCF5-12** M. Fujii et al. (Yokohama N.U.): HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING MULTI LAYER CATHODES
17:30-18:00	**JCF Annual Meeting**
18:00-20:00	**Reception**

December 16 (Tue.), 2003

Gas Permeation (chairman: K. Ota, Yokohama N.U.)

10:00-10:30	**JCF5-13** T. Itoh et al. (Mitsubishi H.I.): Depth Profile and Surface Distribution of Deposited and Transmuted Elements on Pd Complexes using D_2 Gas Permeation Method
10:30-11:00	**JCF5-14** Y. Iwamura et al. (Mitsubishi H.I.): Correlation between Deuterium Flux through Pd Complexes and Quantity of Nuclear Products using D_2 gas Permeation Method
11:00-11:30	**JCF5-15** T. Higashiyama et al. (Osaka U.): THE PHENOMENA OF NUCLEAR TRANSMUTATION BY D_2 GAS PERMEATION THROUGH PD COMPLEX
11:30-12:00	**JCF5-16** H. Yamada et al. (Iwate U.): Elemental Analysis on Pd-foil Surface by TOF-SIMS after Hydrogen Permeation at Room Temperature

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

Theory (chairman: T. Mizuno, Hokkaido U.)

13:00-13:30	**JCF5-17** A. Takahashi (Osaka U.): Clean Fusion by Tetrahedral and Octahedral Symmetric Condensations
13:30-14:00	**JCF5-18** M. Ohta et al. (Osaka U.): ANALYSIS OF NUCLEAR TRANSMUTATION AS SECONDARY REACTIONS OF MULTIBODY-FUSION
14:00-14:30	**JCF5-19** K. Tsuchiya (Tokyo N.C.T.): Quantum States of Charged Bose Particles in Solids
14:30-15:00	**JCF5-20** H. Yamamoto: Revisiting Anomalous Explosion of Hydrogen and Oxygen Mixture from a View Point of Cold Fusion
15:00-15:30	**JCF5-21** N. Yabuuchi (High Sci. Res. Lab.): Nuclear-fusion chemistry through nucleonic liquid crystals
(Paper Only)	**JCF5-22** H. Bottollier-Curtet: Unknown Nuclear effects and Abnormal Isotopic Compositions

Adjourn.

Experiments to Confirm ^{7}Li(d,nα)^{4}He Reaction Rate Enhancement in Liquid Lithium

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Deuterium-induced reactions in condensed matter in sub keV energy range have been studied extensively and a variety of findings has been published; *e.g.* increase in the nuclear reaction rate and observation of nuclear transmutation. The former includes the research made by H. Ikegami *et al.* where enormous enhancement of ^{7}Li(d,nα)^{4}He reaction rate in liquid phase has been observed [1].

The experiments were carried out for metallic Li targets in both solid and liquid phase. In the solid phase, no single event was observed with the α-particle and neutron detectors, which was consistent with the reaction rate estimation based on the published nuclear cross-section data. On the other hand, in the liquid phase, a large number of α-particles were observed on the SSBD (Si Surface Barrier Detector), indicating a rate enhancement by a factor of 10^{10}-10^{15}.

In the present work, we investigate the reproducibility of the ^{7}Li(d,nα)^{4}He reaction rate enhancement. To perform the experiment, we have set up a liquid-Li-loop. Liquid Li heated in the upper Li-tank is dripped into a manifold, and the Li droplets are bombarded with a deuteron beam extracted from a duoplasmatron and mass analyzed with a 60-deg. sector magnet. The α-particles produced in the surface region of Li droplets are observed using an SSBD positioned at an angle of 90 degree and some sheets of solid-state track detectors (CR-39).

Reference

[1] Evidence of Enhanced Nonthermal Nuclear Fusion, H. Ikegami and R. Pettersson, Bulletin of Institute of Chemistry, Uppsala University, September 2002.

D(d,p)t Reaction Rate Enhancement and its Dependence on Target Material under Irradiation of D Ions

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Three-body reactions of low energy deuterons/deuterium(D), $i.e.$, DD(d,^{4}He)pn, DD(d,^{4}He)d and DD(d,^{3}He)t, have been claimed to take place with great enhancements in metal deuterides [1-3]. Nuclear transmutations in a variety of samples have also been reported from many laboratories. The latter include experiments on forced permeation of D through a multilayered film of Pd and Cs [4]. These observations suggest that the density and mobility of D in metals is one of the most important parameters for occurrence of the apparently anomalous phenomena.

To investigate possible anomaly in nuclear reactions in solids, deuterium ion irradiation of deuterated Au/Pd samples has been performed with extensive measurements of reaction products and simultaneous characterization of the samples including ERDA and RBS. We observed the D(d,p)t reaction rate greatly exceeding the calculated one in the Au/Pd mixed layer with a modified composition under 7.5-25 keV D, D_2^+ and D_3^+ irradiation, however, with rather poor reproducibility.

In the present work, we re-regulated the beam optics system; the einzel lens, the Wien filter, the steerer, the entrance aperture and the current measurement system to find the optimum condition for unambiguous beam parameters. The experimental data obtained so far again indicates that the reaction rate exceeds the calculated one only in the Au/Pd layers, however by a rather modest factor of smaller than 10. The energy dependence of the increase in the reaction rate will be discussed in some detail.

[1] A. Takahashi, $et\ al.$; Fusion Technol., 34 (1998) 256.

[2] J. Kasagi, $et\ al.$; J. Phys. Soc. Japan, 64 (1995) 777.

[3] A. Takahashi et al.; Fusion Technol., 34, (1998) 256

[4] Y. Iwamura , $et\ al.$; J. Appl. Phys. 41 (2002) 4642-4650.

JCF5-3

Screening energy of DD reactions in metals

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Recently, low energy deuteron induced reactions with incident energies around 10 keV have revealed the fact that the D+D fusion reactions can be enhanced very strongly when they occur in metals, and systematic data on the screening energy of DD reaction in various host metals have been accumulated.[1,2] However, there are obvious discrepancies on experimental values of the screening energy between our results and those obtained by Rolfs group. In the present talk, we discuss on these discrepancies, based on differences of experimental procedures, conditions, analyses and etc. Furthermore, we will inquire a direction of future experiments.

References

[1]H. Yuki et al., JPSJ 66(1997) 73, J. Phys. G23(1997) 1459,

JETP Lett. 68(1998) 823, JPSJ 71(2002)2881

[2]Raiola et al.,Phys. Lett. B547 (2002) 193

Detection of d + alpha channel by 3D fusion

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Using low energy deuteron beam to irradiate TiDx targets, products of 3D fusion have been searched for a decade of years[1]. Unique emission particles of ^{3}He and triton with 4.75 MeV of initial kinetic energies were detected several times[2,3,4] in charged particle spectroscopy with E-delta-E counter-telescope to show yield ratios [3D]/[2D] on the order of 1E-4 which was very much enhanced in comparison with the conventional value of 1E-30 by random nuclear reaction model.

To study further the 3D fusion process, we have done experiments to observe 15.9 MeV deuteron which would be emitted by a possible branch of 3D to d + alpha channel. Using rather thick delta-E detector and thick absorption foil before delta-E detector, we have tried to catch 15.9 MeV deuterons in delta-E-E coincidence spectra. As a result, we have obtained [3D]/[2D] yield ratio for d + alpha channel to be on the order of 1E-4.

1) A. Takahashi, et al: Studies on 3D fusion reactions in TiDx under ion beam implantation, Proc. ICCF10, August 25-29 2003, Boston USA, in press

2) A. Takahashi, et al: Fusion Technology, 27(1998) 256-272

3) A. Takahashi, et al: Physics Letters A 255(1999)89-97

4) Y. Isobe, et al: Jpn. J. Appl. Phys., 41(2002)1456-1556

Observation of Nuclear Reaction in Glow Discharge Experiment Using Deuterated Palladium Electrode

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Abstract

We previously observed low energy gamma ray emissions in 70-110keV region during DC glow discharge using Pd deuteride in ~3Torr deuterium gas[1]. It was supposed that a low energy nuclear reaction, producing the radioactive source, took place during the experiment. However the phenomenon was irreproducible. In this study, we carried out a similar discharge experiment, but increasing the pressure of atmospheric deuterium gas to ~1atm, expecting the reaction efficiency was enhanced. This discharge condition was definitely different from glow discharge one, then we designated it a "glow-like" discharge. In this experiment, gamma rays in the 80-230keV region were observed more frequently. The result indicates that the reaction is more likely to take place under discharge in higher deuterium pressure, and it can help understand the trigger condition to induce a low energy nuclear reaction.

One of the possible ideas to explain the production of such radioactive sources is the low-energy photofission (LEPF)[2]. In the model, a high peak flux of low energy photons in a dynamic lattice of Pd deuteride can lead to the fission of Pd via selective channels. Our experimental condition, that is, exposing Pd deuteride to discharge, may satisfy the critical condition required to induce the LEPF. In the model prediction, most of fission products are stable isotopes, however there are some channels that produce short-live radio isotopes. ^{51}Ti and ^{56}Cr are predicted to be produced and they can emit 124keV and 83keV gamma rays respectively in their beta decay process. Thus, the gamma rays observed around 80keV and 120keV might correspond to them. However, the gamma rays around 200keV are not emitted from the radioisotopes supposed to be produced in the model. We assume the following two stories: 1) there is another fission channel of Pd to produce radioisotopes which can emit ~200keV gamma rays; 2) Pd is transmuted to other stable isotopes by whichever reactions, fusion or fission (they are still unknown processes), then it fissions to radioisotopes by the LEPF.

For some samples including both types that emitted gamma rays during the discharge and did not, the surface composition was analyzed by the TOF-SIMS to search for fission products of Pd. We also analyzed fresh samples as well as the samples exposed to the discharge, and compared the results.

References

1. H. Yamada *et al.*: Fusion Technol., 39 (2001) 254.
2. A. Takahashi *et al.*: Jpn. J. Appl. Phys. 40 (2001) 7031.

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Measurements of new elements in Pd-H$_2$ thin films

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Presented by F.Celani

A study concerning the performance of Pd thin films (110 nm) treated with hydrogen and excimer laser beams is presented. The films were realized by thermal evaporation on Si wafers with a 1 cm^2 area and soaked in hydrogen at a pressure value of about 5 bar for different days. Every experiment processed two samples, one of which was irradiated by the laser: the number of the shots was 500 and the energy fluence was less than 20 mJ/cm^2 in order to avoid the film ablation. The treated samples were analysed by a Scanning Electron Microscopy (SEM) and an EDX analyser. We have observed that the samples, treated and no-treated by laser, showed morphological modification of the films just after four processing days. The morphological modification consisted in formation of cracks and grains. The samples treated with more than eight processing days presented the formation of grains in which new elements were found. We found also that the concentration of the elements increased by increasing the processing days while the laser action increased the grain density. Some of these samples were analysed by ICP-OES technique. Particularly we aimed our attention on Al and Fe production: the Al quantity increased on processing days, while the Fe quantity increased with respect to the control but its behaviour was not regular, see Table 1.

Samples	Al	Fe
32 days no laser	3.2×10^{-6}	2.3×10^{-6}
16 days laser	1.8×10^{-6}	21.1×10^{-6}
16 days no laser	0.0	4.3×10^{-6}
Virgin	0.0	2.1×10^{-6}

Tab. 1-*Measurements of Al and Fe by ICP-OES technique. The Al and Fe concentrations are normalized on weight of the samples.*

By comparing the concentration of elements in films of different thickness, we can assess if the nuclear reaction occur on the sample surface or in its depth. Work is in progress also to measure the abundance of other elements created during these experiments.

Heating of Heavy Water by Acoustic Wave Propagation in Magnetic Field and Phonon Maser Action of Deuteron

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Professor Emeritus of NIFS

Heating of heavy water of about 10 ℃ at room temperature was observed under the propagation of acoustic wave of 6 MHz with intensity of about 2 Watt / cm^2, which induces pumping transitions between nuclear spin energy levels of deuteron, during the scanning of the magnetic field from 800 to 1000 mT. Control experiment with light water did not show the heating. As a quantitative explanation of the heating, the "spin-flip phonon maser" action of deuteron due to the thermal Raman process of spin-phonon coupling was considered, and obtained a good agreement with the experimental result.

The experiment presented in this paper was intended to simulate the heat evolution, which induced the melting of the deuteron implanted Al on high energy electron bombardment as reported before (1). The melting was presumed to be caused by the phonon-maser action of deuterium precipitates in Al, as briefly discussed in (2).

Spin-flip phonon maser action using unpaired electron of magnetic ions in solid had been studied in the 1960's. However, the amplification of the ultrasonic wave was not effective enough because of its short wave length of sub- μ m, reflecting the large magnetic moment of electron.

If we can use the nuclear spin-flip, instead of the electron spin-flip, for the phonon maser action, the wave length of the emitted phonons will be sub-mm or more, and further, the amplification of coherent phonons is presumed to be much easier.

In the present paper, we employed deuteron as a candidate of the nucleus and transmitted acoustic wave into heavy water in order to induce pumping transition between energy levels of the deuteron spin system in scanning magnetic field and observed the temperature rise of about 10 ℃ at room temperature.

It should be mentioned here, that the intensity of the acoustic wave used in this experiment was about 2 $Watt/cm^2$. This intensity is well below that of the threshold intensity for cavitations to occur in water. The threshold is larger than $10^4 Watt/cm^2$ for 6 MHz acoustic waves in water. Therefore, the present experiment is quite different from that done recently by Teleyarkhan et al.(3) under the condition of the cavitations.

The energy gain, namely the ratio between the energy evolved and the sum of the energies of acoustic wave and magnetic field, of more than 10^6 was obtained.

In the following, we will describe the experimental results of the heat evolution, together with the quantitative explanation of the mechanism, and further considerations to obtain much higher temperature rise.

1) K.Kamada et al. Radiation Effects and Defects in Solid 157, 275 (2002).

2) K.Kamada FED 55, 541 (2001).

3) R.P.Taleyarkhan, Science 295, 1868 (2002).

Neutron emission from D2 gas under magnetic field at low temperature

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Abstract

We observed neutron emissions from pure deuterium gas after it was cooled in liquid nitrogen and compressed under a magnetic field. The neutron count, and duration of the release, and the time of the release after treatment all fluctuated considerably. Neutron emissions were observed in ten out of ten test cases.

The reaction cell was a Pyrex glass tube of 6 mm diameter, 3 mm inner diameter and 100 mm in length. A coil wound in a spiral around the reaction tube supplied the magnetic field. The magnet coil is 1.5 mm diameter copper wire, wound 10,000 turns. The whole system was put in a stainless steel vessel. The outer surface of the vessel is insulated by a Styrofoam, and another layer of 1.5 mm thick stainless steel plates were placed on top of the Styrofoam insulation to prevent electromagnetic noise from reaching the neutron measurement system. The vessel was filled with liquid N_2 gas to cool the coil and the reactor tube.

The magnetic field was 10 kG at the center of the reaction tube. The current for the magnetic coil was supplied by a stable direct current power supply through a resistive wire, to precisely control the current. The magnetic field passes through the reaction tube along the length. The height of the coil is 100 mm; that is, the same as tube length. The current passing through the coil was increased from 0 to 100 A, meaning the intensity of the magnetic field changed from 0 to 10 kG Neutrons were measured with three external He3 detectors placed around the cell, 20 cm from the vessel walls.

The experiment was performed 10 times. A typical example is shown below. Neutron burst of 5.5 c/s were 1000 times higher than the background counts. These bursts occurred 2 times within a 300 second interval. The total neutron emission can be estimated from the counting efficiency, and it was $10^4 \sim 10^5$ c/s.

The reaction we observed came about after cooling deuterium gas to a low temperature in a magnetic field. The reaction appears 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 must involve magnetic field nuclear reactions.

Anomalous Isotopic Distribution of Palladium generated during the Light Water Electrolysis on Palladium and Palladium/Gold Alloy Electrodes and Their Reaction Products

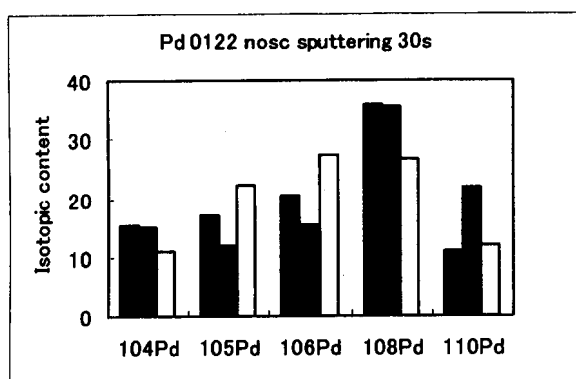T.Ohmori, T.Mizuno (Department of Quantum Energy Technology, Hokkaido University)

H.Yamada, S.Narita (Department of Electrical and Electronic Engineering, Iwata University)

As have reported at the last meeting in Morioka, we observed that the isotopic distribution of Pd of the electrode material markedly caused deviation from its natural values as well as Fe, Pt, etc. produced on the electrode, when the Pd electrodes were electrolyzed for a long period of time at a current density very close to the plasma electrolysis condition. In the present study, we put a lot of emphasis on the reproducibility of these results, in particular, whether the anomaly of the isotopic distribution of Pd is always observed, and whether the production of Pt is a reaction product and not what is caused by the electro-deposition of Pt from anode material.

Figure 1 shows typical isotopic distribution of Pd on the surface layers of the Pd electrodes with and without cold work treatment after the electrolysis for 20 days in 1 M K_2CO_3 solution. As seen from this figure, the isotopic contents of heavier isotopes, ^{108}Pd and ^{110}Pd are increased independent of whether the electrode is subjected to cold work treatment or not. Similar tendency was found in every experiment performed on Pd and Pd/Au alloy.

The production of Pt during the electrolysis on the Pd electrodes is pronounced on cold-worked Pd electrode. On this electrode the production of Au, being comparable to the amount of each Pt isotope produced simultaneously, was confirmed. This result shows that the elements with mass numbers from 194 to 198 were produced by the electrolysis. In addition, the isotopic distribution of the Pt product is different from its natural one. From these results it is concluded that the Pt is a reaction product as well as Au detected concomitantly.

Figure 1 (a)   not cold worked   (b) cold worked
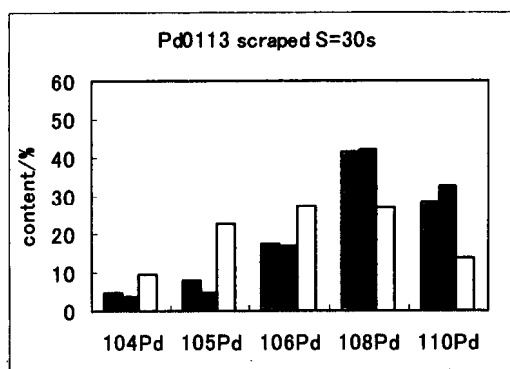
Sputtering time 30s, each left and center bar is experimental value measured at different part of the electrode and each right bar is natural isotopic abundance.

Further tests on composition and isotopic anomalies when Pd thin cathodes are electrolysed in acidic C_2H_5OD/D_2O mixtures added with Th-Hg salts at micromolar concentration.

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Abstract

Following the recent ICCF10 Conference held at Boston (USA) on August 2003, we make a new experiment aimed to reconfirm our previous data about evidence of new elements, with isotopic composition some times different from natural one, after prolonged electrolysis of long and thin Palladium wires routinely cycled between anodic and cathodic conditions. The materials of cell (i.e. Pd and Pt wires, solution and salts) are analysed by a high resolution ICP-MS instrument. As detailed in the http://www.iccf10.org report by the same Authors, the composition of electrolyte and electrolytic current density were quite unusual: C_2H_5OD/D_2O slightly acidic mixtures with addition of Th-Hg salts at micromolar concentration; $10mA/cm^2$. It was built a, completely new, transparent borosilicate (3.1) glass cell with vacuum chamber for thermal insulation.

The most recent experimental results, after one month of operations, will be reported and discussed. Our studies by ICP-MS analysis followed both the experimental results of Y. Iwamura (Mitsubishi Heavy Industries, Yokohama)-with replication at Osaka University-and the theoretical model developed from A. Takahashi (Univ. of Osaka) of a "multi-body resonance fusion of deuterons" related to specific element "transmutation" in a proper multi-layers of Pd-CaO-Pd-Sr (or Cs) subjected to prolonged deuterium gas flow (according to Y. Iwamura procedures).

Search for neutrons form palladium cathodes during alternate electrolysis of heavy and light water

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Keywords: alternate electrolysis, D2O, H2O, neutron

1. Introduction: Highly reproducible experiment of detecting neutrons from a palladium electrode by alternate absorption treatment of deuterium and hydrogen was reported[1]. Soon after that, another group made a similar experiment and obtained a partly positive result[2]. It may be urged to evaluate the reproducibility of the experiment of this type.

2. Experimental setup: A cathode (palladium wire, 1 mm dia. and 3 cm long), anodes (Pt coated titanium mesh), a heavy water electrolyte (0.2 M K_2CO_3, 400 cc), a light water electrolyte(0.2 M K_2CO_3, 1000 cc), two He-3 neutron detectors(Counter A without Cd sheet neutron absorber, 1.5×10^{-2} efficiency , and Counter B with Cd sheet absorber, 1.4×10^{-4} efficiency), and two plastic vessels for the electrolytes were set in a box surrounded by paraffin and plastic blocks. Measurements for successive 2 sec were made of the cathode current and voltage, temperature of the electrolytes and the neutron counts detected by counter A and B .

3. Results: Preliminary results from 6 trials shows no strong neutron bursts.
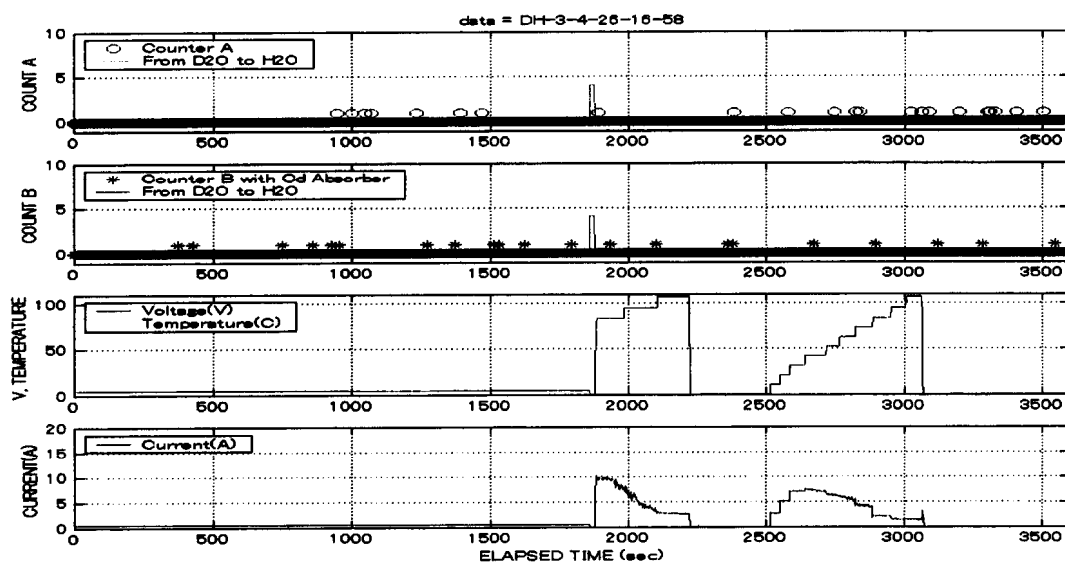
References

(1) Tadahiko MIZUNO, Tadashi AKIMOTO, Tadayoshi OHMORI, Akito TAKAHASHI, Hiroshi YAMADA and Hiroo NUMATA: Jpn. Appl. Phy., Vol.40(2001), p. L989-L991

(2) Takayuki Ohya, Yuji Isobe and Akito Takahashi: JCF4 ABSTRACTS, p. 15

HEAT MEASUREMENT DURING LIGHT WATER ELECTROLYSIS USING MULTI LAYER CATHODES

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We have conducted heat measurement during light water electrolysis using balls cathodes which were made by Al_2O_3 balls sputtered by Pd and Ni with the change of thickness. The total of thickness was 3000 Å. Thickness of Pd and Ni layers were changed within the range of 500 to 2500 Å. The Pd and Ni layers were deposited in the order of Pd and Ni on Al_2O_3 balls under Ar atmosphere($3.0 \cdot 10^{-1}$ Pa) after evacuation to 10^{-4} Pa. The purity of Al_2O_3 balls is 99.9%. The diameter of Al_2O_3 balls is 1mm. The Al_2O_3 balls were set in a spherical mesh basket. The sputtering was performed by the power of 200W, rotating the basket with 1rpm. The electrolysis was conducted at the constant current of 40~200mA. Electrolyte was 1M Li_2SO_4 light water solution and it was circulated in this system passing through a reservoir. The temperature of electrolyte at cell inlet was kept at 296K. The flow rate of electrolyte was fixed at 11ml min^{-1}. The temperature difference of electrolyte was measured by the Pt resistance thermometers placed at the cell inlet and the outlet. The cell was immersed in water bath whose temperature was controlled at 296K. Hydrogen and oxygen that generated during electrolysis were collected in the reservoir and measured the rate of gas generation. The energy that was used water electrolysis reaction was calculated from the rate of gas generation.

Table.1 show the summary of experimental results. Heat recovery was obtained from only temperature difference between cell inlet and outlet. The heat balance was obtained from the temperature difference and the energy that was used for water electrolysis. In 2 runs, small excess heat (less than 5%) was observed. However, we could not observe a clear excess heat in those runs.

Table.1 Heat balance of electrolysis in 1M Li_2SO_4-H_2O using Ni/Pd/Al_2O_3 balls for cathode.

Sample	Cell curent (mA)	Cell voltage (V)	Heat recovery	Heat balance	Sample	Cell curent (mA)	Cell voltage (V)	Heat recovery	Heat balance
Pd(2000Å) Ni(1000Å)	40*	3—3.6	0.5	0.96	Pd(1000Å) Ni(2000Å)	40	2.9—3.5	0.56	0.8
	60	3.7—4	0.57	0.91		60	3.6—3.9	0.6	0.86
	80	4—4.3	0.6	0.93		80	4—4.3	0.63	0.9
	100	4.2—4.6	0.63	0.96		100	4.2—4.7	0.66	0.93
	200	5.7—6.6	0.7	0.95		200	6—6.7	0.71	0.93
Pd(1500Å) Ni(1500Å)	40	3.3—4.4	0.63	0.89	Pd(500Å) Ni(2500Å)	40	2.8—3.4	0.64	0.89
	60	4.4—5	0.66	0.93		60	3.5—3.9	0.64	0.9
	80	5.1—5.8	0.7	0.95		80	3.8—4.2	0.65	0.93
	100	5.7—6.6	0.74	0.99		100	4.1—4.5	0.67	0.95
	200	6.9—9.9	0.87	1.05		200	5.5—6.6	0.81	1.03
Pd(2500Å) Ni(500Å)	40	2.7—3.3	0.57	0.87					
	60	3.3—3.6	0.56	0.9					
	80	3.4—3.9	0.57	0.93					
	100	3.9—4.3	0.59	0.96					
	200	4.9—5.9	0.65	0.92					

* Heat balance was obtained on the assumption that current efficiency was 100%

Depth Profile and Surface Distribution of Deposited and Transmuted Elements on Pd Complexes using D_2 Gas Permeation Method

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We have already reported on observation of low energy nuclear reactions induced by D_2 gas permeation through Pd complexes, which consist of a thin Pd layer, alternating CaO and Pd layers and bulk Pd [1-4]. The Pd complex was located in a vacuum chamber and the elemental analysis was performed using an X-ray photoelectron spectroscopy (XPS) apparatus mounted on the chamber. When Cs was added on the surface of a Pd complex, Pr emerged on the surface while Cs decreased after the Pd complex was subjected to D_2 gas permeation at 343K and 1atm for about one week. In the case of adding Sr on the surface, Mo emerged on the surface while the added Sr decreased after D_2 permeation for about two weeks [1-4].

In this paper, recent progress of our research is described. The experimental set-ups and the procedures are basically the same in the following references [1-4]. The detected Pr was confirmed by various methods such as TOF-SIMS, XANES, X-ray Fluorescence Spectrometry and ICP-MS. Analysis of the depth profile of Pr indicated that a very thin surface region up to 100 angstroms might be the active transmutation zone. The surface distribution of Pr basically seems to be uniform. There is no correlation between Pr and grain boundaries. However, in the case of electrolyte addition, non uniformity of Pr was found.

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Correlation between Deuterium Flux through Pd Complexes and Quantity of Nuclear Products using D_2 gas Permeation Method

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Observations of low energy nuclear reactions induced by D2 gas permeation through Pd complexes (Pd/CaO/Pd) have been already presented at in a paper[1] published in the Japanese Journal of Applied Physics (JJAP). When Cs was added on the surface of a Pd complex, Pr emerged on the surface while Cs decreased after the Pd complex was subjected to D2 gas permeation. When Sr was added to the surface, Mo emerged while the Sr decreased after D2 gas permeation. The isotopic composition of the detected Mo was different from the natural abundance.

In this paper, recent progress of our research is described. The experimental set-ups and the procedures are basically the same in the following references[1]-[4]. Quantitative analysis of Pr and measurement of deuterium flux through Pd complexes have became available. A lot of experimental results suggest that the quantity of Pr was proportional to the deuterium flux through Pd complex. The cross section of transmutation of Cs into Pr can be roughly estimated at 1 barn if we consider the deuterium flux as an ultra low energy deuteron beam.

|REFERNCE|

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THE PHENOMENA OF NUCLEAR TRANSMUTATION
BY D$_2$ GAS PERMEATION THROUGH PD COMPLEX

Taichi HIGASHIYAMA*

Mitsuru SAKANO**

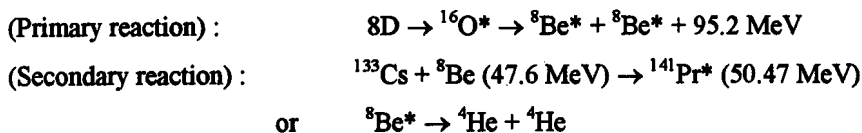Hiroyuki MIYAMARU*

Akito TAKAHASHI*

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In Mitsubishi Heavy Industries (MHI), unusual nuclear transmutation was seen by the experiment of permeating D$_2$ gas through Pd complexes which were consisted of a thin Pd layer, alternating CaO and Pd layers and bulk Pd.[1] When they used samples of Pd complexes with additional Cs on the surface, Pr emerged on the surface while Cs decreased after the Pd complex was subjected to D$_2$ gas permeation at 343 K and 1 atm for about 1 week. The elemental analysis was performed using an X-ray Photoelectron Spectroscopy (XPS). This phenomenon was reproduced qualitatively by the present replication experiment.

D$_2$ gas permeation experiments was done at 3 times similarly to the MHI's experiment[1] and we confirmed production of Pr. The surface of the thin Pd layer of Pd complex sample provided by MHI was washed to remove hydrocarbon by electrolysis before depositing Cs. Cs atoms was deposited by applying weak electric field to 1 mM CsNO$_3$ solution. We made D$_2$ gas permeated through the Pd complexes at 343 K and 1atm for about 5 days. Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was performed to analyze the existence of the elements (Cs and Pr) and mass distribution. The results showed the existence of Pr. And we also confirmed the existence of Pr by using fast Neutron Activation Analysis (NAA) in Fusion Neutronics Source (FNS) of Japan Atomic Energy Research Institute (JAERI).

As a result, it was confirmed the nuclear transmutation reaction, from ^{133}Cs to ^{141}Pr, was occurred. This transmutation suggests mass number and atomic number increase 8 and 4, respectively. It is considered the model of multi-body resonance fusion of deuterons proposed by A. Takahashi[2] can explain this mass-8-and-charge-4 increased transmutation, as follows:

(Primary reaction) : $8D \rightarrow {}^{16}O^* \rightarrow {}^{8}Be^* + {}^{8}Be^* + 95.2\,MeV$

(Secondary reaction) : $^{133}Cs + {}^{8}Be\,(47.6\,MeV) \rightarrow {}^{141}Pr^*\,(50.47\,MeV)$

       or ${}^{8}Be^* \rightarrow {}^{4}He + {}^{4}He$

If the phenomena occur following this model, ^{4}He should also come up. So we are trying to detect ^{4}He.

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Elemental Analysis on Pd-foil Surface by TOF-SIMS
after Hydrogen Permeation at Room Temperature

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Deuterium and hydrogen permeation experiment has an advantage of minimizing contamination to the palladium sample, which is preferably used in investigating small amount of elements. We have performed hydrogen permeation test with Pd foil and have searched for nuclear products as a result of low energy reaction.

The Pd foil samples of 0.1x12.5x12.5 mm and 0.3x12.5x12.5 mm in size were washed by aqua regia and set up into a holder placed between an upper and lower stream chambers. Hydrogen gas was introduced into the upper chamber with the pressure 1-10 atm, and it moved downstream passing through the sample. The lower stream chamber was evacuated to prevent the Pd sample from being contaminated from the atmosphere. After the hydrogen gas permeation for 10-14 days, the sample was taken out and the gas remained in the sample was unloaded. We have analyzed the sample surface of pressurized side by time-of-flight secondary ion mass spectroscopy and have compared the composition of the sample before experiment (control sample) with that after experiment to search for newly produced elements during the gas permeation process.

The primary ion in TOF-SIMS was Ga^+ and measured area was 40×40 micron square. The ratio of total counts to counts of ^{69}Ga was 3.9 and 3.4 for the control sample and the sample after permeation, respectively. The level of contamination as background for the control sample and the sample after permeation was considered to be almost same. Considerable increase of the counts for Cr, Fe, Cu and Ag were found after the permeation using normalized count intensity. Next, we used another normalized intensity that was defined as the count of the secondary ions of ^{56}Fe divided by that of ^{69}Ga, and multiplied by 1000. The effect of sample thickness and applied pressure on this intensity was investigated. Almost no change in the intensity was observed after the permeation for the sample with 0.1 mm thickness under 1 and 3 atm, comparing with the intensity for the control sample. The intensity sometimes increased significantly after the permeation by applying 10 atm for samples with 0.1 and 0.3 mm thickness. No clear thickness effect was observed. The results have suggested that all the four elements were produced by a nuclear transmutation and that the reaction could occur in hydrogen system as well as deuterium system.

Clean Fusion by Tetrahedral and Octahedral Symmetric Condensations

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The model mechanism of deuteron cluster fusion in transient motion of metal-deuteride lattice was proposed[1,2,3]. It was concluded that predominant reactions were of 4D and 8D multi-body fusion. Major claims of CF experiments, i.e., helium generation in correlation of excess heat, minor ^{3}He and tritium generation, very weak neutron generation, can be explained consistently by the model. Claimed transmutations, i.e., two alpha-particles added transmutation[4,5] and fission-like products[6] can be also explained as the secondary reactions by emitted particles of deuteron cluster fusion.

Products of 4D and 8D fusion were expected to be very clean (non-radioactive, no hard radiation), although we thought we needed detailed studies on possible reaction branches. This work treats possible out-going channels of ^{8}Be* and ^{16}O* as intermediate virtual compound nuclei of 4D and 8D simultaneous fusion reactions. Results of analyses and discussions will show that ^{4}He is predominant final products and others (^{3}He, t, d, p, n, etc.) are of very small emission probabilities. 2D fusion rate is proved to be very small, compared with 4D and 8D fusion rates, in the model of modal fusion rates.

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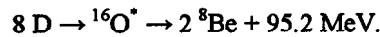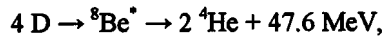
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ANALYSIS OF NUCLEAR TRANSMUTATION
# AS SECONDARY REACTIONS OF MULTIBODY-FUSION

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Multibody Fusion model has been proposed to explain anomalous experimental results in condensed matters like Pd [1]. This model assumes that deuterons are condensed to octahedral- or tetrahedral-sites simultaneously under a transient condition. 4D and 8D fusions are induced by the enhancement of the screening of Coulomb barrier and the symmetry property of nuclear force.

$$4 \, D \rightarrow {}^{8}Be^{*} \rightarrow 2 \, {}^{4}He + 47.6 \, \text{MeV},$$

$$8 \, D \rightarrow {}^{16}O^{*} \rightarrow 2 \, {}^{8}Be + 95.2 \, \text{MeV}.$$

Recently, the Cd and Sn productions and the mass-8 and Z-4 increased transmutations were reported by A.B. Karabut [2] and Y. Iwamura et al [3], respectively. The products by 4D or 8D reactions will induce these transmutations.

$${}^{A}_{Z}M + {}^{4}He \, (\text{or} \, {}^{8}Be) \rightarrow {}^{A+4}_{Z+2}M' \, (\text{or} \, {}^{A+8}_{Z+4}M'').$$
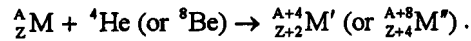
Furthermore, fissions can be induced following these reactions, because these excitation energies are enough high to make fission.

$${}^{A}_{Z}M + {}^{4}He \, (\text{or} \, {}^{8}Be) \rightarrow \text{Fission product} \, 1 + \text{Fission product} \, 2.$$
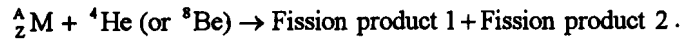
The distributions of these fission products (FPs) can be calculated by the selective channel scission (SCS) model and compared with the experimental results reported by T. Mizuno et al [4]. Also, the comparison with the calculated results by multi-photon induced fission (MPIF) [4] will be discussed.

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Quantum States of Charged Bose Particles in Solids

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This study gives a new method to calculate quantum states of charged bose particles in crystalline solid. It is based on the Kim-Zubarev method [1], which is called equivalent linear two-body (ELTB) method. The original points of this study are following things.

(i) The non-linear screening effect is introduced into the formula for the repulsive interactions between charged bosons.

(ii) The structures of the crystalline solids are taken into account in the lattice summation for the repulsive interaction between a charged boson and a host ion.

The basic equation for N-boson system is written as

$$\left\{ -\frac{d^2}{dx^2} + \frac{p}{x^2} + \sum_{m=2}^{M} A_{N,m} x^{2m-2} + \frac{q}{x} f\left(\sqrt{\frac{\hbar}{m\omega}} x \right) \right\} \Psi(x) = \varepsilon \Psi(x), \qquad (1)$$

where the third and the fourth terms mean boson-boson and boson-host interactions, respectively. The crystal structure of the host lattice is included in the coefficients $A_{N,m}$. The non-linear screening effect is included in the function f. For the case of deuterons in Pd, a trapped solution in octahedral void (VacO) is obtained and plotted in Fig.1. This result suggests that the Bose-Einstein condensation and nuclear reaction in solid may happen. The critical temperature and the nuclear reaction rate are estimated to be $403K$ and $1.1 \times 10^9 sec^{-1}$, respectively.
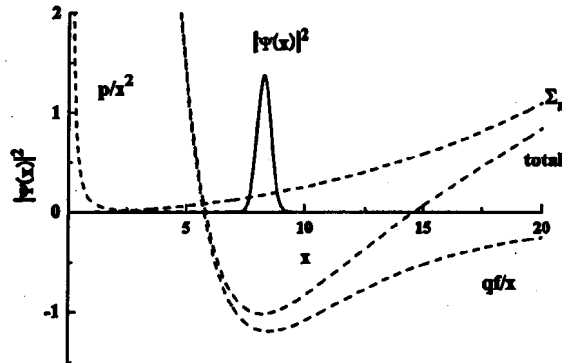

Fig.1 The ELTB solution for the system including 5 deuterons in VacO in fcc Pd. Non-linear screening potential is used for the d-d interaction. The nondimensional quantity x is defined as $x = \sqrt{m\omega/\hbar}\, \rho$, where $\omega = 0.86 \times 10^{14} sec^{-1}$ and $\rho = \left(\sum_{i=1}^{5} r_i^2 \right)^{1/2}$. The solid line means the ELTB solution. The dashed lines mean each potential in eq.(1) normalized by ε.

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Revisiting Anomalous Explosion of Hydrogen and Oxygen Mixture from a View Point of Cold Fusion

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

Introduction

It is well known that mysterious powerful explosions can take places during experiments of cold fusion(1). Also, in Aug 2003, Tokyo Electric Power disclosed that it experienced 8 unusual pressure rises believed to be hydrogen explosion in its nuclear power plants. In order to establish safer hydrogen economy in which hydrogen is the main energy carrier for fuel cells, and to avoid unnecessary hydrogen explosion during experiments of cold fusion, it is imperative to clarify the mechanism of the anomalous explosion of hydrogen. A dividend of cold fusion research gave us a clue to explain this anomalous combustion.

A peculiar explosion at the Kashiwazaki-Kariha Nuclear Power plant unit-3

According to the Tokyo Electric Power's report above mentioned, the pressure rise was estimated around 50MPa resulting in a disengagement of the connector to the pressure gage for measuring the pressure of the main steam line, but it seems no damage to the pressure gage near by. In order to explain this kind of rapid combustion phenomenon, one must establish a new hypothesis.

A candidate hypothesis: BlackLight process by Dr. R. Mills

Dr. Randlle Mills demonstrated that hydrogen atoms can achieve lower states than ground state by a resonant collision with a near by atom or combination of atoms having the capability to absorb the energy to effect the transition, namely, an integer multiple of the potential energy of atomic hydrogen, $m \times 27.2eV$ (m=integer) [2].

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

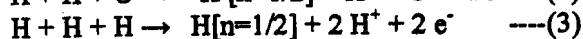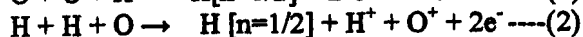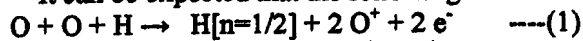## Atomic hydrogen and oxygen in the steam

It is conceived that hydrogen and oxygen in the steam in nuclear power plants are molecular, not atomic, but since these hydrogen and oxygen are generated due to dissociation of water by nuclear radiation, it is quite conceivable that atomic hydrogen and oxygen can co-exist with molecular ones in the nuclear power plants.

Mechanism of anomalous explosion at the Kashiwazaki-Kariha Nuclear Power plant unit-3

The author postulated that 3 body reaction of atomic hydrogen and oxygen can make a BlackLight Process because ionization energy of hydrogen and oxygen is very close as is shown below(3,4).

Hydrogen $=13.598$ eV, Oxygen $=13.618$ eV

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

$$O + O + H \rightarrow H[n=1/2] + 2\,O^+ + 2\,e^- \quad ----(1)$$
$$H + H + O \rightarrow H[n=1/2] + H^+ + O^+ + 2e^- ----(2)$$
$$H + H + H \rightarrow H[n=1/2] + 2\,H^+ + 2\,e^- \quad ----(3)$$

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

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Nuclear-fusion chemistry through nucleonic liquid crystals

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Key words: liquid crystal, nano-space, Platonic structure of atomic nucleus, block arrangement of atomic nucleus, subsidence of Coulomb barrier
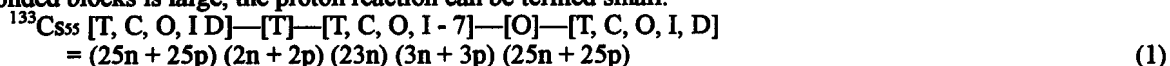
Overview

Nuclear fusion in solids appears to be approaching the final phase at long last. The surface of a solid is at the boundary with the surrounding gas, and because the solid and gas act mutually upon each other, what has heretofore be considered unthinkable is becoming possible. Wolfgang Pauli's musings on the "devilish" properties residing in the surface of a solid are completely on target. In the nanometer-order world of a solid surface, lattices and locations exert effects, giving rise to a "devil." However, because God abhors chaos, order must prevail, and it is the conviction of the author that natural laws apply.

The author has been a proponent of nucleonic crystals composed of Platonic structures, but it appears that in nuclear fusion this nucleonic crystal first becomes a liquid crystal, and this nucleonic liquid crystal fuses with another nucleonic liquid crystal. On the molecular level as well, reactions between two solids are difficult. However, this can also be inferred by analogy from the fact that when in a liquid or liquid-crystal state, the reaction between the molecules are larger and easier than with solids. Using these reasons, the author conducted chemical investigation into fusion by liquid-crystal atomic nuclei in a state intermediate between liquid and crystal.
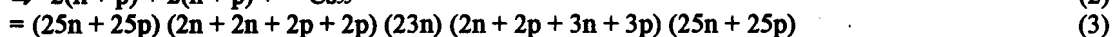
Fusion of nuclei in a liquid-crystal state

The author obtained the chemical formula shown by equation (1) below for the nuclear fusion of liquid-crystal $^{133}Cs_{55}$ and $2(^2D)$. Atomic nuclei that have become liquid crystals in nanometer-order space are respectively arranged and bonded in blocks that have crystallized into Platonic structures. Because these bonds are between liquid crystals, the attraction between the respective blocks is weakened by the large distance between the blocks. Here, blocks are indicated by square brackets ("[ ]"), and the bond between two blocks by a dash ("—"). Because the distance between two bonded blocks is large, the proton reaction can be termed small.

$$^{133}Cs_{55} \text{ [T, C, O, I D]—[T]—[T, C, O, I - 7]—[O]—[T, C, O, I, D]}$$
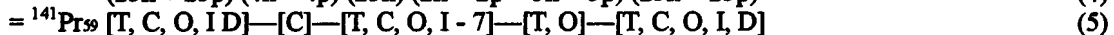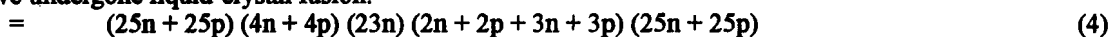$$= (25n + 25p)(2n + 2p)(23n)(3n + 3p)(25n + 25p) \tag{1}$$

The third term from the left in equation (1) represents the outermost shell, which in terms of Platonic structures is an icosahedron, indicated here as an I polyhedron. As shown here, its configuration has been stripped of seven crystalline nucleons (here neutrons).

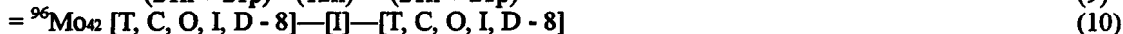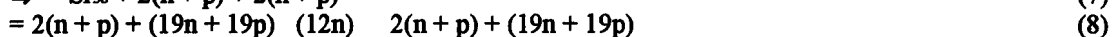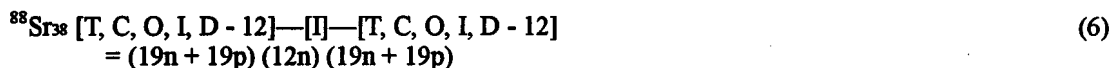The state in which the two ^2D units in equation (1) react is indicated by equation (2).

$$\Rightarrow 2(n+p) + 2(n+p) + {}^{133}Cs_{55} \tag{2}$$
$$= (25n + 25p)(2n + 2n + 2p + 2p)(23n)(2n + 2p + 3n + 3p)(25n + 25p) \tag{3}$$

Equation (3) depicts the state in which the ^2D units in the second and fourth blocks of the nucleons of the $^{133}Cs_{55}$ nucleus have undergone liquid-crystal fusion.

$$= \quad (25n + 25p)(4n + 4p)(23n)(2n + 2p + 3n + 3p)(25n + 25p) \tag{4}$$
$$= {}^{141}Pr_{59} \text{ [T, C, O, I D]—[C]—[T, C, O, I - 7]—[T, O]—[T, C, O, I, D]} \tag{5}$$

Equation (4) indicates the change in the numbers of protons and neutrons that occur due to nuclear reaction in the blocks within the atomic nucleus.

In the atomic nucleus that has undergone nuclear change to become $^{141}Pr_{59}$, indicated by equation (5), in the second block, $(2n + 2p)$ has become $(4n + 4p)$, and the O polyhedron (octahedron) has changed to T polyhedron (tetrahedron) in the inner shell and an O-polyhedral structure in the outer shell. The reason why a change in the crystal is produced because of the change in the numbers of neutrons and protons is related to Kepler's theory of space-filling polyhedra and to quantum change in spaces, and like the mystery of crystallization of snowflakes, remains a topic for future study.

Nuclear reaction can be explained similarly for $^{88}Sr_{38}$ as well. The chemical formula for the nucleus is as follows.

$$^{88}Sr_{38} \text{ [T, C, O, I, D - 12]—[I]—[T, C, O, I, D - 12]} \tag{6}$$
$$= (19n + 19p)(12n)(19n + 19p)$$
$$\Rightarrow {}^{88}Sr_{38} + 2(n+p) + 2(n+p) \tag{7}$$
$$= 2(n+p) + (19n + 19p) \quad (12n) \quad 2(n+p) + (19n + 19p) \tag{8}$$
$$= \quad (21n + 21p)(12n) \quad (21n + 21p) \tag{9}$$
$$= {}^{96}Mo_{42} \text{ [T, C, O, I, D - 8]—[I]—[T, C, O, I, D - 8]} \tag{10}$$

The riddle of nuclear fusion is thus explained. The bonds described are not formed in a chaotic integral atomic nucleus. Fusion can take place in an atomic nucleus having crystalline blocks with weak bonds.

Unknown Nuclear effects and Abnormal Isotopic Compositions

Contribution, on a purely private basis, of Dr. Herve Bottollier-Curtet, nuclear physiSICt

Presented at the Symposium "Do there Exist nuclear reactions on atomic energy levels? "
organized by the Foundation Louis de Broglie, Paris
November, 26th and 27th, 2003

I - Introduction

LENRs (Low Energy Nuclear Reactions, with a threshold lower than 1 keV/atome, even than 1 eV/atome, to compare with the "traditional" threshold of MeV/atome) are scientifically highlighted since about fifteen years in many experiments known as "Cold Fusion" experiments.

One of the arguments of the existence of these reactions (which we will call in a broader way "Unknown Nuclear Effects" or UNEs) in this type of experiments rests on the presence of elements whose Isotopic Composition (IC) strongly deviates from Standard IC (SIC). One qualifies then these ICs of Abnormal Isotopic Compositions (AICs).

First of all, we will specify the differences existing between the SICs, the Non Standard Isotopic Compositions (NSICs), well known physical phenomenon used in various fields of studies, and the AICs.

Then we will see that if the researchers in LENRS are confronted, with great satisfaction, with AICs, they are not the only ones.
Indeed, physisicts of the atmosphere, cosmochimists, volcanologists, geologists, archaeologists, ..., all are confronted with problems of AICs.
But for these researchers, satisfaction yields the step to embarrassment.

II – Standard Isotopic Compositions, Nonstandard and Abnormal

We will limit our matter to the stable isotopes for these 3 categories of ICs.

The SICs are ICs which one finds on ground or in the solar system (sun, moon, planets...), inherited from the proto-solar nebula, itself even sown in isotopes created by stellar nucleosynthesis in the preceding generations of stars.

The NSICs are well known, indexed and explained by the following physical phenomena:
-        isotopic fractionation,
-        decay of radioelements (explaining the NSIcs of terrestrial Pb in particular),
-        nucleosynthesis by spallation of cosmic rays,
-        contribution of various stars with different isotopic signatures,
and marginally, nucleosynthesis carried out by an Oklo type natural nuclear fission reactor.

The most common process is the process of isotopic fractionation: a physical process - evaporation, condensation, diffusion, thermal diffusion, gravity, phase transitions, exhaust of a planetary atmosphere, photolyses... - or a chemical process can support an isotope heavier or lighter, which leads to an IC which deviates from the SIC.
One quantifies the isotopic variation by an Isotopic Delta noted δE (δD, $\delta\,^{18}O$...) expressed in 1 part for 1 000 compared to the most abundant isotope. Isotopic variations δE maximum met in the NSICs are indeed weak, about 10 per thousand (i.e. 1 %), except for C, N and O for which they can reach 10 %, of S, Ca and Pb for which they can reach 20 % and of H, He and for which they can reach 100 %
[1, 2].
Because isotopic fractionation is worth especially for the light isotopes (let us say A<40 is Calcium), a difference in mass of 1 for heavier isotopes quickly becoming negligible.

These NSICs are largely used by the scientific community like physical indicators of phenomena: variation of 3% of the presence of ^{18}O in polar carrots connected to the global temperature, variation of 3 % of the presence of ^{13}C in Chlorophyl connected to the diets of herbivores and carnivores, variation going up to 23 % of the presence of ^{204}Pb in the grounds to discriminate between endogenous lead and industrial lead of industrial...

The AICs, on the opposite to the NSICs, are characterized by the 2 following facts:
-        the mechanisms called upon for the NSICs are not implied,
-        the isotopic variations are very strong and reach 10 000 per thousand for certain elements, even more.

It is necessary to underline here that researchers having published compilations [1, 2] mention the existence of AIC measurements. For example, those obtained in geological samples for Ar, Kr, Rb, Zr, Mo, Ru, Pd, Ag, Cd, In, Sn, Sb, Te, Xe, Ba, Sm, Eu, Gd, Dy, Er, Yb, Lu and Os [1]. But these measurements are systematically rejected, supposed to be sullied with errors, even if those are not identified.

Hence, one understands that NSICs and AICs constitute 2 categories of very different results.
We now will see that the AICs are mesasured in many and various study fields.

III - AICs met in LENRs experiments

The first experiments of Cold Fusion carried out into 1989 reflect in obviousness, beyond the appearance of an excess of heat whose intensity could not be explained by the intervention of chemical reactions, the appearance of Helium (^{4}He) and, more marginally, of Tritium (the appearance of ^{3}He was measured only several years afterwards), coming from D-D fusion.

In 1991, Pr Matsumoto of the Hokkaido University was the first researcher to bring back the observation of new elements produced by LENRs process : Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca, Ti, Cr, Fe, Ni, Cu, Zn, Ru and In [3].
The presence of rare gases (Ne and Ar) and of not very widespread elements (Ru and In) militated for the signature of LENRs.
But for widespread elements such as Al, Si, Ca..., the assumption of a contamination could not be still excluded.

It is to dismiss this assumption that in 1992 Dr. Karabut of Russian laboratory LUTCH measured the radioisotopes of the new elements produced by the LENRs, namely Sr and Rh [4].
It was him also, which, since 1994, was the first to measure ICs of stable isotopes: Li, B, Si, K, Ti, Fe, Zr, Mo and Ag [5].

Since, in LENRs experiments, more than thirty elements presenting AICs were measured: Li, B, C, O, Na, Mg, Al, Si, S, K, Ca, Ti, Cr, Fe, Ni, Cu, Zn, Br, Kr, Zr, Mo, Ru, Pd, Cd, Xe, Hf, Ir, Pt, Hg, and Pb.
It would be tiresome to review all these results. Let us quote for example [6].
It is significant to underline here the universality of this type of results. Indeed, if in the first years, the researchers concentrated their efforts on the electrolytic cells with heavy water and palladium cathode, today, the results are obtained for a large variety of configurations of experiment:
-        various states of the matter for hydrogen penetrating metal: liquid (hydrogenated electrolyte) but also gas, plasma and ion beams,
-        various metals: Pd but also Ti, Co, Ni, Sr, Cs, W, Pt, Au, Pb, U,..
-        deuterium but also protium.
One notes a constant in these experiments: the presence of Hydrogen (protium or deuterium) penetrating a metal, i.e. a condensed medium, in which these nuclear reactions occur. We will thus call these reactions of the Condensed Hydrogenated Medium Nuclear Reactions (CHMNRs).

To summarize the results of these measurements, let us say that:
- for certain elements, IC is close to or identical to the SIC,
- for other elements, IC is an AIC.   Examples : factor 32 on $^{the\ 33}$S, factor 100 on $^{the\ 57}$Fe, factor 20 on $^{the\ 65}$Cu, factor 15 on $^{the\ 202}$Hg...
- these AICs are generally:
- located spatially on the samples analyzed in zones whose dimensions are typically in the range 1-10 µm,
- depending on the depth to which the sample is analyzed.

Thus, the same object (in fact, a piece of hydrogenated metal) will present broad variations of ICs according to the place where will have been taken the sample to analyze.

IV − Short recall of AICs met apart from CHMNR experiments

Many disciplines are confronted with the unexplained AICs:
-        Physics of the atmosphere (ex: enrichment in ^{18}O of ozone - reaching 50 % -, of CO, CO_2, N_2O...),
-        Cosmochemistry
-        Meteorites (many elements in various classes, e.g.: δD = 5.7),
-        Comets (e.g.: ratio D/H of Hale-Bopp 20 times the terrestrial ratio),
-        Interstellar dust (e.g.: δD = 25),
-        Molecular clouds (e.g.: δD = 60),
-        ...
-        Volcanology (e.g.: ratio ^{3}He/^{4}He reaching 37 times the value of the atmosphere ratio),
-        Geology (e.g.: ^{40}Ar excess),
-        Archaeology (many anomalies of ^{14}C dating),
-        ...,

It would have been interesting to examine in detail these results. But the field of study would have been too vast. This is why we will restrict ourselves to the results AICs even more problematic: those obtained for the same object.

V – Results of AICs obtained in a same sample or a same structure

Many variations of ICs on the same object, or the same structure, are measured.

As we mentionned earlier (see paragraph III), such variations are usually measured on samples resulting from CHMNRs experiments.
But they are also measured in all the disciplines meeting AICs and mentioned in the preceding paragraph.

Let us quote :
- ^{18}O of atmospheric ozone [7],
- D in the coma of comet Hale-Bopp [8],
- many elements in different meteorites (cf infra),
- various elements in various samples of interstellar dust (cf infra),
- ^{40}Ar in terrestrial rocks (Argon datings), example: 11 and 18 My for a rock at Simplon [9],
- ^{14}C on ground (Carbon datings) (cf infra):
- bone of a skeleton of Egyptian mummy: 2 000 and 4 000 years,
- carrot of the Bering Strait: 6 measurements of 4 000 to 16 000 years,
- musk ox carcass: 17 000 and 24 000 years,
- prehistoric parietal paintings: 14 000 and 28 000 years, 15 000 and 30 000 years...
- various elements in various enriched samples for the vast 1991 IAEA Inter Comparison (cf infra).

We will examine in detail only the results obtained for 3 categories of objects: prehistoric meteorites, parietal paintings and samples of IAEA 1991 Inter Comparison.

V.1 - Meteorites

The meteorites coming from the belt of asteroids between Mars and Jupiter, in particular chondrites which did not encouter fusion after their accretion, are carefully studied because they are a testimony of the beginning of the solar system.
Most primitive, and thus most famous, are carbonaceous chondrites, and among them C1Orgueil and ÁLLENDE. It is the scientific field in which the greatest number of measurements of IC was carried out since those started nearly 50 years ago.
It is indeed Boato who, in 1954, showed the AIC of Hydrogen (Deuterium excess) in carbonaceous chondrites [10].

Then D. Black discovered in 1969 the AIC of Ne (Ne^{22} excess) in carbonaceous chondrites. In 1972, Black concluded that the origin from this Ne^{22} was an independent source, outside our solar system and then calls this excess of Ne^{22} "Ne-E", E for outside [11].

Then R.N. Clayton [12] discovered in 1973 the AIC of Oxygen not obeying the law, however well checked, of " mass fractionation" in an inclusion rich in Al, Ca and Ti of ALLENDE. He concluded from it that the explosion of a supernova (SN) near the solar system in formation injected Oxygen having its own isotopic signature in the proto-solar nebula.

Since, in inclusions called CAI - FUN for Calcium and Aluminium-rich Inclusions - Fractionation and Unknown Nuclear effects (representing however only one small part of inclusions CAI) and in the chondres (molten silicate droplets solidified very quickly), many other AICs were discovered for nearly about thirty elements: Li, B, C, N, Mg, Si, K, Ca, Cr, Ni, Kr, Sr, Zr, Mo, Ru, Pd, Ag, Xe, Ba, Sm, Nd, Sm and W.
ICs can thus vary inside the same meteorite:
- of an inclusion CAI - FUN or from one chondre to another, distant of ten µm, even 1 µm (see for example [13]),
- of a carbonate grain to the other, grain to which the size is close to 10 µm (see for example [14]).
This type of results is not confined to meteorites. It is also obtained for interstellar dust (see for example [15]). What gives a universal character to him.

If one preserves the assumption of Clayton, i.e. SN having different isotopic signatures, it is necessary to consider today several tens of SN explosions.
Moreover, in situ decay of certain nuclides ($^{26}Al => {}^{26}Mg$, $^{53}mn => {}^{53}Cr...$) place on these explosions a constraint of extremely tight temporal proximity of a few million years (see for example [16]).
Lastly, some isotopic ratios (such as $^{48}Ca/^{46}Ca$, $^{48}Ca/^{50}Ti$, $^{48}Ca/^{54}Cr...$) cannot be reproduced by calculations of stellar nucleosynthesis, some experts qualifying the situation of "intolerable" (see for example [17]).

The succession of all these discoveries thus returned gradually this type of explanation less and less probable.
With philosophy, and humour, the cosmochimists, in waiting to better understand these results, decided to baptize these results of "FUN" for "Fractionation and Unknown Nuclear effects".
It is this term of "Unknown Nuclear Effects" (UNE) which we chose to retain.
Because it is exactly with what CHMNRs researchers are confronted.
This is why it seems to us rational to make the bringing together between these 2 types of results.
It is also why we wish to suggest with the cosmochimists who carry out laboratory experiments to try to reproduce the AICs that they measure, taking into account the configuration of experiments of CHMNRs, configuration which systematically involves Hydrogen (protium or deuterium) penetrating a metal.

V.2 - Prehistoric Parietal Paintings

The ^{14}C dating technique, conceived and used since 1948 by Libby Willard, is currently largely used.
Well adapted to periods going up to 40 000 years, this technique has consequently been very much used in the field of prehistoric cave datings, and this for several decades.
The current precision of measurements is excellent: ± 50 years at 10 000 years, ± 200 years at 20 000 years and ± 400 years at 30 000 years.

Initially a technique of counting of beta decays, the arrival in the 1980s of the new technique of Accelerator Mass Spectrometry (AMS) made possible to decrease the sample size by a factor 1 000 (today, with the new devices, the factor reaches 10 000).
This low size of samples encouraged the archaeologists to require many datings insofar as the objects were not degraded any more by the sampling. Thus most archaeologists make the same object dated several times.

Generally, measurements are coherent between them. For example, 27 measurements of samples taken on 9 paintings of bison located in the Spanish caves of Covaciella, Altamira and El Castillo: from 13 000 to 14 500 LP [18].

But sometimes, they are not, and it is what makes these values interesting for our matter.
It is indeed frequent to have variations of 5 000, 10 000 even 15 000 years:
-        6 000 years of variation for the female mégaceros of Cougnac (25 120 and 19 500 LP) [19],
-        9 000 years of variation for a horse of Chauvet (29 670 and 20 790 LP) [20],
-        15 000 years of variation for the black spots of Candamo (31 000 and 15 000 LP) [21],

-        ....
Let us recall that a 15 000 year variation corresponds to a factor 6 on the measured quantity of ^{14}C nuclides (period 5 730 years).
However the measuring accuracy is several orders of magnitude below such a factor.
The anomaly is thus certain.

The main 3 assumptions selected to explain these variations for the same object are:
-        pollution by some more recent carbon (principal assumption),
-        use by the artist of charcoal more or less old,
-        later final improvement of work by another artist.
These assumptions are reasonable.
However, a doubt remains when one considers the differences between various objects having a strong probability of being contemporary:
-        paintings spatially close in the cave and identical in terms of subject, style and execution by the artist, present sometimes variations exceeding 10 000 years.
-        paintings and other datable objects (furniture, remainders of animals, charcoals...) of the cave present sometimes variations exceeding 10 000 years.
-        identical paintings in terms of subject, style and execution by the artist, present sometimes variations exceeding 10 000 years from one cave to another one.

By analogy with the results obtained for the celestial bodies and materials of CHMNRs experiments, we think that a 4th assumption, verifiable, is worth to be examined: that of the presence of in situ occurring UNEs.
Indeed, unlike the cosmochimists, the specialists in radiocarbon dating do not make the assumption of UNEs. Perhaps because they are interested only in the 3 isotopes of one element, carbon (one indeed also measures ^{13}C in order to make an isotopic fractionation correction to the ^{14}C/^{12}C measured proportion).
But if UNEs occurred in the pigments of these paintings, they do not have any reason to be confined with the Carbone element: measurements of IC of other elements (like Fe, Mn...) could thus bring a valuable information.
The archaeologists could be also confronted with a problem of the ICA, problem broader than a dating problem.
This is why these measurements of IC of various elements appear to us essential.
(NB: If it proved that the AICs are measured for these elements, it would be necessary moreover to determine if these anomalies occur in zones of size 1-10 μm, as in cosmochimy and CHMNRs experiments.)

V.3 - Samples of inter comparison IAEA 1991

This inter comparison on a large scale was carried out from 1988 to 1990, the results being published in 1991 [22].
Measurements of ICs were made in 40 laboratories of 20 countries for 13 samples especially prepared for the occasion, and enriched in D (2 samples), ^{13}C (4 sam.), ^{15}N (5 sam.) and ^{18}O (2 sam.).
The devices used were mainly Mass Spectrometers (of routine, with quadripole, with chemical ionization...) and Emission Spectrometers.
A minimum of 3 determinations per isotope was required, with 6 determinations preferably, to determine the standard deviation of the average given by each laboratory.

Minimal and maximal averages obtained by laboratory:

Isotope	Echantillon	Mini (ppm)	Sigma (%)	Maxi (ppm)	Sigma (%)	Différence (%)
C13	309 A	82,22	1,6	133,60	2	63
N15	310 A	43,34	0,5	66,77	0,6	54
O18	304 B	381,39	0,2	512,33	0,1	34
N15	311	1,64	0,6	2,12	0,4	29
C13	303 A	88,11	0,5	107,50	1,3	22
N15	305 A	37,84	1,1	41,24	0,6	9
C13	303 B	439,32	0,1	477,17	0,2	8,6
N15	305 B	362,35	0,2	388,93	0,6	7,3
O18	304 A	242,95	0,0	258,24	0,4	6,3
N15	310 B	235,07	0,4	247,45	0,0	5,3
C13	309 B	524,42	0,2	544,85	0,1	3,9
D	302 B	981,39	0,5	1 015,60	0,8	3,5
D	302 A	501,25	0,3	512,53	0,1	2,3

NB: 2 laboratories obtained a null dispersion on their average.

Analyze

For the sample 304 B (water), the averages by laboratory are obtained with a sigma of about 0.1-0.2 %. But one has a difference in 34 % between laboratories. I.e 200 times more than dispersion on the average of a laboratory (the limits of detection of the instrumentation of these laboratories are respectively 0.1 and 0.3 ppm for measured values being located around 400 ppm, i.e. 2 000 times more).

For sample 310 A (urea), the difference reaches 100 times the dispersion by laboratory. For sample 311 (sulphate of ammonia), there is a factor 60 and for sample 309 A (UL glucose), a factor 35.
The smallest variation of 2.3 % recorded for sample 302 A is more than 10 times the dispersion on the average by laboratory.

If one takes the extreme of minima and maximum values (which we have eliminated from the preceding table) for which dispersion by laboratory is worse, figures are still worse.
For example, for sample 309 a: Minimal 38.70 ppm, Maximal 133.60 ppm, i.e. a 245 % difference...

These figures are thus quite simply unexplainable.
And one can only be astonished to note that the writers of the final report/ratio did not make any comment on this subject.

It would obviously be necessary to redo this type of very broad intercomparison for a better understanding of where are the most significant differences (between various types of apparatus or apparatuses of the same type).

VI – In situ UNEs and/or UNEs during measurement

Measurements appear, currently, as being reliable and precise.
However, they can give different results for the same object.
That it is for objects having a history amounting of billion years (meteorites), of tens of thousands of years (parietal paintings prehistoric) or in years (samples IAEA).

If UNEs are well the phenomenon in charge for this fact (what other one ?), then those UNEs can take place:
- during the evolution of the object itself,
- during the analysis of the sample by each laboratory,
- during both.

The 1st assumption is viable, the CHMNRs experiments are there to show it.
It will be simply noted that if the AICs are quasi systematically measured during CHMNRs experiments, it is not the case for certain meteorites and certain prehistoric parietal paintings with normal ICs, the conditions to start in situ UNEs in these objects being probably not met, conditions which are always badly defined apart from the necessary presence of Hydrogen.

But taking into account of the 1st assumption involves logically the examination of the 2nd and 3rd assumptions.
The CHMNRs experiments indeed show us that UNEs occur even in media extremely close to the ambient conditions, with low volumic energy density. Let us quote, among others, the experiments described in [23], [24] (70 °C, 1 Hydrogen bar), in [25] (20 °C, 6 bars of Hydrogen) and in [26] (20 °C, from 1 to 10 Hydrogen bars).
It is thus natural to raise the following question: the devices measuring ICs put the nuclides to analyze in media of energy density largely higher than that of the media mentioned above (for example the plasma of an Inductive Coupling Plasma - Mass Spectrometer, ICP-MS, the ionic bombardment of Secondary Ion MS, SIMS...). Why such media wouldn't also be the seat of CHMNRs, thus distorting the results of a class of devices compared to another one but also from one device to another one in the same class [27]?
There is also a potential methodology problem when physicists running CHMNRs experiments under very "soft" conditions, close to the ambient conditions, subject then the nuclides to be analyzed in media "much more distrurbed"? We think that a reflexion must be carried out in this direction.
A reflexion which should interest all the physicists thinking of the problem of the interaction experimenter - experiment, a well-known problem in Quantum Physics.

VII — Conclusions

Physicists of the atmosphere, cosmochimists, volcanologists, geologists, archaeologists all..., are confronted with problems of AICs.

In fact, the only researchers not not to be confronted are :
- researchers of the disciplines using NSIC as tracers (glaciology, ecophysiology, ecology...),
- researchers in nuclear physics who proceed themselves to their nucleosynthesis in their reactors or accelerators and for which it does not exist any more reference IC,
- and, obviuosly, researchers who do not measure ICs.

The recent improvements and the recent wide diffusion of devices able to measure ICs explain why this problem did not appear earlier in all its width.

It is possible that UNEs being held in situ, as already the cosmochimists recognize it, are responsible for this situation.

It is also possible that certain means of isotopic analysis are themselves generating UNEs, thus distorting the results.

Thus, the author of this publication will achieve his goal if he manages to challenge:
- the cosmochimists who should think their laboratory experiments in terms of CHMNRs experiments,
- the archaeologists who should ask for the measurements of ICs in several elements in prehistoric parietal paintings,
- the experts in Ics measurements which should wonder about the nondisturbing aspect of their measurements and multiply the inter comparisons,
- and more largely specialists in other disciplines (physics of the atmosphere, geology, volcanology...) which should take into account the potential existence of UNEs in their reflexions.

Anyway, even if these interpellations initially do not find any echo, one thing is certain: from now on, each year brings its batch of contribution in terms of experimental evidence that Unknown Nuclear Effects lead to Abnormal Isotopic Compositions.

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Thanks

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.

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