ISSN No:-2456-2165

Possibility of Transmutation to Super Heavy Element by Cold Fusion Mechanism

Noriyuki Kodama
Studied Physics at Tokyo Institute of Technology (1983-1987)
Studying cold fusion as an independent researcher since 2020
Sekido 5-2-7, Tama-city, Tokyo, 206-0011, Japan

Abstract:- I proposed the Conceptualized Transmutation reactor to add protons and neutrons to the element. Previous transmutation reactor just adds protons, with small D2 or small H2 based on electron deep orbit theory, which shows that element can have the deeper orbit than n=0, which orbit is at a few femto meter from the nucleus, so the cold fusion occurs for D_2 gas supply, so, I proposed the conceptualized reactor with H_2 gas to prevent cold Fusion. Usually, nuclear experiments on transmutation need both neutron and proton addition, Thus I propose the experiment on Conceptualized transmutation reactor. The mechanism is based on Cold Fusion and gas is H_2 and it is important to control the metal temperature as low as possible to emit small H_2(die-neutron), and for the small proton(neutron) creation, the higher metal temperature is used to breakdown the covalent bond of small H_2(p-p pair in electron deep orbit) to create neutron (proton-electron pair in Electron deep orbit). This transmutation reactor enables the detailed study of the chemical and physical property of the super heavy metals. Another conceptualized reactor uses the compression of covalent bond of metal-none metal element to study the super heavy element metal, starting metal is as heavy as possible so Pb is option and heaviest none metal element is Br and the resulting transmuted element is Ts (Tennessine), which decays to Mc (Moscovium), which attract attentions. The Conceptualized reactor has drawback due to the poor mechanism so I hope the researchers study the mechanism of compression of covalent bonding efficiently.

Keywords:- *Plutonium Moscovium Tennessine transmutation stability island Cold Fusion.*

I. INTRODUCTION

A. Background

In 1989, Martin Fleischmann and Stanley Pons were catapulted into the limelight with their claim to have achieved fusion in a simple tabletop apparatus working at room temperature [1]. Their report described an experiment involving electrolysis using D_2O in which the cathode fused (melting point 1544 ºC) and partially vaporized, and the fume cupboard housing the experimental cell was partially destroyed.

After Fleischmann and Stanley's report, a substantial number of follow-up research was conducted to reproduce the reported Fleischmann and Pons Effect (FPE). Because FPE is NOT Cold Fusion but it is just the electrolysis experiments and Cold Fusion happens to occur under the special condition, the reproducibility was low.

I published several papers on the mechanism of cold fusion in ref [2],[3],[4],[5], and summarize here briefly to explain the mechanism of transmutation based on Cold Fusion.

II. COLD FUSION OVERVIEW

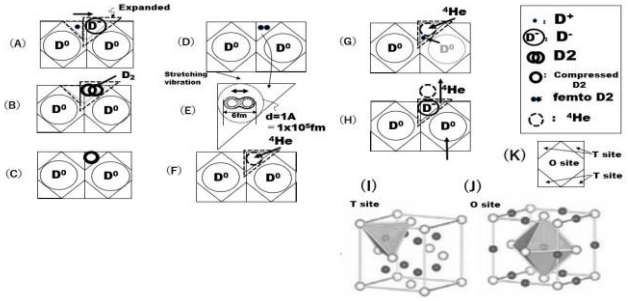


Fig.1: Cold fusion Mechanism [2]

(A) D- in surface T site and D+ in the adjacent surface site.
(B) D+ hops to T site with D- and D2 is created in T site.
(C) D2 is compressed.
(D), (E) D2 turns into smaller D2 with Deep Electron Orbit
(F) Fusion creates 4He

a) Step (A):
D is absorbed into the metal and D^- occupied at the surface T site, D^0 in O site;

I would like to summarize here the nature of hydrogen in metals. Hydrogen is D^0 at O site in Fig. 1, however, strictly speaking, hydrogen can be positive, neutral, and negative ion, depending on the electron exchange with the surrounding electronic state. In case of Hydrogen at T site, Hydrogen is negative (D^-) because it accepts the electron from the surrounding metal atoms due to their electronegativity. Due to the size difference between D and T site, surface T site is expanded.

b) Step (B): Hopping of D^+ to D^- at the surface T sites

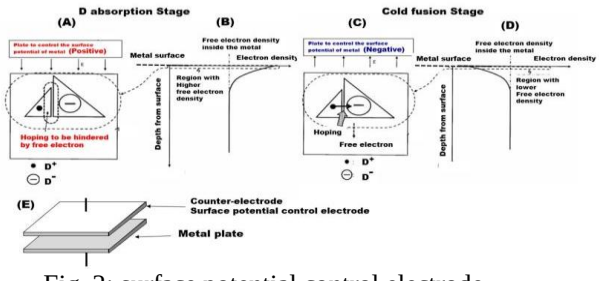


Fig. 2: surface potential control electrode.

(A), (B) Metal surface potential control voltage is positive at the Cold fusion stage, the surface potential of metal is negative.
(C), (D) Metal surface potential control voltage at D absorption stage is negative, the surface potential of metal is positive.
(E) 3D schematic of the Cold fusion with the counter electrode and metal plate, which are the parallel plate electrodes.

The metal surface potential needs to be positive for D to be D^+ and free electron depleted from metal surface to prevent coulomb attractive force shielding between D^+ and D^-. D^+ and D^- join to be D_2 at surface T site, where D_2 is compressed by metal lattice atoms due to the size difference.

c) Experimental evidence of small hydrogen

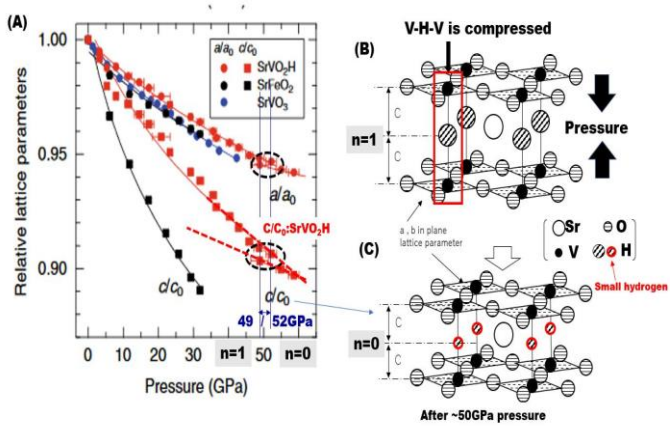


Fig. 3: High-pressure behavior of $SrVO_2H$ and SrFeO [6].

(A)Pressure dependence of lattice parameters for the experimental (red) and the DFT-computed (sky blue) values of $SrVO_2H$ (note that some error bars are smaller than the width of the symbols). The decrease in pressure from 52 GPa to 49 GPa as the cell volume decreases suggests a phase transition to a denser phase. Relative lattice parameters, a/a0 and c/c0, of $SrVO_2H$ (red), $SrFeO_2$(black), and $SrVO_3$(dark blue) as a function of pressure.
(B)Schematics of $SrVO_2H$, and V-H-V bonding, which is compressed by the mechanical pressure.
(C)Schematics of $SrVO_2H$ under the 52 GPa pressure, illustrating the decrease in size of hydrogen negative ion.

Figure 2 is the experimental evidence of smaller hydrogen of the compressed V-H-V bonding [6]. The authors showed via a high-pressure study of anion-ordered strontium vanadium oxyhydride $SrVO_2H$ that H^- is extraordinarily compressible, and that pressure drives a transition from a Mott insulator to a metal at ~ 50 GPa. I think that this experiment is the direct evidence of the existence of EDO as discussed in 2.1.5. I would like to explain D_2 molecule case (D-D bonding) in the actual Cold fusion in place of V-H-V compression as is in Fig. 2(B)-(C).

As is explained in Fig.1, Cold Fusion can be explained by the small hydrogen which is in the electron deep orbit at a few femto meters from the nucleus.

The existence of small hydrogen was proved by the experiments [6], and this experiment also prove the theory of electron deep orbit studied by J. Maly and J. Va'vra and A. Meulenberg, in ref [7]-[22].

d) Mechanism of electron transition from n=0 to electron deep orbit

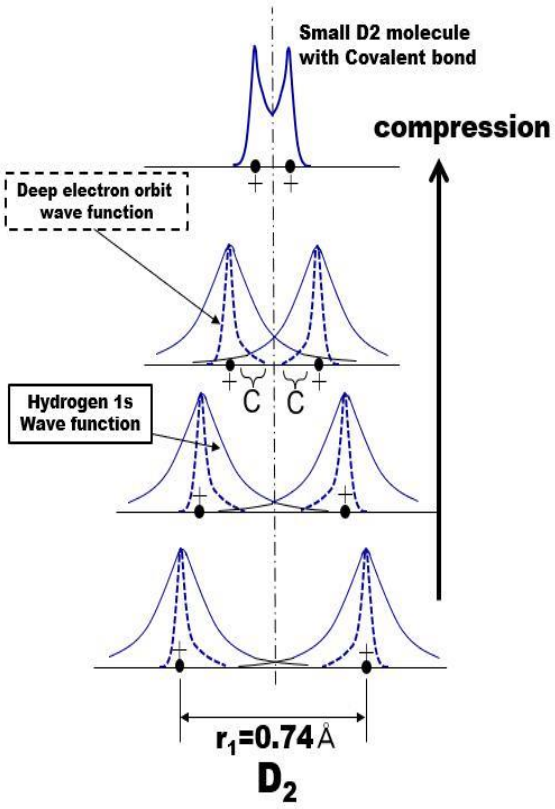


Fig. 4: Mechanism of small atoms (molecules) generation by the compression of D-D covalent bonding.

The mechanism of electron transition to EDO proposed in this work is illustrated in Fig. 4. The size of D_2 at the surface T site is determined by the balance between the compression stress from the lattice metal atoms and the elastic rebound force of covalent bond and due to the nature of the covalent bonding the compression can cause the d-d distance shorter in d-d compression direction that brings two ds to be closer together in a collision direction. Under compression of D_2 by external pressure, the d-d distance can decrease and the D1s wave function tail can extend to overlap with the EDO wave function, which is localized at a distance of a few femtometers from the nucleus. Because the d-d distance is so small, the overlap (C in Fig. 4) of wave functions can be large enough to achieve a high tunneling probability of electrons from D1s to the EDO (D0s). Radius of EDO is calculated to be few femtometers [7], [8], and is by far smaller than that of D1s of 0.53 pm (Bohr radius). A small D_2 molecule can be created due to the simultaneous transition of both D atoms to small D atoms, so D_2 molecule can transform to small D_2 molecule with the covalent electron at EDO as shown in Fig. 6(d).

e) Mechanism of coulomb repulsive force shielding

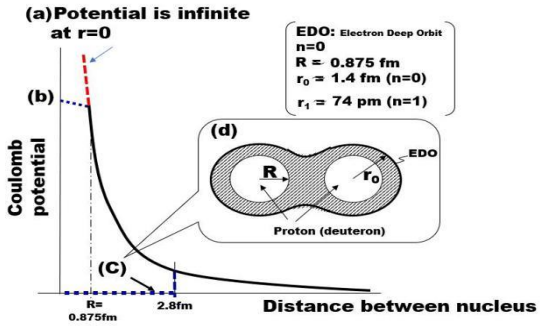


Fig. 5: Coulomb potential shielding by electron deep orbit.

(a) Infinite at r=o incorrect model under the point charge assumption
(b) Correct model under the uniformly distributed in the nucleus.
(c) Repulsive force shielding by electron deep orbit
(d) Small hydrogen; 2 protons with electrons in electron deep orbit.

Fig.2 shows the evidence of small hydrogen by the compression of V-H-V bonding, and the same mechanism of Cold Fusion at the surface T site of metal. The electron deep orbit theory was reported in ref [7]-[22], and initially neutral particle was believed to be proton-electron pair in the tightly bound state, however after the introduction of neutron [23], this was forgotten because of no experimental evidence, and Vavra et al studied this hypo theoretically and prove the existence of electron deep orbit for all of the elements. Report in Fig. 3 and ref [6] is the direct evidence of small hydrogen in electron deep orbit.

f) Correct nucleus model based on the electron deep orbit theory

Before the introduction of neutron, neutral particle is proton-electron pair in the tight state, however this theory was forgotten after the introduction of neutron as neutral particle because no experimental evidence was not available then. Lately Vavra et al studied this electron deep orbit theory and theoretically probed the electron-orbit. I found the evidence of [5], "Neutron to be Tightly Bound Proton-Electron Pair and Nucleus to be Constituted by Protons and Internal Electrons" in the transmutation study by Cold Fusion in ref [24],

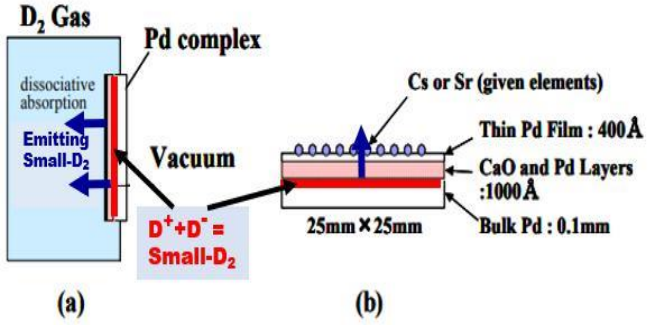


Fig. 6: Transmutation experiment in ref [24]

They reported the transmutation of the following ways.

They use D_2 gas so the created small molecule is small D_2 with d-d and covalent bond between ds, so d is one proton and 1 neutron with the incorrect nuclear theory, and correct theory in ref [5] is d is 2 protons with 2 internal electrons.

They have the transmutation
$^{38}Sr+2d=^{42}Mo$
$^{55}Cs+2d=^{59}Pr$

The above transmutation can be explained if d is 2 protons.

The cold Fusion can be understood by the electron deep orbit theory as is explained in ref [7]-[22], and summarized here.

For their transmutation experiment, small D_2 is created at surface T site and under the lower temperature, they do not fuse and emitted from metal surface.

And my conclusion considering transmutation experiment is that nucleus is constituted by proton and internal electron in ref [5].

III. TRANSMUTATION OVERVIEW

A. Issues of transmutation of heavy element

Although transmutation reactor by Cold Fusion was thought to be transmute P to heavier stabler element, it has difficulty because of the instability of heavy element, and the surface reaction of transmutation by cold fusion. So, I will explain here the difficulty in the next section.

B. Issue of island of stability

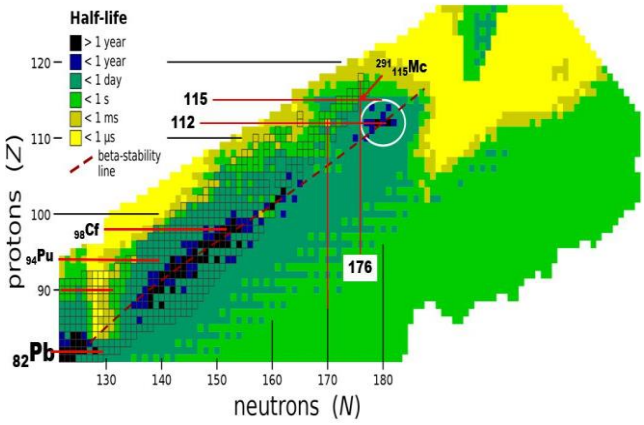


Fig.7: Island of stability

Figure 7 shows the nuclear stability and white circle is the stability island. Mc (Moscovium) is predicted to be located on a stable island centered on 112-Cn and 114-Fl.

The hypothetical isotope $^{291}_{115}Mc$ has only one more neutron than the heaviest known isotope $^{290}_{115}Mc$ and has interesting properties. It is thought to be produced as a decay product of $_{295}Ts$. Eventually it will be $_{291}Cn$, which is located on a stable island and has a half-life of about 1200 years. This is believed to be the most likely way to reach a stable island using current technology.

C. Conceptualized Transmutation Reactor

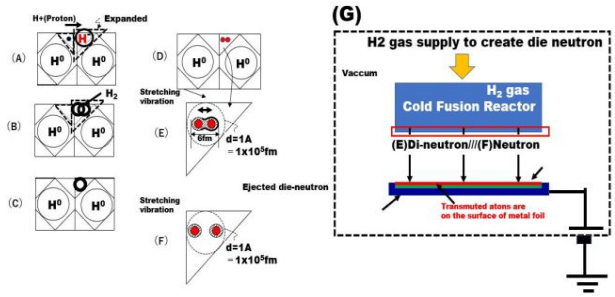


Fig. 8: Conceptualized Transmutation reactor to die-neutron and neutron

(F) die-neutron emission with lower temperature
(G) breakdown of die-neutron with higher temperature

Although experiment on the heavy element needs both the proton and neutron addition, current transmutation reactor can just add protons and no mechanism to add neutrons. Thus, I propose the experiments of this conceptualized transmutation reactor.

In order to create neutron (proton-electron pair in electron deep orbit), metal temperature to be higher to breakdown die-neutron by faster vibration of p-p bonding of small H2.

I am not sure of this mechanism but I think it is possible to have neutrons, and experiment is easy.

D. Biological transmutation

a) Background

The biological transmutation has the same mechanism of Cold fusion, So I briefly discuss its the mechanism as an additional evidence of the Cold fusion mechanism.

It is well known that in biological systems chemical elements can be transmuted into other elements [26].

Although
these facts have been established since the early 19th century, they have been ignored by established science ever since. In [27], the author reported that femto atoms may cause the transmutation.

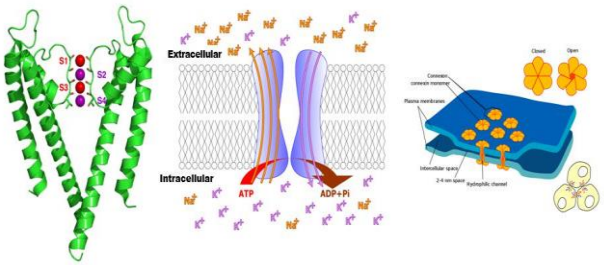
b) Category of biological transmutation

I categorized the types of biological transmutation based
on the report [25,26] as follows:
(1) Adding one proton (adding atomic nucleus of Hydrogen)
$^{39}_{19}K+1p=^{40}_{20}Ca$,
$^{137}_{55}Cs+1p=^{138}_{56}Ba$
(2) Adding 6*proton+6*neutron (adding atomic nucleus of 12C) or adding Si.
$^{28}_{14}Si+^{12}_{6}C=^{40}_{20}Ca$,

As shown above, the biological transmutation can be caused by the compression of the M-C and M-H (carbide and hydride) bonds to create small carbon or small hydrogen shielding the Coulomb repulsive force between M and H, or

C. by the femto atom formation based on the mechanism of transmutation in ref [27]

c) Mechanism of compression of metal-H, metal-C, Metal-Si bond in the biological system with cold fusion



(A) potassium channel **(B) Na⁺/K⁺-ATPase** **(C) gap junction**

Fig. 8: Biological mechanism that incorporates essential elements which can compress the bonding of hydride and carbide. (A)[28], (B)[29], (C)[30]

Because this mechanism is effective to compress from all the directions at the atomic level, I would like to realize a structure that imitates this biological mechanism.

IV. HEAVY ELEMENT INSTABILITY

A. Issues of transmutation of heavy element

Although transmutation reactor by Cold Fusion was thought to be transmute P to heavier stabler element, it has difficulty because of the instability of heavy element, and the surface reaction of transmutation by cold fusion. So, I will explain here the difficulty in the next section.

B. Issue of island of stability

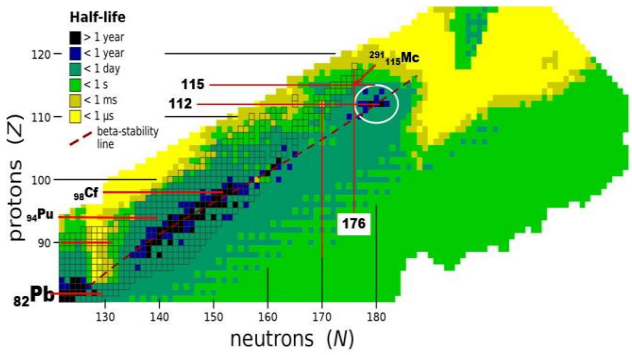


Fig.7: Island of stability

Figure 7 shows the instability of the heavier element and Pu is red rectangle of Z=94.

Fig.7 shows the nuclear stability and white circle is the stability island. Mc (Moscovium) is predicted to be located on a stable island centered on 112-Cn and 114-Fl.

The hypothetical isotope $^{291}_{115}Mc$ has only one more neutron than the heaviest known isotope $^{290}_{115}Mc$ and has interesting properties. Although it is thought to be produced as a decay product of $_{295}Ts$.

Eventually it will be $_{291}$Cn, which is located on a stable island and has a half-life of about 1200 years. This is believed to be the most likely way to reach a stable island using current technology.

V. CONCEPTUALIZED TRANSMUTATION REACTOR BY DI- NEUTRON AND NEUTRON CREATION

A. Conceptualized Transmutation Reactor

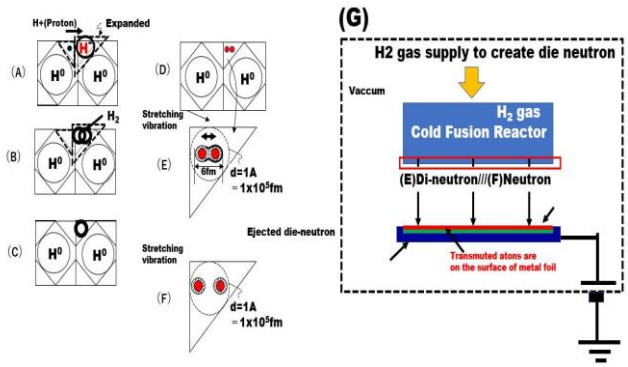


Fig. 8: Conceptualized Transmutation reactor to die-neutron and neutron

(F) die-neutron emission with lower temperature
(G) breakdown of die-neutron with higher temperature

Although experiment on the heavy element needs both the proton and neutron addition, current transmutation reactor can just add protons and no mechanism to add neutrons. Thus, I propose the experiments of this conceptualized transmutation reactor.

In order to create neutron (proton-electron pair in electron deep orbit), metal temperature to be higher to breakdown die-neutron by faster vibration of p-p bonding of small H2.

I am not sure of this mechanism but I think it is possible to have neutrons, and experiment is easy.

VI. BIOLOGICAL TRANSMUTATION

A. Biological transmutation

a) Background

The biological transmutation has the same mechanism of Cold fusion, So I briefly discuss its the mechanism as an additional evidence of the Cold fusion mechanism.

It is well known that in biological systems chemical elements can be transmuted into other elements [26].

Although
these facts have been established since the early 19th century, they have been ignored by established science ever since. In [27], the author reported that femto atoms may cause the transmutation.

b) Category of biological transmutation

I categorized the types of biological transmutation based on the report [25,26] as follows:

- Adding one proton (adding atomic nucleus of Hydrogen)

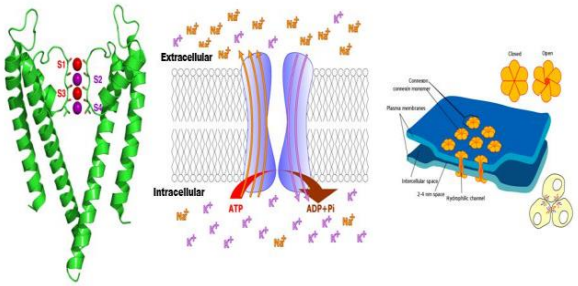
$^{39}_{19}$K+1p=$^{40}_{20}$Ca,
$^{137}_{55}$Cs+1p=$^{138}_{56}$Ba

- Adding 6*proton+6*neutron (adding atomic nucleus of 12C) or adding Si.

$^{28}_{14}$ Si +$^{12}_{6}$C=$^{40}_{20}$Ca,

As shown above, the biological transmutation can be caused by the compression of the M-C and M-H (carbide and hydride) bonds to create small carbon or small hydrogen shielding the Coulomb repulsive force between M and H, or C. by the femto atom formation based on the mechanism of transmutation in ref [27]

c) Mechanism of compression of metal-H, metal-C, Metal-Si bond in the biological system with cold fusion



(A) potassium channel (B) Na⁺/K⁺-ATPase (C) gap junction

Fig.9: Biological mechanism that incorporates essential elements which can compress the bonding of hydride and carbide. (A)[28], (B)[29], (C)[30]

Because this mechanism is effective to compress from all the directions at the atomic level, I would like to realize a structure that imitates this biological mechanism.

VII. TRANSMUTATION TO SUPER HEAVY ELEMENT

A. Possibility of Mc (Moscovium) creation by transmutation from Pb-Br compound to Transmutation to Ts (Tennessine) by Pb-Br Covalent bond compression

As is explained that transmutation is possible by covalent bond compression because the theoretical study shows that all of the element had the electron deep orbit and historical biological transmutation study shows that is by Metal carbide and metal hydride transmutation and based on Cold Fusion mechanism it is possible in the biological mechanism to compress the covalent bonding of Metal-H or Metal-C etc.

Based on the transmutation of metal by the compression of covalent bonding, I select the heaviest stable metal of Pb and Br of the heaviest nonmetallic element.

$_{82}^{(204\sim210)}$ Pb+$_{35}^{(79,81)}$ Br=$_{117}$ $^{(283,291)}$ Ts

The reachable heaviest element is ^{293}Ts; the elements after decay of ^{294}Ts are ^{290}Mc and ^{289}Mc, respectively, and it have the possibility to have ^{291}Mc with this method, and

ISSN No:-2456-2165

study of super heavy element can be easier by this method, which conceptualized reactor is shown in sec.

VIII. CONCEPTUALIZED REACTRO FOR TRANSMUTATION BY COVALENT BOND COMPRESSION

A. Mechanism of covalent bond compression

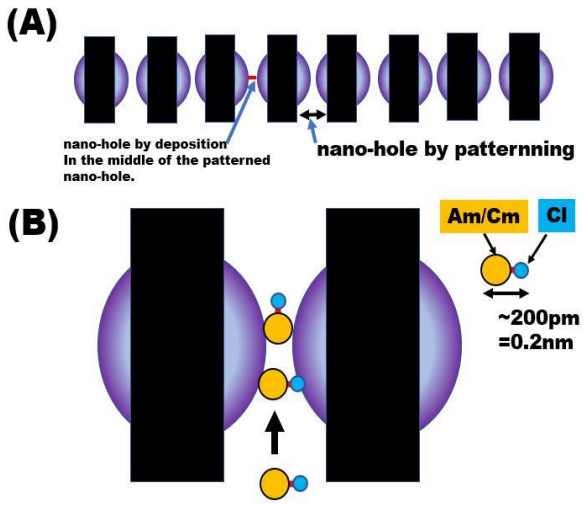


Fig.10: Conceptualized transmutation reactor by covalent bond compression.

It is also possible for transmutation based on cold fusion w\to compress the Pb-Br bonding in VII.

Now we have no reactor of the mechanical compression against such bonding although biological transmutation has mechanism to compress bonding of such molecules.

Thus, we need to develop such bonding mechanism to enable this transmutation.

One possibility is to use the nano hole for hydrogen filtering in ref [31] as is shown in Fig.10. At a glance of the schematics, it is clear that this reactor has drawbacks. Note that mechanism to compress bond in biological system can compress from all directions at atomic level.

Because this has a great impact on the industry and experiment to study the super heavy elements, element-115 has been attracting a lot of attention [32]. I think that this will have a great impact on the industry due to the applicability of this element to the industry if the better transmutation equipment is developed.

Thus, I hope other researchers will study and develop this mechanism.

IX. SUMMARY

I propose the development of conceptualized cold fusion reactor which can use die-neutron (to add 2 protons) and neutron (to add neutron), by adjusting the metal temperature.

Because this transmutation is just on the surface, it is for the experiment on the nature of the heavy element. Because the super heavy element can be created by acceleration and collision experiment, it is just experiment and the efficiency of experiment is very low. Thus, I proposed the new transmutation reactor based on bond compression for transmutation based on the cold fusion mechanism of covalent bond compression to reach element-115. Because the currently available technology cannot realize this compression mechanism, I hope researchers will study and develop the transmutation reactor of the covalent bond compression.

ACKNOWLEDGMENT

I would like to thank Vavra Jerry and Jean-Luc Paillet for useful discussions on EDO.

REFERENCES

[1.] M. Fleishmann, S. Pons, electrochemically induced nuclear fusion of deuterium, J. Electroanal. Chem. 261 (1989) 301-308, Also available from http://www.tuks.nl/pdf/Reference_Material/Cold_Fusion/Fleischmann%20and%20Pons%20-%20Electrochemically%20induced%20nuclear%20fusion%20of%20deuterium%20-%201989.pdf

[2.] N. Kodama, Novel Cold Fusion Reactor with Deuterium Supply from Backside and Metal Surface Potential Control, International Journal of Innovative Science and Research Technology, Volume 6, Issue 6, June, 2021,Also available from https://www.researchgate.net/publication/352694771_Novel_Cold_Fusion_Reactor_with_Deuterium_Supply_from_Backside_and_Metal_Surface_Potential_Control

[3.] N. Kodama, Cold Fusion Mechanism of Bond Compression, International Journal of Innovative Science and Research Technology, Volume 6, Issue 8, August,2021,Also available from https://www.researchgate.net/publication/353996590_Cold_Fusion_Mechanism_of_Bond_Compression

[4.] N. Kodama, Mechanism of Cold Fusion with Nano Metal-Particles and Conceptualized Reactor to Control the Nano Metal Particle Potential, International Journal of Innovative Science and Research Technology, Volume 6, Issue 8, August, 2021,Also Available from https://www.researchgate.net/publication/354142363_Mechanism_of_Cold_Fusion_with_Nano_Metal-Particles_and_Conceptualized_Reactor_to_Control_the_Nano-_Metal_Particle_Potential

[5.] N. Kodama, Neutron to be Tightly Bound Proton-Electron Pair and Nucleus to be Constituted by Protons and Internal Electrons, International Journal of Innovative Science and Research Technology, Volume 6, Issue 5, May, 2021, Also available from https://www.researchgate.net/publication/352284102_Neutron_to_be_Tightly_Bound_Proton-Electron_Pair_and_Nucleus_to_be_Constituted_by_Protons_and_Internal_Electrons

[6.] T. Yamamoto, D. Zeng, T. Kawakami, V. Arcisauskaite, K. Yata, M.A. Patino, N. Izumo, J.E. McGrady, H. Kageyama, M.A. Hayward, The role of πblocking hydride ligands in a pressure-induced insulator-to-metal phase transition in SrVO2H, Nature

Comm. 8 (2017). Also available from https://repository.kulib.kyoto-u.ac.jp/dspace/bitstream/2433/227748/1/s41467-017-01301-0.pdf https://www.jst.go.jp/pr/announce/20171031/index.html

[7.] J. Maly and J. Va'vra, Electron transitions on deep Dirac levels I, Fusion Technol., 24 (1993) 307-318. Also available from https://www.tandfonline.com/doi/abs/10.13182/FST93-A30206. [31]. J. A. Maly, J. Vavra, Electron transitions on deep Dirac levels II, Fusion Technol. 27 (1995) 59-70. Also available from https://www.jstage.jst.go.jp/article/oubutsu1932/60/3/60_3_220/_article

[8.] J. A. Maly, J. Vavra, Electron transitions on deep Dirac levels II, Fusion Technol. 27 (1995) 59-70. Also available from https://www.tandfonline.com/doi/abs/10.13182/FST95-A30350?journalCode=ufst19

[9.] J. Va'vra, ON a possibility of existence of new atomic levels, which were neglected theoretically and not measured experimentally. Available from https://www.slac.stanford.edu/~jjv/activity/DDL/1_st_talk_siegen.pdf

[10.] A. Meulenberg, K. P. Sinha, EDOs, J. Condens. Matter Nucl. Sci. 13 (2014) 368–377. Also available from http://coldfusioncommunity.net/wpcontent/uploads/2018/07/368_JCMNS-Vol13.pdf. [27

[11.] J. Va'vra, A simple argument that small hydrogen may exists, Phys. Lett. B, 794 (2019) 130-134. Also available from https://www.sciencedirect.com/science/article/pii/S0370269319303624 https://arxiv.org/ftp/arxiv/papers/1906/1906.08243.pdf

[12.] J.L. Paillet, On highly relativistic deep electrons, J. Condens. Matter Nucl. Sci. 29 (2019) 472–492. Also available from https://www.vixra.org/pdf/1902.0398v1.pdf.

[13.] J.-L. Paillet, A. Meulenberg, Basis for EDOs of the hydrogen atom, Proc. 19th International Conference on Condensed Matter Nuclear Science, Padua, Italy, 13-17 April 2015. Also available from https://www.researchgate.net/publication/312488578_Electron_Deep_Orbits_of_the_Hydrogen_Atom

[14.] J. Maly and J. Va'vra, Electron transitions on deep Dirac levels I, Fusion Technol., 24 (1993) 307-318. Also available from https://www.tandfonline.com/doi/abs/10.13182/FST93-A30206

[15.] J. A. Maly, J. Vavra, Electron transitions on deep Dirac levels II, Fusion Technol. 27 (1995) 59-70. Also available from https://www.tandfonline.com/doi/abs/10.13182/FST95-A30350?journalCode=ufst19

[16.] J. Va'vra, On a possibility of existence of new atomic levels, which were neglected theoretically and not measured experimentally, presented at Siegen University, Germany, November 25, 1998. Available from https://www.slac.stanford.edu/~jjv/activity/DDL/1_st_talk_siegen.pdf

[17.] J. Va'vra, A new way to explain the 511 keV signal from the center of the Galaxy and some dark matter experiments, ArXiv: 1304.0833v12 [astro.ph-IM] Sept. 28, 2018. Available from https://www.slac.stanford.edu/~jjv/activity/dark/Vavra_small_hydrogen_atom_2018.pdf

[18.] J.-L. Paillet, A. Meulenberg, Highly relativistic deep electrons and the Dirac equation, J. Cond. Matter Nucl. Sci. 33 (2020) 278–295. Also available from https://www.academia.edu/41956585/Highly_relativistic_deep_electrons_and_the_Dirac_equation

[19.] Z.L. Zhang, W.S. Zhang, Z.Q. Zhang, Further study on the solution of schrödinger equation of hydrogen-like atom, Proc. 9th International Conference on Cold Fusion, May 21-25, 2002, Beijing, China, pp. 435-438. Available from https://www.lenrcanr.org/acrobat/ZhangZLfurtherstu.pdf.

[20.] J.L. Paillet, A. Meulenberg, EDOs of the hydrogen atom, J. Condens. Matter Nucl. Sci. 22 (2016) 1–23. Also available from https://www.researchgate.net/publication/312488578_Electron_Deep_Orbits_of_the_Hydrogen_Atom

[21.] A. Meulenberg, Deep-orbit-electron radiation absorption and emission, Available From https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/36501/DeepOrbitElectronRadiationAbstract.pdf?sequence=1&isAllowed=y

[22.] A. Meulenberg, J.L. Paillet, Implications of the EDOs for cold fusion and physics–deep-orbit-electron models in LENR: Present and Future, J. Condens. Matter Nucl. Sci. 24 (2017) 214–229, Also available from http://coldfusioncommunity.net/pdf/jcmns/v24/214_JCMNS-Vol24.pdf

[23.] J. Chadwick, Possible existence of a neutron. Nature, v129 (3252), 312, 1932 https://doi.org/10.1038/129312a0

[24.] Y. IWAMURA, T. ITOH, M. SAKANO, S. SAKAI, S. KURIBAYASHI, Low Energy Nuclear Transmutation In Condensed Matter Induced By D2 Gas Permeation Through Pd Complexes:Correlation Between Deuterium Flux And Nuclear Products, in Tenth International Conference on Cold Fusion. 2003 https://www.lenr-canr.org/acrobat/IwamuraYlowenergyn.pdf

[25.] J. Va'vra, On a possibility of existence of new atomic levels, which were neglected theoretically and not measured experimentally. Available from https://www.slac.stanford.edu/~jjv/activity/DDL/1_st_talk_siegen.pdf.

[26.] A. Meulenberg, K. P. Sinha, EDOs, J. Condens. Matter Nucl. Sci. 13 (2014) 368–377. Also available from https://www.researchgate.net/publication/312488578_Electron_Deep_Orbits_of_the_Hydrogen_Atom

[27.] A. Meulenberg, Femto-atoms and transmutation, 17th Int. Conf. on Condensed Matter Nuclear Science (ICCF-17), Daejeon, 2012. Also available from http://coldfusioncommunity.net/wpcontent/uploads/2018/07/346_JCMNS-Vol13.pdf

[28.] Potassium channels. Available from http://pdb101.rcsb.org/motm/38.

[29.] Gap junction. Available from https://en.wikipedia.org/wiki/Gap_junction.
[30.] Na^+ /K^+ ATPase. Available from https://en.wikipedia.org/wiki/Na%2B/K%2B-ATPase
[31.] Shinichi Nakao, Akabane Noboru, Success in developing a high-performance ceramic hydrogen separation membrane module. Also available from https://www.jfcc.or.jp/press/r070629.html general Incorporated Foundation, Japan Fine Ceramics Center, 2007/06/29 in 2007 Fine Ceramics Center Research Forum
[32.] Does the Real Element 115 Have a Connection With UFOs? Also available from https://science.howstuffworks.com/space/aliens-ufos/element-115.htm