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Conceptualized D_2O Cold Fusion power generator with steam turbine

Noriyuki Kodama
Independent researcher,
Noriyuki.kodama.0820@gmail.com

***Abstract*— Fleischmann and Pons discovered that cold fusion occurs at cathode Pd in strong alkaline D_2O in ref [1]. However, this experiment setting is not based on the mechanism of Cold Fusion because Cold Fusion needs the positive metal potential. Due to the incorrect setting of Pd voltage, heat generation is very low because D^+ concentration is many orders of magnitude lower than OD^- concentration. The rough estimation shows that the reaction can be increased by about 8 orders of magnitude from PH = 3 and PH = 11, and experimental data shows the 3cm^2 Pd plate can generate the heat of W, thus, 1GW need the total surface area of only 9m^2, as reported in ref [2]. Because The trigger of Conventional D_2O Cold Fusion is very difficult due to the high heat conductance to D_2O to cool the heating Pd, we must develop the new Cold Fusion power generating system with steam turbine. Power generator of D_2O Cold Fusion heat generator with steam turbine can be trigger Cold Fusion effectively due to the steam condition with pressure of 24.5 MPa on D_2O to rase the D_2O temperature to 600°C. Thus, D_2O Cold Fusion can be triggered with design optimization of steam turbine and triggering system.**

Thus, I would like to propose that the development of this D_2O Cold Fusion power generator with steam turbine in order to replace heat generator of nuclear fission in nuclear power-plant.

Keywords*—*LENR, ColdFusion, LiOD, D_2O, Steam trubine,

I. INTRODUCTION

Fleischmann and Pons discovered that cold fusion occurs at cathode paradigm, in strong alkaline D_2O in ref [1].

I have reported the correct Cold Fusion heat generator based on the mechanism of Cold fusion in ref [2] and [3], which show that heat generating metal need to be positive potential as is reported. however, the most D_2O Cold Fusion reactors have not based on the mechanism of Cold Fusion, with cathode Pd and anode Pt since the Fleischmann and Pons reported the cold fusion, heating metal have been cathode (negative voltage) in ref [1].

II. COLD FUSION MECHANISM

A. Expandable T site and positive potential for Cold Fusion

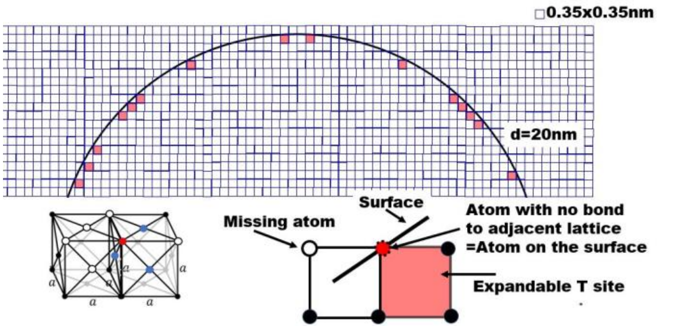


Fig.1 Expandable T site to compress D_2 molecules

Cold Fusion occurs at the Pd surface with nano-roughness. Such surface has the expandable T site which vertex atom of T site of FCC lattice structure, that vertex atoms on the surface with nano-roughness has no bond to the adjacent atom.

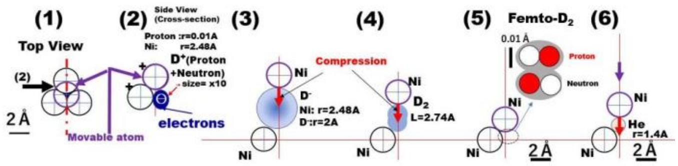


Fig.2 Compression of D_2 at expanded T site

Because T site atom tends to emit electron to the center of T site, where the space is charged negatively as is shown in Fig.2(2), surrounding D^+ is attracted by the negative charge and to be D^-, and due to the larger size of D^-, it expands the T site as is shown in Fig2(3). And D^- attract another D^+ to be D_2 molecules as is shown in Fig.2(4). Compression of D_2 covalent electron of D_2 transits electron of n=1 to Deep electron orbit as is shown in Fig2(5). Because the distance of deep electron orbit from the nucleus is a few femto meters as is shown in Fig2(5), it can shield the coulomb repulsive force between d-d and cause Cold Fusion.

B. **Expandable T site on the grain boundary improves the reaction rate**

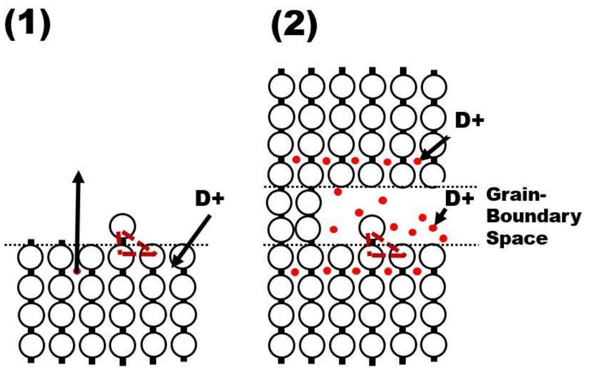


Fig.3 (1) Conventional Cold Fusion Reactor (2) improved Cold fusion reactor by deuterium confined in metal grain boundary in ref [4].

Due to the geometrical model of hydrogen on the hydrogen loading of neutral D into metal is impossible due to the larger size of D, thus, positive potential is needed for D to be d, polycrystalline Pd has the grain-boundary and the sidewall surface of grain-boundary has the many expandable T site, and D can be segregated as d with positive Pd potential to improve the reaction rate drastically.

III. D_2O COLD FUSION REACTOR WITH STRONG ALKALINE D_2O

A. **Fleischmann and Pons experiment in strong alkaline D_2O**

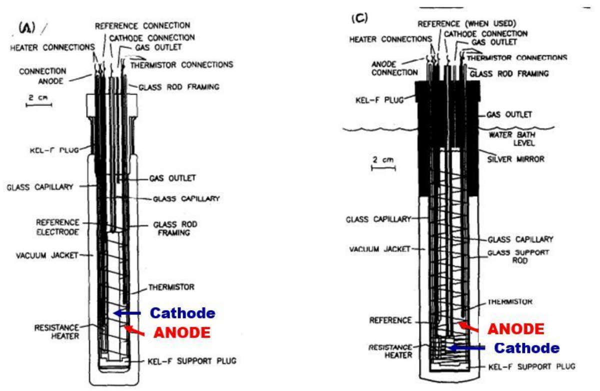


Fig.4 Experimental setup by Fleischmann and Pons [1]

In FIG.3, the wire anode is arranged so that the cathode of Pd metal plate is surrounded by wire anode.

B. ***Trigger of Fleischmann and Pons Effect in ref[3]***

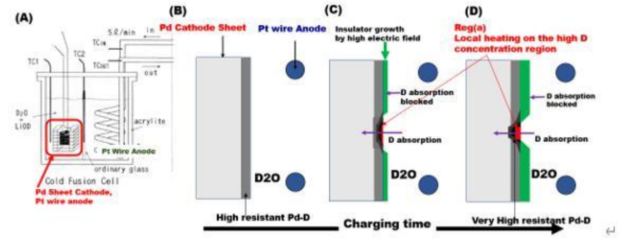


Fig. 5 Fleishmann and Pons Effect experiment [3]

I discovered the mechanism of Cold Fusion trigger for FPE in ref [3]. As is shown in Fig.4, the resistivity increases with longer D charging time, and insulator layer growth on the cathode in electrolysis condition on the negative electrode. Because of wire anode, the coverage of this insulating layer must have the variation of thickness with current is just through the uncovered region with insulator and current becomes lower, the voltage increases to keep the constant current, and local heat generation on the region of current path to trigger D_2O Cold Fusion. Therefore, it is impossible to use this mechanism in D_2O Cold Fusion heat generator.

C. ***Hydrogen loading into Pd in ref [2]***

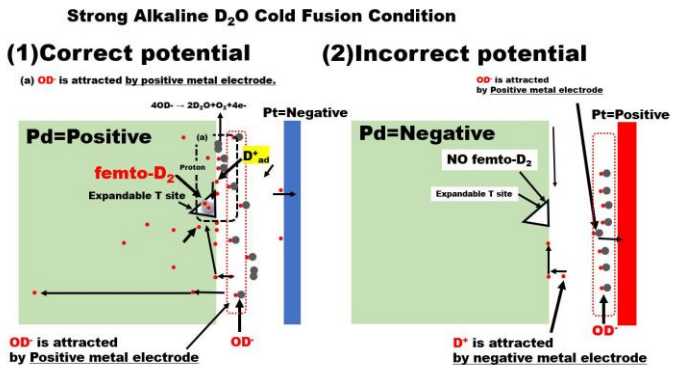


Fig.6 metal potential and D+ loading

Because Cold Fusion needs the D^+ loading into Pd, Pd potential need to be positive. D^+ is by far smaller than space of metal atoms, and it can occupy at the space site of the metal and in case that metal potential is positive, D^+ can exist inside the metal due to this geometrical model of hydrogen.

The following equation shows that strong alkaline conditions, $[D^+]$ becomes very small, and it takes a very long time for palladium to fully absorb deuterium into negative Pd. $[D^+] * [OD^-] = 1.0 \times 10^{-14}$ (mol/L)2(ionic product of heavy water) . If PH = 11, $[D^+] = 10^{-11}$ mol/l and $[OD^-] = 10^{-3}$ mol/l. thus $[OD^-]/[D^+]=10^{-3}/10^{-11}=10^8$ times.

D. Summary of latest D_2O Cold Fusion Reactor

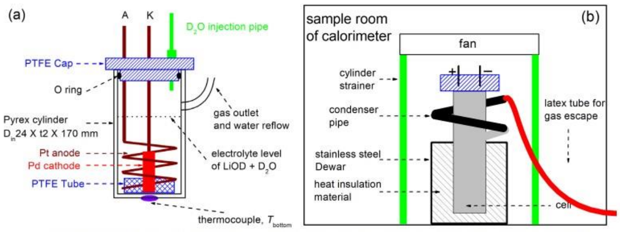


Fig.7 Schematics of Pd-D_2O reflux open-electrolytic cell (a) and the cell with calorimetric attachment (b). in ref [5]

As is shown in Fig.6(a), Pd cathode and Pt anode are incorrect up to 2023.

Table 2. Summary of excess heat in the Pd(Pt)-D_2O+LiOD open-electrolytic cell from 2018 to 2019.

Exp. #	Integrated values $I \times t$ A × h	Q_{in} kJ	Q_{ex} kJ	$\bar{P}_{ex}$ mW	Steady values I mA	P_{in} W	P_{ex} mW	T_{bottom} °C	T_{up} °C	P_{vapor} mW
180911Pt	0.17×48	148.89(33)	−0.49(71)	−2(3)	171	0.381(1)	6(2)	48	NA	NA
	0.34×24				340	0.942(2)	−19(3)	73	NA	NA
181005Pt	0.17×60	114.68(30)	0.35(60)	2(3)	171	0.521(1)	12(3)	51	41	4
					171	0.539(3)	−1(3)	53	42	5
181017Pt	0.17×60	125.69(35)	0.64(63)	3(3)	171	0.578(2)	2(2)	48	39	4
					171	0.573(1)	7(2)	50	39	4
190414Pt	0.17×60	134.83(14)	−0.27(80)	−1(4)	170	0.614(2)	−7(3)	52	40	4
					170	0.638(2)	−4(3)	55	40	4
190502Pt	0.17×60	139.021(14)	−0.23(80)	−1(4)	171	0.638(1)	0(3)	51	41	4
					171	0.631(1)	5(3)	51	41	4
190507Pt	0.34×54	322.23(15)	−0.74(76)	−4(4)	341	1.566(2)	3(3)	76	63	31
190513Pt	0.51×19	239.50(7)	6.32(32)	92(5)	511	3.075(16)	178(20)	93	87	252
190816Pt	0.51×36	191.98(10)	−0.73(56)	−6(4)	511	1.423(4)	5(4)	72	52	25
					511	1.500(3)	5(3)	74	53	26
190904Pd3	0.15×24	188.77(10)	−6.71(52)	−78(6)	148	2.029(115)	−65(117)	82	67	17
					148	2.216(111)	−97(111)	87	69	20
190909Pd3	0.34×22	120.30(5)	−0.27(53)	−3(7)	340	1.207(38)	9(10)	69	50	15
190920Pd3	0.31×60	483.64(17)	−4.58(268)	−21(12)	228	1.522(97)	−24(119)	78	52	11
					228	2.006(59)	36(86)	85	63	21
191005Pd3	0.51×24	191.98(8)	1.64(134)	19(16)	511	2.212(13)	32(27)	78	65	52
191007Pd3	0.55×48	543.64(15)	14.79(220)	86(13)	550	3.060(15)	132(50)	87	76	118
					550	3.381(44)	88(44)	87	77	125
191010Pd3	0.47×48	619.40(17)	20.63(225)	119(13)	541	4.081(15)	182(33)	90	83	190
					360	3.317(24)	46(19)	84	71	55

* Meanings of symbols: I, electrolysis current; t, electrolysis time; Q_{in}, input energy; Q_{ex}, excess heat; P_{ex}, excess power; T_{bottom}, cell-bottom temperature; T_{up}, cell-up temperature; P_{vapor}, evaporation power of heavy water at T_{up} [1,2,5–8].

Fig.8 Summary of excess heat in the Pd (Pt)-D2O+LiOD open-electrolytic cell from 2018 to 2019 in ref [5].

The above reference [5] is a paper presented at ICFF-23, a conference held in 2021, but the electrode potential conditions in the LiOD + D_2O electrolyte are Pd as the cathode and Pt as the anode, are still incorrect.

This is because none researchers have not understood the correct mechanism of Cold fusion presented by my previous papers. [3]

Ref[5] mentions that the anode and its leads are a Pt wire of φ0.5 mm × 1.4 m (99.95%, GRINM, Beijing), and the cathode is Pd as listed in Table 1 or Pt foil of ~ 3.4 cm2 (99.95%, GRINM, Beijing).**Therefore, cold fusion can be triggered in palladium with ~3cm^2**

Under the summary of heat generation in Fig.7, P $_{Vapor}$ is 0 to 190 mW, which is extremely small.

Estimated P $_{vapor}$ with correct potential setting is estimated to be as high as 10^5 W = 100 kW with ration of 10^8.

Because the size of the experimental set-ups is very small and desk-top type reactor, proper design of D_2O cold Fusion Reactor can produce can generate very large amount of heat. **The heat generation efficiency per area is estimated to be 100kW/3cm^2, is by far higher than plasma fusion reactor.**

IV. COLD FUSION POWER GENETOR WITH STEAM TURBINE

A. D_2O Cold Fusion heat generator with steam turbine

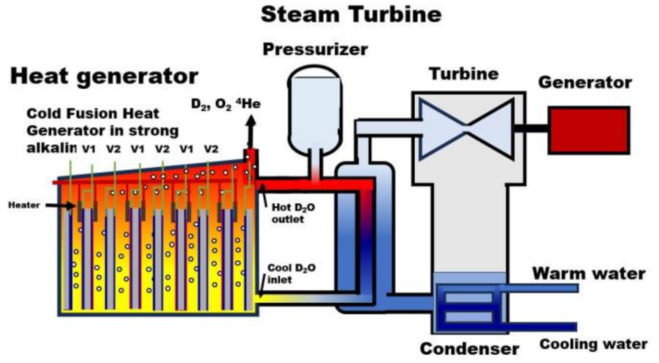
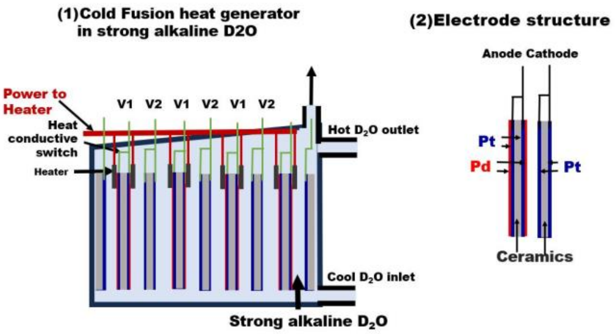


Fig.9 D_2O Cold Fusion Heat generator combined with steam turbine

A steam turbine is a prime mover that extracts power from the thermal energy of steam through the rotation of an impeller. Nuclear power plants and thermal power plants use nuclear reactors or boilers to generate steam, and a generator is connected to a steam turbine to generate electricity. Thermal power plants generate electricity using steam turbines using fuel such as LNG, oil, or coal. Currently, thermal power generation that uses only steam turbines has a maximum thermal efficiency of 43%, and **the steam conditions are a temperature of 600°C and a pressure of 24.5 MPa (245 atmospheres).** This condition is when the water exceeds its critical point and the water changes directly to steam without boiling, and the steam turbine is called a supercritical pressure turbine.

B. Trigger Cold Fusion by local heating



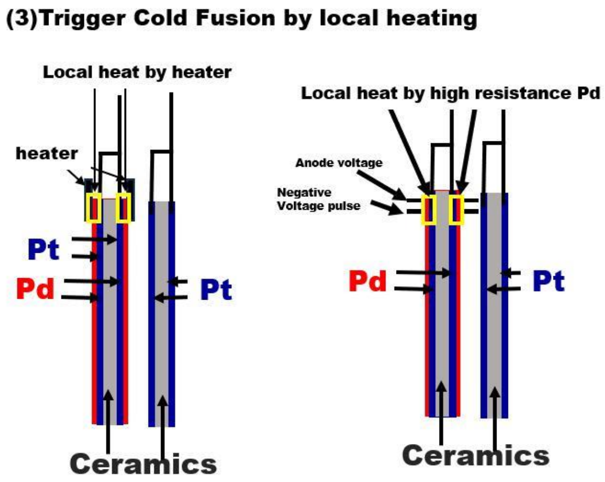


Fig.10 D_2O Cold Fusion Heat generator

Because steam conditions are a temperature of 600°C and a pressure of 24.5 MPa (245 atmospheres), steam turbine enables the trigger of Cold Fusion due to its high temperature of steam at high pressure.

Without steam turbine, boiling temperature of D_2O is so low, the Pd temperature cannot reach the trigger temperature of Cold Fusion(700℃), with the heat conductance to D_2O.

By conventional heater or IR pulse on high resistance Pd layer can create local heat on the contact region of the heater as is shown in Fig. 7 (3) in steam turbine condition. Once the trigger of Cold Fusion on the local area, it can spread the whole area of Pd.

In order to control the high resistive Pd layer, Pd layer is deposited on Pt layer to control the potential of Pd layer as is shown in Fig7(2). And narrow volume of metal (Pd/Pt on ceramics), can saturate D in the metal layer for the fast trigger of Cold Fusion and increase the reaction rate of Cold Fusion.

C. Total area for 1GW power generation

Estimated heat generation efficiency per area with anode Pd and cathode Pt is 100kW/3cm2 as in Fig.2 and Fig.3. 1GW need the total surface area of Pd is 9m2.
Because D_2O Cold Fusion need steam turbine, which size is larger, the target power generation need to be as large as nuclear power plant pr plasma fusion power plant.

To trigger the large area effectively, the area needs to be divided to raise the Pd temperature up to the trigger temperature.

Author would like to propose the development of D_2O Cold Fusion heat generator to replace nuclear fission power generator to use nuclear power plant system in order to abolish the nuclear fission power generator of the current nuclear power plant.

V. SUMMARY

Current D_2O Cold Fusion Reactor has incorrect metal potential setting. Heat generating metal need to be positive based on the Cold Fusion mechanism.

Steam turbine enables the Trigger of Cold Fusion Cold Fusion to generate the 1GW power plant, and D_2O Cold Fusion heat generator can be replaced with heat generation (nuclear fission heat generator) in nuclear power plant.

Since it is possible to effectively utilize the power generation system of a nuclear power plant, D_2O Cold Fusion heat generator is desirable in order to abolish nuclear fission heat sources.

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