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Conceptualized Transmutation Reactor to Mass-Produce Helium-3 and Precious Metals

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Abstract:- I would like to propose the development of a large-scale transmutation reactor with femto-H_2.

Femto-D_2 transmute element was probed by experiment, and Cold Fusion can be caused by femto-D_2 because femto-D_2 has the covalent electrons which orbit is in deep electron orbit deeper than n=1 at a few femto-meters from the nucleus. Because femto-D_2 has so dense electron between d-d, the density of electron between d-d that it can shield the coulomb repulsive force between to cause Cold Fusion.

Brown gas generator is also the transmutation reactor which transmute proton in H_2O to helium-3, thus brown gas a mixed gas of hydrogen, oxygen, helium-3.

Mr. Ohmasa developed Ohmasa gas generator, improved brown gas generator with vertical vibration of the lateral metal plate to generate brown gas, which he named OHMASA gas. Ohmasa gas has higher concentration of helium-3 than conventional brown gas by the vibration.

He also experimentally proved that brown gas generator can transmute tritium and other radioactive element to saver element, and we should note that he produced Ag, Pt, Au from Cu, Cs, Mg, which is a modern alchemy experimentally.

I discovered the rout between such elements by transmutation route analysis based on my femto-H_2 transmutation mechanism.

Femto-H_2 add two protons to the isotope which mass number and atomic increases by 2. In case that that isotope is unstable, it decays to the previous element by electron capture, and in case that that isotope is unstable it decays to the original element with mass increase by 2.

If these steps are repeated, the transmutation route is on the isotopes on smaller mass number side. Therefore, the number of routes is limited.

Based on the transmutation route analysis, I would like to propose the conceptualized transmutation reactor to mass-produce precious elements. Transmutation reactor needs to have the mechanism to improve the element collection to improved transmutation rate. The Conceptualized Transmutation Reactor have the H_2O vibration laterally to the lateral metal plate by ultrasonic transducers, and it has a rapid circulation from transmutation chamber to metal collection chamber, which has the metal plate which voltages are applied negative and ground for the metal precipitates on the negative metal plates. This metal plates collect all of the precious metals. Conceptualized transmutation Reactor has the mechanism to collect Cd and Hg gas in the separate chamber to collect Ag and Au which are the decay product of Cd and Hg respectively.

Keywords:- *Brown's Gas, HHO, Transmutation, Cold Fusion, Femto-H_2, Femto-D_2, Alchemy*

I. INTRODUCTION

I discovered though the logical thinking that brown gas generator transmute proton in H_2O to generate helium-3, which reminded me of the patents published by Mr. Ohmasa.

In his patent, he experimentally proved that his brown gas generator can lower the tritium concentration in tritium contaminated water from Fukushima nuclear power plant, and it can produce Ag, Pt, Au from Cu and Cs, and Ni from Ca.

We have problems regarding the depletion of rare elements as follows.

Now helium-4 is becoming depleted, which is having a significant impact on various fields such as manufacturing equipment used in the semiconductor industry and medical applications. The helium shortage has also begun to affect medical care. Some medical center stopped using its MRI for the brain testing due to lack of helium.

Helium-3 is used to cool down the quantum computer by $^3He/^4He$ dilution refrigerator, however helium-3 is also becoming depleted because it is the decay product from tritium, which was produced in the past as fuel for hydrogen bombs, and is obtained by decaying stored tritium into helium-3 (half-life 10 years). For now, no hydrogen bomb is created, and the storage of tritium is running out.

Helium-3 will be used for the fuel for plasma fusion, and US has a plan to build the moon base to generate helium-3 from the sand on the moon and transport helium-3 to the ground to use as an energy source.

Price of the platinum group, has increased. In particular, prices of palladium and rhodium, which account for more than 80% of the demand and are used in exhaust gas purification catalysts for automobiles (mainly gasoline-powered vehicles), have increased significantly in recent years.

Current industry needs these rare elements, and it is certain that these rare elements will be in short supply in the future. Therefore, it is now important to start the development of a transmutation reactor to mass-produce these rare elements.

II. BACKGROUND

A. Cold Fusion Mechanism by Femto-D2[1],[2],[3]

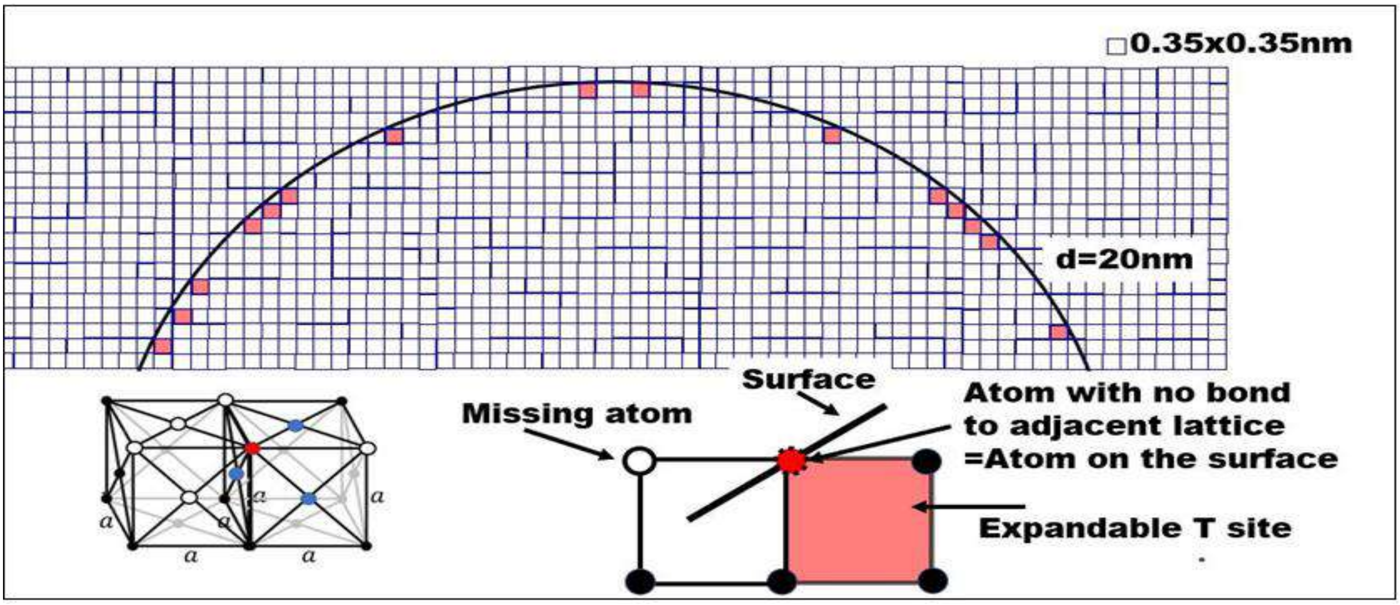

Fig 1 Expandable T Site on the Metal Surface with Nano-Roughness.

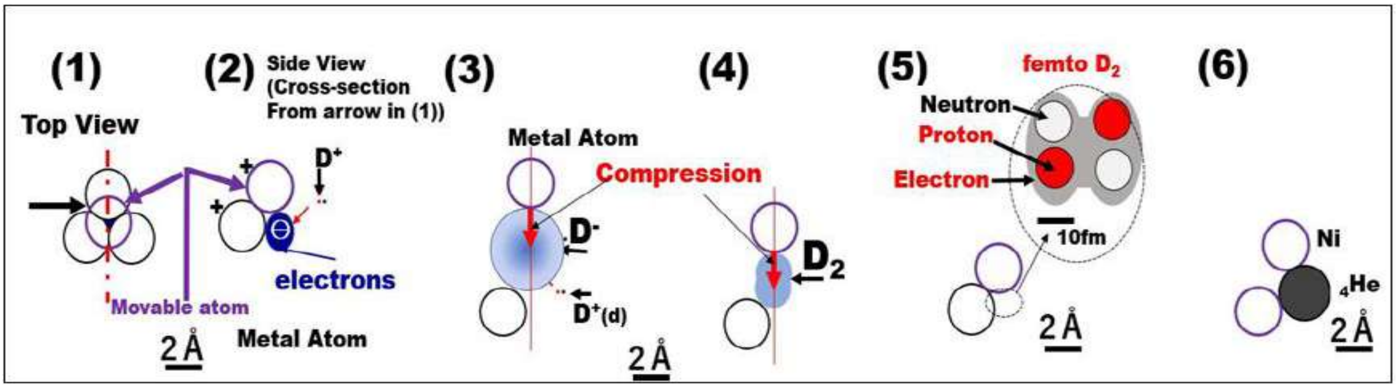

Fig 2 Mechanism of Femto-D_2 Creation

On the metal surface on the sidewall of grain-boundary, expandable T site exists, which can be expanded by occupying a negative deuterium which size is by far larger than T site because vertex atom in that site has no bond to the atom in the adjacent lattice, thus atom can move by a negative deuterium occupation; Thus, I named that site, expandable T site. The negative deuterium attracts a negative deuterium to be D_2, which is compressed by expandable T site, to be femto-D_2, which can cause Cold Fusion by coulomb repulsive force shielding between covalent electron in deep orbit, as is shown in Fig.2 (5). Because femto-D_2 acts as neutral particles by electron in deep orbit, it fuses with another nucleus.

The mechanism of femto-H_2 creation is the same as femto-D_2 creation; femto-H_2 can be created with H loading into metal with FCC lattice structure with positive voltage in a strong alkaline aqueous solution. Positive voltage is needed because proton(H^+) exists at grain boundary at positive voltage and because negative voltage induces the free electron which shield coulomb attractive force between protons.

B. Transmutation with Femto-D_2 [4]

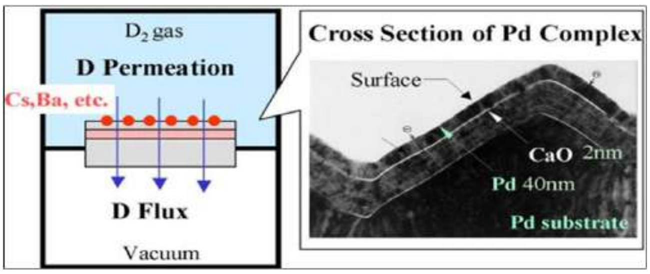

Fig 3 Transmutation Experiment with Femto-D_2 by Iwamura

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Transmutation experiment used femto-D_2 with D_2 gas loading into Pd. This is innovative experiment of transmutation based on Cold Fusion.

This experiment's result shows that increase of atomic number is 4 by one femto-D_2 fusion with the target nucleus, thus, d=2, which means that d is constituted by two protons and one internal electron, which is contradictory to the current nucleus model.

C. Correct Nucleus Model and Neutron Model Proved by Transmutation Experiment [5]

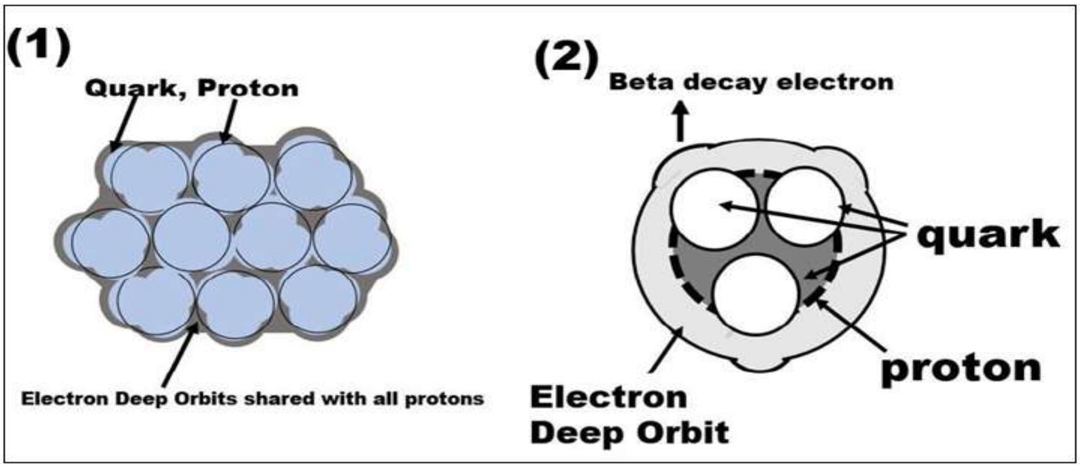

Fig 4 Correct Nucleus Model and Neutron Model

Although d is believed to be a pair of proton and neutron based on current nucleus model, d is proved to be constituted by two protons and one internal electron by transmutation experiment explained above. As is shown in Fig.4(1), The nucleus is constituted only by protons and internal electrons, and no neutron exists; neutron is a pair of proton and electron in deep orbit as is shown in Fin.4(2). This is the nucleus model before introduction of neutron as a fundamental particle.

In order to prove author's Cold Fusion mechanism based on femto-D_2, transmutation experiment with femto-H_2 is straightforward without any doubt that proton is proton.

D. Brown Gas Generator[3]

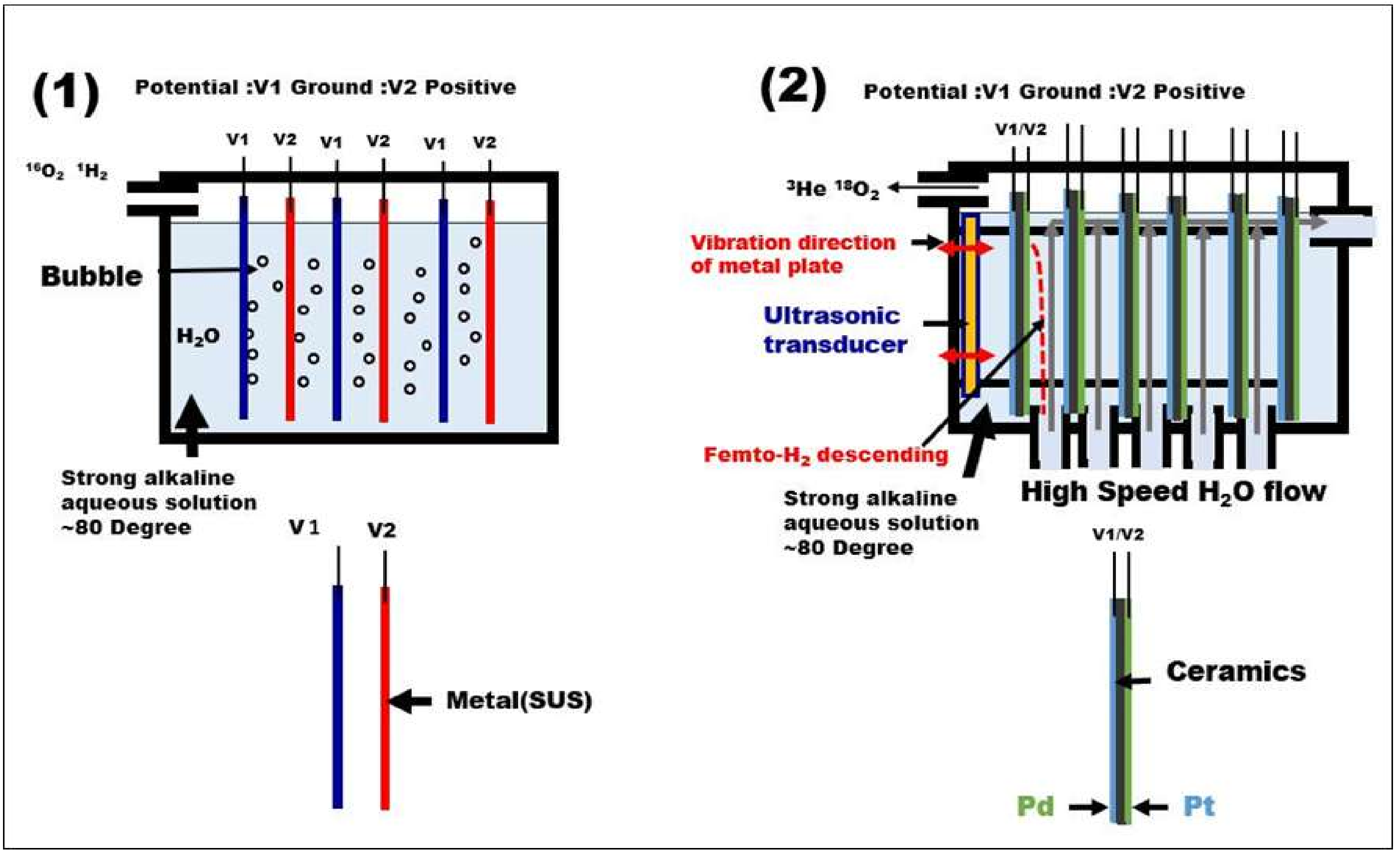

Fig 5 Conceptualized Brown Gas Generator [3]

Conventional brown gas generator in Fig.5 (1) is just electrolyzer, and it may have unintentional vibration of the reactor and may have unintentional H_2O flow which happened to generate femto-H_2 and produce brown gas. Real brown gas generator should be based on femto-H_2 transmutation mechanism shown in Fig.5 (2), which has the controlled vibration laterally and H_2O flow from down side to upside. Transmutation of H2O is as follows.

- p+2p(femto-H_2) $= {}^{3}_{3}Li = {}^{3}_{2}He$ (electron capture)
- ${}^{16}_{8}O$+2p(femto-H_2) $= {}^{18}_{10}Ne \Rightarrow {}^{18}_{9}F \Rightarrow {}^{18}_{8}O$ (electron capture)

Currently most researchers and companies believe that brown gas is HHO that has a special form of Hydrogen and oxygen, it is because the mass-spectra has a peak at mass 18, which is actually oxygen-18, but everyone thought that it is HHO which mass is 18.

III. TRANSMUTATION RULES

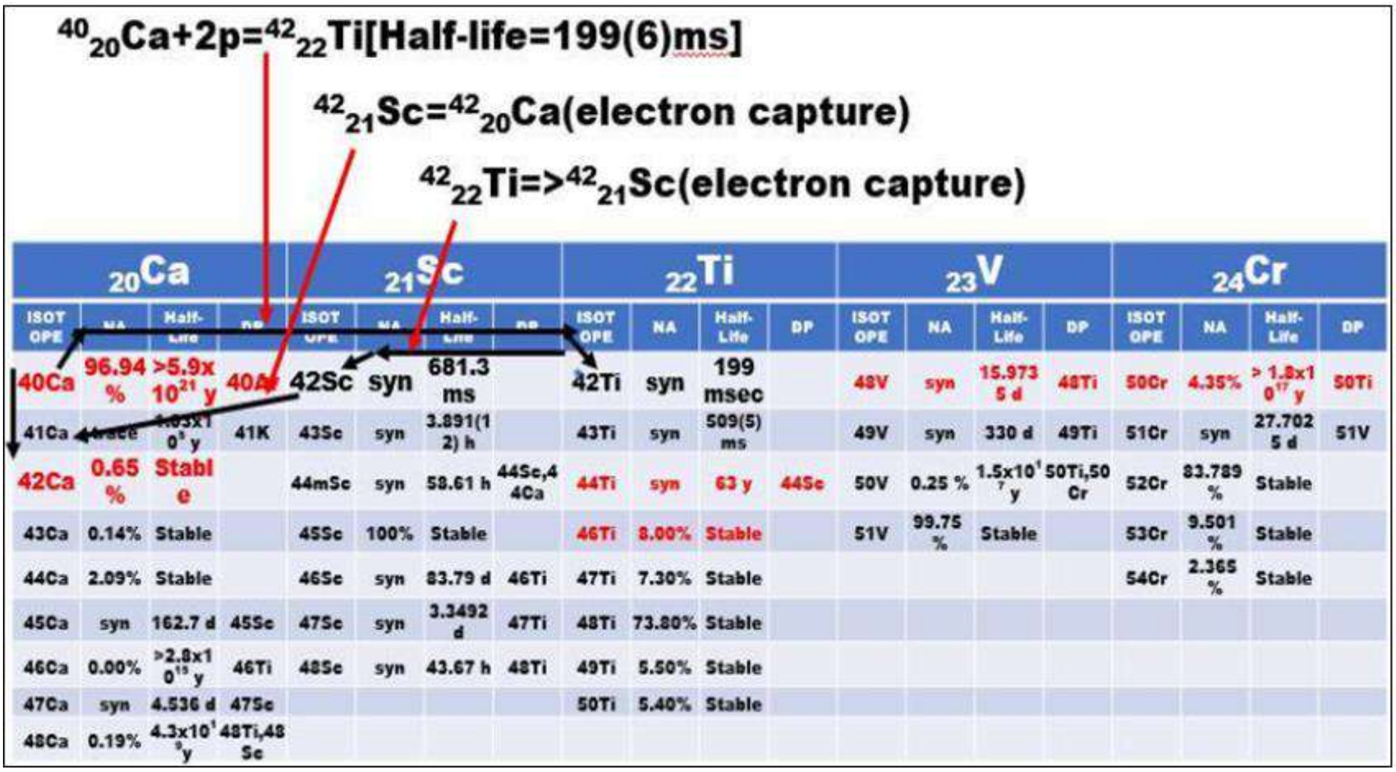

Fig 6 Transmutation Rule with Femto-H_2

I would like to explain the transmutation rule and transmutation route.

Femto-H_2 created at positive metal electrode at the grain boundary of Pd with FCC lattice structure, or stainless steel with FCC lattice structure. Because femto-H_2 act as neutral particles to fuse with another nucleus to transmute the isotope. Strictly speaking it can just increase the mass number in the same element, which is not the transmutation strictly speaking.

As is shown in Fig.6, femto-H_2 add two protons to the isotope of ${}^{40}_{20}Ca$, femto-H_2 fusion is

$${}^{40}_{20}Ca+2p={}^{42}_{22}Ti,$$

Which half-life is 199msec, and I hypothesized that isotopes not listed in Wikipedia have extremely short half-lives compared to the rate of transmutation speed. Probable half-life longer than a few days is in the Wikipedia table.

And electron capture stabilizes the nucleus;

${}^{42}_{22}Ti \Rightarrow {}^{42}_{21}Sc$, which has shorter half-life,

And again, electron capture,

${}^{42}_{21}Sc \Rightarrow {}^{42}_{20}Ca$, which is the same element with mass increase by 2.

This procedure repeated, the transmutation rout is on the isotope with smallest mass number, as is shown in Fig.6, ${}^{43}_{23}V$ and ${}^{50}_{24}Cr$.

In terms of results, author thinks that the shorter half -life is defined correctly in Wikipedia's table is a valid hypothesis because it explained transmutation route of Ohmasa's experiments, however to be more precise, we should calculate the transmutation speed and consider isotopes with longer half-lives. I would like to leave this as a future topic.

Ohmasa added D_2O or used tritium contaminated water to improve transmutation rate. The larger size of d and tritium nucleus than proton can cause larger fusion rate. It can improve the transmutation rate per reaction.

And larger number of protons improve the transmutation rate per elements.

These methods make transmutation so complicated and it can have the diverse generated isotopes, but it will work to have shorter speed of metal production. Ohmasa insists that transmutation with tritium contaminated water nuclear enable the efficient metal production and transmutation simultaneously because tritium enable faster transmutation.

Author thinks that it is possible but not indispensable because it is not so convenient to produce the desired isotopes.

What we can generate is so limited for mass-production, usually isotope with smaller mass number tends to be non-stable isotope though it has very long half-life for the actual use. Because stable Ag and Au has odd mass number, the starting isotopes must have odd mass number, which elements are so limited. Among the candidate, Cu seems to be the best, and other options are discussed in VIII.

IV. TRANSMUTATION FROM CA

The relevant experiments in the embodiments By Ohmasa are described in the patents below and I will show the transmutation route to the desired elements in these embodiments based on my femto-H_2 transmutation mechanism.

P2015-55527A; patent application [6]

P2022-23989A; patent application [7]

A. Embodiment-6(p2015-55527A)

Table 1 Transmutation from $_{20}Ca$

P2015-55527A Embodiment-6	Concentration before	Concentration after
date	2013.08.13	2013.09.02
Process time		20days
$_{20}$Ca	2800mg/L	1800mg/L
$_{26}$Fe	<10μg/L	770μg/L
$_{27}$Co	1μg/L	270μg/L
$_{28}$Ni	12μg/L	14000μg/L
$_{29}$Cu	3μg/L	370μg/L

- A 0.5% aqueous solution of CaCl2.
- Brown gas generator (the same reactor as embodiment-5)

The increase in iron and nickel concentrations is remarkable.

B. Embodiment-7(p2015-55527A)

Table 2 Production Experiment with Actual Ca Made of Chicken Eggs.

P2015-55527A Embodiment-7	Concentration before	Concentration after
date	2013.08.13	2013.09.05
Process time		20days
$_{20}$Ca	3200mg/L	2500mg/L
$_{27}$Co	<1μg/L	180μg/L
$_{28}$Ni	<1μg/L	11000μg/L

In Embodiment-6, "calcium" can be transmuted to the valuable "nickel" and "cobalt".

Therefore, chicken egg shells, which amount of waste per day is several tens of tons and the disposal costs are huge and have become a problem, were crushed into particles with a particle size of several μm to several tens of μm using a crusher, and then added to pure water to form a slurry with a concentration of 10 to 30%, and were transmuted in the same manner as in Embodiment-6.

C. Embodiment-1(p2022-239989A)

Table 3 Transmutation of Ca

P2022-23989A-embodiment-1(mg/L)	$_{20}$Ca	$_{22}$Ti	$_{26}$Fe	$_{27}$Co	$_{28}$Ni	$_{29}$Cu
Concentration before	1400	<0.001	0.116	0.001	0.013	0.012
Concentration after	1050	12	0.5	7	9	11
Concentration after *1	890	23	2	14	26	31

➤ *Experimental Condition*

- A 0.5% aqueous solution of $CaCl_2$.
- Added A 0.5% D_2O(5g/L).
- The high frequency stirrer vibrated at 170 Hz for 3 hours.
- Comparison between metal plate and Palladium plated metal plate (*1).

It is clear that palladium increases the transmutation efficiency, by about 2 to 3 times, although it varies depending on the element. Ohmasa insists that this is caused by the catalytic effect of palladium, which author does not agree.

Author thinks that palladium with FCC lattice structure, can generate femto-H_2 effectively because Pd can have Cold Fusion, and metal plate can be stainless steel with FCC grain boundary and it can create femto-H_2. Because transmutation with femto-H_2, increase rate of mass is 2 per one transmutation, and the atomic number increase rate of atomic number is 2 or less. By femto-D_2, increase rate of mass is 4 per one transmutation, and the increase rate of atomic number is 4 or less. Adding D_2O creates femto-D_2 and femto-HD in H_2O, which has the faster transmutation

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rate in terms of increase in atomic number, so the total number of the generated new element increases, and this misled them.

Although author's route analysis shows that no route from $^{43}_{20}Ca$ (0.14%) to $^{63}_{29}Cu$, author thinks that this is caused by transmutation from $^{53}_{24}Cr$ (9.5%) due to the larger Natural abondance, and Fe, Cu from Cr are also originated from stainless steel (Fe, Cr). As is shown in Embodiment-4(p2022-239989A), which starting element is Cs, however, these elements were found. Author thinks that Ohmsa gas generator and other brown gas generator has developed before understanding the mechanism of Cold Fusion, they just used stainless steel to be stable in strong alkaline aqueous solution.

D. Transmutation Route from Ca

This is the route trace from the starting isotopes based on my femto-H_2 transmutation mechanism.

Red marked isotopes are on the route, and note that they are on the isotopes with smaller mass number. This is the limitation to generate the isotope with larger mass number with femto-H_2. Ohmasa used D_2O or tritium contaminated water to increase the transmutation variety and to increase the transmutation rate, but I just focused on femto-H_2 transmutation because it is easy to trance the route.

Note that Cu and Cs are not the route, thus generation of Cu is not from Ca. The larger concentration of Ni is caused by the multiple isotopes on the route of transmutation in Ni.

Table 4 Transmutation Route from Ca

$_{20}$Ca				$_{21}$Sc				$_{22}$Ti				$_{23}$V				$_{24}$Cr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
40Ca	96.94%	>5.9x10^{21} y	40Ar	44mSc	syn	58.61 h	44Sc,44Ca	44Ti	syn	63 y	44Sc	48V	syn	15.9735 d	48Ti	50Cr	4.35%	> 1.8x10^{17} y	50Ti
41Ca	trace	1.03x10^{5} y	41K	45Sc	100%	Stable		46Ti	8.00%	Stable		49V	syn	330 d	49Ti	51Cr	syn	27.7025 d	51V
42Ca	0.65%	Stable		46Sc	syn	83.79 d	46Ti	47Ti	7.30%	Stable		50V	0.25 %	1.5x10^{17} y	50Ti,50Cr	52Cr	83.789 %	Stable	
43Ca	0.14%	Stable		47Sc	syn	3.3492 d	47Ti	48Ti	73.80%	Stable		51V	99.75 %	Stable		53Cr	9.501 %	Stable	
44Ca	2.09%	Stable		48Sc	syn	43.67 h	48Ti	49Ti	5.50%	Stable						54Cr	2.365 %	Stable	
45Ca	syn	162.7 d	45Sc					50Ti	5.40%	Stable									
46Ca	0.00%	>2.8x10^{15} y	46Ti																
47Ca	syn	4.536 d	47Sc																
48Ca	0.19%	4.3x10^{19} y	48Ti,48Sc																

$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	> 3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co	65Cu	30.85 %	Stable		65Zn	syn	243.8 d	65Cu
54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable						66Zn	27.9 %	Stable	
55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
				58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable						68Zn	18.8 %	Stable	
				59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu					70Zn	0.6 %	Stable	
				60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						72Zn	syn	46.5 h	72Ga

$_{31}$Ga				$_{32}$Ge				$_{33}$As				$_{34}$Se				$_{35}$Br				$_{36}$Kr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
69Ga	60.11 %	Stable		68Ge	syn	270.8 d	68Ga	73As	syn	80.3 d	73Ge	72Se	syn	8.4 d	72As	79Br	50.69 %	Stable		78Kr	0.35 %	Stable	
71Ga	39.89 %	Stable		70Ge	21.23 %	Stable		74As	syn	17.78 d	74Ge, 74Se	74Se	0.87 %	Stable		81Br	49.31 %	Stable		79Kr	syn	35.04 h	79Br
				71Ge	syn	11.26 d	71Ga	75As	100 %	Stable		75Se	syn	119.779 d	75As					80Kr	2.25 %	Stable	
				72Ge	27.66 %	Stable						76Se	9.36 %	Stable						81Kr	trace	2.29 ×105 y	81Br
				73Ge	7.73 %	Stable						77Se	7.63 %	Stable						82Kr	11.60 %	Stable	
				74Ge	35.94 %	Stable						78Se	23.78 %	Stable						83Kr	11.50 %	Stable	
				76Ge	7.44 %	1.78x1021 y	76Se					79Se	trace	3.27x105 y	79Br					84Kr	57%	Stable	
												80Se	49.61 %	Stable						85Kr	syn	10.756 y	85Rb
												82Se	8.73 %	1.08x1020 y	82Kr					86Kr	17.30 %	Stable	

$_{37}$Rb				$_{38}$Sr				$_{39}$Y				$_{40}$Zr				$_{41}$Nb				$_{42}$Mo			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
83Rb	syn	86.2 d	83Kr	82Sr	syn	25.36 d	82Rb	87Y	syn	3.35 d	87Sr	88Zr	syn	83.4 d	88Y	91Nb	syn	6.8×10^{2} y	91Zr	92Mo	14.84%	$>1.9\times10^{20}$ y	92Zr
84Rb	syn	32.9 d	84Kr, 84Sr	83Sr	syn	1.35 d	83Rb	88Y	syn	106.6 d	88Sr	89Zr	syn	78.4 h	89Y	91mNb	syn	60.86 d	91Nb	93Mo	syn	4,000 y	93Nb
85Rb	72.17%	Stable		84Sr	0.56%	Stable		89Y	100%	Stable		90Zr	51.45%	Stable		92Nb	syn	3.47×10^{7} y	92Zr	94Mo	9.25%	Stable	
86Rb	syn	18.65 d	86Sr	85Sr	syn	64.84 d	85Rb	90Y	syn	2.67 d	90Zr	91Zr	11.22%	Stable		92mNb	syn	10.15 d	92Zr	95Mo	15.92%	Stable	
87Rb	27.84%	4.88×10^{10} y	87Sr	86Sr	9.86%	Stable		91Y	syn	58.5 d	91Zr	92Zr	17.15%	Stable		93Nb	100%	Stable		96Mo	16.68%	Stable	
				87Sr	7.00%	Stable						93Zr	trace	1.53×10^{6} y	93Nb	93mNb	syn	16.13 y	93Nb	97Mo	9.55%	Stable	
				88Sr	82.58%	Stable						94Zr	17.38%	$>1.1\times10^{17}$ y	94Mo	94Nb	syn	2.03×10^{4} y	94Mo	98Mo	24.13%	$>1\times10^{14}$ y	98Ru
				89Sr	syn	50.52 d	89Rb, 89Y					96Zr	2.80%	2.0×10^{19} y	96Mo	95Nb	syn	34.991 d	95Mo	99Mo	syn	65.94 h	99mTc
				90Sr	trace	28.90 y	90Y									95mNb	syn	3.61 d	95Nb	100Mo	9.63%	7.8×10^{18} y	100Ru

$_{43}$Tc				$_{44}$Ru				$_{45}$Rh				$_{46}$Pd				$_{47}$Ag				$_{48}$Cd			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
95mTc	syn	61 d	95Mo, 95Tc	96Ru	5.52%	Stable		99Rh	syn	16.1 d	99Ru	100Pd	syn	3.63 d	100Rh	105Ag	syn	41.2 d	105Pd	106Cd	1.25%	$>9.5\times10^{17}$ y	106Pd
96Tc	syn	4.3 d	96Mo	97Ru	syn	2.9 d	97Tc	101Rh	syn	3.3 y	101Ru	102Pd	1.02%	Stable		106mAg	syn	8.28 d	106Pd	107Cd	syn	6.5 h	107Ag
97Tc	syn	2.6×10^{6} y	97Mo	98Ru	1.88%	Stable		101mRh	syn	4.34 d	101Ru	103Pd	syn	16.991 d	103Rh	107Ag	51.839%	Stable		108Cd	0.89%	$>6.7\times10^{17}$ y	108Pd
97mTc	syn	91 d	97Tc	99Ru	12.70%	Stable		102Rh	syn	207 d	102Ru, 102Pd	104Pd	11.14%	Stable		108mAg	syn	418 y	108Pd, 108Ag	109Cd	syn	462.6 d	109Ag
98Tc	syn	4.2×10^{6} y	98Ru	100Ru	12.60%	Stable		102mRh	syn	2.9 y	102Ru	105Pd	22.33%	Stable		109Ag	48.161%	Stable		110Cd	12.49%	Stable	
99Tc	trace	2.111×10^{5} y	99Ru	101Ru	17.00%	Stable		103Rh	100%	Stable		106Pd	27.33%	Stable		111Ag	syn	7.45 d	111Cd	111Cd	12.80%	Stable	
99mTc	syn	6.01 h	99Tc	102Ru	31.60%	Stable		105Rh	syn	35.36 h	105Pd	107Pd	trace	6.5×10^{6} y	107Ag					112Cd	24.13%	Stable	
				103Ru	syn	39.26 d	103Rh					108Pd	26.46%	Stable						113Cd	12.22%	7.7×10^{15} y	113In
				104Ru	18.70%	Stable						110Pd	11.72%	Stable						113mCd	syn	14.1 y	113In, 113Cd
				106Ru	syn	373.59 d	106Rh													114Cd	28.73%	$>9.3\times10^{17}$ y	114Sn
																				115Cd	syn	53.46 h	115In
																				116Cd	7.49%	2.9×10^{19} y	116Sn

$_{49}$In				$_{50}$Sn				$_{51}$Sb				$_{52}$Te				$_{53}$I				$_{54}$Xe			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
113In	4.30%	Stable		112Sn	0.97%	Stable		121Sb	57.36%	Stable		120Te	0.09%	$>2.2\times10^{16}$ y	120Sn	123I	syn	13 h	123Te	124Xe	0.10%	1.8×10^{22} y	124Te
115In	95.70%	4.41×10^{14} y	115Sn	114Sn	0.66%	Stable		123Sb	42.64%	Stable		121Te	syn	16.78 d	121Sb	127I	100%	Stable		125Xe	syn	16.9 h	125I
				115Sn	0.34%	Stable		125Sb	syn	2.7582 y	125Te	122Te	2.55%	Stable		129I	trace	15.7×10^{6} y	129Xe	126Xe	0.09%	Stable	
				116Sn	14.54%	Stable						123Te	0.89%	$>1.0\times10^{13}$ y	123Sb	131I	syn	8.02070 d	131Xe	127Xe	syn	36.345 d	127I
				117Sn	7.68%	Stable						124Te	4.74%	Stable						128Xe	1.91%	Stable	
				118Sn	24.22%	Stable						125Te	7.07%	Stable						129Xe	26.40%	Stable	
				119Sn	8.59%	Stable						126Te	18.84%	Stable						130Xe	4.07%	Stable	
				120Sn	32.58%	Stable						127Te	syn	9.35 h	127I					131Xe	21.20%	Stable	
				122Sn	4.63%	Stable						128Te	31.74%	2.2×10^{24} y	128Xe					132Xe	26.90%	Stable	
				124Sn	5.79%	$>1\times10^{17}$ y	124Te					129Te	syn	69.6 min	129I					133Xe	syn	5.247 d	133Cs
				126Sn	trace	2.3×10^{5} y	126Sb					130Te	34.08%	7.9×10^{20} y	130Xe					134Xe	10.40%	$>1.1\times10^{16}$ y	134Ba
																				135Xe	syn	9.14 h	135Cs
																				136Xe	8.86%	2.11×10^{20} y	136Ba

$_{55}$Cs				$_{56}$Ba				$_{57}$La				$_{58}$Ce				$_{59}$Pr				$_{60}$Nd			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
133Cs	100 %	Stable		130Ba	0.11%	$(0.5-2.7)x10^{21}$ y	130Xe	137La	syn	60,000 y	137Ba	134Ce	syn	3.16 d	134La	141Pr	100%	Stable		142Nd	27.20 %	Stable	
134Cs	syn	2.0648 y	134Xe,134Ba	132Ba	0.10%	$>3x10^{20}$ y	132Xe	138La	0.09%	$1.05x10^{11}$ y	138Ba,138Ce	136Ce	0.19%	$>3.8x10^{16}$ y	136Ba	142Pr	syn	19.12 h	142Nd,142Ce	143Nd	12.20 %	Stable	
135Cs	trace	2.3x106 y	135Ba	133Ba	syn	10.51 y	133Cs	139La	99.91 %	Stable		138Ce	0.25%	$>1.5x10^{14}$ y	138Ba	143Pr	syn	13.57 d	143Nd	144Nd	23.80 %	$2.29x10^{15}$ y	140Ce
137Cs	trace	30.17 y	137Ba	134Ba	2.42%	Stable						139Ce	syn	137.640 d	139La					145Nd	8.30%	$>6x10^{16}$ y	141Ce
				135Ba	6.59%	Stable						140Ce	88.45 %	Stable						146Nd	17.20 %	Stable	
				136Ba	7.85%	Stable						141Ce	syn	32.501 d	141Pr					148Nd	5.70%	$>3x10^{18}$ y	144Ce
				137Ba	11.23 %	Stable						142Ce	11.11 %	$>5x10^{16}$ y	142Nd					150Nd	5.60%	$6.7x10^{18}$ y	150Sm
				138Ba	71.70 %	Stable						144Ce	syn	284.893 d	144Pr								

$_{61}$Pm				$_{62}$Sm				$_{63}$Eu				$_{64}$Gd				$_{65}$Tb				$_{66}$Dy			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
145Pm	syn	17.7 y	145Nd	144Sm	3.07%	Stable		150Eu	syn	36.9 y	150Sm	152Gd	0.20 %	$1.08x10^{14}$ y	148Sm	157Tb	syn	71 y	157Gd	154Dy	syn	$3.0x10^{6}$ y	150Gd
146Pm	syn	5.53 y	146Nd, 146Sm	146Sm	syn	$1.03x10^{8}$ y	142Nd	151Eu	47.8 %	$5 x10^{18}$ y	147Pm	154Gd	2.18 %	Stable		158Tb	syn	180 y	158Gd, 158Dy	156Dy	0.06 %	$>1x10^{18}$ y	152Gd
147Pm	trace	2.6234 y	147Sm	147Sm	14.99 %	$1.06x10^{11}$ y	143Nd	152Eu	syn	13.516 y	152Sm ,152Gd	155Gd	14.80 %	Stable		159Tb	100 %	Stable		158Dy	0.10 %	Stable	
				148Sm	11.24 %	$7x10^{15}$ y	144Nd	153Eu	52.2 %	Stable		156Gd	20.47 %	Stable						160Dy	2.34 %	Stable	
				149Sm	13.82 %	$>2x10^{15}$ y	145Nd					157Gd	15.65 %	Stable						161Dy	18.91 %	Stable	
				150Sm	7.38%	Stable						158Gd	24.84 %	Stable						162Dy	25.51 %	Stable	
				152Sm	26.75 %	Stable						160Gd	21.86 %	$>1.3x10^{21}$ y	160Dy					163Dy	24.90 %	Stable	
				154Sm	22.75 %	$>2.3x10^{18}$ y	154Gd													164Dy	28.18 %	Stable	

$_{67}$Ho				$_{68}$Er				$_{69}$Tm				$_{70}$Yb				$_{71}$Lu				$_{72}$Hf			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
163Ho	syn	4570 y	163Dy	160Er	syn	28.58 h	160Ho	167Tm	syn	9.25 d	167Er	166Yb	syn	56.7 h	166Tm	173Lu	syn	1.37 y	173Yb	172Hf	syn	1.87 y	172Lu
164Ho	syn	29 min	164Dy	162Er	0.14%	$>1.4x10^{14}$ y	158Dy ,162Dy	168Tm	syn	93.1 d	168Er	168Yb	0.13%	$>1.3x10^{14}$ y	164Er, 168Er	174Lu	syn	3.31 y	174Yb	174Hf	0.16%	$2x10^{15}$ y	170Yb
165Ho	100 %	Stable		164Er	1.601 %	Stable		169Tm	100 %	Stable		169Yb	syn	32.026 d	169Tm	175Lu	97.41 %	Stable		176Hf	5.21%	Stable	
166Ho	syn	26.763 h	166Er	165Er	syn	10.36 h	165Ho	170Tm	syn	128.6 d	170Yb	170Yb	3.04 %	Stable		176Lu	2.59 %	$3.78x10^{10}$ y	176Hf	177Hf	18.61 %	Stable	
167Ho	syn	3.1 h	167Er	166Er	33.503 %	Stable		171Tm	syn	1.92 y	171Yb	171Yb	14.28 %	Stable						178Hf	27.30 %	Stable	
				167Er	22.869 %	Stable						172Yb	21.83 %	Stable						178m2Hf	syn	31 y	178Hf
				168Er	26.978 %	Stable						173Yb	16.13 %	Stable						179Hf	13.63 %	Stable	
				169Er	syn	9.4 d	169Tm					174Yb	31.83 %	Stable						180Hf	35.10 %	Stable	
				170Er	14.91 %	$>3.2x10^{17}$ y	166Dy ,170Yb					175Yb	syn	4.185 d	175Lu					182Hf	syn	$9x10^{6}$ y	182Ta
				171Er	syn	7.516 h	171Tm					176Yb	12.76 %	$>1.6x10^{17}$ y	172Er, 176Hf								
				172Er	syn	49.3 h	172Tm					177Yb	syn	1.911 h	177Lu								

$_{73}$Ta				$_{74}$W				$_{75}$Re			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
177Ta	syn	56.56 h	177Hf	180W	0.12%	1.8x10^{18} y	176Hf	185Re	37.40 %	Stable	
178Ta	syn	2.36 h	178Hf	181W	syn	121.2 d	181Ta	187Re	62.60 %	4.12×10^{10} y	183Ta,187Os
179Ta	syn	1.82 y	179Hf	182W	26.50 %	>1.7x10^{20} y	178Hf				
180Ta	syn	8.125 h	180Hf,180W	183W	14.31 %	>8x10^{19} y	179Hf				
180mTa	0.01%	> 1.2x1015 y	180Hf,180W,180Ta	184W	30.64 %	>1.8x10^{20} y	180Hf				
181Ta	99.99 %	Stable		185W	syn	75.1 d	185Re				
182Ta	syn	114.43 d	182W	186W	28.43 %	>4.1x10^{18} y	182Hf,186Os				
183Ta	syn	5.1 d	183W								

$_{76}$Os				$_{77}$Ir				$_{78}$Pt			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
184Os	0.02%	1.1x10^{13} y	180W	188Ir	syn	1.73 d	188Os	190Pt	0.014 %	6.5x10^{11} y	186Os
185Os	syn	93.6 d	185Re	189Ir	syn	13.2 d	189Os	192Pt	0.782 %	>6x10^{16} y	188Os
186Os	1.59%	2.0x10^{15} y	182W	190Ir	syn	11.8 d	190Os	193Pt	syn	50 y	193Ir
187Os	1.96%	Stable		191Ir	37.30 %	Stable		194Pt	32.967 %	Stable	
188Os	13.24 %	Stable		192Ir	syn	73.827 d	192Pt,192Os	195Pt	33.832 %	Stable	
189Os	16.15 %	Stable		192m2Ir	syn	241 y	192Ir	196Pt	25.242 %	Stable	
190Os	26.26 %	Stable		193Ir	62.70 %	Stable		198Pt	7.356 %	>3.2x10^{14} y	194Os,198Hg
191Os	syn	15.4 d	191Ir	193mIr	syn	10.5 d	193Ir				
192Os	40.78 %	> 9.8x10^{12} y	192Pt	194Ir	syn	19.3 h	194Pt				
193Os	syn	30.11 d	193Ir	194m2Ir	syn	171 d	194Ir				
194Os	syn	6 y	194Ir								

$_{79}$Au				$_{80}$Hg				$_{81}$Tl			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
195Au	syn	186.10 d	195Pt	194Hg	syn	444 y	194Au	203Tl	29.52 %	Stable	
196Au	syn	6.183 d	196Pt,196Hg	195Hg	syn	9.9 h	195Au	204Tl	syn	119 Ms	204Pb,204Hg
197Au	100 %	Stable		196Hg	0.15%	>2.5x10^{18} y	192Pt,196Pt	205Tl	70.48 %	Stable	
198Au	syn	2.69517 d	198Hg	197Hg	syn	64.14 h	197Au				
199Au	syn	3.169 d	199Hg	198Hg	9.97 %	Stable					
				199Hg	16.87 %	Stable					
				200Hg	23.1 %	Stable					
				201Hg	13.18 %	Stable					
				202Hg	29.86 %	Stable					
				203Hg	syn	46.612 d	203Tl				
				204Hg	6.87 %	Stable					

$_{82}$Pb											
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
204Pb	1.4 %	> 1.4x10^{17} y	200Hg								
205Pb	syn	1.53x10^{7} y	205Tl								
206Pb	24.1 %	Stable									
207Pb	22.1 %	Stable									
208Pb	52.4 %	Stable									
210Pb	trace	22.3 y	206Hg,210Bi								

V. TRANSMUTATION FROM CU

A. Embodiment-2(p2022-239989A)

Table 5 Transmutation of 29Cu with 0.5% $CuCl_2$

P2022-23989A-embodiment-2 (mg/L)	$_{28}$Ni	$_{29}$Cu	$_{30}$Zn	$_{47}$Ag	$_{79}$Au
Concentration before	0.015	4200	0.018	<0.012	<0.001
Concentration after	12	2800	16	11	8
Concentration after *1	27	1900	31	34	26

➢ *Experimental Condition*

- A 0.5% aqueous solution of $CuCl_2$.
- Added A 0.5% D_2O.
- The high frequency stirrer vibrated at 170 Hz for 3 hours.
- Comparison between metal plate and Palladium plated metal plate (*1).

B. Embodiment-3(p2022-239989A)

Table 6 Transmutation from Mg

P2022-23989A-embodiment-3 (mg/L)	$_{12}$Mg	$_{29}$Cu	$_{47}$Ag	$_{79}$Au
Concentration before	1760	<0.001	<0.001	<0.001
Concentration after *1	1020	48	32	14

➢ *Experimental Condition*

- 0.5% aqueous solution of $MgCl_2$.
- Added 0.5μsv tritium water (5g/L).
- The high frequency stirrer vibrated at 170 Hz for 3 hours.
- Palladium plated metal plate (*1).

Author thinks that this include Cu as the generated element, however no route to Cu

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C. Transmutation from Mg to Cu

Table 7 Transmutation Route from Mg to Cu

$_{12}$Mg				$_{13}$Al				$_{14}$Si				$_{15}$P				$_{16}$S				$_{17}$Cl			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
24Mg	78.99 %	Stable		26Al	trace	7.17 × 105 y	26Mg	28Si	92.23 %	Stable		31P	100%	Stable		32S	95.02 %	Stable		35Cl	75.77 %	Stable	
25Mg	10%	Stable		27Al	100 %	Stable		29Si	4.67 %	Stable		32P	syn	14.28 d	32S	33S	0.75 %	Stable		36Cl	trace	3.01 × 105 y	36Ar, 36S
26Mg	11.01 %	Stable						30Si	3.1 %	Stable		33P	syn	25.3 d	33S	34S	4.21 %	Stable		37Cl	24.23 %	Stable	
								32Si	syn	170 y	32P					35S	syn	87.32 d	35Cl				
																36S	0.02 %	Stable					

$_{18}$Ar				$_{19}$K				$_{20}$Ca				$_{21}$Sc											
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
36Ar	0.337 %	Stable		39K	93.26 %	Stable		40Ca	96.94 %	>5.9x 1021 y	40Ar	44mSc	syn	58.61 h	44Sc, 44Ca								
37Ar	syn	35 d	37Cl	40K	0.012 %	1.248 (3) × 109 y	40Ca, 40Ar	41Ca	trace	1.03x 105y	41K	45Sc	100%	Stable									
38Ar	0.063 %	Stable		41K	6.73 %	Stable		42Ca	0.65 %	Stable		46Sc	syn	83.79 d	46Ti								
39Ar	trace	269 y	39K					43Ca	0.14 %	Stable		47Sc	syn	3.349 2 d	47Ti								
40Ar	99.60 0 %	Stable						44Ca	2.09 %	Stable		48Sc	syn	43.67 h	48Ti								
41Ar	syn	109.3 4 min	41K					45Ca	syn	162.7 d	45Sc												
42Ar	syn	32.9 y	42K					46Ca	0.00 %	>2.8x 1015 y	46Ti												
								47Ca	syn	4.536 d	47Sc												
								48Ca	0.19 %	4.3x1 019y	48Ti, 48Sc												

$_{20}$Ca				$_{21}$Sc				$_{22}$Ti				$_{23}$V				$_{24}$Cr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
40Ca	96.94%	>5.9x10^{21} y	40Ar	44mSc	syn	58.61 h	44Sc,44Ca	44Ti	syn	63 y	44Sc	48V	syn	15.9735 d	48Ti	50Cr	4.35%	> 1.8x10^{17} y	50Ti
41Ca	trace	1.03x10^{5} y	41K	45Sc	100%	Stable		46Ti	8.00%	Stable		49V	syn	330 d	49Ti	51Cr	syn	27.7025 d	51V
42Ca	0.65%	Stable		46Sc	syn	83.79 d	46Ti	47Ti	7.30%	Stable		50V	0.25 %	1.5x10^{17} y	50Ti,50Cr	52Cr	83.789 %	Stable	
43Ca	0.14%	Stable		47Sc	syn	3.3492 d	47Ti	48Ti	73.80%	Stable		51V	99.75 %	Stable		53Cr	9.501 %	Stable	
44Ca	2.09%	Stable		48Sc	syn	43.67 h	48Ti	49Ti	5.50%	Stable						54Cr	2.365 %	Stable	
45Ca	syn	162.7 d	45Sc					50Ti	5.40%	Stable									
46Ca	0.00%	>2.8x10^{15} y	46Ti																
47Ca	syn	4.536 d	47Sc																
48Ca	0.19%	4.3x10^{19}y	48Ti,48Sc																

$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	> 3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co	65Cu	30.85 %	Stable		65Zn	syn	243.8 d	65Cu
54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable						66Zn	27.9 %	Stable	
55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
				58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable						68Zn	18.8 %	Stable	
				59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu					70Zn	0.6 %	Stable	
				60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						72Zn	syn	46.5 h	72Ga

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Because transmutation from Mg to Cu has a route,

Transmutation from Mg has the same rout after Cu, and has Ag, Au.

D. Transmutation Route from Cu to Ag to Cs(to Au)

Transmutation from Cu has Ag and Au. As is shown in the below table, from Cu has a route to $^{133}_{55}Cs$, which leads to Au. Therefore, Au and Ag can be produced from the same isotopes.

Table 8 Transmutation Route from Cu

$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	> 3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co	65Cu	30.85 %	Stable		65Zn	syn	243.8 d	65Cu
54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable						66Zn	27.9 %	Stable	
55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
				58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable						68Zn	18.8 %	Stable	
				59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu					70Zn	0.6 %	Stable	
				60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						72Zn	syn	46.5 h	72Ga

$_{31}$Ga				$_{32}$Ge				$_{33}$As				$_{34}$Se				$_{35}$Br				$_{36}$Kr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
69Ga	60.11 %	Stable		68Ge	syn	270.8 d	68Ga	73As	syn	80.3 d	73Ge	72Se	syn	8.4 d	72As	79Br	50.69 %	Stable		78Kr	0.35 %	Stable	
71Ga	39.89 %	Stable		70Ge	21.23 %	Stable		74As	syn	17.78 d	74Ge, 74Se	74Se	0.87 %	Stable		81Br	49.31 %	Stable		79Kr	syn	35.04 h	79Br
				71Ge	syn	11.26 d	71Ga	75As	100 %	Stable		75Se	syn	119.779 d	75As					80Kr	2.25 %	Stable	
				72Ge	27.66 %	Stable						76Se	9.36 %	Stable						81Kr	trace	2.29×105 y	81Br
				73Ge	7.73 %	Stable						77Se	7.63 %	Stable						82Kr	11.60 %	Stable	
				74Ge	35.94 %	Stable						78Se	23.78 %	Stable						83Kr	11.50 %	Stable	
				76Ge	7.44 %	1.78x1021 y	76Se					79Se	trace	3.27x105 y	79Br					84Kr	57%	Stable	
												80Se	49.61 %	Stable						85Kr	syn	10.756 y	85Rb
												82Se	8.73 %	1.08x1020 y	82Kr					86Kr	17.30 %	Stable	

$_{37}$Rb				$_{38}$Sr				$_{39}$Y				$_{40}$Zr				$_{41}$Nb				$_{42}$Mo			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
83Rb	syn	86.2 d	83Kr	82Sr	syn	25.36 d	82Rb	87Y	syn	3.35 d	87Sr	88Zr	syn	83.4 d	88Y	91Nb	syn	6.8x10^{2} y	91Zr	92Mo	14.84 %	>1.9x10^{20} y	92Zr
84Rb	syn	32.9 d	84Kr, 84Sr	83Sr	syn	1.35 d	83Rb	88Y	syn	106.6 d	88Sr	89Zr	syn	78.4 h	89Y	91mNb	syn	60.86 d	91Nb	93Mo	syn	4,000 y	93Nb
85Rb	72.17 %	Stable		84Sr	0.56 %	Stable		89Y	100%	Stable		90Zr	51.45 %	Stable		92Nb	syn	3.47x10^{7} y	92Zr	94Mo	9.25 %	Stable	
86Rb	syn	18.65 d	86Sr	85Sr	syn	64.84 d	85Rb	90Y	syn	2.67 d	90Zr	91Zr	11.22 %	Stable		92mNb	syn	10.15 d	92Zr	95Mo	15.92 %	Stable	
87Rb	27.84 %	4.88 x10^{10} y	87Sr	86Sr	9.86 %	Stable		91Y	syn	58.5 d	91Zr	92Zr	17.15 %	Stable		93Nb	100%	Stable		96Mo	16.68 %	Stable	
				87Sr	7.00 %	Stable						93Zr	trace	1.53x10^{6} y	93Nb	93mNb	syn	16.13 y	93Nb	97Mo	9.55 %	Stable	
				88Sr	82.58 %	Stable						94Zr	17.38 %	> 1.1x10^{17} y	94Mo	94Nb	syn	2.03x10^{4} y	94Mo	98Mo	24.13 %	>1x10^{14} y	98Ru
				89Sr	syn	50.52 d	89Rb, 89Y					96Zr	2.80 %	2.0x10^{19} y	96Mo	95Nb	syn	34.991 d	95Mo	99Mo	syn	65.94 h	99mTc
				90Sr	trace	28.90 y	90Y									95mNb	syn	3.61 d	95Nb	100Mo	9.63 %	7.8x10^{18} y	100Ru

$_{43}$Tc

ISOTOPE	NA	Half-Life	DP
95mTc	syn	61 d	95Mo,95Tc
96Tc	syn	4.3 d	96Mo
97Tc	syn	2.6x10^{6} y	97Mo
97mTc	syn	91 d	97Tc
98Tc	syn	4.2x10^{6} y	98Ru
99Tc	trace	2.111x10^{5} y	99Ru
99mTc	syn	6.01 h	99Tc

$_{44}$Ru

ISOTOPE	NA	Half-Life	DP
96Ru	5.52 %	Stable	
97Ru	syn	2.9 d	97Tc
98Ru	1.88 %	Stable	
99Ru	12.70 %	Stable	
100Ru	12.60 %	Stable	
101Ru	17.00 %	Stable	
102Ru	31.60 %	Stable	
103Ru	syn	39.26 d	103Rh
104Ru	18.70 %	Stable	
106Ru	syn	373.59 d	106Rh

$_{45}$Rh

ISOTOPE	NA	Half-Life	DP
99Rh	syn	16.1 d	99Ru
101Rh	syn	3.3 y	101Ru
101mRh	syn	4.34 d	101Ru
102Rh	syn	207 d	102Ru,102Pd
102mRh	syn	2.9 y	102Ru
103Rh	100%	Stable	
105Rh	syn	35.36 h	105Pd

$_{46}$Pd

ISOTOPE	NA	Half-Life	DP
100Pd	syn	3.63 d	100Rh
102Pd	1.02 %	Stable	
103Pd	syn	16.991 d	103Rh
104Pd	11.14 %	Stable	
105Pd	22.33 %	Stable	
106Pd	27.33 %	Stable	
107Pd	trace	6.5x10^{6} y	107Ag
108Pd	26.46 %	Stable	
110Pd	11.72 %	Stable	

$_{47}$Ag

ISOTOPE	NA	Half-Life	DP
105Ag	syn	41.2 d	105Pd
106mAg	syn	8.28 d	106Pd
107Ag	51.839 %	Stable	
108mAg	syn	418 y	108Pd,108Ag
109Ag	48.161 %	Stable	
111Ag	syn	7.45 d	111Cd

$_{48}$Cd

ISOTOPE	NA	Half-Life	DP
106Cd	1.25 %	> 9.5x10^{17} y	106Pd
107Cd	syn	6.5 h	107Ag
108Cd	0.89 %	> 6.7x10^{17} y	108Pd
109Cd	syn	462.6 d	109Ag
110Cd	12.49 %	Stable	
111Cd	12.80 %	Stable	
112Cd	24.13 %	Stable	
113Cd	12.22 %	7.7x10^{15} y	113In
113mCd	syn	14.1 y	113In,113Cd
114Cd	28.73 %	> 9.3x10^{17} y	114Sn
115Cd	syn	53.46 h	115In
116Cd	7.49 %	2.9x10^{19} y	116Sn

$_{49}$In

ISOTOPE	NA	Half-Life	DP
113In	4.30 %	Stable	
115In	95.70 %	4.41x10^{14} y	115Sn

$_{50}$Sn

ISOTOPE	NA	Half-Life	DP
112Sn	0.97 %	Stable	
114Sn	0.66 %	Stable	
115Sn	0.34 %	Stable	
116Sn	14.54 %	Stable	
117Sn	7.68 %	Stable	
118Sn	24.22 %	Stable	
119Sn	8.59 %	Stable	
120Sn	32.58 %	Stable	
122Sn	4.63 %	Stable	
124Sn	5.79 %	>1x10^{17} y	124Te
126Sn	trace	2.3x10^{5} y	126Sb

$_{51}$Sb

ISOTOPE	NA	Half-Life	DP
121Sb	57.36 %	Stable	
123Sb	42.64 %	Stable	
125Sb	syn	2.7582 y	125Te

$_{52}$Te

ISOTOPE	NA	Half-Life	DP
120Te	0.09 %	> 2.2x10^{16} y	120Sn
121Te	syn	16.78 d	121Sb
122Te	2.55 %	Stable	
123Te	0.89 %	> 1.0x10^{13} y	123Sb
124Te	4.74 %	Stable	
125Te	7.07 %	Stable	
126Te	18.84 %	Stable	
127Te	syn	9.35 h	127I
128Te	31.74 %	2.2x10^{24} y	128Xe
129Te	syn	69.6 min	129I
130Te	34.08 %	7.9x10^{20} y	130Xe

$_{53}$I

ISOTOPE	NA	Half-Life	DP
123I	syn	13 h	123Te
127I	100 %	Stable	
129I	trace	15.7x10^{6} y	129Xe
131I	syn	8.02070 d	131Xe

$_{54}$Xe

ISOTOPE	NA	Half-Life	DP
124Xe	0.10 %	1.8x10^{22} y	124Te
125Xe	syn	16.9 h	125I
126Xe	0.09 %	Stable	
127Xe	syn	36.345 d	127I
128Xe	1.91 %	Stable	
129Xe	26.40 %	Stable	
130Xe	4.07 %	Stable	
131Xe	21.20 %	Stable	
132Xe	26.90 %	Stable	
133Xe	syn	5.247 d	133Cs
134Xe	10.40 %	>1.1x10^{16} y	134Ba
135Xe	syn	9.14 h	135Cs
136Xe	8.86 %	2.11x10^{20} y	136Ba

$_{55}$Cs

ISOTOPE	NA	Half-Life	DP
133Cs	100 %	Stable	
134Cs	syn	2.0648 y	134Xe,134Ba
135Cs	trace	2.3x10^{6} y	135Ba
137Cs	trace	30.17 y	137Ba

$_{56}$Ba

ISOTOPE	NA	Half-Life	DP
130Ba	0.11%	(0.5-2.7)x10^{21} y	130Xe
132Ba	0.10%	>3x10^{20} y	132Xe
133Ba	syn	10.51 y	133Cs
134Ba	2.42%	Stable	
135Ba	6.59%	Stable	
136Ba	7.85%	Stable	
137Ba	11.23 %	Stable	
138Ba	71.70 %	Stable	

$_{57}$La

ISOTOPE	NA	Half-Life	DP
137La	syn	60,000 y	137Ba
138La	0.09%	1.05x10^{11} y	138Ba,138Ce
139La	99.91 %	Stable	

$_{58}$Ce

ISOTOPE	NA	Half-Life	DP
134Ce	syn	3.16 d	134La
136Ce	0.19%	> 3.8x10^{16} y	136Ba
138Ce	0.25%	> 1.5x10^{14} y	138Ba
139Ce	syn	137.640 d	139La
140Ce	88.45 %	Stable	
141Ce	syn	32.501 d	141Pr
142Ce	11.11 %	> 5x10^{16} y	142Nd
144Ce	syn	284.893 d	144Pr

$_{59}$Pr

ISOTOPE	NA	Half-Life	DP
141Pr	100%	Stable	
142Pr	syn	19.12 h	142Nd,142Ce
143Pr	syn	13.57 d	143Nd

$_{60}$Nd

ISOTOPE	NA	Half-Life	DP
142Nd	27.20 %	Stable	
143Nd	12.20 %	Stable	
144Nd	23.80 %	2.29x10^{15} y	140Ce
145Nd	8.30%	>6x10^{16} y	141Ce
146Nd	17.20 %	Stable	
148Nd	5.70%	>3x10^{18} y	144Ce
150Nd	5.60%	6.7x10^{18} y	150Sm

VI. TRANSMUTATION FROM CL, MN, GA, BR TO AG

Mononuclidic elements are only those with odd atomic numbers. Elements with two stable isotopes also have odd atomic numbers such as Cl, V, Ga, and Br.

Conversely, elements with even atomic numbers have 10 stable isotopes. According to the transmutation rule, mass number is monotonically increases by 2, thus odd mass number isotope transmutes to odd mass number isotope, thus I checked the other elements with odd mass number; Cl, V, Ga, and Br as is the table below.

Surprisingly all of elements with odd atomic number has the route to Ag and Au.

Table 9 Transmutation Route from Cl to Ag, Au;(Cu to Ag & Au)

$_{17}$Cl				$_{18}$Ar				$_{19}$K				$_{20}$Ca				$_{21}$Sc			
												ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
35Cl	75.77 %	Stable		36Ar	0.337 %	Stable		39K	93.26 %	Stable		40Ca	96.94%	>5.9x10^{21} y	40Ar	44mSc	syn	58.61 h	44Sc,44Ca
36Cl	trace	3.01x105 y	36Ar,36S	37Ar	syn	35 d	37Cl	40K	0.012 %	1.248(3)x109 y		41Ca	trace	1.03x10^{5} y	41K	45Sc	100%	Stable	
37Cl	24.23 %	Stable		38Ar	0.063 %	Stable		41K	6.73 %	Stable		42Ca	0.65%	Stable		46Sc	syn	83.79 d	46Ti
				39Ar	trace	269 y	39K					43Ca	0.14%	Stable		47Sc	syn	3.3492 d	47Ti
				40Ar	99.600 %	Stable						44Ca	2.09%	Stable		48Sc	syn	43.67 h	48Ti
				41Ar	syn	109.34 min	41K					45Ca	syn	162.7 d	45Sc				
				42Ar	syn	32.9 y	42K					46Ca	0.00%	>2.8x10^{15} y	46Ti				
												47Ca	syn	4.536 d	47Sc				
												48Ca	0.19%	4.3x10^{19}y	48Ti,48Sc				

$_{20}$Ca				$_{21}$Sc				$_{22}$Ti				$_{23}$V				$_{24}$Cr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
40Ca	96.94%	>5.9x10^{21} y	40Ar	44mSc	syn	58.61 h	44Sc,44Ca	44Ti	syn	63 y	44Sc	48V	syn	15.9735 d	48Ti	50Cr	4.35%	> 1.8x10^{17} y	50Ti
41Ca	trace	1.03x10^{5} y	41K	45Sc	100%	Stable		46Ti	8.00%	Stable		49V	syn	330 d	49Ti	51Cr	syn	27.7025 d	51V
42Ca	0.65%	Stable		46Sc	syn	83.79 d	46Ti	47Ti	7.30%	Stable		50V	0.25 %	1.5x10^{17} y	50Ti,50Cr	52Cr	83.789 %	Stable	
43Ca	0.14%	Stable		47Sc	syn	3.3492 d	47Ti	48Ti	73.80%	Stable		51V	99.75 %	Stable		53Cr	9.501 %	Stable	
44Ca	2.09%	Stable		48Sc	syn	43.67 h	48Ti	49Ti	5.50%	Stable						54Cr	2.365 %	Stable	
45Ca	syn	162.7 d	45Sc					50Ti	5.40%	Stable									
46Ca	0.00%	>2.8x10^{15} y	46Ti																
47Ca	syn	4.536 d	47Sc																
48Ca	0.19%	4.3x10^{19}y	48Ti,48Sc																

$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	> 3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co	65Cu	30.85 %	Stable		65Zn	syn	243.8 d	65Cu
54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable						66Zn	27.9 %	Stable	
55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
				58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable						68Zn	18.8 %	Stable	
				59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu					70Zn	0.6 %	Stable	
				60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						72Zn	syn	46.5 h	72Ga

Table 10 Transmutation Route from Mn to Cu to Ag, Au;(Cu-to Ag, Au)

$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	> 3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co	65Cu	30.85 %	Stable		65Zn	syn	243.8 d	65Cu
54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable						66Zn	27.9 %	Stable	
55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
				58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable						68Zn	18.8 %	Stable	
				59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu					70Zn	0.6 %	Stable	
				60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						72Zn	syn	46.5 h	72Ga

Table 11 Transmutation Route from Ga to Ag, Au

$_{31}$Ga				$_{32}$Ge				$_{33}$As				$_{34}$Se				$_{35}$Br				$_{36}$Kr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
69Ga	60.11 %	Stable		68Ge	syn	270.8 d	68Ga	73As	syn	80.3 d	73Ge	72Se	syn	8.4 d	72As	79Br	50.69 %	Stable		78Kr	0.35 %	Stable	
71Ga	39.89 %	Stable		70Ge	21.23 %	Stable		74As	syn	17.78 d	74Ge, 74Se	74Se	0.87 %	Stable		81Br	49.31 %	Stable		79Kr	syn	35.04 h	79Br
				71Ge	syn	11.26 d	71Ga	75As	100 %	Stable		75Se	syn	119.779 d	75As					80Kr	2.25 %	Stable	
				72Ge	27.66 %	Stable						76Se	9.36 %	Stable						81Kr	trace	2.29×105 y	81Br
				73Ge	7.73 %	Stable						77Se	7.63 %	Stable						82Kr	11.60 %	Stable	
				74Ge	35.94 %	Stable						78Se	23.78 %	Stable						83Kr	11.50 %	Stable	
				76Ge	7.44 %	1.78x1021 y	76Se					79Se	trace	3.27x105 y	79Br					84Kr	57%	Stable	
												80Se	49.61 %	Stable						85Kr	syn	10.756 y	85Rb
												82Se	8.73 %	1.08x1020 y	82Kr					86Kr	17.30 %	Stable	

$_{37}$Rb				$_{38}$Sr				$_{39}$Y				$_{40}$Zr				$_{41}$Nb				$_{42}$Mo			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
83Rb	syn	86.2 d	83Kr	82Sr	syn	25.36 d	82Rb	87Y	syn	3.35 d	87Sr	88Zr	syn	83.4 d	88Y	91Nb	syn	6.8x10^{2} y	91Zr	92Mo	14.84 %	>1.9x10^{20} y	92Zr
84Rb	syn	32.9 d	84Kr, 84Sr	83Sr	syn	1.35 d	83Rb	88Y	syn	106.6 d	88Sr	89Zr	syn	78.4 h	89Y	91mNb	syn	60.86 d	91Nb	93Mo	syn	4,000 y	93Nb
85Rb	72.17 %	Stable		84Sr	0.56 %	Stable		89Y	100%	Stable		90Zr	51.45 %	Stable		92Nb	syn	3.47x10^{7} y	92Zr	94Mo	9.25 %	Stable	
86Rb	syn	18.65 d	86Sr	85Sr	syn	64.84 d	85Rb	90Y	syn	2.67 d	90Zr	91Zr	11.22 %	Stable		92mNb	syn	10.15 d	92Zr	95Mo	15.92 %	Stable	
87Rb	27.84 %	4.88 x10^{10} y	87Sr	86Sr	9.86 %	Stable		91Y	syn	58.5 d	91Zr	92Zr	17.15 %	Stable		93Nb	100%	Stable		96Mo	16.68 %	Stable	
				87Sr	7.00 %	Stable						93Zr	trace	1.53x10^{6} y	93Nb	93mNb	syn	16.13 y	93Nb	97Mo	9.55 %	Stable	
				88Sr	82.58 %	Stable						94Zr	17.38 %	> 1.1x10^{17} y	94Mo	94Nb	syn	2.03x10^{4} y	94Mo	98Mo	24.13 %	>1x10^{14} y	98Ru
				89Sr	syn	50.52 d	89Rb, 89Y					96Zr	2.80 %	2.0x10^{19} y	96Mo	95Nb	syn	34.991 d	95Mo	99Mo	syn	65.94 h	99mTc
				90Sr	trace	28.90 y	90Y									95mNb	syn	3.61 d	95Nb	100Mo	9.63 %	7.8x10^{18} y	100Ru

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$_{43}$Tc				$_{44}$Ru				$_{45}$Rh				$_{46}$Pd				$_{47}$Ag				$_{48}$Cd			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
95mTc	syn	61 d	95Mo,95Tc	96Ru	5.52%	Stable		99Rh	syn	16.1 d	99Ru	100Pd	syn	3.63 d	100Rh	105Ag	syn	41.2 d	105Pd	106Cd	1.25%	> 9.5 x10^{17} y	106Pd
96Tc	syn	4.3 d	96Mo	97Ru	syn	2.9 d	97Tc	101Rh	syn	3.3 y	101Ru	102Pd	1.02%	Stable		106mAg	syn	8.28 d	106Pd	107Cd	syn	6.5 h	107Ag
97Tc	syn	2.6x10^{6} y	97Mo	98Ru	1.88%	Stable		101mRh	syn	4.34 d	101Ru	103Pd	syn	16.991 d	103Rh	107Ag	51.839 %	Stable		108Cd	0.89%	> 6.7 x10^{17} y	108Pd
97mTc	syn	91 d	97Tc	99Ru	12.70%	Stable		102Rh	syn	207 d	102Ru,102Pd	104Pd	11.14%	Stable		108mAg	syn	418 y	108Pd,108Ag	109Cd	syn	462.6 d	109Ag
98Tc	syn	4.2x10^{6} y	98Ru	100Ru	12.60%	Stable		102mRh	syn	2.9 y	102Ru	105Pd	22.33%	Stable		109Ag	48.161 %	Stable		110Cd	12.49%	Stable	
99Tc	trace	2.111 x10^{5} y	99Ru	101Ru	17.00%	Stable		103Rh	100%	Stable		106Pd	27.33%	Stable		111Ag	syn	7.45 d	111Cd	111Cd	12.80%	Stable	
99mTc	syn	6.01 h	99Tc	102Ru	31.60%	Stable		105Rh	syn	35.36 h	105Pd	107Pd	trace	6.5x10^{6} y	107Ag					112Cd	24.13%	Stable	
				103Ru	syn	39.26 d	103Rh					108Pd	26.46%	Stable						113Cd	12.22%	7.7 x10^{15} y	113In
				104Ru	18.70%	Stable						110Pd	11.72%	Stable						113mCd	syn	14.1 y	113In,113Cd
				106Ru	syn	373.59 d	106Rh													114Cd	28.73%	> 9.3 x10^{17} y	114Sn
																				115Cd	syn	53.46 h	115In
																				116Cd	7.49%	2.9 x10^{19} y	116Sn

Table 12 Transmutation Route from Br to Ag, Au

$_{31}$Ga				$_{32}$Ge				$_{33}$As				$_{34}$Se				$_{35}$Br				$_{36}$Kr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
69Ga	60.11 %	Stable		68Ge	syn	270.8 d	68Ga	73As	syn	80.3 d	73Ge	72Se	syn	8.4 d	72As	79Br	50.69 %	Stable		78Kr	0.35 %	Stable	
71Ga	39.89 %	Stable		70Ge	21.23 %	Stable		74As	syn	17.78 d	74Ge, 74Se	74Se	0.87 %	Stable		81Br	49.31 %	Stable		79Kr	syn	35.04 h	79Br
				71Ge	syn	11.26 d	71Ga	75As	100 %	Stable		75Se	syn	119.779 d	75As					80Kr	2.25 %	Stable	
				72Ge	27.66 %	Stable						76Se	9.36 %	Stable						81Kr	trace	2.29 ×105 y	81Br
				73Ge	7.73 %	Stable						77Se	7.63 %	Stable						82Kr	11.60 %	Stable	
				74Ge	35.94 %	Stable						78Se	23.78 %	Stable						83Kr	11.50 %	Stable	
				76Ge	7.44 %	1.78x 1021 y	76Se					79Se	trace	3.27x 105 y	79Br					84Kr	57%	Stable	
												80Se	49.61 %	Stable						85Kr	syn	10.756 y	85Rb
												82Se	8.73 %	1.08x 1020 y	82Kr					86Kr	17.30 %	Stable	

$_{37}$Rb				$_{38}$Sr				$_{39}$Y				$_{40}$Zr				$_{41}$Nb				$_{42}$Mo			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
83Rb	syn	86.2 d	83Kr	82Sr	syn	25.36 d	82Rb	87Y	syn	3.35 d	87Sr	88Zr	syn	83.4 d	88Y	91Nb	syn	6.8x10^{2} y	91Zr	92Mo	14.84 %	>1.9x 10^{20} y	92Zr
84Rb	syn	32.9 d	84Kr, 84Sr	83Sr	syn	1.35 d	83Rb	88Y	syn	106.6 d	88Sr	89Zr	syn	78.4 h	89Y	91mNb	syn	60.86 d	91Nb	93Mo	syn	4,000 y	93Nb
85Rb	72.17 %	Stable		84Sr	0.56 %	Stable		89Y	100%	Stable		90Zr	51.45 %	Stable		92Nb	syn	3.47x 10^{7} y	92Zr	94Mo	9.25 %	Stable	
86Rb	syn	18.65 d	86Sr	85Sr	syn	64.84 d	85Rb	90Y	syn	2.67 d	90Zr	91Zr	11.22 %	Stable		92mNb	syn	10.15 d	92Zr	95Mo	15.92 %	Stable	
87Rb	27.84 %	4.88 x10^{10} y	87Sr	86Sr	9.86 %	Stable		91Y	syn	58.5 d	91Zr	92Zr	17.15 %	Stable		93Nb	100%	Stable		96Mo	16.68 %	Stable	
				87Sr	7.00 %	Stable						93Zr	trace	1.53x 10^{6} y	93Nb	93mNb	syn	16.13 y	93Nb	97Mo	9.55 %	Stable	
				88Sr	82.58 %	Stable						94Zr	17.38 %	> 1.1x10^{17} y	94Mo	94Nb	syn	2.03x 10^{4} y	94Mo	98Mo	24.13 %	>1x10^{14} y	98Ru
				89Sr	syn	50.52 d	89Rb, 89Y					96Zr	2.80 %	2.0x10^{19} y	96Mo	95Nb	syn	34.991 d	95Mo	99Mo	syn	65.94 h	99mTc
				90Sr	trace	28.90 y	90Y									95mNb	syn	3.61 d	95Nb	100Mo	9.63 %	7.8x10^{18} y	100Ru

$_{43}$Tc				$_{44}$Ru				$_{45}$Rh				$_{46}$Pd				$_{47}$Ag				$_{48}$Cd			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
95mTc	syn	61 d	95Mo,95Tc	96Ru	5.52%	Stable		99Rh	syn	16.1 d	99Ru	100Pd	syn	3.63 d	100Rh	105Ag	syn	41.2 d	105Pd	106Cd	1.25%	> 9.5 $x10^{17}$ y	106Pd
96Tc	syn	4.3 d	96Mo	97Ru	syn	2.9 d	97Tc	101Rh	syn	3.3 y	101Ru	102Pd	1.02%	Stable		106mAg	syn	8.28 d	106Pd	107Cd	syn	6.5 h	107Ag
97Tc	syn	2.6x10^6 y	97Mo	98Ru	1.88%	Stable		101mRh	syn	4.34 d	101Ru	103Pd	syn	16.991 d	103Rh	107Ag	51.839 %	Stable		108Cd	0.89%	> 6.7 $x10^{17}$ y	108Pd
97mTc	syn	91 d	97Tc	99Ru	12.70%	Stable		102Rh	syn	207 d	102Ru,102Pd	104Pd	11.14%	Stable		108mAg	syn	418 y	108Pd,108Ag	109Cd	syn	462.6 d	109Ag
98Tc	syn	4.2x10^6 y	98Ru	100Ru	12.60%	Stable		102mRh	syn	2.9 y	102Ru	105Pd	22.33%	Stable		109Ag	48.161 %	Stable		110Cd	12.49%	Stable	
99Tc	trace	2.111 $x10^5$ y	99Ru	101Ru	17.00%	Stable		103Rh	100%	Stable		106Pd	27.33%	Stable		111Ag	syn	7.45 d	111Cd	111Cd	12.80%	Stable	
99mTc	syn	6.01 h	99Tc	102Ru	31.60%	Stable		105Rh	syn	35.36 h	105Pd	107Pd	trace	6.5x10^6 y	107Ag					112Cd	24.13%	Stable	
				103Ru	syn	39.26 d	103Rh					108Pd	26.46%	Stable						113Cd	12.22%	7.7 $x10^{15}$ y	113In
				104Ru	18.70%	Stable						110Pd	11.72%	Stable						113mCd	syn	14.1 y	113In,113Cd
				106Ru	syn	373.59 d	106Rh													114Cd	28.73%	> 9.3 $x10^{17}$ y	114Sn
																				115Cd	syn	53.46 h	115In
																				116Cd	7.49%	2.9 $x10^{19}$ y	116Sn

VII. TRANSMUTATION FROM CS

A. Embodiment-5(p2015-55527A)

Table 13 Radiation dose reduction by brown gas generator 133Cs (reagent) was added to monitor the change of Cs concentration

P2015-55527A Embodiment-5	Concentration before	Concentration at intermediate time	Concentration after
date	2012.12.01	2012.12.12	2012.12.25
Process time		11days	24days
133Cs	350mg/L	350mg/L	350mg/L
Ba	10μg/L	80μg/L	60μg/L
Pt	3μg/L	30μg/L	8μg/L

- 133Cs(reagent) Radioactive cesium contaminated water
- Brown gas generator

It was confirmed that cesium-133 was transmuted to barium and platinum after approximately two weeks of treatment. The intermediate value is larger than the final value, which is caused by continuous transmutation.

B. Embodiment-4(p2022-239989A)

Table 14 Transmutation of Cs with 1% $CaCl_2$

P2022-23989A - embodiment-4 (mg/L)	$_{26}$Fe	$_{27}$Co	$_{28}$Ni	$_{29}$Cu	$_{30}$Zn	$_{47}$Ag	$_{55}$Cs	$_{56}$Ba	$_{74}$W	$_{78}$Pt	$_{79}$Au
Concentration Before Transmutation	0.116	0.001	0.013	0.012	0.018	<0.001	6700	0.21	<0.01	<0.001	<0.001
Concentration After Transmutation *2	0.5	7	12	11	16	11	4800	48	22	24	18
Concentration After Transmutation *3	2	14	27	34	31	34	3880	58	40	40	42

➢ *Experimental Condition*

- A 1% aqueous solution of CsCl2.
- *2 Added 0.5μsv tritium water (5g/L)
- *3 The high frequency stirrer vibrated at 170 Hz for 3 hours.

After transmutation of 3 hours, radiation dose decreased from 0.5μsv to less than 0.05μsv.

Adding tritium water increases the concentrations of all elements.

Author thinks that elements with lower atomic numbers than $_{55}$Cs are experimental mistake, and they must be foreign elements. Fe can be from metal plate in brown gas generator of stainless steel. (Fe is transmuted to Ni, and Zn)

Cr from stainless steel is transmuted to Fe, Co, Ni and Cu.

C. Transmutation route from Cs via W via Pt to Au

Table 15 Transmutation Route from Cs via W, via Pt and to Au.

$_{55}$Cs				$_{56}$Ba				$_{57}$La			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
133Cs	100 %	Stable		130Ba	0.11%	(0.5-2.7)x10^{21} y	130Xe	137La	syn	60,000 y	137Ba
134Cs	syn	2.0648 y	134Xe,134Ba	132Ba	0.10%	>3x10^{20} y	132Xe	138La	0.09%	1.05x10^{11} y	138Ba,138Ce
135Cs	trace	2.3x10^{6} y	135Ba	133Ba	syn	10.51 y	133Cs	139La	99.91 %	Stable	
137Cs	trace	30.17 y	137Ba	134Ba	2.42%	Stable					
				135Ba	6.59%	Stable					
				136Ba	7.85%	Stable					
				137Ba	11.23 %	Stable					
				138Ba	71.70 %	Stable					

$_{58}$Ce				$_{59}$Pr				$_{60}$Nd			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
134Ce	syn	3.16 d	134La	141Pr	100%	Stable		142Nd	27.20 %	Stable	
136Ce	0.19%	>3.8x10^{16} y	136Ba	142Pr	syn	19.12 h	142Nd,142Ce	143Nd	12.20 %	Stable	
138Ce	0.25%	>1.5x10^{14} y	138Ba	143Pr	syn	13.57 d	143Nd	144Nd	23.80 %	2.29x10^{15} y	140Ce
139Ce	syn	137.640 d	139La					145Nd	8.30%	>6x10^{16} y	141Ce
140Ce	88.45 %	Stable						146Nd	17.20 %	Stable	
141Ce	syn	32.501 d	141Pr					148Nd	5.70%	>3x10^{18} y	144Ce
142Ce	11.11 %	>5x10^{16} y	142Nd					150Nd	5.60%	6.7x10^{18} y	150Sm
144Ce	syn	284.893 d	144Pr								

$_{61}$Pm				$_{62}$Sm				$_{63}$Eu			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
145Pm	syn	17.7 y	145Nd	144Sm	3.07%	Stable		150Eu	syn	36.9 y	150Sm
146Pm	syn	5.53 y	146Nd, 146Sm	146Sm	syn	1.03x10^{8} y	142Nd	151Eu	47.8 %	5 x10^{18} y	147Pm
147Pm	trace	2.6234 y	147Sm	147Sm	14.99 %	1.06x10^{11} y	143Nd	152Eu	syn	13.516 y	152Sm,152Gd
				148Sm	11.24 %	7x10^{15} y	144Nd	153Eu	52.2 %	Stable	
				149Sm	13.82 %	>2x10^{15} y	145Nd				
				150Sm	7.38%	Stable					
				152Sm	26.75 %	Stable					
				154Sm	22.75 %	>2.3x10^{18} y	154Gd				

$_{64}$Gd				$_{65}$Tb				$_{66}$Dy			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
152Gd	0.20 %	1.08x10^{14} y	148Sm	157Tb	syn	71 y	157Gd	154Dy	syn	3.0x10^{6} y	150Gd
154Gd	2.18 %	Stable		158Tb	syn	180 y	158Gd, 158Dy	156Dy	0.06 %	>1x10^{18} y	152Gd
155Gd	14.80 %	Stable		159Tb	100 %	Stable		158Dy	0.10 %	Stable	
156Gd	20.47 %	Stable						160Dy	2.34 %	Stable	
157Gd	15.65 %	Stable						161Dy	18.91 %	Stable	
158Gd	24.84 %	Stable						162Dy	25.51 %	Stable	
160Gd	21.86 %	>1.3x10^{21} y	160Dy					163Dy	24.90 %	Stable	
								164Dy	28.18 %	Stable	

$_{67}$Ho				$_{68}$Er				$_{69}$Tm			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
163Ho	syn	4570 y	163Dy	160Er	syn	28.58 h	160Ho	167Tm	syn	9.25 d	167Er
164Ho	syn	29 min	164Dy	162Er	0.14%	>1.4x10^{14} y	158Dy,162Dy	168Tm	syn	93.1 d	168Er
165Ho	100 %	Stable		164Er	1.601 %	Stable		169Tm	100 %	Stable	
166Ho	syn	26.763 h	166Er	165Er	syn	10.36 h	165Ho	170Tm	syn	128.6 d	170Yb
167Ho	syn	3.1 h	167Er	166Er	33.503 %	Stable		171Tm	syn	1.92 y	171Yb
				167Er	22.869 %	Stable					
				168Er	26.978 %	Stable					
				169Er	syn	9.4 d	169Tm				
				170Er	14.91 %	>3.2x10^{17} y	166Dy,170Yb				
				171Er	syn	7.516 h	171Tm				
				172Er	syn	49.3 h	172Tm				

$_{70}$Yb				$_{71}$Lu				$_{72}$Hf			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
166Yb	syn	56.7 h	166Tm	173Lu	syn	1.37 y	173Yb	172Hf	syn	1.87 y	172Lu
168Yb	0.13%	>1.3x10^{14} y	164Er, 168Er	174Lu	syn	3.31 y	174Yb	174Hf	0.16%	2x10^{15} y	170Yb
169Yb	syn	32.026 d	169Tm	175Lu	97.41 %	Stable		176Hf	5.21%	Stable	
170Yb	3.04 %	Stable		176Lu	2.59 %	3.78x10^{10} y	176Hf	177Hf	18.61 %	Stable	
171Yb	14.28 %	Stable						178Hf	27.30 %	Stable	
172Yb	21.83 %	Stable						178m2Hf	syn	31 y	178Hf
173Yb	16.13 %	Stable						179Hf	13.63 %	Stable	
174Yb	31.83 %	Stable						180Hf	35.10 %	Stable	
175Yb	syn	4.185 d	175Lu					182Hf	syn	9x10^{6} y	182Ta
176Yb	12.76 %	>1.6x10^{17} y	172Er, 176Hf								
177Yb	syn	1.911 h	177Lu								

$_{73}$Ta				$_{74}$W				$_{75}$Re				$_{76}$Os				$_{77}$Ir				$_{78}$Pt			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
177Ta	syn	56.56 h	177Hf	180W	0.12%	1.8x10^{18} y	176Hf	185Re	37.40 %	Stable		184Os	0.02%	1.1x10^{13} y	180W	188Ir	syn	1.73 d	188Os	190Pt	0.014 %	6.5x10^{11} y	186Os
178Ta	syn	2.36 h	178Hf	181W	syn	121.2 d	181Ta	187Re	62.60 %	4.12×10^{10} y	183Ta,187Os	185Os	syn	93.6 d	185Re	189Ir	syn	13.2 d	189Os	192Pt	0.782 %	>6x10^{16} y	188Os
179Ta	syn	1.82 y	179Hf	182W	26.50 %	>1.7x10^{20} y	178Hf					186Os	1.59%	2.0x10^{15} y	182W	190Ir	syn	11.8 d	190Os	193Pt	syn	50 y	193Ir
180Ta	syn	8.125 h	180Hf,180W	183W	14.31 %	>8x10^{19} y	179Hf					187Os	1.96%	Stable		191Ir	37.30 %	Stable		194Pt	32.967 %	Stable	
180mTa	0.01%	> 1.2x 1015 y	180Hf,180W,180Ta	184W	30.64 %	>1.8x10^{20} y	180Hf					188Os	13.24 %	Stable		192Ir	syn	73.827 d	192Pt,192Os	195Pt	33.832 %	Stable	
181Ta	99.99 %	Stable		185W	syn	75.1 d	185Re					189Os	16.15 %	Stable		192m2Ir	syn	241 y	192Ir	196Pt	25.242 %	Stable	
182Ta	syn	114.43 d	182W	186W	28.43 %	>4.1x10^{18} y	182Hf,186Os					190Os	26.26 %	Stable		193Ir	62.70 %	Stable		198Pt	7.356 %	>3.2x10^{14} y	194Os,198Hg
183Ta	syn	5.1 d	183W									191Os	syn	15.4 d	191Ir	193mIr	syn	10.5 d	193Ir				
												192Os	40.78 %	> 9.8x10^{12} y	192Pt	194Ir	syn	19.3 h	194Pt				
												193Os	syn	30.11 d	193Ir	194m2Ir	syn	171 d	194Ir				
												194Os	syn	6 y	194Ir								

$_{79}$Au				$_{80}$Hg				$_{81}$Tl				$_{82}$Pb											
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
195Au	syn	186.10 d	195Pt	194Hg	syn	444 y	194Au	203Tl	29.52 %	Stable		204Pb	1.4 %	> 1.4x10^{17} y	200Hg								
196Au	syn	6.183 d	196Pt, 196Hg	195Hg	syn	9.9 h	195Au	204Tl	syn	119 Ms	204Pb,204Hg	205Pb	syn	1.53x10^{7} y	205Tl								
197Au	100 %	Stable		196Hg	0.15%	>2.5x10^{18} y	192Pt, 196Pt	205Tl	70.48 %	Stable		206Pb	24.1 %	Stable									
198Au	syn	2.69517 d	198Hg	197Hg	syn	64.14 h	197Au					207Pb	22.1 %	Stable									
199Au	syn	3.169 d	199Hg	198Hg	9.97 %	Stable						208Pb	52.4 %	Stable									
				199Hg	16.87 %	Stable						210Pb	trace	22.3 y	206Hg,210Bi								
				200Hg	23.1 %	Stable																	
				201Hg	13.18 %	Stable																	
				202Hg	29.86 %	Stable																	
				203Hg	syn	46.612 d	203Tl																
				204Hg	6.87 %	Stable																	

VIII. TRANSMUTATION MECHANISM DISCUSSION

A. Inconsistent Data with Route Analysis

Ohmasa's embodiment data has the inconsistent element creation with transmutation route analysis based on femto-H_2 transmutation mechanism, which is no route from $^{40}_{20}$Ca (NA=96.94%) to ^{63}29Cu nor $^{65}_{29}$Cu, because Cu has odd mass number and $^{40}_{20}$Ca had even mass number, and mass number increases by2.

As is shown below, $^{43}_{20}$Ca (NA=0.14%) has the route to Cu, but NA is too small.

$^{53}_{24}$Cr (NA=9.5%) has route to Cu.

Author thinks that Cr and Fe are caused by metal plate of the stainless steel in Ohmasa gas generator.

B. Ni Concentration is Very High.

Ohmasa wants to use Ca to generate Ni, which concentration is very high, because Ni has multiple isotopes with longer half-life, thus mass increase in Ni 3 times.

As I discussed in IX, Fe and Ni can be collected in strong alkaline aqueous.

C. Cr to Cu [$^{53}_{24}$Cr has the Route to $^{63,65}_{29}$Cu]

Table 16 Transmutation Route to Cu from Cr

$_{24}$Cr				$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
50Cr	4.35%	>1.8 $\times 10^{17}$ y	50Ti	52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7 x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
51Cr	syn	27.7025 d	51V	53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co					65Zn	syn	243.8 d	65Cu
52Cr	83.789 %	Stable		54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable		65Cu	30.85 %	Stable		66Zn	27.9 %	Stable	
53Cr	9.501 %	Stable		55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
54Cr	2.365 %	Stable						58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable		TO Ag, Au				68Zn	18.8 %	Stable	
								59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu								
								60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						70Zn	0.6 %	Stable	
											61Co																
											62Co													72Zn	syn	46.5 h	72Ga

D. From Ca to Cu [$^{43}_{20}$Ca (0.65% Stable) to $^{53}_{29}$Cu, ^{53}Cu]

Table 17 Transmutation Route to Cu from Ca

$_{20}$Ca				$_{21}$Sc				$_{22}$Ti				$_{23}$V				$_{24}$Cr			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
40Ca	96.94%	>5.9x10^{21}y	40Ar	44mSc	syn	58.61 h	44Sc,44Ca	44Ti	syn	63 y	44Sc	48V	syn	15.9735 d	48Ti	50Cr	4.35%	> 1.8 $\times 10^{17}$ y	50Ti
41Ca	trace	1.03x10^{5}y	41K	44Sc								49V	syn	330 d	49Ti	51Cr	syn	27.7025 d	51V
42Ca	0.65%	Stable		45Sc	100%	Stable		46Ti	8.00%	Stable		50V	0.25 %	1.5 $\times 10^{17}$ y	50Ti,50Cr	52Cr	83.789 %	Stable	
43Ca	0.14%	Stable		46Sc	syn	83.79 d	46Ti	47Ti	7.30%	Stable		51V	99.75 %	Stable		53Cr	9.501 %	Stable	
44Ca	2.09%	Stable		47Sc	syn	3.3492 d	47Ti	48Ti	73.80%	Stable						54Cr	2.365 %	Stable	
45Ca	syn	162.7d	45Sc	48Sc	syn	43.67 h	48Ti	49Ti	5.50%	Stable									
46Ca	0.00%	>2.8x10^{15}y	46Ti					50Ti	5.40%	Stable									
47Ca	syn	4.536 d	47Sc																
48Ca	0.19%	4.3x10^{19} y	48Ti,48Sc																

$_{25}$Mn				$_{26}$Fe				$_{27}$Co				$_{28}$Ni				$_{29}$Cu				$_{30}$Zn			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
52Mn	syn	5.591 d	52Cr	54Fe	5.8 %	3.1x10^{22} y	54Cr	56Co	syn	77.27 d	56Fe	58Ni	68.077 %	> 7 x10^{20} y	58Fe	63Cu	69.15 %	Stable		64Zn	48.6 %	Stable	
53Mn	trace	3.74x10^{6} y	53Cr	55Fe	syn	2.73 y	55Mn	57Co	syn	271.79 d	57Fe	59Ni	trace	76000 y	59Co					65Zn	syn	243.8 d	65Cu
54Mn	syn	312.3 d	54Cr	56Fe	91.72 %	Stable		58Co	syn	70.86 d	58Fe	60Ni	26.223 %	Stable		65Cu	30.85 %	Stable		66Zn	27.9 %	Stable	
55Mn	100%	Stable		57Fe	2.2 %	Stable		59Co	100 %	Stable		61Ni	1.14 %	Stable						67Zn	4.1 %	Stable	
				58Fe	0.28 %	Stable		60Co	syn	5.2714 y	60Ni	62Ni	3.634 %	Stable		TO Ag, Au				68Zn	18.8 %	Stable	
				59Fe	syn	44.503 d	59Co					63Ni	syn	100.1 y	63Cu								
				60Fe	syn	2.6x10^{6} y	60Co					64Ni	0.926 %	Stable						70Zn	0.6 %	Stable	
							61Co																
							62Co													72Zn	syn	46.5 h	72Ga

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E. From $^{63}_{29}$ Cu to $^{107}_{47}$Ag [^{63}Cu and ^{65}Cu has the route to $^{105,107,109}_{47}$Ag]

Table 18 Transmutation Route from Cu to Ag

$_{29}$Cu			$_{30}$Zn			$_{31}$Ga			$_{32}$Ge			$_{33}$As			$_{34}$Se		
isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life
63Cu	69.15 %	Stable	64Zn	48.6 %	Stable	69Ga	60.11 %	Stable	68Ge	syn	270.8 d	73As	syn	80.3 d	72Se	syn	8.4 d
			65Zn	syn	243.8 d	70Ga						74As	syn	17.78 d			
65Cu	30.85 %	Stable	66Zn	27.9 %	Stable	71Ga	39.89 %	Stable	70Ge	21.23 %	Stable	75As	100 %	Stable	74Se	0.87%	Stable
			67Zn	4.1 %	Stable				71Ge	syn	11.26 d				75Se	syn	119.79 d
			68Zn	18.8 %	Stable				72Ge	27.66 %	Stable				76Se	9.36%	Stable
			69Zn						73Ge	7.73 %	Stable				77Se	7.63%	Stable
			70Zn	0.6 %	Stable				74Ge	35.94 %	Stable				78Se	23.78 %	Stable
			72Zn	syn	46.5 h				76Ge	7.44 %	1.78x10^{21} y				79Se	trace	3.27x10^{5} y
															80Se	49.61 %	Stable
															82Se	8.73%	1.08x10^{20} y

$_{35}$Br			$_{36}$Kr			$_{37}$Rb			$_{38}$Sr			$_{39}$Y			$_{40}$Zr			$_{41}$Nb		
isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life
79Br	50.69 %	Stable	78Kr	0.35%	Stable	83Rb	syn	86.2 d	82Sr	syn	25.36 d	87Y	syn	3.35 d	88Zr	syn	83.4 d	91Nb	syn	6.8x10^{2} y
			79Kr	syn	35.04 h	84Rb	syn	32.9 d	83Sr	syn	1.35 d	88Y	syn	106.6 d	89Zr	syn	78.41 h	92Nb	syn	3.47x10^{7} y
81Br	49.31 %	Stable	80Kr	2.25%	Stable	85Rb	72.17 %	Stable	84Sr	0.56%	Stable	89Y	100%	Stable	90Zr	51.45 %	Stable	93Nb	100%	Stable
From^{77}Se			81Kr	trace	2.29x10^{5} y	86Rb	syn	18.65 d	85Sr	syn	64.84 d	90Y	syn	2.67 d	91Zr	11.22 %	Stable	94Nb	syn	2.03x10^{4} y
			82Kr	11.60 %	Stable	87Rb	27.84 %	4.88x1010 y	86Sr	9.86%	Stable	91Y	syn	58.5 d	92Zr	17.15 %	Stable	95Nb	syn	34.991 d
			83Kr	11.50 %	Stable				87Sr	7.00%	Stable				93Zr	trace	1.53×106 y			
			84Kr	57%	Stable				88Sr	82.58 %	Stable				94Zr	17.38 %	>1.1×1017 y			
			85Kr	syn	10.756 y				89Sr	syn	50.52 d				96Zr	2.80%	2.0×1019 y[3]			
			86Kr	17.30 %	Stable				90Sr	trace	28.90 y									

$_{42}$Mo			$_{43}$Tc			$_{44}$Ru			$_{45}$Rh			$_{46}$Pd			$_{47}$Ag			$_{48}$Cd			
isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	DP
92Mo	14.84 %	>1.9x10^{20} y	95mTc	syn	61 d	96Ru	5.52%	Stable	99Rh	syn	16.1 d	100Pd	syn	3.63 d	105Ag	syn	41.2 d	106Cd	1.25%	>9.5x1017 y	106Pd
93Mo	syn	4,000 y	96Tc	syn	4.3 d	97Ru	syn	2.9 d	101Rh	syn	3.3 y	102Pd	1.02%	Stable	106mAg	syn	8.28 d	107Cd	syn	6.5 h	107Ag
From ^{93}Nb 94Mo	9.25%	Stable	97Tc	syn	2.6×106 y	98Ru	1.88%	Stable	101mRh	syn	4.34 d	103Pd	syn	16.991 d	107Ag	51.839 %	Stable	108Cd	0.89%	>6.7x1017 y	108Pd
95Mo	15.92 %	Stable	98Tc	syn	4.2×106 y	99Ru	12.70 %	Stable	102Rh	syn	207 d	104Pd	11.14 %	Stable	108mAg	syn	418 y	109Cd	syn	462.6 d	109Ag
96Mo	16.68 %	Stable	99Tc	trace	2.111×105 y	100Ru	12.60 %	Stable	103Rh	100%	Stable	105Pd	22.33 %	Stable	109Ag	48.161 %	Stable	110Cd	12.49 %	Stable	
97Mo	9.55%	Stable				101Ru	17.00 %	Stable				106Pd	27.33 %	Stable	111Ag	syn	7.45 d	111Cd	12.80 %	Stable	
98Mo	24.13 %	>1x1014 y				102Ru	31.60 %	Stable	105Rh	syn	35.36 h	107Pd	trace	6.5x106 y				112Cd	24.13 %	Stable	
99Mo	syn	65.94 h				103Ru	syn	39.26 d				108Pd	26.46 %	Stable				113Cd	12.22 %	7.7x1015 y	113In, 113Cd
100Mo	9.63%	7.8x1018 y				104Ru	18.70 %	Stable				110Pd	11.72 %	Stable				114Cd	28.73 %	>9.3x1017 y	114Sn
						106Ru	syn	373.59 d										115Cd	syn	53.46 h	115In
																		116Cd	7.49%	2.9x1019 y	116Sn

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The rout from Cu to Ag is so complicated as is in table 18.

It is important to understand the mechanism of higher concentration of Ag, and Au generation is similar.

${}^{63}_{29}$Cu+2p=${}^{65}_{30}$Zn; ${}^{65}_{30}$Zn+2p=${}^{67}_{30}$Zn

or ${}^{63}_{29}$Cu+2p=${}^{65}_{39}$Cu; ${}^{65}_{39}$Cu+2p=${}^{67}_{30}$Zn

${}^{67}_{30}$Zn+2p=${}^{69}_{31}$Ga; ${}^{69}_{31}$Ga+2p=${}^{71}_{32}$Ge ; ${}^{71}_{32}$Ge+2p=${}^{73}_{33}$As ;

${}^{97}_{44}$Ru+2p=${}^{99}_{45}$Rh; ${}^{99}_{45}$Rh+2p=${}^{101}_{45}$Rh; ${}^{101}_{45}$Rh+2p=${}^{103}_{46}$Pd

${}^{103}_{46}$Pd+2p=${}^{105}_{47}$Ag;

${}^{105}_{47}$Ag+2p=${}^{107}_{47}$Ag (Stable,100%);

${}^{107}_{47}$Ag+2p=${}^{109}_{47}$Ag (48%)

${}^{105}_{47}$Ag+2p=${}^{107}_{48}$Cd[6,5h] =>${}^{107}_{47}$Ag (Stable, 100%)

${}^{107}_{47}$Ag+2p=${}^{109}_{47}$Ag (48%) or ${}^{107}_{47}$Ag+2p=${}^{109}_{48}$Cd[463d]

Because transmutation continues beyond the desired element/isotope, Ag must have transmuted to the next element of Cd. Actually, Ag is detected in many embodiments, thus there must have cause. Transmutation route tend to be on the isotopes with lower mass number, the route in the table. ${}^{107}_{48}$Cd and ${}^{109}_{48}$Cd, which decay to ${}^{107}_{47}$Ag and ${}^{109}_{47}$Ag, and they are on the isotopes with smaller mass number, and it is important to note that starting isotope must have odd mass number because femto-H_2 add two protons, and stable Ag and Au with largest NA has odd mass number.

F. ${}^{133}_{55}$Cs to ${}^{197}_{79}$Au ; From ${}^{181}_{74}$W to ${}^{197}_{79}$Au(Latter half)

Table 19 Transmutation Route from W to Au.

$_{74}$W				$_{75}$Re				$_{76}$Os				$_{77}$Ir				$_{78}$Pt				$_{79}$Au				$_{80}$Hg			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
180 W	0.12 %	1.8x 1018 y	176Hf	185 Re	0.374	Stable		184 Os	0.02 %	1.1x 10^{13} y	180 W	188 Ir	syn	1.73 d	188Os	190 Pt	0.014 %	6.5x 10^{11} y	186Os	195 Au	syn	186.10 d	195Pt	194 Hg	syn	444 y	194Au
181 W	syn	121.2 d	181Ta					185 Os	syn	93.6 d	185Re	189 Ir	syn	13.2 d	189Os	192 Pt	0.782 %	>6x10^{16} y	188Os	196 Au	syn	6.183 d	196Pt,196Hg	195 Hg	syn	9.9 h	195Au
182 W	26.5 %	>1.7 x10^{20} y	178Hf	187 Re	0.626	4.12 x10^{10} y	183Ta,187Os	186 Os	1.59 %	2.0x10^{15} y	182 W	190 Ir	syn	11.8 d	190Os	193 Pt	syn	50 y	193Ir	197 Au	100 %	Stable		196 Hg	0.15 %	>2.5 x10^{18} y	192Pt,196Pt
183 W	14.31%	>8x10^{19} y	179Hf					187 Os	1.96 %	Stable		191 Ir	37.30%	Stable		194 Pt	32.967 %	Stable		198 Au	syn	2.69517 d	198Hg	197 Hg	syn	64.14 h	197Au
184 W	30.64%	>1.8 x10^{20} y	180Hf					188 Os	13.24%	Stable		192 Ir	syn	73.827 d	192Pt	195 Pt	33.832 %	Stable		199 Au	syn	3.169 d	199Hg	198 Hg	9.97 %	Stable	
185 W	syn	75.1 d	185Re					189 Os	16.15%	Stable		193 Ir	62.70%	Stable	193Ir (193m)	196 Pt	25.242 %	Stable		201 Au				199 Hg	16.87 %	Stable	
186 W	28.43%	>4.1 x10^{18} y	182Hf,186Os					190 Os	26.26%	Stable		194 Ir	syn	19.3 h	194Pt,194Ir(meta)					203 Au				200 Hg	23.1 %	Stable	
								191 Os	syn	15.4 d	191Ir					198 Pt	7.356 %	>3.2x 10^{14} y	194Os,198Hg					201 Hg	13.18 %	Stable	204Pb
								192 Os	40.78%	> 9.8x 10^{12} y	192Pt													202 Hg	29.86 %	Stable	
								193 Os	syn	30.11 d	193Ir													203 Hg	syn	46.612 d	203Tl
								194 Os	syn	6 y	194Ir													204 Hg	6.87 %	Stable	

➢ *Route*

${}^{191}_{77}$Ir+2p=${}^{193}_{78}$Pt; ${}^{193}_{78}$Pt+2p=**${}^{195}_{80}$Hg[9.9h]=>${}^{195}_{79}$Au[186d]**

${}^{195}_{79}$Au+2p=**${}^{197}_{80}$Hg[64.14h]=>${}^{197}_{79}$Au[Stable]** ;

${}^{197}_{79}$Au+2p=${}^{199}_{80}$Hg[Stable] ; ${}^{199}_{80}$Hg+2p=${}^{201}_{80}$Hg[Stable]

${}^{201}_{80}$Hg+2p=${}^{203}_{81}$Tl [Stable]

This route is similar with the rout to Ag because Ag and Au belong to the same group on the periodic table, so they have similar chemical characteristics.

Similarity is the decay from Hg, or Cd.

This is discussed later.

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G. From $^{63}_{29}$Cu to Ag

Embodiment-2(p2022-239989A) shows the transmutation from $_{29}$Cu to $_{30}$Zn,$_{47}$Ag,$_{79}$Au. From $_{47}$Ag, to $_{79}$Au, is so long, thus I separate at $^{133}_{55}$Cs, which is transmuted to $^{\mathbf{197}}_{\mathbf{79}}$**Au**.

Table 20 Transmutation Route from Cu to ^{55}Cs.

$_{29}$Cu			$_{30}$Zn			$_{31}$Ga			$_{32}$Ge			$_{33}$As			$_{34}$Se		
isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life
63Cu	69.15 %	Stable	66Zn	27.9 %	Stable	69Ga	60.11 %	Stable	68Ge	syn	270.8 d	73As	syn	80.3 d	72Se	syn	8.4 d
			67Zn	4.1 %	Stable	70Ga						74As	syn	17.78 d			
65Cu	30.85 %	Stable	68Zn	18.8 %	Stable	71Ga	39.89 %	Stable	70Ge	21.23 %	Stable	75As	100 %	Stable	74Se	0.87%	Stable
			69Zn						71Ge	syn	11.26 d				75Se	syn	119.779 d
			70Zn	0.6 %	Stable				72Ge	27.66 %	Stable				76Se	9.36%	Stable
																^{79}Kr	
			72Zn	syn	46.5 h				73Ge	7.73 %	Stable				77Se	7.63%	Stable
									74Ge	35.94 %	Stable				78Se	23.78 %	Stable
									76Ge	7.44 %	1.78x 10^{21} y				79Se	trace	3.27x 10^5 y
															80Se	49.61 %	Stable
															82Se	8.73%	1.08x 10^{20} y

$_{35}$Br			$_{36}$Kr			$_{37}$Rb			$_{38}$Sr			$_{39}$Y			$_{40}$Zr			$_{41}$Nb		
isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA ^{93}Mo	half-life
79Br	50.69 %	Stable	78Kr	0.35%	Stable	83Rb	syn	86.2 d	82Sr	syn	25.36 d	87Y	syn	3.35 d	88Zr	syn	83.4 d	91Nb	syn	6.8x1 0^2 y
^{77}Se			79Kr	syn	35.04 h	84Rb	syn	32.9 d	83Sr	syn	1.35 d	88Y	syn	106.6 d	89Zr	syn	78.4 h	92Nb	syn	3.47x 10^7 y
81Br	49.31 %	Stable	80Kr	2.25%	Stable	85Rb	72.17 %	Stable	84Sr	0.56%	Stable	89Y	100%	Stable	90Zr	51.45 %	Stable	93Nb	100%	Stable
			81Kr	trace	2.29x1 0^5 y	86Rb	syn	18.65 d	85Sr	syn	64.84 d	90Y	syn	2.67 d	91Zr	11.22 %	Stable	94Nb	syn	2.03x 10^4 y
			82Kr	11.60 %	Stable	87Rb	27.84 %	4.88x1 010 y	86Sr	9.86%	Stable	91Y	syn	58.5 d	92Zr	17.15 %	Stable	95Nb	syn	34.99 1 d
			83Kr	11.50 %	Stable				87Sr	7.00%	Stable				93Zr	trace	1.53×106 y			
			84Kr	57%	Stable				88Sr	82.58 %	Stable				94Zr	17.38 %	> 1.1×1 017 y			
			85Kr	syn	10.756 y				89Sr	syn	50.52 d				96Zr	2.80%	2.0×1 019 y[3]			
			86Kr	17.30 %	Stable				90Sr	trace	28.90 y									

$_{42}$Mo			$_{43}$Tc			$_{44}$Ru			$_{45}$Rh			$_{46}$Pd			$_{47}$Ag			$_{48}$Cd			
isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	isotope	NA	half-life	DP
92Mo	14.84 %	>1.9x1 0^{20} y	95mTc	syn	61 d	96Ru	5.52%	Stable	99Rh	syn	16.1 d	100Pd	syn	3.63 d	105Ag	syn	41.2 d	106Cd	1.25%	> 9.5x10 17 y	106Pd
^{91}Nb 93Mo	syn	4,000 y	96Tc	syn	4.3 d	97Ru	syn	2.9 d	101Rh	syn	3.3 y	102Pd	1.02%	Stable	106mAg	syn	8.28 d	107Cd	syn	6.5 h	107Ag
94Mo	9.25%	Stable	97Tc	syn	2.6×1 06 y	98Ru	1.88%	Stable	101mRh	syn	4.34 d	103Pd	syn	16.991 d	107Ag	51.839 %	Stable	108Cd	0.89%	> 6.7x10 17 y	108Pd
95Mo	15.92 %	Stable	98Tc	syn	4.2×1 06 y	99Ru	12.70 %	Stable	102Rh	syn	207 d	104Pd	11.14 %	Stable	108mAg	syn	418 y	109Cd	syn	462.6 d	109Ag
96Mo	16.68 %	Stable	99Tc	trace	2.111 ×105 y	100Ru	12.60 %	Stable	103Rh	100%	Stable	105Pd	22.33 %	Stable	109Ag	48.161 %	Stable	110Cd	12.49 %	Stable	
97Mo	9.55%	Stable				101Ru	17.00 %	Stable				106Pd	27.33 %	Stable	111Ag	syn	7.45 d	111Cd	12.80 %	Stable	
98Mo	24.13 %	>1x1014 y				102Ru	31.60 %	Stable	105Rh	syn	35.36 h	107Pd	trace	6.5x10 6 y				112Cd	24.13 %	Stable	
99Mo	syn	65.94 h				103Ru	syn	39.26 d				108Pd	26.46 %	Stable				113Cd	12.22 %	7.7x10 15 y	113In, 113Cd
100Mo	9.63%	7.8x1018 y				104Ru	18.70 %	Stable				110Pd	11.72 %	Stable				114Cd	28.73 %	> 9.3x10 17 y	114Sn
						106Ru	syn	373.59 d										115Cd	syn	53.46 h	115In
																		116Cd	7.49%	2.9x10 19 y	116Sn

$_{48}$Cd			$_{49}$In			$_{50}$Sn			$_{51}$Sb			$_{52}$Te			$_{53}$I			$_{54}$Xe			$_{55}$Cs		
ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life									
106Cd	1.25%	> 9.5x10^{17} y	113In	4.30%	Stable	112Sn	0.97 %	Stable	121Sb	57.36 %	Stable	120Te	0.09%	> 2.2x10^{16}y	123I	syn	13 h	124Xe	0.10%	1.8x1022 y	133Cs	100 %	Stable
107Cd	syn	6.5 h										121Te	syn	16.78 d				125Xe	syn	16.9 h	134Cs	syn	2.0648 y
108Cd	0.89%	> 6.7x10^{17} y	115In	95.7? %	4.41x10^{14} y	114Sn	0.66 %	Stable	123Sb	42.64 %	Stable	122Te	2.55%	Stable				126Xe	0.09%	Stable	135Cs	trace	2.3×106 y
109Cd	syn	462.6 d				115Sn	0.34 %	Stable				123Te	0.89%	> 1.0x10^{13} y				127Xe	syn	36.345 d	137Cs	trace	30.17 y[2]
110Cd	12.49 %	Stable				116Sn	14.54 %	Stable							127I	100 %	Stable	128Xe	1.91%	Stable			
111Cd	12.80 %	Stable				117Sn	7.68 %	Stable										129Xe	26.40 %	Stable			
112Cd	24.13 %	Stable				118Sn	24.22 %	Stable							129I	trace	15.7x10^{6} y	130Xe	4.07%	Stable			
113Cd	12.22 %	7.7x10^{15} y				119Sn	8.59 %	Stable										131Xe	21.20 %	Stable			
114Cd	28.73 %	> 9.3x10^{17} y				120Sn	32.58 %	Stable							131I	syn	8.02070 d	132Xe	26.90 %	Stable			
115Cd	syn	53.46 h																133Xe	syn	5.247 d			
116Cd	7.49%	2.9x10^{19} y																134Xe	10.40 %	>1.1x1016 y			
																		135Xe	syn	9.14 h			
																		136Xe	8.86%	2.11x1020 y			

^{175}Au

H. $^{133}_{55}$Cs to $^{197}_{79}$Au($^{133}_{55}$Cs to $^{181}_{74}$W)

Table 21 transmutation route from Cs to W.

$_{55}$Cs			$_{56}$Ba			$_{57}$La			$_{58}$Ce			$_{59}$Pr		
ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life
133Cs	100 %	Stable	130Ba	0.11%	(0.5-2.7)x1021 y	137La	syn	60,000 y	134Ce	syn	3.16 d	141Pr	100%	Stable
134Cs	syn	2.0648 y	132Ba	0.10%	>3x1020 y	138La	0.09%	1.05 × 1011 y	135Ce			142Pr	syn	19.12 h
135Cs	trace	2.3x106 y	133Ba	syn	10.51 y	139La	99.91%	Stable	136Ce	0.19%	> 3.8 × 1016 y	143Pr	syn	13.57 d
136Cs			134Ba	2.42%	Stable				137Ce		9.0(3) h			
137Cs	trace	30.17 y[2]	135Ba	6.59%	Stable				138Ce	0.25%	> 1.5 × 1014 y			
			136Ba	7.85%	Stable				139Ce	syn	137.640 d			
			137Ba	11.23%	Stable				140Ce	88.45%	Stable			
			138Ba	71.70%	Stable				141Ce	syn	32.501 d			
									142Ce	11.11%	> 5 × 1016 y			
									143Ce					
									144Ce	syn	284.893 d			

^{143}Nd

$_{60}$Nd			$_{61}$Pm			$_{62}$Sm			$_{63}$Eu			$_{64}$Gd		
ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life
142Nd	27.20%	Stable	145Pm	syn	17.7 y	144Sm	3.07%	Stable	150Eu	syn	36.9 y	152Gd	0.20 %	1.08x1014 y
143Nd	12.20%	Stable	146Pm	syn	5.53 y				151Eu	47.8 %	5x10^{18} y	154Gd	2.18 %	Stable
144Nd	23.80%	2.29x 10^{15} y	147Pm	trace	2.6234 y	146Sm	syn	1.03 x 10^{8} y	152Eu	syn	13.516 y	155Gd	14.80 %	Stable
145Nd	8.30%	>6x 10^{16} y				147Sm	14.99%	1.06 x 10^{11} y	153Eu	52.2 %	Stable	156Gd	20.47 %	Stable
146Nd	17.20%	Stable				148Sm	11.24%	7 x 10^{15} y	154Eu			157Gd	15.65 %	Stable
148Nd	5.70%	>3x 10^{18} y				149Sm	13.82%	>2 x 10^{15} y	155Eu			158Gd	24.84 %	Stable
150Nd	5.60%	6.7x 10^{18} y				150Sm	7.38%	Stable				160Gd	21.86 %	> 1.3x1021 y
						152Sm	26.75%	Stable						
						154Sm	22.75%	>2.3 x 10^{18} y						

^{157}Tb

$_{65}$Tb			$_{66}$Dy			$_{67}$Ho			$_{68}$Er			$_{69}$Tm		
ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life
157Tb	syn	71 y	154Dy	syn	3.0x106 y	163Ho	syn	4570 y	164Er	1.601 %	Stable	167Tm	syn	9.25 d (169Yb)
158Tb	syn	180 y	156Dy	0.06 %	>1x1018 y	164Ho	syn	29 min	165Er	syn	10.36 h	168Tm	syn	93.1 d
159Tb	100 %	Stable	158Dy	0.10 %	Stable	165Ho	100 %	Stable	166Er	33.503 %	Stable	169Tm	100 %	Stable
			160Dy	2.34 %	Stable	166Ho	syn	26.763 h	167Er	22.869 %	Stable	170Tm	syn	128.6 d
			161Dy	18.91 %	Stable	167Ho	syn	3.1 h	168Er	26.978 %	Stable	171Tm	syn	1.92 y
			162Dy	25.51 %	Stable				169Er	syn	9.4 d			
			163Dy	24.90 %	Stable				170Er	14.91%	>3.2x1017 y			
			164Dy	28.18 %	Stable				171Er	syn	7.516 h			
									172Er	syn	49.3 h			

$_{70}$Yb			$_{71}$Lu			$_{72}$Hf			$_{73}$Ta			$_{74}$W		
ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life	ISOTOPE	NA	Half-Life
166Yb	syn	56.7 h	173Lu	syn	1.37 y	172Hf	syn	1.87 y	177Ta	syn	56.56 h	180W	0.12%	1.8×1018 y
168Yb	0.13%	>1.3x1014 y	174Lu	syn	3.31 y	173Hf		23.6(1) h	178Ta	syn	2.36 h	181W	syn	121.2 d
169Yb	syn	32.026 d	175Lu	97.41 %	Stable	174Hf	0.16%	2×1015 y	179Ta	syn	1.82 y	182W	26.50%	>1.7×1020 y
170Yb	3.04 %	Stable	176Lu	2.59 %	3.78×1010 y	175Hf		70(2) d	180Ta	syn	8.125 h	183W	14.31%	>8×1019 y
171Yb	14.28 %	Stable				176Hf	5.21%	Stable	180mTa	0.01%	> 1.2x1015 y	184W	30.64%	>1.8×1020 y
172Yb	21.83 %	Stable				177Hf	18.61%	Stable	181Ta	99.99%	Stable	185W	syn	75.1 d
173Yb	16.13 %	Stable				178Hf	27.30%	Stable	182Ta	syn	114.43 d	186W	28.43%	>4.1×1018 y
174Yb	31.83 %	Stable				178m2Hf	syn	31 y	183Ta	syn	5.1 d			185Os =>197 79Au
175Yb	syn	4.185 d				179Hf	13.63%	Stable						
176Yb	12.76%	>1.6x1017 y				180Hf	35.10%	Stable						
177Yb	syn	1.911 h				182Hf	syn	9×106 y						

I. $^{133}_{55}$Cs to $^{197}_{79}$Au ($^{181}_{74}$W to $^{197}_{79}$Au)

Table 22 Transmutation Route from ^{181}W to ^{107}Au.

$_{74}$W				$_{75}$Re				$_{76}$Os				$_{77}$Ir				$_{78}$Pt				$_{79}$Au				$_{80}$Hg			
ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP	ISOTOPE	NA	Half-Life	DP
180W	0.12 %	1.8x1018 y	176Hf	185Re	0.374	Stable		184Os	0.02 %	1.1x10^{13} y	180W	188Ir	syn	1.73 d	188Os	190Pt	0.014 %	6.5x10^{11} y	186Os	195Au	syn	186.10 d	195Pt	194Hg	syn	444 y	194Au
181W	syn	121.2 d	181Ta		To ^{197}Au			185Os	syn	93.6 d	185Re	189Ir	syn	13.2 d	189Os	192Pt	0.782 %	>6x1 ... y	188Os	196Au	syn	6.18 d	196Pt,196Hg	195Hg	syn	9.9 h	195Au
182W	26.5 %	>1.7x10^{20} y	178Hf	187Re	0.626	4.12x10^{10} y	183Ta,187Os	186Os	1.59 %	2.0x10^{15} y	182W	190Ir	syn	11.8 d	190Os	193Pt	syn	50 y	193Ir	197Au	100 %	Stable		196Hg	0.15 %	>2.5x10^{18} y	192Pt,196Pt
183W	14.31%	>8x10^{19} y	179Hf					187Os	1.96 %	Stable		191Ir	37.30%	Stable		194Pt	32.967 %	Stable		198Au	syn	2.69517 d	198Hg	197Hg	syn	64.14 h	197Au
184W	30.64%	>1.8x10^{20} y	180Hf					188Os	13.24%	Stable		192Ir	syn	73.827 d	192Pt	195Pt	33.832 %	Stable		199Au	syn	3.169 d	199Hg	198Hg	9.97 %	Stable	
185W	syn	75.1 d	185Re					189Os	16.15%	Stable		193Ir	62.70%	Stable	193Ir (193m)	196Pt	25.242 %	Stable		201Au				199Hg	16.87 %	Stable	
186W	28.43%	>4.1x10^{18} y	182Hf,186Os					190Os	26.26%	Stable		194Ir	syn	19.3 h	194Pt,194Ir(meta)					203Au				200Hg	23.1 %	Stable	
								191Os	syn	15.4 d	191Ir					198Pt	7.356 %	>3.2x10^{14} y	194Os,198Hg					201Hg	13.18 %	Stable	^{204}Pb
								192Os	40.78%	>9.8x10^{12} y	192Pt													202Hg	29.86 %	Stable	
								193Os	syn	30.11 d	193Ir													203Hg	syn	46.612 d	203Tl
								194Os	syn	6 y	194Ir													204Hg	6.87 %	Stable	

All isotope of W has the route to ^{190}Pt,^{192}Pt and ^{193}Pt. Although ^{193}Pt has shorter half-life of 50 y, which can be used for industry.

J. Thransmutation stops at Ag and Au by vaporizing Cd and Hg.

Although the transmutation continues beyond the desired element, both transmutations can be stopped by the vaporized Cd, or Hg in the air in the chamber for a long time to decay to AG or Au to move back to the aqueous solution.

Author thinks that the following reaction by gas phase Cd and Hg, which increase the concentration during mass analysis because Ag and Au drops into the aqueous solution.

$^{197}_{80}$Hg [64.14h] =$^{197}_{79}$Au [Stable]

$^{107}_{48}$Cd [6.5h] =$^{107}_{47}$Ag[stable]

IX. CONCEPTUALIZED TRANSMUTATION REACTOR

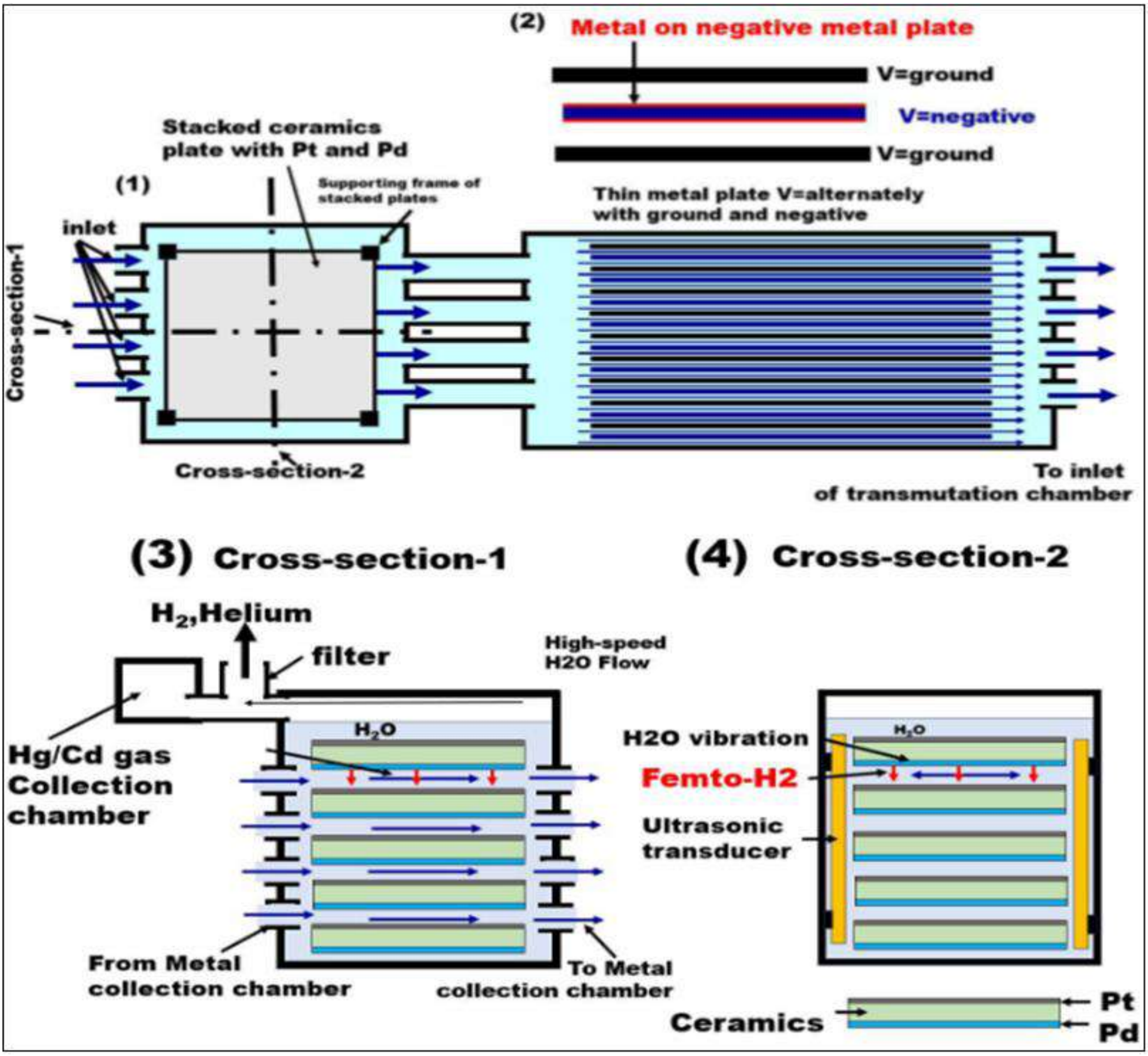

Fig 7 Conceptualized Noble Element Generator

The conceptual transmutation reactor is to High-speed H_2O flow is to improve the transmutation efficiency and metal collection efficiency by H_2O vibration and high-speed H_2O flow to circulate the lower concentration of generated metal, which is collected by the separate chamber with negative metal plate.

A. Metal collection

Ionization tendency is Li K Ba Sr Ca Na Mg Al Zn Fe Ni Sn Pb (H) Cu Hg Ag Pt Au. In strong alkaline aqueous solution, [H+] is so low, and if the concentration of the metal is by far larger than [H+] in strong aqueous solution the metal metals with moderate ionization tendency can precipitate on the negative metal electrode, such as Fe, Ni.

Therefore, the negative electrode of the conventional brown gas generator has the precipitation of such metals.

Thus, in order to improve the metal production efficiency, generated element needs to be removed from the production chamber as soon as possible after generation.

Because the conventional brown gas generator in ref [8] has the vibration perpendicular to the electrode, it increases the precipitation on the negative electrode in the brown gas generator. Therefore, I would like to propose the new transmutation reactor which has H_2O vibration along with lateral metal electrode to improve the transmutation rate and to have high-speed H_2O flow from transmutation chamber to the metal collection chamber with metal plate which collect the metals as is shown in Fig.6.

B. *Transmutation rate*

Transmutation rate is improved by the H_2O motion perpendicular to the femto-H_2 trajectory, but Ohmasa gas generator (conventional brown gas generator) uses the metal electrode vibration perpendicular to metal electrode, it increases the collision rate of H_2O onto metal electrode and increase the precipitation of generated metals.

Thus, to improve the transmutation rate, H_2O vibration along the metal electrode with ultrasonic transducers, and high speed H_2O flow along with metal electrode which is also for the improvement of metal generation to collect metals in the separate chamber.

C. *Gas Collection*

As is discussed, Hg and Cd are volatile and they evaporate and stay as gases in the chamber till they decay to metal. Thus, brown gas generator needs to have Hg and Cd collection mechanism of Hg and Cd gas to collect Ag and Au. It is also for the safety because both of them are hazardous. Conceptualized Transmutation Reactor needs to have precious metal collection mechanism and H_2O flow to with lower noble metal concentration needs to be circulated after collecting precious metals. Precious metal can be collected by their precipitation on the metal electrode with negative voltage.

Hg and Cd gas can be collected in potassium permanganate solution.

D. *W to Au*

As is shown in Table 22, ^{181}W and ^{183}W are transmuted to 187Au, all isotopes are transmuted to $^{184\sim188}$Os, ^{188,189,191}Ir, $^{190\sim193}$Pt. Production of Au, Pt form W is possible, and if Au can be collected from vaporized Hg, Pt also can be produced effectively with negative metal plate electrode. Otherwise, production of metal of from Os to Pt, and Au can compete. Therefore, starting element is important, and for Au and Pt production, W is available because Cu has issue which also produce Ag, meaning that Ag and Au cannot be separated.

E. *Mo to Ag*

Table 23 Transmutation Route from Mo to Ag.

$_{42}$Mo				$_{43}$Tc				$_{44}$Ru				$_{45}$Rh				$_{46}$Pd				$_{47}$Ag				$_{48}$Cd				$_{49}$In			
isotope	NA	half-life	DP	isotope	NA	half-life	DP	isotope	NA	half-life	DP	isotope	NA	half-life	DP	isotope	NA	half-life	DP	isotope	NA	half-life	DP	isotope	NA	half-life	DP	isotope	NA	half-life	DP
92Mo	14.84%	>1.9×10^{20} y	92Zr	95mTc	syn	61 d	95Mo,95Tc	96Ru	5.52%	Stable		99Rh	syn	16.1 d	99Ru	100Pd	syn	3.63 d	100Rh	105Ag	syn	41.2 d	105Pd	106Cd	1.25%	>9.5x10^{17} y	106Pd	113In	4.30%	Stable	
93Mo	syn	4,000 y	93Nb	96Tc	syn	4.3 d	96Mo	97Ru	syn	2.9 d	97Tc	101Rh	syn	3.3 y	101Ru	102Pd	1.02%	Stable		106mAg	syn	8.28 d	106Pd	107Cd	syn	6.5 h	107Ag	115In	95.70%	4.41x10^{14} y	115Sn
94Mo	9.25%	Stable		97Tc	syn	2.6x106 y	97Mo	98Ru	1.88%	Stable		101mRh	syn	4.34 d	101Ru,101Rh	103Pd	syn	16.991 d	103Rh	107Ag	51.839%	Stable		108Cd	0.89%	6.710x10^{17} y	108Pd				
95Mo	15.92%	Stable		97mTc	syn	91 d	97Tc	99Ru	12.70%	Stable		102Rh	syn	207 d	102Ru,102Pd	104Pd	11.14%	Stable		108mAg	syn	418 y	108Pd,108Ag	109Cd	syn	462.6 d	109Ag				
96Mo	16.68%	Stable		98Tc	syn	4.2x106 y	98Ru	100Ru	12.60%	Stable		102mRh	syn	2.9 y	102Ru	105Pd	22.33%	Stable		109Ag	48.161%	Stable		110Cd	12.49%	Stable					
97Mo	9.55%	Stable		99Tc	trace	2.111x105 y	99Ru	101Ru	17.00%	Stable		103Rh	100%	Stable		106Pd	27.33%	Stable		111Ag	syn	7.45 d	111Cd	111Cd	12.80%	Stable					
98Mo	24.13%	>1x10^{14} y	98Ru,99mTc	99mTc	syn	6.01 h	99Tc	102Ru	31.60%	Stable		105Rh	syn	35.36 h	105Pd	107Pd	trace	6.5x10^{6} y	107Ag					112Cd	24.13%	Stable					
99Mo	syn	65.94 h	99mTc					103Ru	syn	39.26 d	103Rh					108Pd	26.46%	Stable						113Cd	12.22%	7.7x10^{15} y	113In				
100Mo	9.63%	7.8x10^{18} y	100Ru					104Ru	18.70%	Stable						110Pd	11.72%	Stable						113mCd	syn	14.1 y	113In,113Cd				
								106Ru	syn	373.59 d	106Rh													114Cd	28.73%	>9.3x1017 y	114Sn				
																								115Cd	syn	53.46 h	115In				
																								116Cd	7.49%	2.9x1019 y	116Sn				

In order to produce Ag and Pd from base metal, Mo is option because molybdenum has an atomic number close to those of these precious metals. Because Ru, Rh are also noble element, production of Pd and Ag competes with Ru and Rh.

Platinum group elements such as ruthenium (Ru), rhodium (Rh), and palladium (Pd) are used as exhaust gas catalysts for automobiles to reduce nitrogen oxide (NOX) generation, catalysts for chemical industries such as petrochemicals and pharmaceuticals, etc. they are widely used. Therefore, production of these element benefits these industries. For the production of these element, starting metal of Mo is available.

Some of the transmuted isotopes are unstable with the half-life is longer than a few days, which will decay to the stabler isotopes in platinum group.

X. DISCUSSION

A. Precious Metal Production

Platinum group elements are ruthenium (Ru), rhodium (Rh), palladium (Pd), osmium (Os), iridium (Ir), and platinum (Pt), which are widely used in automobile exhaust gas catalysts to reduce nitrogen oxide (NOX) generation, and catalysts for chemical industries such as petrochemicals and pharmaceuticals.

All platinum group metals are fairly rare, but rhodium, osmium (Os), and iridium (Ir) are particularly rare.

They can be mass produced by transmutation from W and Mo. Some of them is stable isotopes, but many of them is isotopes with shorter half-life and decay to other platinum group elements.

B. Helium-3 Production and Tritium Transmutation from Nuclear Power Plants.[8]

This reactor can produce helium-3 and simultaneously reduce tritium concentration in tritium contaminated water from nuclear power plants by transmutation. Thus, impact on the industry is enormous.

C. Diffilulty in Finding the Transmutation Route

Now I used Wikipedia data of Isotope, and it is tedious and may have some mistakes. Thus, I would like the researcher to develop software to find the rout of transmutation based on the latest study of nucleus stability.

XI. FOR MASS-PRODUCTION OF NOBLE METALS

Other than Ag and Au, if the reactor has a mechanism to collect the desired element, mass production of the desired element becomes possible. Thus the noble metal can be collected in the transmutation reactor in strong allaline aqueous with plate applied the negative voltage to precipitate the noble metal.

A. Brown Gas Generator that has Collecting Mechanism of the Desired Target Element.(Noble Metals Collection)

I think that noble metal can be precipitate on the metal with negative voltage in strong alkaline aqueous.

But this competes with B.

B. Brown Gas Generator that has Collecting Mechanism of the Desired Target Element.(Hg and Cd Gas Collection)

I would like to propose the brown gas generator to have the mechanism that collecting gas and generated elements in the chamber for $^{197}_{79}$Au[stable] and $^{107}_{47}$Ag[stable].

XII. POWER GENERATION BY BURNING BROWN'S GAS WITH COLLECTION OF HELIUM-3 AND HYDROGEN[3],[8]

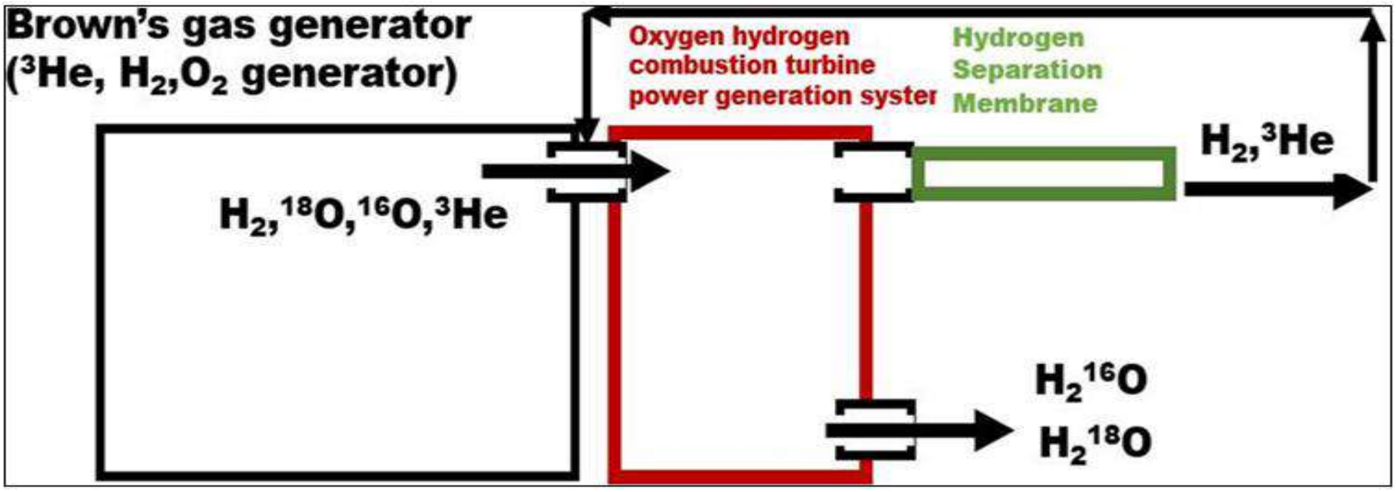

Fig 8 Conceptualized Hydrogen Turbine System to Generate Power and to Collect 3He and ^{16,18}O.

Because this transmutation reactor created helium-4, helium-3 hydrogen oxygen18, oxygen-16, burning in hydrogen turbine can produce power greater than input power of electrolysis in transmutation reactor due to the mixture of helium, and it is easier to retrieve oxygen-18 from H_2O.

And helium can be filtered with hydrogen and they need to be return to hydrogen turbine input to increase the produced power.

Study on the mixing helium-4 with hydrogen and oxygen is reported. They use helium-4 and they showed the clear difference between other gas and helium-4.

XIII. PRECIOUS ELEMENT MASS-PRODUCTION AND OF HELIUM-3

Because transmutation is continuous and it proceeds beyond the target metal towards higher atomic number elements, transmutation reactor needs to have the mechanism to stop transmutation to the target element. For precious metal it can be collected by standard method to use negative metal electrode for precious metals to be precipitated on.

Possibility is to use gas phase element; Hg in strong alkaline aqueous evaporates from the aqueous, and decay to gold.

Due to the limitation of production of precious metal and helium-3 from earth, we should have the large-scale Transmutation reactor to produce the precious rare elements for the industry.

XIV. CONCLUSION

A. Ohmasa's Experiments are Proved to be Correct by Route Analysis Based on My Femto-H_2 Transmutation Mechnaims.

Cu and Cs have the routes to Ag and Au proved by the transmutation route analysis based on my femto-H_2 transmutation mechanism.

B. Porposition to Devalop Large-Scale Conceptualized Transmutation Reactor to Produce the Desired Rare Element on Earth

Because transmutation proceeds beyond the desired element, it needs the mechanism to collect the desired element before the transmutation to the next isotope.

Due to the risk in shortage of rare element, such as helium-3, helium-4, Pd Rh Pt, etc, large scale transmutation reactor can mass-produce these rare elements.

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