Erzion Model Features In Cold Nuclear Transmutation Experiments

Yu. N. Bazhutov
Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation (RAS)
142092, Troitsk, Moscow region, Russia
bazhutov@izmiran.ru

I describe the history of Erzion Model from its appearance in Cosmic Rays in 1982 and its development to explain the main features of Cold Fusion Experiments.

Erzion Model can explain in principle many problems in Astrophysics and Geophysics, such as: 1) Dark matter in Universe; 2) Solar neutrino problem; 3) Jupiter energetic unbalance; 4) Tritium & He^3 abundance in volcano products; 5) Ball-lightning & forest fire nature amongst others.

Some applied problems can be decided within the framework of the Erzion Model, such as: 1) new ecology-pure energy with rather simple nuclear technology; 2) elimination of certain radioactive wastes; 3) cheap production of some chemical elements & isotopes (gold for example).

The Erzion Model can explain many experiments in Cold Fusion and can predict many new experiments for its testing.

Erzion Model History in Cosmic Rays & Cold Fusion

The hypothesis of the new stable massive hadrons existence in Cosmic Rays has been appeared in 1981 to explain abnormal energy spectrum of vertical component of Cosmic Rays Muons [1]. Many characteristics of this hadron (named later as Erzion) such as: mass, charge, lifetime, intensity & spectrum, nuclear interaction modes & paths, were predicted phenomenologically. From this year the direct Erzions search had started [2-4].

Moreover Erzion existence could explain also some other abnormal experimental results in Cosmic Rays such as:

1. Long length hadron cascades;
2. Delayed particles in Air Showers;
3. High energy neutral particles flux from local space sources;
4. Large across momentums in high energy cascades and etc.

But it was a great present for the author that Erzion existence in nature could explain on principle the new Fleishmann & Pons Phenomena of Cold Fusion [5,6] by Erzion Catalysis Mechanism [7].

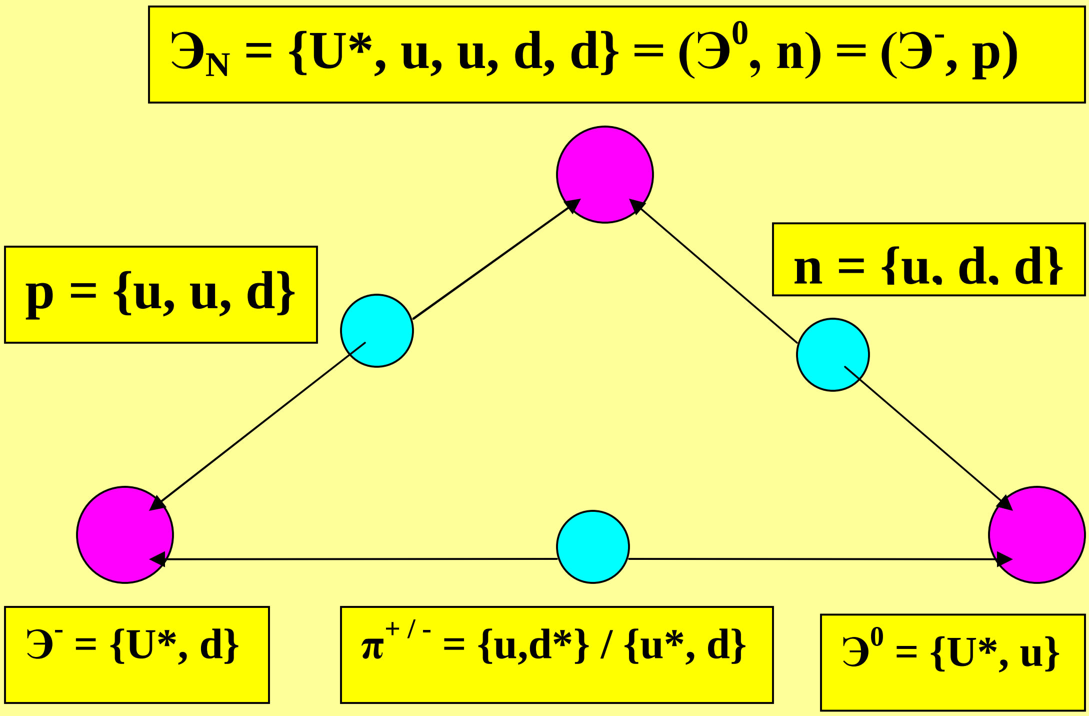
For strong theoretical interpretation of such exotic particles existence in nature in 1990 the Mirror model $U(1)xSU_l(2)xSU_r(2)xSU(3)$ had been proposed by Vereshkov G.M. [8-10]. This model without any contradiction with all world totality of experimental results in high energy & cosmic ray physics could explain main part of abnormal experimental results in orthodox physics & main unusual features in Cold Fusion such as:

1. Suppression of the neutron to tritium yield ($10^3 – 10^{11}$ times);
2. Reducing of tritium to energy yield (~ 10^3 times);
3. Unstationary condition of CF reactions running;
4. Great yield fluctuation (up to 10^5 times);
5. New isotopes & element production & etc.

The main features of Erzion model

In the framework of this Mirror model the new massive & stable Mirror antiquark (U*) must exist with very small concentration as a relict component relatively to usual quarks ($C_{U*} / C_{u,d} \sim 10^{-15}$). This antiquark can be hadronized together with our usual (u) or (d) quarks into new meson pair: neutral Erzion – $Э^0$ = {U*,u}, or negative charged Erzion $Э^-$ = {U*,d}. The features of quark numbers of this antiquark U* are going to the unusual feature of repulsion forces of strong interaction of Erzions. Such way this mesons couldn’t be captured by all nuclear besides only nucleons forming 5-quark bag, stable singlet state, named as Enion ($Э_N$={U*,u,u,d,d}). As you can see from fig.1, this particle can dissociate or to charged pair ($Э_N = Э^- + p – \Delta E1$), or to neutral pair ($Э^0 + n – \Delta E2$).

Fig. 1 Erzion structure scheme



Such way in nuclear exchange reactions these Erzions & Enions can be inter-converted into each other. On the every isotope up to 6 nuclear exchange reactions can occur by this Erzion catalysis mechanism:

1. $(A,Z) + Э_N = Э^0 + (A+1, Z) + \Delta E_1$;
2. $(A,Z) + Э_N = Э^- + (A+1, Z+1) + \Delta E_2$;
3. $(A,Z) + Э^0 = Э_N + (A-1, Z) + \Delta E_3$;
4. $(A,Z) + Э^0 = Э^- + (A, Z+1) + \Delta E_4$;
5. $(A,Z) + Э^- = Э_N + (A-1, Z-1) + \Delta E_5$;
6. $(A,Z) + Э^- = Э^0 + (A, Z-1) + \Delta E_6$;

In this Erzion Catalysis model we have only 2 free energy parameters (ΔE1 & ΔE2), which we can choose for proper Cold Fusion reactions. So in framework of Erzion Catalysis model we can know all energy reactions for all nuclear Erzion reactions & can predict what (exothermic) reactions can be running.

Enion due to its special peculiarity, caused by its special quantum numbers, has strong repulsive forces. But due to its dipole electric moment thermolized Enion can attract nuclei & create connected state with rather small bounded energy from E_b~1,5eV for proton up to E_b~60eV for Pb^{208}. The main condition for creation of such stable long-lived state is absence of exothermic exchange reactions with such nuclear. Such nuclei were named as Donor nuclei (H^1, He^4,C^{12},O^{16},Ni^{64},…). In nuclear exchange reactions Erzions ($Э^-$,$Э^0$) must convert into Enions ($Э_N$) or Erzions with another charge ($Э^0$,$Э^-$) and inversely. In this way there exist only 6 different Erzion nuclear exchange reactions on any nuclear (see above - 1.,2.,3.,4.,5.,6.) with 6 their reaction energies (ΔE_1, ΔE_2, ΔE_3, ΔE_4, ΔE_5, ΔE_6 - negative for endothermic reaction & positive for exothermic reaction) on each nuclear. Such way in almost any matter we have very small concentration ($C(Э_N)$~10^{-15} per nuclear) of captured Enions. When this Enions became free they can react with nuclei by means of exchange exothermic Erzion nuclear reactions with very large cross sections (σ~Mbn). Such way the frequency of such reactions chain is equal to GHz at best conditions.

At usual temperatures only exothermic reactions can run. There are few such reactions among stable isotopes. In the usual matter consisted from stable isotopes of light chemical elements only following Erzion nuclear catalytic reactions can run [11]:

^1H ($Э^-$, $Э^0$) ^0n + 1,65 MeV	(100 %)	(1)
^2H ($Э^-$, $Э_N$) ^0n + 5,6 MeV	(0,016 %)	(2)
^2H ($Э_N$, $Э^0$) ^3H + 0,1 MeV	(0,016 %)	(3)
^2H ($Э^0$, $Э_N$) ^1H + 3,9 MeV	(0,016 %)	(4)
Li^6 ($Э_N$, $Э^0$) ^7Li + 1,1 MeV	(7,5 %)	(5)
Li^6 ($Э^0$, $Э_N$) ^5Li+ 0,5 MeV	(7,5 %)	(6)
^5Li - > ^4He + ^1H + 1,7 MeV		
Li^6 ($Э^-$, $Э_N$) ^5He + 3,2 MeV	(7,5 %)	(7)
^5He - > ^4He + ^0n + 1,36 MeV		
^7Li ($Э_N$, $Э^-$) ^8Be + 9,5 MeV	(92,5 %)	(8)
^8Be - > $2 \cdot {}^4He$ + 4,8 MeV		
^{13}C ($Э_N$, $Э^0$) ^{14}C + 2,0 MeV	(1,1 %)	(9)
^{13}C ($Э^0$, $Э_N$) ^{12}C + 1,2 MeV	(1,1 %)	(10)
^{14}C ($Э_N$, $Э^-$) ^{15}N + 2,4 MeV	(---)	(11)
^{14}N ($Э^-$, $Э^0$) ^{14}C + 2,3 MeV	(99,6 %)	(12)
^{14}N ($Э^-$, $Э_N$) ^{13}C + 0,25 MeV	(99,6 %)	(13)
^{14}N ($Э_N$, $Э^0$) ^{15}N + 4,7 MeV	(99,6 %)	(14)
^{15}N ($Э_N$, $Э^-$) ^{16}O + 4,3 MeV	(0,37 %)	(15)
^{17}O ($Э_N$, $Э^0$) ^{18}O + 1,9 MeV	(0,038 %)	(16)
^{17}O ($Э^0$, $Э_N$) ^{16}O + 2,0 MeV	(0,038 %)	(17)
^{18}O ($Э_N$, $Э^-$) ^{19}F + 0,2 MeV	(0,2 %)	(18)

$^{19}F\ (Э_N, Э^0)\ ^{20}F + 0{,}45$ MeV	(100%)	(19)
$^{19}F\ (Э_N, Э^-)\ ^{20}Ne + 5{,}05$ MeV	(100 %)	(20)
$^{23}Na\ (Э_N, Э^0)\ ^{24}Na + 0{,}8$ MeV	(100 %)	(21)
$^{23}Na\ (Э_N, Э^-)\ ^{24}Mg + 3{,}9$ MeV	(100 %)	(22)
$^{27}Al\ (Э_N, Э^0)\ ^{28}Al + 1{,}6$ MeV	(100 %)	(23)
$^{27}Al\ (Э_N, Э^-)\ ^{28}Si + 3{,}8$ MeV	(100 %)	(24)

As you can see, the rarest reactions are with neutral Erzion - $Э^0$. There are only 11 stable isotopes reacting with this Erzion, named as Converters. So if you want have the reserved Erzion nuclear reaction chains you must have in your reactor system besides Donor isotopes such Converter isotopes. The best among them is Deuterium [12]. For generating neutrons you must have Hydrogen or Lithium elements in your CF reactor.

All our CF experiments [13-17] (only some last from them) fulfilled in accordance with Erzion model predictions & every time they confirmed it and had success.

Erzion Model in Astrophysics, Geophysics & Practice

Erzion Model can give principle explanation for many problems in Astrophysics and Geophysics [10,18,19], such as:

1) Dark matter in Universe;
2) Solar neutrino problem;
3) Jupiter energetic disbalance;
4) Tritium & He^3 abundance in Volcano products;
5) Ball-lightning & Forest Fire nature and some else.

Some applied problems can be decided in framework of Erzion Model [10,19], such as:

1) Creating the new energy-capacious, ecology-pure with rather simple technology nuclear energetics;
2) Principle & radical utilization of radioactive wastes;
3) Cheap production of some chemical elements & isotopes (gold for example).

Conclusion

I want thank everybody who helped me last 20 years in work on developing of such very interest & fruitful problem of Erzion Catalytic Model & hope that it will reach success.

References

1. Bazhutov Yu.N., Khrenov B.A., [Khristiansen G.B.] “About One Opportunity of Second Shower Spectrum Interpretation Observed at Small Depth Underground”, Izvestiya AN USSR, ser. Phys., 1982, v.46, 9, p.2425-2427.
2. Bazhutov Yu.N., “A Search for the Decay of Hypothetical Penetrating Particles”, Proc. 18-th Int. Cosmic Ray Conference, Bangalore, 1983, He-2, 2-18, p.24-26.
3. Abramov A.V., Bazhutov Yu.N., Khrenov B.A. et al. “Search for Massive Charged Elementary Particles” Proc. All-Union Cosmic Ray Conference, Alma-Ata 1989, v.1, p.101-102.
4. Bazhutov Yu.N., Vereshkov G.M. “Search for New Stable Hadrons in Cosmic Rays”, Preprint No.2, Central Research Institute of Machine Building, 1990.
5. Fleischmann M., Pons S., Hawkins M., Journal Electroanalytic Chemistry, 1989, v261, p.301.
6. Jones S.E., Palmer E.P., Criss J.B. et al., Nature, 1989, v338, p.737.
7. Bazhutov Yu.N., Vereshkov G.M., Kuzmin R.N. & Frolov A.M. “Interpretation of Cold Fusion by Erzion Catalysis”, Proc. “Plasma Physics and some questions of General Physics”, CSRIMash, Kaliningrad, Moscow region, 1990, p.67-79.
8. Bazhutov Yu.N., Vereshkov G.M. «New Stable Hadrons in Cosmic Rays, their Theoretical Interpretation & Possible Role in Catalysis of Cold Nuclear Fusion». Preprint No.1, Central Research Institute of Machine Building, 1990.
9. Bazhutov Yu.N., Vereshkov G.M. “A Model of Cold Nuclear Transmutation by the Erzion Catalysis”, Proceedings of ICCF-4, Hawaii, 1993, v.4, 8-1.
10. Bazhutov Yu.N., Vereshkov G.M., Kuksa V.I. «On a Possibility of Existing New Stable Hadrons-Hypothetical Catalyst of Cold Nuclear Transmutation». Proceeding of 3-d Russian Conf. On Cold Fusion & Nuclear Transmutation, Dagomys-1995, Moscow, 1996, p.157.
11. Bazhutov Yu.N., [Kuznetsov A.B.], Pletnikov E.V. "Spectroscopy of Erzion Catalytic Nuclear Transmutation". Preprint № 1 SRC PhTP «Erzion», CSRIMash, 1993, p.1-172.
12. Bazhutov Yu.N. “Influence of Spin & Parity Preservation Lows on Erzion Model Predictions in Cold Fusion Experiments”, Proceedings of ICCF-7, Vancouver, 1998, p.437-440.
13. Bazhutov Yu.N., Koretsky V.P., [Kuznetsov A.B.] et al. “Tritium, Neutron & Radiocarbon Registration with the Yusmar Hydrofacility Running”, Proceedings of ICCF-6, Japan, 1996, v.1, p.387-391.

14. Bazhutov Yu.N., Koretsky V.P. “Neutron Generation at Ultrasonic Cavitation of some Liquids”, Proceedings of ICCF-7, Vancouver, 1998, p.427-436.

15. Bazhutov Yu.N., Bazhutova S.Yu., Dyad’kin A.P., et al. “Calorimetric & Neutron Diagnostics of Liquids during Laser Irradiation”, Proceedings of ICCF-11, Marseilles, 2004, p.374-378.

16. Bazhutov Yu.N., Grishin V.G., [Nosov V.N.] “Electrolysis with Gas Discharge at Anode”, Proceeding of 10-th Russian Conference on Cold Nuclear Transmutation, Dagomys-2002, Moscow, 2003, p.19-26.

17. Bazhutov Yu.N., Grishin V.G., [Eremeev A.V.], Velikodny V.Yu. et al. “Nuclear Diagnostic of Cold Nuclear Transmutation at Electrolysis with Anode Gas Discharge in Water Solutions”, Proceeding of 13-th Russian Conference on Cold Nuclear Transmutation, Dagomys-2005, Moscow, 2006, p.71-83.

18. Bazhutov Yu.N. “Erzion Construction of Magnetic” Rodionov” Fluxes & Possible Consequences of their Existence in Nature”, Proceeding of 10-th Russian Conference on Cold Nuclear Transmutation, Dagomys-2002, Moscow, 2003, p.12-18.

19. Bazhutov Yu.N. “Erzion Discovery in Cosmic Rays and its Possible Great Role in Nature in Framework of Erzion Model in Cold Nuclear Transmutation”, Proceedings of ICCF-8, Lerici (La Spezia), 2000, p.269-275.

Biberian, J.P. and N. Armanet. *Excess Heat Production During Diffusion Of Deuterium Through Palladium Tubes*. in *8th International Workshop on Anomalies in Hydrogen / Deuterium Loaded Metals*. 2007. Sicily, Italy.

Excess Heat Production During Diffusion Of Deuterium Through Palladium Tubes

Jean-Paul Biberian and Nicolas Armanet
Département de Physique, Faculté des Sciences de Luminy, Université d'Aix-Marseille II,
163 Avenue de Luminy, 13288 Marseille cedex 9, France.
jpbiberian@yahoo.fr, armanetnicolas@hotmail.com

ABSTRACT

Following the work by several researchers we have undertaken experiments with deuterium gas flowing through the walls of a palladium tube. Tubes were heated at various temperatures and either filled with palladium powder or palladium compounds or empty. Our mass flow calorimeter enables us to accurately measure excess heat production. We usually used palladium tubes 10 cm long, 2 mm outer diameter with 200 µm thick walls, and closed at one end. Deuterium gas is introduced in the tube at various pressures, and temperatures and diffuses out through the walls of the tube. Thermal energy is determined by measuring inlet and outlet temperatures of cooling water and its mass flow. The energy yield of this calorimeter is 95-98% depending on input power. Our best result so far is an excess heat of 3 W with an input power of 47 W using an oxidized palladium tube filled with palladium powder. In addition to these results we describe an experiment where temperature oscillations have been measured, indicating the importance of temperature in excess heat production.

1. Introduction

Arata and Zhang (1) used a DS-cathode (that is, a “double-structured” cathode; i.e. a hollow palladium cathode filled with palladium nano powder). They show large excess heat production when using heavy water and no excess heat with ordinary water. They also measured production of helium-4 during these runs (2). Recently the same authors have developed an alternative technique to obtain similar results applying high pressure deuterium gas on the outside of a palladium tube filled with palladium nano powder.

Li et al. (3) have also observed excess heat when deuterium gas flows through a palladium foil. In 1989, Fralick et al. (4) reported a similar experiment. They loaded a hydrogen gas purifier with deuterium, and then pumped it out. They observed a temperature rise with deuterium versus no temperature change with hydrogen. However the experiments performed by Arata (2), Li (3) and Fralick (4) are based on temperature measurements, and do not provide accurate calorimetric data.

In a previous paper (5) we described in detail our experiments with deuterium diffusion through the walls of palladium tubes. This paper gives additional results, especially temperature oscillations that indicate the role of temperature on excess heat.

2. Experimental setup

The calorimeter used in this work is described in Fig. 1. In future experiments we have improved the design in order to avoid heat transfer by conduction and convection between the palladium tube and the walls of the calorimeter (5). The vacuum chamber is a stainless steel cylinder 7 cm in diameter and 50 cm long. It is surrounded by a second stainless steel envelope where 30°C de-ionized water circulates at a constant flow rate of 180 ml/min. Inlet and outlet water temperatures are measured with two calibrated thermistors. A palladium tube closed at one end usually 10 cm long and 2 mm in outer diameter is welded on a 6 mm diameter stainless steel rod which is attached to a 6 mm diameter stainless steel tube with a Swagelok® fitting (Fig. 2). A thermocouple is inserted inside the stainless steel rod up to the center of the palladium tube. In the case of powder filling, the thermocouple is at the edge of the tube. Due to heat losses by conduction (through metal parts) and non-uniform heating, the temperature of the palladium tube is not uniform along the tube.

The palladium tube is heated by radiation with a Thermocoax® direct-current resistor wrapped around it. Four stainless steel concentric reflectors are positioned around the resistor in order to minimize heat losses by radiation. Input heat applied to the resistor is dissipated mainly by radiation and is collected by the water cooled envelope. However part of the heat is lost by conduction through the 6 mm stainless steel tube attached to the palladium tube and also through the metal flange which holds the electric feedthroughs and the various pumping tubes.

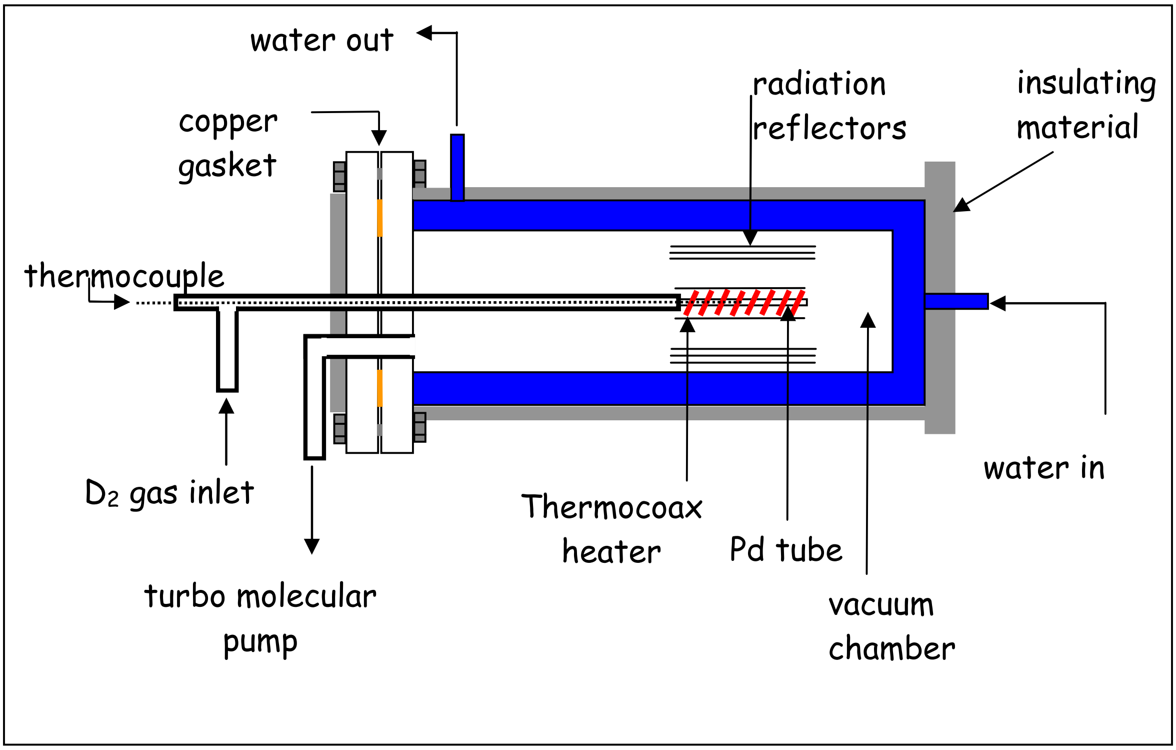


Figure 1. Design of the mass flow calorimeter.

Figure 2. Top: photograph of the palladium tube. Bottom: photograph of the vacuum chamber.

3. Calibration

Input power is measured accurately since the heater is driven by a DC power supply. Output power is measured via the temperature difference given by two thermistors, one at the inlet, and the other one at the outlet. Temperature is measured with precision of +/- 0.01 K. The mass flow rate of the de-ionized cooling water is measured with accuracy better than 1%. As mentioned above, most heat is recovered by the flowing water, and therefore taken into account in determining the output power. However some heat is lost through the large flange of the vacuum chamber which is not cooled by the flowing water. In order to have an accurate value of the losses, we performed a blank run without the palladium tube. We replaced it with an open stainless steel tube. Our calibration shows that a correction of 2 to 5% of the input power must be added to the output power to take into account the heat loss. This value varies with input power: the larger the input power the less correction is needed percentage wise.

However, to avoid having to perform this correction, it is even better to compare the output power with deuterium to the one with the tube under vacuum. No correction is therefore needed; we simply compare the two situations.

4. Experimental results

4.1 Excess heat

Most experiments we have performed so far have been described previously (5). Figure 3 shows excess heat of 1.8 W without any correction, and probably 3 W when corrected for heat loss. The palladium tube was oxidized in air at 500°C for two hours and filled with palladium powder from Goodfellow (80–180 nm). The deuterium pressure was 9 atmospheres; and the temperature measured at the base of the tube was 85°C. More details about this work are described in Ref. 5.

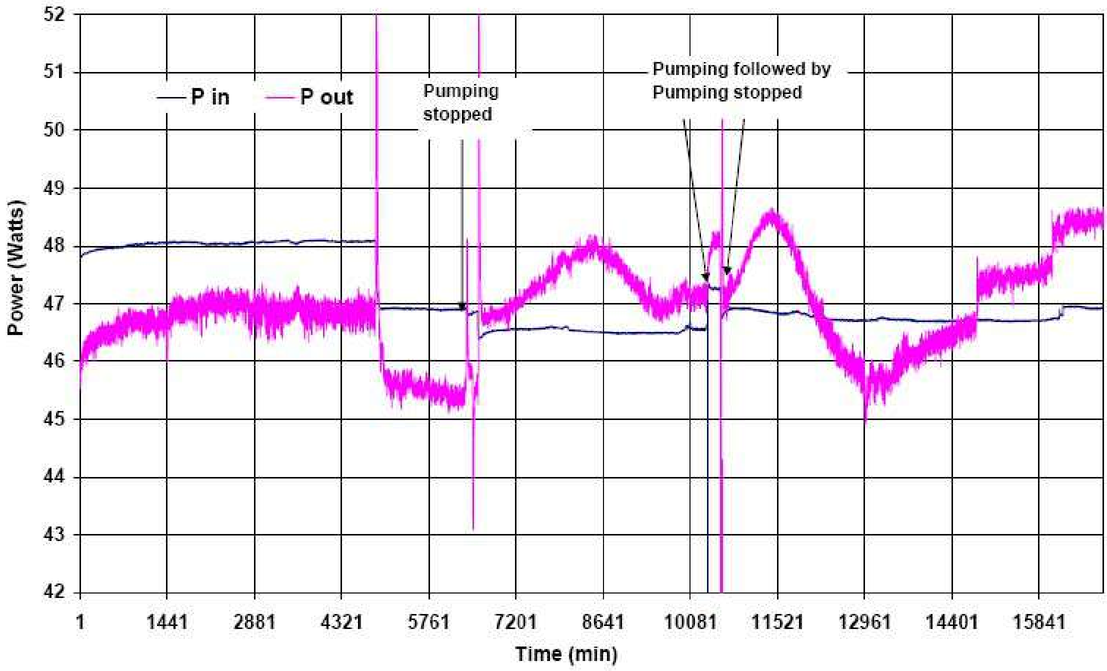


Figure 3. Input and output power during the final phase of the experiment, showing an uncorrected excess heat of 1.7 W.

4.2 Temperature oscillations

In a previous work, we measured the temperature of the palladium tube, while lowering the input power. We observed an anomalous effect of temperature oscillations with a magnitude of 9°C, as shown in Fig. 4. These oscillations do not seem to exist at all temperatures. This is an indication of a role of temperature in the reaction. Unfortunately when these temperature anomalies were recorded, the excess heat could not be measured due to a problem with the water mass flow which was unstable.

Later experiments were performed with palladium powder inside the tube, so that the temperature measured corresponded to the temperature at the Swagelok fitting, and therefore small variations in temperature of the tube were damped by the heat capacity of the stainless steel. So that these temperature oscillations have not been observed again.

Figure 5 shows Scanning Electron Microscopy images of the surface of the tube after the experiment showing the formation of melted area and volcano type.

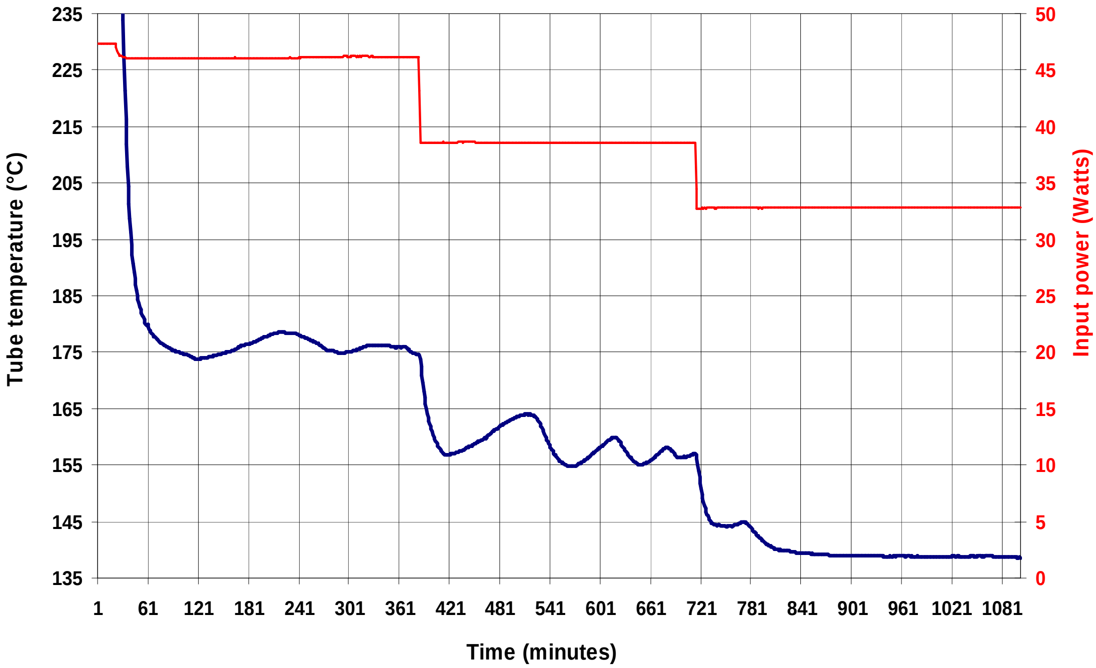


Figure 4. Temperature oscillations of the palladium tube as the input power is decreased by steps.

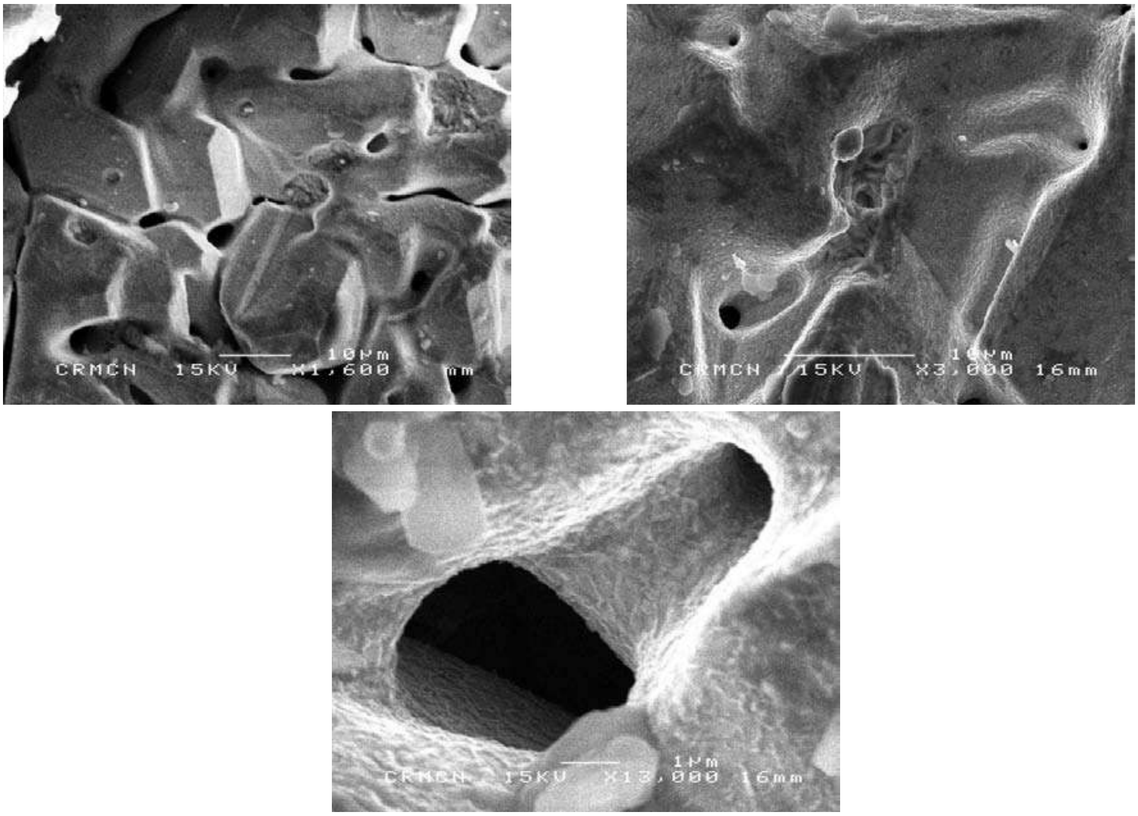


Figure 5. SEM images of the palladium surface.

5. Conclusion

We have shown that anomalous heat effects are produced when deuterium gas under a pressure of 9 atmospheres flows through the walls of a palladium tube. We have measured excess heat up to 3 W when the tube is oxidized in air at 500°C and filled with palladium micro powder. Also we have shown temperature oscillation anomalies when the power input is reduced. These oscillations have an amplitude up to 9°C, and need a theoretical explanation that might be helpful in understanding the actual mechanism of the Fleischmann-Pons effect.

Acknowledgments

We would like to acknowledge Gilles Arthaud who built our experimental setup, and Jacque Kurdjian, Michel Buxerolles and Jean-Louis Rechatain for giving us the palladium tubes.

References

1. Y. Arata, and Y. C.Zhang, Proc. ICCF12, Yokohama, edited by A. Takahashi, Y. Iwamura, and K. Ota, World Scientific **2006** p44-54
2. Y. Arata, and Y. C. Zhang, Jpn. J. Appl. Phys. Part 2 38 (7A), L774, **1999**.
3. X. Z. Li, B. Liu, N. Cai, Q. Wei, J. Tian, and D.X.Cao, in Tenth International Conference on Cold Fusion, editors Hagelstein, P. L. and Chubb, S. R. World Scientific Publishing Co., Cambridge, MA, **2003**, p. 113.
4. G. C. Fralick, A. J. Decker, and J. W. Blue, NASA Technical Memorandum 102430, **1989**
5. J. P. Biberian, N. Armanet, Proceedings ICCF13, Socchi, Russia 2007.