Alternatives To Calorimetry

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Since the first publication of Martin Fleischman and Stanley Pons in 1989, the majority of articles in the LENR field have focused on calorimetry. [1] This is true for both electrolysis experiments and gaseous loading experiments. [2]

Many calorimetry experiments are masterpieces of science [3] Nevertheless, despite the experimental evidence, the results indicating excessive heat have not convinced the scientific community. Well-designed calorimetry experiments are slow to develop. It's an issue, because it would be good to test many alloys systematically. It is likely that there are still unknown alloys whose ability to generate what Ed Storms calls a "Nuclear Active Environment" [4] is greater than that of palladium. It is certain that low concentrations of elements such as lithium, boron, beryllium in these alloys will have undoubtedly positive effects. We need fast and reproducible tests to sort all these alloys and select the most promising samples. Several authors have suggested that the quantum condensation of deuterium nuclei is at the root of the appearance of "NAE" [5] [6] [7] [8]

For this purpose, we propose three simple techniques to implement:

1) The "Fusion Diode" effect: deuterated alloys in contact with a semiconductor cause the appearance of an easy-to-measure electrical voltage. If this voltage is actually due to the direct conversion of LENR, we have a simple method to select the most promising alloys.

2) The Reifenschweiler effect [9]: the variation of tritium beta-rays bremsstrahlung conversion efficiency as a function of temperature is also a simple method for sorting the most efficient alloys. [10]

3) The magnetic alignment of the tritium pairs: this effect, which we have postulated, but not yet observed, would make it possible to very quickly test many new alloys. [11]

4) The rare neutrons observed are one of the most indisputable proofs of the reality of LENR. A new and extremely sensitive method of detecting neutrons in the 4Pi of space around a LENR device will also be discussed, along with two new improved calorimetry methods.

ALTERNATIVES TO CALORIMETRY

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ICCF 21, Colorado State University, Fort Collins, Co.
3-8 june 2018
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Many calorimetry experiments are masterpieces of science [3]. Nevertheless, despite the experimental evidence, the results indicating excessive heat have not convinced the scientific community. Well-designed calorimetry experiments take a very long time to be developed. It's an issue, because it would be good to test many alloys systematically.
<table>
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<tr>
<th>Type of Hydride</th>
<th>Metal/Alloy</th>
<th>Hydride</th>
<th>Structure</th>
<th>Wt.% Hydrogen</th>
<th>Peq., T(K)</th>
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<td>Pd</td>
<td>PdH$_{0.6}$</td>
<td>$Fm\bar{3}m$</td>
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<td>0.02 bar @ 298K</td>
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<td>$AB_3$</td>
<td>LaNi$_5$</td>
<td>LaNi$_5$H$_6$</td>
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<td>2 bar @ 298K</td>
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<td>$AB_2$</td>
<td>ZrV$_2$</td>
<td>ZrV$<em>2$H$</em>{5.5}$</td>
<td>$Fd\bar{3}m$</td>
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<td>$10^{-8}$ bar @ 323 K</td>
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<td>TiV$_2$</td>
<td>TiV$_2$H$_4$</td>
<td>BCC</td>
<td>2.6</td>
<td>10 bar @ 313 K</td>
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Intermetallic Compounds and their Hydrogen Storage Properties comparing to palladium. From “Metal Hydrides for MnH battery Applications, Danesh Chandra, Wen-Ming Chien and Anjali Talekar, University of Wisconsin, Material Matters, Vol 6, n°2, Sigma-Aldrich eds, 2010
It is likely that there are still unknown alloys whose ability to generate what Dr. Ed Storms calls a "Nuclear Active Environment" [4] is greater than that of palladium. It is certain that low concentrations of elements such as lithium, boron, beryllium in these alloys will have undoubtedly positive effects. We need fast and reproducible tests to sort all these alloys and select the most promising samples. Several authors have suggested that the quantum condensation of deuterium nuclei is at the root of the appearance of "NAE" [5] [6] [7] [8]. It would be very useful to provide irrefutable proof of the existence of these quantum phases. But on top of that, these quantum phases could provide a relatively easy way to sort out the most useful alloys for LENRs.
For this purpose, we propose three relatively simple techniques:

1) The "Fusion Diode" effect: deuterated alloys in contact with a semiconductor cause the appearance of an easy-to-measure electrical voltage. If this voltage is actually due to the direct conversion of LENR, we have a simple method to select the most promising alloys.

2) The Reifenschweiler effect [9]: the variation of tritium beta-rays bremsstrahlung conversion efficiency as a function of temperature is also a simple method for sorting the most efficient alloys. [10]

3) The magnetic alignment of the tritium pairs: this effect, which we have postulated, but not yet observed, would make it possible to very quickly test many new alloys. [11]
In this presentation, we want to discuss how it is possible to find alternatives to calorimetric experiments.
1) The Fusion Diode Effect
It is very difficult to make good calorimetric recordings. It is more easy to count X-rays. But the more easiest way to get a scientific evidence about any kind of phenomena is to do electrical recording.
When fusion reactions take place near the metal/semiconductor contact, at the beginning we had high energy quanta, (in the MeV range) and then thermalization occurs, leading to Anomalous Heat Effect \textit{(Down-conversion of Hagelstein)}. But before thermalization, the decaying energy match the level of excitation of the electrons of the metal: some energy is transmitted to the electrons before thermalization (Like in a photovoltaic cell, but in our diodes, the energy source is expected to be the fusion of deuterium, protium, or perhaps lithium, Boron, or Beryllium.)
Principe de fonctionnement d'une cellule solaire
P-N junction betavoltaic battery

Basic attributes
- Long-lived (with suitable isotope choice)
- Completely solid-state
- No maintenance
- Low power but high power density
- Direct nuclear-to-electric conversion

Advantages over thermoelectric
- No plutonium
- Potential for higher efficiency

Advantages over vacuum collector
- No high voltages
- Higher energy density
Electron Beam Induced Current

EBIC is a method to test our PN junction response to beta emission without needing to physically deposit nuclear material.

**Physical Setup**
- SEM e-beam irradiates P-N junction contact
- Internal SEM ground
- External picoammeter

**Circuit Schematic**
- Direction of e-flow
- Internal SEM ground
- Faraday cup used to calibrate the beam current
We can record the voltage and the intensity of the resulting current at the positive and negative side of the diode. This simple device allows a simple recording of the total output power, because there is no electrical input. We plan to record this electrical energy during months or even years, to exclude the possibility of a chemical origin. It is important to note that these devices has no electrical input. There is also no thermal input. The energy is released as electrical current, and this is very easy to record with high accuracy. We are using diodes made of palladium as the metal, and silicon as the semiconductor. We have also tried other semiconductors like aluminium nitride and organic semiconducting ink. But we only published our experiments with silicon. The palladium is loaded with deuterium simply by the gas-loading method. We don’t know the effective loading value, but it is probably rather high, because of the micrometer size of the palladium powder.
A diode is basically a surface of contact with a metal (electronic conductor) and a semiconductor (hole conductor).
In order to get a surface of junction as large as possible, our fusion diodes are made as powder diodes, with a large surface junction made up of a semiconductor powder in contact with palladium powder charged with deuterium. (5) The weight of palladium powder is comprised between 1 g and 2 g by diode.
1 - Electrical connection.
2 - End cap, with threading.

3 - Mix of silicon and palladium powder.
   - At the bottom: pure palladium, and then
     an increasing concentration of silicon.
   - At the middle of the diode: 50% silicon, 50% palladium
   - At the top: pure silicon
   - The result is a very large surface rectifier diode.

4 - Inner plastic tube for insulation
5 - Aluminium container
7 - End cap
8 - Valve
Since the first publication of Martin Fleischman and Stanley Pons in 1989, the majority of articles in the LENR field have focused on calorimetry. [1] This is true for both electrolysis experiments and gaseous loading experiments. [2]
This energy very quickly appears as a spontaneous potential difference which can reach over 0.5 volt per junction. (open circuit)

Diodes comprising of a stack of junctions were made, making it possible to obtain over 1 volt at the poles of a very compact device of a few centimeters length. The released power remains very low for the moment, (in the nanowatt range) but it should be noted that it is presented in the form of directly usable electrical energy, and not of thermal energy. (Fig. IV)

Of course, we have made blank and control experiments. We have built three diodes each time, one filed with pure deuterium (1.5 bar) another filed with hydrogen at the same pressure, and another filled with pure argon.

We observed no voltage with argon filling, a little voltage with hydrogen, twice the voltage with deuterium. We think that the observed voltage with hydrogen is generated by the little amount of deuterium in the hydrogen. (0.015% of deuterium in natural hydrogen)
This energy very quickly appears as a spontaneous potential difference which can reach over 0.5 volt per junction. (open circuit) Diodes comprising of a stack of junctions were made, making it possible to obtain over 1 volt at the poles of a very compact device of a few centimeters length. The released power remains very low for the moment, (in the nanowatt range) but it should be noted that it is presented in the form of directly usable electrical energy, and not of thermal energy. (Fig. IV) Of course, we have made blank and control experiments. We have built three diodes each time, one filed with pure deuterium (1.5 bar) another filed with hydrogen at the same pressure, and another filled with pure argon.

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Vendredi 03/06/2011

Deutérium 2 atmosphères

Courtesy Pr. Biberian, university of Marseilles
But it is difficult to avoid the deuterium leak, and the ensuing voltage drop. We plan to seal a diode in a glass tube, and measure the energy produced for several months by copper plating. It will then suffice to weigh the deposited copper to have a reliable estimate of the energy released. Thus, it will be possible to determine whether the energy observed is actually of nuclear origin, or if it is an artefact of electrochemical origin.
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In order to answer to this question, we plan to seal fusion diodes in glass tubes. The energy produced will be estimated by copper electrodeposition. After several months, it will be sufficient to weigh the copper deposited on a cathode whose weight is known at the beginning of the experiment to prove that the energy produced is of nuclear origin. (or not...)

Of course, it is rather tedious to work with powders. But the “Fusion Diode” effect is highly reproducible, even with thin films of organic semiconductors. The authors used many different embodiments of the “Fusion Diode”.
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Another team working on "fusion diodes" has made diodes by vacuum metallizing silicon wafers. On one side is deposited a palladium film, and on the other a gold film. (forthcoming publication)
We used sheets of aluminum foil covered on one side by a thin sheet of palladium, and on the other by a layer of semiconducting paint. (Plexcore® Organic Conductive Ink) Little disks are then cut with a punch and these disks are stacked on top of one another and compressed with a hydraulic press. A valve makes it possible to pressurize the container with deuterium.
Since the first publication of Martin Fleischman and Stanley Pons in 1989, the majority of articles in the LENR field have focused on calorimetry. [1] This is true for both electrolysis experiments and gaseous loading experiments. [2]
A better method would be to use a plastic film covered with a palladium sheet on one side, and a gold leaf on the other side.

Whether in the form of metal powders or thin metal foils, it is possible to quickly test a large number of alloys containing deuterium or hydrogen. The higher the voltage, the better the LENR properties of the tested alloy.

A large number of new alloys have been developed over the last 20 years by the metal-hydride battery industry, and also for the storage of hydrogen. Many of these alloys are available in the suppliers catalogs (Sigma-Aldrich). These alloys are much cheaper than palladium, and their price will drop considerably as soon as they are produced in industrial quantities.

Nickel alloys look promising. (2)

By way of example, the properties of the ZrV$_2$ H$_{5.5}$ alloy are better than those of pure palladium. (3% weight of hydrogen versus 0.5% for PdH$_{0.6}$ and Equivalent Pressure at 300 K of 10$^{-8}$ bar versus 0.02 bar for palladium) (Ref: D. Chandra et al., Material Matters, Vol 6, n°2, Sigma-Aldrich eds, 2010)
2) The use of the Reifenschweiler effect.
Otto Reifenschweiler was heading the neutrons generators departement of PHILLIPS during the 60's. In 1964, Reifenschweiler noticed that the apparent beta-decay of the tritium absorbed into titanium changes with the temperature of the titanium. Reifenschweiler has waited his retirement to publish his observations (9).
This is the experimental device of Reifenschweiler.

Please note that there is a strong vertical temperature gradient.
Here is the curve obtained by Reifenschweiller: the apparent radioactivity of tritium decreases by 40% between 100°C and 200°C (the complete curve is a little more complicated).
Fig. 3

- Temperature Gradient
- Shrinkage
- Hg - diffusion pump
- liquid nitrogen trap
- REFENSCHEWEILER
- EXPERIMENTAL DEVICE
- oven
- glass
- covar
- Ti soot layer
- evaporator
- Air cooling
- Al 10 µm
- stainless steel 18 µm
- metal
- asbestos
- thermocouples

Graph:
- Apparent activity of the tritiated titanium layer
- $115^\circ C$ ($a = 100\%$)
- $160^\circ C$ ($a = 72\%$)
- $275^\circ C$ ($a = 60\%$)
- $360^\circ C$

Vertical axis: $a$ (C/min)
Horizontal axis: $T$ (°C)
In our opinion, the number of disintegrations per second does not change, it is just the yield of counting x-rays produced by bremsstrahlung that varies.

We must remember that the energy of beta-decay is shared betweeen three entities:

We believe that at low temperatures, the tritium nuclei contained in the metal combine two by two to form composite bosons. (Two tritium nuclei of opposite spin form a composite boson, such as helium 3 nuclei in superfluid helium 3). These composite bosons can therefore form a Bose-Einstein Condensate (We will not discuss here the physical phenomena that make possible the existence of a BEC at room temperature) (10,11)
In this case, during the beta decay of a triton in this BEC, there is no more recoil of the nucleus: the energy of beta rays and neutrinos increases. The whole spectrum of beta electrons is shifted slightly towards high energies, and the counting efficiency increases.
The whole spectrum of beta electrons is shifted slightly towards high energies, and the counting efficiency increases. As the temperature increases, the pairs of tritium nuclei breaks and the Bose-Einstein Condensate disappears, and thus the counting efficiency of the radioactivity decreases.
This phenomenon is very important for our field of research because many authors have asserted that the "Nuclear Active Environment" that allows the LENRs is due to the formation of Bose-Einstein Condensates. (4,5,6,7)

It is therefore possible to use the Reifenschweiller effect to sort the new alloys containing hydrogen according to their capacity to house BECs

(Of course, we will use a simpler experimental device than that of Reifenschweiler: small sealed glass tubes containing the alloy powder and tritium, and a small programmable oven)

It is probably possible to design experimental devices even simpler, and bringing even more convincing results:
3) The magnetic cancellation of the tritium pairs.

This effect, which we have postulated, but not yet observed, would make it possible to very quickly test many new hybrid-forming alloys.
We propose to make sealed glass sources containing alloy powder and tritium. These sources will be placed in the gap of a powerful electromagnet. When the electromagnet will be activated, the spins of the tritium nuclei will align with the magnetic field and the composite bosons will be destroyed. The Condensate of Bose-Einstein will disappear. The beta spectrum will be shifted slightly towards the low energies and the counting efficiency of the radioactivity will decrease.
If it exists, this new effect will be easy to prove and it can be very useful to sort the best NAE alloys, regardless of the theoretical importance of this effect.
CONCLUSION

Despite the quality of the experimental results proving the reality of the Fleischman-Pons effect (Excess heat in palladium and deuterium alloys), the majority of scientists are still not convinced of the existence of LENRs.

We believe that the three phenomena of the "Fusion Diode" effect, the Reifenschweiler effect, and the magnetic suppression of the tritons pairs, if confirmed, could be the basis for new techniques to confirm the calorimetry experiments. It would also be possible to use these effects to quickly select new alloys that can be used to produce LENRs.
Thank you for your attention
REFERENCES
Introduction

Since the first publication of Martin Fleischman and Stanley Pons in 1989, the majority of articles in the LENR field have focused on calorimetry. [1] This is to be expected as calorimetry experiments provide the most direct method for detecting and measuring the conversion of nuclear energy into translational and rotational energy of the LENRs. Many calorimetry experiments are insensitive to nuclear fusion. However, subsequent calorimetry experiments have not controlled the scientific community from the beginning of the phenomenon. Some authors have focused on the fact that the number of disintegrations per second does not change, it is just the yield of counting x-rays produced by these disintegrations.

We believe that at low temperatures, the tritium nuclei contained in the metal combine two by two to form composite bosons. (Two tritium nuclei of opposite spin form a composite boson, such as in fraction 3: in a superconducting fraction 3). These bosons have an anomalous heat effect with a temperature dependence of +100 K of 10\(^{-2}\) K. This would enable us to build experimental devices even simpler, and bringing even more convincing results.

In this presentation we want to discuss how it is possible to find alternates to calorimetric experiments.

Results

We will show in this presentation some experimental results related to the “Fusion Diodes”.

1) The Fusion Diode Effect

It is very difficult to make good calorimetric recordings. It is too easy to count X-rays, but the more easily it is to get a scientific evidence of the LENRs, the less precise it is to do the electric measurements.

We have suggested the idea of “Fusion Diode”. Fusion diodes are made of polycrystals or polycrystalline alloys in contact with semi-conductors. This is a semi-conducting device.

When fusion reaction takes place near the metal-semiconductor contact, at the beginning we find high energy gamma rays (of MeV energy) and the transformation occurs, leading to a modification of the LENR (Diamond-conversion of Lignocused). But before transformation, the decaying energy match the level of excitation of the electrons of the metal: some energy is transformed into the electrons before thermalization (Effect in a photovoltaic cell). But in this case, the energy source is expected to be the radiation of ultraviolet, or perhaps photons, or at least photons. In Fusion Diode.

We can record the voltage and the intensity of the resulting current at the positive and negative side of the diode. This simple device allows a simple measurement of the power. However, it is not as easy as it is expected. We plan to record this electric energy during months or even years, to validate the possibility of a chemical origin. It is important to note that these devices have an electrical output. There is also a thermal output. The energy is released as electrical energy, and this is very easy to record with high sensitivity. We are using devices made of polycrystals or polycrystalline alloys in contact with semi-conductors. This is a semi-conducting device.

But it is difficult to avoid the formation of a thin oxide film, and the voltage drop is.

Is the electric energy produced by a nuclear reaction, or is it an artefact of the electrical origin?

In order to respond to this question, we plan to seal fusion diodes in glass tubes. The energy studied will be emitted by a copper grid placed at the back. After several months, we will see if the weight of the copper grid is decreased. (We have done studies with copper grid placed on the surface of metal powder, and no weight change observed). We will observe if the voltage is generated when the alloy is placed in contact with the photovoltaic pixel. A wire brush is possible to provide the contact with the semiconductor.

2) The use of the Reifenschweiler effect.

For this purpose, we propose three relatively simple techniques:

1) The Fusion Diode Effect: a metal-semiconductor contact is exposed to an array of tritium electrons. This device is actually due to the direct conversion of LENR, not a simple method to sort the most efficient alloys.

2) The Reifenschweiler effect [9]: the variation of tritium beta-rays bremsstrahlung conversion efficiency as a function of temperature is also a simple method for sorting the most efficient alloys.

3) The magnetic cancellation of the tritium pairs: this effect, which we have published, could be very quickly test many new alloys [11].

CONCLUSION

Despite the quality of the experimental results proving the reality of the Fusion Diode effect (laser heat in polycrystals and low-temperature quasiparticle heating effect), the majority of articles in the LENR field have focused on calorimetry.

We believe that the three phenomena of the “Fusion Diode” effect, the Reifenschweiler effect, and the magnetic cancellation of the tritium pairs, if confirmed, could be the basis for new techniques to confirm the calorimetric experiments. It would also be possible to use these effects to quickly select new alloys that can be used to produce LENRs.

REFERENCES


