ISSN: 2639-0426

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International Journal of Physics: Study and Research

Letter to Editor

Open Access

The Electron's Hidden Role in Cold Fusion/LENR

Frederick J. Mayer

Mayer Applied Research, Inc., USA

Article Info

***Corresponding author:**
Frederick J. Mayer
Mayer Applied Research, Inc.,
1417 Dicken Drive, Ann Arbor, MI 48103
USA
E-mail: fred@frederickjmayer.net

Received: September 20, 2024
Accepted: September 27, 2024
Published: October 07, 2024

Citation: Mayer FJ. The Electron's Hidden Role in Cold Fusion/LENR. *Int J Phys Stud Res*. 2024; 6(2): 119-121.
doi: 10.18689/ijpsr-1000120

Published by Madridge Publishers

Abstract

Observations of the *Fleischmann-Pons Heat Effect* is considered with a new theoretical picture of energy generation via Compton composites—specifically *tresinos* and *tandem electrons*.

Keywords: Fleischmann-Pons Heat Effect

Background

Over thirty years ago, the quest for understanding the so-called *excess heat* in the Fleischmann and Pons (FP) article started a long series of experiments and controversies that became known as *cold fusion* (CF), and later as *low-energy nuclear reactions* (LENR). A good paper about this long but complicated period was published, a few years back, by a respected researcher in the field, McKubre [1].

In this paper, I will not attempt to unravel the many difficulties of this period, including theories, except to say that the initial FP suggestion about *cold fusion* has not survived the scientific community's criticisms due to the fact that most experiments did not detect the "expected" nuclear-reaction particles. On the other hand, the measurements of *excess heat* have survived the community's criticisms because many electrochemists have reproduced the *excess heat* observations.

Instead, the purpose of this paper is to introduce a new theoretical picture that finds the *Fleischmann-Pons excess heat* (FPEH) to not be related to nuclear reactions but rather to the generation of tresinos and the release of their *binding energy*. In such cases, the experiments "appear" to be rather more like unobserved chemical reactions. For readers unfamiliar with Compton composites, it could be useful to examine my late colleague (John Reitz) and my earlier papers, specifically [2], [3] & [4] as well as my recent paper [5]. These references do have associated *excess heat* but they are being produced in geophysical and/or astrophysical settings.

Most experiments and theories in CF and LENR research are focussed on nuclear reactions. However, in this paper I show that *electrons* play a crucial yet "hidden role" in excess *heat* generation.

A Different Perspective on Electrochemical Experiments

The usual picture of the electrochemical experiments, like those of FP, are considered as taking place in a solid-state Pd metal with absorbed protons or deuterons often located at the octahedral interstices in the metal lattice. However, I believe this picture should be modified to be more akin to *plasma*, except that the hydrogen ions are not "free" but are attached by electrostatic forces to the nearby Pd atoms. On the other hand, the electrons are more or less" free to roam" throughout the lattice, so they are able to "scatter" on the hydrogen ions and can either lose or gain energy from such collisions at relatively high rates. In addition, due to the large differences between the masses of electrons and ions, such collisions will generally not dislodge the ions from their positions. So finally the collisions act only to *accelerate* the electrons, perhaps multiple times, eventually raising their temperatures compared to the local temperatures of the ions and Pd lattice.

The bottom line is that the embedded hydrogen ions at many places throughout the lattice act as local *accelerators* for the many *free electrons* of the Pd metal; this perspective allows a straight forward "plasma-like" calculation of the electron accelerations.

The Electron Acceleration Dynamics

The electron-hydrogen ion collisions are well known in plasma physics, and I have chosen the "Collisions and Transport" section of Book's article [6] in the "Physics Vade Mecum" of the AIP 50th Anniversary Edition. The important question to be considered is: will the energy levels produced in such collisions be high-enough to produce *tandem electrons* [7] (electron-pairing) as described in the astrophysical context in my recent paper [5]. If the electron energies in the Pd acceleration can get to about 20 eV, then they will be sufficient for generating *tandem electrons* and will then become available in the "loaded" Pd lattice for *tresino* generation, hence releasing their "binding-energy" (3.7 keV). The electron acceleration in collisions with the hydrogen ions (protons or deuterons) is the focus of the reminder of this paper.

Characterizing the PD "Plasma" Initial Values

First, the palladium metal has an atomic number density n_{Pd} of about 6.83 × 10^{22}/cc, assuming one "free" electron per Pd atom then the electron number density is also 6.83 × 10^{22}/cc. In addition, I define a "loading fraction" as fn_{Pd} where f is a fraction indicating the number of sites of the Pd metal containing either protons or deuterons.

Evaluation of Energy Transfer Rates

The energy transfer rate equations ν are taken from page 263 of Book [6], where the subscript *i* is specialized to indicate electrons scatterings on either protons or deuterons.

For protons;
$\nu_{\epsilon}^{e/p} = 4.2 \times 10^{-9} n_p \lambda_{ep} [\epsilon^{-3/2} - 8.9 \times 10^4 (1/T)^{1/2} \epsilon^{-1} - exp(-1836_{\epsilon}/T)]\ s^{-1}$.

For deuterons;
$\nu_{\epsilon}^{e/d} = 4.2 \times 10^{-9} n_d \lambda_{ed} [\epsilon^{-3/2} - 8.9 \times 10^4 (2/T)^{1/2} \epsilon^{-1} - exp(-1836 * 2\epsilon/T)]\ s^{-1}$.

where λ_{ep} and λ_{ed} are the Coulomb logarithms (usually between 10-20) (see Book [6] pg 264).

Solutions

Using the input data from *Section IV* above and selecting choices for *f*, results in the plots of the energy transfer rates ν data as a function of energy ϵ in eV for electron-proton (Black) and electron-deuteron (Blue) plots. Typical additional parameters for e-p collisions are $T_p = 10^{-3}$ and $\lambda_{ep} = 10$ and similar values taken for e-d collisions (see Figure 1 plots). It is clear from these plots that *tresinos* will be created more readily in e-p collisions than in e-d collisions. Furthermore, these plots show that increasing the "loading fraction", *f*, of the Pd metal increases the energy transfer rates ν, at the higher-energy values approaching or equaling the the important value for creating *tandem electrons*—a value of about 20 eV. The P_t values shown are calculated as ν[20] × 3700 eV where the last factor is the *tresino binding energy*. Interestingly, the increase of P*t* with increasing *f* appears to be consistent with the observations of McKubre, et al., in [9].

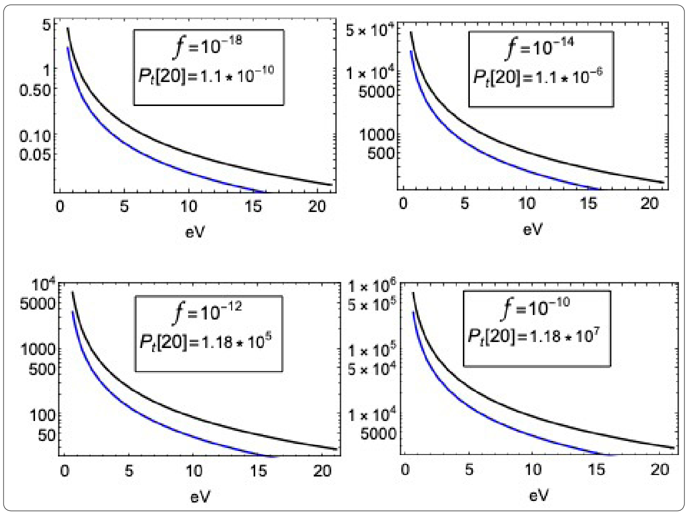

Figure 1. Plots of the energy transfer rates ν for electron-proton (Black) and electron-deuteron (Blue) collisions. The *f* values chosen are indicated as are the computed powers P_t[ergs/sec] that are expected if all the *tresinos* produced at the ϵ = 20 eV points were released. Note that the power produced at f = 10^{-10} is about 1 watt. See the text for other typical parameters.

Discussion

As mentioned in *Section I*, the observations of excess *heat* by FP (and later by others) interpreted their observations of excess heat as signs of nuclear reactions because they could rule out chemical reactions. But the generation by *tandem electrons* and then *tresinos* (both of which are Compton-scale composites) was not considered because this energy generation mechanism was not understood at that time. Therefore, the complications of this era of research in CF and LENR were all driven by the early misinterpretation by FP of observed *excess heat*.

Conclusions

The formation of *tresinos* is clearly a *new* non-nuclear source of energy in electrochemical experiments. Yet, the formation requires a second Compton composite *tandem electrons* to be formed first—that this occurs has been calculated and presented in this Letter.

Finally, it is my hope that this work may initiate a *new beginning* for energy generation via Compton composites in all its various manifestations.

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