AN INTERPRETATION OF THE PIANTELLI EFFECT BASED UPON THE LANT HYPOTHESIS AND ECFM MODEL FOR COLD FUSION

Robert T. Bush
Physics Department, California State Polytechnic University*
(Pomona)
and
ENECO **
Proteus Processes and Technology, Inc.***

ABSTRACT

The recently announced (January, 1994) Piantelli effect [1] of anomalous heat production in a hydrogen-loaded rod located in a hydrogen-pressurized chamber provides an important challenge for hypotheses and models on "cold fusion." The present author's hypothetical LANT Hypothesi [5] ("Lattice Assisted Nuclear Transmutation"), a generalization of his earlier CAF Model [4] ("Cold Alkali Fusion") and an attempt, like the latter, to unify the heavy water/excess heat effect (Fleischmann/Pons [2]) and the light water excess heat effect (Mill [3]), is applied to the Piantelli Effect [1] hypothesized to be an example of light water "cold fusion." For the Piantelli Effect, LANT predicts which metals should be most effective. A theoretical basis for LANT is hypothesized to be the author's ECFM [6,7,8] ("Electron Catalyzed Fusion Model").

INTRODUCTION

Recently, in a brief note in the January, 1994 issue of Il Nuovo Cimento, entitled "Anomalous Heat production in Ni-H Systems", F. Piantelli of the University of Siena and his collaborators, S. Focardi and R. Habel [1] (Hereafter: F/H/P) announced evidence for the excess heat production of up to 50W in a hydrogen-loaded nickel rod.

Controlled experiments devised to investigate the effect, discovered by Piantelli at the end of 1989, were begun around the end of 1992 at the University of Siena. Briefly, a nickel rod in the form of a solid cylinder of 5 mm diameter, and 90 mm length is heated by a platinum heater coil inside a stainless steel reaction chamber pressurized with hydrogen gas. Hydrogen was initially expected to be relatively neutral, with deuterium gas anticipated to produce the effect. Surprisingly to F/H/P it was found that ordinary hydrogen gas produces the heat anomaly. A stainless steel rod of the same size serves as an excess heat blank. Temperatures as high as about 450 C were employed with typical hydrogen gas pressures around 500 mbar. It will be hypothesized that the Piantelli Effect is closely related to the light water excess heat effect originally achieved by Mills [3] with an electrolytic cell employing a nickel cathode and a light water based potassium carbonate electrolyte. Moreover, it should be pointed out that, apparently unknown to F/H/P, the author and his colleague R. Eagleton at Cal Poly (Pomona) have achieved essentially 100% reproducibility for the light water excess heat effect with gains of 30% or more with closed electrolytic cells (platinum black recombiner utilized) employing nickel mesh cathodes and light water based electrolytes of carbonates and hydroxides of potassium, sodium, rubidium, and cesium [9,10,11,13].

THE LANT HYPOTHESIS

The author's LANT Hypothesis [5] ("Lattice Assisted Nuclear Transmutation") is a generalization of the author's previous CAF Hypothesis [4] ("Cold Alkali Fusion") seeks to unify the heavy water and light water excess heat effects. According to CAF the excess heat for an electrolytic cell with a nickel cathode and light water based electrolyte of an alkali atom salt of lithium, sodium, potassium, rubidium, or cesium, is essentially the positive Q value for the cold nuclear reaction in which a nucleus for one of the above alkali atoms somehow adds a proton to become a nucleus, respectively, of helium, magnesium, calcium, strontium, or barium. Strong preliminary evidence has been found for the production of both calcium in the case of potassium cells and strontium in the case of rubidium cells [11].

CAF is unifying in that it considers isotopic hydrogen as special cases of alkali atoms. So, it encompasses the D-D reaction to give He-4 and the hypothetical cold nuclear reactions of protons, deuterons, and tritons with other alkali atom nuclei. The LANT Hypothesis generalizes CAF in recognizing that the two reactants could be other than an alkali atom nucleus and a nucleus of isotopic hydrogen, and that there could even be more than two reactants. As in the case of CAF the Laws of Physics may not be broken, and the excess heat is assumed to be essentially the positive Q value given by the difference in the sum of the rest-mass energies of the reactants and that of the products.

A LANT HYPOTHESIS EXPLANATION OF THE PIANTELLI EFFECT

In what follows, three versions are presented, all highly hypothetical. Version A is the simpler of the three attempting to explain effects in terms of cold nuclear reactions that begin with stable nuclides and end with stable nuclides. No attempt is made with regard to the cross-sections of the reactions. Version B is more complex in bringing in hypothetical nuclear cross-sections and treating all nuclides present as potential reactants. Like B, Version C treats all nuclides present as potential reactants. However, like A it is simpler than Version B in leaving out nuclear cross-section considerations. All three versions make predictions of reactivities of materials with ordinary nickel taken as the standard.

Version A

LANT, in the absence of an alkali atom species such as rubidium, implicates the nickel material of the cylindrical rod as a candidate reactant. However, the prime candidate reaction is

$$p + Ni^{62} \rightarrow Cu^{63} \ [6.12 \text{ MeV}]$$

This is a cold nuclear reaction in which a Ni-62 nucleus adds a proton in a lattice-assisted cold nuclear reaction to become a nucleus of Cu-63. The Q value of 6.12 MeV is assumed to end up essentially as excess heat in the nickel lattice. Note that Ni-64 could not substitute for Ni-62 in the reaction since the Q value is negative. The natural abundance of Ni-62 is 3.66%.

Stainless steel blank comparison: For the iron constituent, the only candidate is Fe-58, with a natural abundance of 0.33%. The reaction adding the proton is then written in analogy to the earlier nickel reaction as $Fe^{58} + p \rightarrow Co^{59}$ [7.37 MeV]. If iron were the only constituent of stainless steel, it should be an excellent heat blank with a ratio of excess power to the nickel cylinder of the same size of about one tenth as seen by the following:

$$(7.37 \text{ MeV}/6.12\text{MeV})(0.33\% / 3.66\%) = O.11$$

However, iron is not the only component of stainless steel. Off-the-shelf stainless steel varies widely in the constituents alloyed with iron. However, the key constituent for excess heat considerations based upon

LANT is manganese. Only Mn-55 is stable (100% abundant) and the relevant reaction is $Mn^{55} + p \rightarrow Fe^{56}$[6.03MeV]. Another constituent is chromium with the relevant reaction $Cr^{54} + p \rightarrow Mn^{55}$ [8.00 MeV]. The stainless steel designated **403 (The double asterisks are part of the designation given in the Handbook of Physics and Chemistry [12], which contains: 86% iron, 13% chromium, and 1% manganese: Multiplying the fractional constituency by the natural abundance fraction and then by the excess energy (i.e., Q value) in MeV and adding these products for iron, chromium, and manganese, yields a "LANT index" for stainless steel **403 of 0.06:

$$(0.86)(0.0033)(7.37) + (0.13)(0.0238)(8.00) + (0.01)(1.00)(6.03) = 0.06.$$

This is to be compared for the LANT index for the nickel cylinder:

$$(1.00)(0.0366)(6.12) = 0.22$$

The ratio is in favor of the nickel. If on the other hand, one uses -202 stainless steel (which is at the high end of manganese content the situation changes drastically: 65% iron, 19% chromium, 6% nickel, and 10% manganese). Now, the LANT index becomes

$$(0.65)(0.0033)(7.37) + (0.19)(0.0238)(8.00) + (0.06)(0.0366)(6.12)+$$

$$0.10)(1.00)(6.03) = 0.66.$$

Which is about 3 times the nickel index. So that now the -202 stainless steel sample would give three times the excess power given by the nickel cylinder. Thus, if Version A of LANT is correct, the excess heat yield for stainless steel cylinders of the same size should depend critically upon the manganese content. And, manganese by itself would do best of all.

LANT index calculations for some other metals with nickel taken as (1.0) are as follows: Mn: (46.3), Rh: (39.5), Cu: (36.1), Sn: (11.8), Pb: (16.6), Ge: (11.3), Pt: (6.6), Zn: (5.5), stainless steel (-202): (3.0), Ti: (1.9), Ni: (1.0), stainless steel (**403): (0.27), and Fe: (0.1).

Possible evidence in favor of LANT, and Version A in particular, involves the high relative LANT index of Cu (36.1), and the low relative index of Fe (0.1). Thus, Bush [9] recently hypothesized that the addition of Cu to the nickel fibrex cathode would improve the excess heat yield for light water cells with nickel cathodes, and Bush and Eagleton [9] have demonstrated this for the cases of potassium, rubidium, and cesium. Corroboration for the case of potassium has come from the Srinivasan et al [15] of BARC (Bombay, India). In addition, Srinivasan et al. [15] have experimental evidence that the addition of Fe to the light water cell with nickel cathode tends to suppress the excess power yield, which would be consistent with the low relative index value (0.1) of iron.

Version B

In this more complex version an attempt is made to allow proton addition in a cold nuclear reaction, i.e. lattice-assisted, to all stable isotopes whether or not the reaction leads directly to another stable isotope or not. An attempt is also made to put in a relative reaction cross-section as a factor in a modified LANT index. Since it is the author's opinion, and based upon his ECFM, that "cold fusion" is genuine cold fusion catalyzed by a collapse of the electron to a ground state orbit very near the nucleus, it was decided to employ the cross-section for the absorption of a thermal neutron as a relative cross-section factor with the idea that the collapsed proton electron system would very much resemble a neutron on the scale employed. (All of the Q values, abundances, and thermal neutron absorption cross-sections are from Ref. [16].)

Calculation of this modified LANT index with the thermal neutron cross-sections in barns produced the following results: nickel: (32.8), stainless steel **403: (16.9), stainless steel ⁻202: (28.0). Thus, we see that there is still a considerable difference between the two extremes in manganese content of off-the-shelf stainless steel in terms of relative excess heats. However, **403, which should afford the best heat blank of the off-the-shelf stainless steels based upon the manganese content, would give one half the heat of the nickel sample. This seems too large for the heat blank and suggests an advantage of LANT Version A over Version B.

For other representative metals relative to nickel as 1.O, Version B predicts the following modified relative LANT Indices Rh: (38.1), Au: (21.4), Mn: (4.1), Pt: (1.9), Ni: (1.0), Cu: (0.86), stainless steel (-202): (0.85), stainless steel (**403): (0.52), Fe: (0.51), Pb: (0.02), and Sn: (0.008). So, while the two Versions show some similarities, there are enough differences to make a testable distinction. Thus, while Fe (0.51) is still low relative to nickel in Version B, it is much lower in Version A [Fe (O.1)] suggesting a superior excess heat suppressant in the case of A. In addition, Cu (0.86) is lower than nickel on the basis of B, and much higher on A [Cu(36.1)] showing that A supports Cu as a promoting agent for excess power, while B indicates that Cu is slightly suppressive. It is important to bear in mind for purposes of comparison that factors as relative number of interstitial sites and relative affinity of the surface for hydrogen could also be significant.

Version C

Version C is like B except that the thermal neutron cross-sections are left out of the modified relative LANT indices. Ni corresponds in this scheme to an absolute value of 8.49. However, taking Ni as having a relative index of 1.0, one obtains the following values for some representative metals: Mn: (1.20), Rh: (1.02), Ni: (1.00), Pt: (0.93), stainless steel (⁻202): (0.93), stainless steel (**403): (0.87), Cu: (0.84), Au: (0.84), Fe: (0.74), Sn: (0.44). As was the case for Version B, Version C suffers in comparison with the LANT Version A based upon the consideration of the stainless steel blank, Cu as an excess heat promoter, and Fe as a significant suppressor.

CONCLUSIONS: SUPERIORITY OF LANT VERSION A

It is interesting that all three versions suggest the superiority of manganese (Mn) with respective relative indices of (46.3), (4.1), and (1.20). (Ni taken as 1.00.) Finally, there is some preliminary experimental evidence from the Cal Poly research suggesting the efficacy of tin (Sn) as a promoter of the light water excess heat effect. With the respective LANT index values for Sn of (11.8), (0.008), and (0.44), it is clear that only LANT Version A suggests tin as a promoter. We can conclude, then, that the bulk of the evidence presently available favors Version A of the author's LANT Hypothesis. To summarize the supporting evidence in favor of LANT Version A over B and C: Thus, Version A: {l} Suggests a stainless steel variety that would serve as an effective blank (0.27), whereas neither B (0.52) nor C (0.87) do. {2} Predicts that Cu (36.1), a demonstrated excess heat promoter, is an excess heat promoter, whereas B (0.86) and C (0.84) predict Cu as an excess heat suppressor. {3} Predicts that Fe (0.1), a demonstrated excellent excess heat suppressor, is a suppressor, whereas B (0.51) and C (0.74) predict only slightly suppressant properties for Fe. {4} Predicts that Sn (11.8), for which there is preliminary evidence of being a promoter, is one, whereas B (0.008) and C (0.44) suggest suppressant properties. {5} By leading from a stable reactant to a stable product predicts minimal radiation, which is well-known for "cold fusion," and measured for the Piantelli Effect [1]. Thus, Version A is preferred.

DOES THE ZERO-POINT ELECTROMAGNETIC FIELD EXPLAIN COLD FUSION?: THE ECFM ("ELECTRON CATALYZED FUSION MODEL") TO EXPLAIN LANT.

The LANT Hypothesis is meaningful only if there is a way of getting through the Coulomb barrier, which is obviously more severe the greater the positive charges of the reactants. In the author's opinion the tunneling rate is significantly enhanced in the condensed matter environment by virtue of a reduced width of the Coulomb barrier achieved in one of two ways: (1) S-electrons spending part of their time inside a proton or deuteron. The delocalization of electrons in the lattice allows them to be much more effective in this role than in the case of a gas. (2) Electron collapse into ground state orbits of small enough radius. The author's ECFM [6,7,8] ("Electron Catalyzed Fusion Model") achieves this by employing the zero-point electromagnetic field. (Note that the "novel chemistry" explanation by Mills [3] to provide nuclear effects cannot explain the Piantelli Effect, since Mills requires potassium carbonate (absent from the F/H/P experiment) in his explanation. However, this problem does not afflict the author's ECFM [6,7,8] in that protons near the nickel surface can provide the "Casimir reflectors" required for the ECFM's more substantial electronic orbital collapse resulting in nuclear effects.)

ACKNOWLEDGEMENTS

H. Fox is thanked for his encouragement. F. Jaeger, President of ENECO (Salt Lake City, UT) and G. Thorne, Vice President of ENECO, are thanked for their information and encouragement. ENECO, Proteus Processes and Technology, Inc., of Denver, CO., J. Ignat, CEO and Ron Flores of Proteus Processes and Technology, Inc., are thanked for their support and encouragement. Thanks to M. Srinivasan (BARC, Trombay, Bombay, India) for alerting me to the F/H/P work. Finally, I am grateful to my colleague, R. Eagleton at Cal Poly (Pomona) for his encouragement and for serving as a sounding board for my ideas.

*3801 West Temple Avenue, Pomona, CA 91768.
**University of Utah Research Park, 391-B Chipeta Way, Salt Lake City, Utah 84108.
*** 1570 Emerson Street, Suite 100, Denver, CO 80218-1450.

REFERENCES

[1] S. Focardi, R. Habel, and F. Piantelli, "Anomalous Heat Production in Ni-H Systems", *Il Nuovo Cimento*, vol 107, p 103, January 1994.

[2] M. Fleischmann and S. Pons, "Electrochemically Induced Nuclear Fusion of Deuterium," *J. Electroanal. Chem.*, 261, 301 (1989).

[3] R. Mills and K. Kneizys, "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion", *Fusion Technol.*, vol 19 (1991).

[4] R. Bush, "A Light Water Excess Heat Reaction Suggests That 'Cold Fusion' May Be 'Alkali-Hydrogen Fusion', *Fusion Technol.*, 22, 301 (1992).

[5] R. Bush, "Towards a Nuclear Physics of Condensed Matter", accepted for *Fusion Technol.*, under revision.

[6] R. Bush, "An Electron-Catalyzed Fusion Model (ECFM) Suggests a Unification of Heavy- and Light Water Cold Fusion Phenomena", manuscript submitted for publication to *Fusion Technology*.

[7] R. Bush, "A Unifying Model for Cold Fusion," talk delivered at Maui Conference, 4-ICCF, 1993.

[8] R. Bush, "A Unifying Model for Cold Fusion", submitted to the Proceedings of the 4-ICCF.

[9] R. Bush and R. Eagleton, "Calorimetric Studies for Several Light Water Electrolytic Cells With Nickel Fibrex Cathodes and Electrolytes with Alkali Salts of Potassium, Rubidium, and Cesium", submitted to Proc.4-ICCF, (1994).

[10] R. Bush and R. Eagleton, "Experimental Studies Supporting the Transmission Resonance Model for Cold Fusion in Light Water: II. Correlation of X-Ray Emission with Excess Power", Proc. 3-ICCF, 409 (1993).

[11] R. Bush and R. Eagleton, "Strontium Production in Two Electrolytic Cells with Light Water Based Rubidium Carbonate Electrolytes and Nickel Mesh Cathodes," talk delivered at the Maui Conference, 4-ICCF (1993), submitted to the Proceedings.

[12] R. Weast, editor, CRC Handbook of Chemistry and Physics, 61st Edition, CRC Press, Inc., Boca Raton, Florida, 1980-1981.

[13] R. Bush and R. Eagleton, "The Transmission Resonance Model for Cold Fusion in Light Water: I. Correlation of Isotopic and Elemental Evidence with Excess Power", Proc. 3-ICCF, 409 (1993).

[14] R. Bush, "Evidence for an Electrolytically Induced Shift in the Abundance Ratio of Sr88 to Sr86", submitted to the Proceedings of the Minsk Conference, May 1994.

[15] M. Srinivasan, P. Adi Babu, M. Bajpai, D. Gupta, U. Mukherjee, H. Ramamurthy, T. Sankarnarainan, A. Sinha, and H. Shyam, "Excess Heat and Tritium Measurements in Ni-H2O Electrolytic Cells", submitted to Proc. 4-ICCF.

[16] Bureau of Radiological Health, Radiological Health Handbook, January 1970.