1.8 DOE report 2004

Five "proposers" (P.L. Hagelstein,[1] M.C.H. McKubre,[2] D.J. Nagel,[3] T.A. Chubb,[4] and R.J. Hekman) requested DOE to revisit the question of scientific evidence of low energy nuclear reactions postulated due to D-D fusion (sometimes referred to as "cold fusion").

The proposers presented a document "New Physical Effects in Metal Deuterides" to DOE. DOE chose nine scientists to peer review the document and also nine scientists to attend a one-day review of oral presentations for about one hour each by six research groups.

We see the outline of the document by its Abstract, Introduction and Conclusions cited below:

Abstract of the document

The experimental evidence for anomalies in metal deuterides, including excess heat and nuclear emissions, suggests the existence of new physical effects.

1. Introduction of the document

Following the initial claims of 1989,1,2 the body of research on anomalous effects in metal deuterides has grown to include thousands of papers on a wide spectrum of topics. DoE, to facilitate their review of this set of research, has asked for the preparation of the following summary. The entire body of research is not addressed. Rather, a subset of research from two areas is presented: selected issues associated with excess heat production in deuterated metals, and a brief discussion of some aspects of nuclear emissions from deuterated metals.

6. Conclusions of the document

The research discussed in this paper provides evidence for effects in three categories:
(1) The existence of a physical effect that produces heat in metal deuterides. The heat is measured in quantities greatly exceeding all known chemical processes and the results are many times in excess of determined error using several kinds of apparatus. In addition, the observations have been reproduced, can be reproduced at will when the proper conditions are reproduced, and show the same patterns of behavior. Furthermore, many of the reasons for failure to reproduce the heat effect have been discovered.
(2) The production of ^{4}He as an ash associated with this excess heat, in amounts

commensurate with a reaction mechanism consistent with D + D → ^{4}He + 23.8 MeV (heat).
(3) A physical effect that results in the emission of: (a) energetic particles consistent with d(d,n)^{3}He and d(d,p)t fusion reactions, and (b) energetic alphas and protons with energies in excess of 10 MeV, and other emissions not consistent with deuteron-deuteron reactions.
Experimental results for tritium production were noted, and anomalous results from deuteron beam experiments on TiD*x* were discussed briefly. In each case, the effects cannot be accounted for by known nuclear or solid state physics. The underlying processes that produce these results are not manifestly evident from experiment. The scientific questions posed by these experiments are, in the opinion of the authors, both worthy and capable of resolution by a dedicated program of scientific research.

The main object of this document by five researchers is to show the occurrence of d-d fusion reactions in transition-metal deuterides (especially in PdD_x) and its explanation by a theory.

The result of the peer review by DOE is summarized in the Conclusion of DOE's "Report of the Review of Low Energy Nuclear Reactions":
http://www.science.doe.gov/Sub/Newsroom/News_Releases/DOE-SC/2004/low_energy/CF_Final_120104.pdf
Conclusion of the Report

While significant progress has been made in the sophistication of calorimeters since the review of this subject in 1989, the conclusions reached by the reviewers today are similar to those found in the 1989 review.

The current reviewers identified a number of basic science research areas that could be helpful in resolving some of the controversies in the field, two of which were:

1) material science aspects of deuterated metals using modern characterization techniques, and

2) the study of particles reportedly emitted from deuterated foils using state-of-the-art apparatus and methods.

The reviewers believed that this field would benefit from the peer-review processes associated with proposal submission to agencies and paper submission to archival journals.

About the theoretical verification of the d-d reaction producing ^{4}He and lattice energy,

the "Report" discussed as follows:

Charge Element 2: Determine whether the evidence is sufficiently conclusive to demonstrate that such nuclear reactions occur.

Reviewers expert in nuclear physics noted that the cold fusion mechanism put forward by proponents is not in accord with presently accepted knowledge of D + D fusion. Specifically, D + D fusion is accompanied by the production of protons, neutrons, tritons, ^{3}He, ^{4}He and high energy gamma rays, all in well known proportions. The fusion channel resulting in ^{4}He and high energy gamma rays occurs approximately only once for every 10^{7} D + D fusion reactions. These characteristic proportions for the production of the fusion products are found for every energy of the incident deuteron measured so far, down to the lowest that has been measured.

The review document and oral presentations made the argument that the branching ratios are different at low energies and that in cold fusion, ^{4}He fusion channel is predominant. According to the review document, no high energy gamma rays appear to accompany the ^{4}He, as is observed in D-D fusion reactions. Instead, the approximately 24 MeV in energy resulting from D-D fusion was purported to appear as heat in the material lattice. To explain these unusual characteristics, the reviewers were presented with a theoretical framework that purported to describe how collective energy from the material lattice couples to a deuteron pair to induce fusion, how the only fusion reaction channel that occurs would be the production of ^{4}He, and how all the energy is coupled back into the material in the form of heat instead of high energy gamma-rays. The reviewers raised serious concerns regarding the assumptions postulated in the proposed theoretical model for the explanation for ^{4}He production.

The preponderance of the reviewers' evaluations indicated that Charge Element 2, the occurrence of low energy nuclear reactions, is not conclusively demonstrated by the evidence presented. One reviewer believed that the occurrence was demonstrated, and several reviewers did not address the question.

Author's comment on this issue

As we have already seen in this Chapter and will see in following Chapters more extensively, CFP is not so simple phenomenon as explained by d-d fusion reactions, if any.

The most important factor we have to notice in CFP is complexity. From its nature of complexity, we can not expect the quantitative reproducibility of events in CFP. It is necessary to use a concept of qualitative reproducibility to specify CFP. This point of view is missing in the proposers' document and therefore in DOE's Report.

The second point we have to recognize in the CFP is variety and diversity of events occurring not only in transition-metal deuterides but also in hydrides. Furthermore, we know it occurs in cross-linked polyethylene with appropriate ions diffused. If we want to treat the CFP as a whole from a unified point of view, we have to seek a common cause for various events both in deuterides and hydrides. The proposers' point of view is on the extension of the line proposed by Fleischmann et al. (the Fleischmann's hypothesis) confined to deuterides using subtle experimental evidences of ^{4}He detection.

These problems are related with essential factors of the CFP and will be discussed in later Chapters phenomenologically inherent in natural science as a positivistic science.

(The DOE Report 2004, "*Report of the Review of Low Energy Nuclear Reactions*." Is posted at the following website:
http://www.science.doe.gov/Sub/Newsroom/News_Releases/DOE-SC/2004/low_energy/CF_Final_120104.pdf.
This report is now also posted at the *New Energy Times* website:
http://newenergytimes.com/v2/government/DOE2004/7Papers.shtml
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