Cold Fusion: A Hypothesis

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It is suggested that the evidence for the putative phenomenon of cold fusion is valid, but that the effect is not dominated by a DD reaction.

On March 23, 1989, in a news conference at the University of Utah, the electrochemist B. S. Pons (also speaking for his colleage M. Fleischmann) claimed [1] that nuclear energy, in the form of heat, was liberated by a room temperature "table-top" apparatus that used a palladium (Pd) cathode to electrolyze heavy water (D_2O). In a paper submitted for publication a few days earlier [2], the two chemists had written that "the bulk of the energy release is due to a hitherto unknown nuclear process or processes (presumably ... due to clusters of deuterons)". The immediate – and thereafter unrelenting – reaction of the hot fusion community was disbelief based on the absence at the expected intensities, of the customary signs of a DD reaction, such as neutrons ($d+d \rightarrow n+{}^3He$) and high energy γ-rays ($d+d \rightarrow \gamma+{}^4He$).

The hypothesis that I now advance has the following ingredients:

(1) The claim of Pons and Fleischmann to have realized cold fusion is valid.

(2) But, this cold fusion process is not powered by a DD reaction. Rather, it is an HD reaction, which feeds on the small contamination of D_2O by H_2O.

(3) The HD reaction $p+d \rightarrow {}^3He$ does not have an accompanying γ-ray; the excess energy is taken up by the metallic lattice of Pd alloyed with D. (Others have mentioned the possible importance of an HD reaction, but without reference to the lattice, and with no claim for its dominance over DD reactions.)

(4) The coupling with the Pd–D lattice that rapidly siphons off nuclear energy, as it becomes available, had previously acted to suppress the Coulomb repulsion between p and d, and, indeed, to overcome it with an energy of attraction that significantly ameliorates the effect of Coulomb barrier penetration.

(5) The asymmetry of the pd situation, compared with the symmetry of dd, enhances the HD reaction over DD reactions.

In this view, the dominant fusion reaction produces neither neutrons nor high energy γ-rays. Of course, the same could be said of a purely chemical reaction. But the specific fusion hypothesis outlined here invites a critical experimental test, one to which neither a DD nuclear reaction nor a (unkown) chemical reaction would appear to be sensitive: Compare the heat outputs of cells that are similarly prepared in all respects but the varied small admixtures of H_2O in the D_2O. This may be an overly idealized proposal, however. The short, bloody, history of cold fusion indicates that "similarly prepared" is not a trivial condition. An alternative, and apparently simpler, procedure is to add a small percentage of H_2O to a functioning cell, but here one must not allow the long term effects to be obscured by transient phenomena. Finally, concerning the oft repeated demand for a control experiment using H_2O, one should note the possibility of a converse effect of the HD reaction: Through the natural presence of D_2O in ordinary water, such a control experiment might produce an otherwise puzzling amount of heat.

Note added in proof: The details of the lattice coupling mechanism are described in a series of papers with the title: Nuclear Energy in an Atomic Lattice. The initial paper appeared in Z. Physik D **15,** 221 (1990).

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[1] New York Times (National Edition), March 24, 1989, p. A 16.

[2] M. Fleischmann, S. Pons, and M. Hawkins, J. Electroanal. Chem. **261,** 301 (1989); errata: **263,** 187 (1989).

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