Possible Participation of Lithium in Fleischmann-Pons Reaction is Testable

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If the amount of heat reported by Fleischmann and Pons to occur in their electrochemical "fusion" experiment is assumed to be produced entirely by the "clean" nuclear reaction $^6Li + ^2D \rightarrow 2\,^4He$ (22.4 MeV), then the concentration of ^6Li in the reaction fluid should during a period of 120 hours go down by a measurable amount, namely between 3.4 and 0.25 percent dependent on whether the natural isotopic mixture of (less likely) pure ^6Li was used in the experiment.

Fleischmann and Pons [1] recently reported on an electrochemical experiment in which "too much" heat was produced to be accounted for by chemical reaction. Nevertheless, only a very small amount of gamma radiation, neutron flux production and tritium production was observed – by a factor of 10^9 too small, in fact, if one assumes $^2D + ^2D$ reactions to account for the heat. The authors therefore hypothesized that an "unknown" nuclear reaction may be participating.

While the details of the experiments have yet to be confirmed by other groups – so far only inconclusive and contradictory results are available – the question is interesting enough to be taken seriously in its own right. Recently, Jones [2] in a different context discussed as an especially clean nuclear reaction the example of

$$^6Li + ^2D \rightarrow 2\,^4He \quad (22.3714\ \text{MeV}) \quad (\text{see [3]}). \tag{1}$$

Among the various Li + D-reactions we concentrate on (1); for this reaction is "appealing because there are no neutrons in the final state" [2]. As it happens, also the radiation production is exceedingly low. The reaction (1) is of potential interest because lithium has been used by Fleischmann and Pons as a 0.1 molar solution within the heavy water electrolyzed, in contrast to the second recently claimed electrochemically induced "cold fusion" by Jones et al. [4], who had not reported an excessively high production of caloric energy. Assuming the reaction (1) to be responsible for the major part of the apparent heat, the measured neutrons and gammas might stem from subordinate $^2D + ^2D$ reactions.

Of course, a mechanism for the deuterons either colliding with each other or colliding with other light nuclei inside the palladium is still pending. The hypothesis that the positive deuterons might be "delocalized" within the palladium crystal among the positive palladium ions, with the consequence that a Bose condensation (with the fermion subparticles forming a degenerate Fermi gas) might possibly form, was recently proposed [5]. This condensation might potentially be responsible for a "surreptitious" mutual approach up to the minimum tunneling distance required for the nuclear reaction in question to occur. This, of course, is only a speculation at the time being.

At any rate, there is evidence that lithium can be taken up into the palladium crystal much like hydrogen and the noble gases [6]. Therefore there is the possibility that, if for some reason the deuterons could come close to the lithium, the above reaction might take place. Although the question would have to be answered how competing $^2D + ^6Li$ reactions leading to byproducts like neutrons, protons or gammas could be suppressed, it is perhaps of interest to see whether the reaction named (1) can *in principle* account for the observed energy production as well as the cleanness reported.

Fleischmann and Pons [1] reported that $14.6 \cdot 10^{23}$ deuterium atoms were present in their experiment using the rod-shaped electrode, which lasted for 120 hours. This yields a volume employed of 21.6 ml. A 0.1 molar solution of LiOD in heavy water then contains $1.3 \cdot 10^{21}$ lithium ions. To obtain an energy output of 26.8 watts, $7.5 \cdot 10^{12}$ reactions (1) would be needed per second. In 120 hours, about $3.2 \cdot 10^{18}$ fusion events would occur.

This means that, if all lithium ions present originally were ^6Li, about 0.25 percent would have had to be used up at the end of the experiment. If, on the other hand, natural lithium (7.3 percent ^6Li, the rest ^7Li) has been used as likely, 3.4 percent would have had to be used up. *Both* rates of decrease are readily measurable with current methods.

To conclude, we propose to monitor the ^6Li concentration in future runs of the Fleischmann-Pons exper-

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iment. In addition the amount of the ^{4}He produced could be measured too. Because of probable energy transfers to the Pd-lattice, a measurement of the α-radiation has to be complemented by an analysis of the Pd electrode with respect to embedded α's.

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Note added in proof: After our paper was submitted, two analogous ideas have been reported [7, 8]. That lithium might play a crucial role is indicated by some results of J. Appleby [9]. However, our proposal is not contingent on the ultimate outcome of the Fleischmann-Pons debate, but provides another possibility to falsify (or – perhaps – corroborate) their conjecture of nuclear reactions.

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