Electrodeless, Multi-Megawatt Reactor for Room-Temperature, Lithium-6/Deuterium Nuclear Reactions

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ABSTRACT

This paper describes a reactor design to facilitate a room-temperature nuclear fusion/fission reaction to generate heat without generating unwanted neutrons, gamma rays, tritium, or other radioactive products.

The room-temperature fusion/fission reaction involves the sequential triggering of billions of single-molecule, Li^6D "fusion energy pellets" distributed in lattices of a palladium ion accumulator that also acts as a catalyst to produce the molecules of Li^6D from a solution comprising D_2O, Li^6OD with D_2 gas bubbling through it. The D_2 gas is the source of the negative deuterium ions in the Li^6D molecules.

The next step is to trigger a first nuclear fusion/fission reaction of some of the Li^6D molecules, according to the well-known nuclear reaction:

$$Li^6 + D \rightarrow 2\ He^4 + 22.4\ MeV$$

The highly energetic alpha particles (He^4 nuclei) generated by this nuclear reaction within the palladium will cause shock and vibrations in the palladium lattices, leading to compression of other Li^6D molecules and thereby triggering a second series of similar fusion/fission reactions, leading to a third series, and so on. The absorption of the kinetic energy in the palladium will, in turn, generate a continuous flow of heat into the heavy water carrier, which would be removed with a heat exchanger.

FRONTIERS OF COLD FUSION

The reactor apparatus has several potential advantages over the Pons-Fleischmann ("P-F") electrolytic cell structure. In particular, the reactor apparatus allows scaling up the number of reactor cells and the reactor size to meters or even kilometers, to permit multi-megawatt power levels. It also is much safer to work with since there are no electrodes or oxygen gas that could trigger the chemical reaction D + O and an explosion.

1. Introduction

The Pons-Fleischmann experiments, announced in March 1989, brought us a nuclear energy source of significant potential. However, the P-F electrolytic cell does not offer the designer of a high-power reactor much design latitude. It is as simple in its design and power level as the Fleming valve, the first vacuum diode used in radio. Fifty years later, the inventions of the magnetron and klystron, with their large distributed energy interaction areas, enabled multi-megawatts to be generated. The concept of distributed interaction areas for energy generation also can be applied to a room-temperature fusion/fission reactor.

2. Analysis of the Pons-Fleischmann Electrolytic Cell

How does the P-F electrolytic cell achieve room-temperature nuclear reactions? Analysis has led to the conclusion that the P-F electrolytic cell accomplishes two initial functions: (a) it generates deuterium gas and deuterium ions at the palladium cathode surface through electrolysis of the heavy water and (b) the voltage gradient pushes the positive lithium-6 ions into the surface lattices of the palladium cathode.

Such a simple electrolytic cell performing both of these initial functions and also "catalyzing" the room-temperature nuclear reaction as well is truly amazing. How does one optimize the design of such a simple structure when it is accomplishing all of these functions? Any attempt to optimize one of the functions might degrade the others. It is impressive that Pons and Fleischmann found designs that worked at all.

3. The Synthesis of the Electrodeless, Multi-Megawatt, Drexler Reactor

Without electrodes, electrolysis, or voltage gradients in the Drexler reactor, other methods are used to provide the necessary deuterium gas and the essential flow of lithium-6 ions into the palladium lattices. These other methods use (a) a pressurized tank, to feed the deuterium gas into the heavy water at a number of key points and (b) mechanical pump(s), to cause a significant flow of heavy water containing lithium-6 ions through a closed-loop torus (toroid), multi-cell reactor structure, as shown later in Figures 1 and 2.

Without the palladium cathode of the P-F cell, the Drexler reactor must use other ion accumulator designs such as the perforated, palladium-based baffles shown later in Figures 3 and 4. Ionized D_2O (containing D_2 and Li^6OD) is pumped through the torus (doughnut)-shaped, multi-cell reactor structure and through the baffles at pressures and flow rates determined by the number of holes, their sizes, and the pump capacity. The pressure at the palladium-coated surfaces of the baffles will force deuterium and lithium ions into the palladium lattices, where they can chemically react to form large numbers of single-molecule, Li^6D "fusion energy pellets." Shock and vibration from the turbulent heavy-water flow, ultrasonics, or other methods would then trigger some of the Li^6D molecules into the fusion/fission reaction:

$$Li^6 + D \rightarrow 2\ He^4 + 22.4\ MeV$$

The highly energetic alpha particles generated by this nuclear reaction will cause shock and vibrations in the palladium lattices, leading to compression of other Li^6D molecules and thereby triggering a second series of similar fusion/fission reactions, leading to a third series, and so on. The absorption of the kinetic energy in the palladium will, in turn, generate a continuous flow of heat into the D_2O carrier, which would be removed with a heat exchanger.

This reaction is called a fusion/fission reaction since initially it forms the fusion product beryllium-8, which instantly fissions into two energetic alpha particles. The use of lithium-6 deuteride pellets as a nuclear energy source is not new--in fact, they are used in some hydrogen bomb designs to enhance energy output. Also, in generating multi-megawatts, there always is concern about generating undesirable neutrons, gamma rays, tritium, or other radioactive byproducts. This well-known nuclear reaction avoids all of those byproducts.

4. Summary

This room-temperature fusion/fission reactor design overcomes the power-generation limitations of the P-F electrolytic cell and avoids the use of electrodes and electrolysis inherent in the P-F cell design. Its key features are: (a) no electrolysis--deuterium gas is injected, (b) multi-cell structure for large power output, (c) closed-loop reactor for thermal efficiency and to isolate reactants from the atmosphere, (d) energetic alpha particles are the only reaction products, (e) no oxygen gas--threat of explosion is removed.

The author's international patent application, PCT/US91/03503, entitled, "Distributed Deuterium-Lithium Energy Apparatus," [priority date May 25, 1990] describes this torus-shaped reactor, helical-shaped reactor designs, and ion accumulators using beds of palladium particles.

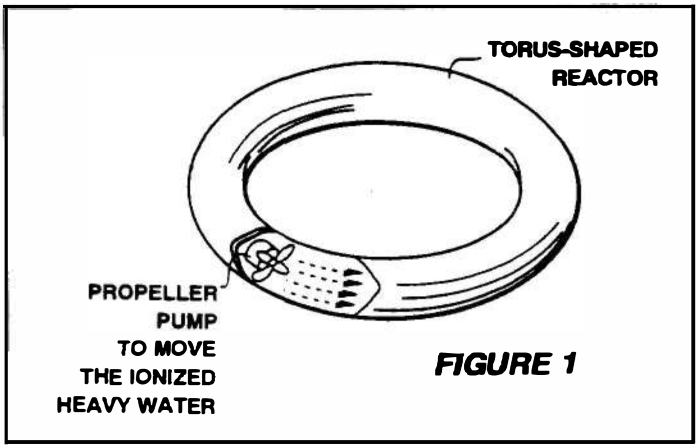
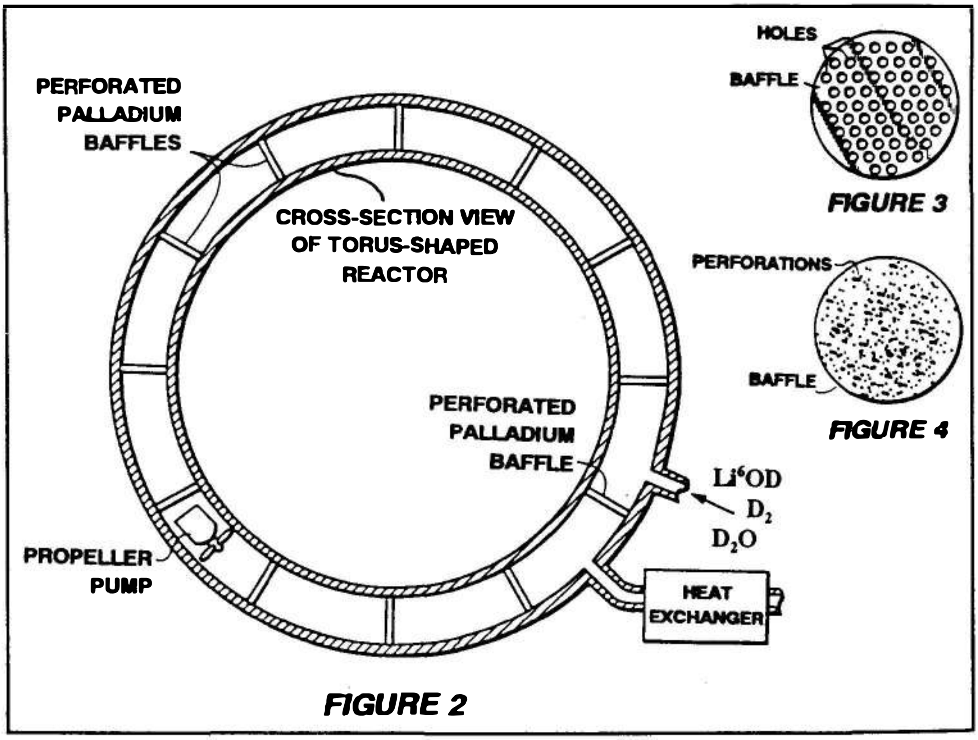


Figure 1. Perspective view of the electrodeless "cold fusion" reactor apparatus, showing a propeller pump for driving the ionized heavy water through a closed-loop torus.



Figures 2 - 4. Figure 2 is a sectional view of the reactor apparatus showing the propeller pump and a sequence of perforated palladium baffles, represented by Figure 3 and Figure 4, which may be used as palladium- or palladium-alloy ion accumulators.