ENERGY AMPLIFIER WITH MULTILAYER THIN FILM ELECTRODES

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ABSTRACT

The application of the "swimming electron layer" theory [1-4] to the design of multilayer thin film electrodes is discussed. A key advantage of this approach is that the enhanced reaction rate at interfaces between select metals is predicted to produce a high power density throughout the volume of the multilayers. Initial experimental studies of heat production by electrolysis, using a multilayer thin-film cathode specially designed on the basis of this theory, are presented.

INTRODUCTION

The excess heat during heavy or light water electrolysis using Pd cathode with LiOD (LiOH) electrolyte has been reported by several groups [5]. To date, heat production equal to as much as ten times the input energy has been reported from some of these experiments [6]. Many theoretical explanations have been offered to explain these exciting experimental results. Most of these theories explain the reaction as a quantum mechanical tunneling effect in the presence of a solid lattice. This does not, however, explain the high reaction rates observed in the experiments which are thought to involve surface or intersurface effects [7]. Thus the "swimming electron layer" theory was developed to address that issue [1-2]. This model is based on the effect of surface tension on an exotic plasma at metallic interfaces, resulting in enhanced reaction rates.

In the present research, we have concentrated on the experimental investigation of excess heat production phenomena, using a unique multilayer electrode design that is predicted to increase reaction rates by increasing the electrode interface area and by using select metals with large Fermi-energy-level differences. Initial experimental studies of heat production by electrolysis, using a multilayer thin-film cathode specially designed on the basis of the "swimming electron layer" theory is described.

"SWIMMING ELECTRON LAYERS" THEORY

Several experiments reported by other workers have indicated that cold fusion is a surface-related exothermic phenomena. The "swimming electron layer" theory is consistent with this observation and suggests the use of multilayer thin foils in order to induce reactions throughout the volume of an electrode. This approach would in turn allow direct scaling to high power levels in minimum size cells.

Multilayer electrodes suggested by this model will have closely spaced interfaces at which cold fusion would occur to provide a high power output. Related experiments using coated electrodes have been reported by Arata and Zhang [7], where as multiple large volume Pd/Si layers have been studied by T. Claytor [8]. Both experiments were quite successful and thus provide encouragement for the multilayer

film concept.

The metal pairs used in the present experiments for fabricating multilayer electrodes are selected so that the metals do not diffuse into each other, maintaining well-defined interfaces. Differences in Fermi levels adjust at the interfaces creating an electron layer that is most effective in shielding the positive charges of fusing deuterons. The dynamic shielding effect of the electron layer may further be enhanced if the electrode is connected to the negative terminal of a power source that floods the conduction bands of metals with electrons. Thus, when one uses an AC power source or ramps the current from a DC source during the electrolysis, a dynamical non equilibrium condition is created. This effect is related to the enhanced reaction rate observed by others using oscillating or ramped voltages [7,8].

The basis process is viewed as involving colliding thermal deuterons in a double potential layer region developed at the internal interfaces of the multilayer electrodes. At the low speeds involved, the D^+ nuclei will be polarized (see Figure 1). The shielding of the positive charge in this state by swimming electron layer allows a very close approach, where the nuclear forces become effective to form a compound nucleus in an excited state [1].

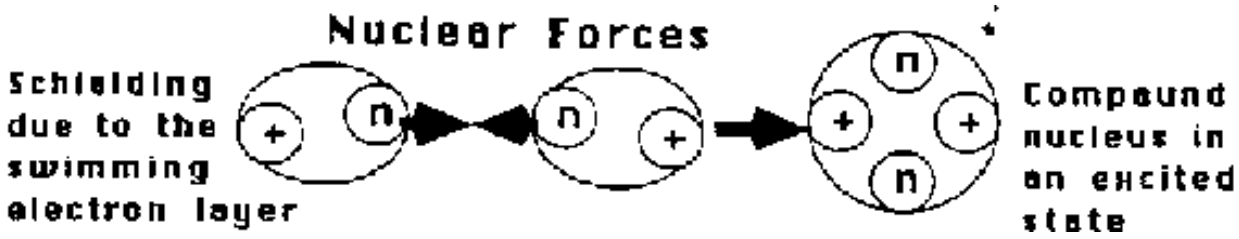

Figure 1. Cold fusion of D^+ shielded by swimming electron layer.

3. EXPERIMENTAL INVESTIGATION.

The experiments were carried out by observing the temperature increase and gas production compared to input power. The experiment employed a calorimeter technique, which used paired identical electrolytic cells. These cells were identical except that one utilized the multilayer cathode, while the second used a plain stainless steel (copper) plate of the same size. The multilayer cathode is made from a stainless steel plate (copper), 25 mm x 25 mm x 3 mm thick, coated with alternating layers of Ti and Pd, deposited by a unique e-beam evaporation method specifically developed for this purpose. The cathode has six layers of Ti, alternating with five layers of Pd per side (having a total thickness of 100 Å) sandwiched around the stainless steel core.

The electrolyte cell design is shown in Figure 2. Each cell represents 250-ml vacuum jacked dewars closed by 5-cm thick tapered rubber stopper. Glass boxes (60x40x20 mm) with a system of electrodes and 0.1 - 0.57 molarity LiOH electrolyte solution were placed into both dewars. The glass box is used for decreasing the amount of electrolytes and as a result increasing the thermal sensitivity of this apparatus. The space between dewar's wall and the glass box was filled with distilled water to increase the heat system's capacity.

Both cells were connected on parallel to the same power supply, in order to provide a matched power deposition. Midway during the experimental run, as an added control, the electrodes were interchanged between the cells.

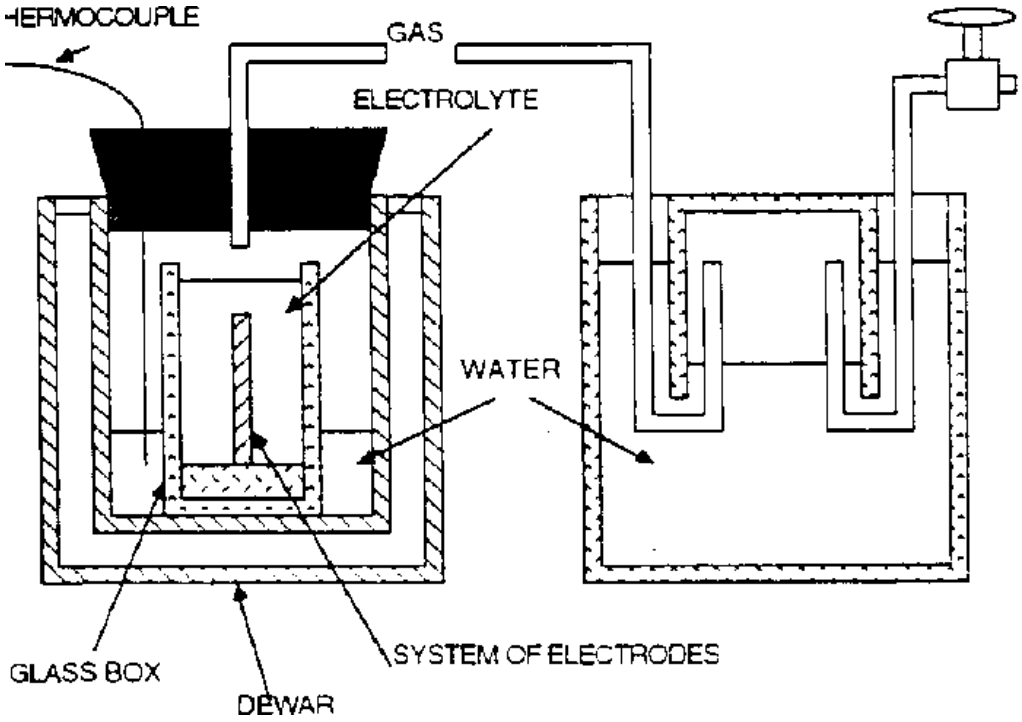

Figure 2. The electrolyte cell design.

The temperature of the multilayer-cathode cell was consistently 1.5 ± 0.5 °C higher than that of reference cell, but for short periods limited by damage flaking of the thin films on the electrode surface. This corresponds to ~2 kW/cm^3 energy production in the thin-film interface region, assuming reaction occurs, as predicted, over a region extending an electron-Debye length from the interface. The total volume average power, if applicable, would be several orders of magnitude lower than the interface value.

These results must be viewed as very preliminary, since the experimental runs have been limited by early flaking of thin layers, probably due to differential expansion of the layers during intense heating. Also, this preliminary calorimeter technique involves some assumptions that need further study. Some advantages and disadvantages of conventional calorimetric methods have been eliminated in this design, which provides a closed system and allows simultaneous measurement of both gas and heat production.

A new electrode design, with several improvements to increase film stability, has been developed for future experiments. This design and results using it will be presented.

CONCLUSION

The approach proposed here is unique in describing cold fusion as an interface phenomenon, consistent with both the "swimming electron layer" theory and with experimental results that indicate reactions mainly occur at electrode surfaces. Techniques have been developed to fabricate multilayer thin film electrodes, and preliminary experiments indicate a high power density throughout the film volume. If a stable film design can be found, this approach could be a promising one for an energy amplifier.

REFERENCES

1. H. Hora, J.C. Kelly, J.U. Patel, M.A. Prelas, G.H. Miley, and J.W. Tompkins, "Screening in Cold Fusion Derived from D-D Reactions," *Phys. Lett. A,*, vol 175, p 138 (1993).

2. H. Hora, G.H. Miley et al., "Surface Models for Cold Fusion and the Possibility of Multilayered Cells for Energy Production," Proceedings, 8th World Hydrogen Energy Conference. Cold Fusion Symposium, Hawaii Natural Energy Institute, U. of Hawaii, p 169 (1990).

3. G.H. Miley, H. Hora, J. Javedani et al., "Multi-Layer Thin Film Electrodes for Cold Fusion," Proceedings of the Third International Conference on Cold Fusion, Nagoya, Japan, October 21-25, p 54 (1992).

4. G.H. Miley, E.G. Batyrbekov, J.U. Patel et al., "Heat Production with Multilayer Thin-Film Electrodes," Proceedings of the Fourth International Conference on Cold Fusion, Lahaina, Hawaii, December 6-9, C 3.1 (1993).

5. Will be included in the Proceedings of the Fourth International Conference on Cold Fusion, December 1993, Lahaina, Hawaii.

6. E. Storms, "Review of Experimental Observations About the Cold Fusion Effects," *Fusion Technology,* vol 20, p 433 (1991).

7. Y. Arata and Y.-C. Zhang, "Reproducible "Cold" Fusion Reaction Using a Complex Cathode," Fusion Technology, vol 22, p 287 (1992).

8. T. Claytor, D.G. Tuggle and H.O. Menlove, "Tritium Generation and Neutron Measurements in Pd-Si under High Deuterium Gas Pressure". Proceedings of the Second Annual Conference on Cold Fusion, Villa Olmo, Como, Italy, June 29-July 4, p 34 (1991).