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Concentrated Energy and Micro Nuclear Fusion

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Abstract
For a electrolysis cell, high persistent electrical fields (>10^7 V/cm) and large equivalent capacitance on cathode surface lead to a high concentrated energy density in the double layer. The enhancement of localized fields due to normally existing protrusion or cracks after long period loading with deuterium on the palladium cathode surface conducts high transient current density. Nonequilibrium conditions lead to the occurrence of energy concentration, the current filamentation and the chaotic processes in the lattice for the fusion reaction to occur.

Key words: Cold fusion, Electrolysis, Field enhancement, Concentrated energy

I. Introduction
Cold nuclear fusion appears to be a sporadic, nonequilibrium processes in the Pd-D,Ti-D or Ni-D systems. A highly concentrated energy is required for the area where nuclear fusion reaction occurs. For an electrolytic cell, one can see that bubble chains of hydrogen gas come out mostly from the protrusion of the cathode. This phenomena implies that denser electron flux appears on protrusions of cathode surface due to the tip effect similar to the point discharge of the electrodes in air or in vacuum. The high energy densities and high charge densities occur on the tips due to high electric field.
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II. Electrochemical Double Layer and Point-effect

For an electrolysis cell, the electrolyte with high conductivity, and the electrochemical double layer with large layer capacity lead to a typical structure of the cathode potential distribution similar to the cathode potential drop of glow discharge in low gas pressure (Fig. 1).

For a compact layer, the thickness of double layer equals to one ionic layer and across which is a linear fall of potential. Thus a high electric field appears on the surface of the cathode.

The local enhancement of electric field on the cathode surface within the double layer is related to the protrusions and cracks similar to the tip effect of discharge in air or in vacuum. The current distribution depend strongly on the surface roughness and the work function of the electron emission. A high transient current density (>10^6 A/cm^2) could be expected due to the enhanced field.

![Fig. 1 Potential distribution of electrolysis cell with high conductivity of electrolyte. A: Anode; K: Cathode; Va: Applied voltage.](image)

III. Concentrated Energy and Cold Fusion

On the cathode surface the high persistent electrical fields (>10^7 V/cm), and large equivalent capacitance (>250 μF/cm^2) lead to a high energy concentration in the double layer. The concentrated field on the tips of the protrusions or cracks after long period loading with deuterium on the palladium cathode surface creates a high transient electron flux because of the large distributed capacitance and the negligible inductance in a localized discharge mini-network (Fig. 2).

As electron flux with high current density is extracted from the tips of cathode surface, a tiny vortex of cluster containing electrons and deuterons could form in the interface between the cathode and the electrolyte of heavy water. The experimental data show that the locus of the cold fusion reactions is the surface of some metallic deuterides (hydrides). The reactions take place only in some restricted areas that have specific properties. The idea of micro fusion due to some effects of the tip effect, the formation of bubbles and cracks leading to the energy concentration and the deuteron flux focusing could be used to explain cold fusion.
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![RLC network diagram](image)

Fig. 2 Equivalent RLC mini-network of the electrochemical double layer.
R: Resistance; L: Inductance; C: Capacitance.

IV. Nonlinear Processes

In metal deuterids there exist a possible transient dynamic process which may generate the close pairs and clusters of deuteron in the motion to induce a strong screen effect on the repulsive barrier. There is a variety of nonlinear processes which could be taken into consideration.

a. Work function changing due to loading ratio of D/Pd
b. Electrical conductivity changing due to loading ratio of D/Pd

The experimental results prove that the resistance of Pd with a loading ratio of D/Pd over 0.85 decreases eventually. Such a behaviour could conduct cascade effect in a tiny area with concentrated deuteron flux.

c. Temperature raises locally.

Higher temperature occurs in the tiny area due to Joule heating by locally high current density. This factor leads to a transient deuteron flux in the phase boundary area.

d. Influence of magnetic field on the distribution of deuterium.

Azimuth magnetic field created by transient electron current with high flux density causes redistribution of the deuterons inside the palladium lattice.

e. Polarization and coherence effects

High persistent field in addition of the transient electric and magnetic fields lead to the polarization and coherence of the deuterons with quadrupole momentum.

![Triplet region diagram](image)

Fig. 3 Triplet region of protrusion in the electrochemical double layer.
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f. Triplet region (Fig. 3)

The transient processes of triplet of the interface of the palladium lattice, the electrolyte and the gas bubble should be taken into careful examination due to its complicated situation.

![Fig. 4](image)

**Fig. 4** The tracks on the CR-39 detector, a: track cluster; b: distribution of energetic particles caused tracks; c: back side of the track cluster on the same region with case b; d: typical tracks of background radiation.

V. Experiment

The CR-39 plastic films possessing with a high degree of optical clarity and isotropy in track response, and sensitive to n, p, t, alpha particles were used to detect the products of CF. The films of CR-39 were immersed in the NaOH electrolyte of heavy water and placed adjacent to the tips of the cathode. After 110 hours electrolyte experiment with the applied 1V and the current 2mA, the CR-39 detectors were taken out of the electrolysis cell and then etched by 6.25N NaOH solution in 70°C for 11 hours. The photo micrograph in Fig. 4 shows the cluster of tracks forming a circle crater with ~ 100μm in diameter and ~ 25μm in depth. According the etching condition, the energies of the most of particles of the fusion products p, t, Alpha are estimated roughly to be in the range of 1-4MeV. From the tiny track cluster of ~ 100μm in diameter, one can easily deduce that the fusion reaction area should be smaller, and we could draw a conclusion on this, the case of tiny fusion area is closely related to the point-effect.

For the enhancement of the point-effect and energy concentration, the high voltage pulse (30KeV) have been applied on the electrolysis electrodes, the total electrolysis currents are more than 100A, neutron bursts have been detected (Fig. 5).
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From Fig.5, one can see that for the similar electrolysis cell, the neutron counts are slightly higher than background counts. When higher currents have been applied, higher counts have been detected. The rapid movements of deuterium inward and outward of the palladium lattice are believed to be beneficial for nuclear fusion.

![Neutron counting of the electrolysis cell with intense pulsed currents by BF₃ detector.](image)

**Fig. 5** Neutron counting of the electrolysis cell with intense pulsed currents by BF₃ detector.

VI. Conclusion

As the researchers, theorists or experimentalists of cold fusion should pay great attention on the general process of the electrolysis to find the key points which could play major role of the transit from the electrochemical processes to the electromagnetic processes and further to the nuclear processes. For authors's point of view, the evolution of double layers is of importance to understand the anomalous effects.

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**REFERENCES**