Fractofusion Mechanism

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ABSTRACT

The fractofusion mechanism of Cold Fusion is investigated theoretically. The conditions necessary for fractofusion are clarified. The origin and quantity of the electrical field inside cracks in the conductor are clarified also. The characteristics of Cold Fusion are explained by the mechanism. Almost all the total neutron yields experimentally observed are smaller than the upper limit predicted by the fractofusion mechanism. It indicates that they can be explained by the fractofusion mechanism.

1. Introduction

In some cold fusion experiments, excess neutrons were clearly observed during electrolysis of D_2O by Pd cathodes, though in many other experiments no excess neutrons were observed. Fractofusion mechanism is that D^+ ions are accelerated by electric field inside cracks and that fusion reactions take place during the penetration of such accelerated D^+ atoms in Pd. In spite of many theoretical investigation of fractofusion mechanism, three important problems remain. One is the origin and the quantity of electric field inside cracks in conductor. Another is what are necessary conditions for fractofusion. The third is whether so called cold fusion experiments are really explained by fractofusion mechanism or not.

2. Electric potential in cracks in conductor

We have concluded that the electric field in cracks in conductor, whose existence is experimentally confirmed, is due to the contact charging at crack surfaces as a result of different work functions between touching two grain surfaces. The charge density ς on crack surfaces is

$$\varsigma = \frac{\varepsilon}{d}\Delta \tag{1}$$

where ε is the dielectric constant, d is the shut down distance of tunneling current, and Δ is the difference of work functions. The electric potential (V) between two crack surfaces is

$$V = \frac{\varsigma l}{\varepsilon} \tag{2}$$

where l is the width of crack. If we assume d=1(nm) and $\Delta = 0.5$(eV), then $\varsigma = 5 \times 10^{-3}$ (C/m^3). Thus V = 5x10 l where l is in mm(l$\leq$ 1mm), and V is in keV. Here we assumed that no discharge takes place during the separation of two facing crack surfaces. This assumption is valid only when the pressure of gas in a crack is less than 10^{-2} Torr (no breakdown), the velocity of crack propagation is more than 10^2 (m/s) (neglect of prebreakdown current), and the electric resistance around a crack increases to more than $10^6\Omega$(neglect of current around a crack).

3. Conditions necessary for fractofusion

(a) Crack generations at grain boundaries, (b) high orientation angle of grains, (c) rapid crack formation, (d) increase of electric resistance around cracks, (e) wider cracks, and (f) many crack generations.

4. Are the cold fusion experiments really explained by fractofusion mechanism?

A. Characteristics of cold fusion

The results of cold fusion experiments have three qualitative characteristics. The first is that excess neutrons were observed in only a few experiments while in many other experiments no excess neutrons were observed. The second is that excess neutrons were observed often in bursts. The third is that sometimes large deformation of Pd specimen coincides with the excess neutron observation. These three characteristics are explained by fractofusion mechanism successfully as follows. The first one is due to the existence of many required conditions for fractofusion. The second characteristic is explained as follows. Fractofusion occurs incracks. When one crack is generated, some amount of fusion events take place immediately at once. The third characteristic is explained as follows. When a Pd specimen is deformed, many cracks are generated. This is the direct result of fractofusion.

B. Quantity of neutron yield

(1) Fusion yield by E (keV) D^+ ion during the penetration in Pd-D

$$Y = 1 \times 10^{-6} exp(\frac{-44.24}{\sqrt{E}}) \tag{3}$$

(2) Electric potential in a crack

$$E = 50 \times a^2 \tag{4}$$

where a is the grain size in mm and E is in keV.Then

$$Y_{tot} = 5 \times 10^7 \frac{exp(\frac{-2}{a})}{a} \tag{5}$$

$$Y^{u.l.}_{tot.max.} = 7 \times 10^6 \tag{6}$$

where $Y^{u.l.}_{tot.max.}$ is the upper limit of the fractofusion yield per 1 cm^3 .The comparison with the experimental data is shown in table 1. Detailed calculations are in Ref.[19].

Table 1. The comparison between the total neutron yield observed in the experiments and the theoretically estimated upper limit

experiments				theory
Ref.	Volume of Pd (cm^3)	Method	Y_{tot}	
1	15.7	electrolysis	10^{11}	1×10^8
2	7	electrolysis	10^4	5×10^7
3	8	electrolysis	7×10^4	6×10^7
4	14	electrolysis	4×10^4	1×10^8
5	1.3	electrolysis	2×10^3	9×10^6
6	1.1	electrolysis	10^4	8×10^6
7	0.8	electrolysis	7×10^5	6×10^6
8	0.01	electrolysis	2×10^3	7×10^4
9	0.4	electrolysis	10^4	3×10^6
10	0.6	electrolysis	3×10^5	4×10^6
11	7.7	electrolysis	4×10^5	5×10^7
12	0.3	electrolysis	10^4	2×10^6
13	0.5	electrolysis	10^3	4×10^6
14	0.5	electrolysis	10^4	4×10^6
15	0.3	electrolysis	6×10^5	2×10^6
16	0.9	electrolysis	10^6	6×10^6
17	0.6	electrolysis	10^8	4×10^6
18	0.9	gas release	10^6	6×10^6

5. References

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