Front. Phys. China (2007) 1: 96－102
DOI 10.1007/s11467-007-0005-8

REVIEW ARTICLE

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Nuclear fusion inside condense matters

Abstract This article describes in detail the nuclear fusion inside condense matters—the Fleischmann-Pons effect, the reproducibility of cold fusions, self-consistentcy of cold fusions and the possible applications.

Keywords Fleischmann-Pons effect, reproducibility of cold fusions, self-consistent of cold fusions and the possible applications

PACS numbers 21.45.+v

1 Introduction

In March 23, 1989, Martin Fleischmann and Stanley Pons, in the process of electrolysing heavy water using Pd as the cathode and Pt as anode, got more energy output than they had put into the system. The excess energy could not be explained by chemical processes, so they announced the discovery of cold fusion.

In the Autumn of 1989, the DoE (Department of Energy) of the US organized a review headed by science skeptics Huizenga, who recognized that the phenomenon of cold fusion is conflict with the well known nuclear theory, so that cold fusion was impossible, and concluded that the federal funding of the US should not support cold fusion research [1].

Fifteen years later, in December of 2004, the US DoE organized another review of cold fusion, a lot of laboratories around the world have been able to repeat the Fleischmann-Pons effect. The new review recognized that cold fusion did not get great progress after more then 10 years, but the new review "identified areas of research that 'could be helpful in resolving some of the controversies in the field'—specifically, characterization of deuterated metals and the search for fusion in thin deuterated films—and recommends that agencies consider funding individual proposals in those areas" [1].

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Received November 25, 2006

2 Reproducibility of cold fusion

In the process of electrolysis of heavy water using Pd as the cathode and Pt as the anode, if the following two conditions are satisfied spontaneously, excess energy will be produced [2].

2.1 D/Pd ratio larger than 0.88

Figure 1 is the relation of the excess heat and the D (Deuterium) atom introduced into the Pd (Palladium) metal using the process of electrolysis of heavy water by using Pd as the cathode and Pt as the anode. One can see that after D/Pd ratio becomes larger than 0.88, excess heat occurred.

2.2 The current density of the electrolysis is larger than 280 mA/cm^2

Figure 2 is the relation of the excess heat and the current density of the electrolysis. One can see that after the current density of the electrolysis becomes larger than 280 mA/cm^2, excess heat will occur. The horizontal line is the result of a control experiment of the electrolysis of light water (H_2O). One can see that there is no excess heat occurring.

Above experiments were done by Michael C.H. McKubre in Stanford Research Institute (SRI).

Table 1 shows the statistics of the cold fusion experiments around the world, one can see that recently the reproducibility of the cold fusion experiments in some countries

have reached 100 percent [3].

The cold fusion experiments show that the excess heat comes from the reaction:

$$D + D \rightarrow {}^{4}He + \Delta E \text{ (23.8 MeV)} \quad (1)$$

Figure 3 is the relation of the excess heat and the ^{4}He produced in the cold fusion experiments. One can see that the excess heat is proportional to the ^{4}He productions.

At present, the well known nuclear theory cannot explain the phenomenon of the cold fusion. According to the well known nuclear theory, D-D fusion should have the following reactions:

$$D + D \rightarrow {}^{3}He \text{ (0.87 MeV)} + n \text{ (2.45 MeV)} \quad (2)$$

$$D + D \rightarrow t \text{ (1.008 MeV)} + p \text{ (3.02 MeV)} \quad (3)$$

$$D + D \rightarrow {}^{4}He \text{ (7.6 keV)} + \gamma \text{ (23.7 MeV)} \quad (4)$$

Reactions (2) and (3) are strong reactions, they are charge independent: the reaction ratio of (2) to (3) should be equal to 1. Reaction (4) is an electromagnetic reaction, reaction ratio of (4) to (2) equals to 10^{-7}. But, in cold fusion, only the reaction: $D + D \rightarrow {}^{4}He + \Delta E$ (23.8 MeV).

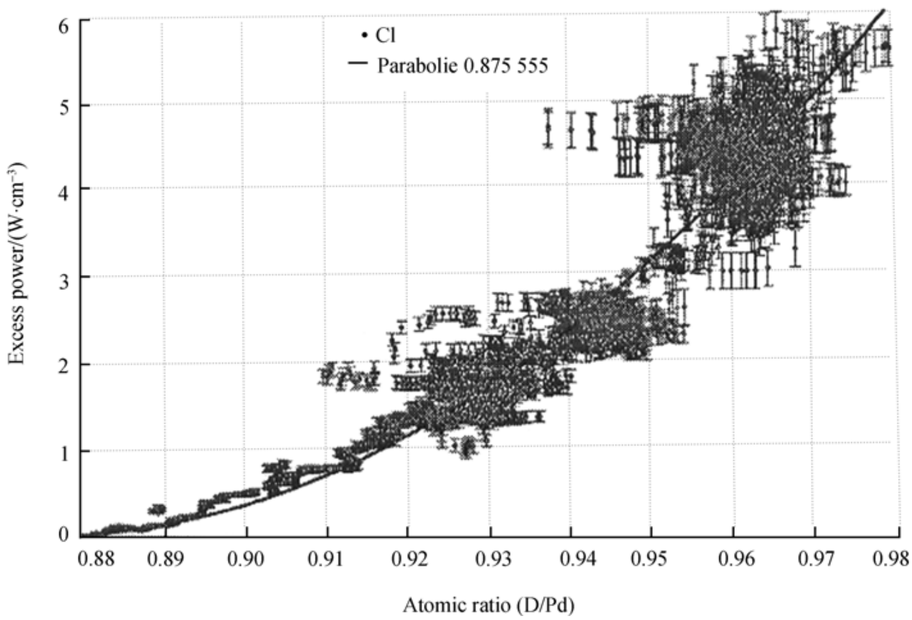

Fig. 1 The relation of the excess heat and the atomic D/Pd ratio.

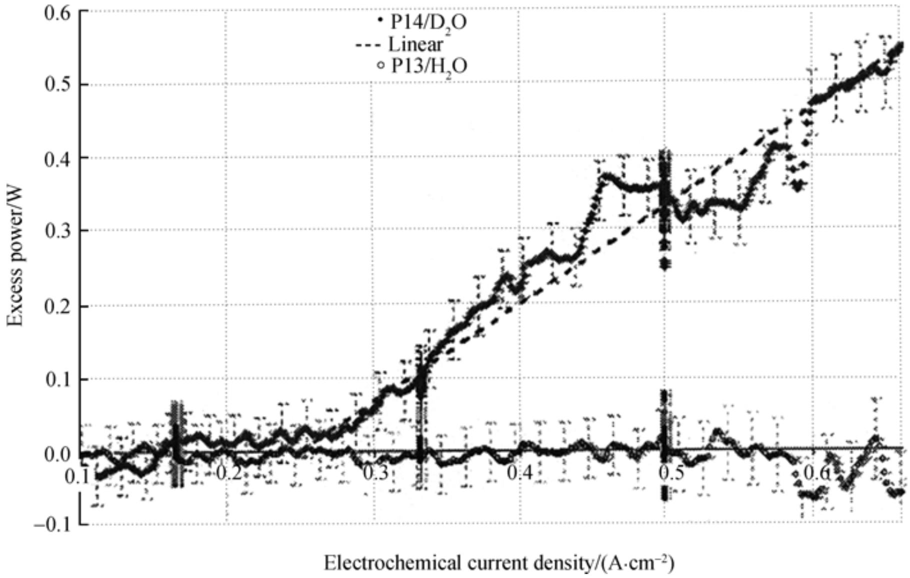

Fig. 2 The relation of the excess heat and current density of the electrolysis.