Experimental Studies on the Anomalous Phenomenon in Pd Metal Loaded with Deuterium

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ABSTRACT

The anomalous phenomenon in metal loaded with deuterium has been studied, using the electrolysis and the cycle method of temperature and pressure (CMPT). In the report, the experimental results are introduced, including the explosion occurred, and nuetron and tritium measured in electrolysis experiment. The sensitization phenomenon of X- ray film was found in CMTP experiment. It is considered that the reason of sensitization is derived from the chemical reaction and the anomalous effect in metal loaded with deuterium.

1. INTRODUCTION

Since M. Fleischmann, S. Pona[1] and S. E. Jones[2] published the experimental results on cold fusion in march, 1989, we have studied the phenomenon of cold fusion. In electrolysis experiment of April 21, 1989, we had measured neutron by the fission chamber, and tritium by the dual-channel liquid scintillation counter[3]. Since 1991 the phenomenon of cold fusion has been studied by electrolysis and CMTP[4]. The experimental results are briefly expressed below.

2. ELECTROLYSIS EXPERIMENT

2.1 Measurement of D/Pd

A Pd tube, $\Phi 1.67 \times \Phi 1.07 \times 80$ (mm), was used to electrolyze heavy water, 99.5% in purity, with 0.1mol ^{6}LiD. The Pd tube is treated, including excluding oxygen and air, cleaning, anneal and activation. Variation of D/Pd with electrolytic time was determined by weighing. The experimental result of the variation is shown in Fig. 1.

2.2 Explosion Phenomenon in Electrolysis

Two sets of electrolytic cell exploded one after another in

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electrolysis experiment at end of April, 1991. The explosion may be derived from sudden release of a large amount of heat which was in a micro-zone of PdDx.

2. 3 Measurement of Neutron

The Pd rod, $\Phi 5 \times 30$ (mm), was put into heavy water with 0. 1mol ^{6}LiD to absorb deuterium by electrolysis. The electrolytic current was from 20mA/cm^2 to 100mA/cm^2. The temperature of cooling water was from 10 °C to 40°C. After 24 hours, the current rose to 100mA/cm^2, and the temperature of electrolyte was higher than 30°C. At this time counts of neutron were measured. The neutron detectors were two sets of parallel BF_3 counters as shown in Fig. 2.

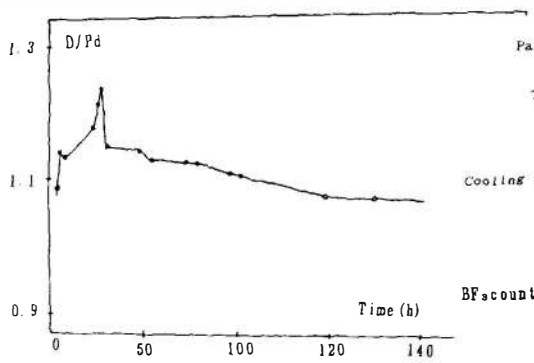

Fig. 1. Variation of D/Pd with electrolytic time

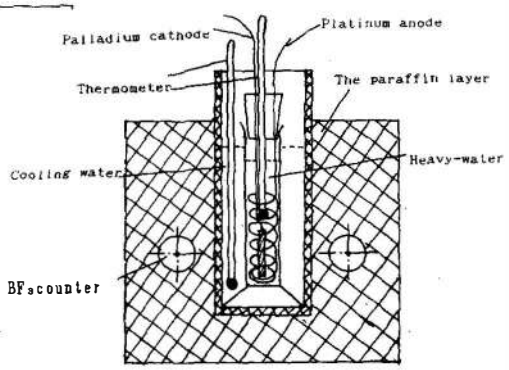

Fig. 2. Set- up of an electrolytic cell and neutron detectors

An Am-Be neutron source was used to calibrate BF_3 counters which efficiency was about 0. 7%. The neutrons in cold fusion were detected by BF_3counters. A multichannel analyzer was used to record counts of neutron. The pulse height spectra recorded are shown in Fig. 3.

Fig. 3. indicates that there are differences between characteristic spectra of $^{10}B(n, \alpha)^{7}Li$ reaction produced by neutrons from Am-Be neutron source and cold fusion reaction.

(1) There are indistinct two peaks in the characteristic spectrum of Am-Be source neutrons. The two peaks may be due to overlap of pulses which are produced by charged particles of $^{10}B(n, \alpha)^{6}Li$ reaction and γ-ray of Am-Be source.

(2) The plane and long trail is in the rear of characteristic spectrum of neutrons from cold fusion. The trail may be produced by burst neutrons. It indicates that neutrons from cold fusion reaction may be burst ones and repeatedly emitted. In the experiment, a scaler was used to record neutron count and to measure variation of neutron count with time as shown in Fig. 4.

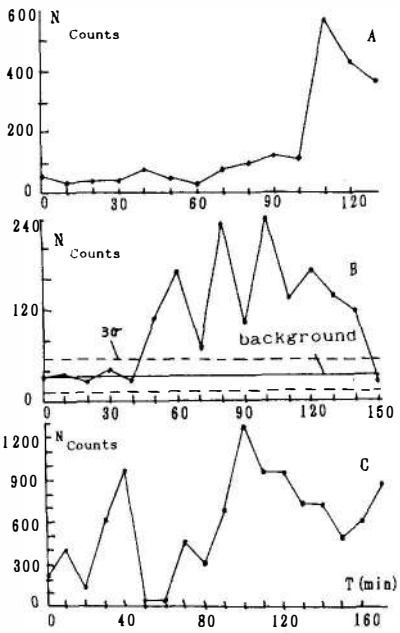

Fig. 4. Variation of neutron count with time

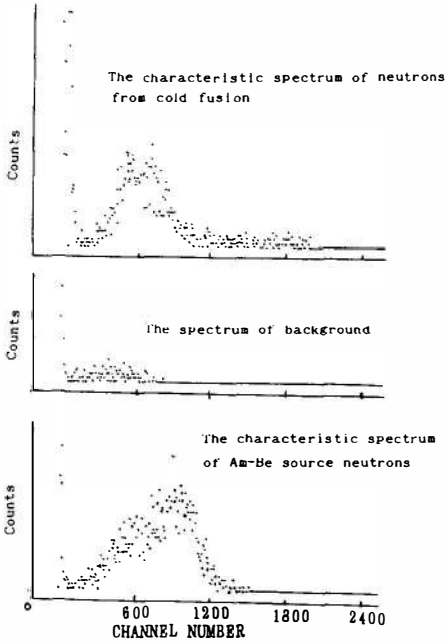

Fig. 3. The pulse height spectra of $^{10}B(n, \alpha)\ ^{7}Li$ reaction

2.4 Measurement of Tritium

The results of measurement are listed in table 1.

Table 1. βactivity of tritium

No. of cell	cathode material			β counts (n/min)
	size (mm)	purity (%)	weight (g)	
1	Φ5 Pd rod	99.95	7.0800	125±6
2	Φ5 Pd rod	99.95	7.0286	147±7
3	Φ3×0.5 Pd tube	钯银合金	2.8812	145±7
counts of background (n/min)				103±5

3. EXPERIMENT BY THE CYCLE OF TEMPERATURE AND PRESSURE

3.1 Experimental Conditions

a) Sample

Three kinds of metal slices were used to perform the experiment: (1) Pd slice 0.5mm in thickness; (2) Ti slice 0.1mm in thickness; (3) Pd slice of which Ti 0.5μm in thickness was evaporated on two surfaces.

b) Process of Experiment

Metal slices having been treated were sealed into copper vessel which vacuum was $10^{[-4]}$ torr to $5x10^{[-5]}$ torr. The vessel was put into liquid nitrogen ($LN_{[2]}$) and filled with deuteriulm gas of 10atm in order to perform the cycle of temperature and pressure. After the cycle, to reach vacuum in the vessel deuterium gas was exhausted. The samples were preserved in vacuum more than 48 hours.

3.2 Measurement

By the cycle of temperature and pressure, the sensitization results of X-ray films are stated as follows:

Films were sensitized in full area. But there was a image of Pd slice in full background of sensitized films which were in contact with Pd slice as shown in Fig. 5.

The experimental result indicates that there is a image of Pd tube on films as shown in Fig. 6.

Fig. 5. An image of Pd slice

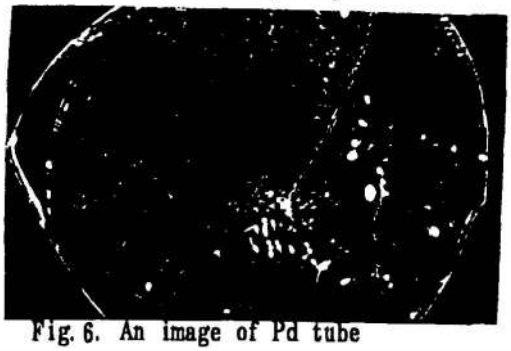

Fig. 6. An image of Pd tube

Several experiments with and without Pd slice and tube have been done. Two reasons of sensitization on films are found. One is that the reaction of deuterium with Br in a film produced DBr and Ag ion was displaced out. Another one is that an anomalous effect in Pd metal loaded with deuterium sensitize films, further studies will be carried out.

REFERENCES

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