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Correlation of Excess Heat and Neutron Emission in Pd-Li-D Electrolysis

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Abstract

To investigate the dominant factors that allow a reproducible nuclear reaction in D-Pd systems, the initial electric resistance and the hardness of the Pd cathode have been examined for excess heat generation and the excess neutron emission in LiOD-Pd electrolysis cells. Two background (control) runs and one foreground run with the Pd cathode of high electric resistance and high hardness gave no nuclear effects, while one foreground run with low electric resistance and low hardness gave appreciable excess neutron emission and the excess heat generation. Reversed correlation was found between the two nuclear effects.

1. Introduction

The dominant factors to reproduce the cold fusion phenomena should be clarified firstly to elucidate the mechanism of the cold phenomena and to find the new nuclear energy system based on the deuterium nuclear reaction in the condensed matters. A series of basic research projects have been carried out to realize the anomalous distribution of deuterium with high concentration in the surface of Pd cathode by means of high/low pulse mode electrolysis. The reproducibility of the occurrence of the cold fusion phenomena became appreciably higher than the cases of the constant current electrolysis.[1] In the present study, we have examined the effects of the initial electric resistance and the hardness of the Pd electrode to the reproducibility of the cold fusion phenomena in a series of heavy water electrolysis with high/low pulse mode.

2. Experimental

The Pd cathodes used were prepared from a Pd plate of 1mm thickness cut into plates 10mm × 25mm. After washing in an ultrasonic bath of acetone and drying in ambient air, their Vicars-hardness was measured and then their electric resistance were evaluated as the cell voltage in Pd-Pt pair in LiOD electrolyte. We selected two pairs of Pd electrodes: one of them is a pair of high electric resistance and high hardness, and the another one is a pair of low electric resistance and low hardness. One pair was used in two background runs with LiOD-Pd system and the pair was used in two foreground runs with LiOD-Pd system.

The electrolysis cells used here were the same cells used in the previous studies reported by the present authors. [1,2,3] The details of an excess heat monitoring system and a NE213 liquid scintillation neutron detector were described in the previous papers.[1,2,3]

The electric current of high density of 800mA/cm^2 was applied for 1 hour and the low density of 20mA/cm^2 was applied for 3 hours repeatedly for about 25 days. The temperature of the electrolyte was measured by the three thermocouples and the data were stored into a computer in every 30 sec, and the counting rate from the NE213 neutron detector was stored into the computer in every 3 min. The experimental conditions are listed in Table l.

3. Results and Discussion

3-1. Excess heat generation

The electrolyte temperatures obtained in the couple of background run (Run 3) and foreground run (Run 1) using the Pd cathodes with low electric resistance and low hardness are plotted in Fig. l and Fig. 2 as a function of the input power. In Fig. 2, we see an appreciable upper deviation of the plots from the calibration line. From the upper deviation, we can conclude that the excess heat was generated in this foreground run. As has been reported, we have no excess heat detection in the all cases with LiOH-Pd electrolysis, the same as in the present study, while more than 60% of LiOD-Pd electrolysis with high/low pulse mode gave the excess heat as shown in Fig. 2. According to our data, the excess heat generation should be recognized as specific to deuterium in the LiOD-Pd electrolysis.

The averaged electrolyte temperature is plotted as a function of the input power in Fig. 3 for background run (Run 4) and Fig. 4 for foreground run (Run 2) obtained with the couple of the Pd electrodes of high electric resistance and high hardness, respectively. The solid lines in these figures represent the calibration lines for each runs.

In these runs, there are no clear upper deviations of the plots of the electrolyte temperatures, so it is concluded that we had no excess heat in these runs.

3-2. Excess neutron emission and its correlation with the excess heat generation

The details of the evaluation of the excess neutron emission was described in the previous papers. In the present study, the correlation between the excess heat generation obtained in Run 1 (F.G.) and the excess neutron emission obtained from Run 1 and Run 3 (B.G.) is demonstrated for the electrolysis time. It is very clear that the correlation between excess neutron emission and the excess heat generation is just reversed, or anti-correlated with each other, as illustrated in Fig. 2 and Fig. 5.

In Fig. 6, we can find the neutron energy spectra from the ratio of the neutron emission rate obtained in Run 1 and that in Run 3. The result is very similar to many other data obtained and reported previously by the present authors. It can be said that the neutron emission rate is very low and the energy of the emitted neutrons varied so wide from 1 MeV to 7 MeV, and the neutrons in the higher energy region may be dominant relatively, as discussed by us [3] and by Takahashi et al.[4]

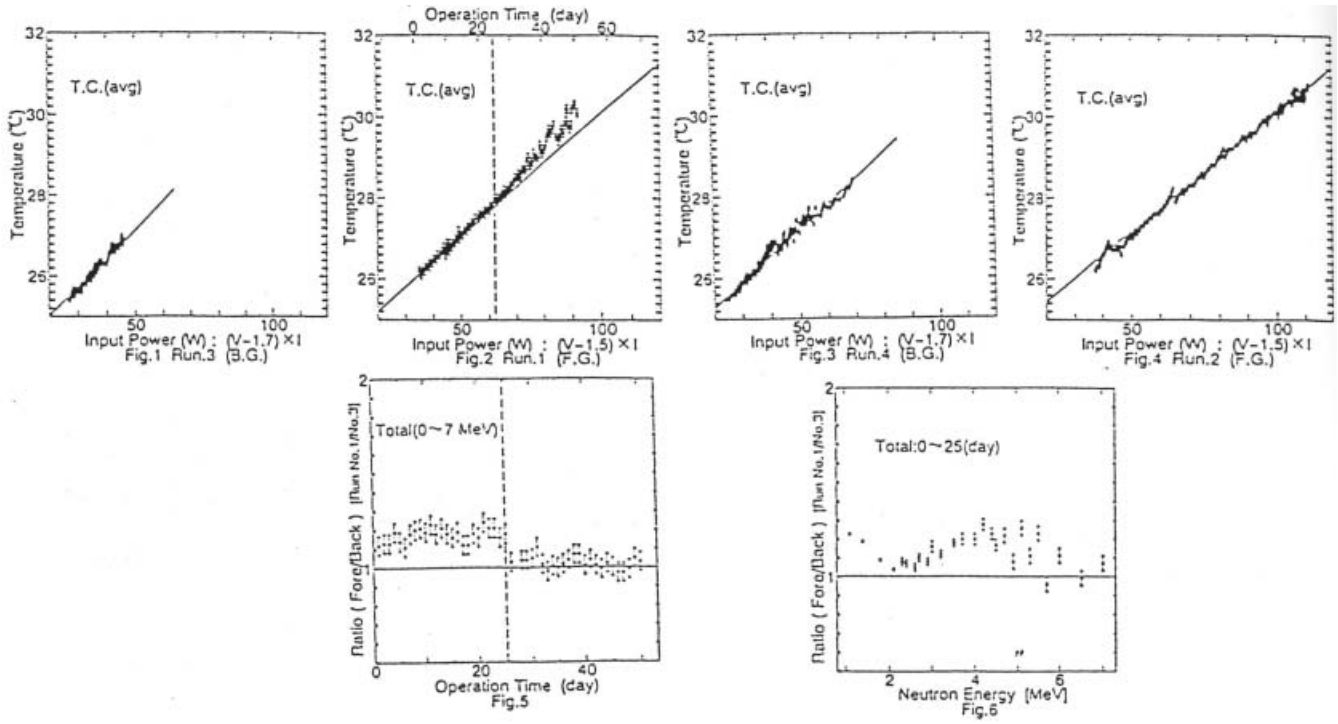
4. Conclusion

The Pd plates characterized in terms of their initial electric resistance and the hardness were examined as the cathodes in the cold fusion test cell. The Pd cathodes with high electric resistance and high hardness gave no excess heat and also no excess neutron, even in the foreground run in LiOD-Pd electrolysis, while the Pd cathode with low initial electric-resistance and low hardness gave the excess heat generation and the excess neutron emission. The correlation between the excess heat generation and the excess neutron emission was found to be reversed with respect to the operation time.

Further examination should be carried out on the characteristics of Pd electrodes to clarify the key factors that satisfy reproducibility of the cold fusion phenomena.

Table 1. Experimental Conditions

		Hardness	Cell Voltage (V)	Electrolyte (1 M)	Normal Electrolysis Runs	Pulse Mode Electrolysis Runs	Measurement System
F.G. (D_2O)	Run 1	Low (118)	Low (7.5)	LiOD	7	52	I
	Run 2	High (138)	High (8.6)	LiOD	7	43	II
B.G. (H_2O)	Run 3	Low (119)	Low (7.5)	LiOH	9	29	I
	Run 4	High (136)	High (8.6)	LiOH	8	34	II



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