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# ANOMALOUS NEUTRON BURST IN HEAVY WATER ELECROLYSIS

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Abstract: Anomalous neutron burst has been detected in heavy water electrolysis using a Pd cathode. The burst events occurred five times periodically for ca. 140 hours. The numbers of the burst neutrons increased gradualy from 5.3$\sigma$ (the 1st event/10min.) to 135$\sigma$ (the 5th event/10min.) and the last event continued for 50 min. and gave 1779 neutrons to the five $^3$He neutron countors of 1% detection efficiency. The reproducibility has been examined three times, but any further event did not occurred.

## INTRODUCTION

We have tried to find the reaction system which has strong neutron emission with adequate reproducibility using many shapes of Pd electrode in the heavy water electrolysis. Till today, more than 30 Pd electrodes of different shapes have been examined under the almost same electrolysis conditions, under which we have detected appreciable neutron bursts using thin Pd plates as the cathode in three times with good reproducibility. Including these, only 6 cases gave neutrons including large neutron burst with more than 10$\sigma$ from a spiral Pd wire electrode. Recently, we detected an anomalous neutron bursts occurred five times periodically in a 140 hours operation with strong neutron emissions. In the present paper, the details of the neutron burst are described.

## EXPERIMENTAL

The Pd electrodes used for the experiments were treated before the electrolysis as reviously reported.[1] The electrolytic cell was same as the previous one in principle, but modified as shown in Fig.1. The electrode of size 5 mm $\phi$ and 40 mm long Pd lod which absorbed $D_2$ gas under 10 atm for 24 hours prior to the electrolysis was placed in the electrolytic cell imediately after the gas loading, and the electrolysis was performed in the constant current manner. The electrolyte was 250 ml of heavy water:99.7% and in which Li metal was dissolved to contain 0.1 mole/$dm^3$ of LiOD. The conditions of electrolysis were as follows; the current density is 0.24 ~ 0.27 mA/$cm^2$, voltage ~ 3V, in ambient temperature of an airconditioned room.

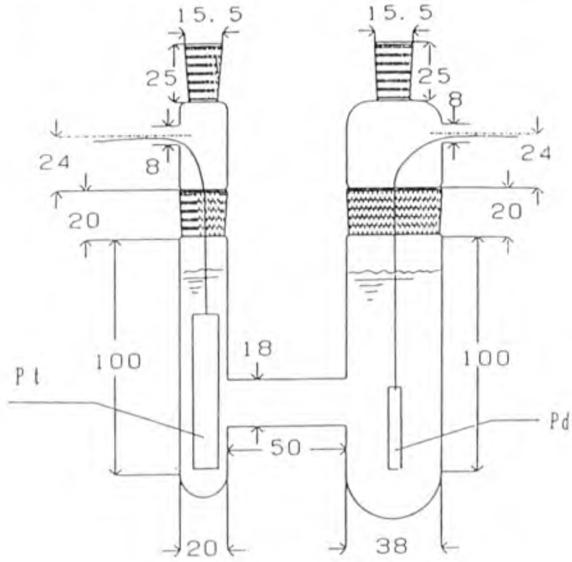


Fig. 1 The electrolytic cell

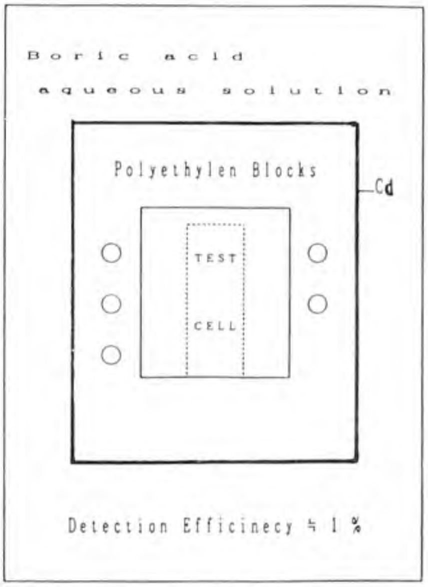


Fig. 2 Crossectional view of neutron detecting system

The sectional view of the neutron detecting system is shown in Fig.2. The system has 1 % detection efficiency of thermal neutron which was calibrated by use of a $^{252}$Cf source. The frontal part of the system is oppened for the access. The fresh heavy water was added into the cell during the electrolysis to keep the level of the heavy water.

## RESULTS AND DISCUSSION

The neutron counts detected from the present electrolytic cell are shown in Fig.3. The first neutron burst event happened 22 h 40 min. after the start of electrolysis operation and gave 59 neutron/10 min. which corresponds 4.7 $\sigma$ to the standard deviation of the background neutron. After this, four neutron burst events were detected alomost periodically in each 20 hours. All of the neutron burst events gave appreciable neutron counts more than 5 $\sigma$. In these events, the second event continued for 40 min. and the last (fifth) event continued for 50 min. The number of the evaluated source neutron are 30800/40 min. and 177900/ 50 min. for the second event and fifth event, respectively. The details of the neutron burst in the fifth event are shown in Fig.4

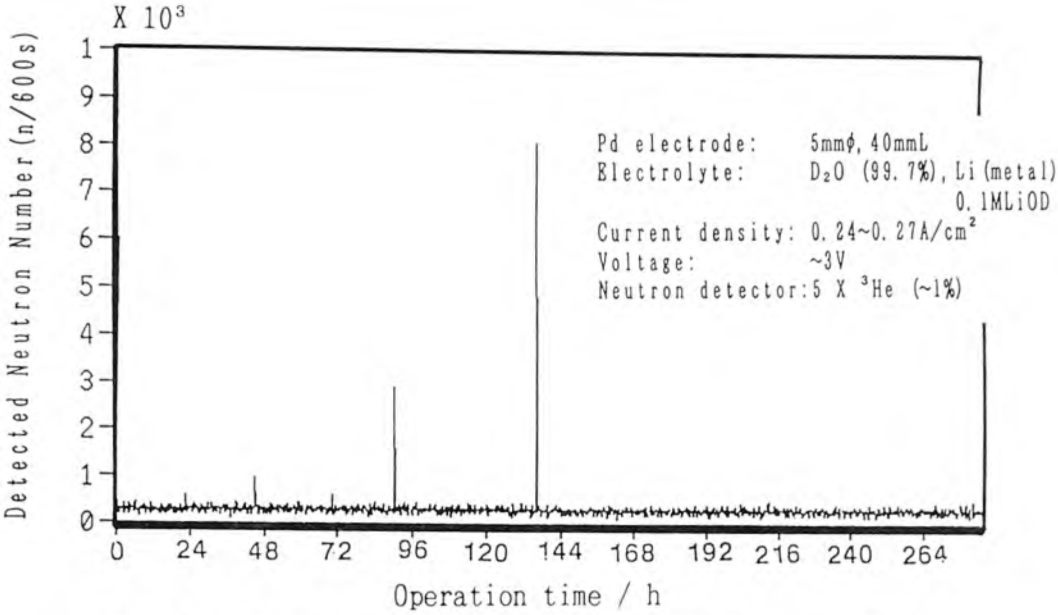


Fig. 3 The neutron counts in the peridical neutron bursts

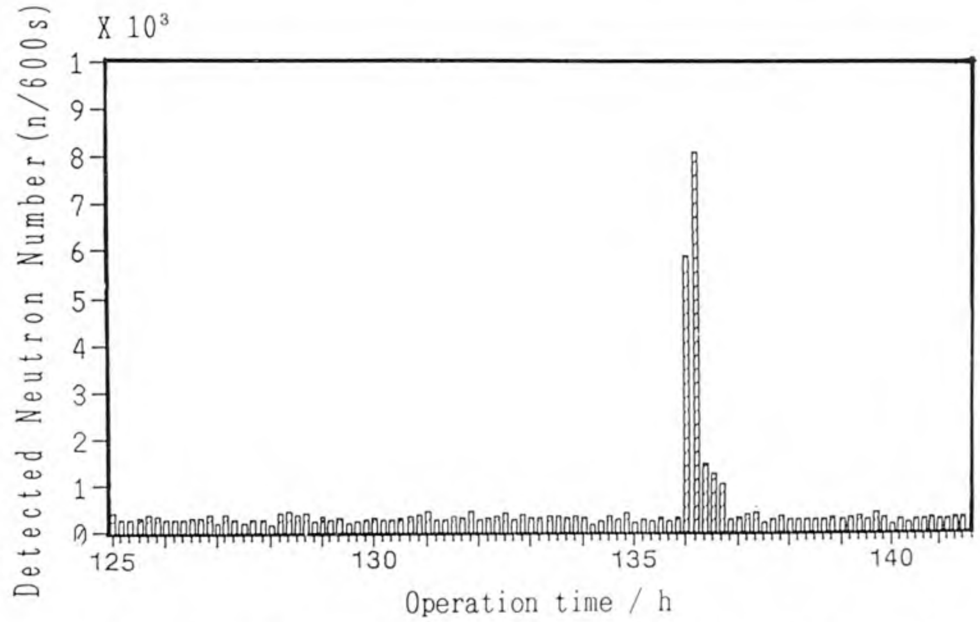


Fig. 4 The details of neutron counts in the 5th. event

The neutron burst data are summarized in Table 1. Here, we used the average neutron counts detected in 10 hours before and after the events as the background for each event.

The fifth event had occurred from 136 hours after start of electrolyis and continued for 50 min. with the many neutrons detected. The most strong neutron burst observed in the second 10 min. and give 811 neutrons which correspond 135 $\sigma$ standard deviation. The number of the source neutron evaluated from the detection efficiency (ca. 1%) of the $^3$He neutron countors is 177900 n/50 min.

Table 1 The details of the periodical neutron burst

| Event No. | Time after start | Detected neutron n / 10 min | Deviation from BG. σ | Number of source neutron / event |
|---|---|---|---|---|
| 1 | 22:49 | 59 | 4.70 | 5900 |
| 2 − 1<br>2<br>3<br>4 | 44:50 | 97<br>75<br>75<br>61 | 11.81<br>8.01<br>8.01<br>5.60 | 30800 |
| 3 | 70:30 | 59 | 5.25 | 5900 |
| 4 | 90:10 | 291 | 45.32 | 29100 |
| 5 − 1<br>2<br>3<br>4<br>5 | 136:00 | 589<br>811<br>148<br>126<br>105 | 96.78<br>135.13<br>20.62<br>16.82<br>13.19 | 177900 |

The present meutron bursts show an anomously even as the cold fusion evidence in preodically occurring of the events in relatively short operation time, gradual increase of the number of neutrons and very strong evidence as seen in the 5th event.

The reproducibility of the present event has been tested three times using the same electrolytic system, however, any further event could not be found as same as the other previous experiences of our group since 1989. We have carried out more than 18 runs experiments by the same experimental procedures with 12 different shapes of Pd electrodes in the recent 10 months including some cases of the reproducibility tests, only two runs gave the appreciable neutron burst but no reproducibility. Thus, we concluded that the shapes of Pd electrode is not essencial point for the neutron burst phenomenon, rather some kind of irregurality caused by the electrolytic process in the homogenity of the Pd electrodes seems to be essencial point.

The fusion rate is estimated to be $10^{-21}$ fusion/d-d/sec. for the 5th. event from the d/Pd ratio of ca. 0.2, the source neutron number and the weight of original Pd electrode.

FUTURE WORK

After this finding, we employed a NE-213 (5 X 5 inch) liquid scintilation detector with n-$\gamma$ pulse shape discrimination to check the energy of neutrons in the neutron detecting system. Four other $^3$He detectors were also equipped to the neutron detecting system to set up the two channels of the neutron detction, one channel consists of 6 $^3$He detectors and the other of 3 $^3$He detectors. The total neutron detecting efficiency become 1.6 %. The NE-213 detector has been examined to have adequate sensitivity for high energy neutrons and the resolution power to n-$\gamma$ discrimination for 2.45 MeV neutron. Tritium monitoring system has been alos examined to show the perfect recovery of tirtium with enough sensitivity.

Further experiments shall be carried out to elucidate the anomalous nuclear phenomena occurred in d-Pd systems. [ IL DADO É TRATTO : ALEA IACTA EST ]

Reference: T. Sato, M. Okamoto, P. Kim , O. Aizawa and Y. Fujii, Fusion Technol. 19, 357-363, (1991).