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Characteristic X-ray and Neutron Emissions from Electrochemically Deuterated Palladium

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Abstract

Characteristic x-ray and neutron emissions have been observed during electrochemical loading of deuterium into palladium metal. It shows that anomalous phenomena occur in deuterium-palladium system as shown in our previous paper and the others on cold fusion.

1. Introduction

As we reported in ICCF-4, we observed neutron emissions and tritium productions several times from deuterated palladium samples when the deuterium gas was released by heating them[1]. We started electrochemical loading experiments after ICCF-4, in addition to the gas release experiments with high loading ratio[2]. In this paper, experimental results on x-ray and neutron measurement of electrochemical cells are presented.

2. Experimental

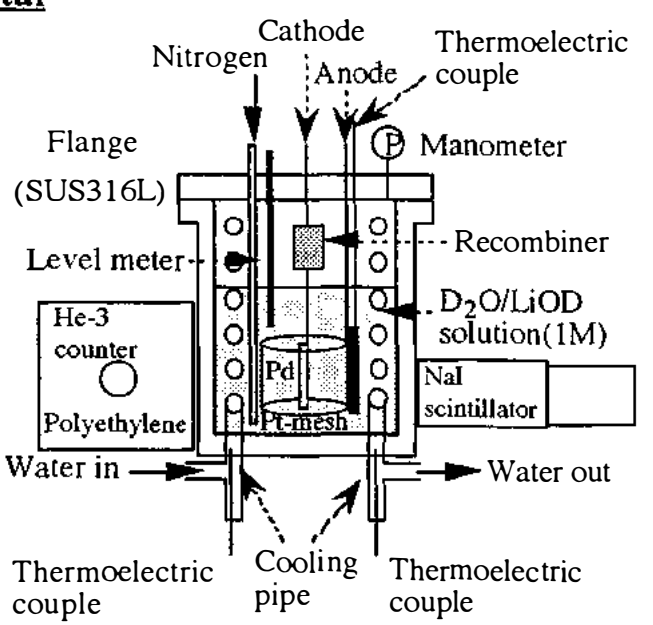

Fig.1 Schematic of Experimental Apparatus

Palladium rods (ϕ3X25mm) were heated and melted in the air by a portable propane burner and cooled down quickly to room temperature(~ 298K) in pure water. After pre-loading (D/Pd ~ 0.66) in deuterium gas, we set the deuterated palladium sample in a closed type of electrochemical cell with 1M LiOD-D_2O solution.

Figure 1 shows the schematic of experimental apparatus. The electrochemical cell consists of a cathode of palladium rod, an anode of platinum mesh, a recombiner and a cooling pipe for measuring excess heat generation. The excess heat was evaluated by the difference between input and output temperature of the water that passed through the cooling pipe. Neutron counting was performed by a He-3 detector with a polyethylene modulator. A NaI scintillation counter was used for both x-ray counting and spectroscopy. All cells and measurement systems are located in a clean-room where temperature and humidity are always kept constant.

3. Results and Discussion

Figure 2 and 3 show experimental results of sample G-10 and G-18, respectively. Horizontal axes mean elapsed time from the beginning of the experiments. X-ray and neutron counts increase clearly as shown in these figures. In Fig.3, neutron emission was observed after several hours from the end of electrolysis. Such phenomena as neutron emissions after electrolysis were observed in the other samples. It is considered that these neutron emissions occurred during diffusion process of deuterium atoms, since it takes about 20 hours to reach equilibrium state.

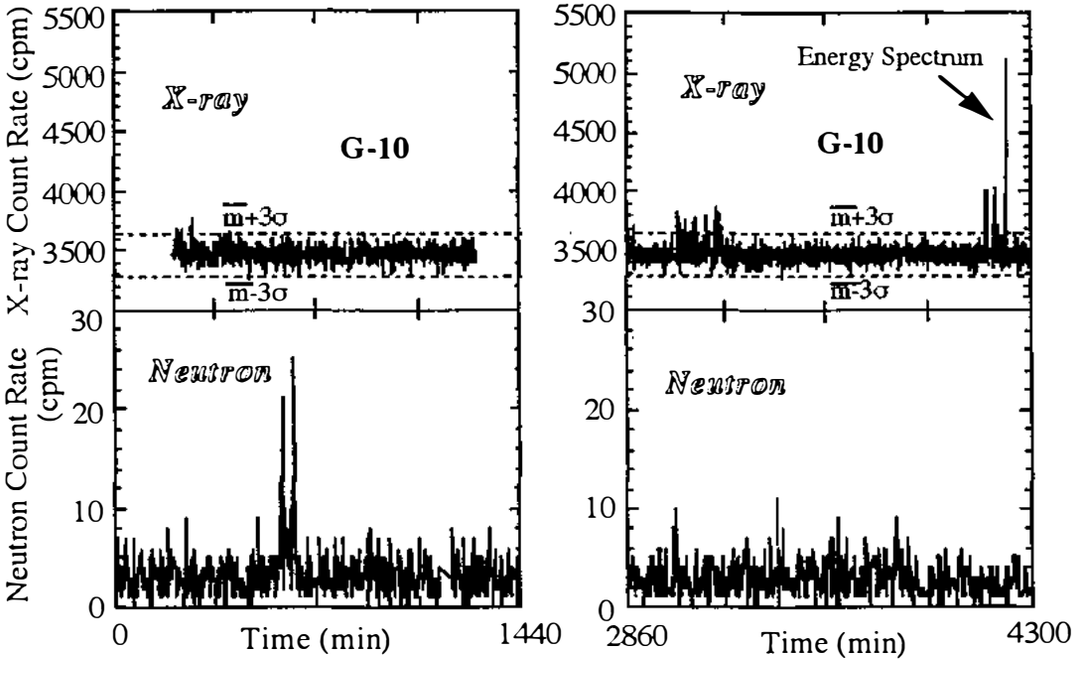

Fig.2 X-ray and neutron emissions from G-10

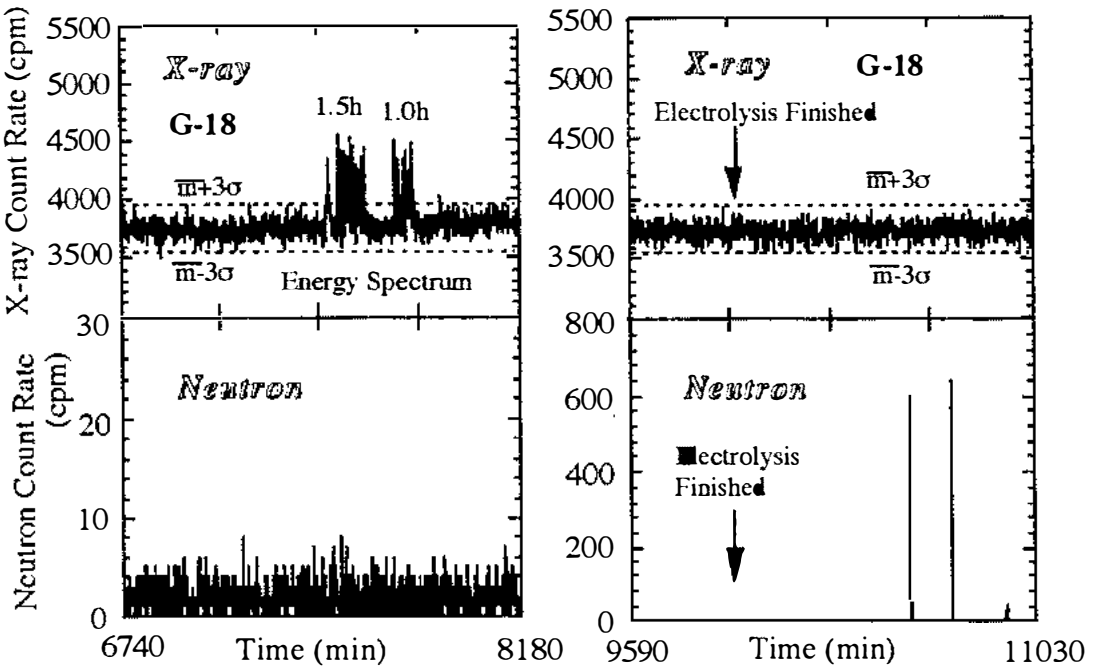

Fig.3 X-ray and neutron emissions from G-18

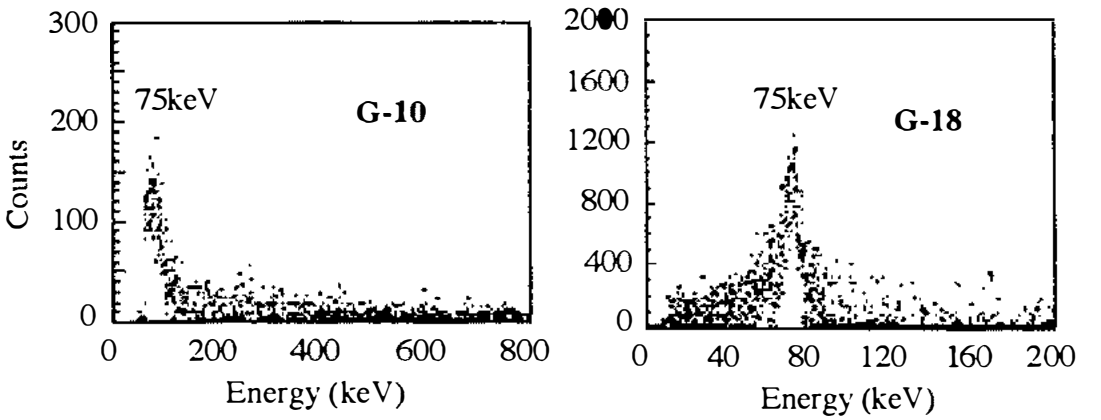

Fig.4 X-ray energy spectra for G-10 and G-18

It should be recognized that we have no correlation between x-ray and neutron emissions by our experimental data. Therefore, it can be said that x-ray and neutron are generated by different reactions.

Figure 4 shows the results of x-ray spectroscopy for the counting data in Fig.2 and 3. We subtract background x-ray data from foreground. Clear peaks can be seen around at the energy of 75keV in both cases.

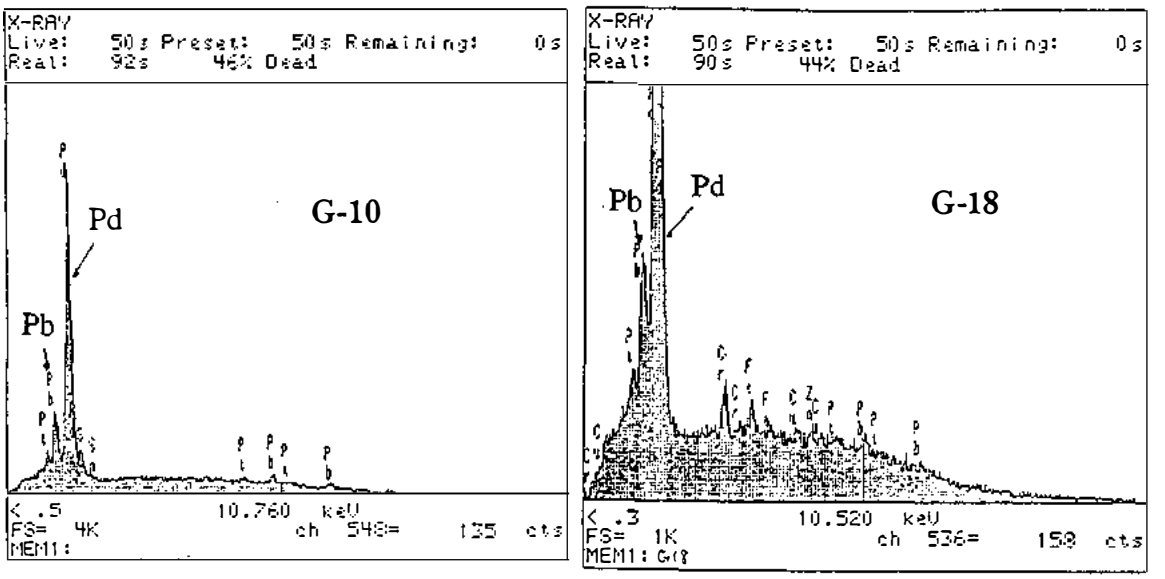

Fig.5 Analysis of electrode surfaces of G-10 and G-18 by EPMA

Figure 5 shows the results of analysis of electrode surfaces of G-10 and G-18 by EPMA. We found much Pb atoms on the palladium cathode after the electrolysis. No Pb atoms have been detected except G-10 and G-18. It should be noticed that the energy of K-α characteristic x-ray of Pb is about 75keV. Therefore Pb atoms detected on the Pd electrodes correspond to the x-ray energy observed during these experiments as shown in Fig.4.

4. Concluding Remarks

Characteristic x-ray and neutron emissions were observed during electrochemical loading of deuterium into palladium metal. We can say that anomalous nuclear reactions must occur and induce characteristic x-ray and neutron emissions in the electrochemical cells at room temperature.

References

1. Y.Iwamura,T.Itoh and I.Toyoda,"Observation of Anomalous Nuclear Effects in D_2-Pd System", *Proc. of ICCF-4,* Maui, Hawaii, December 6-9,1994, vol.2, p.12. EPRI TR-104188-V3 (1994)

2. T.Itoh, Y.Iwamura, N.Gotoh and I.Toyoda, "Observation of Nulear Products under vaccum conditon from deterated palladium with high loading ratio" , to be published in the present proceedings