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Excess Heat Production in a D-Pd Gas-solid System

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Abstract. Evidence of some excess heat triggered by electric current and pressure change in a D-Pd system and details of the calorimetric measurements were reported in this paper. The system produced an excess energy of about 80MJ in 83 hours, which was corresponding to 1.8×10^4eV for each palladium atom. The results of SEM and EDS implied that there might be a nuclear reaction in the exothermic process.

Introduction

S. Focardi et al [1] reported on the existence of a large excess heat production observed in a H-Ni gas loading system. A. Rossi [2] developed the method and enlarged the phenomenon into 1MW in recent days. Few of people knew Rossi's secret catalyzer and had many curiosities and questions on it. With the skeptics a D-Pd gas-loading system was chosen and made a series of experiments in order to prove if the evidence was true[3].

Experimental

Experimental apparatus. Figures 1 and 2 gave a schematic of the experimental system. Figure 1 was a reaction chamber that made up of stainless steel with a double-Jacket structure, where the circulation water could flow through. It has internal dimension of diameter =100mm and hight = 240mm with useful capacity about 1.9 dm^3. Palladium wires(99.98% purity made by National Non-ferrous Metal Research Acadamy, Beijing), with dimension of diameter = 0.5mm and lengh = 210cm ($V= 4.123\times10^{-1}cm^3$) for experimental and Φ =0.5mm and L = 400cm ($7.854\times10^{-1}cm^3$) for heating the system. In order to continuous monitoring of its energy balance by measuring the equilibrium temperature at different positions, the reaction chamber has seven Pt100 resistor thermometers (see figure 1 for temperature sensors position). The presence of an excess heat was detected by the increase of all the monitored temperatures. Where 1 inlet of circulation water; 2,4 ceramic tube; 3 Pd wire for heating; 5 Pd wire for experimental; 6 outlet of circulation water; 7 circulation water; T1～7 Pt100 resistor thermometers for taking the temperatures at different purposes: T1 the middle of the chamber inside the ceramic tube; T2 wounded around heating Pd wire; T3 wounded around experimental Pd wire; T4 inside the chamber between inside wall and outside ceramic tube; T5 in the place near the aero-plug; T6 adhesive on the outside wall of the chamber; T7 ambient temperature.

The experimental apparatus for the chember was shown in figure 2, where 1 was the reaction chamber; 2 the inlet and ourlet for circulation water arround the chamber; 3 transition chamber; 4 D_2 needle valve; 5 D_2 generator; 6 air needle valve; 7 gate valve; 8 molecular pump; 9 the inlet and ourlet mouth for water circulation on the top; 10 DC power supply; 11 vaccum gauge; 12 Keithley 2700 multifunction date-inquiration meter; 13 a computer for data recording and controling; 14 a mechanical pump.

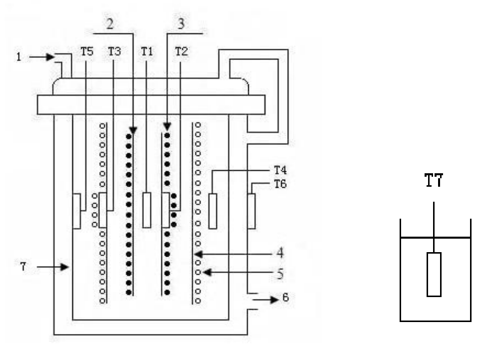

Fig. 1 Schematic of reaction chamber

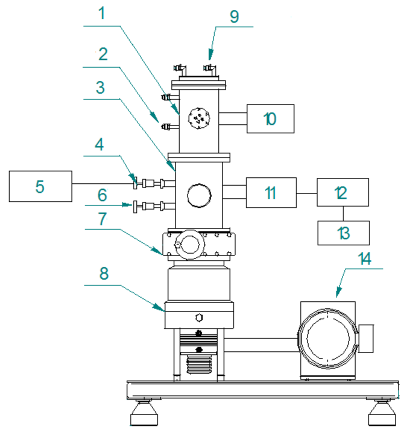

Fig. 2 Experimental apparatus

Calibration. The excess heat power can be calculation by eq.(1), where Po was overheating output power, Pi was input power, because all the physico-chemial processes last for a limited time period, and the heating coefficient (k) can be considered as a constant in the explored temperature range[1].

$$Po = Pi - \frac{T6 - T7}{k} \tag{1}$$

So, before the triggering experiments, a series of calibration were carried out for determine the normal status behavior of the system. The heating Pd wire was passed through some different electrical currents at 9×10^4 Pa under N_2 environment. When the temperature of the system because equilibrium a pair of data (temperature, pressure, voltage and current) were recorded by a 12-bit National Instrument interface Keithley 2700. The results are shown in figure 3.

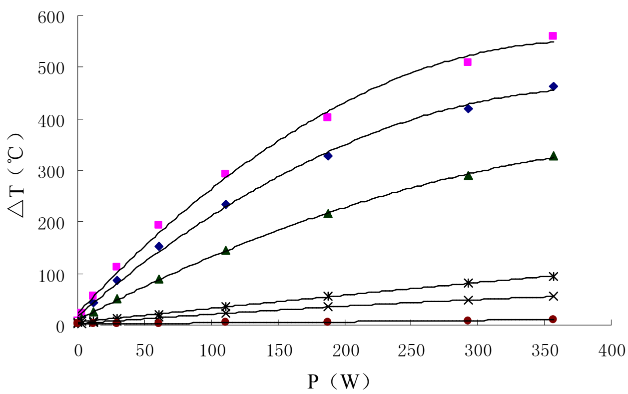

Fig. 3 Calibration curves; temperature (relative to the T7) vs. power under N_2 environment at 9×10^4 Pa (T1(◆), T2(■), T3(▲), T4(×),T5(*) and T6(●))

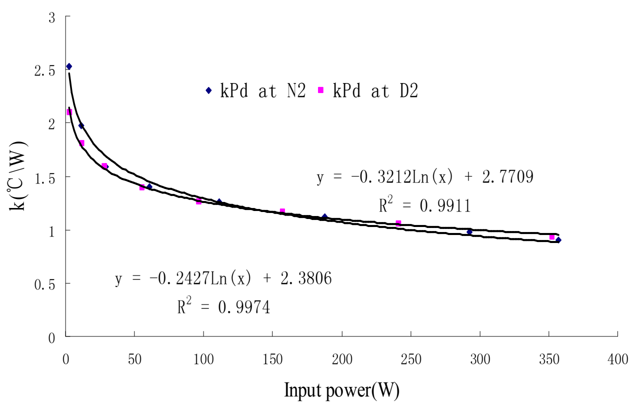

Fig. 4 The fitting curve of input power and k under N_2(◆),D_2(■) environment at 9×10^4 Pa

This work compared the heating coefficient (k) for a D/Pd gas-solid system with N/Pd gas-loading system triggered by same current within different pressures[4,5].

$$k = {\Delta T}/{\Delta P} \,(°C/W) \tag{2}$$

ΔT was the temperature of difference equilibrium before and after some certain electric power put into the system. ΔP was the actual input power change on palladium wire. The k in N_2 and D_2 environment at 9×10^4 Pa can be obtained from a calibration procedure during which a known power was supplied to the chamber and the equilibrium temperatures T6 and T7 are measured, as shown in table 1.

Table.1 The k (℃/W) of different input power in N_2 and D_2 environment at 9×10^4 Pa

Input power (W)	357.06	292.81	187.39	111.28	60.74	29.14	11.37	2.62
k (℃/W) N_2	0.905	0.976	1.123	1.261	1.401	1.593	1.977	2.530
k (℃/W) D_2	0.969	1.017	1.124	1.249	1.394	1.571	1.797	2.149

For the case of calculation, the relation between input power and k of experimental palladium wire at N_2 , D_2 were fitted. The fitting curves were as shown in figure 4. From it we can see that the value of k at N_2 environment was greater than thatt at the D_2 environment when input power was less than 150W, but when the input power was greater than 150W, the value of k at D_2 environment was greater than that in the N_2 environment at high temperature. And with the input power increases, the greater the difference between k in D_2 environment and k in N_2 environment. However, taking into account the specific circumstances of laboratory equipment and the palladium wire, we set the input current of 8.0A in the experiment finally.

Experimental process and results

Excess heat estimation. Our previous experimental work indicated that the maximum excess heat power occured at the current 8A through heating palladium wire, pressure 9×10^4 Pa, so we consider whether can repeat the experiment, and can realize the self-sustained heating. Based on this reason, the current decreased gradually from the 8A, in order to find the suitable input power which was the maximum of excess heat power (Po) and input power (Pi) ratio, and at which condition the self-sustained heating experiment could be obtained

Input current decreased from 8A by 1.0A，0.5A，0.25A, to determine the excess heat output power and input power than the maximum input power, the experimental data were shown in table 2. Experimental results showed that, the excess heat power decreased as input power decreased, no matter what the current decline manner, however, its decline rate of different, the manner of 0.25A reduces the current to the 7.0A, excess heat power 35.20W, the manner of 0.5A reduces the current to the 7.0A, excess heat power 32.11W, the manner of 1.0A reduces the current to the 7.0A, excess heat power 11.73W. In addition, the ratio of excess heat output power (Po) and input power (Pi) was also different, with the 0.25A manner to reduce the current to the 7.0A, ratio of 0.143, with the 0.5A manner to reduce the current to the 7.0A, ratio of 0.131, with the 1.0A manner to reduce the current to the 7.0A, ratio of 0.049. So the best of the excess heat power and ratio are appeared at the manner of 0.25A reduces the input current. And when the input current decreased to the 7.25A at the manner of 0.25A, the ratio was maximum about 0.143. So, we decreased the input current from 8.0A to 7.25A witch was the maximum ratio by the manner of 0.25A.

So, we took the maximum ratio at current 7.25A by decreased manner 0.25A under D_2 environment at 9×10^4 Pa, let the current pass heating Pa wire to heat the reaction chamber for about 83 hours 17 minutes. When the system got a thermal equilibrium the excess heat production could be calculated by the difference temperature of T1 ~ T7 as shown in figure 5. The average excess heat power was 265.37W, the total excess heat energy about 79.58MJ, which was corresponding to 1.8×10^4eV/atom Pd. Apparently it was greatly more than the energy the hydrogen atom release in a chemical process.

Table.2 Po and Po/Pi about heating current decreased from 8.0A by 1.0A，0.5A，0.25A

heating current(A)	0.25A		0.5A		1.0A	
	Po(W)	Po/Pi	Po(W)	Po/Pi	Po(W)	Po/Pi
8.00	47.476	0.094	33.711	0.094	18.640	0.053
7.75	45.057	0.136				
7.50	42.285	0.141	32.190	0.108		
7.25	38.969	0.142568				
7.00	35.202	0.142557	32.115	0.131	11.728	0.049
6.75	31.477	0.141				
6.50	27.86364	0.138747	24.238	0.112		
6.25	24.61942	0.13658				
6.00			16.473	0.103	2.702	0.017
5.75						
5.50			11.285	0.089		

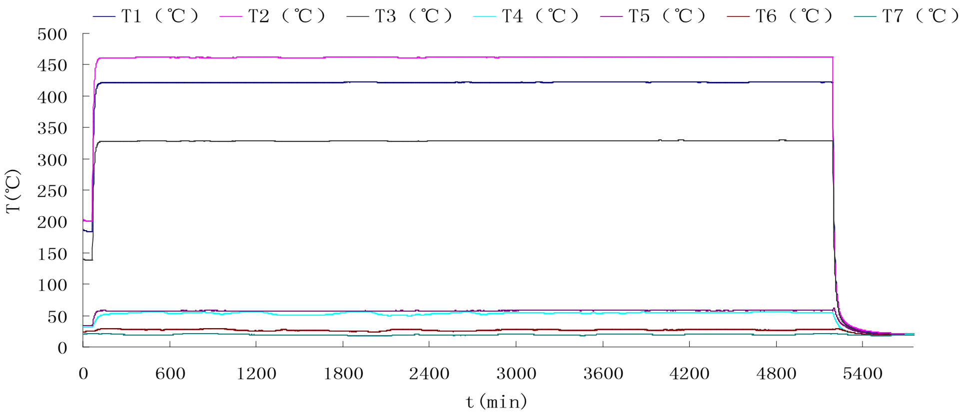

Fig. 5 The difference temperature of T1 ~ 7 under D_2 environment at 9×10^4 Pa

SEM and EDS analysis. Analysised on experimental palladium wire for SEM, a magnification of 2418 times, as shown in figure 6. Observed local with granular particles whiches exceptionally bright produced in the field of view, this region was further amplified by 19345 times, shown in figure 7, and carries on the EDS analysis, the results shown in figure 9 and table 3.

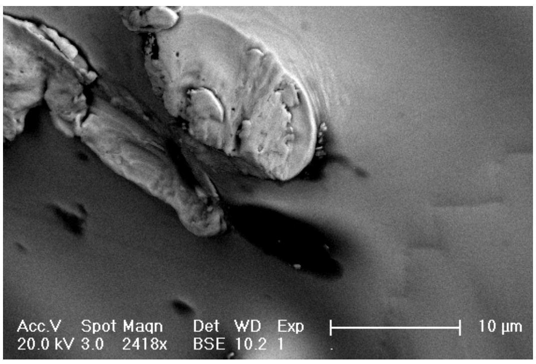

Fig. 6 SEM of experimental palladium wire (2418×)

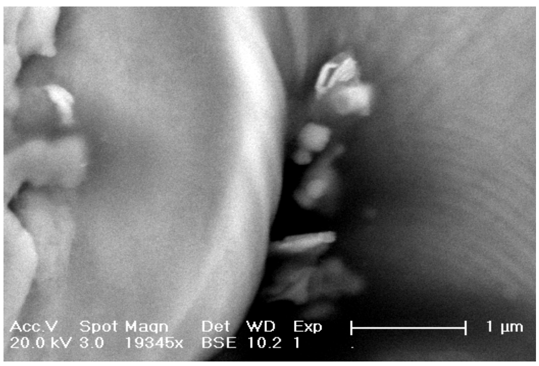

Fig. 7 SEM of partial enlargement experimental palladium wire (19345×)

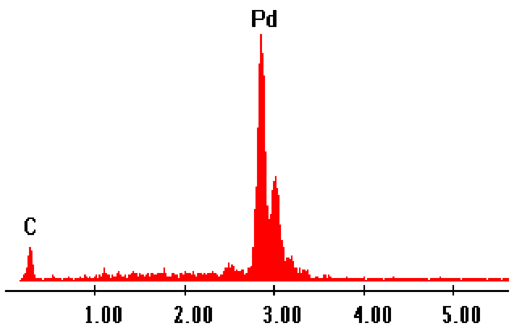

Fig. 8 EDS of palladium origin

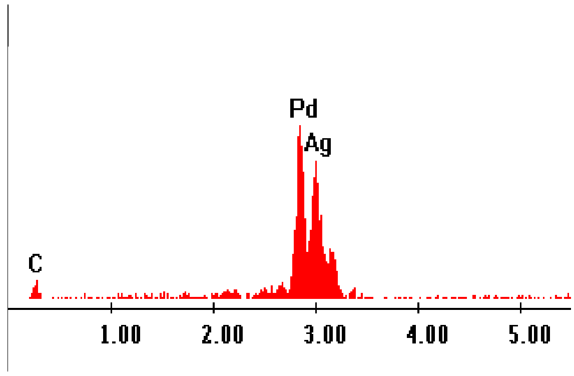

Fig. 9 EDS of Fig7 palladium sample

The original palladium wire was analysised with an EDS (Fig. 8). The result indicated that the sample was of nearly 100% palladium. The experimental palladium wire (show in figure 9) in EDS analysis shown in figure 9, the results of composition and proportion of the elements in table 3. From figures 8 and 9 we chould see that after excess heat, there was Ag which Wt% about 31.26 on experimental palladium surface. Ag might be produced during the excess heat process.

Table.3 Composition and proportion of elements in figure 9

Element	Wt%	At%
C	5.96	36.04
Pd	62.79	42.9
Ag	31.26	21.06
Total	100	100

Conclusions

In the process of achieving self-sustained manner, we got a great amount of excess heat by using the maximum ratio at current 7.25A by decreased manner 0.25A from 8A under D_2 environment at 9×10^4 Pa. The excess heat lasted for about 83 hours 17 minutes, the average excess heat power was 265.37W, the total excess heat energy was about 79.58MJ, which was corresponding to 1.8×10^4eV/atom Pd. Apperently that was much more than the energy in a chemical process. And on the fused section of experimental palladium smoe Ag element was found and its origin might come from a nuclear transmutation process.

References

[1] S. Focardi, V. Gabbani, V. Montalbano, Large excess heat production in Ni-H systems, J. IL Nuovo Cimento. 11 (1998) 1233-1242.

[2] Information on http://ecatnews.com/?p=1160 /2011/10/30

[3] J.Tian et al : "Excess Heat" and "Heat after Death" in a Gas-loading Hydrogen/Palladium System, in The 9th International Conference on Cold Fusion, Condensed Matter Nuclear Science. 2002. Tsinghua Univ., Beijing, China: Tsinghua Univ. Press, p360

[4] Jian Tian et al. An Excess Heat Phenomenon Triggered by Pressure in a H-Pd Gas-loading System, J .Advanced Materials Research Vols. 399-401 (2012) 1433-1438.

[5] Tang Tao et al.Thermodynamic Investigation of Interaction between Palladium withHydrogen (H_2, D_2) , J .Chinese Journal Of Rare Metals.2,28 (2004)308-312.

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