Cold Fusion in an Ni-H System (II)

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Abstract

The excess heat production in Ni – H system of gas phase was investigated again. In a previous paper, a qualitative explanation of the experiment was reported. A quantitative analysis of excess heat production in Ni – H system is given in this paper.

There is a coincidence in the order of magnitude with another experiment in a Ni – H system. The successful analysis using the TNCF model shows the reality of trapped thermal neutrons in a crystal lattice.

1. Introduction

We have developed the Trapped Neutron Catalyzed Fusion (TNCF) model[1,2] to analyze quantitatively the Cold Fusion (CF) phenomena with excess heat and various nuclear products (neutron n, tritium t, γ- ray, ^{4}He, etc.) nuclear transmutation NT in various systems.

The model is based on the stable existence of thermal neutrons with a density n_n in the sample. If we assume there are trapped thermal neutrons in the crystal, the neutrons cause nuclear reactions with an occluded hydrogen isotope or with a nucleus of the minor elements in the sample. Then, various CF phenomena can be explained with nuclear processes and conventional physics.

In this paper we give a quantitative analysis of the experiment observing the excess heat generation in an Ni – H system[3] with an arbitrary parameter n_n, which was investigated in previous paper qualitatively[4].

2. Experimental Data in a Ni - H System

Focardi et al.[3] observed the excess heat generation in a Ni rod loaded with hydrogen from a gas phase. The Ni rod having 5 mm diameter and 90 mm length was placed in the chamber filled with H_2 gas.

The loading process was shown in the paper[3]. The temperature of the Ni rod was varied in a range of 160 ~ 470 °C in each loading step by a platinum heater placed in the chamber. The typical amount of gas loaded in the step was ~ 0.05 $l \cdot$ atm at 400 K.

After several loading steps, a mean excess heat production of 44 W (= 2.8 x 10^{14} MeV/s) was observed for 24 days. Neutrons and γ- rays were not detected during the process.

3. Analysis of Experimental Data in Ni - H System

Let us analyze the experiment[3] on TNCF model, which assumes the stable existence of trapped neutrons in the Ni rod, and its fusion reaction with occluded protons. If trapped neutrons exist in the Ni rod, neutrons cause the following reaction with the occluded protons:

$$n + p = d\,(1.33\text{ keV}) + \gamma(2.22\text{ MeV}).$$

If only the emitted photons with the energy 2.22 MeV contribute to the observed excess heat generation, the number of reaction per unit time $N\gamma$ is estimated as follows; $N\gamma =$ 2.8 x 10^{14} (MeV/s) / 2.22 (MeV) = 1.3 x 10^{14} (/s).

On the other hand, the number ν of this reaction per unit time can be calculated by the relation:

$$\nu = 0.35 n_n v_n N_p s_{n-p},$$

where $0.35 n_n v_n$ is the flux of the trapped neutron, n_n and v_n are the density and velocity of the trapped neutron, respectively, N_p is the number of the occluded protons in Ni rod and σ_{n-p} is the fusion cross section.

For the mean temperature in the loading step ~ 600 K, we can use the following values; v_n = 3.1 x 10^5 cm/s and σ_{n-p} = 0.13 barn. The number of the occluded protons in each loading step was estimated in the experiment as 1.0 x 10^{21}. Then the number of the occluded protons is estimated ass N_p = 3.0 x 10^{21} after the several (~ 3) loading steps. And the number of the reaction ν is essentially equal to the number of reaction per unit time N_γ; $\nu = N_\gamma$ = 1.3 x 10^{14} (/s).

Using these values, we can obtain the density of trapped neutrons in Ni rod.

$$n_n = 3.0 \times 10^{12}\text{ cm}^{-3}.$$

This value of the density of trapped neutrons can be compared with the value obtained in previous analysis[5,6] of the experiment showing the nuclear transmutation in Ni – H system[7];

$$n_n = 5.4 \times 10^{11}\ cm^{-3}.$$

There is a coincidence of the determined parameters n_n from the two experiments[3,7] in the Ni – H systems. That is to say, if the number of trapped neutrons (~ 10^{12}) exists in Ni sample, the CF phenomena occurs along the line of the conventional nuclear physics.

4. Conclusion

In this paper, a quantitative analysis of the experiment in Ni - H system was given. According to the data of the conventional physics the results obtained in the experiment cannot be explained only by *p - p* or *p - d* reaction. If we assume the existence of trapped neutron in crystal, we can explain the results in the conventional physics by *n - p* reaction.

We have done more than 15 analyses of the experiment in various systems[8]. From our point of view, based on TNCF model, experiments in gas phase are explained the same as using electrochemical method. Furthermore, a unified interpretation is given in spite of the difference of the cathode materials, hydrogen isotopes, species of electrolytes and so on.

The success of analysis on TNCF model shows the reality of trapped thermal neutrons in crystal.

We hope further experiments taking into account the trapped neutrons and the theoretical and experimental studies of the trapped neutron itself will be done.

References

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