The Detection of 4He in Ti-Cathode on Cold Fusion

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Abstract

The Ti- cathode has beeen examined after electrolysis with remarkable phenomenon of "excess heat" by SIMS. The special mass peak of 4 amu in SIMS spectra of Ti-cathode has been detected by a series of experiments. It' s concluded that the mass peak of 4 amu is the mass peak of ^4He in Ti-Cathode produced in cold fusion.

To avoid interference of D_2 and H_2D with ^4He in SIMS spectra, the negative SIMS spectra are used in the detection of ^4He.

I Experimental Condition

The detection of ^4He produceed on cold fusion is an important step to determine if a theoretical model or an experimental method on cold fusion is feasible. We designed three experiments to determin the exist of ^4He in Ti-cathode after electrolysis. No matter whether the cold fusion occures, H and D which may exist in the forms of D_2 and H_2D may be absorbed in the Ti-cathode. Prof. Ning has found that the negative SIMS method can avoid the interference of D_2 and H_2D with ^4He in SIMS spectra. Therefore, the negative SIMS method was applied to detect the presence of ^4He in Ti-cathode.

The analysis of ^4He has been made on the VG Microlab MK Ⅱ surface analysis instrument with Ga ion gun.

Beam current is 30nA, beam voltage is 10KV.

Target bias voltage is 5. 5V.

Pole bias voltage is 7. 9V.

Base vaccum is 2×10^{-9} mbar.

Flood oxygen gas on sample in analysing process to increase positive ion yields and stabilize the negative ion yields.

Ga^+ ion source is used to raise negative ion yields.

The peaks of D_2 and H_2D will overlap the peak of ^4He in produst of cold fusion. We have found that the negative SIMS method can avoid the interference of D_2 and H_2D with ^4He in SIMS spectra. Therefore, the negative SIMS method was applied to detect the existence of ^4He in Ti-cathode.

FRONTIERS OF COLD FUSION

Ⅱ Experimental method and it's results

1. We examined the Ti-cathode which has undergone electrolysis with remarkable phenomenon of "excess heat" .[2] In the electrolytical experiment, the Ti-rod-cathode was half immersed in the heavy water and the other half above the surface of heavy water. Along the rod, samples a, b, c, d are taken from the segment immersed in and samples a′ , b′ , c′ , d′ are taken from the segment above the surface of it. (Figure 1.)

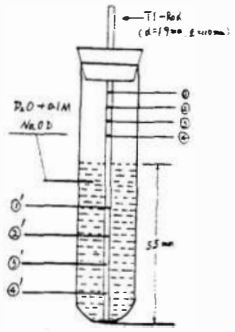


Figure 1. The distribution of Samples taken

Fig 2 (a) and Fig 2 (b) are the negative SIMS mass spectra of samples a, b, c, d and a′ , b′ , c′ , d′ respectively. Comparing these spectra with each other, we found that the peak of D^- (2amu) exist both in Fig 2 (a) and Fig 2 (b), but the peak of 4 amu only exists in spectro of Fig 2(b). It shows that the helium exist exactly in Ti-cathode after producing "excess heat" .

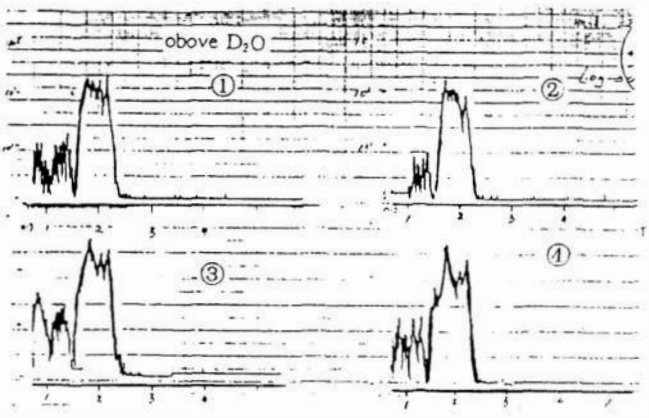


Figure 2 (a) The SIMS Spectra of Ti-rod above D_2o

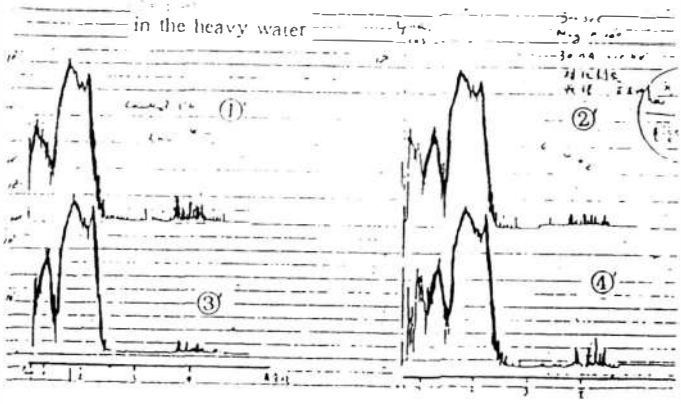
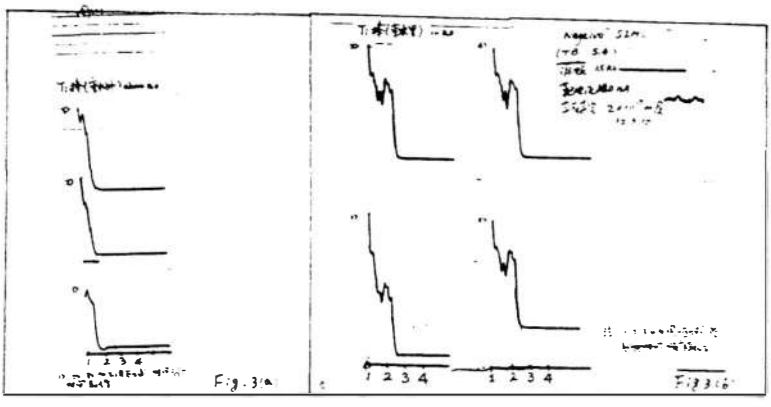


Figure. 2 (b) The SIMS spectra of Ti-rod immersed in D_2o

2. As a comparative experiment, we examine the other Ti-cathode which has undergone electrolysis for fifteen days without any phenomenon of "excess heat" and the electrolyty contained more water (H_2O) . The sample (E) is taken from the segment of Ti-rod above the heavy water along the Ti-rod and sample (F) is taken from the segment immersed. The results of negative SIMS detection are shown is Fig 3 (a) and Fig 3 (b) .



1, 2, 3 are the same deepth and different area

Figure 3 (a). The SIMS Spectra of Ti-rod immersed in (D_2O+H_2O) .

1, 2, 3, 4 are the same area and different deepth
1. is the minimum deepth
4. in the maximum deepth

Figure 3 (b). The SIMS Spectoa of Ti-rod immersed in (D_2O+H_2O) .

Fig 3 (a) shows that the hydrogen peak is the only peak, because the capability of hydrogen to be adsorbed by titanium rod is much greater than that of deuterium.

Fig 3 (b) shows that the amount of deuterium in the surface is less than that in the deeper layer, but the deuterium never form the peak of 4amu in the Ti-rod after electrolysis.

3. A clear Ti-rod is placed in a vaccum chamber and heated to give off gas at 600℃. In this process, the vaccum is kept to 2×10^{-5}mbar. While the Ti-rod turns cold, let high purity He gas into the champer. After then, the rod has been placed in He gas for 4 hours. Sample G is taken from it.

After the sample G was detected by negative SIMS, no any hydrogen deuterium and helium peaks can be foumd in the negative SIMS spectra.

Ⅲ Discussion

1. The peak of negative SIMS of helium only exist in titanium rod after "excess heat" experiment as Fig 2 (b) shows. It shows that the helium is formed in the titanium crystal latlice after producing $D+D\rightarrow{}^4He^*\rightarrow{}^4He+Q$.

2. Fig 2 (a) and Fig 2 (b) show that neither Two hydrogen atoms in the crystal lattice of Ti-cathode can form 2 amu peak, nor two deutarium cam form 4 amu peak. under the detection of negative SIMS.

3. Fig 3 (a) and Fig 3 (b) show that if there are no "excess heat", the helium may not be produced in crystal lattice of Ti-rod after electrolysis.

4. From test result of sample G, We found that the helium ion or atom can not enter the crystal lattice of titanium by means of Van der Wadls force. Therefore, if He exist in crystal lattice of titaium, it must be formed by means of: $D+D\rightarrow{}^4He+Q$ process.

Ⅳ Conclusions

Our experiments show:

1. The "excess heat" phenomenon is related to the helium products, so the process of $^2D+^2D\rightarrow{}^4He+23.8Mev$ may exist in the cold fusion.

2. The method of negative SIMS is feasible for detecting He in the Ti-rod after "excess heat". And the detailed research report of SIMS technigue will be published later.

3. The further study in this field is underway.

Reference

[1] M. Fleischmann, S. Pons, (1989) J. Electroanal Chem. 261 301—308

[2] Q. Q. Gou, Z. H. Zhu, Q. F. Zhang, (1990) 《Chinese Journal of Atomic and Molecular Physics》 7. 3 1491—1495