Conference Proceedings Vol. 33
«The Science of Cold Fusion»
T. Bressani, E. Del Giudice and G. Preparata (Eds.)
SIF, Bologna 1991

SEARCH FOR BETTER MATERIAL FOR COLD FUSION EXPERIMENT USING CR–39 DETECTOR

Ke L. Wang, Xing Z. Li, Shi Y. Dong, Shi C. Wang①, Da W. Mo
Cheng M. Luo, Qin R. Lin, Xiao D. Wu, Wei Z. Li
Yong F. Zhu, Ping L. Zhou, Lee Chang

Tsinghua University, Beijing 100084, CHINA

Ⅰ. Introduction

It was noticed that most of the "cold fusion" experiments were using palladium or titanium just based on the first set of experiments [1], [2]. However, based on our own experience [3] the results of experiments depend heavily on each material. Even if for the same material, it seems that the performances of the materials from different manufactories are different. For example, the palladium film from Russia produced the greatest density of energetic charged particle tracks.

It was also noticed that some surface processes might affect the performance as well. For example, the cleaning by aqua regia might introduce a deep layer of chlorine on the palladium surface and deteriorate the performance.

It is natural to raise two questions: whether there is any better material for the "cold fusion" experiment? whether there is any surface process which may enhance the effect of cold fusion phenomenon?

In our first set of experiments the plastic track detector (CR–39) was proved to be a good tool to make a scrutiny of the materials and surface processes. CR–39 is very sensitive and efficient, we need only a little sample (several square centimeters of foil with thickness of $20 \sim 30\mu$) for the test. Therefore, in a small pressurized vessel (volume of 10 cubic centimeters) we might put 10 samples in it. This makes the scrutiny quicker and guarantees the same condition for a batch of

①Institute of High Energy Physics, Beijing 100039, CHINA

materials; hence, the comparison between different materials and different surface processes is easier. More than 200 samples were tested in about 20 runs of Frascati–type [4] experiments.

Ⅱ. Experimental Arrangement

As described in Ref.[3], CR–39 plastic track detector were combined with Frascati–type gas–loading experiment to detect the energetic charged particles, which were supposed to be the token of the anomalous nuclear effect (cold fusion phenomenon). Preetching of CR–39 was done to distinguish the background tracks which were produced between the time it was manufactured and the time it was used in experiment. The control run was done to discriminate the effects due to radioactive impurities in the samples (e.g. uranium 238, radon's daughter et al.), or due to air borne radon, or due to cosmic rays. Dozens of different materials were tested. Most of them were palladium and titanium from various sources. We tested titanium alloys (e.g. V6–Al6–Sn2), silver, zirconium, nickel, lanthanum, cerium, niobium, rhenium, ceramic and hydrogen–storage materials (e.g. $LaNi_5$, TiFe) also. The palladium were from Russia, USA, Northeast China and Southwest China. They were in the shape of tube, foil, wire, powder, sponge, chips turnings and vapour deposit film.

Many kinds of processing were used to induce any possible effect. For example, we tried (1) annealing under high vacuum (500℃–1500℃); (2) irradiation by laser beam; (3) irradiation by neutron source; (4) irradiation by protons, or helium using tandem accelerator; (5) mechanical cold work; (6) surface cleaning by hydrofluoric acid.

Ⅲ. Primary Results

The Russian palladium foil imported in 1950's gave the highest yield of charged particles. In average it is higher than 1000 particles per cm^2 per day. The Ti–662 alloy was not as good as Russian palladium; its yield was about several hundred particles per cm^2 per day. However, Ti–662 alloy had high repetition rate. Other materials did not give evident signals distinct from background, which was less than 100 particles per cm^2 per day.

The highest yield from Russian palladium foil was more than 10^5 particles / cm^2. Table 1 gives the results of 11 runs of experiments using Russian palladium foils.

Fig.1 Tracks from Russian Palladium Foil

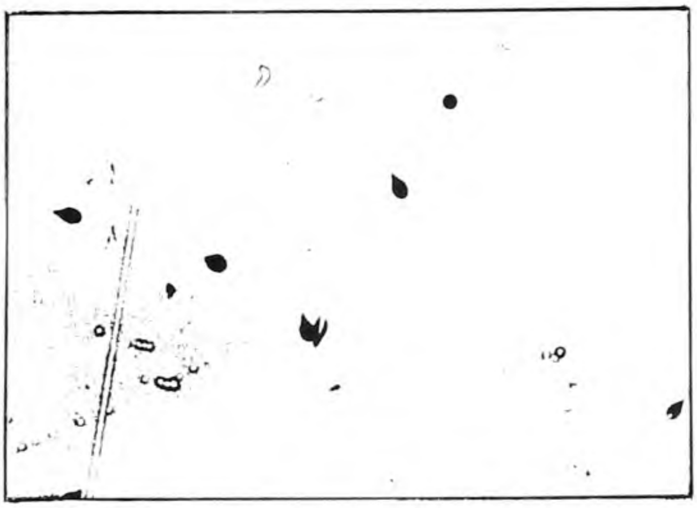

Fig.2 Tracks from Used Russian Palladium Foil

Fig.3 Tracks from American Palladium Foil

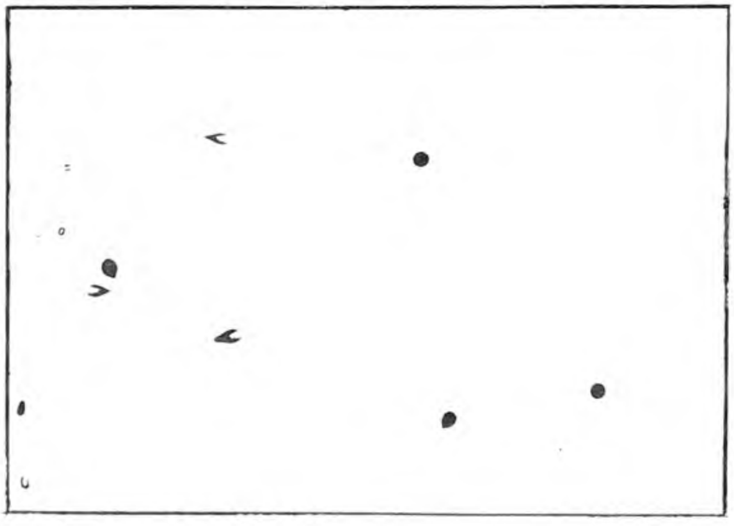

Fig.4 Tracks from Ti—662 Alloy Shaving

TABLE 1 Tracks in CR−39 (for Russian Palladium)

Run No.	Tracks (particles / cm^2)
1	10^5
2	1.1×10^3
3	1.6×10^5
4	10^4
5	3×10^3
6	100 (cleaned by aqua regia)
7	2×10^4
8	$>10^3$
9	3.5×10^4(average)
10	2.7×10^4(average) ($2-4\times10^4$)
11	6.5×10^4(average) (Maximum 7.5×10^4)

The palladium foil from America (Johnson Matthey Inc.) produced similar charged particle density as that from Ti−662 alloy. The Chinese palladium wire gave a positive result of 2×10^3 particles / cm^2. The palladium foils from both Northeast China and Southwest China did not give any positive result.

The Russian palladium foil became worse after the first usage. It exhibited a decaying behavior. Fig.1 is a photo for CR−39 taken by microscope with a magnification of 150x. This CR−39 recorded the charged particles from the Russian palladium foil. Fig.2 is a similar photo, but the Russian palladium had experienced once in the previous D_2 gas−loading experiment. The density of charged particles reduced by an order of magnitude. Fig.3 is the similar photo for American palladium foil. Fig.4 is the photo for Ti−662 alloy foil. The contrast is very clear.

Using vapour deposit technique to plate the Russian palladium on another substrate did not give positive result. In fact we did not find any processing, which might enhance the positive result.

Ⅳ. Acknowledgements

This work is supported by Natural Science Foundation of China and the contingent research funds from the National Education Commission and Tsinghua University. Mr. Tang Lin's deep concern is gratefully acknowledged.

Reference

〔1〕 M.Fleischmann and S. Pons, J. Electroanalytical Chemistry and Interfacial Electrochemistry, Vol.261, 301 (1989).

〔2〕 S.E. Jones, et al., Nature, 338, 737 (1989).
〔3〕 X.Z.Li, et al., The Proceedings of Anomalous Nuclear Effects in Deuterium / Solid Systems (Provo, UT, 1990), Ed. S.E. Jones, F.Scaramuzzi, and D. Worledge (AIP, New York).
〔4〕 De Ninno, et al., Europhysics Letters, Vol.9, 221 (1989).