Repetition Experiment of Laser Deuterium (Hydrogen) Palladium

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Abstract

The Cold Region Research Engineering Laboratory (CRREL) of the US Army Engineering Research and Development Center released anexperiment result in March 2023, which is a repetition of the same experiment of Biberian of France (Proc. ICCF23, 2021) and Mastromatteo of Italy (JCMNS19:173, 2016). The specific experiment is to apply a laser irradiation onto Pd-H system for stimulation of possible nuclear transmutation.

Qiuren Lab of XiAn, China repeated the above experiments with a similar schemes and materials. The only difference is that the laser source is a carbon dioxide laser, which is used to stimulate a specific Pd-H system, specifically the palladium metal sheet in a sealed vacuum chamber filled with hydrogen or deuterium gas with a certain pressure.Through surface electron microscope analysis, new elements were found in the surface of irradiated palladium sheet, suggesting that nuclear transmutation may occur during irradiation.The verification, quantitative analysis and mechanism research behind the experimental results still need to be further carried out.

Key words: laser, deuterium-palladium, nuclear transmutation

1、 PrecedentExperiments

In March 2023, CRREL reported the working results of laser irradiation target hydrogen (Pd-H) system of Biberian (Proc. ICCF23, 2021) and Mastromatteo (JCMNS19:173, 2016) to stimulate nuclear transmutation (see Figure2).This test used 1g 99.95% palladium ingot, vacuumized to about 44mTorr (about 5.8661Pa), filled with hydrogen at a pressure of 300kPa, respectively irradiated the palladium hydrogen (Pd-H) system as the experimental target with a red pulse laser at a power level of 5mW, a wavelength of 640nm, a green pulse laser at 532nm at a power level of 200mW, and a blue laser at a power level of 20mW, a wavelength of 405nm.The diameter of the irradiation spot is about 0.5 mm, which lasts for 9days.The experiment failed to identify the green light irradiation point from the sample surface, so only the results of red and blue light irradiation were discussed, as shown in Figure3.9-3.11 below.The nuclear track was observed at the irradiation point with CR-39, which is similar to the result of Biberian.

In 2016, Mastromatteo used 633nm, 0.9mW laser with a spot area of 1cm^{2}to irradiate 250 nm thick Pd-H film, and rushed into the hydrogen gas at a pressure of 150,000Pa. Two weeks

later, Na, Si, Al, Mg and Ca were generated on the surface.The 350nm thick Pd-H film (2Atom H2) was irradiated by a 650nm, 5mW laser for three months in Biberian, and there were N, O, Na, S, Mg, Fe and Ni in the center of the 0.2mm diameter black spot formed by laser irradiation.Compared with the three, the laser wavelength used is similar, but the laser power surface density of Biberian is the highest, CRREL is in the middle, and Mastromatteo is the lowest.As far as transmutation products are concerned, if the results of blue light are included, all three produce Na;Both Biberian and CRREL produce Mg and Ni;Both CRREL and Mastromatteo produce Si, Al and Ca;Only Biberian produced Fe.According to the evolution theory of elements in the universe, iron is the end point of fusion, and the final product of Pd absorbing H fission only releases the most energy to Fe. It seems that high laser power density is conducive to transmutation to the most stable nuclear product. In addition, Mastromatteo found that the effect at 633 nm is stronger than that at 405 nm. Here, 640 and 405 nm lasers are effective, but 532 nm lasers have no effect (at least the effect is weak). If the effect of laser wavelength can be confirmed, it will be of great significance for mechanism research.

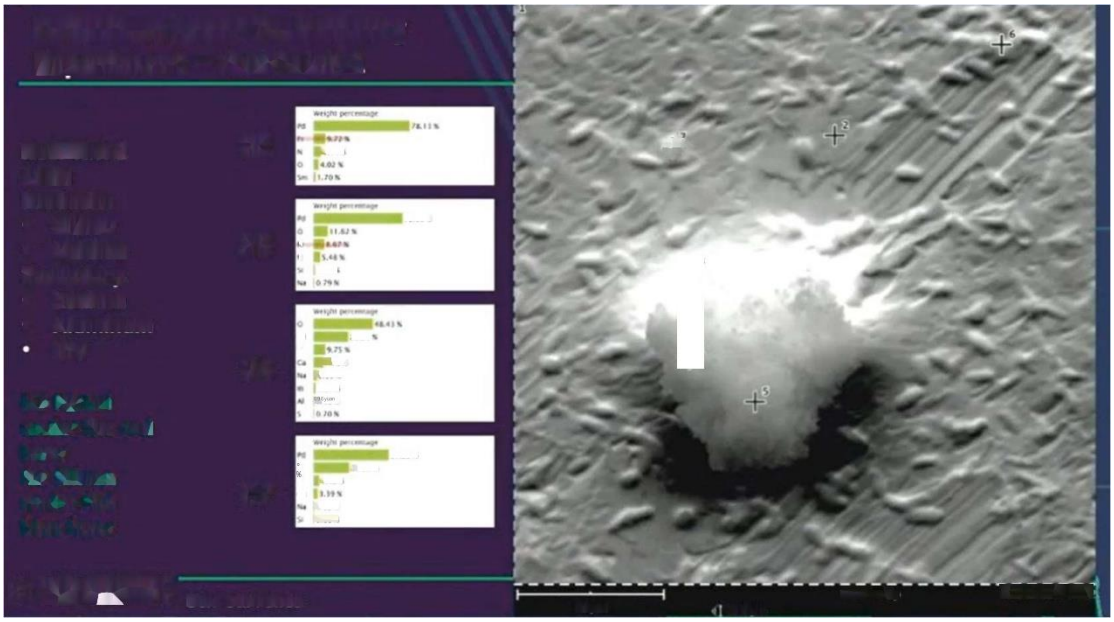

Figure 1: The nuclear products after CRREL red light irradiation are mainly Si and Ca, then Na, Al and Mo, but there is no Ni produced in blue light (see Figure 2).

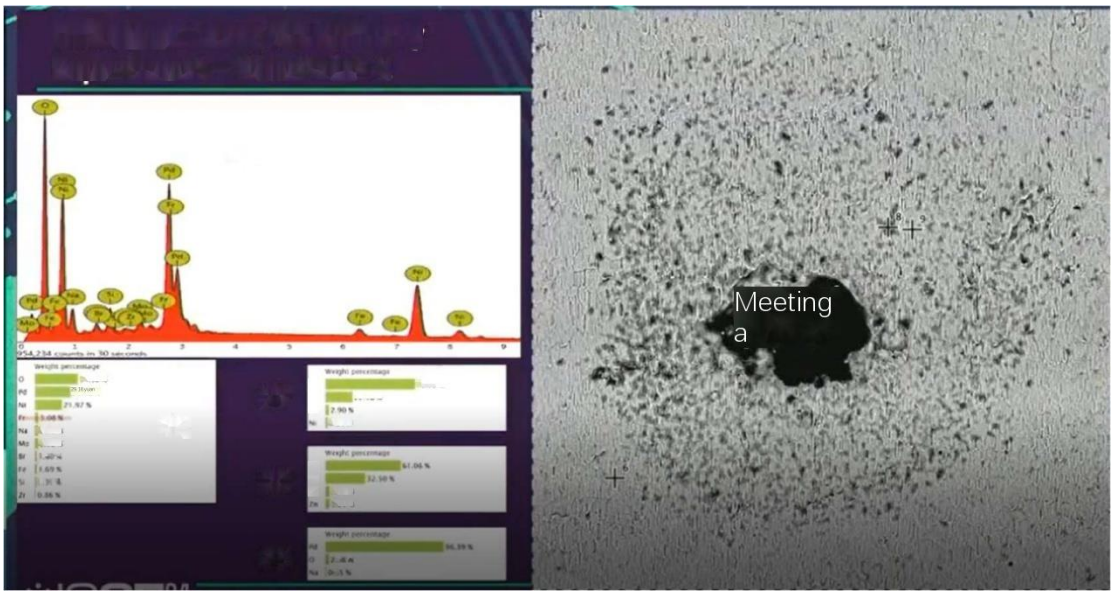

Figure 2: Elements at different positions after CRREL blue laser irradiation

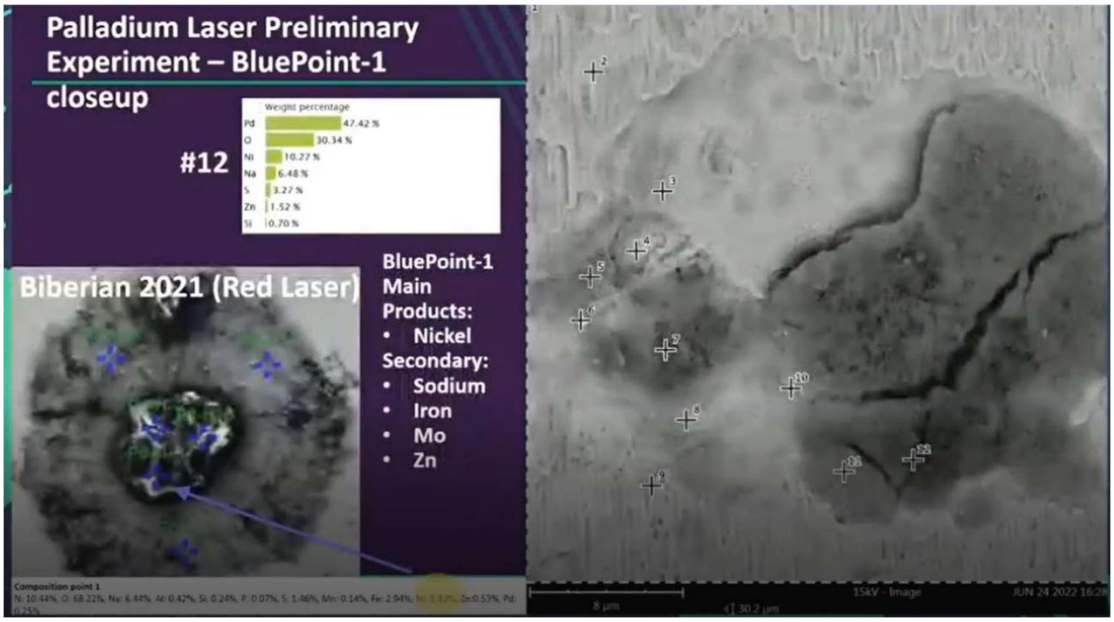

Figure 3: Comparison of nuclear products and Biberian results after CRREL blue laser irradiation,

Based on the above experimental results, the commonality of the irradiated products was found to be Ni, Na and Zn, and there were also Fr and Mo.But there is no Si produced in red light (Figure 2 in this paper).Fr (francium) in this result is a radioactive element with atomic number of 87. If Fr is really produced, measureβ. This isotope distribution can be determined by X-ray spectrum [3].

2、 Experimental Device

The experimental devices and materials used in this study are as follows.

2.1 Raw material preparation

The palladium sheet used for laser irradiation in this experiment is a circular sheet with a diameter of 15mm, a thickness of 0.1mm and a mass of 0.1g.

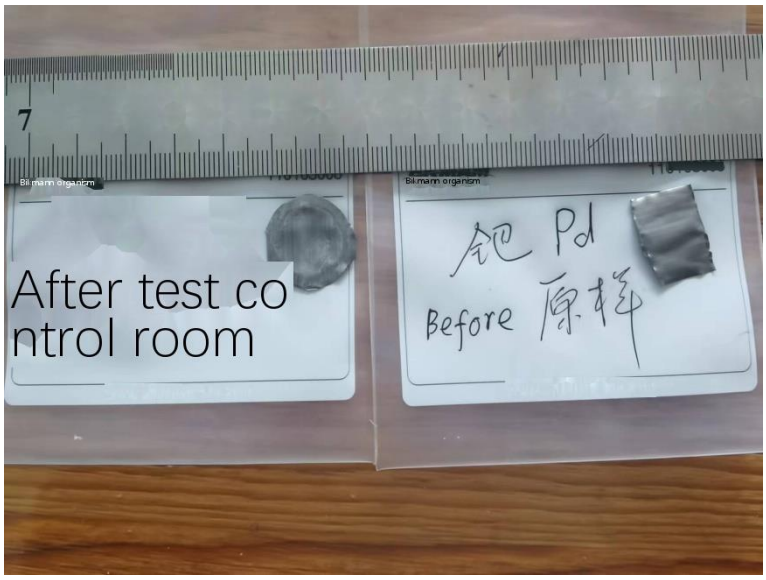

Figure 4: Materials before and after laser irradiation

2.2 Laser Source

The CO2 laser is adopted with the maximum laser output power of 30W, laser wavelength of 10.6μm and output spot diameter of 2mm.The pulse frequency is set as 2000Hz, and the duty cycle can be adjusted from 1% to 100%.Since the operating frequency of the CO2 laser is in the infrared band, the radiation and the target center are adjusted mainly by reflecting light on the material cake. During the implementation, hand burns should be avoided.

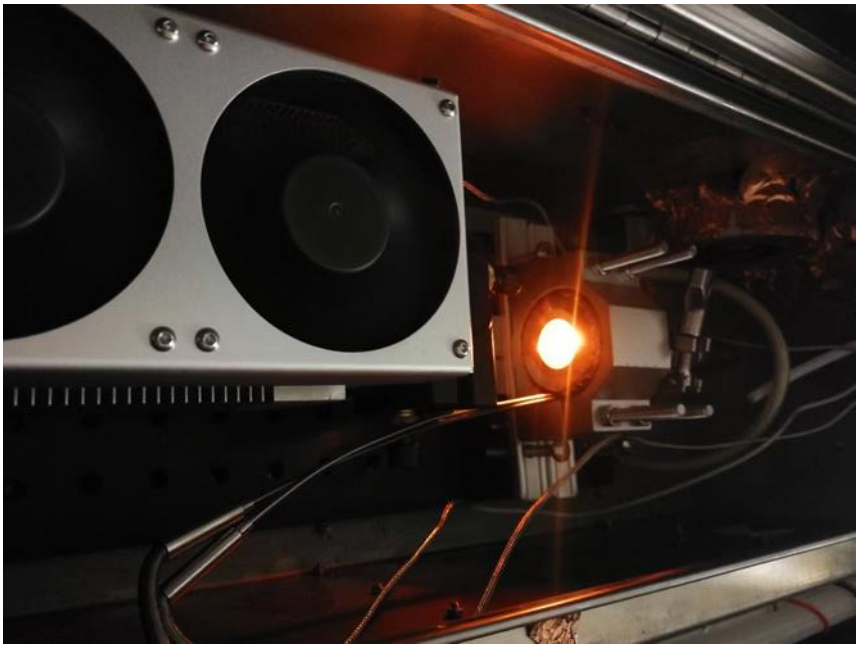

Fig. 5 Visible light can be generated when CO2 laser irradiates materials

2.3 Reaction Chamber

The structure of the reaction kettle is basically the same as that of Ubaldo Mastromatteo [2]. It is worth noting that ordinary optical glass cannot be used for the window glass, but special laser glass for zinc selenide should be used. Ordinary glass will absorb infrared wave band laser, and the glass lens will be heated and broken.

Figure 6, Reaction kettle

3、 Experimental Conditions

The sample is put into the reactor target for fixation, and the air is discharged. The reactor is respectively filled with hydrogen and deuterium gas for laser irradiation. The absolute pressure of hydrogen and deuterium gas is 300kPa.The frequency of the laser pulse is 2000Hz, and the duty cycle gradually increases from 10% to 50% (adjusted once every 24 hours). Each sample is irradiated in hydrogen for 5 days, and then in deuterium for 5 days. Samples are taken out and sent to the Chien-Jia-Geng Laboratory of Xiamen University for SEM and EDS testing. The results are as follows

4、 Experimental Result

The metal EDS test of the sample after laser irradiation found new element production, and the results are as follows:

Table 1 Comparison of elements before and after experiment results byQiuran

	C	O	Na	Mg	Al	Si	S	Cl	K	Ca	Zn	Y	Pd	Pb
Pd after	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pd before	●	●			●	●					●	●	●	●

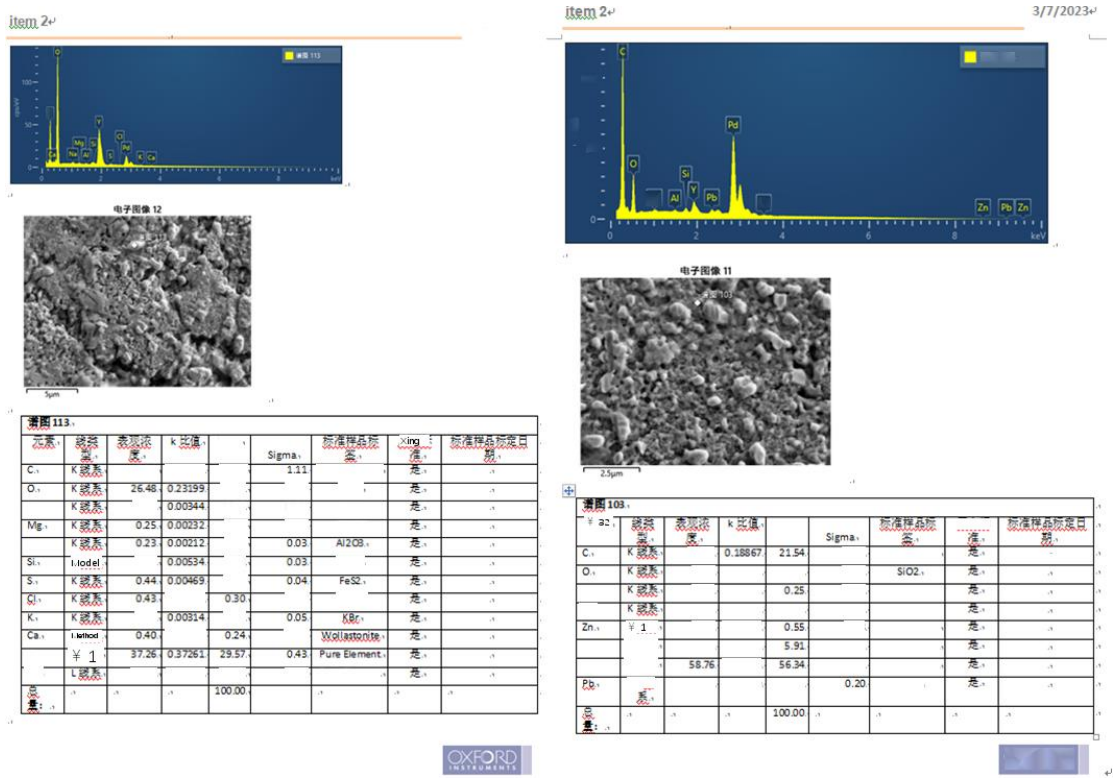

Figure 7 Elements before and after laser irradiation, left after irradiation, right before irradiation

Table 2. Comparison of new elements produced bydifferent research groups

	N	O	Na	Mg	Al	Si	S	Cl	K	Ca	Fe	Ni	Mo

Mastromatteo			●	●	●	●				●			
Biberian	●	●	●	●			●				●	●	
CRREL			●		●	●				●			●
QIURAN			●	●			●	●	●	●			

It can be seen from the table above that the probability of occurrence of the new element sodium, magnesium and calcium is relatively high.

5、 Summary and Discussion

The results of this study and related studies show that the generation of new elements has been found in palladium irradiated by lasers of different wavelengths in deuterium atmosphere.The laser wavelength used in this study is significantly different from the known similar studies.In terms of newly formed elements, this study has similar findings with related studies, and the reaction probability of producing sodium, magnesium and calcium is high.

This research is still an early exploration, and the next step includes fully verifying the causal relationship between the newly generated elements and the laser irradiation test, quantitative research on the correlation between the newly generated elements and the test scheme, and research on the relevant mechanisms and mechanisms.

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Reference

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