Low energy nuclear reaction occurring in hydrogen-loaded nickel wire

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Introduction

In this post, we reported a study of excess heat production in the hydrogen-loaded nickel wire . The experiment was carried out on June 3, 2014. The systematic diagram of experiment set-up is shown in Fig. 1. The detailed description of set-up was present in previous report (http://www.e-catworld.com/2015/05/30/new-result-of-anomalous-he the at-production-in-hydrogen-loaded-metals-at-high-temperature-new-report-by-songsheng-jiang-of-the-china-institute-of-atomic-energy-ciae/). Reactor chamber was filled with hydrogen gas (100 -200kPa). The 0.5 mm purity nickel wire was wound on a stainless-steel tube with inner diameter 10 mm, external diameter 12 mm and length150 mm. The mass of nickel wire was 16 g (Fig. 2).

The temperature was measured by stainless-steel shielded K-type thermocouples, thermocouple T1 is located on the outer surface of the stainless-steel reaction chamber, T2 is placed in contact with the surface of the nickel wire and T3 is inserted inside the stainless-steel tube.

The AC power was controlled by an electric circuit to keep temperature of thermocouple T1 within $\pm$ 5 ^{0}C. Variation of T1, T2, and T3 temperature may keep in an interval of $\pm$ 5 ^{0}C. If excess heat was produced in the reactor chamber and extra heat cause T1 temperature increasing greater than 5 ^{0}C, then temperature control was failed and T1, T2 and T3 temperature may all be increased at a constant power.

Anomalous rapidly increasing of T1, T2 and T3 temperature were observed. The enhanced temperature lasted about 80 minutes, and then dropped down (Fig. 3a and 3b). The T1, T2 and T3 temperature all exceeded 1000 ^{0}C, a setting value of upper limit of temperature recorder. The increased temperature of T3 was greater than 140 ^{0}C.

About 2 hours after previous event, a small increase of T2 and T3 temperature was observed. The increased temperature was about 3 ^{0}C, and lasted about 210 minutes. This extra heat can spread to T1 and forced temperature control circuit to reduceT1 temperature (electric power). T1, T2 and T3 temperature oscillation is relay effect of control circuit (Fig. 3a and Fig. 4). Increase of T2 and T3 temperature clear shows existence of extra heat source at nickel wire, although the increase of temperature is very small.

A test was carried out with no power control. T3 temperature rising from 850 ^{0}C to 900 ^{0}C took about 4 hours under non equilibrium condition (Fig. 5). Therefore, a rapidly rising T1, T2 and T3 temperature as shown in Fig. 3a cannot be explained by control malfunction.

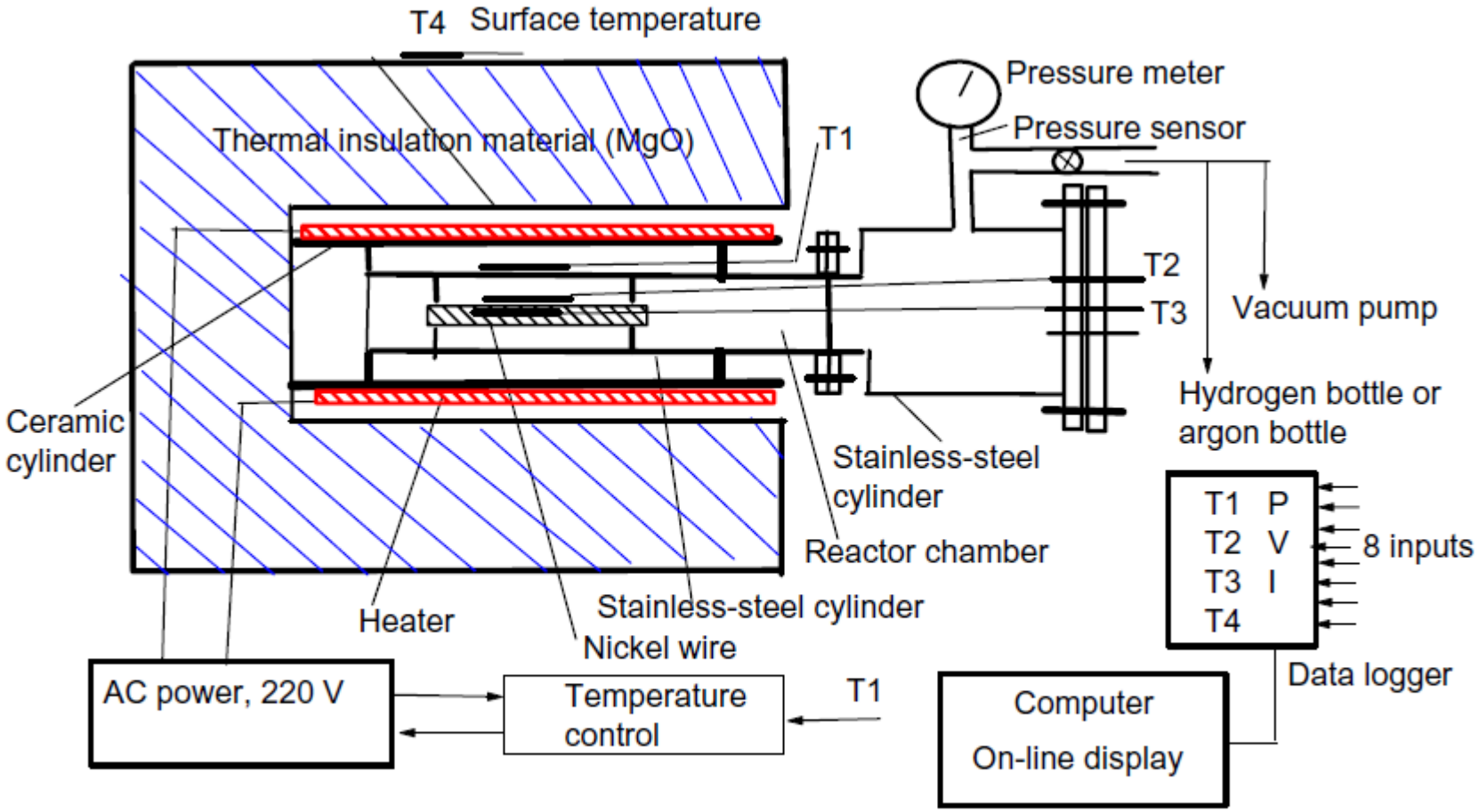
A control measurement was carried out with no nickel wire. No anomalous heat was observed (Fig. 6).

The expansion and loose of the front portion of the nickel wire can be observed after experiment (Fig. 7). Variations of the surface structure of the nickel wire were found using scanning electron microscopy (Fig. 8). The change of front portion of the nickel wire and damage of surface structure are possibly following excess heat release from the nickel wire.

The excess heat power, P_{excess}, is defined as $K \times \Delta T3$, $\Delta T3$ is the increase of T3 temperature, and power-temperature factor, k, is derived to be 1.7 ($1 \pm 20\%$) $W/^0C$, from the different electrical power and the difference of corresponding T3 temperature.

The excess heat power was derived to be greater than 240 W, and the energy greater than 1100 kJ for the first excess heat event, and excess heat power was about 5 W and energy was about 64 kJ for the following small excess heat event.

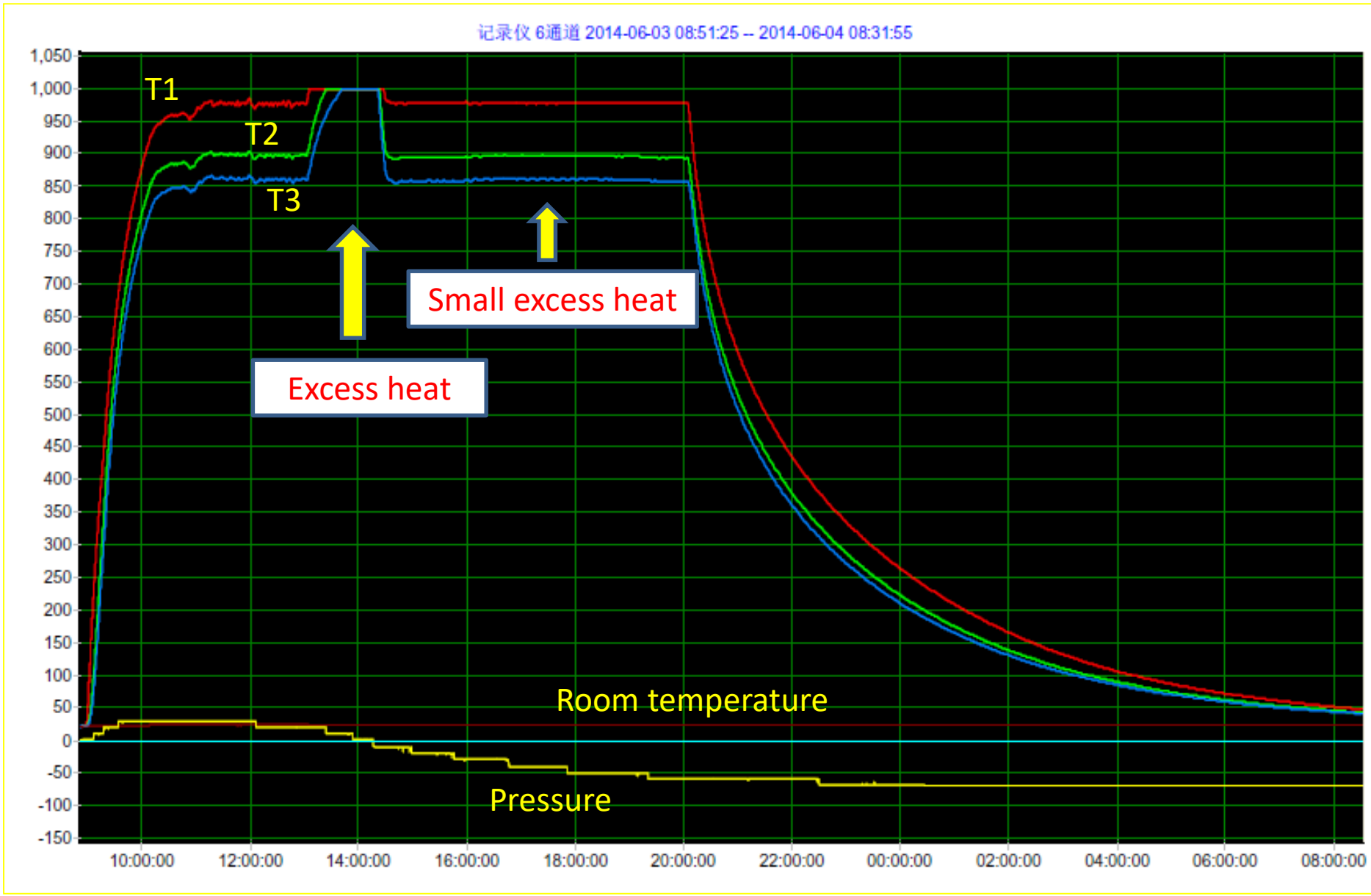
The reason for the excess heat automatic stopping after 80 minutes is unknown. We suppose that the excess heat ceased when nickel wire was loosed at extra high temperature, and the loose of nickel wire might cause a possible electric field decreasing between the surfaces of the nickel wire and stainless-steel tube. The excess heat event was not observed in the repeat measurement and then the reactor chamber was opened and found the loose of nickel wire.



A Schematic diagram of experiment set-up

Fig. 1

Figure 2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650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
T1
T2
T3
Small excess heat
Excess heat
Room temperature
Pressure
10:00:00
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
00:00:00
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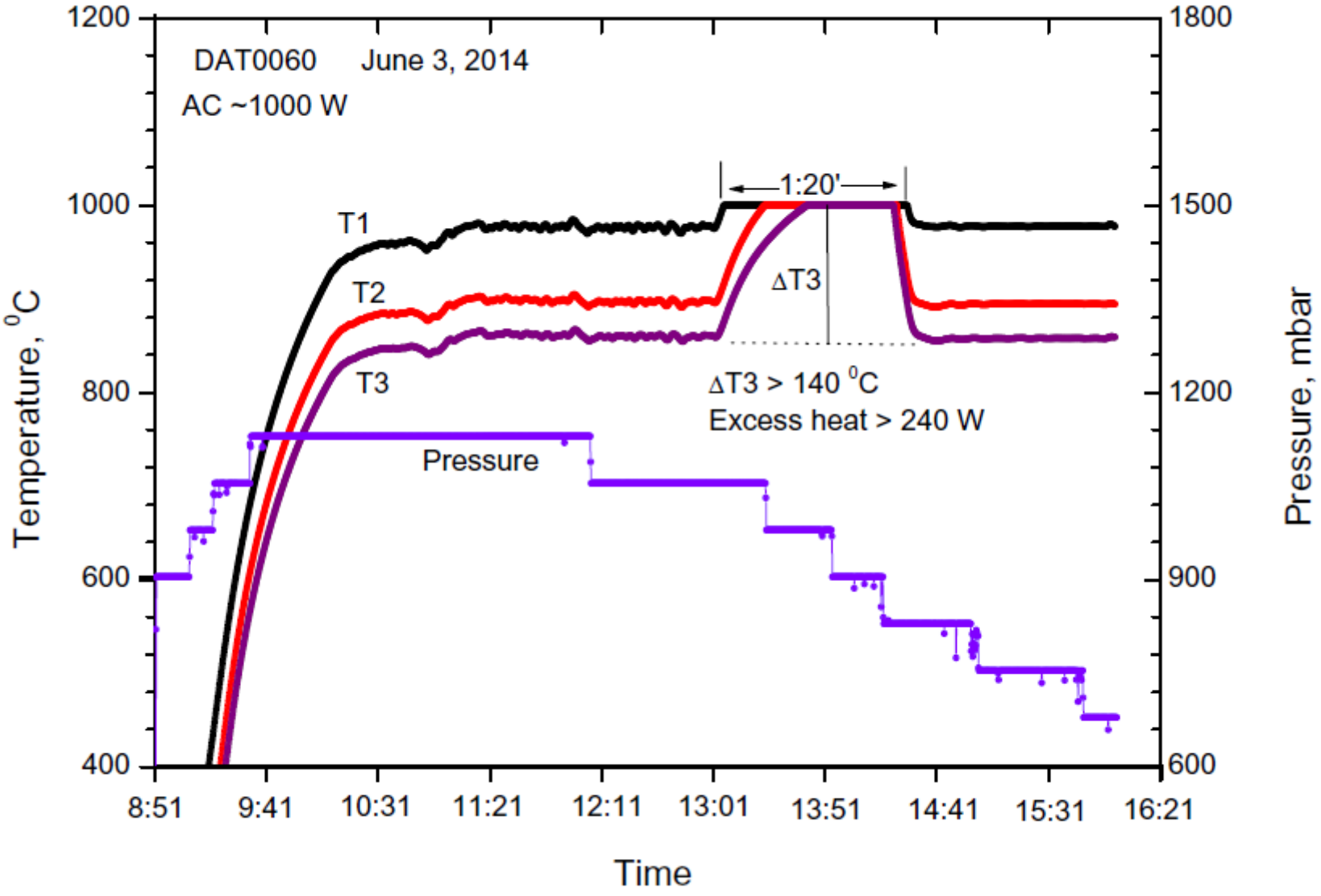
06:00:00
08:00:00

Figure 3a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AC ~1000 W
1:20'
T1
T2
T3
ΔT3
ΔT3 > 140 °C
Excess heat > 240 W
Pressure
Temperature, °C
Pressure, mbar
Time
1200
1000
800
600
400
1800
1500
1200
900
600
8:51
9:41
10:31
11:21
12:11
13:01
13:51
14:41
15:31
16:21

Fig. 3b

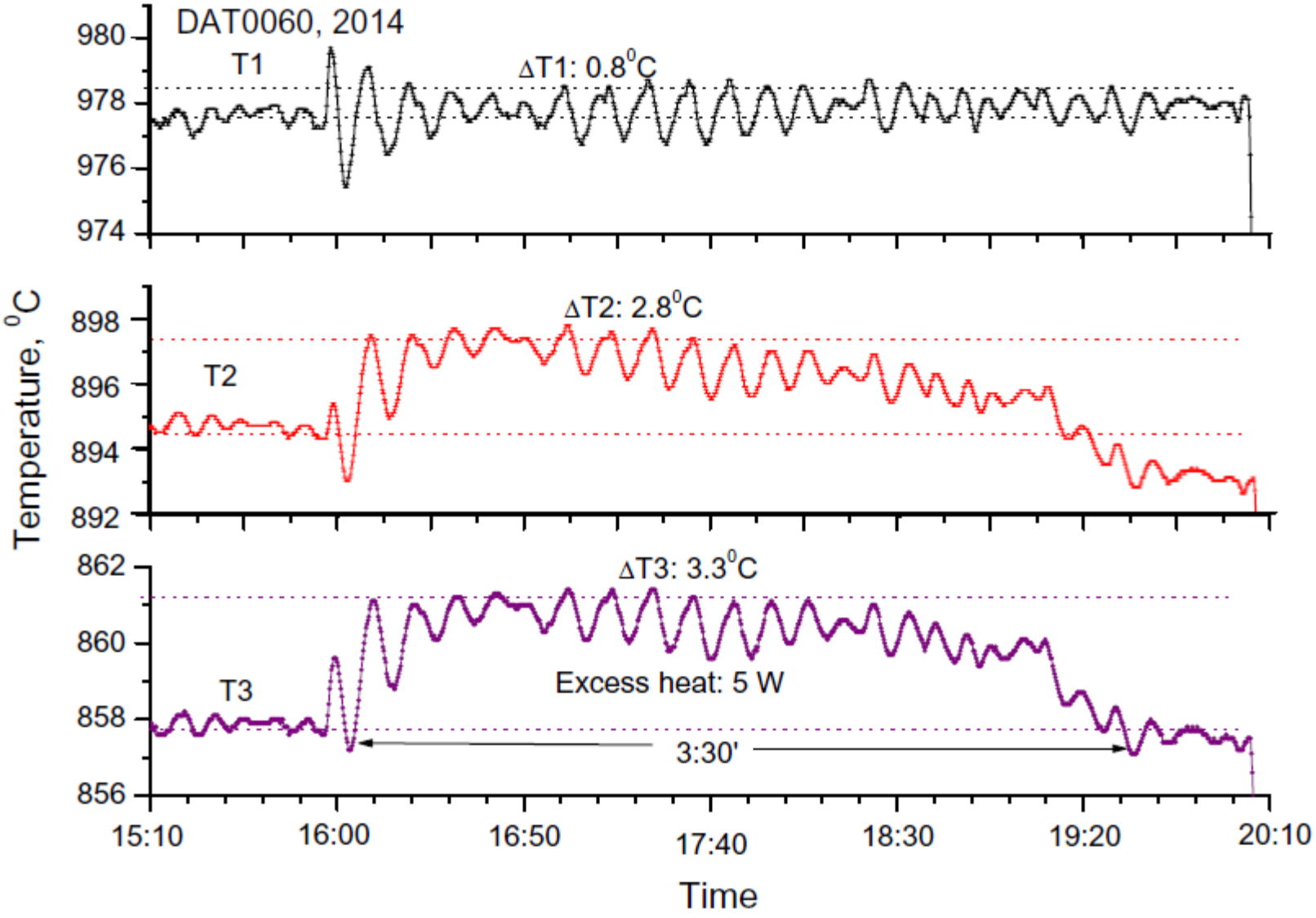

DAT0060, 2014
T1
ΔT1: 0.8°C
T2
ΔT2: 2.8°C
T3
ΔT3: 3.3°C
Excess heat: 5 W
3:30'
Temperature, °C
Time
980
978
976
974
898
896
894
892
862
860
858
856
15:10
16:00
16:50
17:40
18:30
19:20
20:10

Fig. 4

DAT0064

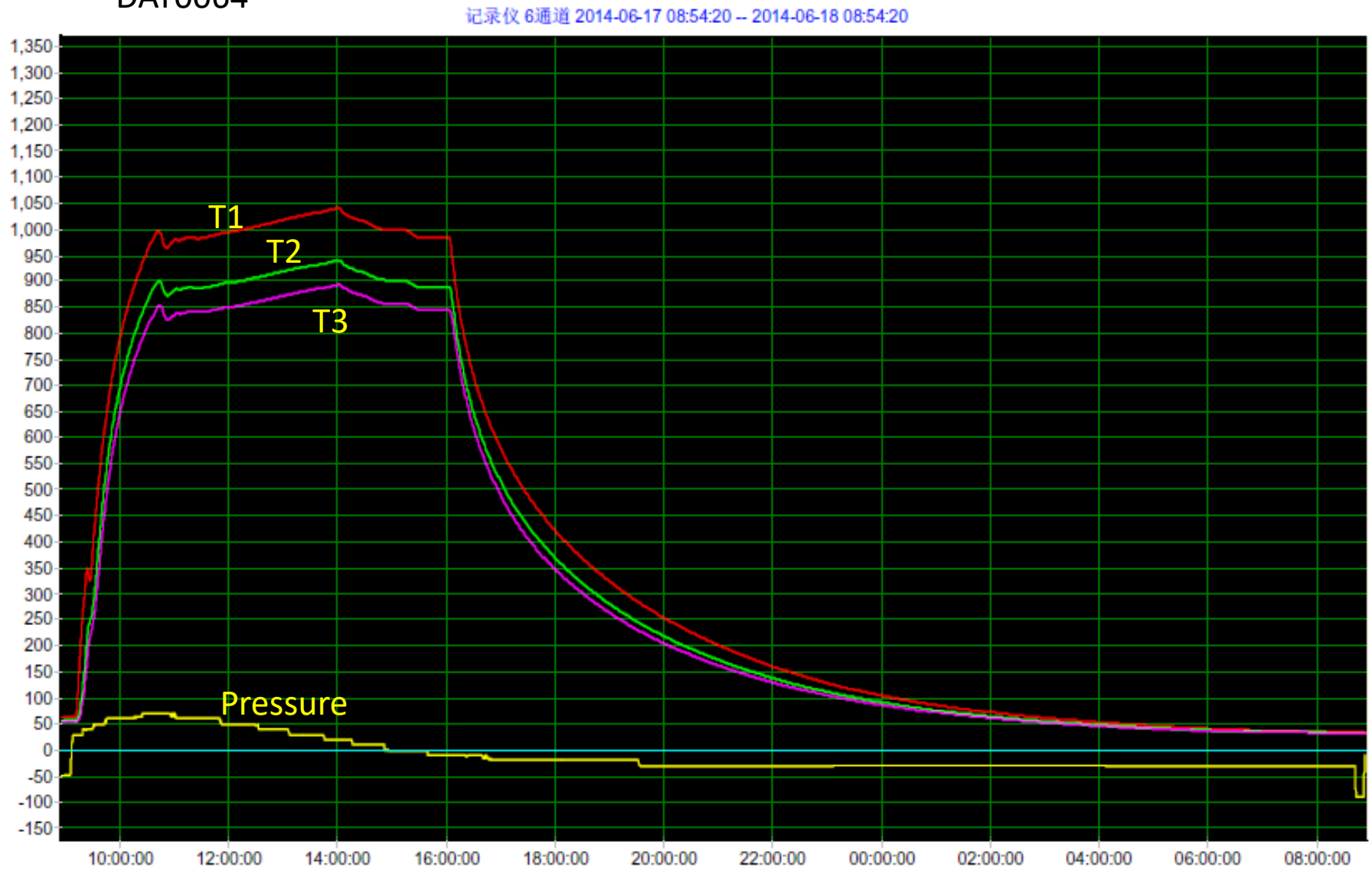
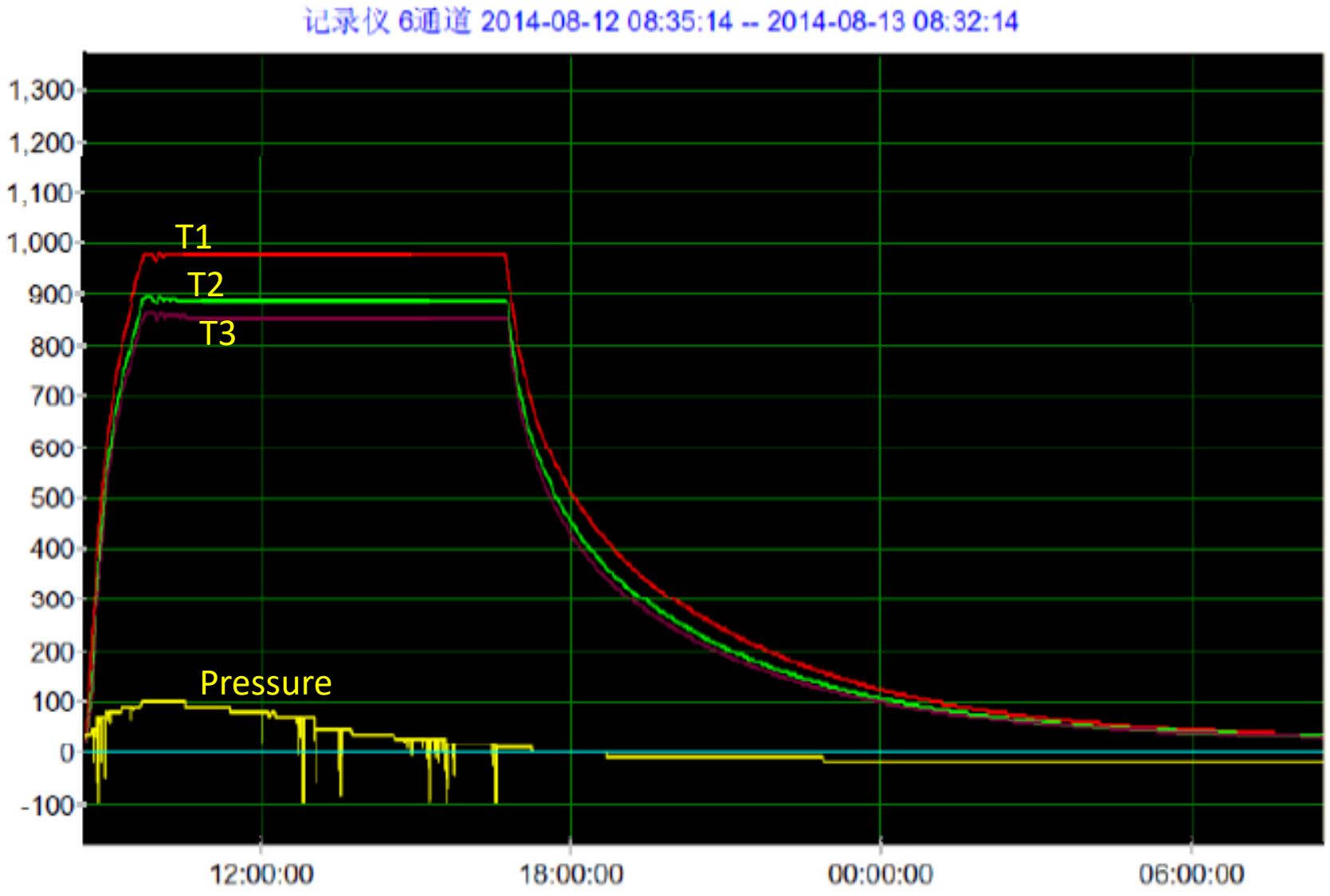


Fig. 5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700
600
500
400
300
200
100
0
-100
T1
T2
T3
Pressure
12:00:00
18:00:00
00:00:00
06:00:00

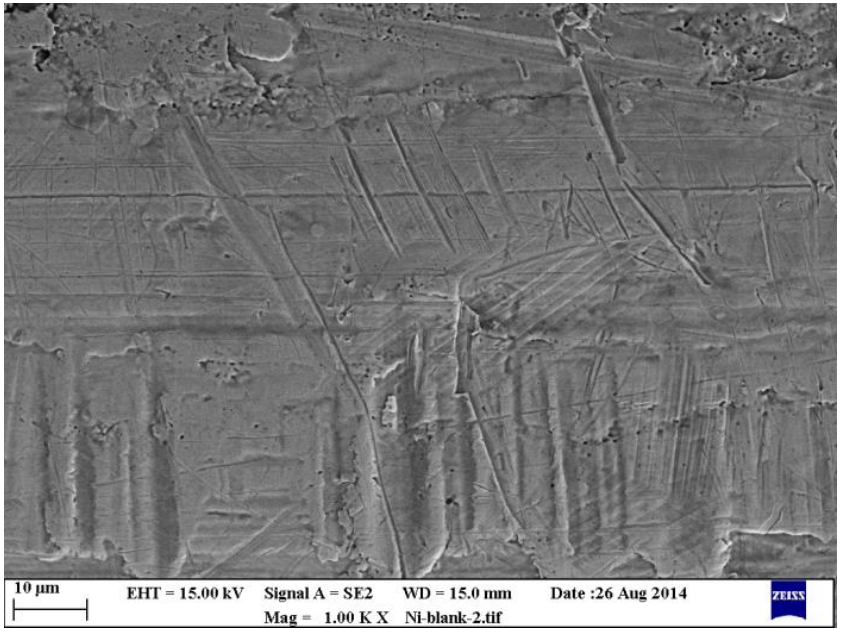
Fig. 6

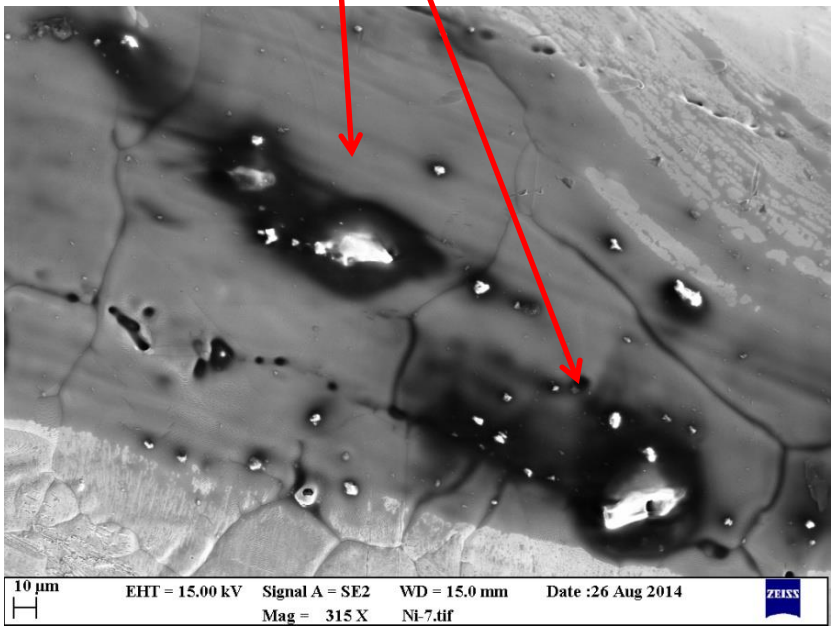
Before experiment

After experiment

Fig. 7

Micro “hot spots”





Origin Nickel wire

After excess heat production

Fig. 8

Conclusions

The excess heat production and damage of surface structure of nickel wire are observed. The thermocouples worked well in the experiment. When cooling down to room temperature, T1, T2 and T3 temperature was 28.1, 28.0 and 28.0 ^{0}C respectively. After excluding any electric power change and chemical reactions, we consider that the observed excess heat probably is a result of low energy nuclear reaction occurring in the hydrogen-loaded nickel system. However, the reaction mechanism unknown. The result may be helpful to study of LENR.