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Research Article

Hydrogen Absorption and Excess Heat in a Constantan Wire with Nanostructured Surface

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Abstract

To go beyond the important and encouraging results obtained in Pd–D and Pd–H systems, overcoming the limitations related to the relative rareness of Pd, several tests were made using constantan wires with nanostructured surface in hydrogen atmosphere and temperatures up to 350°C.

Keywords: Constantan, LASER, LENR, Palladium, Transmutations

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1. Introduction

Why Constantan: As per Celani's data presented at ICCF17 in 2012, Constantan has at least five times more catalytic power (related to H_2 dissociation) than palladium. Hence Constantan is not only much cheaper than Pd, but it is also more effective in supporting the Anomalous Heat Effect (AHE) process. Two different Constantan wires were used: with nanostructured layers (Celani) and bulk (Mastromatteo).

A Constantan wire (diameter 200 μm, length 25 cm, weight ~50 mg), previously treated to induce the formation of two nanostructured layers on its surface, was used for AHE detection in hydrogen atmosphere at different temperatures. The reactor (Fig. 1) and wire main parameters were monitored (heater power, wire resistance and temperature, chamber temperature, hydrogen pressure, ambient temperature) from ambient up to the maximum temperature of 350°C.

After the temperature exceeded 150°C, we observed a substantial decrease in the wire resistance as already highlighted in previous experiments with a similar material [1]. Conversely, using a material without nanostructured surface treatment, the wire resistance change was negligible. A thermal reactor calibration was performed with several tests

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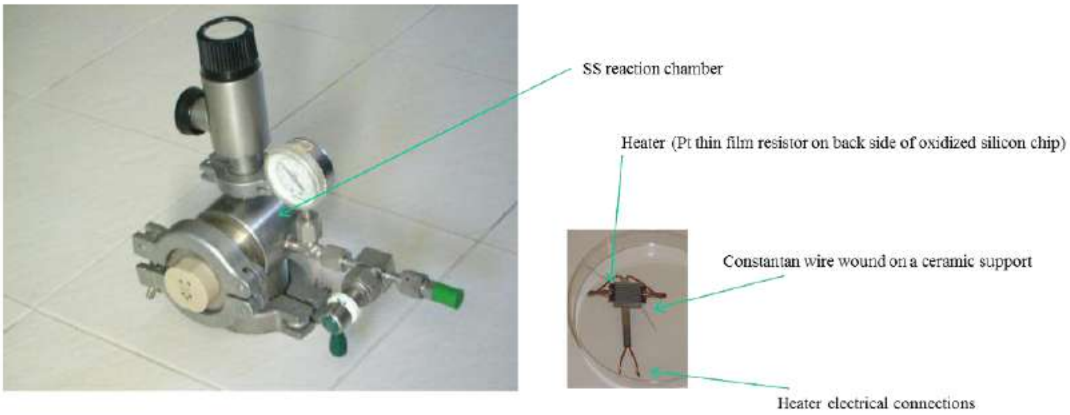


Figure 1. Reaction chamber and typical sample holder .

using inert materials. Then, using the surface-treated wire (after stabilization of the resistance value >170°C), we observed a decrease in the necessary heater power in comparison with the power used during reactor calibration. The highest deviation of 1.2 W (a 5% reduction in input power) was measured at 350°C.

After a "positive " test generating excess heat, an EDX analysis of the active wire in areas with surface morphological changes showed the presence of elements unrelated to the original composition of Constantan wire. The transmutation elements found are also the same highlighted by other researchers in similar test conditions, even though they were using different materials or alloys. Similar findings were also observed with thin films of palladium in deuterium or hydrogen gas at room temperature. It is interesting to note that in hydrogen, hot spots and transmutations occurred only with irradiation by means of low-power HeNe laser [3].

2. Material Characteristics and Preparation

As reported by Celani in ICCF17 [1,2], the material used in the experiments described here is commercial, low cost ISOTAN 44, with a nominal composition Cu55Ni44Mn. It was developed many years ago by Isabellenhutte Heusler, GmbH, KG-Germany. The ISOTAN 44 was selected for the following reasons:

(a) The possibility, at least in principle, of producing *nano-micro structures* at the surface, or even deeper into the bulk, using *selective oxidation of Cu in the alloy* at high temperatures (650–1050°C) and segregation of pure Ni by fast cooling.
(b) To obtain three-dimensional nano-structures, called *Skeleton type*. Such three-dimensional geometry has several intrinsic potentialities with respect to gas absorption.
(c) To use ONLY one material (Constantan alloy) and take advantage of its intrinsic, multi-element composition. This reduces the complexity of preparation and the cost. Our treatment process, in principle, is similar to what used for SELF-SUPPORTED catalyzer manufacturing; catalyzers often used in oil refining processes.

3. H_2 Absorption

While heating the wire from ambient temperature up to a maximum temperature of 350°C, the reactor and wire main parameters were continuously monitored (heater power, *wire resistance* and temperature, chamber temperature,

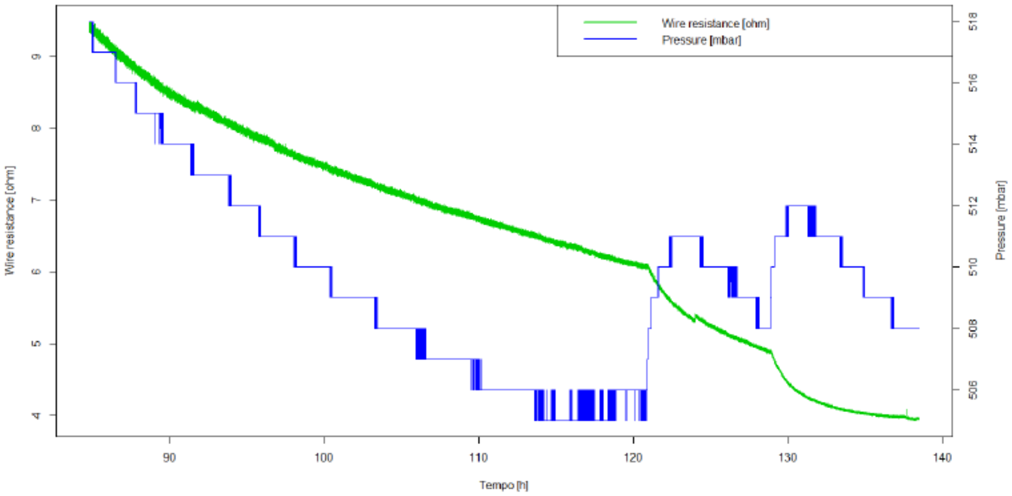


Figure 2. The graph shows the wire resistance and pressure decrease above a threshold temperature (temporary pressure increase is due to programmed temperature increase).

hydrogen pressure, ambient temperature).

As mentioned before, at temperatures above 150°C, we observed a substantial decrease in the wire resistance, together with a very clear pressure reduction in the chamber, indicating quite high hydrogen absorption (Fig. 2) [1]. An estimate of the H/Ni ratio can be done, based on the volume of the chamber (about 300 cm^3) and the initial pressure (500 mbar). The pressure change (in three steps) is about 3.5%, corresponding to 4.7×10^{-4} H_2 absorbed moles; 40% of Ni in the wire (120 mg) indicates 48 mg = 8.3×10^{-4}mol, and then 4.7 × 2 / 8.3 = 1.1 H/Ni ratio.

4. Excess Heat Production

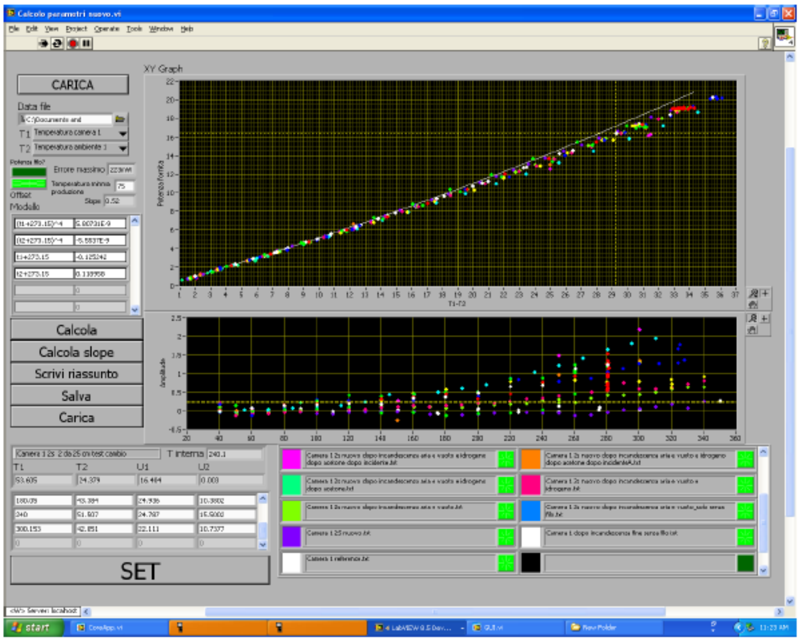
Figure 3 shows a screen shot which summarizes the trend of excess power produced in several experiments. Reactor calibrations have been performed without "active" material on the heated wire. It was also observed that tests with the active material had a thermal trend similar to that of the calibration test or with very small excess power.

Several experiments instead showed a clear (up to about 2 W) decrease of the input power needed to reach the temperature of the chamber established with the calibration curve (X axis, T_{reactor}–T_{ambient}). This 2 W change is therefore attributable to extra heat production inside the reactor. All data shown were obtained with indirect heating of the wire; that is, using the platinum heater underneath the silicon chip. It can also be noted that until a wire temperature reaches 120°C, the excess power value for all of the test is under the estimated error (dotted line) while the higher deviation from the calibration curve is at 300°C (2.2 W).

Indeed, a strange trend was noted: direct heating of the wire tended to reduce the excess heat. So, to convince ourselves this was not an artifact, or behavior related to instability of the system, we produced a deliberate reduction of excess heat by moving part of the power to direct heating, and then returning to indirect heating.

In this way—as can be noted by the presence of points with the same color (meaning the same experiment) with different values of extra power but with the same value of delta T (X-axis at 280°C)—it is confirmed that the value of the excess heat measured was real within the limits of the estimated error (±250 mW).

Here is more detail: as described above, in the reaction chamber it is possible to split the input power between



Data file: C:\Documents and
T1 Temperatura camera 1
T2 Temperatura ambiente 1
Errore massimo 223mW
Temperatura minima produzione 75
Slope 0.52

Modello

(t1+273.15)^4	5.00731E-9
(t2+273.15)^4	-5.5837E-9
t1+273.15	-0.125242
t2+273.15	0.119958
	0
	0

Camera 1 2s 2 da 25 cn test cambio T interna 240.1

T1	T2	U1	U2
53.605	24.379	16.404	0.003
180.09	43.384	24.936	10.3802
240	51.937	24.787	15.9002
300.153	42.851	22.111	10.7377
0	0	0	0

Figure 3. Excess power evaluation.

the oxidized silicon heater and the Constantan wire wound on the ceramic support (the wire and heater are in thermal contact), with the measurement of the temperature of the Constantan wire made through a miniaturized Pt 100 sensor in contact with the wire itself. So, the temperature of the wire can be determined by distributing power between the heater (indirect) and the wire (direct). As stated earlier, at the same temperature of the wire (obtained by setting the control system to maintain a constant temperature, which in this case was 280°C), it was observed that by fixing part of the direct power to a value different from zero, the total power supplied externally to maintain the set temperature (the sum of the power to the heater and the wire), was greater than in the case of zero direct power. In our opinion this means that at this temperature with only indirect heating power, some extra power was generated in the Constantan wire (Fig. 3 vertical column of red dots at 280°C).

5. Transmutations

EDX analysis of the active wire after a "positive" test (with excess heat) showed many hot spots with the presence of elements unrelated to the original composition of the Constantan wire. The elements found are the same ones found by other researchers in similar test conditions using different materials (Fig. 4).

In particular, the EDX spectra in Fig. 5 are from experiments done in a Siena laboratory under the direction of Prof. Piantelli. They are from a pure nickel rod of 0.5 mm diameter and about 10 cm length heated up to 350°C inside a stainless steel chamber filled with hydrogen at a pressure of less than 1 bar. The system produced long-lasting excess heat of several watts, and clear transmutation effects were found at the end of the experiment. Similar findings were also observed with thin films of palladium in deuterium or hydrogen gas at room temperature, with the very specific circumstance that in the case of hydrogen the hot spots and transmutations occurred only with irradiation with a

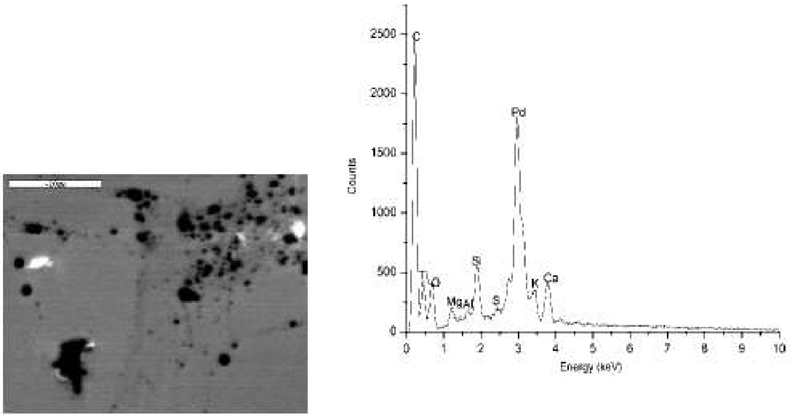


Figure 4. EDX Spectrum of a spot on Pd sample processed 76 days with 2mW/cm^2 He-Ne laser.

low-power He–Ne laser [3]. What is important to note is that in all the experiments, the atomic weights of the detected elements are all below nickel or palladium. In our opinion this important nuclear signature deserves more attention by researchers for the purpose of obtaining a better interpretation of these anomalies.

6. Conclusions

The concreteness of LENR anomalies appears to be confirmed in several experiments with different embodiments, even though the explanation of the phenomenon still seems far away. The random activation of the surface of the material under test indicates a low probability of the "ignition" conditions for the reactions, and raises the question of why the reaction only occurs at some points and not over the entire surface (Fig. 6). Some stimuli (LASER) on the material increase the probability of reaction on Pd, although apparently not on Ni or Constantan. A test through an optical

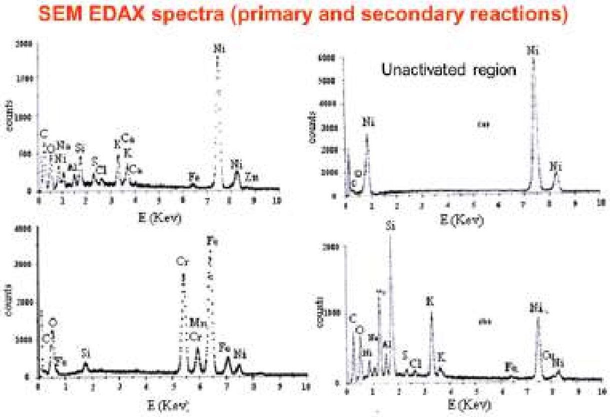


Figure 5. Ni–H experiments. Source: Poster presented at the 2005 Pontignano workshop by Prof. Piantelli and collaborators.

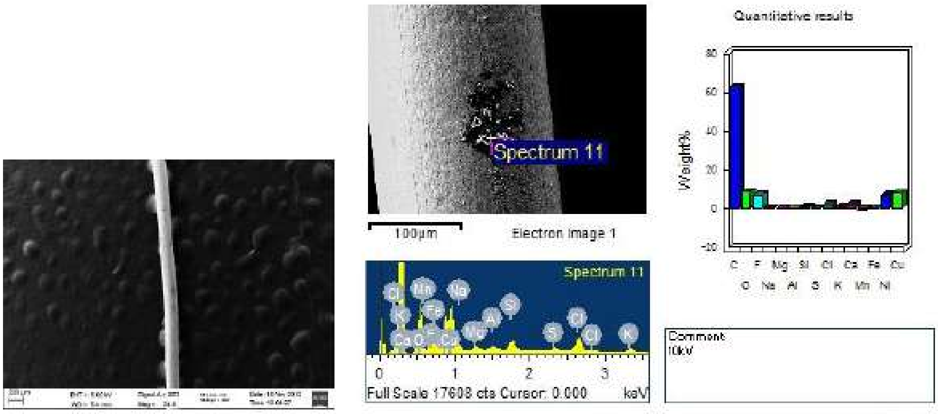


Figure 6. EDX Spectrum of a spot on constantan wire after an excess power experiment.

window on a Constantan wire at 300°C did not produced anomalous heat. The specific power output is estimated in the tens of kilowatts per kilogram.

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