We restart from the Research to safeguard the Creation.

The role of forced, active gas, flux for the generation of AHE in LENR experiments: discussion on procedures to increase it.

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Hotel Domus Pacis Assisi, Piazza Porziuncola 1, 06081 Santa Maria degli Angeli (PG)-Italy

Outline

A) **General overview of INFN-LNF experiments using Constantan wires and motivations.** Several of key points shown at ICCF22 (September 8-13, 2019, Assisi-Italy), [DOI: 10.13140/RG.2.2.26669.64485].

B) **Experimental evidence of the role of the Deuterium gas flux and electrical excitations, by unbiased collection and analysis of (our) over 80 tests/experiments (July-September 2019):** mostly published on J. Condensed Matter Nucl. Sci. 33 (2020) 1-28.

C) **Short description of the new circuitry, developed and used since October 2019 for new experiments: able to inject AC Voltage, Current limited (i.e. +-600 V, 200 mA), at overall efficiency quite larger than described in the JCMNS paper. Based on an array (series-parallel) of High Voltage (120 V), High Current (50 mA), high speed (Tr=100ns) Constant Current Diode (*SiC* tech.); added booster capacitors to accomplish DBD regimes, if any.**

D) **Overall conclusions with possible line-guides to get AHE: discussed along the whole talk.**

Path to get AHE, after 31 years of experiments.

(according to general and our specific know-how)

1) **At first, it is necessary to load proper materials (Pd, Ti, Ni, alloys) with active gas (H_2, D_2,..);**
   ➔ Commons experience, worldwide, in almost all LENR experiments;

2) **Induce *Non-equilibrium conditions* of loaded materials by: thermal or concentration gradients, movement of charged species, phase transitions, voltage stimulation,…………..;**
   ➔ Mostly our specific evidence/suggestion, since April 1989, later-on “common sense”;

3) **Observed experimentally that the “interaction” of active gas with the gas-loaded material, *as strong and fast as possible*, is main factor governing the AHE generation: the *active gas FLUX* seems to be the main parameter but it needs external energy to activate it;**
   ➔Almost clear proof only after in-deep analysis of >80 experiments (IJCMNS, July 2020);

4) **Efforts to develop innovative procedures to minimize the (electrical) external energy needed to generate non-equilibrium of the, gas loaded, active material: both into the bulk (like electromigration phenomena) and at the surface (at sub-micrometric size).**
   ➔Current and next experiments at INFN-LNF.

Procedures

1) Explore, in some details, the role of ***Hydrogen (H) or Deuterium (D) flux through specific sub-micrometric materials interacting, at their surface, with accelerated electrons and/or ions***, to produce AHE in a way as stable as possible, avoiding its reduction over time. The kind of gas used depends mainly on the host material that [ab/ad]sorbes it.

2) Tentative ***simplifications*** of control/excitation parameter: mainly, simple, electrical stimulation, unipolar (+,-) or ***bipolar*** up to **1200 Vpp at 50 Hz sinusoidal** (at the moment; in the future highers frequencies/volts and asymmetric shapes), by a counter electrode.

3) New geometrical set-up, with the ***core of the reactor as homogeneous as possible in respect to local temperature gradients inside the reactor: NO knots, Capuchin knots, super-Capuchin knots, as previously developed by our group since 2015***.

4) **Local thermal gradients, due to specific geometrical assembling (like several simple knots, Capuchin knot), although don't need extra energy to operate (i.e. intrinsically they have very high efficiency), are quite difficult to be modelled and prone to aging effects (due to thermal cycling), up to catastrophic failure of the active wires.**

5) **We need *UNDERSTANDING of the effects*: simplification (i.e. avoiding) of each extra contributes, even if previously proved to be useful for AHE generation, is mandatory at this stage of the research. We need to evaluate the "weight" of each contribute.**

6) **Focused on the roles of: A) *Richardson's* (i.e. electron emission, due to the absolute temperature of the kind of material at the Anode surface, adopting old nomenclatures of *vacuum tube*) and *Child-Langmuir laws* (electron transport, apart specific constant and surface area, are proportional to the Anode-Cathode Voltage^1.5 and distance^-2): active at quite low pressures; B) *Paschen* regimes (DC and even AC, mainly due to H, D and/or noble gas mixtures) operated at mild pressures, as later detailed;**

7) **Results on AHE values and its stability over time depend, among others, on the waveform at the counter-electrode surface, especially high frequency components (several times "spontaneous") when some proper high voltage threshold are overcome: sometimes we observed that non-linear effects, in proper conditions, could induce positive feedback of our specific interest*****. It is one of the effects to be investigated in the near-future experiments.***

Evolution of the experimental set-up from the point of view of counter-electrode

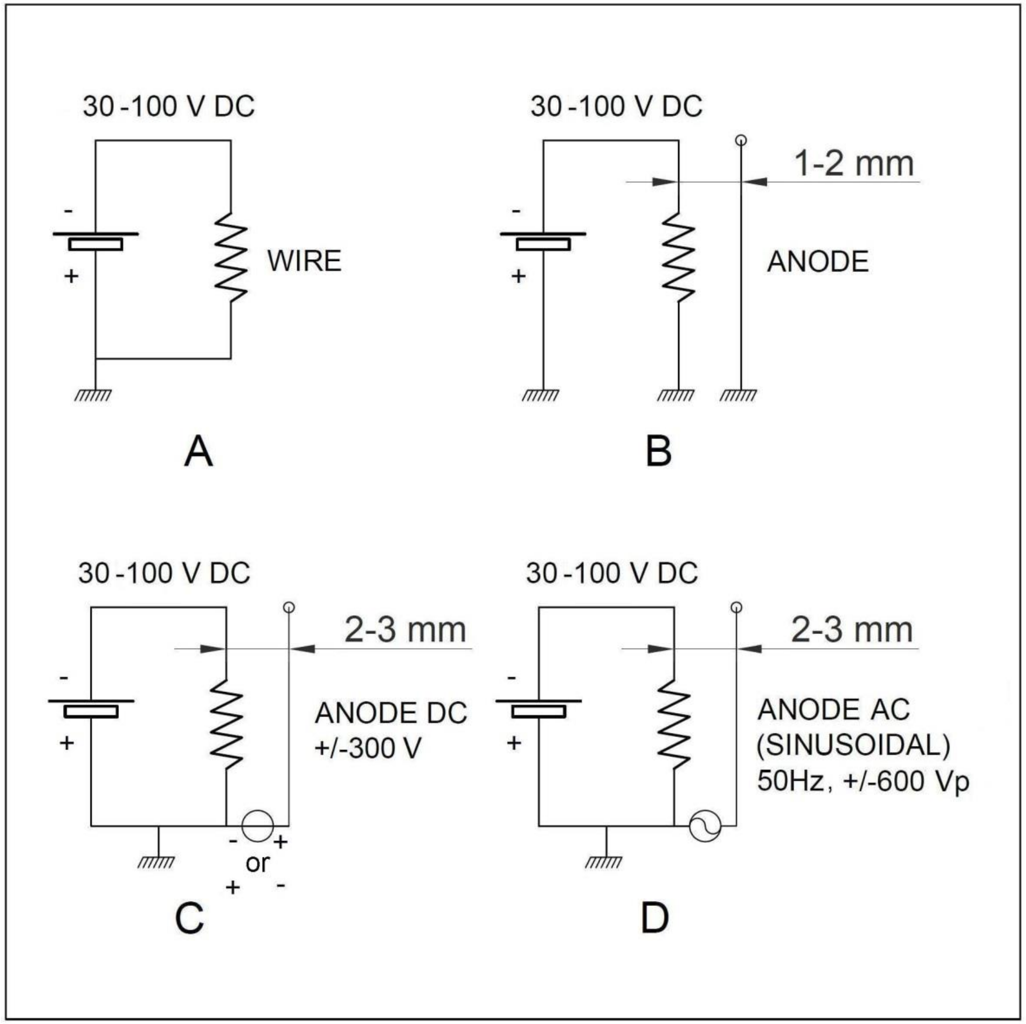

Fig. 1. Constantan wire reactor (A); added counter-electrode grounded (B); counter-electrode polarized with direct current (C); counter-electrode polarized with alternating current (D).

Basic starting points and conflicting requirements

A) **In principle, to get some kind of anomalous effects (thermal and/or "nuclear") in the experiments using some specific elements (Pd, Ti, Ni, alloys,…) that interact with Hydrogen and/or their isotopes, is quite simple: just allow that the H, D is LARGELY absorbed on the surface (even bulk) of the specific material, especially with sub-micrometric (or better nanometric) dimensionality, and "force" the H, D to move (i.e. "flux") inside/outside of the material, avoiding that the H, D fully escape out (e.g. experiments made by G. F. Fralick-NASA 1989, Y. Iwamura, F. Celani, G. Preparata, M. Mc. Kubre, M. Swartz,….).** ***It was observed, few times, that also large flux of electrons is beneficial to increase the effects.***

B) Recently, in gaseous High Temperature LENR system we found and showed that, almost always, the *AHE*, if and when obtained (under large operating difficulties), *tends to decrease over time,* until reaches values close to Zero Watts: the system is self-stabilizing toward ZERO AHE. Periodic external "excitation" to resume (at least) flux is needed to keep the AHE alive. Some details described/discussed at *"2019 MIT Colloquium" (March 2019, USA), "Assisi nel Vento 3" Meeting (May 2019, Italy), ICCF22 (September 2019, Assisi, Italy).*

C) More generally, at least according to our experience/experimentations, we have conflicting requirements about the operating conditions: *it seems a target impossible to achieve,* as explained in D) and E).

D) High pressures (as high as possible) of H_2 (or D_2) are needed to allow loading of the active material: historically pure Pd, Ti, Ni; now alloys like Ni-Cu at submicrometric. size.*Adopted by us Cu_{55}-Ni_{44}-Mn_1 alloy (named Constantan) further coated by large amounts of Fe, Sr, K, Mn (multilayer construction, sub-micrometric dimensionality).

E) Low pressures are needed to allow emission of electrons, similarly to (old) vacuum tube devices (i.e. Diode, Triode, ...) from the active material having Low Working Function, H loaded, at high temperatures. But *low pressures---high temperatures* combinations cause the de-loading of stored H in short times (hours at the best, depends on temperature).

F) The use of mild pressures and quite *high voltages* (Paschen curve) in the counter electrode is a compromise among such conflicting requirements. Obviously the distance among the 2 electrodes has to be kept as low as possible (few millimeters) to avoid operations at prohibitive high voltages.

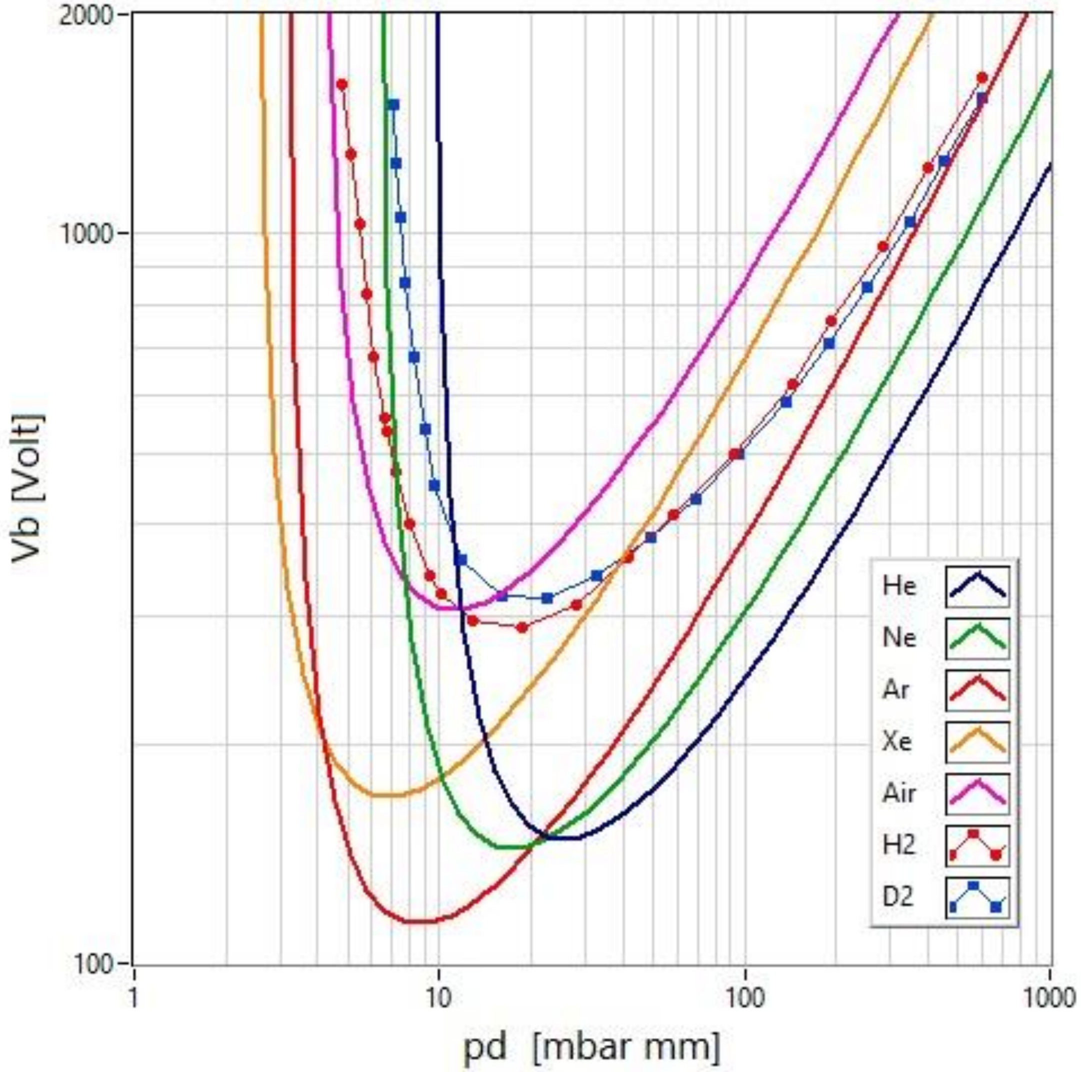

Fig. 2. Paschen curve. Direct current breakdown tension Vb, at RT, of several gases versus pressure*distance (p*d) between electrodes . Ar mixtures enables discharges at lower voltages.

Short history about the specific use of Constantan and knots.

(Extr. from: ICCF21, June 2018; IWAHLM13, Oct. 2018; MIT 2019 Colloquium, March; ICCF22, Sept. 2019)

- **Anomalous Heat Effects (AHE) have been observed by us in wires of $Cu_{55}Ni_{44}Mn_{1}$ (Constantan) exposed to H_2 and D_2 in multiple experiments along the last 9 years.**

- **The Constantan, a quite low-cost and old alloy (developed around 1890 by E. Weston), has the peculiarity to provide extremely large values of energy (1.56--3.16 eV) for the catalytic reactions toward Hydrogen (and/or Deuterium) *dissociation from molecular to atomic state*: $H_2 \rightarrow 2H$. In comparison, the most known and very costly Pd (a precious metal) can provide only 0.424 eV of energy: computer simulation from S. Romanowsky et al., 1999. The energy given out during fast recombination process is quite high (about 4.5 eV): one of the largest among the chemical reactions. In deep space, at low Hydrogen pressures, the measured temperature is 36000 K: equilibrium among *dissociation< -- >recombination*.**

- **Some *H* (according to resistance reduction value up to 20-25 %; first measurements by German Scientists on 1989) is almost *stored inside the Constantan lattice*, after its absorption at high temperatures (> 180°C), few bars of pressure, several hours.**

- **We made systematic studies (and published most of the know-how obtained, in agreement with *Live Open Science* approach followed by *MFMP collaboration*), since 2011, to study the absorption behavior versus temperature, pressure and surface "shape".**

- **The *amount of ratio among the active volume* (i.e. the thickness of sub-micrometric one) *and the bulk* (used both as support and in-deep storage), increases reducing the diameter of the wire. *A qualitative sketch was introduced by us in Fig. 2*. We observed (by SEM) that, at least in our experimental conditions of wires preparation, the thickness of the most active section is of the order of 10-30 μm. Main drawback is the easiness of the wire breaking at low dimensionality (Φ<100 μm). Moreover such deleterious effect is worsened at the highest (and most useful!!) temperatures (>700°C) operated in the test.**

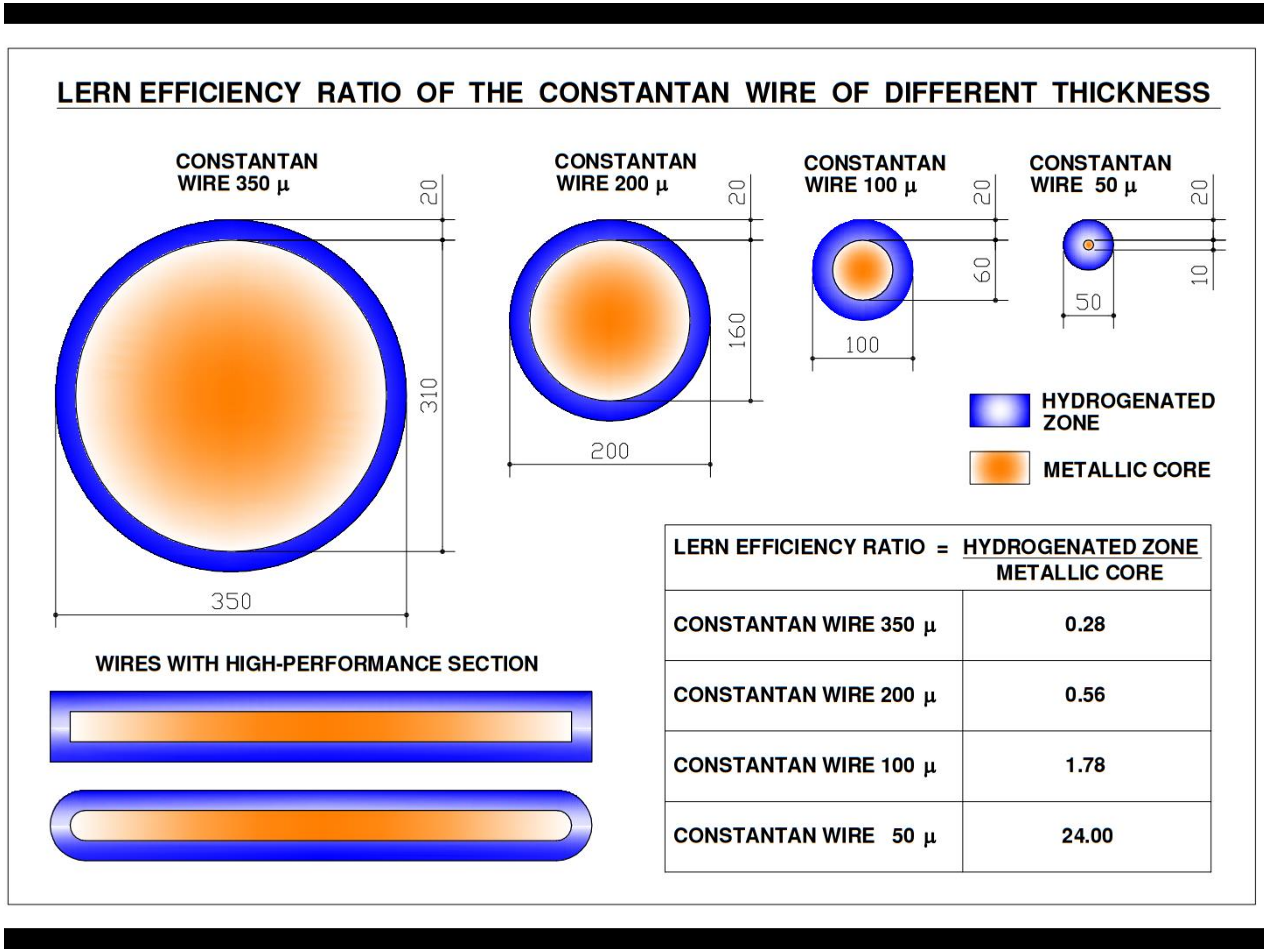

Fig. 3. Qualitative sketch of the ratio among the "most active region" (sub-micrometric sponge) for fast Hydrogen absorption/storage (blue color, mean thickness 20 μm), and the metallic bulk (brown color), changing the initial diameter of the wire.

- **Improvements in the magnitude/reproducibility of AHE were reported by us in the past and related to wire preparation and reactor design: *work in progress*.**

- **In facts, an oxidation of the wires by several hundred pulses of high intensity electrical current (up to 10-20 kA/cm^2, even neglecting skin effects present because fast rise time, <1 μs, of the pulses) in air (and related quenching) creates a rough surface *(like sponge)*. It is featured a *sub-micrometric texture* that proved particularly effective at inducing thermal anomalies (once the H, D is absorbed/adsorbed) when *both temperatures* exceeds 300-400 °C *and* proper kinds of *non-equilibrium conditions* are promoted. *The effects increase as temperatures are increased, until adverse self-sintering effects (almost out of control, at the moment) damage the sponge structures and most of the AHE usually vanish.***

- **The hunted effect appears also to be increased substantially by deposing segments of the wire with a series of elements: Fe, Sr (via thermal decomposition of their nitrates) properly mixed with a solution of $KMnO_4$ (all diluted in acidic heavy-water solution).**

- **Side Effects. The magnetic proprieties of Constantan wires change dramatically after the coating of Fe nitrate (further decomposed to FeOx) from "a-magnetic" to strong ferromagnetic. The special geometry of *Capuchin knot* (see later-on), as speculation, could enhance such aspects. It is noteworthy that FeOx are recently reported to have magnetic properties enhanced up to 100-10000 times when at low dimensionality (10 micron down to 10 nm) as in our specific fabrication procedures (thin multilayers).**

- **Useful Co-Factors. Furthermore, an increase of AHE was observed after introducing the treated wires inside a sheath made of *borosilicate* glass (mainly Si-B-Ca; *BSC*), and even more after impregnating, the sheath with the same elements (Fe, Sr, K, Mn) used to coat the wires. Liquid nitrated compounds were first dried and later-on decomposed to oxides by high temperature (400-500 °C) treatments. The procedure was repeated several times: *multilayer approach.***

- **Finally, AHE was augmented after introducing equally spaced knots (the knots were locally coated with the mixture of Fe, Mn, Sr, K) to induce large thermal gradients along the wire (knots become very hot spots when a current is passed along the wire).**

- **Interestingly, the coating appears to be nearly insulating and it is deemed being composed of mixed oxides of the corresponding elements (mostly FeO_x, SrO).**

- **Having observed a degradation of the *BSC* fibers at high temperature, an extra sheath made of quartz fibers was used to prevent the fall of degraded fibers from the first sheath, i.e. made a sort of *coaxial construction.* Main drawback was its larger dimensionality. We recall that some *specific borosilicate glass* has the peculiarity of adsorbing Atomic Hydrogen *(dissociated from molecular state by the Constantan)*, as discovered by Irving Langmuir (Nobel Laureate, on 1928, using W). In our procedures the possibility to have a "thank" of atomic hydrogen, very close to the wire surface, is one of the main aspects.**

- **Technological Improvement. The quite large problem of excessively tick insulating material was solved thanks to a close collaboration among:**

  a) A Metallurgical Company (at North of Italy), for long time involved in LENR experiments in their own laboratory, and which whom we collaborate since 2011,;

  b) The SIGI-Favier Company (I, F) that produce insulating glass and SiO_2-Al_2O_3 sheaths;

  c) Our group.

It was developed an innovative insulating sheath that has both advantages of glass (i.e. capability to absorb atomic Hydrogen, maximum temperature 700°C) and high temperature (up to 1200 °C) performances of SiO_2-Al_2O_3 material. Shortly, it was made a, close distance, net of glass and SiO_2-Al_2O_3 bundles, each of thin fibers (5 μm diameter) crossed at an inter-distance of only 500 μm. In such a way, after high temperature conditioning (up to 800 °C), there are enough empty space (about 30-40 %) of total, to allow free path for electrical conductions, to get any of Richardson, Paschen, DBD regimes, without short circuit limitations.

- **Unexpected Effect. In 2014, the Authors introduced a second independent wire, "floating" in the reactor chamber, and observed, just by chance, a weak electrical current (up to hundreds of μA, with several mV at the end of the wire), flowing in it while power, (i.e. high temperatures induced), was supplied to the first.**

- **At that time only the wires got coating of LWF materials: the sheaths were NOT impregnated by nitrate/oxide mixtures, so, possible leakage currents were unlucky to happen. The effect was also confirmed/certified (at Frascati Laboratory by their own instrumentations and specific SW for data acquisition) and (later-on) independently reproduced, by the MFMP group (M. Valat, B. Greeiner).**

- **This current proved to be strongly related to the temperature of the first wire and clearly turned to be the consequence of his *Thermoionic Emission* (where the treated wire represents a *Cathode* and the second wire an *Anode*), according to the Richardson law.**

Thermoionic emission applied to surface-coated Constantan wires.

The key parameter of thermoionic emission is the Work Function (Φ), usually 1.5-5 eV, for electron emission, from the surface of the materials:

$$J=A_g T^2 \exp(-\Phi/K_B T)$$

with:

- **J=emission current density [A/m^2];**
- **T=absolute temperature, in K;**
- **$A_g = \lambda_R A_0$; λ_R is a correction factor depending on the material (0.5—1);**
- **$A_0=(4\pi q_e m_e k_B^2)/(h^3)=1.2*10^6$ [A/m^{2}K^2], *Richardson constant***
- **$q_{e=}1.6*10^{-19}$ C, electron charge;**
- **$m_e=5.11*10^5$ eV, electron mass;**
- **$k_B=8.617*10^{-5}$ eV/K, Boltzmann constant.**

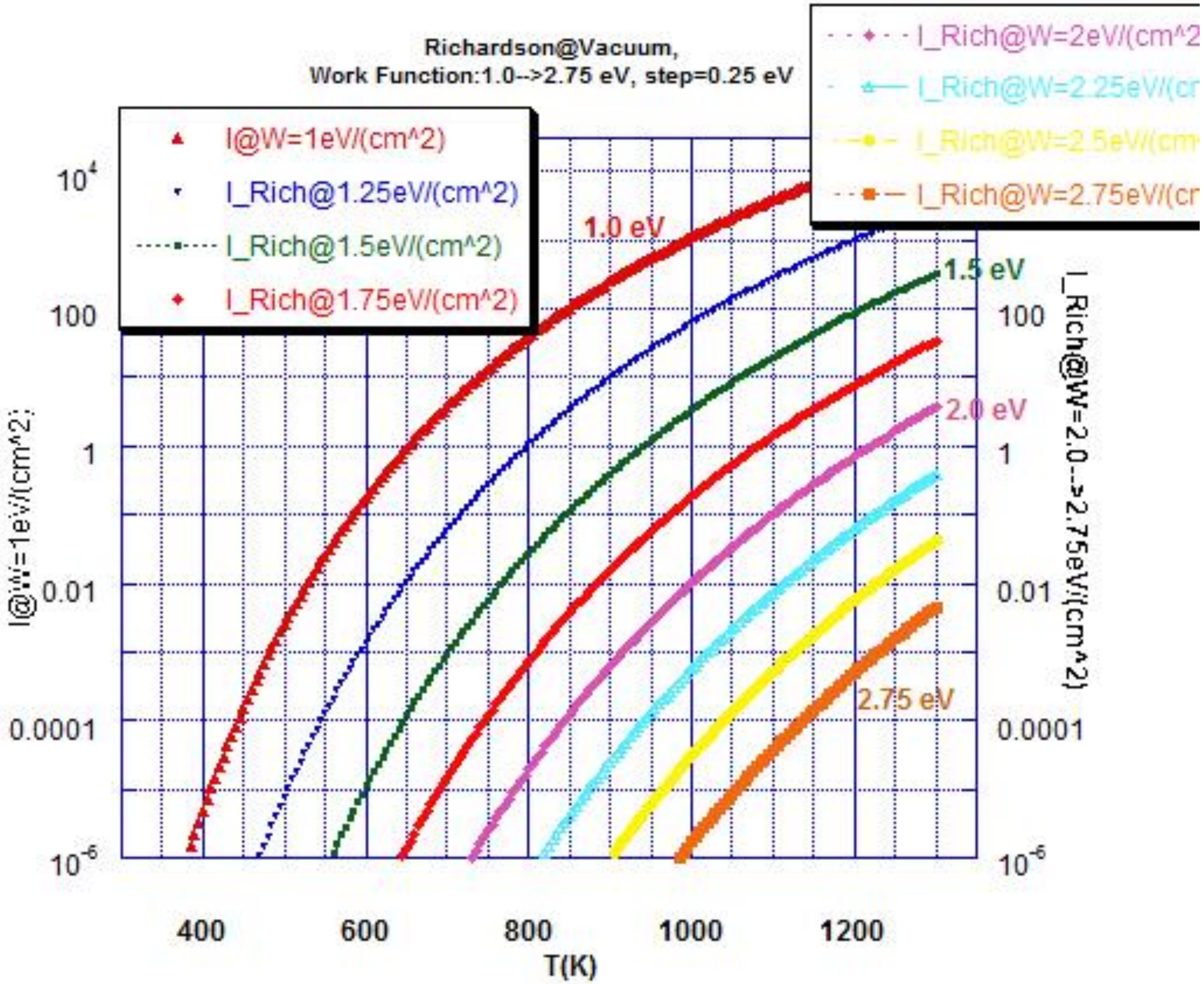

Fig.4. Dependence of maximum electron emission (A/cm^2) at the surface of a wire changing Temperature (300--1300 K) and Work Function (1--2.75 eV).

- **The presence of the thermoionic effect and a spontaneous tension between the two wires did strongly associate to AHE: we guessed that it is a co-factor useful to induce AHE.**

- **The thermoionic effect is enhanced, in our specific procedures, by deposition of Low Working Function materials (LWFm), like SrO, at the surface of the Constantan's wire, several thin layers.**

- ***In the Cold Fusion-LENR-AHE studies the Researcher that first (1996) introduced, intentionally, LWFm was Yasuhiro Iwamura at Mitsubishi Heavy Industries (Yokohama-Japan). Since that time he used CaO and later-on also Y_2O_3, both in electrolytic and gas diffusion experiments at mild (<80 °C) temperatures.***

The role of thermal large gradients at short distances

- **The presence of thermal and/or chemical gradients has been stressed as being of relevance, especially when considering the noteworthy effect of knots (by us introduced since 2015) on AHE.**

- **From that moment, attempts to further increase AHE focused on the introduction of different types of knots, leading to the choice of the *"Capuchin"* type (see Fig. 4) and, later, the *"advanced Capuchin knot"* *(but mechanically quite delicate-weak).***

- ***The knot design, specially Capuchin one, leads indeed to very hot spots along the wire and features three areas characterized by a temperature delta up to several hundred degrees (e.g 600→800→1000 °C in the photo shown).***

- **Flux is induced by very large, short distance, thermal gradients: *Capuchin knot***

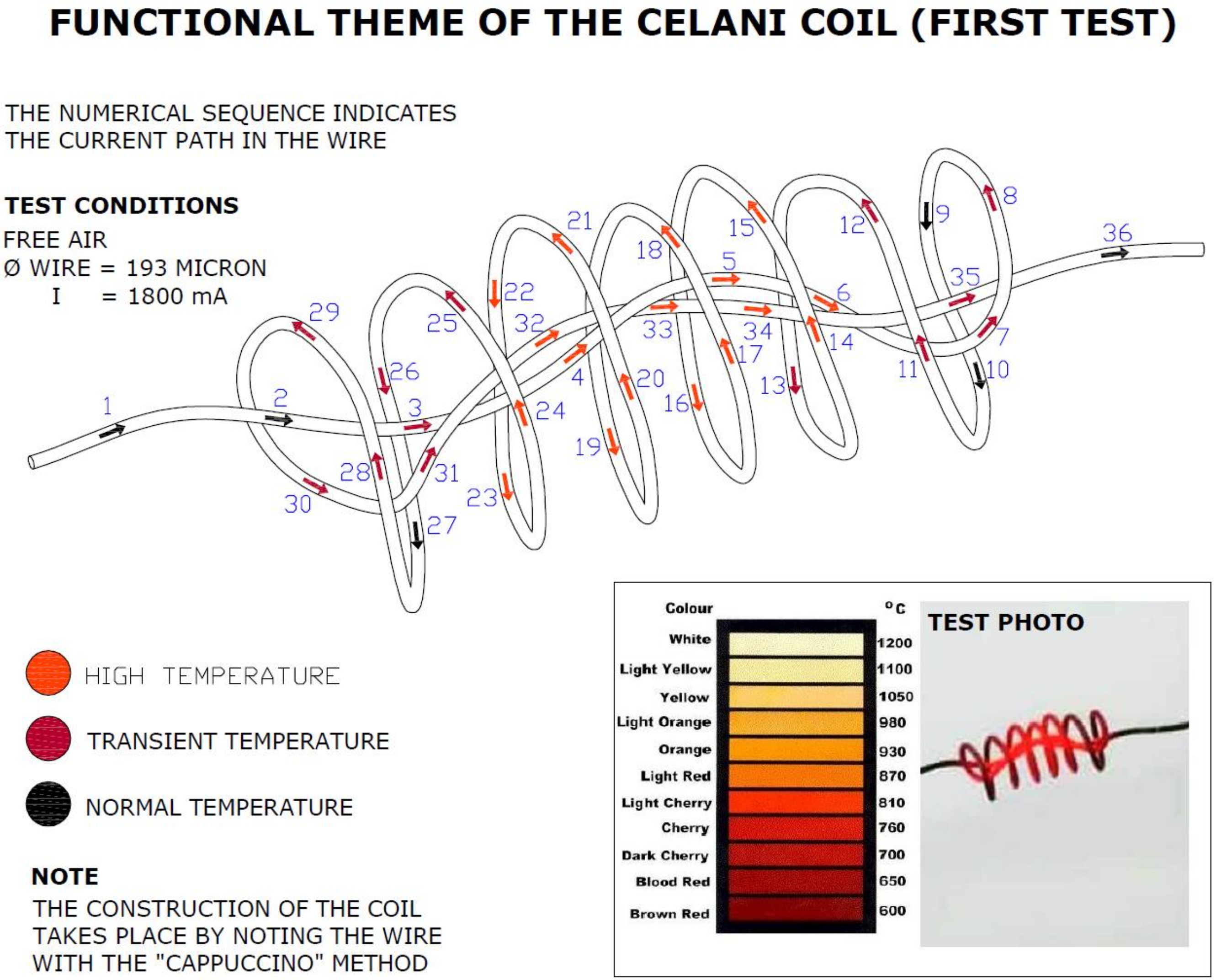

Fig. 5. Photo, in DC, I=1900 mA, of a piece of Constantan wire having a diameter of 193 µm. Capuchin knots with 8 turns. Temperatures estimated by color. Darkest area is at temperature <600°C; external helicoidal section is at about 800 °C; inmost section, linear, up to 1000 °C in some points. Distance is few mm.

General assembling of the reactor, keep constant from 9 months, to inter-compare results changing only the core.

a) **Energy balance measurements by air flow calorimetry.**

b) **Calibration by a Joule heater put inside a Borosilicate glass tube, with the same dimension of main reactor. Both glass tube are close each other and thermally connected by several Al foil darkened (paint 900 °C type, emissivity close to 95%), inside the main insulating box.**

c) **In and out of air inlet at the same height, large vortexes are promoted just by specific geometry at the input of the air (several tubes of different lengths);**

d) **Monitored the speed of the fan (life-time rated at 5 years of continuous operation).**

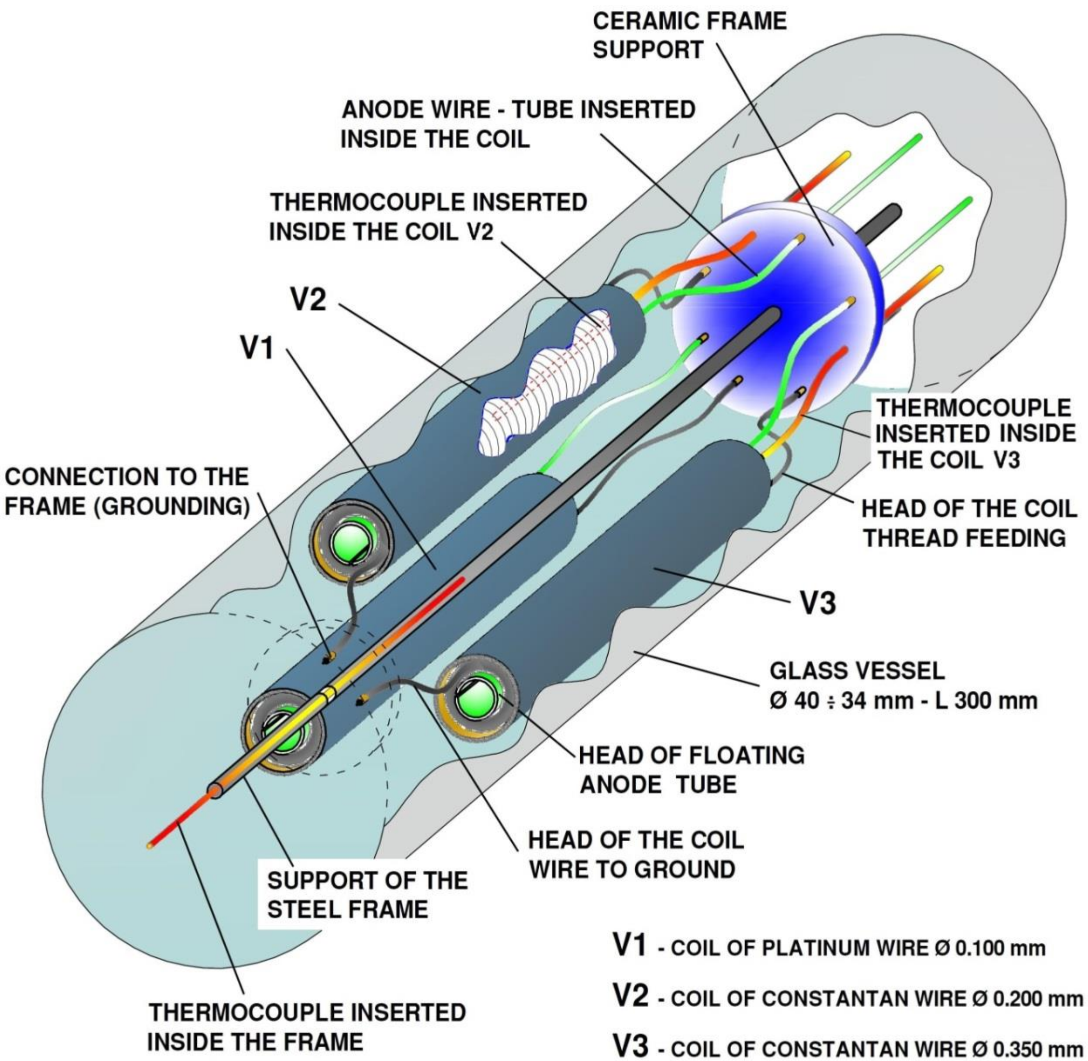

Fig. 6. Schematic of the assembling the 3 coaxial coils inside the glass reactor.

Fig.7. Photo of the reactor assembled, just before to be located into the air flow calorimeter.

Fig. 8. Photo of the reactor, and calibrator (Ni-Cr wire) put inside the calorimeter (advanced version, 2 insulating and reflecting walls)

Schematic drawing, Fig.9, of the new COAXIAL geometry of each core of the reactor.

- **The *coaxial geometry*, up to now, is the most efficient geometrical configuration, i.e. the most compact, to promote non-equilibrium situations by application of voltages (DC and/or AC) among the active Constantan wire and the counter-electrode.**

- **Because calibration purposes and cross check, we made 3 coils (Pt=T1, Constantans with Φ=200 μm=T2 and Φ=350 μm=T3) with dimensions as similar as possible. The inmost main support is a Fe tube.**

- **T1: Pt (99.9% purity), Φ=127 μm; stress realized, smooth surface, no multilayer coating;**
- **T2: Constantan, Φ=200 μm; surface sponge-like, multilayer coating of Sr, Fe, K, Mn;**
- **T3: Constantan, Φ=350 μm; surface sponge-like, multilayer coating of Sr, Fe, K, Mn.**

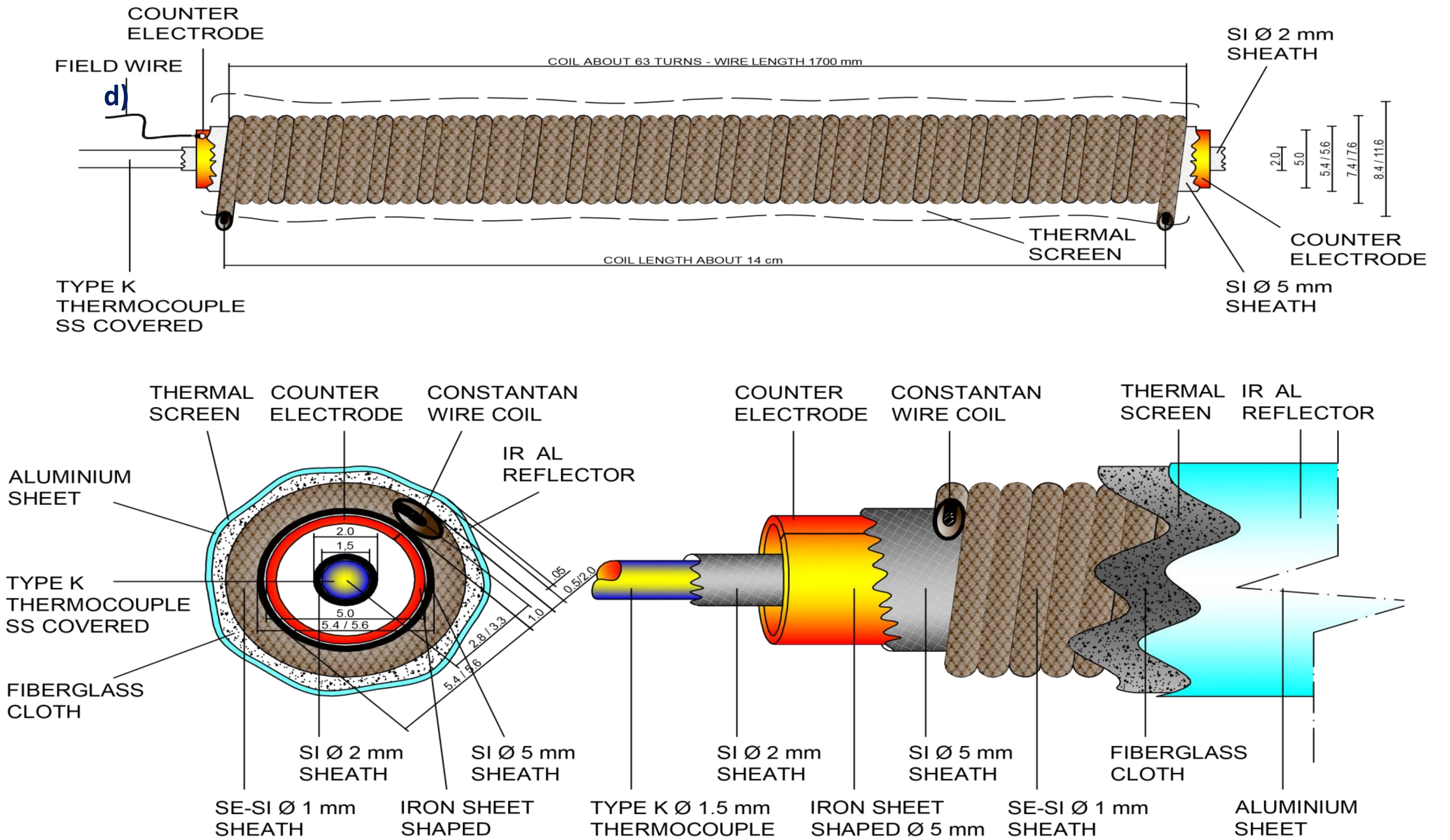

Fig. 9. Sketch of the core of each active (or inert) wire: coaxial geometry.

Schematic of each core and auxiliary circuitry

- **Fig. 10. DC polarization network, for low power (i.e. R/Ro) measurements (based on constant current diode J511) and High Power (based on 600V, 5A Diode).**

Added several Zener diodes and resistances for protection purposes against possible excessive interferences due to AC High Voltages (up to +-600 Vp) at the counter electrode, i.e. Fe tube.

Fig.11. Circuit for AC stimulation, mainly based on 2 low-power transformers in series and limiting resistor (10 kOhm) at the output, used also as current measuring point ($I=\Delta V/10^4$).

Since October 2019 the limiting circuitry , and current measurements, were largely improved, as later detailed.

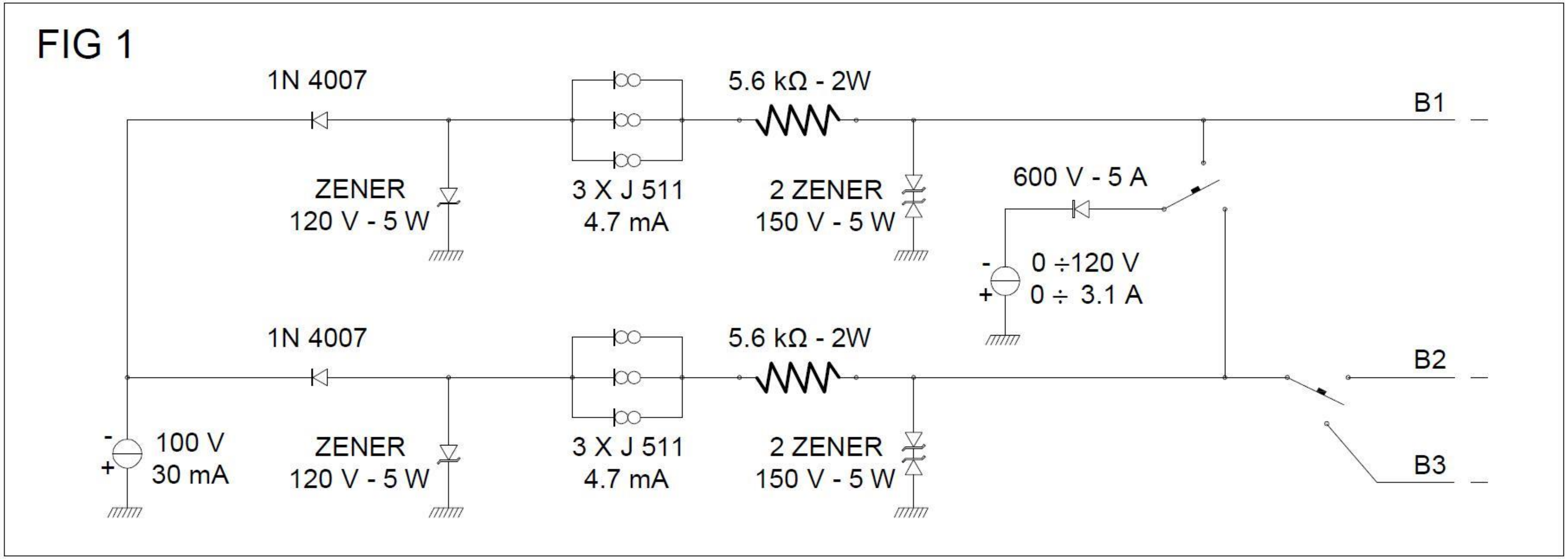

Fig. 10. Schematic of the main circuitry adopted, both for R/Ro measurements (always connected to the wires) based on JFET J511 (Constant Current diode, 3 in parallel, each providing 4.7 mA of current) and main high power (by high power diode of 600V, 5A) to be injected along the wires, one each time.

In the Fig. the symbol B1, B2, B3 are equivalent respectively to V1, V2, V3, or T1, T2, T3:just different names.

The sections at low power and high power have has several protection networks (based on Zener diodes and resistors) in common, to avoid catastrophic failures due to unexpected pulses coming from the AC power (up to +-600 Vp) injected to the counter electrode to promote both Richardson (positive region of the wave, low pressures) and Paschen regime.

FIG 2

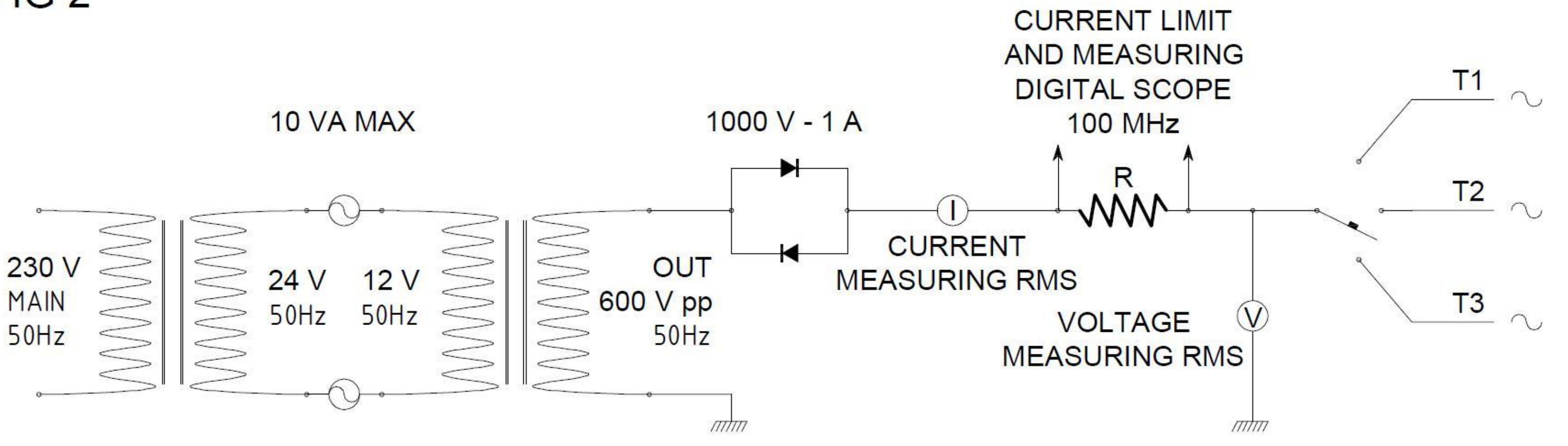

Fig. 11. Circuitry to generate AC voltage (up to +-600 Vp), at low current (absolute limit 60 mA with 10 kOhm resistor) to promote both Richardson and Paschen regimes. The current injected has a typical value up to 10-15 mA peak and RMS value up to 5-6 mA, as measured by Fluke 187 multimeter (BW=100 kHz). The RMS Voltage is of the order 250-280 V, as measured by Tektronix DMM916 Multimeter (BW=20 kHz). For higher accuracy, and better understanding of waveform, the signals at the end of 10 kOhm resistor are sent to a Fluke 198c Digital Scope (BW=100 MHz).

Some typical results

A) 3 main Oscilloscope observations, Fig. 12, 13, 14, of waveforms and related effects in respect to AHE, if any.

Fig. 12. Typical excitation with NO effects in respect to AHE generation.

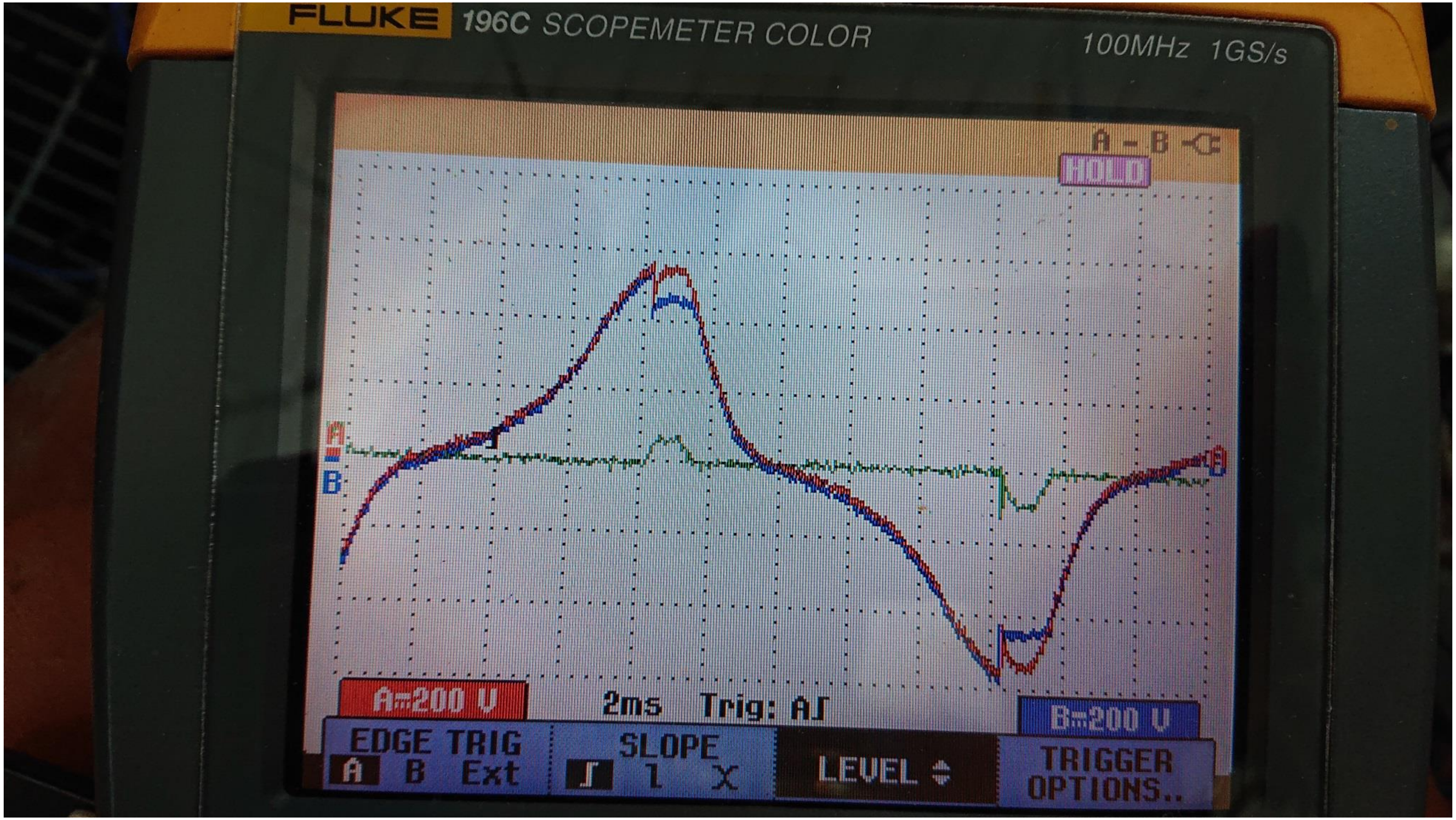

Fig. 13. Typical excitation at high temperature (>700 oC) but too-low pressure. Mild effect on AHE stability. Easy to deload Deuterium.

Fig. 14. One of the best regimes (temperature-pressure) that optimized both the Richardson and Paschen regimes, with the largest AHE values reached (18 W) by the T2 wire. The drawback is the limited range of operating regime. We are thinking to further optimize the regimes by A.I. approach. We guess that the HF components could be related to Dielectric Barrier Discharge (DBD) regimes.

Correlations among wire content variation of Hydrogen and AHE.

- **In the discussion we used indifferently the term of *active gas* used as Hydrogen or Deuterium, depending on specific test.**

- **The main observed parameter that correlates the amount of AHE with the true situation of H stored is the *R/Ro value*, i.e. the variation of wire resistance R with the operating point. Ro is its value at the beginning of the experiment, before H absorption.**

- **The main discovery is that the AHE is correlated both with the variation speed of R/Ro versus time and amplitude of "oscillation" over time, if present.**

Short discussion among the most significant 80 tests performed

(reported in Tab. 1 as addendum)

- **In a particularly impressive experiment, 18 W of AHE were observed for an input power of 99.7 W (line #38 of Table 2 in Appendix B), recorded when using a 200 µm wire (coil V2, Φ=200 µm) at a temperature of 716°C. The counter-electrode excitation consists of +270 V bias and 3 mA current, the behavior of R/ R_0 was oscillating over time. The effect lasted over 5 hours**

- **Afterward AHE decreased to 9.5 W (line #39), perhaps due to air intake from a leak. In fact, the pressure increased from about 300 up to about 316 mbar. Anyway, the effect had a remarkable time span of over 15 h.**

- **When the polarity was changed from positive to negative (line #40), AHE decreased from 9.5 to 7.4 W.**

- **The shift (line #41) from unipolar negative to bipolar oscillation (+- 600 Vp, 50 Hz) increased AHE from previous 7.4 to 10.7 W, the effect lasted about 4 h.**

- **Reducing the pressure from 341 to 98 mbar (line #42) the effect increased from 10.7 to 14.5 W, always under AC oscillation and current (rms value) of 2-3 mA. The effect lasted 4 h.**

- **After the interruption of the AC stimulus (line #43) leakage was observed, causing a pressure increase from 98 to 250 mbar, this was followed by a reduction of AHE from 14.5 W to 2.4 W. AHE slowly vanished following stabilization of R/R_0 (that was unstable and oscillating proportionately to AHE).**

- **When AC oscillation (line #44) was resumed at a constant pressure of 250 mbar, AHE rise again, from 2.4 to 9.2W.**

- **Eventually the only way to recover large values of AHE (i.e. 14.4W, line #59), was to power 200 µm wire (V2) add some Ar to the gas mixture, keep the pressure relatively low (36 mbar), and use AC excitation to the counter electrode.**

- ***In general, much lower AHE values were observed when using the larger diameter wire coil V3 (350 µm). .***

Conclusions #1, observations

From the collected data the following conclusions can be drawn:

a) **The AHE occurrence is correlated with fast loading or unloading of the wire. In the case of unloading however, after a short time, the AHE vanishes.**

b) **When loading/unloading occurs slowly, AHE is significantly reduced.**

c) A state of oscillation seems to be the most efficient since it produces AHE for a longer time with respect to fast loading or unloading (especially when a dielectric barrier discharge occurs).

d) **Loading and unloading occurrence, as assumed from R/R_0 and variation in reactor pressure, strongly support the key role of deuterium flux.**

There are additional external conditions, such as high temperature, low pressure, purity of the gas that facilitate the AHE. In any case, after some time, even the optimal conditions described above are not sufficient to maintain AHE release. That being said, the major finding we would like to emphasize is the ability of the counter-electrode stimulus to keep the AHE active for longer times, perhaps indefinitely.

Also, the role of non-equilibrium conditions and flux were suggested by several Researchers since the beginning of "Cold Fusion" experiments.

Convincing proofs being said, *the set of experiments summarized in Table of the present work consistently shows a strong correlation between a change in loading/pressure and the occurrence of AHE, hence providing a strong support to the "flux model" or hypothesis.*

Also, although most of the tests here described are in agreement with the "flux model", some results are still difficult to interpret. We think that this could be due to accidental contamination of the deuterium due to an insufficiently air-tight glass reactor, especially at high temperature and low pressure.

Conclusion #2, external conditions

Moreover, a critical analysis of the data collected in Table 2 (Appendix), allow us to highlight a series of observations or possible generalizations on the best conditions enabling AHE release for the selected reactor geometry:

a) **Temperature must be as high as possible, provided that sintering of the spongy surface does not occur. Also, high temperature is one of the key factors for electron emission from low work function materials. We speculate that a high intensity emission may interact with deuterium (or hydrogen) leading to useful phenomena. This last statement is purely based on associations during experiments (i.e. between thermionic emission and AHE).**

b) **Low pressure is useful to increase the e^- emissions. However, below a certain pressure the effect may be deleterious due to excessive deuterium release (unloading) from the wires. We would like to highlight that the occurrence of a dielectric barrier discharge (Fig. 13) is associated with a remarkably intense AHE. Although at this stage we would like to avoid venturing into a discussion of possible reaction mechanisms, we recognize some analogies with previous work and that of Randell Mills and Jacques Dufour.**

c) The addition of low-thermal conduction noble gases (like Ar or Xe) is generally useful both to increase the temperature inside the reactor core and promote the Paschen regime, when the counter-electrode has sufficiently high voltage.

d) High DC voltages along the active wire are useful (perhaps due electro-migration, NEMCA and/or Preparata effects). As a consequence, thinner wires are usually more efficient at producing AHE.

e) The effect of AC has to be fully explored in all of its potential (varying frequency, voltage, waveform, bias and/or asymmetries). Nevertheless, we observed an unexpected but clear correlation with the negative side of AC wave and an increase of the temperature in the reactor core when certain conditions of temperature and pressures are fulfilled. In general, AC stimuli seems to counteract the AHE decline observed in previous experimental projects.

f)* The *flux of deuterium trough the active material (Constantan)*, seems to be the most important factor driving the AHE generation. Based on experimental observations, we speculate that *inducing oscillations of flux may be the best method for triggering or increasing AHE.

g) **Contamination of the reactor atmosphere (e.g. by air and/or degradation of glassy sheaths) has a deleterious effect on AHE. Unfortunately, due to budget constraints, up to now we could not afford a Residual Gas Analyzer (RGA) placed in-line with the reactor to diagnose this problem.**

Near Future Work.

- **Our current work aims at preventing the issues of the described experimental setup such as the frequent leakages and poor control of gas compositions.**

- **This will be achieved with a new stainless steel reactor equipped with residual gas analysis (RGA).**

- **We are also working to improve the electronics used as AHE stimulus and for DBD plasma generation, as well as at finding the optimal operating conditions both with conventional high tension, medium-high frequency generators, as well with pulsed DC power supplies. At present, we improved the 50 Hz, +-600 V, 200mA excitations by circuitry based on CCD (Constant Current Diode) in SiC (Silicon Carbide) technology and used since October 2019: *very satisfactory results obtained from the point of view of understanding*.**

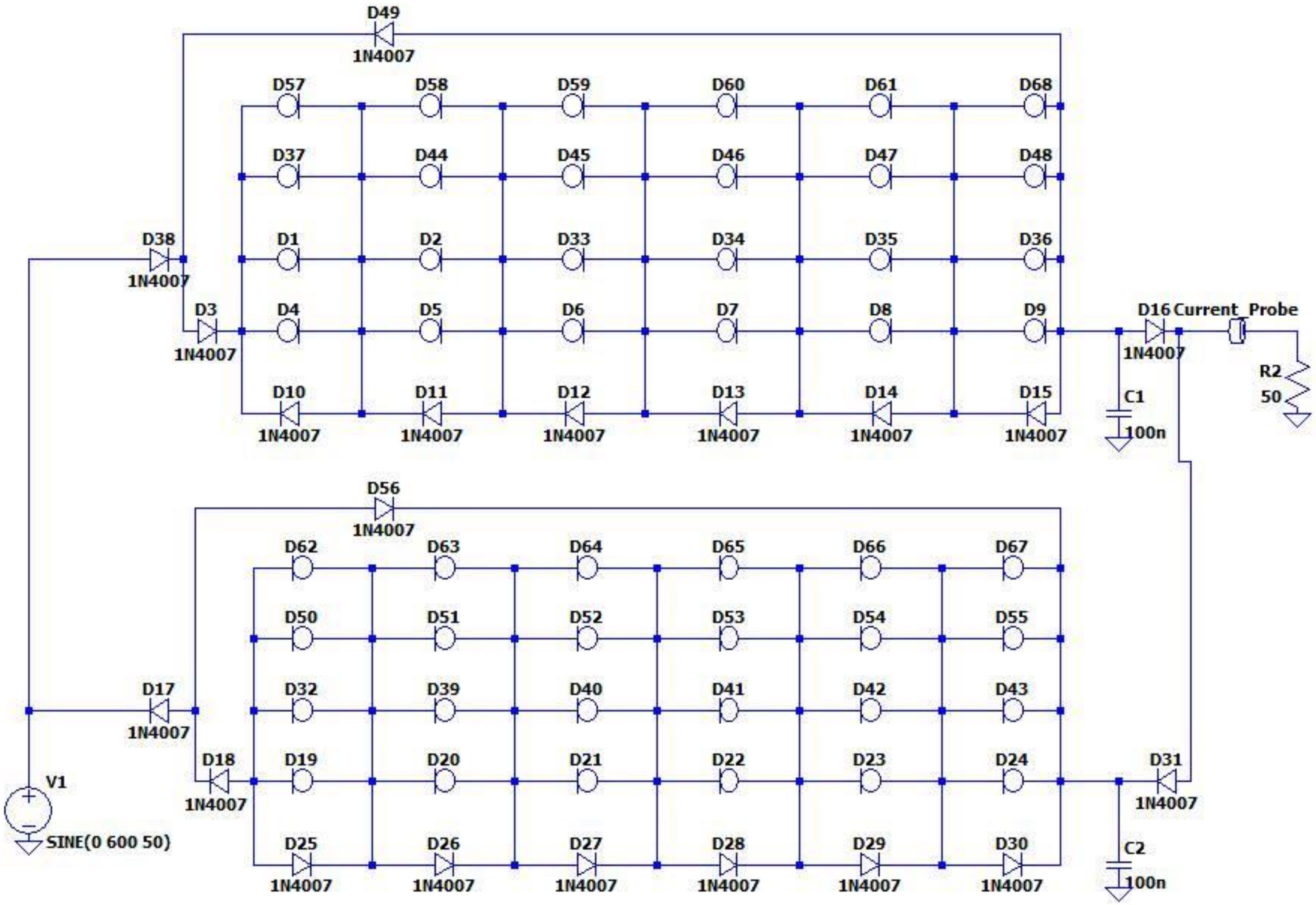

Fig. 15 Schematic of High Voltage (+-600V), Constant Current (+-200 mA), High frequency circuitry with booster capacity for DBD regimes (if any). CCD are based on SiC technology.

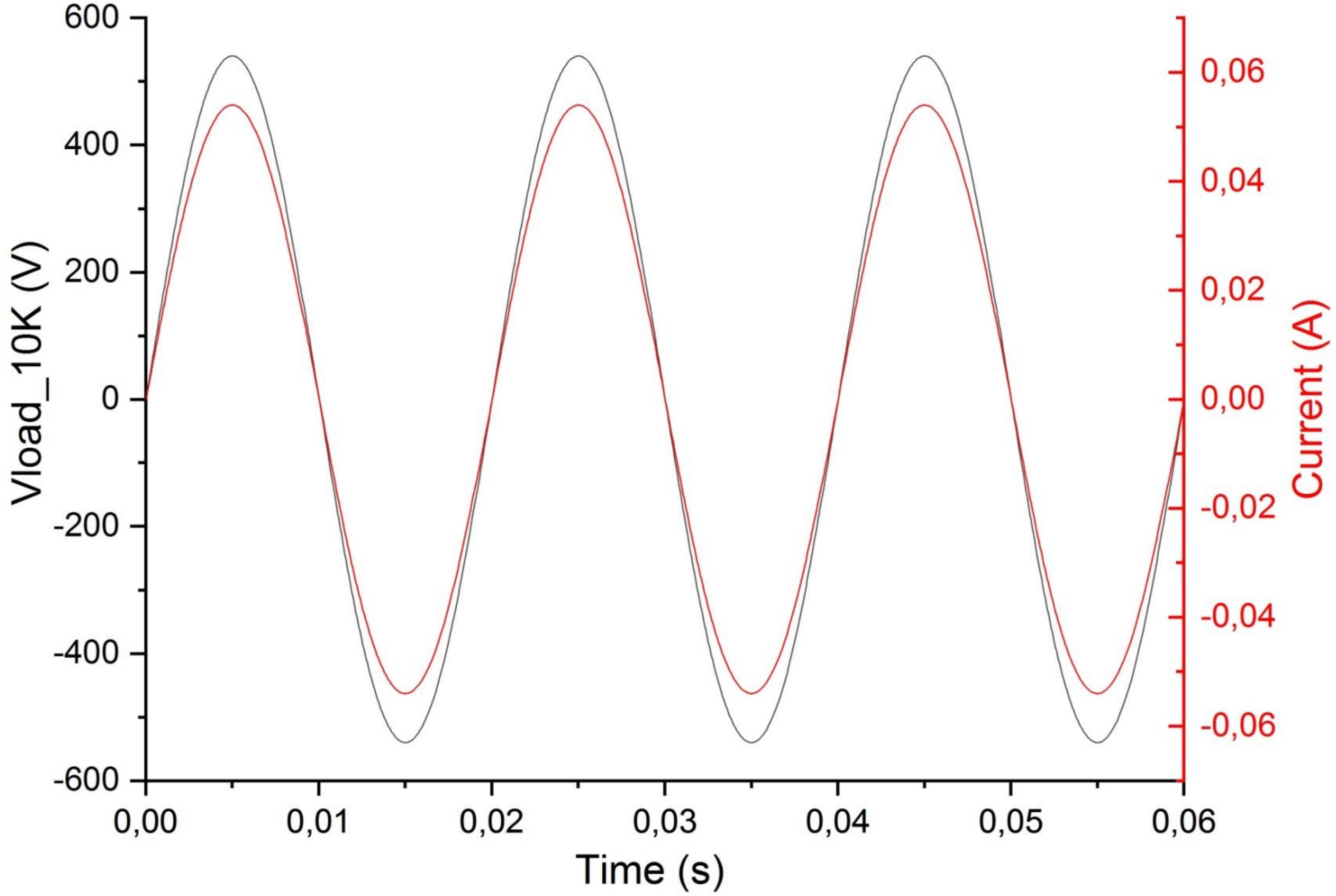

Fig. 16 Computer simulation of circuit waveforms, V-I, with R_load=10 kOhm. Results in agreement with experimental test using high power transformer at the input of CCD.

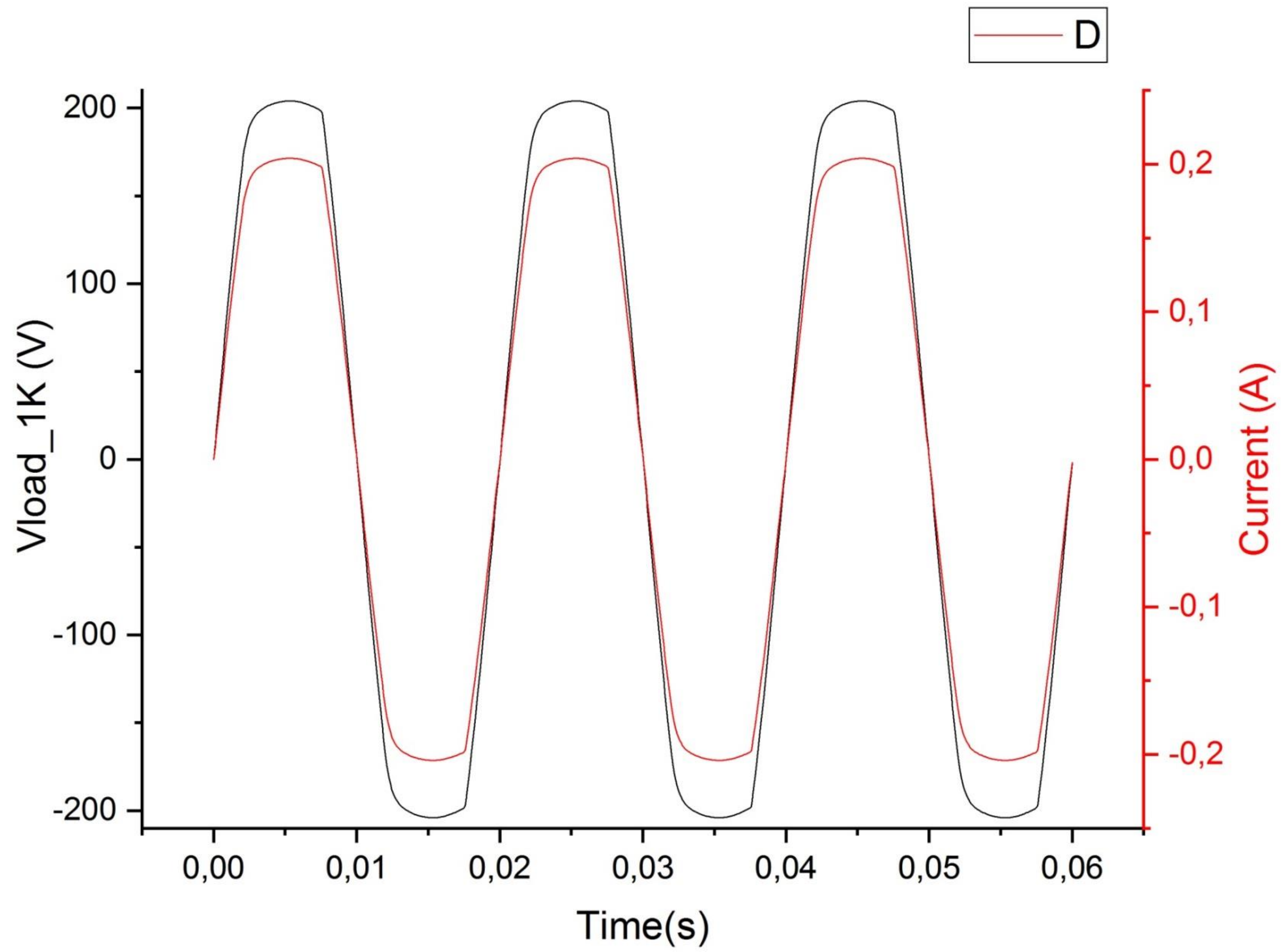

Fig. 17. Computer simulation of circuit waveforms, V-I, with R_load=1 kOhm. Results in agreement with experimental test using high power transformer at the input of CCD.

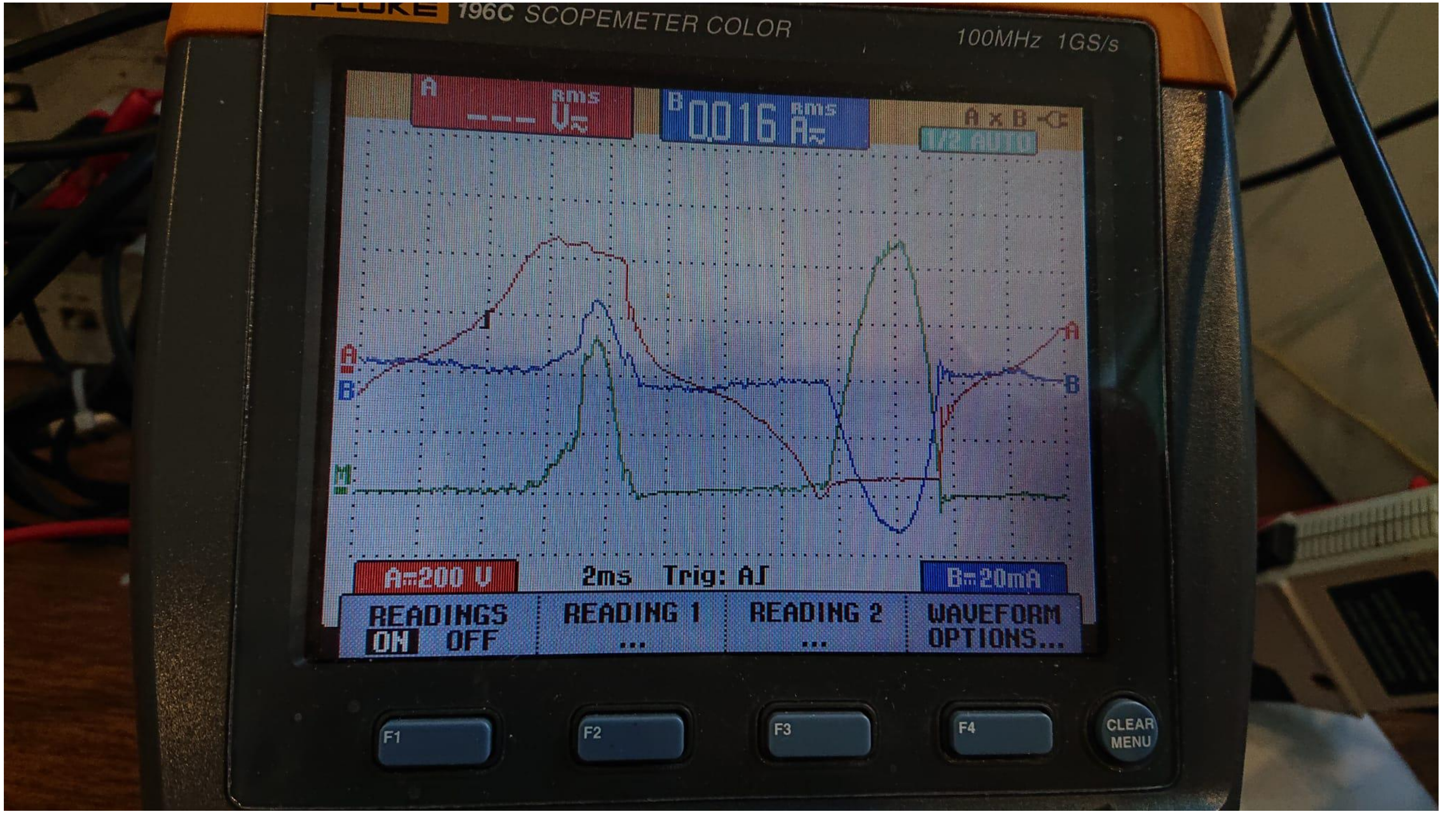

Fig. 18. Example of Voltage (Red)-Current (Blue)-Power (Green) waveforms observed, at RT and free air in flux (35 mbar of pressure) because calibration purposes. Results obtained using the SiC CCD circuitry. The peak voltages largely decreases from +- 600 V (in conditions of high pressure, >300 mbar or vacuum, i.e. no Richardson or Paschen regimes active) up to (about) 420 V (positive section) and 340 V (negative) because intrinsic power limitation of 2 transformers in cascade used (max 9VA each).

Acknowledgements

A) We continue to be indebted with the Metallurgical Company, located at the Nort-East of Italy, for his continuous economical support (since 2011) and several "practical" suggestions to help solving several of the critical aspects in developing our non-conventional "AHE reactors". Some specific test, performed in their own Laboratory, helped us to be more confident in some specific aspects of so complex experiments.

B) Some of expenses needed to attend International Meetings/Workshops/Conferences, (even abroad) and repairing damaged instrumentations were provided by IFA (*Water&Energy_Company*)-Italy. Some technical discussions, with one of their Researchers, about the possible role of localized RF excitation, were stimulating to us.

Addendum: key information of over 80 test/experiments performed.

Table 2 summarizes over eighty tests performed during two months of experiments using Constantan wires, 1.7 m long, with a diameter of 200 or 350 μm.

During these experiments the active wire polarity was kept negative and the extremity of each wire was grounded; the power supply was operated in the constant-current mode.

The table includes the following data:

C1: Identification of the experiment, time [s] since the start of specific data logging;

C2: Wire diameter [mm];

C3: Electric input power [W], Voltage along the wire [V], Current [A];

C4: Gas type, pressure [mbar];

C5: Temperature at the core of each tube/cartridge used for the Constantan wires (inside the Fe counter-electrode); the R/R_0 value of the wire; the trend of its variation over time (reported on the last 10 ks) as observed in the plot of raw data.

The wire loading during the experiments was classified, as follows:

C5.1 **I**ncrease of **L**oading (**IL**), corresponds to a R/R_0 decrease; it can be Slow (**S**) or Fast (**F**)

(e.g. **IL_S** means slow increase of loading)

C5.2 Decrease of **L**oading (**DL**), corresponds to a R/R_0 increase; it can be Slow (**S**) or Fast (**F**)

C5.3 Oscillation. The R/R_0 values oscillate around a certain mean value. The larger is the amplitude of oscillations, the larger AHE is.

C5.4. Constant. The R/R_0 not varying significantly over time. In this conditions AHE is absent.

We assume that these behaviors are closely correlated with a flux of the active species thorough the surface and/or bulk of the wire;

C6: Electric conditions of the counter-electrode, i.e. V, I, in DC or AC;

C7: AHE values [W], calculated using Eq. 10.1-3. Maximum value measured was +18 W with 100 W input.

C8: Short comments on the experimental conditions and results.

C1 Test # *Timer (s)	**C2** Wire, diameter [mm]	**C3** *Pw-_in [W] * V [V], I [A]	**C4** Gas type, Pressure [mbar]	**C5** *T_core[°C]; *R/R_0 wire; * **loading variation.**	**C6** Counter Electrode, V, A; DC or 50 Hz AC (rms),	**C7** AHE [W]	**C8** Notes
#1 599280	0.350	40.6 19.5, 2.08	D_2 1810	318 0.885 **DL_S**		-0.7	10 July 2019. File started 03 July 2019, 16h 44m after several calibrations using Nichrome an Platinum heaters
#2 616410	0.350	60.6 24.1, 2.51	D_2 1770	427 0.905, **DL_F**		+8.7	Gas leak. Fast Deuterium de-loading. Higher temperatures and fast unloading effective to get AHE.
#3 691100	0.350	80.6 28.6, 2.8	D_2 1100	544 0.9524 **DL_F**		+7.8	Gas leak. Fast de-loading.
#4 767700	0.350	97.4 31.6, 3.08	D2 1100	630 0.964 **DL_S**		+0.5	Gas leak. Slow unloading. The ***rate*** of unloading is a key factor to get AHE.
#5 1005840	0.350	49.4, 22.2, 2.2	Ar/D2=1.34	483 0.945 **C**		+0.2	R/R_0 almost constant. No AHE observed

			1160				
#6 1015360	0.350	59.8, 24.6, 2.43	Ar/D2= 1.34 1210	546 0.953 **DL_F**		+4.5	Fast unloading. AHE recovered.
#7 1020670	0.350	70.2, 26.7, 2.62	Ar/D2= 1.34 1230	603 0.961 **IL_S**		+2.8	Low speed loading, reduced AHE.
#8 1029100	0.350	80.5, 28.7, 2.80	Ar/D2= 1.34 1270	656 0.966 **IL_SO**		+8.6	Increasing loading, noisy R/R_0. The AHE increased largely, perhaps due to R/R_0 oscillations.
#9 1037080	0.350	90.5, 30.6, 2.96	Ar/D2= 1.34 1300	702 0.972 **CO**		+6.6	R/R_0 almost flat but with several instabilities. AHE present.
#10 1097810	0.350	97.7, 31.7, 3.08	Ar/D2= 1.34 131	725 0.972 **CO**		+4.4	R/R_0 almost flat but with instabilities. Also the oscillations are useful to get AHE.

			0				
#11 1340 New File			D2 fresh 1960	22 0.926			Calorimeter opened and re-closed to repair a large gas leak. New file 170719_12:01
#12 18350	0.350	59.9, 24.4, 2.46	D2 2610	420 0.906 **IL_S**		-0.5	In almost static conditions and high pressure no AHE, although some loading.
#13 24230	0.200	60.4, 40,1.51	D2 2440	439 0.949 **IL_SO**		+0.8	Gas leak. Pw at V2. Very slow loading. Some R/R_0 instability. Similar to test #12 but some weak oscill.
#14 92900	0.200	60.1, 39.8, 1.51	D2 2050	433 0.946 **C**		-0.7	Gas leak. 50ks measurement. R/R_0 flat. No AHE.
#15 172570	0.200	61.1, 40.1, 1.52	D2 2610	438 0.947 **C**		0	Very long measures, 180ks. R/R_0 flat. No AHE
#16 185120	0.200	80.5, 46.5, 1.73	D2 2670	529 0.962 **C**		0	Long duration measures. R/R_0 flat. No AHE.
#17 195370	0.200	99.7, 52.1, 1.91	D2 2710	607 0.977 **DL_S**		+5.3	R/R_0 slowly increased. Some oscillations were the source of AHE.

				O			
#18 196100	0.200	99.9, 52.2, 1.91	D2 1970	611 0.978 **O**		+*10.1*	Forced pressure reduction. R/R_0 quite unstable: origin of AHE. *Short time test.*
#19 196550	0.200	100.0, 52.3, 1.91	D2 1470	617 0.978 **DL_FO**		+*9.7*	Forced pressure reduction. R/R_0 increased. *Short test.*
#20 196960	0.200	100.0, 52.3, 1.91	D2 1040	634 0.981 **DL_F**		+*7.7*	Forced pressure reduction. *No thermal equilibrium*
#21 197320	0.200	100.4; 52.4, 1.91	D2 660	636 0.982 NA		+*6.0*	Forced pressure reduction. *No thermal equilibrium*
#22 198070	0.200	100.2; 52.5, 1.91	D2 440	659 0.986 NA		+*4.0*	Forced pressure reduction. *No thermal equilibrium*
#23 198600	0.200	100.6; 52.7, 1.91	D2 300	685 0.990 NA		+*5.9*	Forced pressure reduction. *No thermal equilibrium*
#24	0.200	100.2	D2	713		+*5.*	Forced pressure reduction.

199160		; 52.7, 1.90	196	0.995 NA		*5*	*No thermal equilibrium*
#25 199860	0.200	99.9; 52.7, 1.89	D2 156	733 0.997 NA		*+8.1*	Forced pressure reduction. *No thermal equilibrium*
#26 431190	0.200	81.2; 47.2, 1.72	D2+ air 216	612 0.983 **C**		+0.5	Long measurement (>60H). Leakage: air intake, initial 158mbar at same temperatures. Some oscill.
#27 432920	0.200	81.2; 47.1, 1.72	D2+ air 214	612 0.982 **O**	+300 V, 0.250 mA	+3.1	Counter electrode has positive Polarization: some AHE, at least at for short time.
#28 443190	0.200	81.1; 47.1, 1.72	D2+ air 209	613 0.983 **C**	-300 V 0.210 mA	-2.1	Counter electrode Negative Polarization: AHE vanished, ***even endothermic effects.***
#29 451110	0.200	81.0; 47.1, 1.72	D2+ air 218	614 0.983 **C**	-300 V 0.200 mA	-0.9	Pol. Neg. long time (>2H). Slowly AHE endothermic region vanished.
#30 598310	0.200	98.9; 52.1, 1.90	D2+ air 330	688 0.983 **IL_S**		+1.7	Long measurement. Slow improvement of loading: some AHE.

#31 77.7 616520	0.200	79.9; 46.5, 1.72	D2+ air 270	596 0.969 **C**		+1.1	Leakage air intake observed. After an initial improvement, later R/R_0 flat.
#32 620080	0.200	80.1; 46.6, 1.72	D2+ air 184	609 0.972 **O**	+, -300V 0.5-2 mA	+3.4	Forced pressure reduction. Several test with DC field Pos. and Neg. Indications that a change of polarity could be useful to get AHE.
#33 623680	0.200	80.0; 46.6, 1.72	D2+ air 211	613 0.973 **O**		+5.9	Abrupt temperature increase. DC field removed
#34 626380	0.200	80.2; 46.7, 1.72	D2+ air 168	628 0.975 **DL_S**		+2.5	Forced pressure reduction.
#35 630540	0.200	80.4; 46.8, 1.72	D2+ air 187	631 0.976 **DL_F**	+296V, 2.7 mA	+2.8	Pressure reduction and recovery. Fast increase R/Ro DC field
#36 683800	0.200	80.7; 46.8, 1.72	D2+ air 183	628 0.975 **IL_SO**	+296V, 2.7 mA	+3.2	Long time with field. R/Ro noisy. First time observed AHE not decreasing over time with Power constant.
#37 697670	0.200	89.7; 49.5, 1.81	D2+ air 230	672 0.981 **DL_F**	+297 V, 2 mA	+4.0	Pw increased from 80 to 90W. Fast increase of R/R_0, oscillations of R/R_0

				O			
#38 716220	0.200	99.7; 52.3, 1.90	D2+ air 300	716 0.985 **DL_FO**	+290 V, 3.2mA	+18.0	Pw increased from 90 to 100W. Fast increase of R/R_0. Osc. large AHE observed
#39 771310	0.200	99.7; 52.2, 1.91	D2+ air 316	709 0.981 **IL_SO**	+297V 3.15mA	+9.5	Long duration 50ks, at 100W, DC field +300V. R/R_0 decreased
#40 775060	0.200	99.6; 52.2, 1.91	D2+ air 317	707 0.981 **O**	-297 V, -3.5mA	+7.4	Test with Negative field. Slowly decreasing AHE: Negative field effect.
#41 789230	0.200	99.3; 52.1, 1.90	D2+ air 341	706 0.981 **O**	AC, 260V 2-3 mA	+10.7	AC stimulation, 1st time. RMS values. R_equiv: 100 kOhm. AHE recovered.
#42 803300	0.200	100.2; 52.6, 1.90	D2+ air 98	767 0.989 **DL_F**	AC, 260V 2-3 mA	+14.5	Pressure reduced several times. AC on. Large R/R_0 increase.
#43 1029400	0.200	99.2; 51.9, 1.91	D2+ air 250	708 0.973 **IL_SO**		+2.4	Long time meas. Air intake: Press. increased. Temp. decreased. AHE decreased slowly. Loading Oscillations.

#44 10320 30	0.200	99.2; 51.9, 1.91	D2+ air 252	708 0.973 **O**	AC, 280V 1-2 mA	+9. 2	AC stimulation: recovered partially AHE, i.e. 2.4->9.2 W
#45 11143 30	0.350	60.7; 24.7, 2.45	D2+ air 118	531 0.922 **IL_S**	AC, 260V 5-6 mA	+0. 2	Active wire 0.35 mm. First time.
#46 11305 70	0.350	79.8; 28.6, 2.79	D2+ air 163	634 0.934 **DL_S**	AC, 262V 5mA	- 1.1	R/R_0 slowly decreased. No AHE.
#47 11433 30	0.350	90.1; 30.4, 2.96	D2+ air 190	678 0.939 **O**	AC, 262V 5 mA	+6. 5	Several spikes at AC, R/R_0 noisy. Increasing Pw and temperature were useful.
#48 12036 90	0.350	60.4; 24.7, 2.45	D2+ air 104	539 0.921 **DL_S**	AC 260V, 7 mA	+0. 7	Regular oscillations. Weak AHE, although AC oscillation.
#49 12157 50	0.350	60.9; 24.9, 2.44	D2+ air 90	557 0.930 **DL_S**	AC, 263V 5.8mA	+0. 9	Forced pressure reduction. No effect to recover AHE.
#50 12193 20	0.350	60.7; 24.8, 2.45	D2+ air 85	576 0.927 **IL_S O**	AC, 262V 6.0mA	+2. 1	Forced pressure reduction. Increase of internal temperature and AHE.
#51	0.200	61.2;	Ar=	575	AC,	+3.	After vacuum new gas (Ar=D2 70 mbar at RT), Wire

12896 70		40.4, 1.51	D2 87	0.956 **O**	293V <<1 mA	1	switch (V3 to V2). Smaller wire diameter, i.e. higher DC voltage, increased AHE.
#52 13065 80	0.200	80.15; 46.6,1 .72	Ar= D2 80	684 0.970 **DL_S**	AC, 293V <<1 mA	+2. 2	Forced pressure reduction R/R_0 stable last 2 h.
#53 13195 20	0.200	100.1; 52.3, 1.91	Ar= D2 90	770 0.980 DL_F **O**	AC, 293V <<1 mA	+9. 1	Forced pressure reduction. AHE improved.
#54 13215 10	0.200	100.1; 52.4, 1.91	Ar= D2 72	777 0.982 **DL_S O**	AC, 293V <<1m A, self-pulse at HF.	+11 .3	Forced pressure reduction R/R_0 noisy. Further increase of AHE. HF self-pulses look useful.
#55 13700 80	0.200	99.7; 52.0, 1.92	Ar= D2 +air 125	734 0.974 **IL_S**	AC, 299V <<0.5 mA	+9. 8	Leakage air intake. Several pressure reductions. AC current almost vanished. Still AHE.
#56 13748 40	0.200	100.6; 52.5, 1.92	Ar= D2 +air	799 0.982 **D-I-L**	AC, 299V <<0.5	+1 0.2	Several forced pressure reduction. AHE correlated with fast R/R_0 variation, oscill. high temperature

			45	**O**	mA		
#57 1393640	0.200	99.5; 52.0, 1.91	Ar= D2 +air 94	750 0.974 **O**	AC, 299V <<0.5 mA	+8.7	Leakage air intake. Reducing local temperature decreases AHE.
#58 1395760	0.200	101.3; 52.9, 1.92	Ar= D2 +air 41	854 0.991 **IL_FO**	NO AC	+6	Forced pressure reduction. One of co-factor effects for AHE generation is AC stimulation, although HT increased (750 to 854).
#59 1403770 02/08/20 17:57	0.200	99.9; 52.2,1.91	Ar= D2 +air 36	778 0.978 **IL_FO**	AC, 290V 2-4 mA	+14.4	Forced pressure reduction. Large AHE. Geiger-Muller gamma detector several times in alarm (>>4 BKG). R/R_0 decreased.
#60 1447460	0.350	41.0; 20.3, 2.02	Ar= D2 +air 66	510 0.917 **C**		-0.7	New file: 19082019, 13:37 Over 15 days operation at low power. No AHE.
#61 1456770	0.350	41.1 20.4, 2.02	Ar= D2 +air 30	547 0.924 **DL_S**	AC, 247V 5.5 mA	+0.1	Reducing pressure and adding AC stimulation induced some AHE.
#62	0.350	41.0	Ar=	534	AC,	-	AC excitation ended 2h before measurement. AHE

14613 80		20.3, 2.01	D2 +air 45	0.922 **C**	270V 2-3 mA	0.1	vanished.
#63 15220 10	0.350	50; 22.5, 2.22	Ar= D2 +air 57	582 0.926 **DL_S**	NO AC	-1.4	Without AC the weak AHE disappeared.
#64 15497 30	0.350	50; 22.5, 2.22	Ar= D2+ air 50	576 0.927 **DL_S**	AC, 247V 4.9mA	+0.6	Forced pressure reduction. AC field from 20 ks. No HF discharge. Weak AHE
#65 15540 10	0.350	49.9; 22.5, 2.22	Ar= D2+ air 46	574 0.925 **IL_S**		+1.6	Pressure reduction. AC off since 1H. R/R_0 decreased but AHE weak.
#66 16101 50	0.350	50; 22.5, 2.22	Ar= D2+ air 55	578 0.927 **DL_S**		-1.3	AC off since 16H. Pressure increased, AHE vanished.
#67 16278 60	0.350	50; 22.3, 2.22	Ar= D2+ air 60	582 0.928 **Osc.**	AC, 290V 1mA	+1.5	AC field since 4H R/R_0 noisy. Recovering of AHE.
#68	0.350	50;	Ar=	578	NO	+0.	Pressure reduced. AC stopped: AHE vanished.

1633300		22.5, 2.22	D2 +air 41	0.925 **IL_S**	AC	1	
#69 1640820	0.350	50.2; 22.6, 2.22	Ar= D2 +air 20	600 0.930 **IL_S Osc**	AC, 290V 1-2 mA	+2.6	Forced pressure reduction, AC ON since 2H. AHE resumed.
#70 1695500	0.350	60.5; 24.8, 2.43	Ar= D2 +air 60	632 0.932 **C**		-1.8	NO AC. Pressure increased. R/R_0 stable; AHE absent.
#71 1713770	0.350	60.5; 24.9, 2.43	Ar= D2 +air 30	660 0.936 **IL_S**	AC, 280V 2-3mA	+1.2	Forced pressure reduction. AHE improved.
#72 1780200	0.350	80.1; 28.7, 2.79	Ar= D2 +air 75	700 0.937 **IL_S**	AC, 253V 4.5mA. NO HF.	-1.3	AC seems NOT effective to stimulate AHE without HF component.
#73 1787240	0.350	80.0; 28.6, 2.79	Ar= D2 +air 85	692 0.937 **IL_FO**	AC, 253V 4.5mA.	+3.2	AC ON, sometimes HF. R/Ro noisy.

					Some HF		
#74 1806940	0.350	97.8; 31.7, 3.08	Ar=D2 +air 150	757 0.942 **IL_FO**		+4.8	R/R_0 decreasing. Absolute value of local high temperature (760°C) is also important.
#75 1812230	0.350	98.2 31.9, 3.08	Ar=D2 62	802 0.946 **IL_FO**	AC, 260V 4mA	+7	AC ON, some spontaneous HF. Forced pressure reduction. Combined effect of higher temperature, low pressure-AC excitation is
#76 2043780	0.350	97.4 31.6, 3.08	Ar=D2 +air 146	719 0.935 **IL_S**	AC, 290V <1mA.	+2.8	AC ON, leakage air intake. AHE reduction (7.2->2.8) because: pressure increasing, lower AC, lower temperature.
#77 76650 New file 260827, 11:27	0.350	40.6; 20.1, 2.02	D2 fresh 440	336 0.906 **IL_SO**	AC, 290V 1-2mA.	+1.8	After vacuum, fresh D2 (380 mbar at RT). Increasing of loading. Noisy. Some AHE, although low power and temperature. Flux of D2 looks important.
#78 26480 New file	0.200	40.5; 32.4, 1.25	D2, 480	463 0.929 **IL_S**	AC, 300V <0.5mA	-0.3	Re-activated V2. Slow loading speed. No AHE, although AC oscillation but no HF components. Pressure excessive and temperature not sufficient for AHE.

270819, 10:18					NO HF		
#79 37570	0.200	60.7; 40.1, 1.51	D2 15	580 0.959 **O**	AC, 290V <0.6mA	+4.9	Forced pressure reduction. R/R_0 noisy: combined effects with HT. AHE resumed.
#80 89.1 116590	0.200	81.5; 47.0, 1.73	D2 26	720 0.971 **IL_F Osc.**	AC, 290V 0.3-1 mA	+11.5	Forced pressure reduction. R/R_0 noisy and decreasing. HT, low pressure, oscill.: ingredients to get AHE.
#81 174740	0.200	81.2; 46.7, 1.73	D2 +air 34	691 0.964 **IL_FO**	AC, 290V 0.4 mA	+8.3	AC polarization started. Leakage, air intake observed. Reduction of temperature decreases AHE (11.5->8.3).
#82 195640	0.200	100.4; 52.2, 1.92	D2 +air 75	764 0.970 **IL_FO**	AC, 290V 0.2-1 mA	+13.0	AC always active. R/R_0 noisy and decreasing fast. The AC keeps AHE stable over time.
#83 204780	0.200	101; 52.6, 1.92	D2+ air 30	808 0.981 **IL_FO**	AC, 290V 0.2-1 mA	+12.8	Several pressure reduction steps. AC always active. R/R_0 noisy and decreasing. Although air intake AHE almost stable.
#84	0.200	100.3;	D2+	753	AC,	+11	Long duration measures. AC ON. Leakage and air

25766 0		52.1, 1.92	air 50	0.97 **IL_F Osc.**	290V 0.2-0.5 mA	.2	intake occurred. R/R_0 noisy and decreasing. The combined effect of high temperature, AC oscillation and sufficiently low pressure overcome the deleterious effect of air intake even for long times (>14h). **Last measurement before ICCF22.**