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Abstract

Numerous experiments (Ohsawa, Monti, Sundaresan and Bockris, Ransford) have been conducted with electric discharges between two carbon rods submerged in de-mineralized water, and some transmutation elements, such as Fe, Cr, Co and Zn, were subsequently found in the residues. In the present paper, a nuclear transmutation with carbon rod and oxyhydrogen plasma will be investigated. An oxyhydrogen gas obtained from water by an electrolyzer (developed by ©SOHE) was used as is, in order to obtain plasma with very low electron temperature (between 120 and 150°C). The plasma temperature was determined by a technique called Moiré deflectometry used to measure temperature and electrons density distribution of the atmospheric arc plasma. An optical spectroscopy measurement was performed on the oxyhydrogen plasma alone, with a low-resolution Ocean Optics 2000 spectrometer (spectral range of 180-880nm), which indicated that only the OH radicals were present in the 280-330nm range. Graphite rod (99.8% pure carbon) was used as a testing element, and it was treated with the oxyhydrogen plasma.

At the precise moment when the graphite rod was inserted into the plasma, we were able to see - beside the broadband spectrum center measured around 680nm - very strong Na D-lines at 589.0 and 589.6nm, as well as K lines at 766.4 and 769.9nm. Another measurement performed by a high-resolution spectrometer (constructed by ©SOHE), with a range of 4nm and a resolution of 0.01nm, confirmed the occurrence of the same lines. In addition, radiation measurements were carried out with a calibrated 360° Gamma Radiation Detector (made by ©SOHE), which did not indicate any radioactivity during the tests. The electric nature of the oxyhydrogen plasma enabled us to obtain nuclear transmutation by annihilating most of the graphite rod, and elements such as Si and Al were found in small transparent spheres (diameters between 10-150µm). Measured quantities of Si and Al by SEM/EDX in those spheres were many orders of magnitude higher than the initial values measured in the graphite rod with the Inductively Coupled Plasma - Mass Spectrometry (ICP-MS). The quantity augmentation of these elements could be explained by the “Kervran Effect”, named after the scientist Corentin Louis Kervran. It is important to highlight that all these elements were present in the graphite rod before the experiment, but in very small quantities measured under 0.014% weight concentration. Their presence is considered by Kervran to be an “activator” of the creation of supplementary quantity of the same elements.

All of the aforementioned analytical methods (optical microscopy, radiation detector, Raman spectroscopy, SEM/EDX, ICP-MS) were used in order to characterize the graphite rod, and to identify and quantify different transmutation elements.

Keywords: Oxyhydrogen plasma, Nuclear transmutation, Kervran Effect

1. Introduction

A nuclear transmutation has been investigated for a long time by a plethora of scientists and experimentalists, from hellenistic Egypt, through medieval Europe, to the modern period and contemporary physics. Stellar nucleosynthesis, natural radio-active transformation into a new chemical element, or a biological transmutation by means of bacteria, are all proofs of nuclear transmutation. The biological transmutation or, as described in this article, the LENR transmutation, known as transmutation at low energy, are not accepted by the mainstream science because there is no detected radioactivity or liberation of a huge amount of energy as proof of such a process. A cleavage between Classical Physics and non-mainstream research appeared with the following assumptions of mainstream scientists:

- the speed of light is constant
- the Theory of Relativity is accurate
- the only transmutation that could occur in the nature is either the Fission Transmutation that involves the process of bombarding the nucleus with a high energy particles, or a very high-temperature Fusion Transmutation which occurs in the Sun.

On the other hand, scientists like Corentin Louis Kervran and Georges Ohsawa worked essentially on a biological transmutation, and Roberto Monti was considered to be a "modern alchemist" who also claimed that transmutations occurred in his experiments. Numerous experiments with graphite and electricity were also conducted by Emmanuel Ransford, R. Sudhir Sundaresan and John O'M. Bockris in order to prove that transmutations could occur at room temperature and pressure. The purpose of these experiments was to show that energy density transmitted through a solid matter was greater than that of a plasma reactor, because of which no high temperature and pressure were required for the occurrence of elements' "fusion".

In his recent experiments with a self-designed microwave resonant chamber ("Nova Reactor") that he calls "Dusty Plasma" reactor, Dr. Georges Egely, later joined by the Martin Fleischmann Memorial Project (MFMP), could observe a transmutation of different elements. As far as other scientists and experiments are concerned, such as the SAFIRE Project conducted by Montgomery Childs and Dr. Michael Clarage [13], even without further analysis of the samples found on the electrode in the SAFIRE Project, the same elements were detected as in the Ohsawa's experiments and the Nova Reactor (reproduced from Dr. Georges Egely's Reactor by Martin Fleischmann Memorial Project (MFMP) [12]).

In the present paper, a nuclear transmutation was investigated with the use of graphite rod and oxyhydrogen gas obtained from the standard electrolysis of water, whereby a quantity increase of Si, Al, Fe, Ca, Mg and some other elements was observed after the experiment.

2. Setup and Experiments

2.1 Setup

A graphite rod with 5mm diameter was placed in a sample feeder with a computer-controlled stepper motor, which supplied the rod under the nozzle of the oxyhydrogen plasma gun (*Fig.2*). The sample feeder has a resolution of 0.5mm/step, so that the sample could be placed precisely under the nozzle. The plasma was generated by the use of oxyhydrogen gas produced by the water electrolyzer [1]. Different measuring devices such as OceanOptics 2000 Spectrometer, HighRes Spectrometer (*Fig. 3*) and 360° Radiation Detector (*Fig. 4*) (both ©SOHE) were placed around the contact point of the graphite rod and oxyhydrogen plasma (*Fig. 5, 6*). All processes (supplying rod, oxyhydrogen production, spectral and radioactivity measurements) were supervised from the monitoring center.

2.2 Experiment

The power used by the electrolyzer was 26VDC and 60-70A, and the amount of the oxyhydrogen gas that was produced was about 600L/h. The produced plasma was analyzed with a low-resolution OceanOptics 2000 spectrometer, with a range of 180-880nm and slit width of 25µm. The spectrum determined by the OceanOptics spectrometer was for the hydroxyl radicals at 307 and 309nm (*Fig 7*).

Once the plasma was applied on the graphite, a radical change in the spectrum was observed. Strong Na Doublet line at 589nm, as well as K lines at 766.4 and 769.9nm appeared on the top of the broadband spectrum with its center around 690nm (*Fig. 8*). As it was not possible to resolve the Sodium Doublet with the low resolution of the OceanOptics 2000 (with FWHM from 1.5 to 2.3 nm), the HighRes Spectrometer (©SOHE) with an adjustable range of 4nm in visible spectrum (400-

800nm), slit width of 10µm and FWHM of 0.01nm, was used, and it confirmed the occurrence of Na D-lines at 589.0 and 589.6nm (*Fig. 9*). A software used for the real-time spectroscopy analysis was RSpec, by Tom Field (www.rspec-astro.com). A mono-atomic hydrogen was not found in the oxyhydrogen plasma alone, nor in the oxyhydrogen/graphite spectrum analysis.

The disappearance of the hydroxyl radicals from the spectrum (*Fig. 7, 8*), and the appearance of strong peaks of Na and K, and of the broadband, led to a conclusion that the OH radicals participated in the creation of sodium and potassium from the graphite. All the O and H recombined with C from the graphite formed elements like Na and K, whereas Mg and Ca, as well as the Carbon lines, did not appear in the spectrum of the graphite/oxyhydrogen spectral measurement, the cause of which remains unknown.

Based on the assertion of Dr Kervran [8], the following steps of the creation of different elements could be elaborated (*Table 1*):

$_{8}O + {}_{6}C \rightarrow {}_{14}Si$ (1)

$_{14}Si + {}_{6}C \rightarrow {}_{20}Ca$ (2)

$_{20}Ca - {}_{8}O \rightarrow {}_{12}Mg$ (3)

$_{12}Mg - {}_{1}H \rightarrow {}_{11}Na$ (4)

$_{20}Ca - {}_{1}H \rightarrow {}_{19}K$ (5)

$_{19}K - {}_{8}O \rightarrow {}_{11}Na$ (6)

$_{11}Na + {}_{8}O \rightarrow {}_{19}K$ (7)

Table 1 - Scheme of creation of different elements

Element	Detected (ng/mg)	Weigth (%)	Measured (ng/mg)	Weigth (%)
Fe	1284.980	0.1285	1154.631	0.1155
Al	242.010	0.0242	193.691	0.0194
Ca	0.250	0.0000	136.558	0.0137
Si	137.280	0.0137	115.877	0.0116
Ni	87.910	0.0088	83.954	0.0084
K	90.627	0.0091	41.610	0.0042
Zn	57.690	0.0058		
Na	67.949	0.0068	40.300	0.0040
Ti	47.480	0.0047		
V	38.535	0.0039		
Mg	49.080	0.0049	35.213	0.0035
Pb	31.080	0.0031	27.446	0.0027
Cu	12.630	0.0013	10.482	0.0010
Ba	9.450	0.0009		
Sr	6.900	0.0007		
Ce	6.360	0.0006		
Mn	11.250	0.0011	8.885	0.0009
Cr	6.230	0.0006		
Co	5.100	0.0005		
La	4.644	0.0005		
W	3.010	0.0003		
Zr	2.880	0.0003		
Sb	2.340	0.0002		
Nd	1.840	0.0002		
Mo	1.210	0.0001		
Li	0.808	0.0001		
Nb	0.589	0.0001		
Ge	0.580	0.0001		
Sn	6.230	0.0006	5.016	0.0050
Total	**2216.922**	**0.2217**	**1853.662**	**0.1899**

Table 2 - List of elements present in the graphite rod before treatment

The graphite rod was analyzed prior to the experiment with the Inductively Coupled Plasma - Mass Spectrometry. As displayed in (*Table 2*), 29 elements were detected by the ICP-OES 5110 (Agilent) mass spectrometer (University of Lausanne, Switzerland), which represents only 0.19% of weight per mg, the rest of the graphite rod, i.e. 99.81%, being composed of pure carbon. Precise measurement ("Measured" column) was performed only for a few chemical elements which were found in the graphite after the treatment with the oxyhydrogen plasma.

After the oxyhydrogen plasma treatment, the following step involved the scratching of the graphite rod surface in order to obtain a powder which was analyzed with the PHENOM ProX SEM - EDX (Schaefer-Tec, Switzerland) and with the Tescan Mira II LMU (University of Lausanne, Switzerland). The powder contained a lot of different types of crystalline structures, as well as multiple plain transparent spheres, with different diameters, between 10 and 150µm (*Fig. 10*). Small air bubbles were perceived in some of those spheres that were mostly composed of C, O and Al. Equally detected were a very high percentage of Ca and Fe, and a lower percentage of Mg, Na and K.

The EDX measurements provided a shorter list of elements found in the micro-spheres, but the concentration of those elements was much higher than that of the previous measurement in the graphite rod sample. Calculated concentrations within one sphere were based on two different measurements, where a percentage augmentation between the measurements before and after the oxyhydrogen treatment was observed (*Table 3, 4*).

Element Number	Element Symbol	Element Name	Before treatment Weight conc. (%)	After treatment Weight conc. (%)	Agmentation (times)
8	O	Oxygen	not measured	60.85	-
14	Si	Silicon	0.0115877	17.84	1539.6
13	Al	Aluminium	0.0193691	11.93	615.9
20	Ca	Calcium	0.0136558	3.86	282.7
26	Fe	Iron	0.1154631	3.08	26.7
12	Mg	Magnesium	0.0035213	1.05	298.2
11	Na	Sodium	0.0040300	0.23	57.1
19	K	Potassium	0.0041610	0.10	24.0

Table 3 - Measurements made with PHENOM ProX SEM - EDX

As it is well known, the "Kervran Effect" was studied only in biological systems, but we can see in the present paper that the same principle could also be applied in this experiment where "sintering" and "cleavage" of the

Element Number	Element Symbol	Element Name	Before treatment Weight conc. (%)	After treatment Weight conc. (%)	Agmentation (times)
8	O	Oxygen	not measured	47.20	-
14	Si	Silicon	0.0115877	21.90	1889.9
13	Al	Aluminium	0.0193691	12.00	619.5
26	Fe	Iron	0.1154631	9.40	81.4
20	Ca	Calcium	0.0136558	8.30	607.8
12	Mg	Magnesium	0.0035213	1.20	340.8

Table 4 - Measurements made with Tescan Mira II LMU

stable nuclei of different elements are obtained by using the oxyhydrogen plasma.

The more energy gets applied in the process, the less distance between the two nuclei is observed, and without "fusing" a new element is formed. In that sense, there is no neutron emission and no detectable radioactivity, because they do not "fuse" and liberate a neutron, but rather stay close to each other with their respective nucleus intact and rotate on the common gravitational axis [2].

Possible formation of different elements is presented in (*Table 5*):

$$_8O + {}_6C \rightarrow {}_{14}Si \quad (8)$$

$$_6C + {}_6C \rightarrow {}_{12}Mg \quad (9)$$

$$_{14}Si + {}_6C \rightarrow {}_{20}Ca \quad (10)$$

$$_{12}Mg + {}_8O \rightarrow {}_{20}Ca \quad (11)$$

$$_{12}Mg + {}_1H \rightarrow {}_{13}Al \quad (12)$$

$$_{14}Si - {}_1H \rightarrow {}_{13}Al \quad (13)$$

$$_{13}Al + {}_{13}Al \rightarrow {}_{26}Fe \quad (14)$$

$$_{12}Mg + {}_{14}Si \rightarrow {}_{26}Fe \quad (15)$$

Table 5 - Different possibilities of formation of elements found in the spheres

As we can deduce from (*Table 2,3,4*), the augmentation of different elements exceeds 26 to 1800 times the initial concentration of elements, which represents a huge augmentation that cannot be explained just by a possibility of impurities in the ambient air, or by elements migration within the graphite rod.

The impurities in the graphite rod before the treatment have their importance, as those are considered to be the "seed" for the creation of the same elements [2]. Pure carbon rod, free from any impurity, could give a poorer reaction or no reaction at all. As for the creation of synthetic diamonds or sapphires, it is shown that certain proceedings need a "seed" of diamonds in order to get the crystallization started. The initiation of crystalline structure of the element is needed in order to capture new elements as they are created and thus grow the seed. It is equally important to calculate the augmentation of the elements from the impurities, as it is to search for the creation of new elements that have not been present at the beginning of the process. Undoubtedly, less energy is needed to obtain the transmutation elements if there exists a seed as a "starter".

Other elements also appeared in the SEM analysis (*Fig. 11a*) of the powder obtained after the oxyhydrogen treatment of the graphite rod, and we could see their composition as presented in (*Table 6*). Some new elements were identified, such as Cl and S, that were not present in the initial analysis.

Element Number	Element Symbol	Element Name	Weight Conc. (%)	Density (g/cm3)	Density (ng/µm3)
8	O	Oxygen	61.83	58.74	0.05874
6	C	Carbon	23.28	16.6	0.0166
13	Al	Aluminium	12.62	20.22	0.02022
17	Cl	Chlorine	0.73	1.54	0.00154
12	Mg	Magnesium	0.71	1.03	0.00103
20	Ca	Calcium	0.66	1.58	0.00158
16	S	Sulfur	0.15	0.29	0.00029

Table 6 - Measurements made with PHENOM ProX SEM - EDX

Their possible formation might be explained by the following reaction (*Table 7*) :

$$_8O + {}_8O \rightarrow {}_{16}S \quad (16)$$

$$_{16}S + {}_1H \rightarrow {}_{17}Cl \quad (17)$$

Table 7 - Possible formation of S and Cl

It is interesting to notice that in our experiment one element being composed of 100% carbon was found in great quantity (*Fig. 11 b, c*). Taskaev S. and al. [9] analyzed some crystals from the meteorite dust that fell on the Earth on 15 February 2013 in the area of Chelyabinsk (Russia). The external crystalline structure of our specimen presents facets under the SEM, and this specimen seems to be identical to the Taskaev's. What was found particularly difficult was to recognise the 100% carbon element among other graphite elements because of their visual similarity and composition. The (*Fig. 11d*) represents the magnification of the element shown in (*Fig. 11c*), which has a similar formation, but with a multiple layer structure inside. It is possible that this last element actually represents an early stage of the creation of element in (*Fig. 11b*).

One of the elements that were found in the graphite powder (*Fig. 12a*) was analysed by the Raman spectrometry in order to determine the crystalline structure. The analysis showed that this element was actually an Anorthite glass ($CaAlSi_2O_8$) which can be seen on the Raman spectra (*Fig. 12 b*).

2.3 Radiations and Energies

Detection of possible strong *β* and *γ* radiations was performed by the 360° Radiation Detector (©SOHE) (*Fig. 3*) installed around the graphite/oxyhydrogen plasma contact point.

Radiation detector is a solid-state Silicon PIN photodiode-based gamma-photon detector, which uses multiple BPW34 photodiodes connected in parallel as sensors and controlled by an Arduino microcontroller. The detector comprises 12 modules, one of which has 6 detectors, each with 3 photodiodes, so the sensor surface per module is 22.5mm^2. Total surface covered with twelve modules is 270mm^2. The background noise is under 30mV, well under the input signal from the environment radioactivity. The sampling frequency per detector is 1.5kSample/s or 650µs/Sample, limited by microcontroller processor frequency, which is 16MHz.

While the experiment was running, no radiation was detected that exceeded the normal background emissions.

The temperature of the oxyhydrogen plasma was calculated by applying the Wien's displacement law, which says that for a blackbody radiator, the temperature can be found from the wavelength at which the radiation curve peaks [4]:

$$\lambda_{peak}\mathrm{T} = 2.898x10^{-3}m * K$$

whereby a reached temperature is 9383.15K for the oxyhydrogen peak at 308.85nm. The temperature of the broadband spectrum for the oxyhydrogen plasma/graphite rod was also calculated with the same equation, and this gives us a temperature of 4211.15K for the broadband peak at 688.17nm. Peaks of Na and K were not taken into account in the broadband temperature calculation.

The calculated oxyhydrogen plasma temperature does not correlate with the measured temperature [1], therefore further analysis and calculations should be performed.

The most interesting phenomena of the oxyhydrogen plasma, which may explain the energy involved in these transmutations, are supposedly the so called Condensed Plasmoids [11] represented in (*Fig. 1*). As the oxyhydrogen plasma passes through a 2-3mm diameter hole in the graphite, more energy gets concentrated in the middle of the plasma, thus creating a visible laser effect. This characteristic requires further investigation in future experiments.

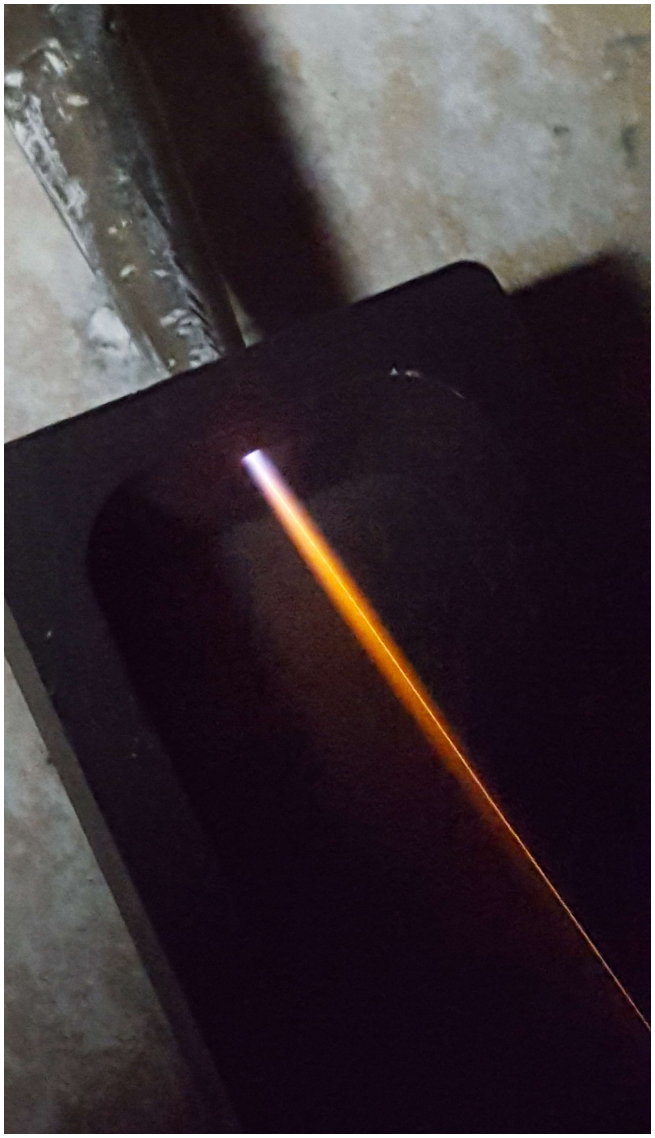


Fig. 1 -Strange effect of the oxyhydrogen plasma in contact with the graphite

3. Discussion

As it can be seen from calculations, the experiment with the oxyhydrogen plasma/graphite rod is endothermic, which means that more energy is consumed than released in the process of sintering nuclei together, and this energy is produced with the oxyhydrogen plasma. Contrary to the experiments conducted by Sundaresan and Bockris [3], Ransford[5], Monti[6], and Ohsawa[7], in which the main source of energy was electricity, in our experiment only the oxyhydrogen plasma was used.

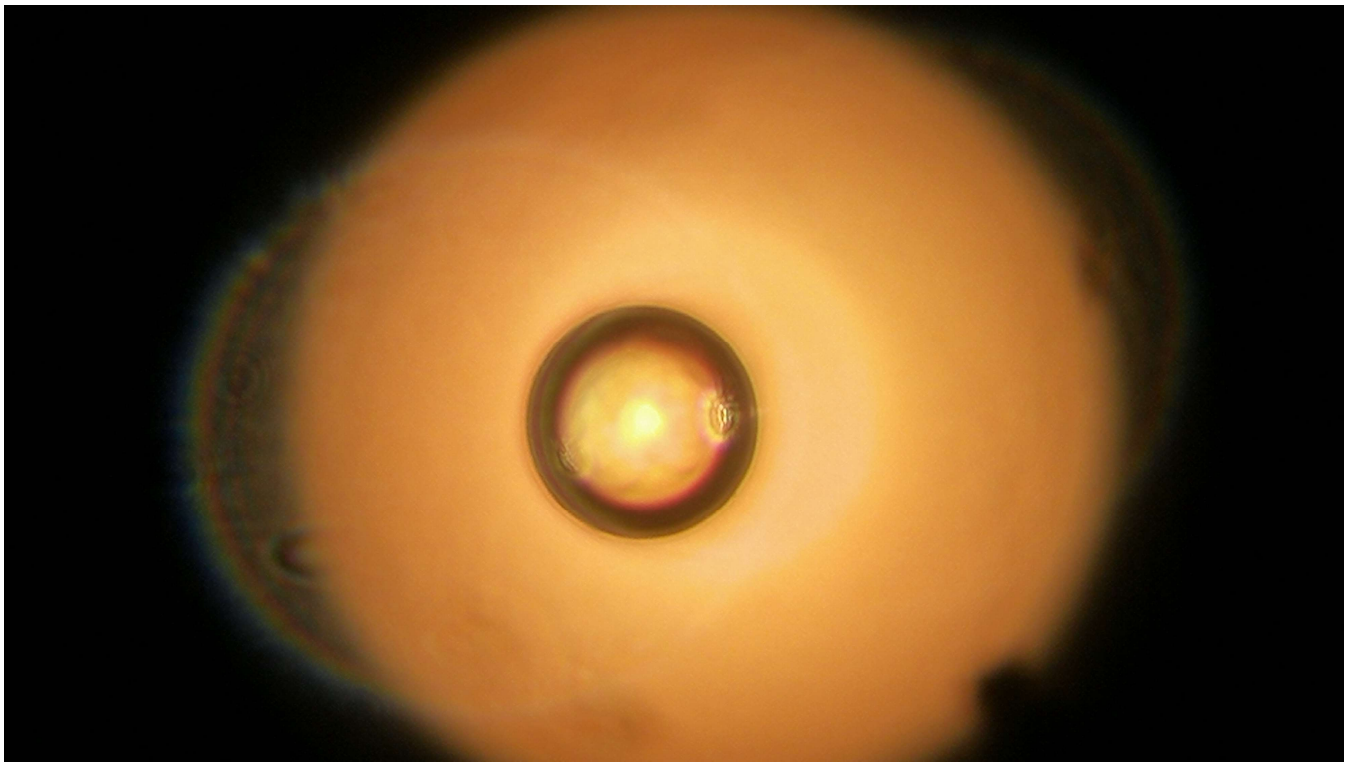
One plausible theory behind the whole process stipulates that the electrons are "trapped" in "Rydberg clusters" [10] and released as they enter in contact with

the graphite surface. The electrons then penetrate into the crystalline structure of the matter and break the bonds. The energy liberated at that moment is used in the process of “sintering” and “cleavage” of different nuclei in order to produce the same element.

Next steps in the research path of nuclear transmutation with the oxyhydrogen plasma would include the following: measurement of the electro-magnetic field and electric current generated in the plasma; analysis of the plasma in the VUV/EUV and NIR range; measurement of potential radiation of slow neutrons; measurement of possible CO and CO_2, as well as testing other materials, and further analysis with SEM/EDX and Raman spectrometry.

4. Acknowledgements

We hereby aknowledge the precious help from Tom Field (www.rspec-astro.com) for modifications of his software in order to meet our needs, Schaefer-Tec company from Switzerland for their help in the sample analysis, and Bob Greenyer from MFMP for fruitful discussions. This work was funded and executed exclusively by the Swiss Oxyhydrogen Energy.



One of the spheres found in the graphite sample after the treatment with oxyhydrogen plasma

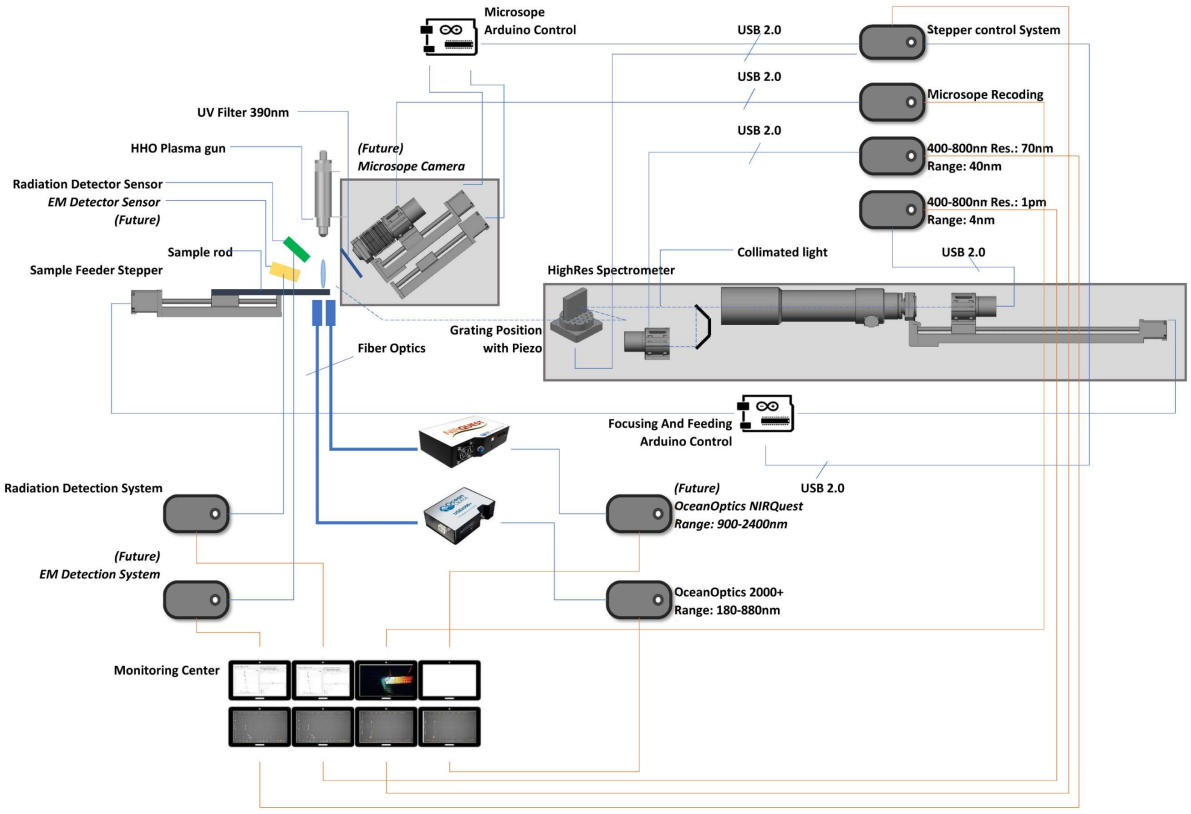


Fig. 2 - Experimental setup

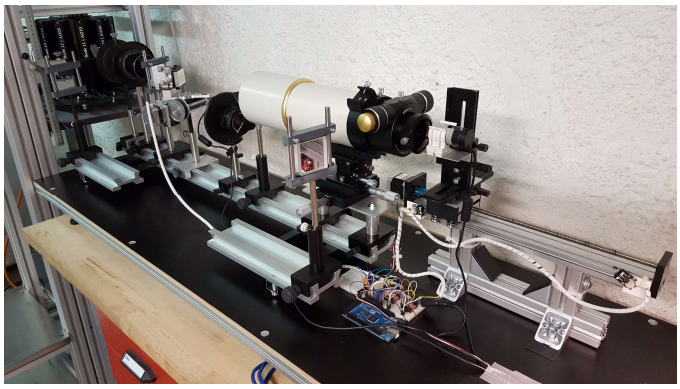


Fig. 3 - HighRes Spectrometer (without cover) (by SOHE)

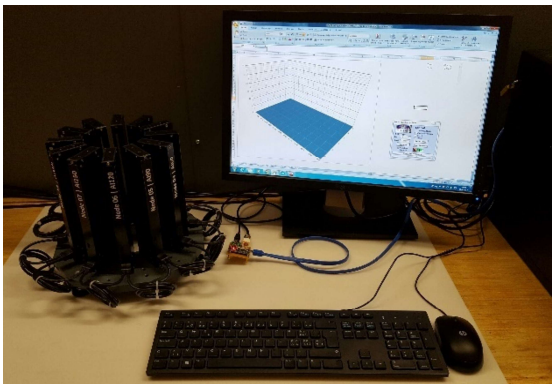


Fig. 4 - 360° Radiation Detector (by SOHE)

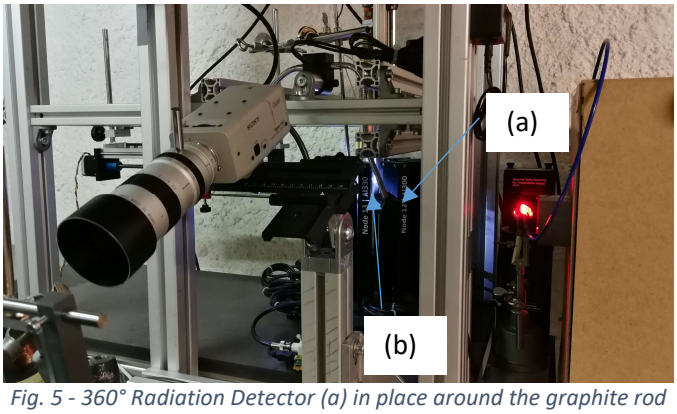


Fig. 5 - 360° Radiation Detector (a) in place around the graphite rod (b)

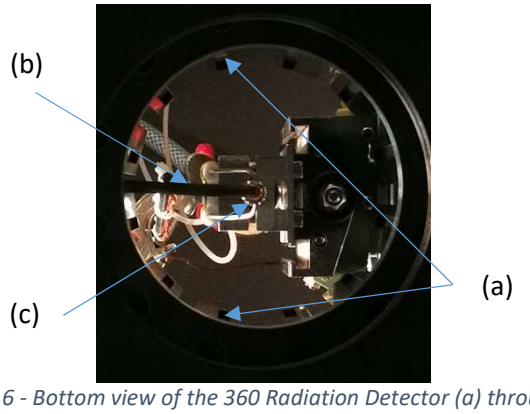


Fig. 6 - Bottom view of the 360 Radiation Detector (a) through the evacuation hole, the graphite rod (b) and plasma nozzle (c)

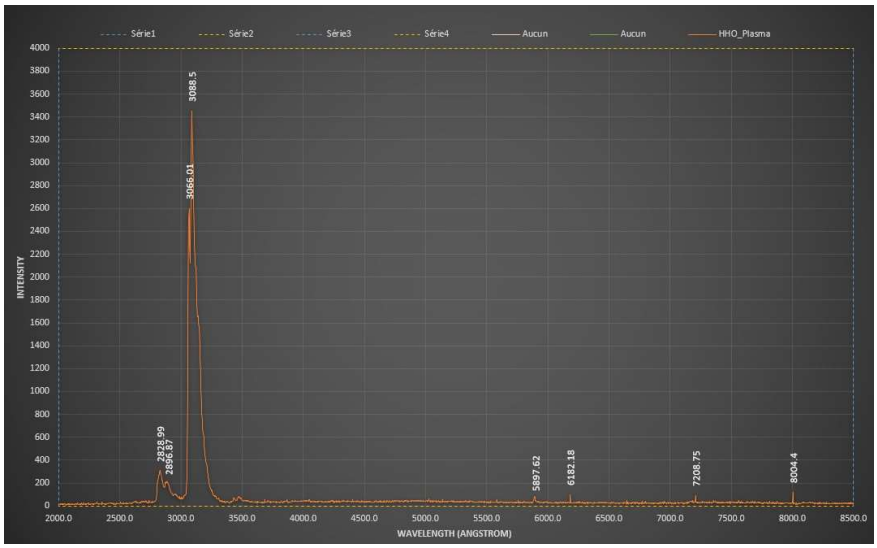


Fig. 7 - Spectra of hydroxyl radicals

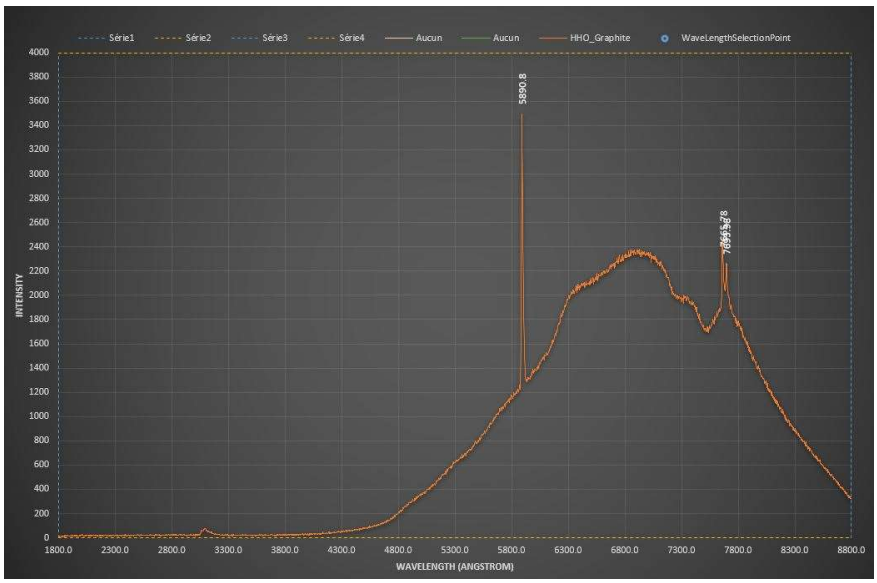


Fig. 8 - Spectra of the graphite rod under oxyhydrogen plasma (orange), with Na Doublet line at 589nm and K lines at 766.4 and 769.9nm and oxyhydrogen plasma alone (green)

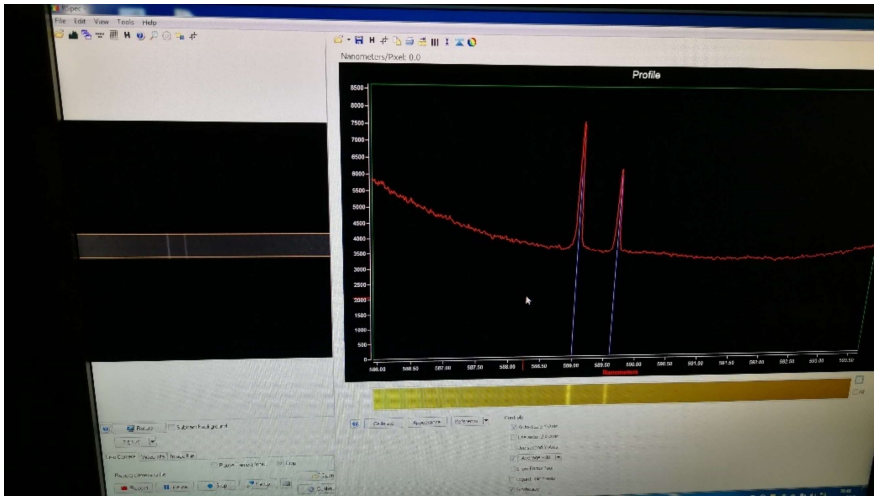


Fig. 9 – HighRes Spectrometer (by SOHE) resolved Na D-lines at 589.0 and 589.6nm (software by Tom Field, www.rspec-astro.com)

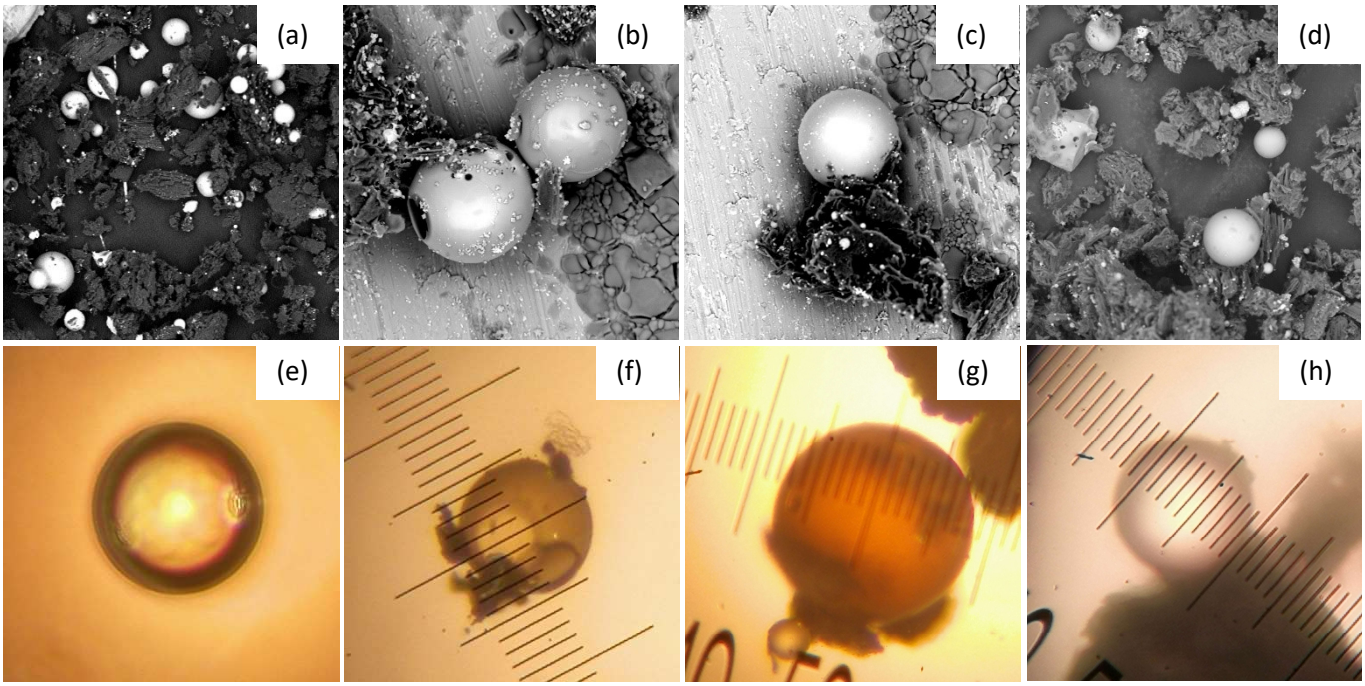


Fig. 10 - Multiple spheres observed under SEM (a-d) and under optical microscope (e-h)

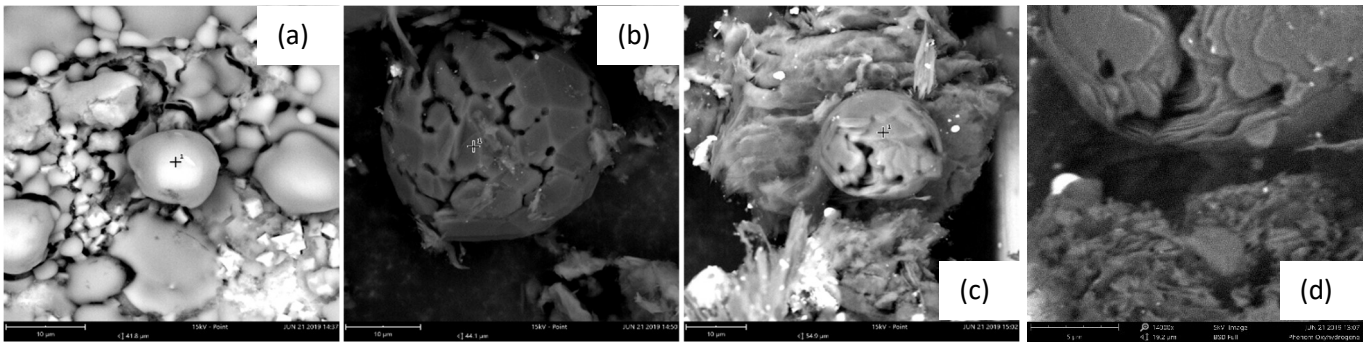


Fig. 11 – Different structures observed under SEM

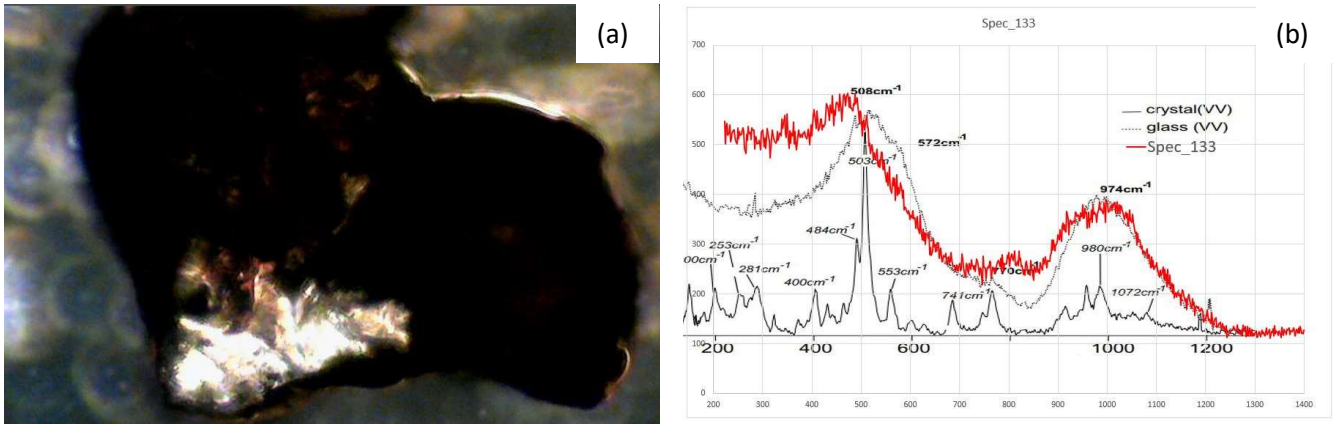


Fig. 12 - Anorthite glass, Spec_133 (a) and Raman spectra of the Spec_133 (b)

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