Microwave induced nuclear transmutations

Ernő Lakatos
2484 Agárd, Hungary
e-mail: lakatos.erno@t-online.hu

Low energy nuclear transmutation reactions were found in microwave induced plasma states created from solids irradiated by an intense microwave field. A modified commercial microwave owen was applied as a source of the intense electromagnetic field. Samples were fabricated from solid Pb placed on ceramic substrate which construction absorbed microwave power efficiently resulting arc discharge and producing plasma state. Possible nuclear transmutations originated form K and Si of the components of the ceramic substrate were observed resulting Cl and S in such quantity that was not present before microwave irradiation. A possible qualitative theoretical explanation of the experienced nuclear transmutation is also suggested.

PACS numbers:
Keywords: Low energy nuclear reaction, LENR, transmutation, microwave energy, plasma, CICP, cooperative internal conversion process, non thermal microwave effects

I. INTRODUCTION

Fleischmann and Pons [1] announced their discovery on 'Cold Fusion' in 1989. They observed large scale excess heat in their electrolysis experiment and claimed that it was generated by nuclear fusion process at room temperature. This new phenomenon, which is called low energy nuclear reaction (LENR), has been investigated by several research groups all over the world since then [2], [3] and [4].

The concept of LENR, as well as the above mentioned research findings, have been refused by the majority of the main stream scientific world due to the following reasons:

Based on the standard nuclear fusion model the Coulomb barrier cannot be overcome by positively charged nuclei (protons) in low temperature.

There are missing nuclear particles and radioactive emission, which are considered to be accompanying effects of the standard nuclear fusion (hot fusion) processes.

Most of the LENR experiments are successfully replicable only randomly. This seems to be the most annoying factor for scientists. Additionally, unexpected nuclear transmutations accompany LENR in several experiments, which arises further questions.

In this paper we propose a novel approach to microwave induced nuclear transmutations, both from experimental and theoretical aspects.

The microwave processing of materials is a relatively new technology that provides new approaches to change and improve the physical properties of materials. The use of intense microwaves for processing solids or ceramics has been widely studied and reported [5]-[8]. There have been numerous publications which mainly reports chemical and physical reactions resulting new properties of proccessed materials. The majority of the reactions can be attributed to thermal or temperature effects alone but in some cases extra effects like thermal runaway and hot spots could play significant roles. The hotspot is created by thermal-runaway instability which is ceased by a phase transition, namely by melting, evaporation, or breakdown of the material in the sample, forming liquid, gas, or plasma, respectively. Up to now there is no precise or acceptable explanation of them. These phenomena bring up the possibility of attendance of low energy nuclear processes in microwave induced surroundings.

The microwave plasma processing has been applied effectively in metals and ceramics [9], [10]. In our experiments the plasma state plays key role to transform materials into atomic state. The low energy nuclear reactions can occur with observable probability in that state of materials. [11], Therefore the microwave induced plasma allows nuclear transmutation.

II. EXPERIMENTAL SETUP AND OBSERVATIONS

The following equipment were used in the experiments:
- a modified MW311 microwave owen with net output power 800 W produced the microwave field,
- a GAMMA-SCOUT Geiger-Müller counter was applied to determine the level of gamma radiation,
- the OLYMPUS Delta Professional XRF Analyzer was used to obtain elemental composition,
- a Canon EOS 60D video camera with macro lens recorded the events.

The sample (see Figure 1) consisted of a piece of lead alloy (L: 28mm, W: 3,5mm, H: 1,3mm), and a ceramic holder (L: 48mm, W: 18mm, H: 22mm). The elemental composition of the lead alloy is showed in Fig. 2 and the elemental composition of the ceramic holder can be seen in Fig. 3. Here LE and ND mean light elements and not detectable, respectively. The elemental composition measurements were done by X-ray fluorescent (XRF) analyzer in both cases.

The conditions of the surroundings before the start of microwave irradiation were the following: the temperature was 22 $^{\circ}C$ and the pressure was normal atmospheric

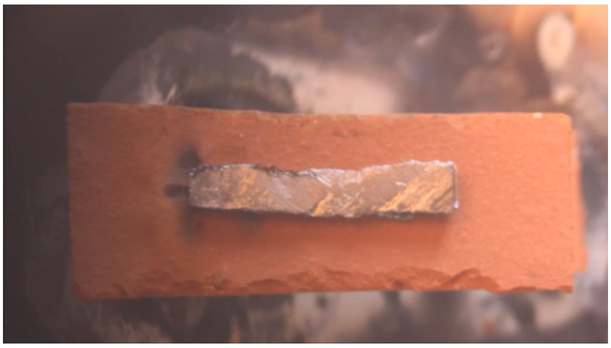

FIG. 1: Picture of the sample before microwave irradiation

Element	Ti	Fe	Ni	Sb	Ir	Pb
Vol. %	8.65	0.1018	0.2070	0.5209	2.25	88.27

FIG. 2: Elemental composition of lead alloy before irradiation.

pressure. The level of gamma radiation fell in the range of $0.100 - 0.200$ micro Sievert which can be considered to be a normal background value.

The power of the applied microwave field of multi mode operation was 800W. The irradiation time took 45 sec. (The complete video of the experiment can be seen at the web-site: https://www.youtube.com/watch?v=C-i5vvWmLCg)

It can be seen in Fig. 6 that new elements such as Cl and S were significantly created in consequence of nuclear transmutation (as will be shown later) during this complex process caused by microwave irradiation. Although the non processed ceramic holder had some small portion of S (0.3183 %), the S content increased conspicuously (9, 0497 %) in the irradiated sample. The experiment was replicated with same conditions/setup and the nuclear transmutation occurred again. (The video of the second experiment can be accessed at the web-site: https://www.youtube.com/watch?v=Wu7HhtnY4HY)

In both cases the measured gamma ray intensity was in the same range as it was without microwave irradiation.

Element	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V
Vol. %	1.00	5.46	18.42	0.1896	0.3183	ND	5.0773	2.0153	0.2949	0.0292

Element	Mn	Fe	Co	Ni	Zn	Zr	Cd	Sn	Sb	LE
Vol. %	0.0789	4.0238	0.0249	0.0096	0.0104	0.0233	0.0257	0.0285	0.0373	62.92

FIG. 3: Elemental composition of the ceramic holder before irradiation.

FIG. 4: Picture of the sample during microwave irradiation.

FIG. 5: Picture of the sample after microwave irradiation.

III. DISCUSSION AND SUMMARY

In a recent paper [11] a new phenomenon called cooperative internal conversion process (CICP) was discussed. The CICP is a special type of the well known internal conversion process [12]. In CICP two nuclei cooperate by neutron exchange creating final nuclei of energy lower than the energy of the initial nuclei. The process is initiated by the coupling of bound-free electron and neutron transitions in the initial atom, leading to the creation of a virtual free neutron which is captured due to strong interaction by an other nucleus (for the details see [11]). In an other paper [13] cooperative internal conversion process by proton exchange (CICP-PE) was also investigated. In CICP-PE the coupling of bound-free electron and proton transitions due to the dipole term of their Coulomb in-

Element	Mg	Al	Si	P	S	Cl	K
Vol. (%)	1,97	0,31	2,59	0,0965	9,0497	15,46	6,11

Element	Ca	Fe	Ni	Sn	Sb	Pb	LE	Sum
Vol. (%)	3,9317	0,1944	0,1199	4,4216	1,2711	31,11	23,38	100,0149

FIG. 6: Elemental composition of of the irradiated sample.

teraction permits cooperation of two nuclei leading to a proton exchange between them which is accompanied by creation of a free electron.

However, there are other possibilities to realize CICP when, instead of proton exchange, an other charged heavy particle is exchanged [13]. If the heavy charged particle, which is exchanged, is ${}^{4}_{2}He$ then the process is called cooperative internal conversion process by ${}^{4}_{2}He$ exchange .

The following CICP processes can be found with ${}^{4}_{2}He$ exchange which are able to create new elements from K and Si such as Cl and S:

$$e_1 + {}^{41}_{19}K + {}^{28}_{14}Si \rightarrow e_1' + {}^{37}_{17}Cl + {}^{32}_{16}S + 0.725\ MeV,$$

$$e_1 + {}^{39}_{19}K + {}^{30}_{14}Si \rightarrow e_1' + {}^{35}_{17}Cl + {}^{34}_{16}S + 0.706\ MeV.$$

Summarising, this experiment showed up a completely new approach of LENR process. It was presented the proof of the novel theory CICP-HeE. There is a big chance to find out and describe precisely the whole and very complex process by additional research activities. Further investigation is needed e.g. in direction of material science and EM field and material interaction.

The author is indebted to P. Kálmán for the valuable and stimulating discussions.

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