Microwave Induced Elemental Transmutation in Compact Flourescent Lamps

Ernő Lakatos
TKI-Ferrit Ltd

Microwave Induced Elemental Transmutation in Compact Flourescent Lamps

Ernő Lakatos

lakatos.erno@lenrhun.hu

web: lenrhun.hu

Hungary

Abstract

The low energy nuclear transmutation reactions were investigated within a compact flourescent lamp (CFL), which was irradiated by intense microwave energy. A modified microwave owen operated as a source of intense electromagnetic field. Solids like glasses or CFLs absorbed efficiently microwave energy (E+H field both) resulting arcing, ionization and plasma state. We observed and measured possible elemental transmutation of the P to Si and S in CFL-s during intense microwave (MW) irradiation. Since this phenomenon seems to be very complex, therefore it requires multidisciplinary approaches.

Keywords: Low energy nuclear reaction, LENR, transmutation, microwave energy, plasma, atomic state, hot spots, CICP, cooperative internal conversion process, Compact Flourescent Lamp, CFL,

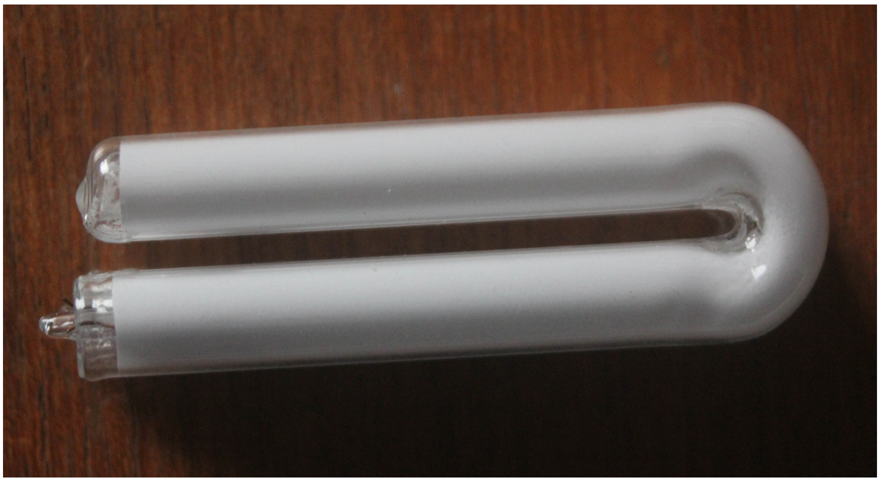
1. Introduction

The microwave processing of materials is a relatively new technology that provides new approaches to improve the physical properties of materials. The use of intense microwaves for the processing solids or ceramics has been widely studied and reported [1–4]. There have been numerous publications which mainly reports chemical and physical reactions resulting new properties of proccessed materials. The majority of the reactions can only be attributed to thermal or temperature effects but in some cases non

thermal effects like thermal runaway and hot spots could play significant roles and so far there is no precise or acceptable theory for them.
The microwave plasma processing has been applied effectively in metals and ceramics processes [5-6]. The interactions among the physical and chemical components of a microwave plasma system are numerous and not understood or described well so far [7-11].
The plasma state plays key role to transform materials into atomic state, where the low energy nuclear reaction could occur with highest probability. The compact flouseccent lamp is an ideal device to create ionized and plasma state components which can interact each other resulting new elements. This study describes the processes and results and give a theoretical explanation as well.

2.The Experiment Setup

First of all we had to prepare the two CFLs for the experiment. We took new lamps and removed the ballast/electric components (see Picture 1). One of them was smashed and all the internal components (including electrodes) was measured by XRF analyzer providing us the results of the elemental components before microwave irradiation (Figure 1). The second one was placed into the applicator (see Picture 2) and then it was irradiated by P=150W microwave power for 4 minutes. The temperature of the lamp increased to 110 Celsius continously. After that we increased the power to P= 400 W, the lamp temperature reached the 346 Celsius at the centre of the lamp, the irradiation took only additional 2 minutes and 21sec when the lamp was melted and broken (see Pictute 3,4,5).



Picture 1. The CFL without ballast

2.1 The equipments used for the experiments as follows:

-Applicator (reactor) system made of rectangular waveguide (see Picture 2),
-FLUKE 65 Infrared Thermometer ,
-GAMMA-SCOUT Geiger-Müller counter,
-OLYMPUS Delta Professional XRF Analyser ,
-Video camera Canon EOS 60D + Macro lens

-The type of the compact fluorescent lamp: 11W E14 SES
Produced by TUNGSRAM

2.2 The measured elemental composition of the compact fluorescent lamp (CFL)before irradiation was:

	Elements	Mg	Al	Si	P	S	Cl	K	Ca	Ti
Before	Vol.(%)	3.13	11.96	12.92	2.1736	ND	ND	1.1701	0.3501	0.6752

Figure 1. The relevant elemental composition of the CFL internal components before microwave irradiation

2.2 The general conditions during microwave irradiation :

Ambient temperature: 22 Celsius

Pressure: normal atmospheric pressure

Power of microwave irradiation was150- 400W, single mode

Gamma ray was in the range of 0.100 -0.200 mikro Sievert (normal background values)

Picture 2.: CFLis located in applicator

3. Atomic and Ionic Polarizations

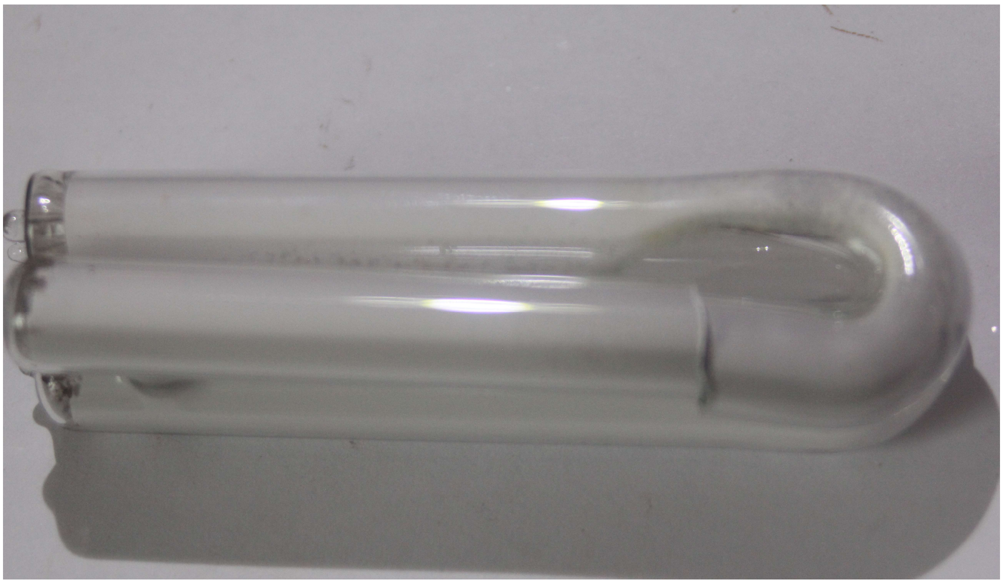
Under an electric field, E, the electron cloud in an atom may be displaced relative to the nucleus, leaving an uncompensated charge *-q* at one side of the atom and *+q* at the other side. The uncompensated charges produce an electric dipole moment and the sum of those dipoles over a unit volume is the polarization, P. The single atom can have the shape of the "electron cloud" surrounding the nucleus distorted by the electric field. In general, atoms with many electrons (high atomic number) are more easily distorted and are considered more "polarizable". Similarly, deformation of a charged ion relative to other ions produces dipole moments in the molecule. Those are the atomic and ionic polarizations induced by the electric field. Although atomic and ionic polarizations occur at microwave irradiation of the material, they do not contribute to microwave heating, but they can foster the emergence of the plasma state.

4. Plasma Generation

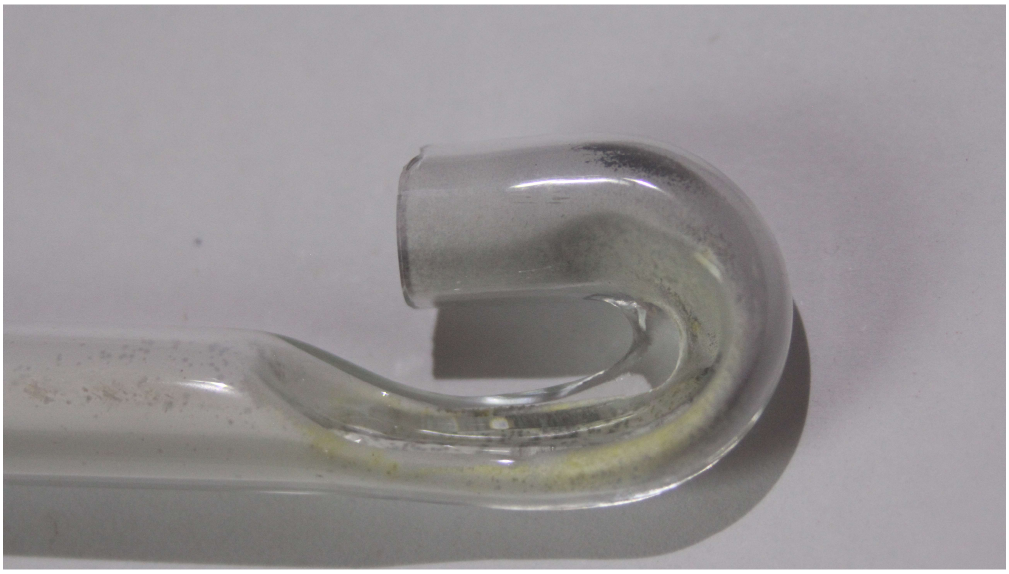
Microwave plasmas can be generated in single-or multimode cavities. Microwave excitation readily forms plasmas at reduced gas pressures. Atomic or ionic species in the plasma may react with the substrate to form volatile constituents (etching), or species in the plasma may react to form solid materials, which are deposited on the substrate (plasma-enhanced chemical vapor deposition). Plasma surface modification processes may involve either of these interactions. The interactions among the physical and chemical components of a microwave plasma system are numerous and not well understood. Further work of a basic nature is required to better elucidate these interactions. In our experiment to generate plasma state is key process in the way to get atomic state materials which then are able to react each other at low energy level. This (the atomic state) is one of the basic requisite to initiate LENR (Low Energy Nuclear Reaction).

5. Results

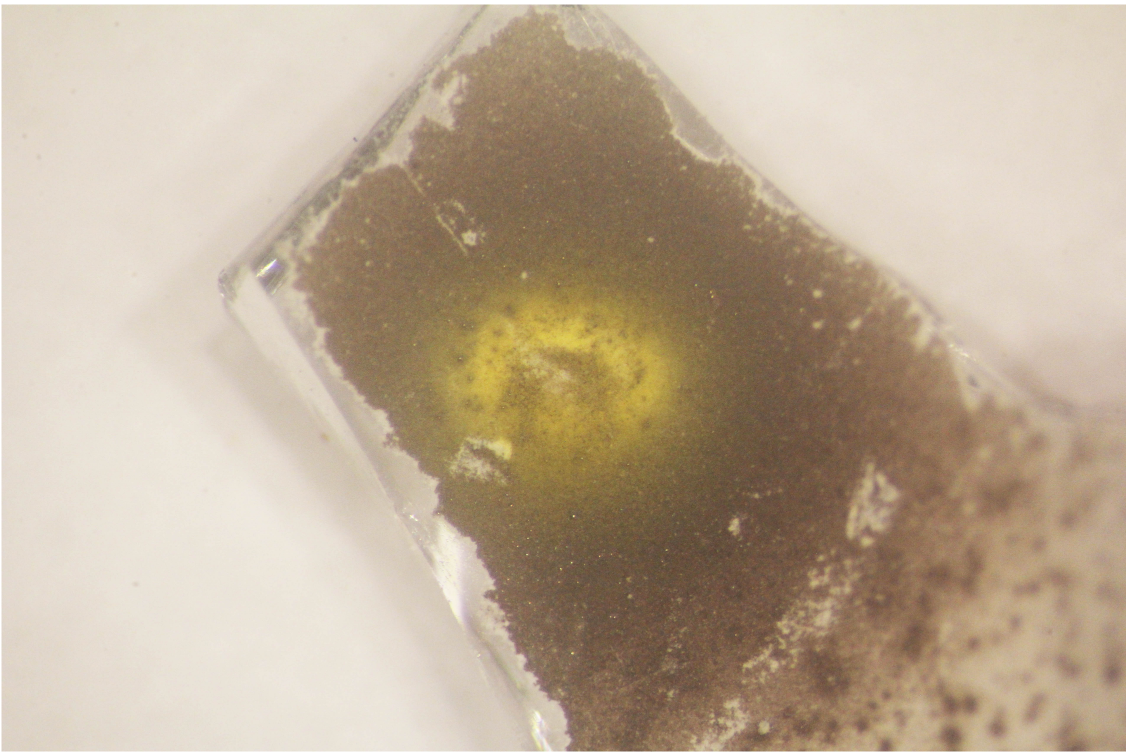
The CFL was smashed after MW irradiation and the content of the melted part was measured by XRF analyzer in several points.



Picture 3.: CFL after MW irradiation



Picture 4.: CFL after MW irradiation



Picture 5.: Hot spot with sulpur from the melted CFL pieces.

5.1 The material composition of the sample after irradiation

	Elements	Mg	Al	Si	P	S	Cl	K	Ca	Ti
BEFORE	Vol.(%)	3.13	11.96	12.92	2.1736	ND	ND	1.1701	0.3501	0.6752
AFTER	Vol.(%)	1.17	0.70	13.52	0.1941	0.3030	ND	3.91	1.1446	0.5476

Figure 2. Elemental composition of the CFL before and after MW irradiation.

As it can be seen in Figure 2. new element, sulfur (S) appeared/transmutated during this complex process, after MW irradiation. Furthermore it was assumed that Si (Silicon) was generated as well. The experiment was replicated with similar conditions/setup with different type of CFLs and the elemental transmutation repetead again. Besides the observed elemental transmutation process ,remarkable heat energy was released , melting the glass tubes of CFLs.

The measured Gamma ray intensity was in the same range as it was before the irradiation.

5.2 Theoretical explanation of the elemental transmutation.

In a recently published paper [12] a new phenomenon, the cooperative internal conversion process (CICP) was discussed. The CICP is special type of the well known internal conversion process [13]. 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 due to the dipole term of their Coulomb interaction in the initial atom ,leading to the creation of a virtual free neutron which is captured through strong interaction by an other nucleus. An additional paper [14] was published on cooperative internal conversion process by proton exchange.

In this theoretical study the process formula is

$$e_1 + {}^{A_1}_{Z_1}X + {}^{A_2}_{Z_2}Y \rightarrow e_1' + {}^{A_1-1}_{Z_1-1}V + {}^{A_2+1}_{Z_2+1}W + \Delta$$

(where X and Y are the original elements, V and W are the transmutated elements, delta= the excess energy of the reaction,
A=mass numbers, Z= proton numbers, e1= bound electron, e’= free electron)
The process formula is in a special case where X=Y :

$$e_1 + {}^{A_1}_{Z_1}X + {}^{A_1}_{Z_1}X \rightarrow e_1' + {}^{A_1-1}_{Z_1-1}V + {}^{A_1}_{Z_1}$$

In our experiment X= P (Phosphor), V= Si (Silicon) and W= S (Sulphur).
The result is colored by red in Table I.

$Isotope$	$Products$	$\Delta_-(MeV)$	$\Delta_+(MeV)$	$\Delta(MeV)$
^{19}F	$^{18}O, ^{20}Ne$	-0.705	5.555	4.850
^{23}Na	$^{22}Ne, ^{24}Mg$	-1.505	4.404	2.899
^{27}Al	$^{26}Mg, ^{28}Si$	-0.982	4.296	3.314
^{31}P	$^{30}Si, ^{32}S$	-0.008	1.575	1.567
^{45}Sc	$^{44}Ca, ^{46}Ti$	0.400	3.056	3.456
^{55}Mn	$^{54}Cr, ^{56}Fe$	-0.778	2.895	2.117
^{59}Co	$^{58}Fe, ^{60}Ni$	-0.075	2.245	2.170
^{103}Rh	$^{102}Ru, ^{104}Pd$	1.076	1.369	2.445
^{127}I	$^{126}Te, ^{128}Xe$	1.083	0.873	1.956
^{133}Cs	$^{132}Xe, ^{134}Ba$	1.204	0.879	2.083

TABLE I: Data for cooperative internal conversion process by proton exchange. (Data to reaction (11).) In the first column the initial stable isotope (of unity relative natural abundance) and in the second column the reaction products can be found.

The 3rd column + 4th column energy data = 5th column final or excess energy data, which were calculated on Table of Isotopes [15] data . If the final energy has positive value then the reaction is possible to take place.

6. Conclusions

This experiment showed up a possible LENR process where P(phosphor) transmutated to Si (Silicon) and S (Sulphur) during MW irradiation. The silicon transmutation was not proven since it existed before MW irradiation as well (the glass tube was made of silicon). The microwave was just a simple tool to have heated materials, to achieve plasma state, atomic state where the reaction can take place. In several cases when non thermal effects like thermal runaway and hot spots take place during microwave processing of different kind of materials, they also can be associated with LENR processes. In order to have more detailed explanation, further experiments are needed.

References

[1] Stein, D.F. 'Microwave Processing of Materials', Committee on Microwave Processing of Materials, National Materials Advisory Board, 1994.
[2] Osepchuk, J.M. 'Microwave Power Applications', IEEE T. Microw. Theory, 50, 2002, 975–985.
[3] Clark, D.E. and Sutton, W.H. 'Microwave processing of materials', Annu. Rev. Mater. Sci., 26, 1996, 299–331.
[4] Ishii, T.K. (Ed.) 'Handbook of Microwave Technology Vol. 2 Applications', Academic Press, London, 1995.
[5] Gupta, M.,Wong Wai Leong, E. 'Microwaves and Metals', John Wiley & Sons (Asia) Pte Ltd. 2007.
[6] Committee on Microwave Processing of Materials: An Emerging Industrial Technology, Commission on Engineering and Technical Systems, National Research Council. 'Microwave Processing of Materials'.1994.
[7] Kingston H. M. and Jassie L. B. "Introduction to microwave samplepreparation—theory and practice". ACS professional reference book. AmericanChemical Society. Chapters 2 and 3.1988
[8] Meredith Roger J. "Engineers'handbook of industrial microwave heating".No. 25. IET, 1-12.1988
[9] Thostenson E. T. and Chou T.-W. "Microwave processing: fundamentals and applications". Composites: Part A, 30,pp. 1055–1071.1999
[10]Nanthakumar B., Pickles C. A., and Kelebek S. "Microwave pretreatmentof a double refractory gold ore". MineralsEngineering, 20, pp. 1109–1119.2007
[11] Meredith Roger J. "Engineers'handbook of industrial microwave heating".No. 25. IET, 1-12. 1998
[12] P. Kálmán and T. Keszthelyi, arXiv: 1511.07164. 2015
[13] J. H. Hamilton, Internal Conversion Processes (Academic, New York). 1966.
[14] P. Kálmán and T. Keszthelyi, arXiv: 1602.05774. 2016.
[15] R. B. Firestone and V.S. Shirly, Tables of Isotopes, 8th ed.(Wiley, New York).1996.
[16] G. A. Kriegsmann, "Thermal runaway in microwave heated ceramics: A 1-D model," *J. Appl. Phys.*, vol. 71, pp. 1960–1966, 1992.
[17] X.Wu, J. R. Thomas, and W. A. Davis, "Control of thermal runaway in microwave resonant cavities," *J. Appl. Phys.*, vol. 92, pp. 3374–3380