GLOBULAR LASER IN/ON DBD PLASMA

Gheorghe DONCEAN[1]

e-mail: g-doncean@yahoo.com

Abstract

The paper presents the characteristics of the globular laser generated under resonance conditions. It highlights the diameter and internal architecture featuring spokes and rolling surfaces, depending on whether contact medium is ambient air or DBD plasma at atmospheric pressure. The paper present transitory expansion structures at high voltage, when resonance is exceeded.

Keywords: globular laser, DBD plasma, diameter, rolling path, spoke, rolling surface, CIExy diagram

Natural ball lightning, *figure 1.a*, is an explosive gas plasma sphere (5-30 cm diameter, the life of t = 0.01 to 120 s, in the linear t[s] = 0.01 D [cm]) with an ionogenic internal structure that contains an impressive amount of energy, W, composed of electromagnetic energy (Wem), chemical energy (Wch), energy of nuclear synthesis (Wsn):

$$W[J]=Wem + Wch + Wsn$$

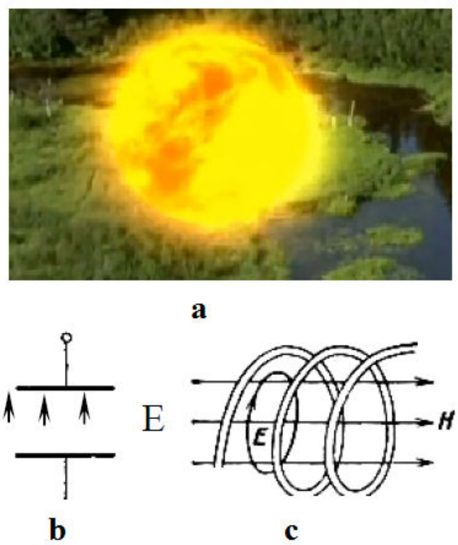


Figure 1 **Natural ball lightning - a and methods to produce it: in an electric field (E) – b and in magnetic field (B) – c;.**

The movement of the ionised gaseous mass and concentration by enveloping and rolling in the electric field E or the magnetic field B, *figures 1b* and *1c*, are attempts to generate ball lightning with military and nuclear power applications (Vlasov A.N., 2009). Cold nuclear chemical synthesis is a goal for the future. The orientation towards classic technological processes provides the advantage of constructive simplicity and a high efficiency of internal power conversion.

In another variant (Shabanov G. D., 2010), Gennady Shabanov obtained a ball lightning with loads **concentrated** in the coating.

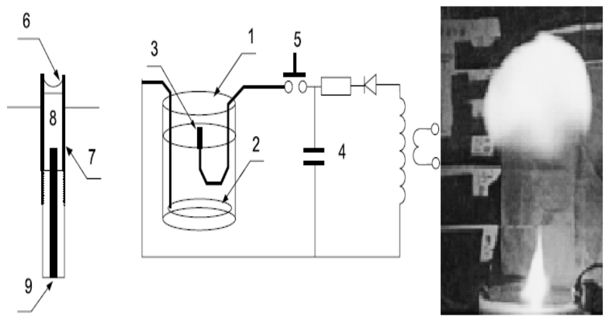


Figure 2 **Shabanov reactor**
1 – reaction container, 2 ,3 – electrodes, 4 – capacitor battery, 5 – discharger, 6 – liquid (water or suspension), 7 – quartz capillary tube, 8 - metal or coal electrode, 9 – copper strip

MATERIAL AND METHOD

Technical system

The referenced paper (Doncean Gh., 2014) presented structural characteristics of the system used to generate DBD plasma at atmospheric pressure.

To obtain the globular laser (the directed form of ball lightning) a multilayer composite electrode was designed, with unidirectional insertion, cf. *figure 3*, properly placed in relation to the ground electrode in order to ensure that the forced pulsed rolling movement of electrons in a preferred direction.

In the linear field, the duration t[s]=0.01 D, where D [cm] stands for the diameter.

[1] Assoc. prof. eng, "Gheorghe ASACHI" Technical University of Iaşi

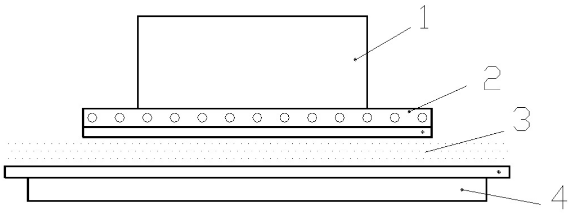


Figure 3 **Base active electrode circuit design 1- alveolar capacitor, 2 – composite active electrode, 3 – distance between electrodes (3 mm), 4 – base electrode**

RESULTS AND DISCUSSIONS

Preliminary results

Electrical discharges occur when the distance between the electrodes is not observed, reaching thrust potential Es [kV/m]. The emergence and development of formations (plasmoid) was noted, which are elongated, irregular, brown, thrusting, millimetres in length, cf. *figure 4*. These formations take the geometric of the discharge arc, *figure 5*.

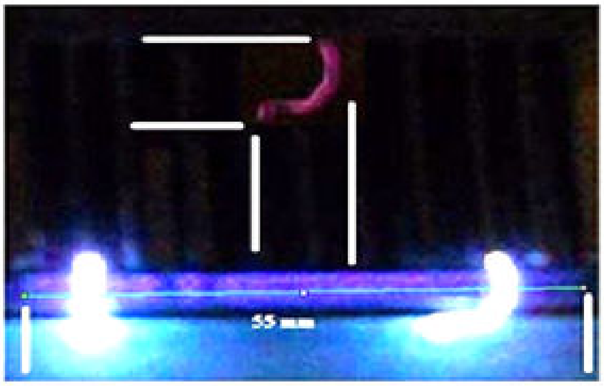


Figure 4 **Electrical discharges between electrodes and plasmoids**

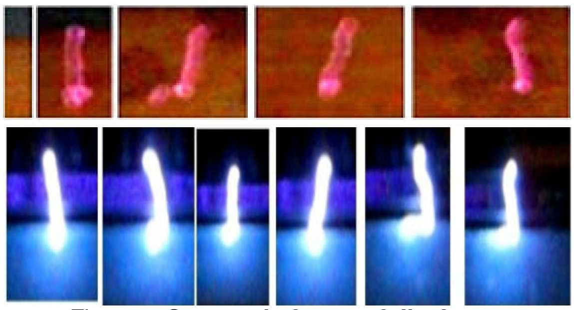
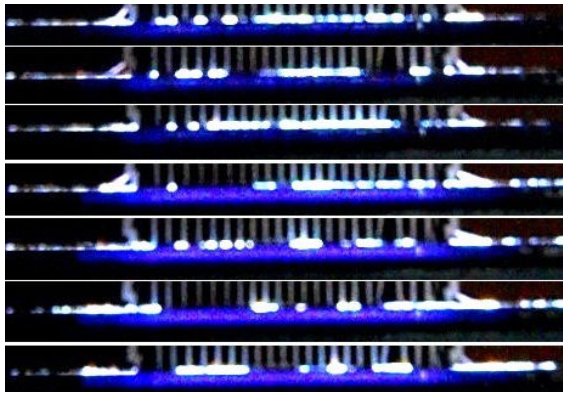


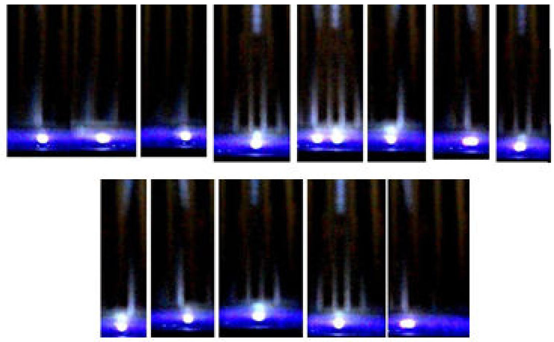
Figure 5 **Geometric forms of discharge**

Globular laser

Depending on how the two-side (A) and (B) working electrode relates to the base electrode, the globular laser is generated in/on plasma.



a



b

Figure 6 **Formation of globular laser on DBD plasma (a) and in DBD plasma (b).**

Regardless of the type of generation, with the A or B side of the active electrode in relation to the base electrode, the CIE x-y colour space highlighted energy positions for the two forms: DBD plasma and globular laser.

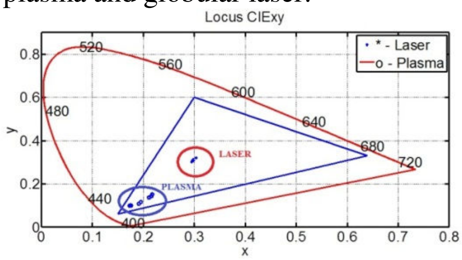


Figure 7 **Locus for DBD plasma and globular laser in CIExy plasma**

Geometric analysis of globular laser

a. Globular laser on plasma

Table 1

Diameter of globular laser on plasma

No./ Category	Input voltage [V]	Diameter [mm]	Perimeter [mm]	Area [mm^2]
	220	2.7800	8.7337	6.0700
	220	2.2284	7.0006	3.9000
	220	2.3235	7.2994	4.2400
Mean		**2.4440**	**7.6779**	**4.7367**
Average squared deviation		**0.2949**	**0.9265**	**1.1671**
4.	240	1.7590	5.5260	2.4300
5.	240	1.9083	5.9950	2.8600
6.	240	2.0591	6.4688	3.3300

7.	240	1.8814	5.9105	2.7800
8.	240	1.8403	5.7816	2.6600
Mean		**1.8896**	**5.9364**	**2.8120**
Average squared deviation		**0.1103**	**0.3464**	**0.3319**
Mean		**2.0975**	**6.5895**	**3.5337**
Average squared deviation		**0.3378**	**1.0612**	**1.2018**

b. Globular laser in DBD plasma

Table 2

Diameter of globular laser in plasma

	Voltage, V			
	180	**200**	**220**	**240**
Average diameter, [mm]	**1.1348**	**1.3604**	**1.8491**	**1.4288**
Standard deviation	**0.1110**	**0.3142**	**0.3979**	**0.3540**
Average value, [mm]	**1.6137**			
Average squared deviation	**0.4385**			

Analysis of the internal geometry of globular laser

a. Formation of globular laser on plasma, with internal rolling spokes

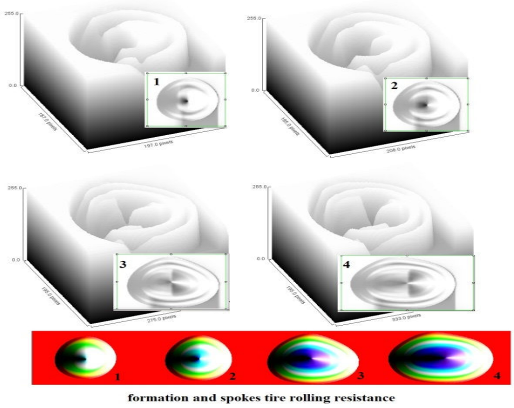
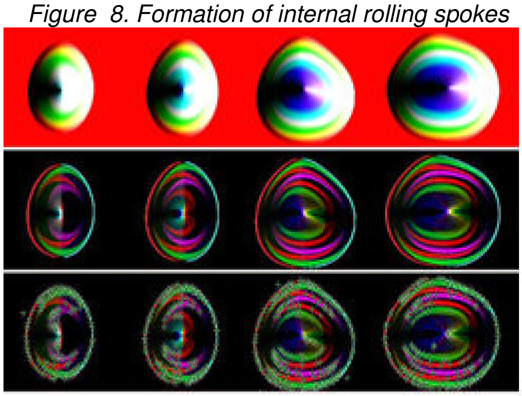


Figure 8. Formation of internal rolling spokes



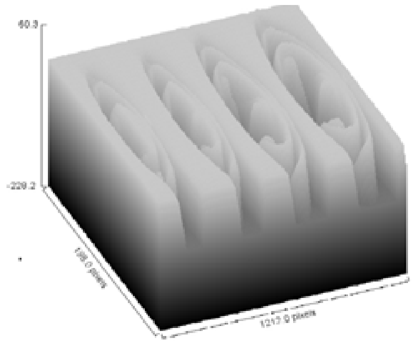


Figure 9 **Kinetics of the formation of globular laser on plasma**

b. Formation of globular laser in plasma, with internal rolling surfaces

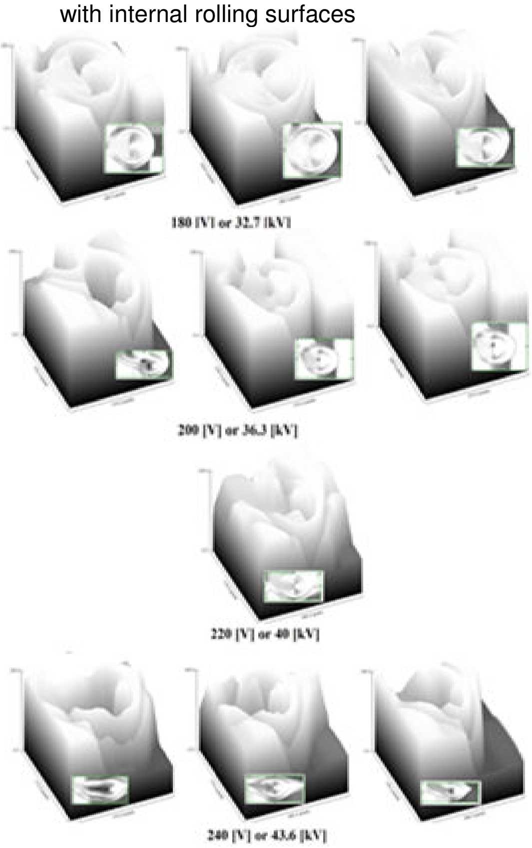


Figure 10 **Formation of the internal rolling surfaces**

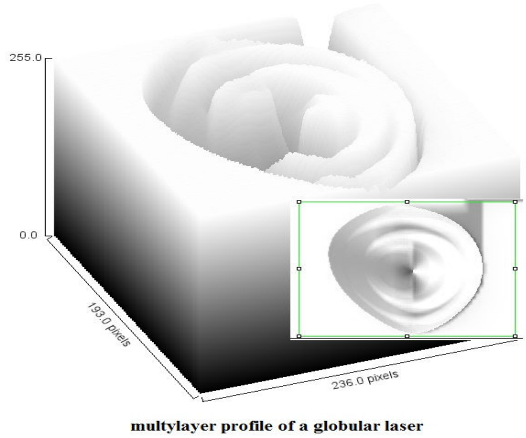
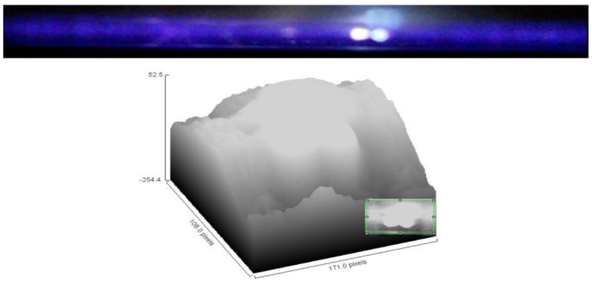


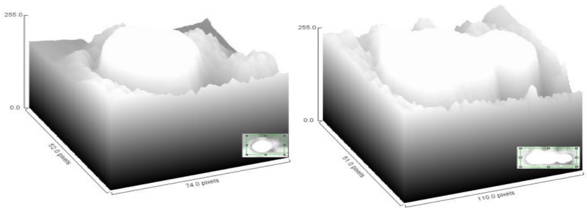
Figure 11 **Multiple-layer structure of globular laser in DBD plasma**

Phenomena in DBD plasma at high voltage (240 [V] or 43.6 [kV])

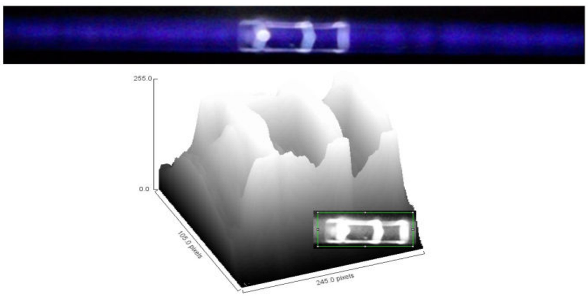
a) Stages in the formation of globular laser



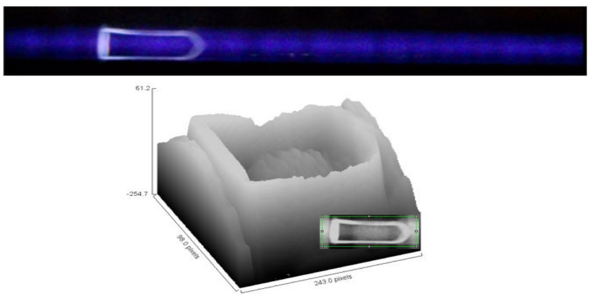
b) Joining of structural units



c) Successive formation of pentagon geometric shapes and the direction of movement



d) Extension of movement, expansion



CONCLUSIONS

If the distance between electrodes is not observed, uneven discharges result on the outside of the electrodes and elongated plasmoid shapes appear, that pierce the skin, *figure 4* and *5*.

Depending on the position of side A or B of composite active electrode in relation to the base electrode, the globular laser forms on plasma, *figure 6.a* or in plasma, *Figure 6.b*.

Regardless of the manner in which it is generated, the coherence of the globular laser is confined to a limited space in the CIExy space, *figure 7*.

From the geometric analysis of the diameter, more dense means are generated on plasma by increasing the voltage from 220 V to 240 V, Table 1 and in plasma, if voltage is raised to 220 V then a maximum diameter of 1.84 mm is achieved, *table 2*.

In globular laser on plasma, internal rolling spokes form, figure 8 and diameter grows with the rolling time, figure 9.

In plasma, globular laser develops internal rolling surfaces, *figure 11*.

At the primary voltage of 240 V, equivalent to the 43.6 kV secondary voltage, the density of the formation of globular laser increases in numerical terms too, with the expansion of pentagon-shaped globular units which are oriented to the top.

Whether in or on plasma, globular laser extends left to right across the width of the active electrode, which is much greater than the width of the alveolar capacitor, *figure 5.a*; *5.b* and Doncean Gh., 2014.

Why globular laser?

The alveolar condenser with a constant distance between the alveolar structural units, powered by impulses, accumulates constant energy volumes correlated with the frequency of the power source, discharging successively in the internal network of active electrode. Energy units are directed to the periphery of the electrode with a greater width than the width of the capacitor, generating laser and plasma expansion. At higher input voltages, there is a considerable increase in the number of lasers formed successively that build up through expansion.

The surface resonance of the system, established experimentally, is achieved at the primary voltage the 220 V or 40 kV in the secondary.

REFERENCES

Doncean Gh., 2014, *Conditions for obtaining uniform plasma in atmospheric electrical discharge with double barrier (D-DBD)*, Lucrări Ştiinţifice – vol. 56, Nr.1/2014, ISSN: 2069-6727, Iasi,

Shabanov G. D., 2010, *Lightning ball: experiments on creation and hypotheses*, Physics ± Uspekhi 53 (2) 215 ± 216;

Vlasov A.N., 2009,- *Induction discharges and MHD model of ball lightning,* Proceredings of the 16-th Russian Conference on Cold Nuclear Transmutation of Chemical Elements and Ball lightning, Dagomys, city of Sochi, ISBN 978-5-93271-428-7, pg. 81-113;

*** - http://www.revagrois.ro/index.php?lang=ro &pagina=pagini/acasa.html