ISSN: 2834-4928

Research Article

Journal of Electrical Electronics Engineering

A Model Recording Ultra-Weak Electromagnetic Radiation from Metals and Semiconductors

Batyanov A.P*

Institute of General Pathology and Pathophysiology Baltiyskaya st., Moscow, Russisa

*Corresponding Author
Batyanov A.P, Institute of General Pathology and Pathophysiology Baltiyskaya st., Moscow, Russia.

Submitted: 2024, Sep 05; **Accepted**: 2024, Oct 01; **Published**: 2024, Oct 25

Citation: Batyanov, A.P. (2024). A Model for Recording Ultra-Weak Electromagnetic Radiation from Metals and Semiconductors. *J Electrical Electron Eng, 3*(5), 01-16.

1. Introduction

In previous work, the question of a possible analogy of the physical processes of generation of ultra-weak electromagnetic radiation in biological and inorganic systems was considered [1]. The effect of ultra-weak electromagnetic radiation (UWER) from metals and semiconductors in a model system of light insulation of the studied samples in a hollow resonator emitter (SGK) is shown. It was established: 1) "quenching effect" - a decrease in the PMT signal during photoexcitation (250 nm) of W,Mo,Pt- transition metal samples and an increase in the signal during electrification of W,Al,Pt,Ge samples. 2) dependence of the resistance of the AlGaN LED on the sample under study. 3) the appearance of diffraction bands and images of structural elements on "conventional photographic film" - writing paper with HgS (cinnabar), during remote optical contact with (SGK). It is assumed that the effects obtained are caused by coherent radiation arising during electronic transitions in the system of hybrid orbitals of transition metals and semiconductors. This work presents additional data on the features of UWER of metals and semiconductors, in particular, an analysis of the "quenching effect" on photomultipliers in comparison with a similar effect from phosphorylating mitochondria [2].

2. Materials and Methods

The samples under study were placed inside a light-hermetic plastic capsule (SGK) to cut off radiation in the UV, visible and near-IR regions of the optical spectrum. The capsule is a hollow plastic cylinder (with a linearly increasing transmittance up to 15% from λ= 8μ to λ= 28μ), with a built-in LED, internal diaphragm and samples, in turn, was placed in a light-isolated space and considered as an emitter-resonator {Fig. 1}. To generate radiation, photoexcitation of the samples inside the emitter cylinder (250nm.470nm~15min.) or unipolar electrification was used - the sample was connected to one pole (-) of a direct current source. For optimal control over the dynamics of the UWER intensity and the reaction of the samples to photoexcitation and electrification, the experiment time (~75min) was divided into 5 equal (~15min.), successive stages-phases; Phase 1-5 - maximum light insulation of the PMT photocathode (background-1, background-2), phase 2-4-radiation of a hollow resonator with samples, without excitation (signal+background-1 and signal+background-2), phase-3 photoexcitation samples or electrification. The detector of expected radiation (UWER) was: FEU-106, with an amplification system, recording pulse / 10 sec. and two semiconductor systems - LED Al GaN and HgS (cinnabar based on aniline) applied to writing paper - a conventional analogue of photographic film [1].

3. Results and Discussion

A reliable and significant difference in the intensity of UWER (average number of pulses per 10 sec.) was observed both for a number of metals (Pb, W, Au, Mo, Cr, Cd, Ta, Pt, Al) and for semiconductors (InAs, Ge, InSb ,GaAs) at all stages of the experiment {Table 1}. In the temperature zone from 19 C to 24 C, a clear difference in the intensity of UWER for metals and semiconductors was observed, with an increase in T to 31 C this difference decreased significantly {Fig. 2}. At the same time, for each sample under study there is its own specific dependence of the UWER intensity on temperature. Among the metals, the highest UWER intensity was observed for W, Pb.Au.Mo, the lowest for Pt, Al, Cr, Cd. {Table 1}. For a number of semiconductors, the highest UWER intensity was observed for GaAs, the lowest for InAs, {Table 1} Taking into account the data on the high dependence of the dark current and sensitivity of antimony-cesium photocathodes on temperature, it is interesting to note the significant differences in the correlation coefficients between temperature and average radiation values (imp/10sec) for some metals [3]. So, for Pb the correlation coefficient is -0.23, for Ta 0.96, it is possible that such a difference indicates the influence of a non-thermal factor on the sensitivity of the photocathode. Significant variations in the correlation coefficient between the system emission level and the LED forward current in the SGK are also observed. During photoexcitation of the samples under study, it was established: upon irradiation (250 nm) of W foil placed in the SGK (phase-3), a significant decrease in the number of pulses at the (PMT) is observed, compared with the level in the previous (phase-2), from -038% to min. up to -6.37% per min. for individual experiments, for a group of 6 experiments, on average by -1.36% per minute {Fig.3}. However, the very effect of quenching PMT signals upon photoexcitation (250 nm) of W foil occurs only one day after the initial photo contact (~1 hour) with the SGK containing W. In this case, the primary, noticeable reaction of the PMT is an increase in the dark background (background-1), an average amount impulse/10 sec increases approximately 3.5 times {Fig4}. Subsequently, during successive experiments (~1 hour during the day), significant fluctuations in the PMT signals are observed, especially in the third phase of the experiment (irradiation at 250 nm) {Fig. 5}, which is possibly due to the uneven accumulation of electron traps in the photocathode system and its deviation from normal temperature regime with subsequent restoration, while the SGK with sample W was in light for 13 days isolated installation space{Fig.1}, and the background reversion to the initial level (before using W) takes about 5 days {Fig. 4a}. It is interesting to note that the mass and size of the sample (W) do not significantly change the specificity of UWER. For example, a fragment of a tungsten filament from a 60w incandescent lamp. when irradiated (250 nm) it gives a similar "quenching effect on the PMT" {Fig. 6}, an increase in the dark background of the PMT and significant fluctuations in signals in all phases of the experiment are also observed in comparison with other samples {Fig. 7}.

A less pronounced and temperature-dependent effect of "quenching" of the PMT signal was observed upon photoexcitation (250 nm) in (SGK) samples: InAs, InSb, Mo {Fig. 8}. When photoexciting, under similar conditions, samples: Ta, Cr, Au, Cd, Pt, the opposite trend was observed. When studying the influence of electrification of the samples under study on (UWER) it was established; supply (connection) of one negative pole of the element (voltage 5v, 8 v) to samples (W.Al,Pt,Ge) placed in (SGK) causes a reliable increase in the signal (PMT) {9}. Noteworthy is that when samples are electrified, more significant fluctuations in PMT signals are observed than during photoexcitation {10}. This may be due to a more pronounced shift in the electronic equilibrium during electrification [4]. The following diagram of the physical process leading to the effect of "quenching" of the PMT signal seems to be the most rational. All three factors influencing the samples under study (temperature activation, photoexcitation, electrification) are associated with the activation of electrons and disruption of electronic equilibrium in the outer electron orbitals, while generation of radiation in long-wavelength region of the optical spectrum. In this case, the stimulated radiation has signs of coherence, since it effectively affects the photocathode of the photomultiplier, changing its temperature dependence and sensitivity depending on the structural features of the samples under study, i.e. carries information about the structure of the process of its generation. This is especially noticeable for W (a sharply pronounced "quenching" effect of the PMT signal, as in the case of phosphorylating mitochondria {11}); it is very likely that the photoinduced radiation of tungsten and other samples under study creates traps for electrons in the system of electronically excited states of photocathode elements, and thereby reduces the intensity of the PMT signal. The data obtained on the effect of electrification of samples on the intensity and dynamics of UWER, as well as the appearance of diffraction bands on adsorbed HgS crystals, confirm the assumption of a connection between the electronically excited systems of the samples under study and the photocathode of the PMT in addition to radiation in the UV, visible and near infrared regions of the spectrum. Thus, it can be argued with a high degree of probability that the obtained data on the impact of the samples under study on the photocathode of the photomultiplier and recording semiconductor systems (AlGaN.HgS) are determined by the general energetic, non-thermal factor, possibly coherent radiation in the long-wave region of the optical spectrum as a result electronic transitions in the system of outer electronic bands (including s-conduction electrons and d-electrons of the valence band of transition metals W.Mo) [1]. The data obtained indirectly confirm previously stated assumptions that similar physical processes underlie bioeffects; distant-optical interaction of biological objects with each other and inorganic structures including the effect of the quenching effect of phosphorylating mitochondria on photomultipliers as well as non-chemical interaction of carcinogenic substances and biological objects [5-9].

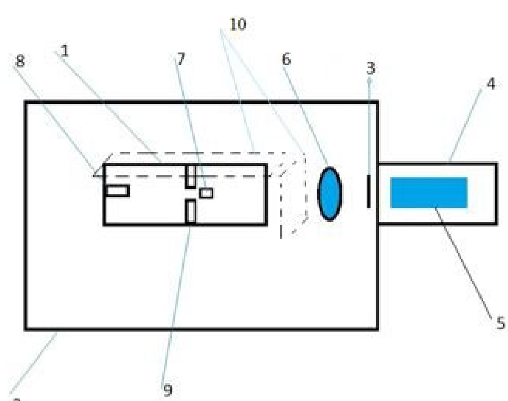

Figure 1: Block Schema

- Light-hermetic, plastic chamber (SGK)
- Lightproof camera
- Ebonite shutter in front of the FEU-106 photocathode
- Lightproof chamber for FEU-106
- Photomultiplier with end photocathode-FEU-106
- Quartz lens
- Test sample inside (SGK)
- LED (250nm) inside SGK
- Foam seal-diaphragm inside the SGK
- Cinnabar-coated paper strips (HgS)

Sample element	Pb	W	Mo	Ta	Au	Cr	Cd	Al	Pt	GaAs	Ge	InSb	InAs
Average acount signals/10sec inPMT	325,6	104	53.7	51.3	39.3	24.7	24.4	23.8	22.6	57.4	56.9	46.9	24.1
Correlation with T.C	-0,23	0,66	0,4	0,96*	0,64	0,81*	0,93*	0,14	0,78*	0,47	-	0,79*	0,57*
with I(f)	-0.51*	0.74	-0.75*	-0.11	0.3	0.26	-0.83*	0.16	0.54	-0.3		-0.49*	0.7*

Table 1: Radiation Intensity from Metals and Semiconductors Placed in the SGK

*The noted correlations are significant at the p≤ 0.05 level, all presented samples were irradiated (250nm) in the 3rd phase of the experiment
If –direct current of LED (8) { Figure1}

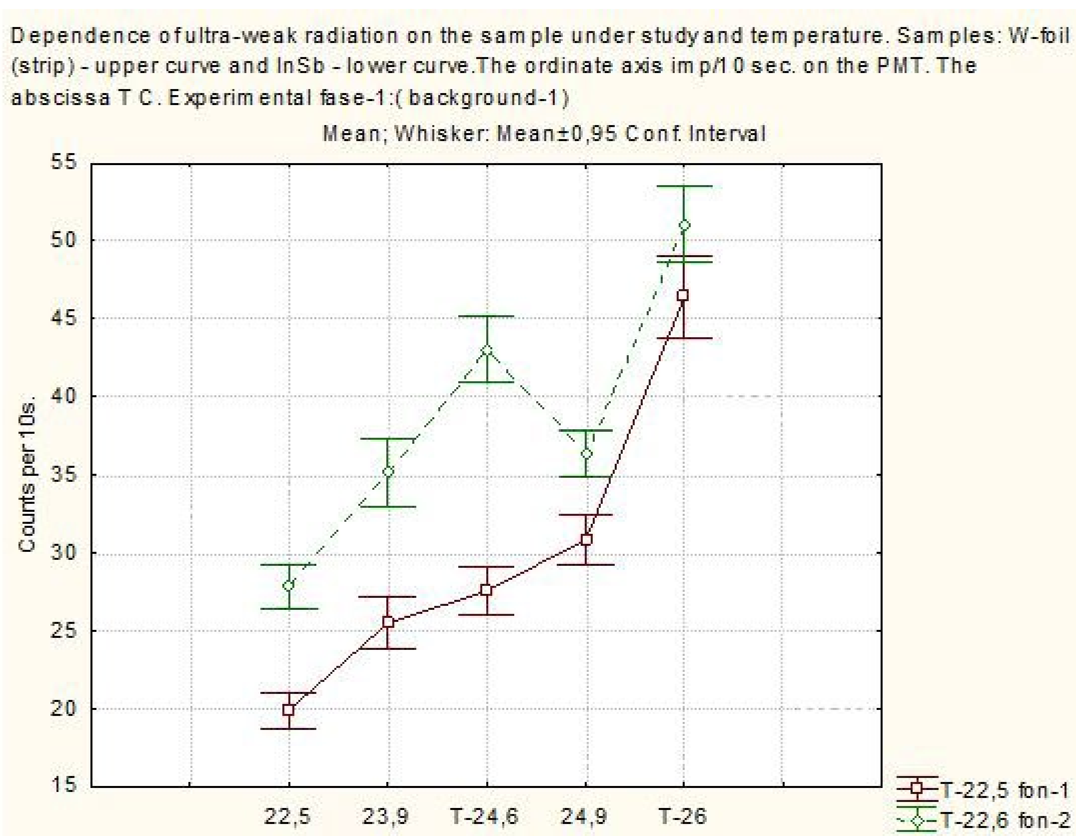

Figure 2:

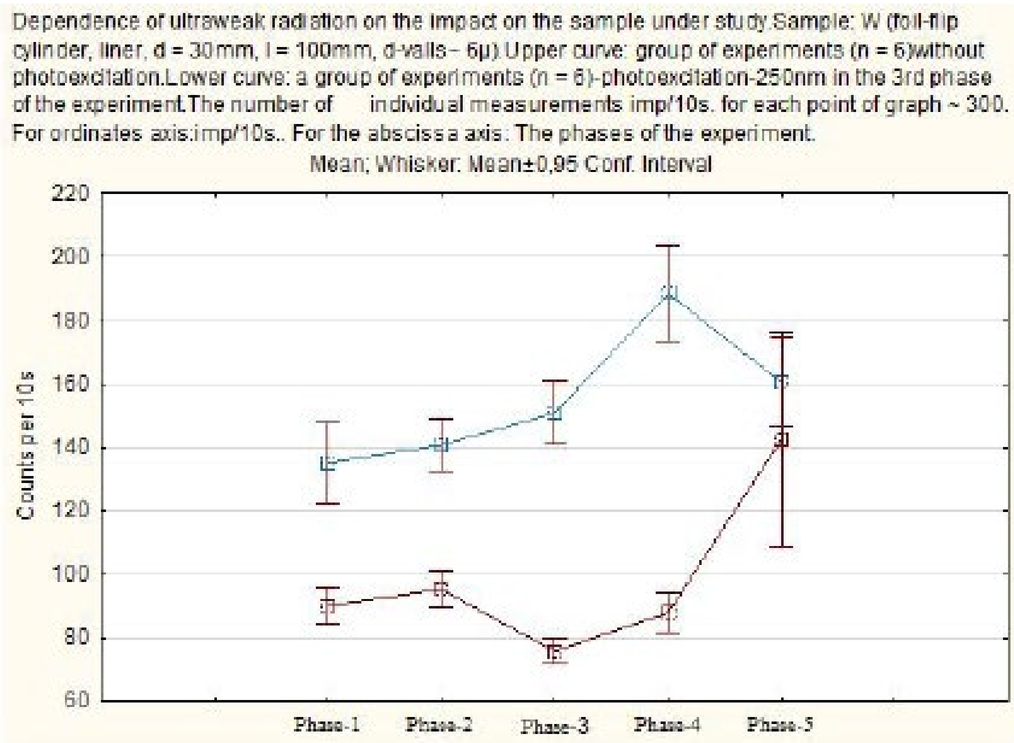

Figure 3:

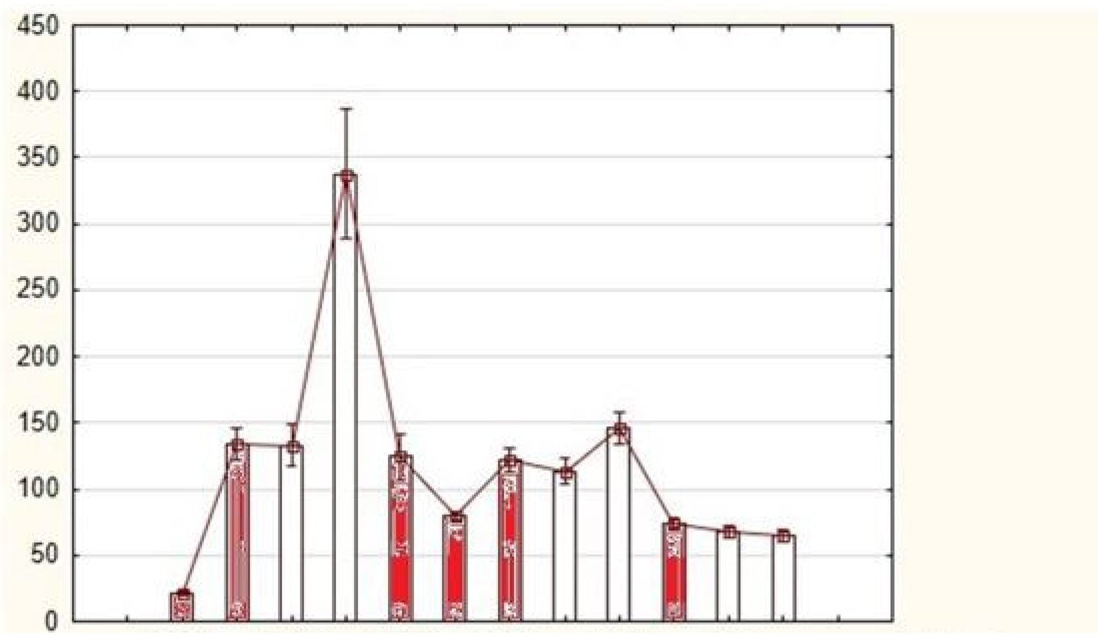

Figure 4: Average Number of Pulses/10 sec. on PMT in Successive Experiments in Phase-1. Sample: W-foil. Along the Ordinate Axis: Pulses/10 sec. Along the Abscissa Axis: T, C. Sign * - the Sample was Irradiated (250 nm) in the 3rd Stage of the Experiment. For Each Point of the Graph, the Number of Individual Measurements Pulses/10 sec. ~ 50

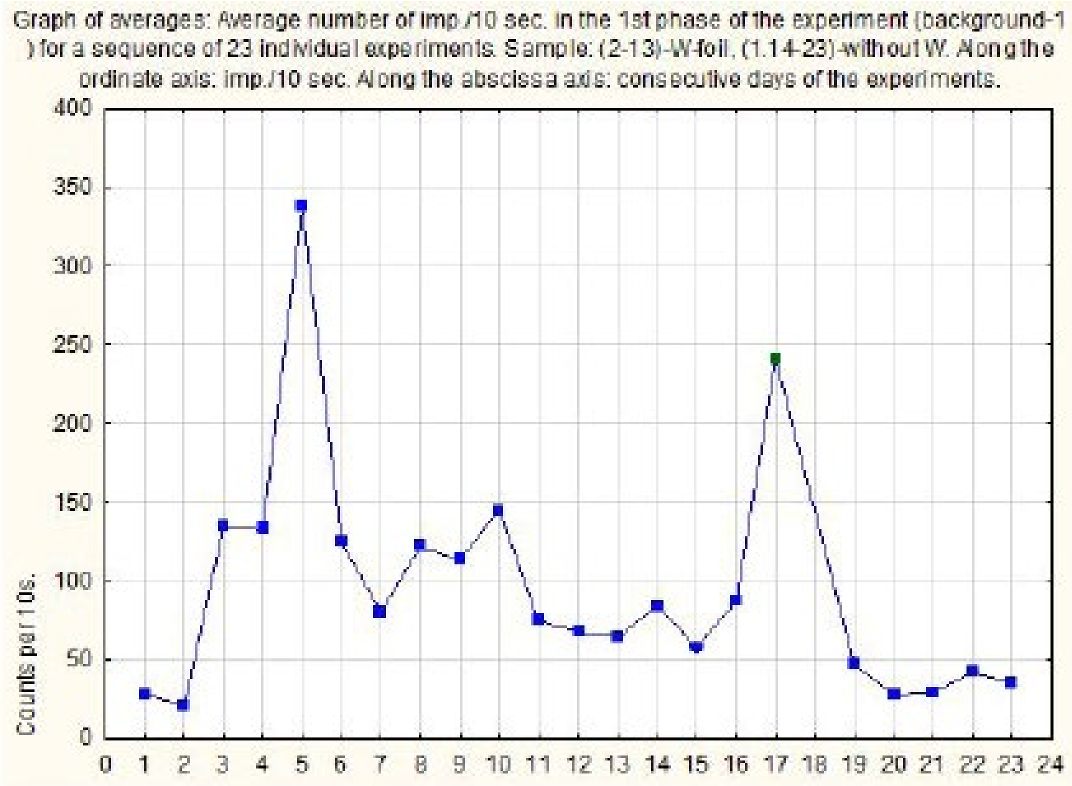

Figure 4a:

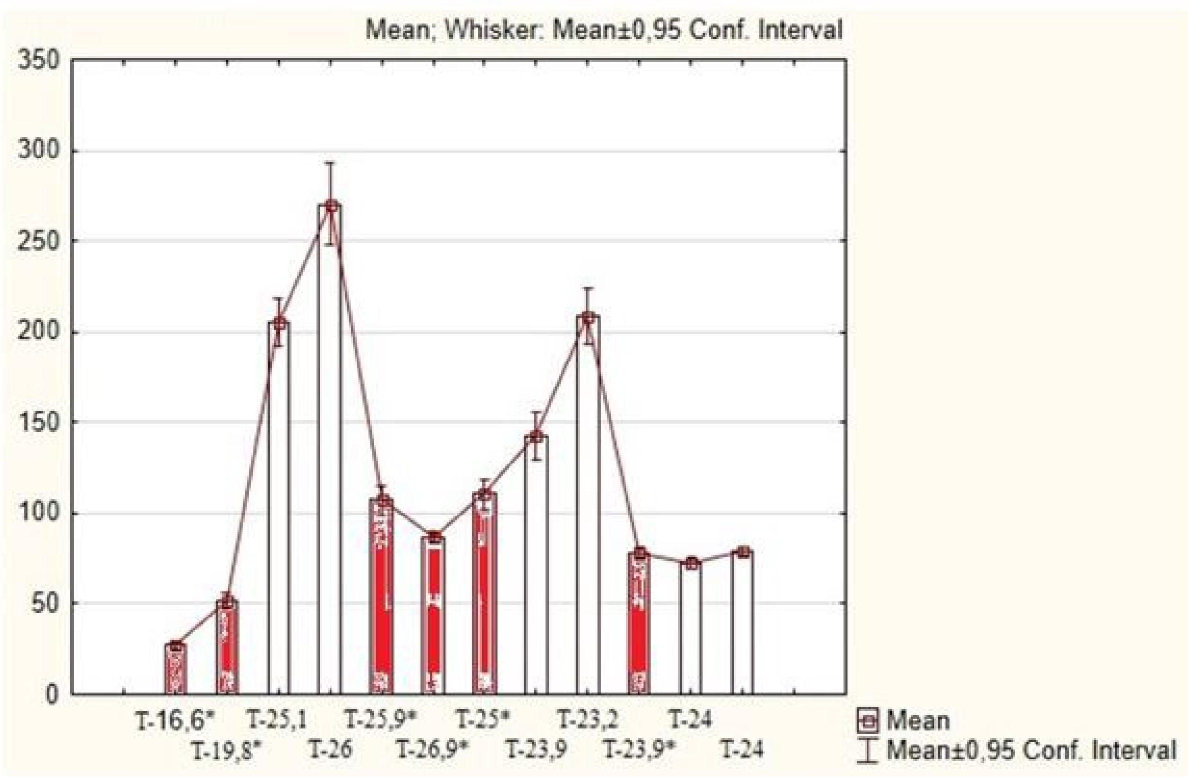

Figure 5: Average Number of Imp/10 sec. on PMT in Successive Experiments in Phase-3. Sample: W-foil. On the Ordinate Axis Imp/10 sec. on PMT. On the Abscissa Axis: T, C. Sign * - Sample Irradiated (250 nm) in Phase-3. For Each Point of the Graph the Number of Individual Measurements Imp/10 sec. is ~50

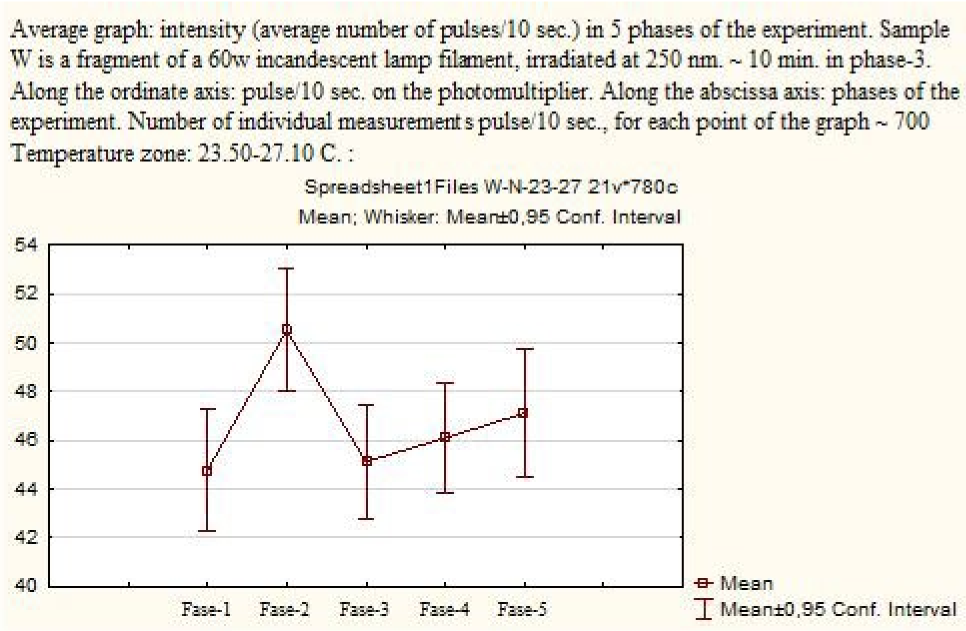

Figure 6:

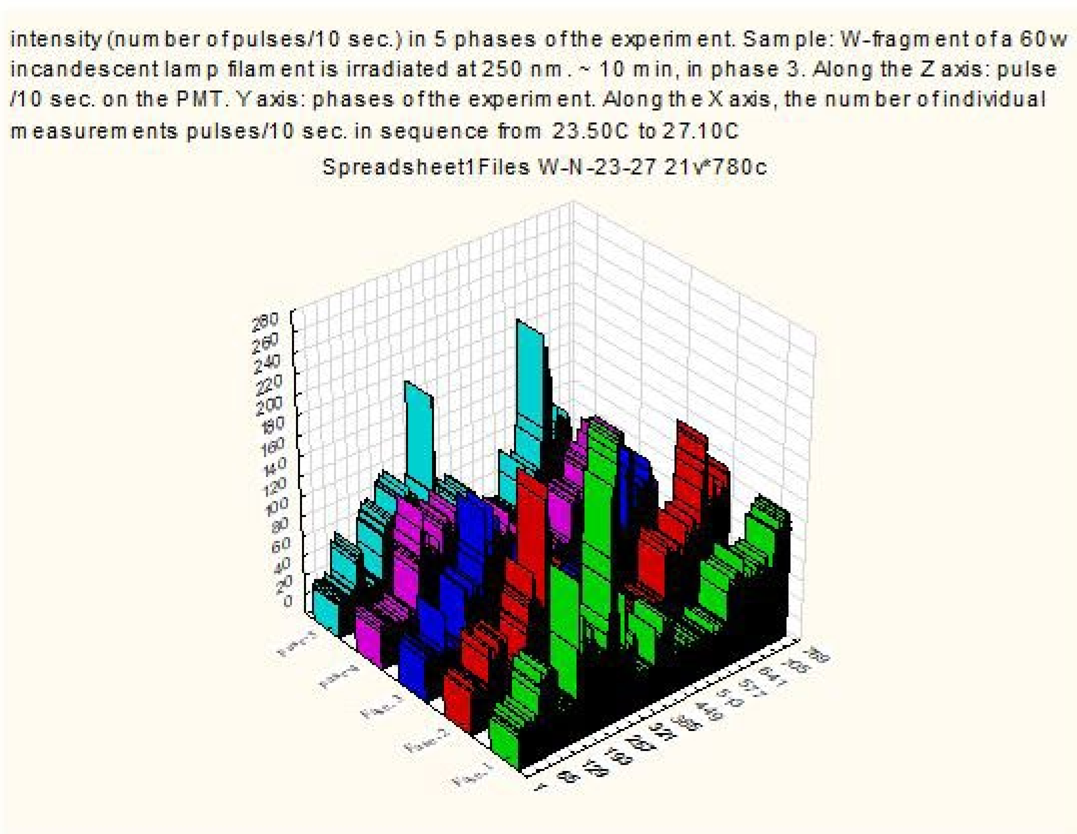

Figure 7:

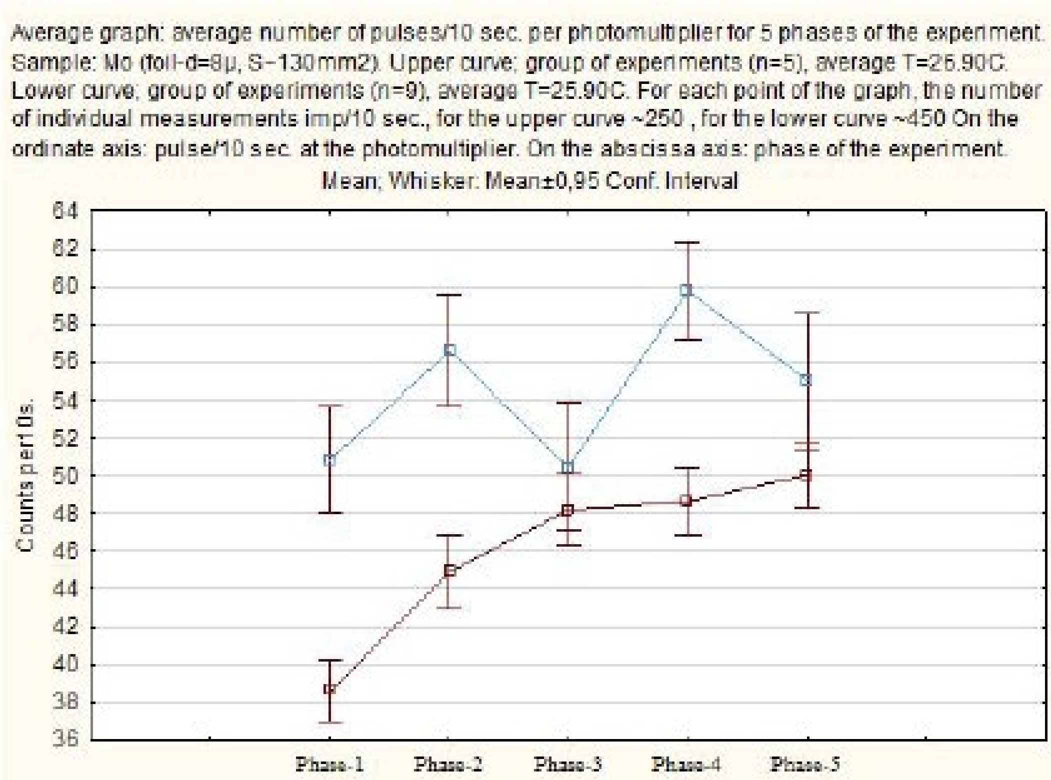

Figure 8:

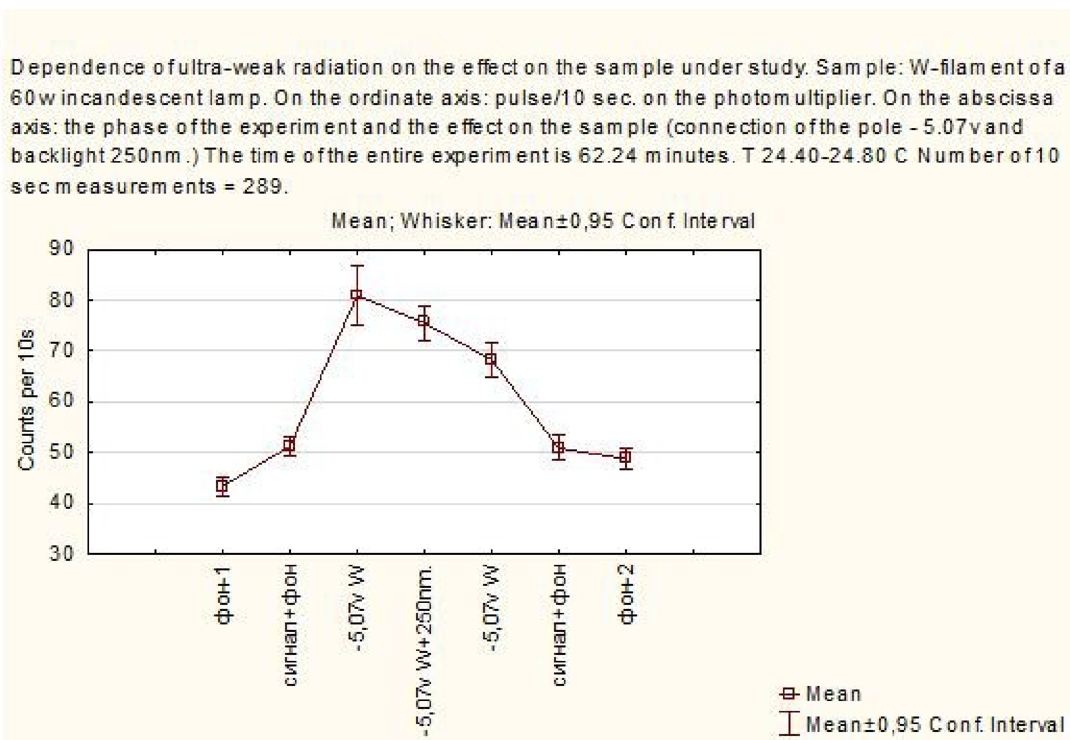

Figure 9:

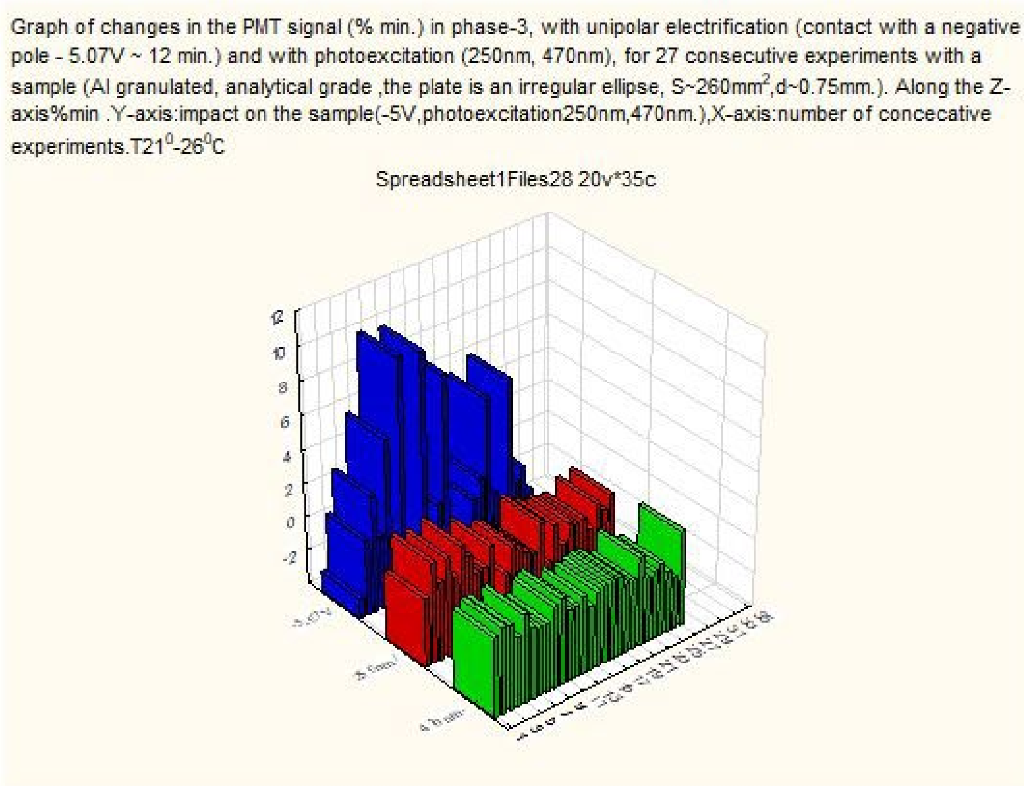

Figure 10:

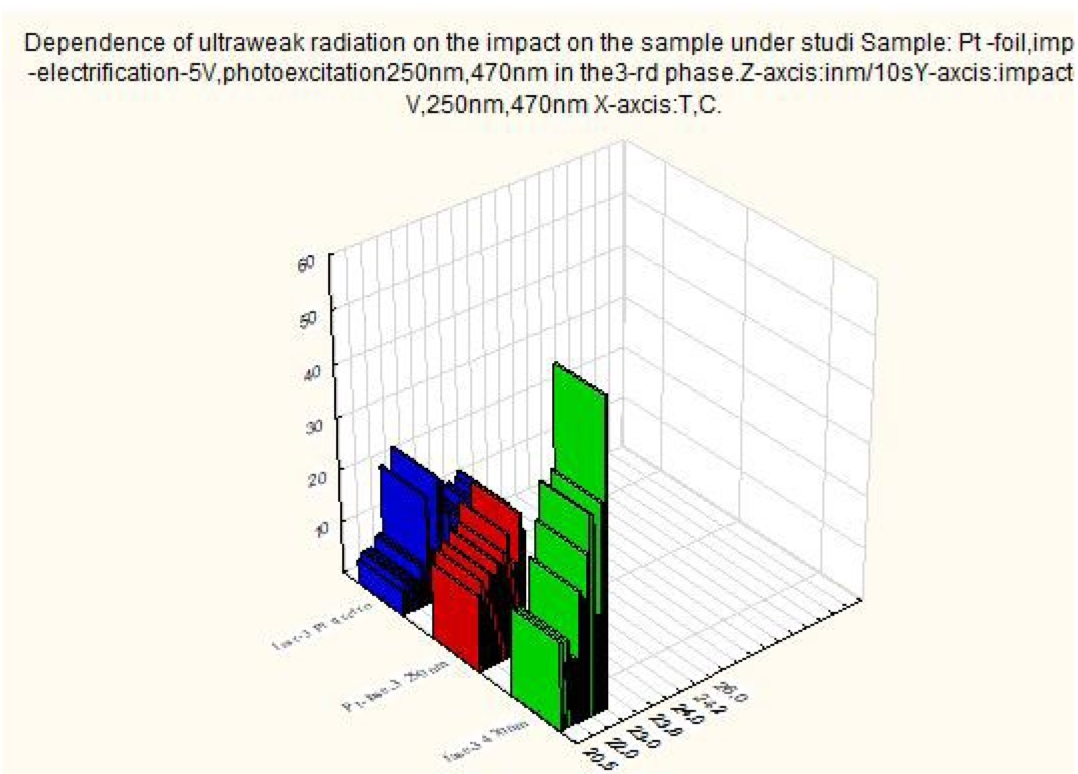

Figure 10a:

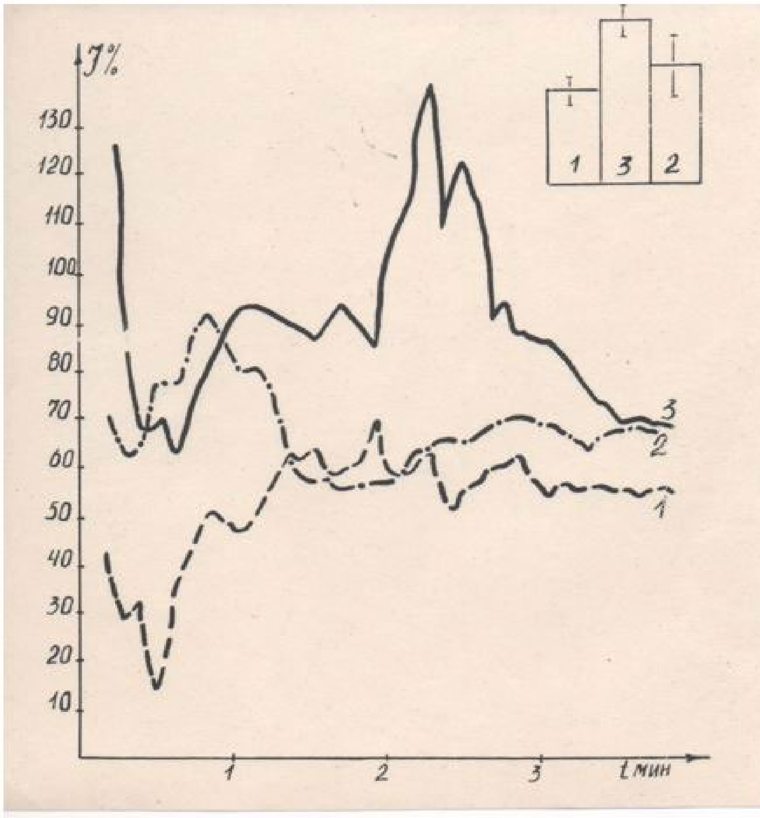

Figure 11: Dynamics of Chemiluminescence of Isolated Mitochondria in the Aerobic Phase. 1- Phase of Phosphorylation (0.2 mM ADP), 2- Phase of Substrate Respiration (5 mM succinate), 3- Phase of Uncoupled Respiration (5 mM succinate + 0.1 mM DNP) Along the Ordinate: Chemiluminescence Intensity (% of background). Along the Axis Abscissa: Time. In the Upper Right Corner Is the Average Number of Signal Pulses. Confidence Interval P <0.05 [2].

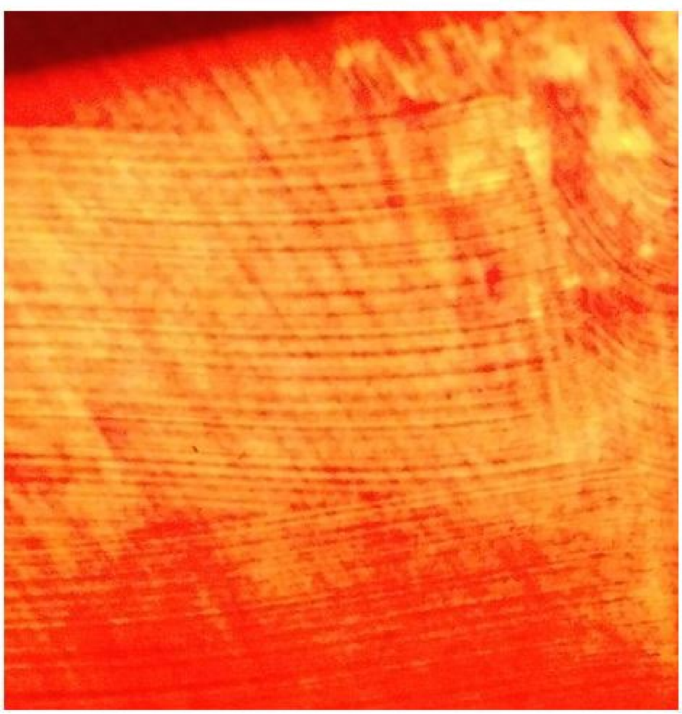

Figure 12: Diffraction Lines: W-Fragment of a 60w Lamp Filament, Electrified (-8v, ~ 1.5 Hours, 14 days). In the Upper Right Corner are the Outlines of the Structure Inside the SGK (W Filament and Two Mo Supports). Horizontal Position of the "Photo Paper" with HgS on the SGK Body

Figure 13: Diffraction Lines: W-Fragment of a 60w Incandescent Lamp Filament, Electrified (-8v, ~ 1.5 Hours, 14 days). Vertical Position of "Photo Paper" with HgS - in Front of SGK ~ 12mm

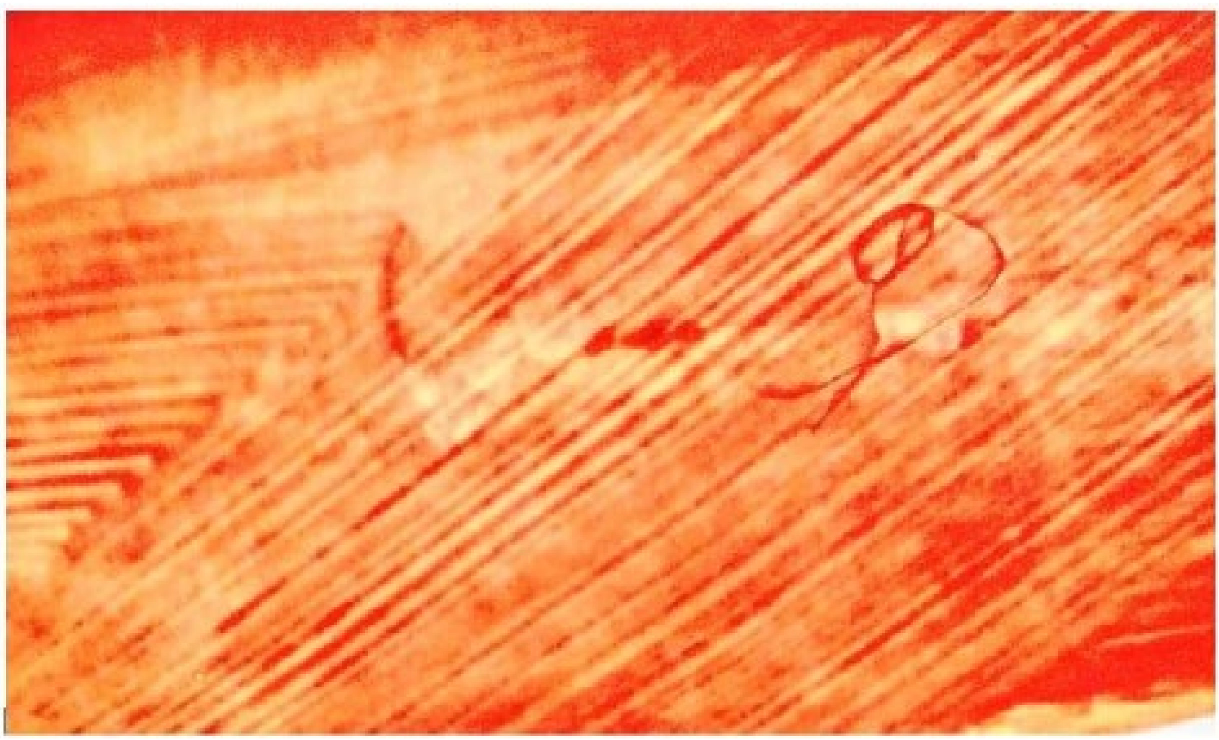

Figure 14: Diffraction Lines: Sample-Pb (strip), Electrified; -5v. ~ 1.5 Hours, 14 Days. In the Center of the Photograph are the Contours of a Structural Element: A Thread for Fixing "Photo Paper" with HgS on the Surface of the SGK - Horizontal Position

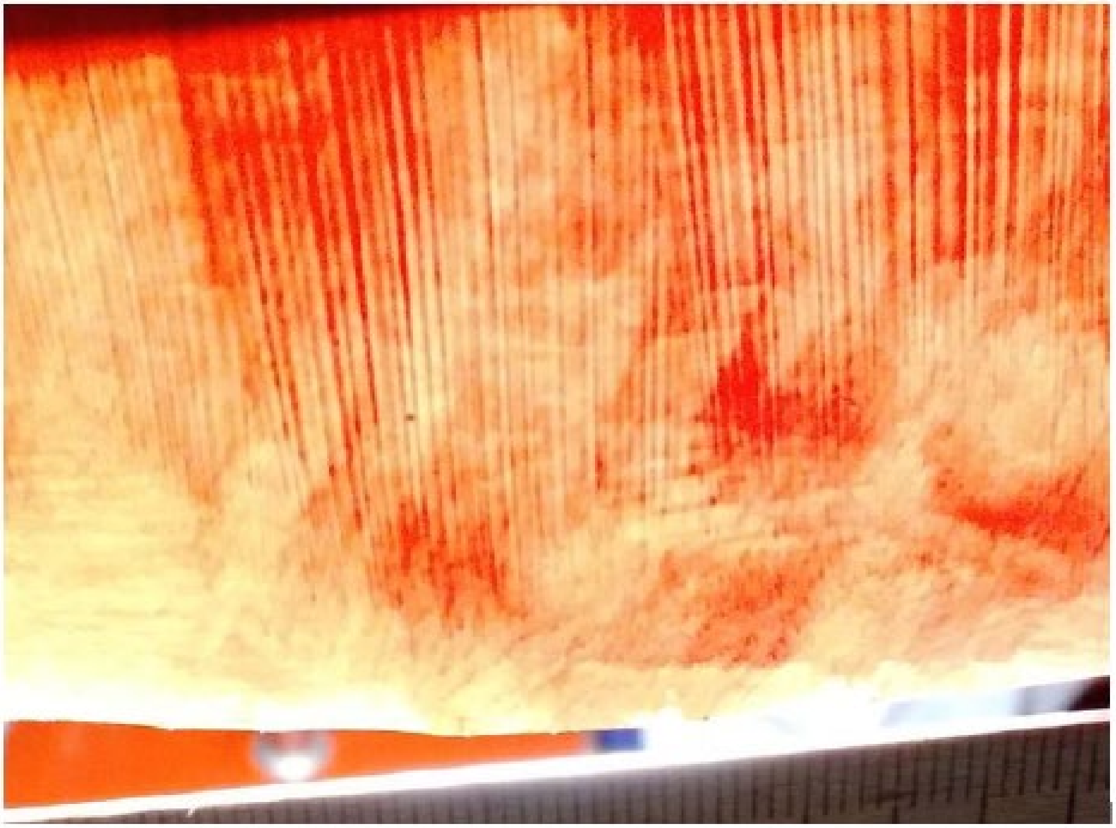

Figure 15: Diffraction Lines: Pb Sample (strip), Electrified; -5v, ~1.5 Hours, 14 Days. The Vertical Position of the “Photo Paper” with HgS is in Front of the SGK~ 12mm. At the Bottom of the Photograph there is a Graduation Scale mm

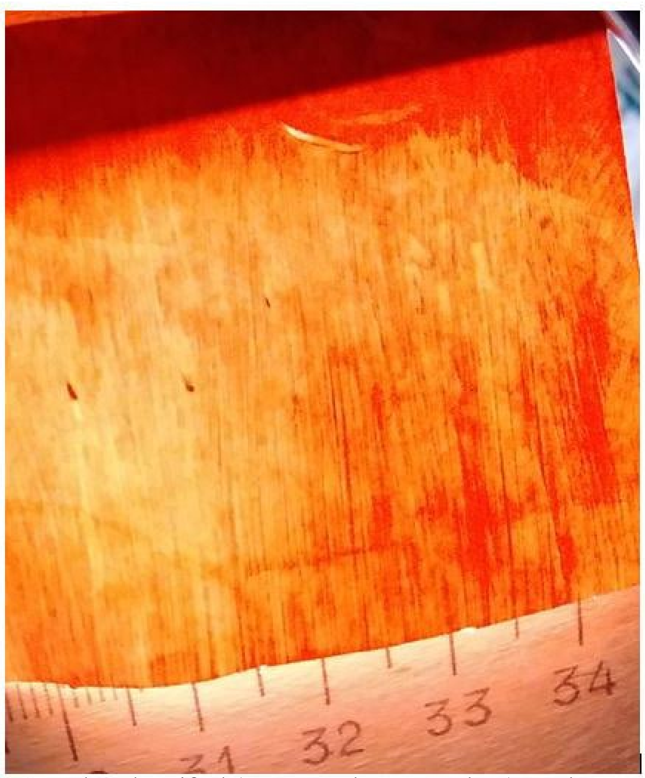

Figure 16: Diffraction Lines: Si-p Type Sample, Electrified (-8v, ~ 1.5 hours, 21 days). In the upper part of the Photograph There is a Structural Element - Wiring Contours under 7-8 Layers of Dark Electrical Tape. In the lower Part of the Photograph there is a mm Scale. Horizontal Position of “Photo Paper” » with HgS-on the Surface of the SGK

Figure 17: Diffraction Lines: Si-p Type Sample, Electrified -8v ~ 1.5 hours, 21 days. Vertical Position of “Photo Paper” with HgS – in Front of SGK ~ 12mm

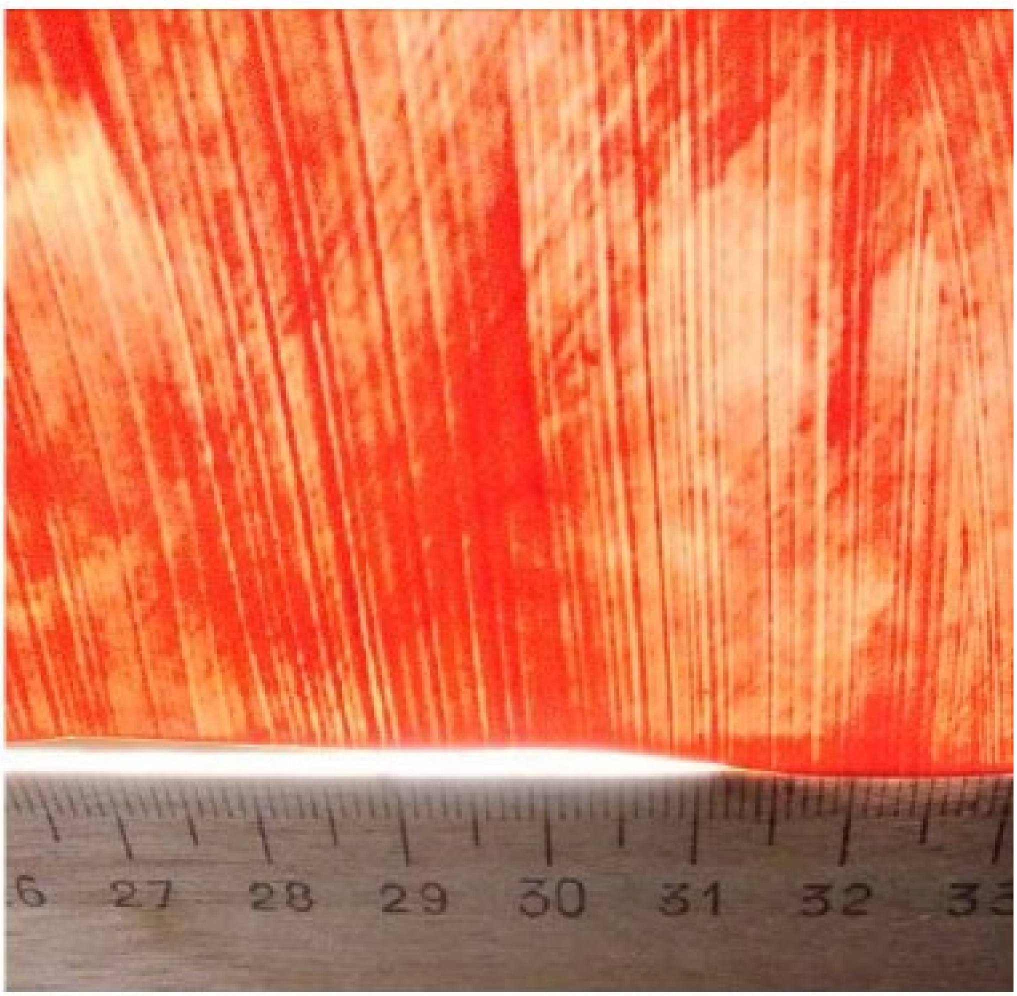

Figure 18: Diffraction Lines: In Sample (Plate), Electrified -5v, ~1.5 Hours, 25 days. Horizontal Position of the “Photo Paper” with HgS is on the SGK Body. At the Bottom of the Photograph there is a mm Scale

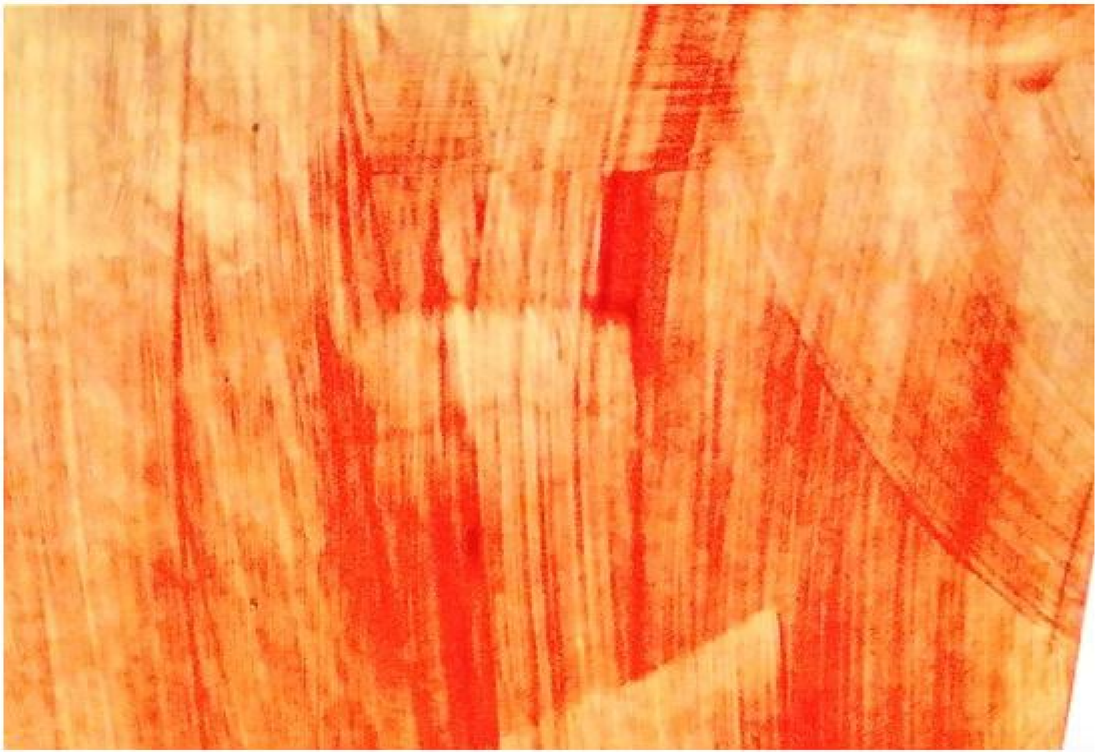

Figure 19: Diffraction Lines: In Sample (Plate), Electrified; -5v. ~ 1.5 hours, 25 Days. Vertical Position of “Photo Paper” with HgS – in Front of SGK ~ 12mm

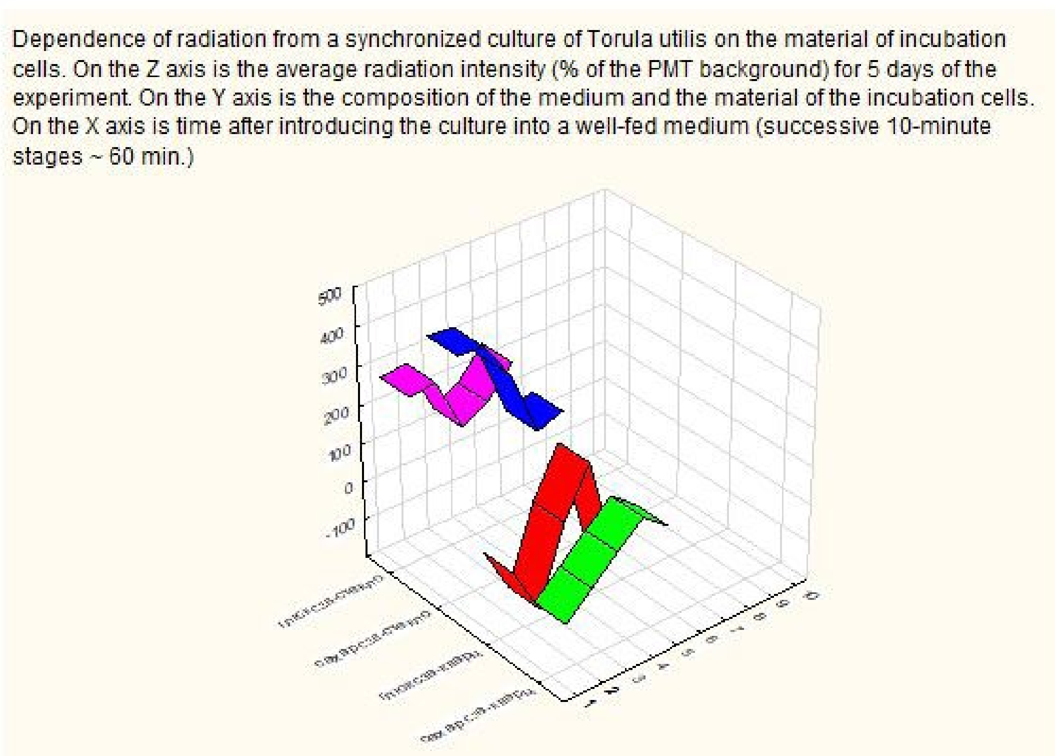

Figure 20: Quenching Effect of Torula Utilis(A.A. Gurvich, unpublished Data)

Figure 21: Diffraction Lines; Sample-W Foil (Double Cylinder). Photoexcitation (250nm) ~ 15min 14 days. Horizontal Position of "Photo Paper" with HgS, on the SGK

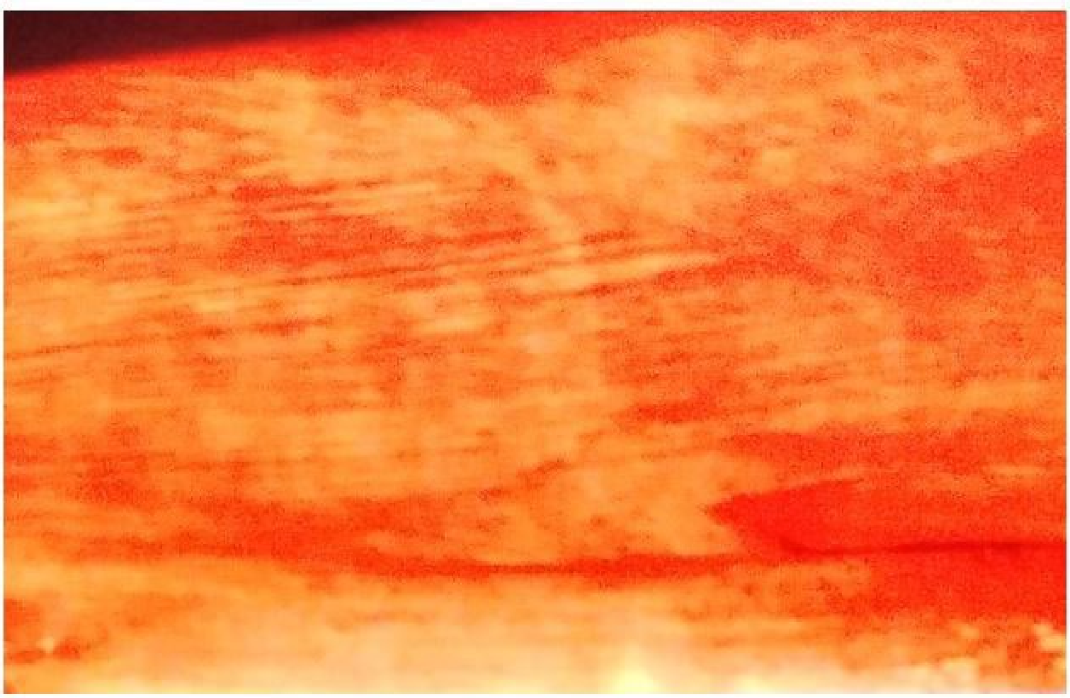

Figure 22: Diffraction Lines; Sample W-foil (Double Cylinder in the SGK) - Photoexcitation (250nm) ~ 15 min, 14 days. In the Center of the Photograph there are LED Contours in the Frontal Plane. Vertical Position of the "Photo Paper" with HgS, in Front of the SGK ~ 40 mm

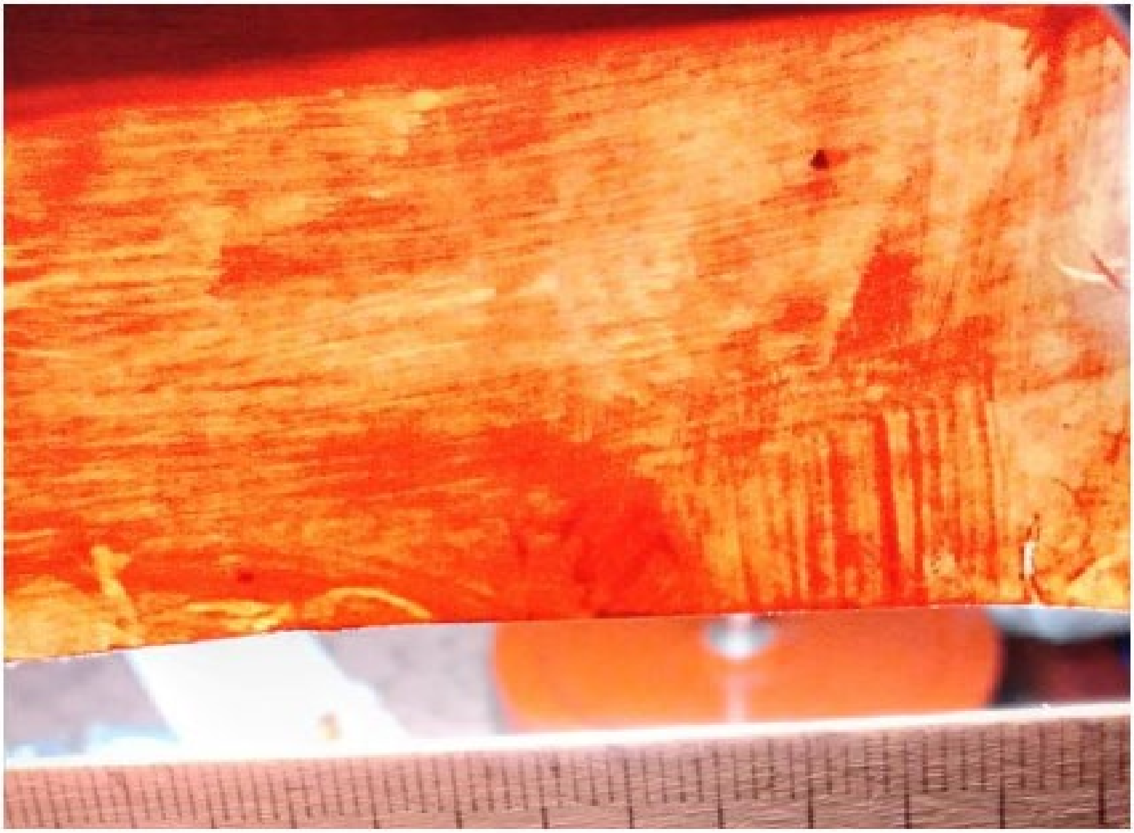

Figure 23: Diffraction Lines; Sample-Cu (3mm*5mm) - Electrified - 5V~1.5h. 21 days. At the Bottom of the Photo, on the Right and Left, are the Wiring Contours Under 7-8 Layers of Electrical Tape. Horizontal Position of “Photo Paper” with HgS. on SGK

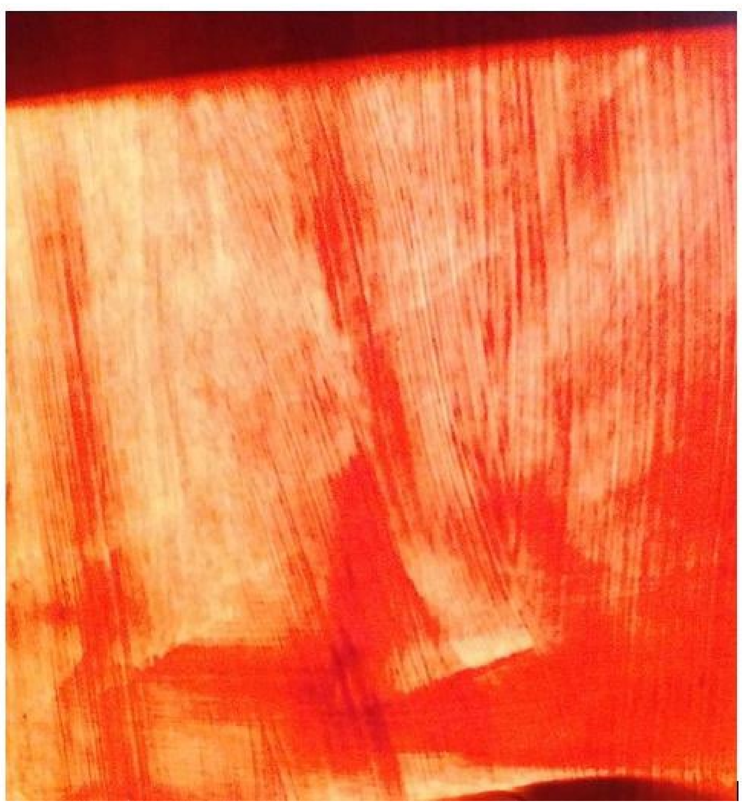

Figure 24: Diffraction Lines; Cu Sample (3mm*5mm) - Electrified - 5V ~ 1.5 Hours 21 days. Vertical Position of “Photo Paper” with HgS in Front of SGK ~ 12mm

Figure 25: Diffraction Lines: Sample-Pt Horizontal Position in The Center of the Photo - Wiring Contours under 7-8 Layers of Dark Insulating Tape on the Emitter Body

References

1. Batyanov, A.P. (1989). Chemiluminescent analysis of metabolic disorders of liver mitochondria in certain types of pathology. Abstract of Candidate of Dissertation, Research Institute of General Pathology and Pathological Physiology. Academy of Medical Sciences of the USSR Moscow.
2. Chechik N.O., Fainshtein S.M., T.M. Lifshits T.M. (1957). Electronic multipliers. *State publishing house of technical and theoretical literature*. Moscow.
3. Gurvich A.M. (1982). *Introduction to the physical chemistry of crystal phosphors.* Moscow Higher School.
4. Gurvich A.A. (1968). *The problem of mitogenetic radiation as an aspect of molecular biology Leningrad Medicine.*
5. Popp, Fritz-A. (1983). New horizons in medicine/by Fritz-Albert Popp. - Heidelberg;Haug. ISBN3-7760-0715-X.
6. Treasurer V.P. Mikhailova L.P. (1985). Bioinformational function of natural electromagnetic fields Novosibirsk Nauka.
7. Batyanov, A.P. (1994). Non-equilibrium and Coherent Systems in Biology Biophysics Biotechnology.International A.G.Gurwitsch conference Editors:Lev V.Beloussov,Fritz-Albert Popp. BioInform Services co.,Russia Moscow.p.439-446.
8. Batyanov, A.P. (2023). Physical Aspects of Chemical Carcinogenesis. *J.Electrical Electron. Eng.2*(3) 282-293.

Copyright: *©2024 Batyanov A.P. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.*