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Ultra-Weak Electromagnetic Radiation of Mitochondria and Inorganic Systems

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Abstract

This article provides a comparative analysis of data on ultra-weak electromagnetic radiation (UWR) obtained at different times from bio and inorganic systems. The unifying physical principle was the presence of hybrid orbitals in the outer electron shells in the systems under study and the generation of coherent radiation in them. The data of a model experiment on ultra weak radiation of metals and mitochondria in the long-wavelength region of the optical spectrum are presented, indirectly confirming this.

Keywords: Mitochondria, Transition Metals, Hybrid Orbitals, UWR, Quenching Effect, Possible Analogy

Abbreviations

- **UWR:** Ultra-Weak Electromagnetic Radiation
- **PMT:** Photomultiplier
- **SGK:** Light-Sealed Plastic Capsule
- **MX:** mitochondria
- **ADF:** Adenosine Diphosphoric Acid
- **DNF:** Dinitrophenol

Introduction

The issue of ultra-weak electromagnetic radiation (UWR) in biosystems has been discussed in the literature for a long time [1-2]. The action of this radiation explains the phenomena of non-thermal and non-chemical (remote-optical) interaction of biological objects with each other and non-biological systems, including carcinogenic agents [3-6].

Since there is no general physical theory for such phenomena, model experiments with non-biological systems are advisable to establish general, analogous physical processes of UWR generation. In the previous work, a possible analogous role of hybrid orbitals of the outer electron layers in the process of UWR generation was considered, both in biological and non-biological systems [7-8].

This work presents additional data obtained at different times on the possible analogy of the processes of generation and action of UWR of isolated mitochondria, transition metals and semiconductors.

Materials and Methods

Rat liver mitochondria were isolated using the usual method [9]. The same experimental scheme (with the most approximate parameters) was used to register the UWR from mitochondria, metals and semiconductors. Four experimental schemes with different radiation recorders and receivers were used to register the UWR from a suspension of isolated mitochondria. Schemas:

1. PMT-106 antimony-cesium, multi-alkali, with a spectral sensitivity range from 170 nm to 830 nm, with a maximum spectral sensitivity from 400 to 440 nm, operating in photon counting mode, cooled with dry ice, with an amplification system recording the number of pulses in 10 sec. (imp. /10 sec.)
2. Aqfa Gevaret photographic plate
3. solutions of crystal phosphors (3%suspension of PbS in an aqueous 0.001% solution of FeSO4 or 0.1% KMnO4 + 0.001% CuSO4) placed in a special cuvette and separated from the MX suspension by a polypropylene film (0.02 mm) or a plexiglass plate (0.1 mm)
4. Plexiglass plate

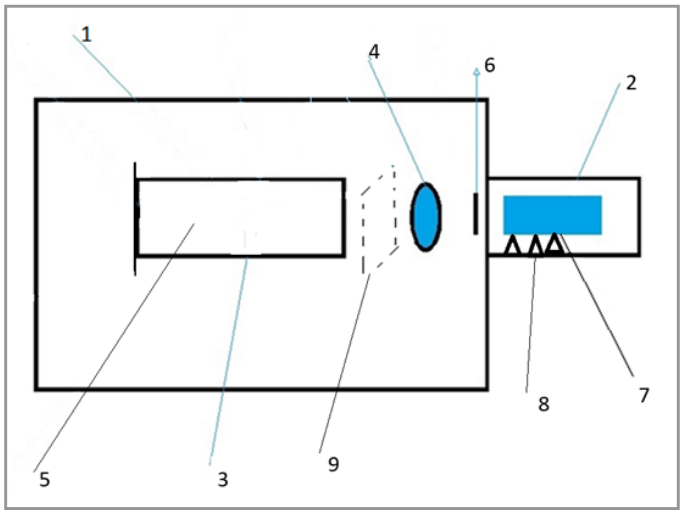

Figure 1: Experimental scheme-1 for recording ultra-weak mitochondrial radiation

1. Lightproof camera
2. Light and heat-sealed chamber for PMT-106.
3. Quartz cylinder with a lapped lid (fused quartz with a lower transmission limit of 200nm., l-20mm, D-10mm, d wall-1mm,) located at the focal length in front of the quartz lens along the longitudinal axis.
4. Quartz lens
5. Suspension mitochondria(3,5mg mitochondrial protein+0.15M sucrose+0.015M KCl, 5mM KH2PO4+2.5M MgCl2 and Succinate 5mM+0.2μM ADF
6. Ebonite shutter in front of the PMT-106 photocathode
7. Photomultiplier with end photocathode-PMT-106.
8. Dry ice
9. Aqfa Gevaret photographic plate (for experimental scheme-2)

The experimental scheme-2, for recording ultra- weak mitochondrial radiation differs from scheme-1 because the Aqfa Gevaret photographic plate serves as a light receiver instead of the PMT-106. The position of the photographic plate at a 16-hour exposure with MX is shown in Figure1. The distance between the end surface of the cylinder (3) and the light layer is ~15mm, while the PMT-106 is closed and turned off.

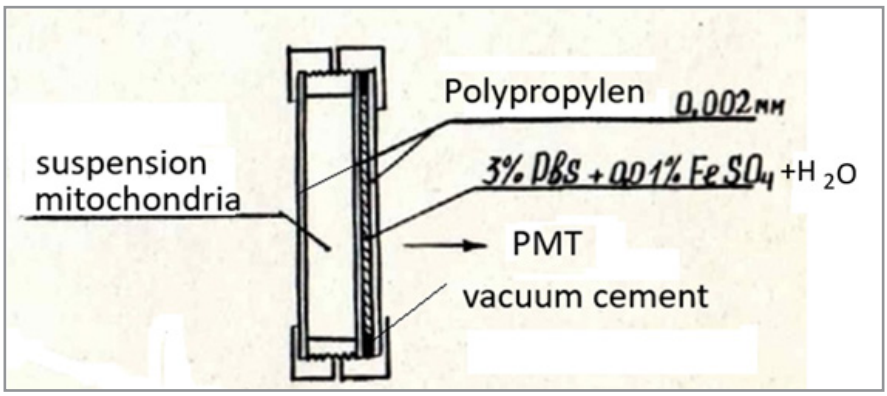

Figure: 2

The experimental scheme -3 for recording ultra-weak mitochondrial radiation differs from scheme-1 in that flash phosphors placed in a special cuvette and separated from the MX suspension by a polypropylene film or plexiglass plate serve as a radiation receiver. The position of the cuvette in front of the PMT during exposure with MX corresponds to the position of the quartz cylinder (3) in Figure1.

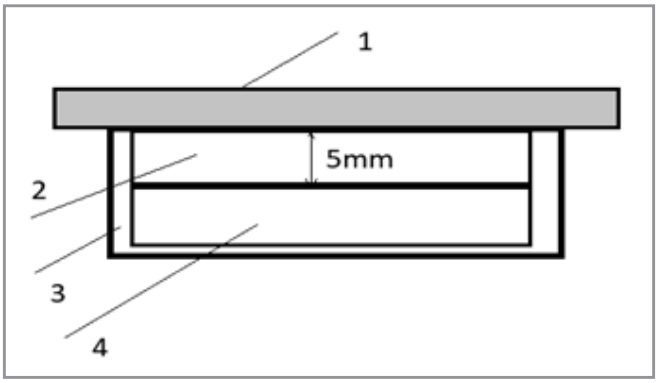

Figure 3: Experimental schema-4 for recording the effect of ultra-weak mitochondrial radiation on plexiglass during distant optical contact. The cuvette made of plexiglass with a suspension of MX is covered with a plate of plexiglass, exposure time ~5min., in a darkened chamber (1) Figure 1

1. Plexiglass plate-01mm.
2. Air layer-5mm
3. Plexiglass cuvette
4. Suspension of mitochondria

To determine the radiation of metals and semiconductors, the studied samples (7) were placed inside a light-sealed plastic capsule (SGK) to cut off radiation in the UV, visible and near IR regions of the optical spectrum. The capsule - a hollow plastic cylinder (with a linearly increasing transmission of up to 15% from $\lambda = 8$ μ to $\lambda = 28$ μ), with a built-in LED (8), an internal diaphragm (9) and samples, in turn, was placed in a light-insulated space and considered as an emitter-resonator (1) {Fig. 1}. To generate radiation, photoexcitation of samples inside the emitter cylinder (250nm.470nm~15min.) or unipolar electrification was used - the sample was connected to one pole (-) of the DC source.

For optimal control over the dynamics of the intensity of the UWR and the response of the PMT to photoexcitation and electrification of samples, the experiment time (~75min) was divided into 5 equals (~15min.), consecutive stages-phases. 1-5 phases (background-1, background-2) - maximum light insulation of the PMT photocathode without excitation of samples, shutter (3) is closed {Fig. 1}. 2-4 phases (signal + background-1 and signal + background-2) - radiation of a hollow resonator with samples without excitation, the shutter (3) is open. 3 phase - photoexcitation of samples or electrification, the shutter (3) is open.

The detector of the expected radiation (UWR) was: PMT-106 (5), with an amplification system, recording pulses / 10 sec. and two semiconductor systems - LED Al GaN (8) and HgS (cinnabar on an aniline base) deposited on writing paper - a conditional analogue of photographic film [7, 8].

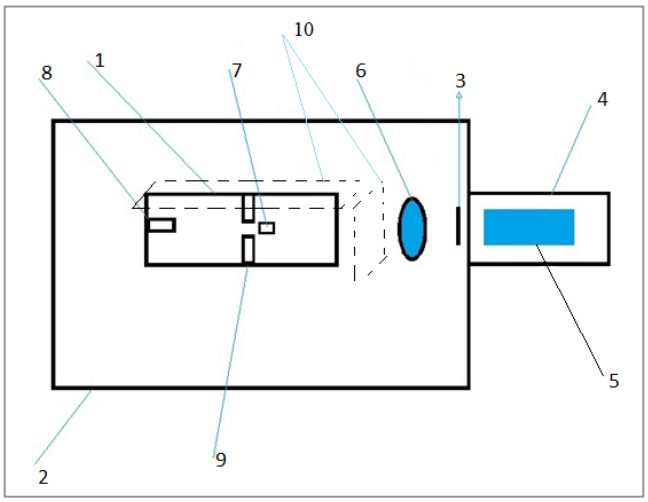

Figure 4: experimental scheme for recording ultra-weak radiation of metals and semiconductors

1. Light-hermetic, plastic chamber (SGK)
2. Lightproof camera
3. Ebonite shutter in front of the PMT-106 photocathode

4. Lightproof chamber for PMT-106
5. Photomultiplier with end photocathodePMT -106
6. Quartz lens
7. Test sample inside (SGK)
8. LED (250nm) inside SGK
9. Foam seal-diaphragm inside the SGK
10. Cinnabar-coated paper strips (HgS)

Results and Discussion

MX radiation registered in the system1 in different functional states

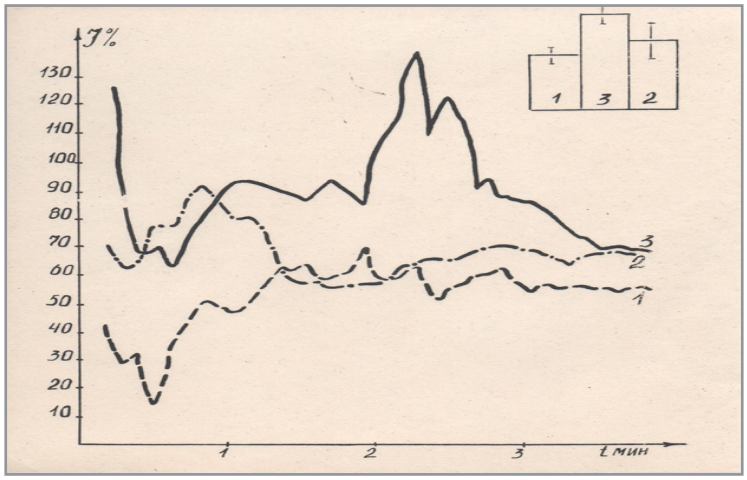

Figure 5: Dynamics of Chemiluminescence of Isolated Mitochondria in the Aerobic Phase.

1. Phase of Phosphorylation (5 mM succinate+ 0.2μM ADP),
2. Phase of Substrate Respiration (5 mM succinate),
3. Phase of Uncoupled Respiration (5 mM succinate + 0.1 μM 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.]

The decrease in the PMT signal in the phosphorylation phase is noteworthy, in accordance with earlier works [10, 11]. However, when replacing the light-receiving device (photographic plate instead of PMT) - system-2, a sharply expressed reaction of quenching of photoexcitation of the photosensitive layer of the plate during photocontact with phosphorylating MX is also observed.

The irradiated plate (which was in photocontact with MX in a light-insulated space for 16 hours) is almost completely discolored-lightened, in contrast to the control-darkened one (which was in the same space without photocontact with MX). Thus, it can be assumed that the constantly low level of the PMT signal during photocontact with phosphorylating MX is due to the quenching effect of MX radiation on the PMT photocathode.

It is possible that the quenching effect is realized due to the formation of traps for photoelectrons both in the photocathode of the photomultiplier and in the photosensitive layer of the plate under the influence of the MX radiation. It is likely that the MX radiation, initially of ultra-low intensity, but capable of significantly reducing the signal of the photomultiplier and blocking the photoexcitation of the photographic plate, should be coherent, i.e., maximally effectively, in a coordinated manner change the electron equilibrium in the irradiated system. It is interesting to note that a similar quenching effect was observed in the study of ultra-weak radiation of the yeast culture Torula Utilis, while the background of the photomultiplier was reduced [12].

The dependence of the radiation of the synchronized culture of Torula utilis on the material of incubation cells..On the Z axis is the average radiation intensity (% of the background of the PMF).Along the Y axis-the composition of the medium and the material of the incubation cells (green-quartz, sucrose; red-quartz, glucose) and (blue-glass, sucrose; pink-steglo, glucose).On the X axis is the time after applying the culture to a well-fed medium (consecutive 10-minute stages ~60min.)

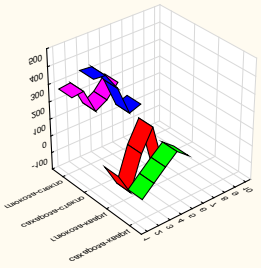

Figure 6: (A.A. Gurvich, unpublished data)

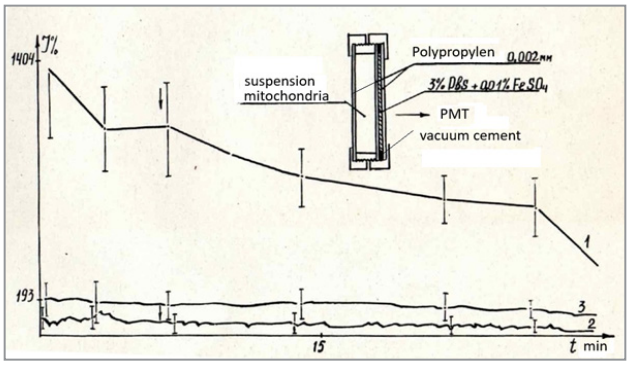

Figure: 7

1. Luminescence of flash phosphorus (3% suspension of PbS in 0.001% aqueous solution of FeSO4) induced by suspension of mitochondria (mitochondria are separated from phosphorus by a polypropylene film(d=0.002mm).
2. Chemiluminescence of mitochondria in the phase of substrate respiration without phosphorus
3. Phosphor luminescence without mitochondria.

Curves 1,2,3 are calculated by averaging individual half-hour measurements, for each curve the number of measurements is n =10. Along the ordinate axis. The luminescence intensity is % of the background. On the ordinate axis: time min. The measurement step is 7 seconds. |Arrow down the beginning of the anaerobic phase. The confidence interval at P<0.05.

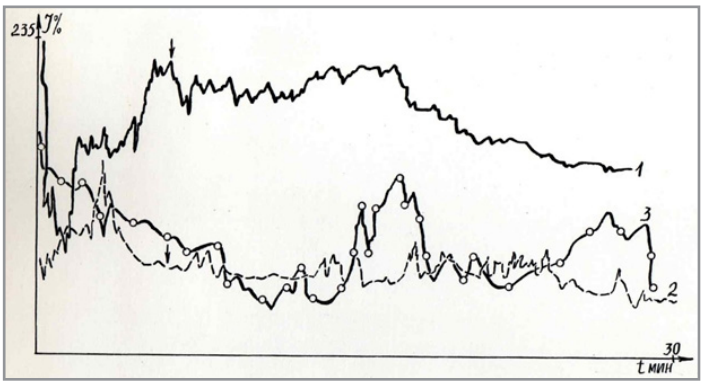

Figure: 8

1. Luminescence of flash phosphorus (aqueous solution-0.1%KMnO4+0.001%CuSO4) induced by a suspension of MX (mitochondria are separated from phosphorus by a 0.1mm thick plexiglass plate).
2. Chemiluminescence of MX in the phase of substrate respiration without phosphorus.
3. Phosphor luminescence without mitochondria.

Curves 1,2,3 are obtained by averaging individual half-hour measurements, 10 for each curve. Along the ordinate axis: luminescence intensity % of the background. Along the abscissa axis: time in minutes. The measurement step is 7 seconds. | Arrow down -the beginning of the anaerobic phase.

Under the action of MX radiation on flash crystal phosphors through a polypropylene film or plexiglass plate, a flash of radiation occurred, i.e. the electronic equilibrium of phosphors was disturbed sufficiently to release stored light energy [1, 2].

The experimental scheme -4: the effect of ultra-weak mitochondrial radiation on plexiglass during distant optical contact

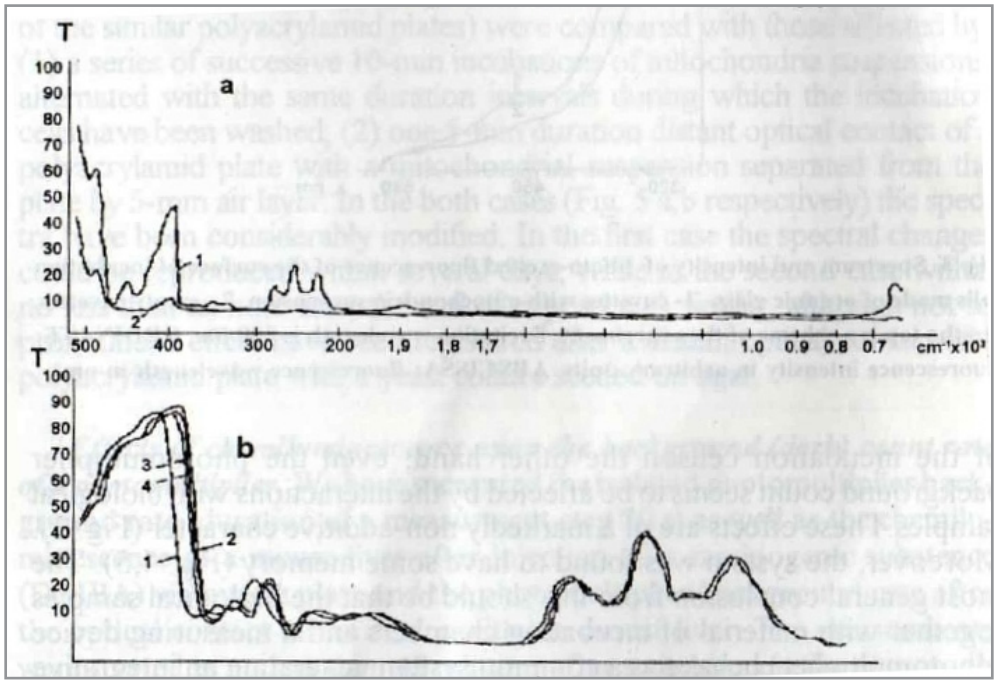

Figure 9: Changes in the infrared absorbtion spectrum of a plexiglass wall of an incubation cell after repeated incubations of mitochondria (2a) and after the distant optical contact with mitochondria suspension (1b). Absorbtion spectrum of an intact cells (1a, 2-4b)

During distant optical contact of the MX suspension with an organic glass plate (1) Fig3, changes in the IR absorption spectrum of the organic glass were observed through a layer of air, which in turn is associated with the reorientation of the electron density in the polymer molecules. Thus, the presented data indicate the possibility of ultra-weak MX radiation to cause significant changes in the electronically excited systems of irradiated objects, which is impossible for ultra-weak radiation of an incoherent nature.

The possibility of generating UWR of metals and semiconductors under photoexcitation (250 nm, 470 nm) and under electrification is shown [7, 8]. In this case, of all the studied samples, the most pronounced "quenching effect", similar to the effects of phosphorylating MX and a synchronized culture of Torula Utilis, was observed during photoexcitation of W foil{Fig.10-11}. When replacing the light receiver (instead of FEU-106, a sample of "conditional photographic film" is installed - HgS-cinnabar on writing paper), with a long exposure (from 14 days), diffraction bands and images (contours of structural elements) are visible on the conditional photographic film {Fig.14-15}.

When electrifying W samples, the opposite effect is observed - an increase in the PMT signal, the diffraction bands and images take on a different character {Fig.12,13}. Thus, it can be considered proven that the violation of electron equilibrium during photoexcitation and electrification of metals and semiconductors generates UWR similar in intensity and activity to the radiation of biological objects - mitochondria and yeast.

In this case, the radiation has both a quenching and exciting effect on photosystems, i.e. can create (or transfer) traps for electrons and new electron-excited levels. For mitochondria and yeast, this principle is realized in various functional states - a multidirectional level of radiation. For inorganic systems, a method of disrupting the electron equilibrium and the structural features of the outer electron shells. The appearance of diffraction bands and images of the contours of structural elements on a conventional photographic film with HgS are also indirect evidence of the action of coherent radiation in the systems under study.

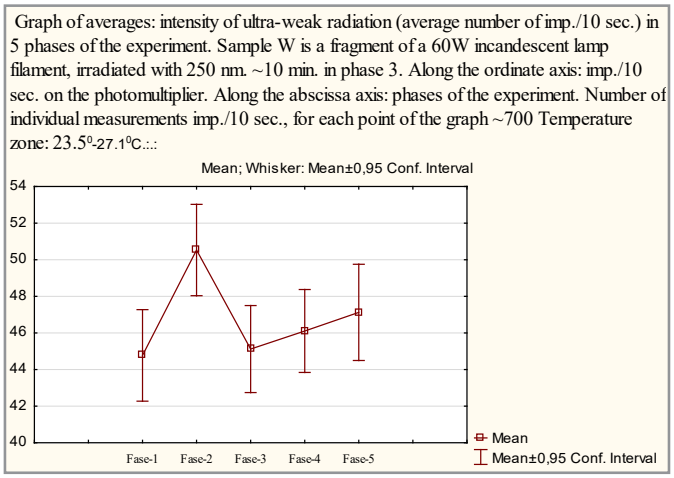

Figure : 10

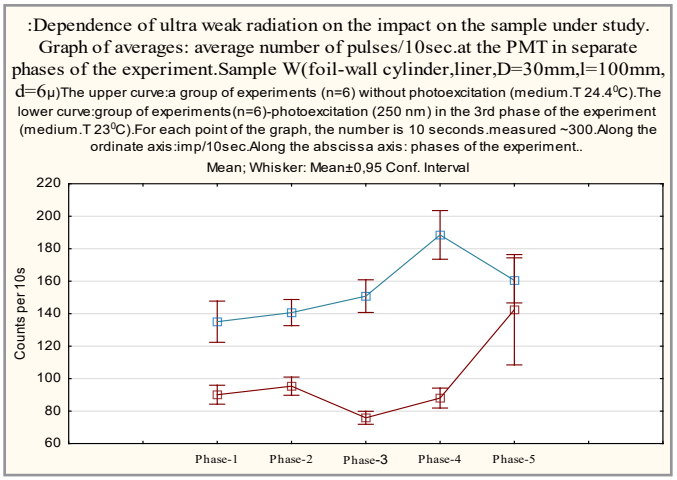

Figure 11

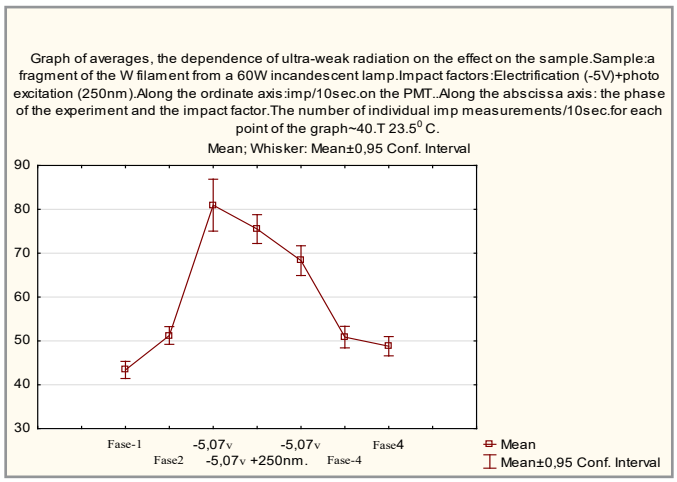

Figure : 12

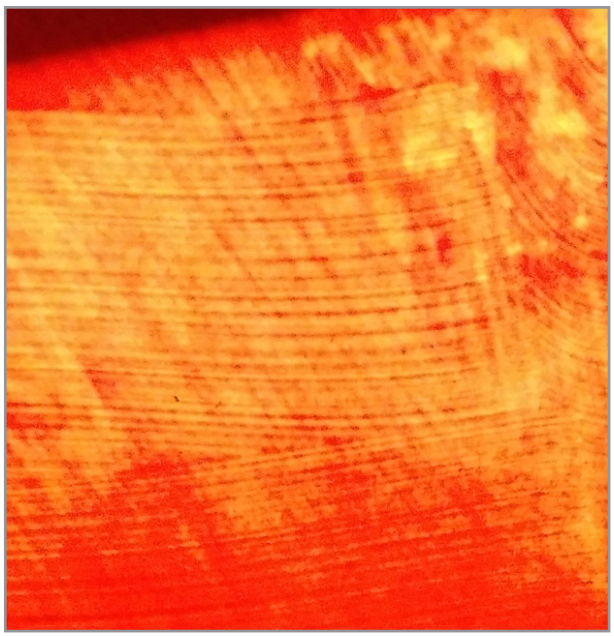

Figure13: Diffraction Lines: W-Fragment of a 60w Lamp Filament, Electrified (-8v, ~ 1.5 Hours, 14 days). In the Upper Right Corner are the Outlines of the Structure Inside the SGK (W Filament and Two Mo Supports). Horizontal Position of the "Photo Paper" with HgS on the SGK Body

Figure14: Diffraction Lines; Sample-W Foil (Double Cylinder). Photoexcitation (250nm) ~ 15min 14 days. Horizontal Position of"Photo Paper" with HgS, on the SGK

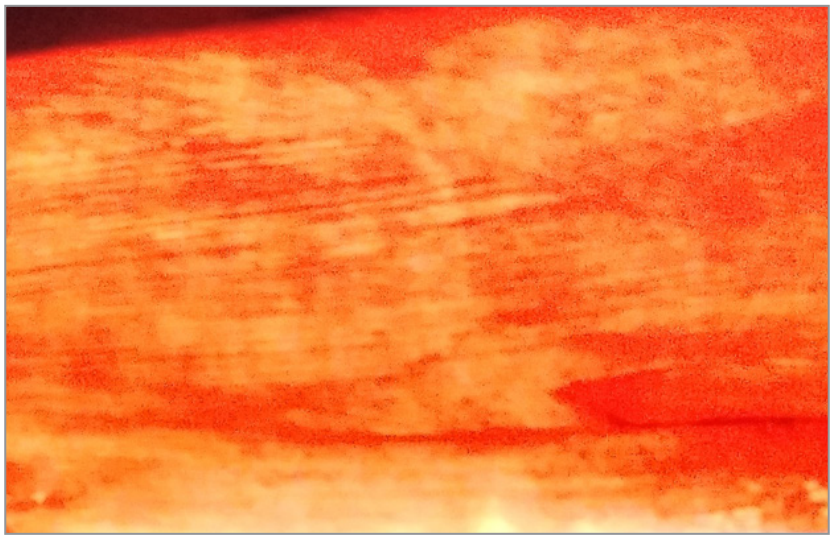

Figure15: Diffraction Lines; Sample W-foil (Double Cylinder in the SGK) - Photoexcitation (250nm) ~ 15 min, 14 days. In the Center of the Photograph there are LED Contours in the Frontal Plane. Vertical Position of the "Photo Paper" with HgS, in Front of the SGK~40mm.

Declarations

Ethical Approval

Institutional Review Board Statement: The study was conducted according to the guidelines of the (DIRECTIVE 2010/63/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the protection of animals used for scientific purposes of 22.09.2010.), and approved by the Institutional Ethics Committee of the Institute of General Pathology and Pathophysiology (final protocol # 1 of 01.02.2023.)

Competing interests

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Authors Contributions

Inadaptability

Funding

This research received no external funding.

Availability of Data and Materials

Data Availability Statement: The data presented in this study are available on request from the corresponding author

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