THE PHOTO – THERMAL THE UNIFIED THEORY OF COHERENT PHENOMENON OF ELECTRICITY AND HEAT

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ABSTRACT
In this paper we will explain the coherent phenomenon of electricity and heat in the bodies. We will try to explain step by step what causes electricity and what causes heat in any body (metallic) radiated by light. Based on the law of conversation of energy, we will try to explain how the energy of any source of light gets transformed.

Keywords: *Phenomenon of electricity and heat of bodies, conversation of energy of light.*

1. INTRODUCTION

When a metallic surface is exposed to electromagnetic radiation above a threshold frequency (which is specific to the surface of the material), the photons are absorbed and current is produced. No electrons are emitted for radiation with a frequency below that of the threshold because the electrons are unable to gain sufficient energy to overcome the electrostatic barrier.
By the law of conservation of energy, the electron absorbs the energy of the photon and if sufficient, the electron can escape the material with a finite kinetic energy. A single photon can only eject a single electron because the energy of one photon can only be absorbed by one electron.
The photons of the light beam have a characteristic energy determined by the frequency of the light. In the photoemission process, if an electron absorbs the energy of one photon and has more energy than the work function, it is ejected from the material. If the photon energy is too low, the electron is unable to escape the surface of the material. Increasing the intensity of the light beam does not change the energy of the constituent photons, only the number of photons. Thus the energy of the emitted electrons does not depend on the intensity of the incoming light, but only on the energy of the individual photons.
Electrons can absorb energy from photons when irradiated, but they follow an "all or nothing" principle. All of the energy from one photon must be absorbed and used to liberate one electron from atomic binding, or the energy is re-emitted. If the photon energy is absorbed, some of the energy liberates the electron from the atom, and the rest contributes to the electron's kinetic energy as a free particle.

2. PHOTO – ELECTRIC EFFECT

The photoelectric effect is a quantum electronic phenomenon in which electrons are emitted from matter after the absorption of energy from electromagnetic radiation such as x-rays or visible light. The emitted electrons can be referred to as *photoelectrons* in this context. The effect is also termed the Hertz Effect**.**

2.1 Laws of photoelectric emission

- For a given metal and frequency of incident radiation, the rate at which photoelectrons are ejected is directly proportional to the intensity of the incident light.
- For a given metal, there exists a certain minimum frequency of incident radiation below which no photoelectrons can be emitted. This frequency is called the threshold frequency.
- Above the threshold frequency, the maximum kinetic energy of the emitted photoelectron is independent of the intensity of the incident light but depends on the frequency of the incident light.
- The time lag between the incidence of radiation and the emission of a photoelectron is very small, less than 10^{-9} seconds.

2.2 Photoelectric equations

In analyzing the photoelectric effect quantitatively using Einstein's method, the following equivalent equations are used:

$$hf = \Phi + E_{K\max} \qquad (1)$$

Energy of photon is equally with energy needed to remove an electron plus kinetic energy of the emitted electron.
Where:

- h – is Planck's constant
- f – is the frequency of the incident photon
- $\Phi = hf_p$ – is the work function, the minimum energy required to remove a delocalized electron from the surface of any given metal
- $E_{K\max} = \frac{1}{2}mv_m^2$ – is the maximum kinetic energy of ejected electron f_p – is the threshold frequency for the photoelectric effect to occur
- m – is the rest mass of the ejected electron
- v_m – is the velocity of the ejected electron

3. PHOTO – THERMAL EFFECT. THE UNIFIED THEORY FOR BOTH EFFECTS (ELECTRIC AND THERMAL

The light sources by which the metallic surfaces are radiated, usually are sources of incoherent light (i.e. they emit the radiation with different frequencies) and as a result, not all the quants have enough energy to eject electrons from atoms.

Based on the frequency of radiations we have two types of photons:

- Photons who's frequency is greater than the threshold frequency $\upsilon > \upsilon_p$ or shortly $\upsilon_{>p}$
- Photons who's frequency is smaller than the threshold frequency $\upsilon \leq \upsilon_p$ or shortly $\upsilon_{\leq p}$

Those who cause the photoelectric effect are exactly the photons who's energy is $\upsilon > \upsilon_p$. And, the photons who's frequency is smaller than threshold frequency are responsible for heat (they cause heat) and this is the explanation of coherent phenomenon of electricity and heat in any metal.

Based on "equation" (1) we can do this formulation:

The energy of the source photons is equally with the energy needed to cause photoelectric effect plus the thermal energy (energy of heat).

Suppose a source of two photons. Than its energy is:

$$E = h\upsilon_{\leq p} + h\upsilon_{\rangle p}$$

$$E = h(\upsilon_{\leq p} + \upsilon_{\rangle p}) \qquad (2)$$

Where E is the source energy.

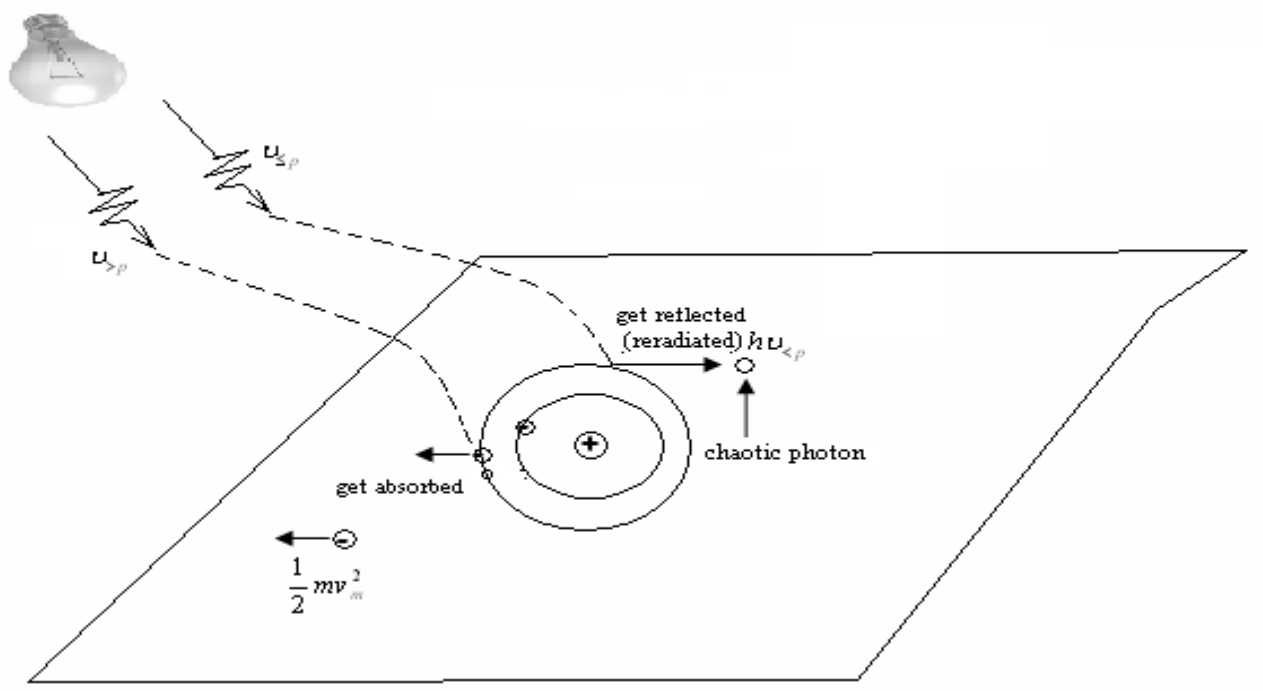

Fig.1. Two source photons of different frequencies. One of them has enough energy to eject the electron from atom and the other (because its frequency is smaller than threshold frequency) radiates as heat.

Than:

$$E = \Phi + E_{K\max} + E_T$$

$$E = \Phi + \frac{1}{2}mv_m^2 + E_T \qquad (3)$$

Where E_T is thermal energy

By substituting:

$$E_{ef} = \Phi + \frac{1}{2}mv_m^2$$

Than:

$$E = E_{ef} + E_T \qquad (4)$$

Where:

$$E_{ef} = f(\upsilon_{>P}) \; and \; E_T = f(\upsilon_{\leq P})$$

And for multiple photos equation (4) will be:

$$\sum h(\upsilon_{\leq P} + \upsilon_{>P}) = \sum E_{ef} + \sum E_T \qquad (5)$$

4. CONCLUSION

With this analysis we can conclude that the thermal energy, created in (metal) bodies radiated by the light source, is the sum of the energy of the photons who's frequency is smaller than threshold frequency, i.e. the photons which have no sufficient energy to eject electrons get radiated as heat. So, we shouldn't look for the origin of heat on the motion of atoms and electrons or their collision; but the heat is nothing but a flux of photons with smaller energy (frequency) than threshold energy.

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