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An Application of the Frequency Dependent Energy Equation of the Electromagnetic Wave: the Explanation of the photoelectric effect

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Light have two different sets of behaviors (photon and wave) under different circumstances. In a sense it should be more logical. It required building a theory to deal with a unique nature of light for best scientific satisfaction. According to the Maxwell's equation the theoretical speed of electromagnetic (EM) wave is almost same as the speed of the light which inspires to the scientists to believe that the light is EM wave only. A new energy equation of EM wave may solve the problem of duality nature of the light. We have proposed new energy equation of light by help of the classical theories of electromagnetism. According to our modified theory of light it is possible to explain that an enough energetic EM wave (greater than the work function of a material) is capable to move the electrons from the surface of a material such as photoelectric effect. Einstein has given an explanation of the photoelectric effect on the base of the quantum theory. However the photoelectron is released from the metal surface almost perpendicularly, and the photocurrent takes a small time to reach the maximum value in the initial time but there are no descriptions about these in the explanation of photon concept. Einstein has reported that the kinetic energy of the photoelectrons as well as the stopping potential is proportional to the frequency but constant with intensity of the incident light. However the kinetic energy of the photoelectrons depends also on the intensity of the light as our experimental observation indicates. The photoelectrons emit with opposite direction of the incidence light from the photocell however according to the photon concept the direction of the photoelectron emission should be the same (or part) of the direction of incidence light that means the photoelectrons should be ejected only from the back side of the photocell for the collision between the corpuscle of light and the electrons. The EM wave theory is able to explain all above facts. If the incidence energy of the EM wave has not been absorbed by other purpose, then the Einstein's equation of photoelectric effect can be replaced as $\frac{1}{2}\pi f \varepsilon_o \mu_o E_o H_o A^2 = w_o + \frac{1}{2}mv^2$. Here "$\frac{1}{2}\pi f \varepsilon_o \mu_o E_o H_o A^2$" is the energy of EM wave (incident light), ε_o, μ_o, E_o, and H_o are the as usual parameters, f is the frequency of the EM wave and A is the irradiate area of the material. w_o is the work function of the materials and $\frac{1}{2}mv^2$ is the kinetic energy of the released electron. The light contains 90° phase difference in between the electric and magnetic fields. Thus the free electrons of the surface of the material get a circular motion with the frequency of the EM wave (Fig. 1). The radius of the circle depends on the intensity of the light. The speed (v = 2πfr, r is the radius of the circular path) of electrons should be proportional with both the frequency and the radius of the circle as well as intensity of the light. So, the released electrons get more kinetic energy for increased intensity of light. From the figure it is clear that the electron come out from the front side of the surface perpendicularly which make clear that the perpendicular emission from the front side of the photocell. The experimental results reveal that the stopping potential has been increased by the intensity of light remarkably.

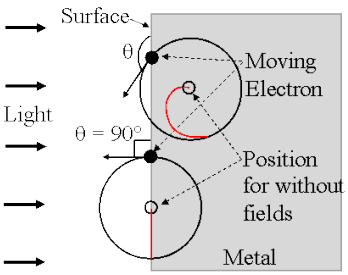

Fig. 1. Circular movement of the free electrons of the photocell by EM radiation for different deepness.