The photoelectric effect

Sjaak Uitterdijk
sjaakenlutske@hetnet.nl

Abstract- Given the evidence that a photon is a short period of an electromagnetic wave with a well defined amount of energy, the theory how light can cause an electron to escape from a metal can easily be shown to be the reverse process.

Introduction

The photoelectric effect is the physical process of the transformation of light to electric current. "Light" to read as: an electromagnetic wave of a certain frequency (Hz), with a certain power density (W/m^2) and of a certain length, expressed in time (s), shortly: a photon.
"Electric current" to read as: the electrons that got escaped from a (cathode's) surface (due to the collision/entering of a photon with an atom in that surface) and accelerated in the direction of the anode as a result of the applied voltage between cathode and anode.

1 Theoretical approach in modern physics

Reference [1] presents the following text:

"In 1905, Einstein proposed a theory of the photoelectric effect using a concept first put forward by Max Planck that light consists of tiny packets of energy known as photons or light quanta. Each packet carries energy $h\nu$ that is proportional to the frequency ν of the corresponding electromagnetic wave. The proportionality constant h has become known as the Planck constant. The maximum kinetic energy K_{max} of the electrons that were delivered this much energy before being removed from their atomic binding is $K_{max} = h\nu – W$, where W is the minimum energy required to remove an electron from the surface of the material. It is called the work function of the surface and is sometimes denoted Φ or ϕ. If the work function is written as $W = h\nu_0$ the formula for the maximum kinetic energy of the ejected electrons becomes $K_{max} = h(\nu - \nu_0)$."

Comment:
In the next chapter it will be shown that, if the relation $K_{max} = h(\nu - \nu_0)$ would be correct, the so called "Cathode radiant sensitivity" in figure 3 would be a straight line, decreasing with increasing wave length/decreasing frequency. That figure thus shows that Einstein's relation is incorrect.
Besides that, it has been pointed out in reference [2] that the relation $E = h\nu$ is only valid in the situations where the Rydberg expression is satisfied.

2 Theoretical background based on the theory that a photon is not a particle

As described in [2] the *generation* of a photon is based on the following theory:
1   An orbiting electron is equivalent to a circular shaped electric current, creating a magnetic field through the plane of the orbit.
2   When the electron jumps out of its orbit, to whatever underlined outer orbit or out of the atom, the strength of this magnetic field changes, creating an electric field.
3   A source of an electromagnetic wave has emerged, emitting a so-called photon.
4   When the new atom configuration has been stabilized, this source stops the emission.

It is hypothesized that the photoelectric effect is basically configured by the reverse process.

1   An external magnetic field, entering the plane of an orbiting electron, causes that electron to increase / decrease its velocity, depending on the direction of that external magnetic field in relation to the direction of the internal magnetic field, perfectly supported by an animation movie, copied from reference [1], and shown in figure 1 and 2.

2   An in- resp. decreasing velocity of an orbiting electron results in an escape from the existing orbit towards an outer resp. inner orbit.

3   Several situations are now possible, of which the most extreme one is the escape of the electron out of the atom as a free electron.

4   In all other situations the electron only changes its orbit. In case the electron jumps to an outer orbit, a new photon will be emitted, most likely of a different frequency.

5   If an electron jumps to an inner orbit, the intrinsic energy of the atom will increase and manifest itself as an increased temperature of the material to which the atom belongs. See ref. [3]: "How Electromagnetic radiation raises temperature".
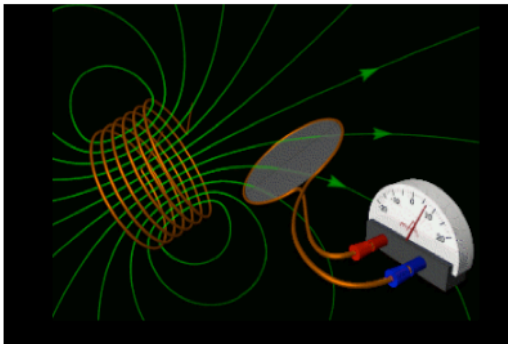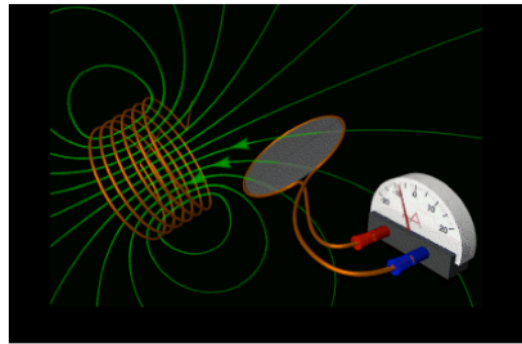

Figure 1

Figure 2

The single winding has to be interpreted as the orbit of the electron. The changing magnetic field of the coil as the magnetic part of the electromagnetic field of the entering photon.

3.   Experimental evidence

Like the frequency of emitted photons from a certain material is restricted to a certain range, so is the sensitivity of a certain material restricted to a certain range of frequencies regarding the transformation of light into free electrons. See figure 3 belonging to phototubes with different kinds of cathode material. The figure has been copied from reference [4].
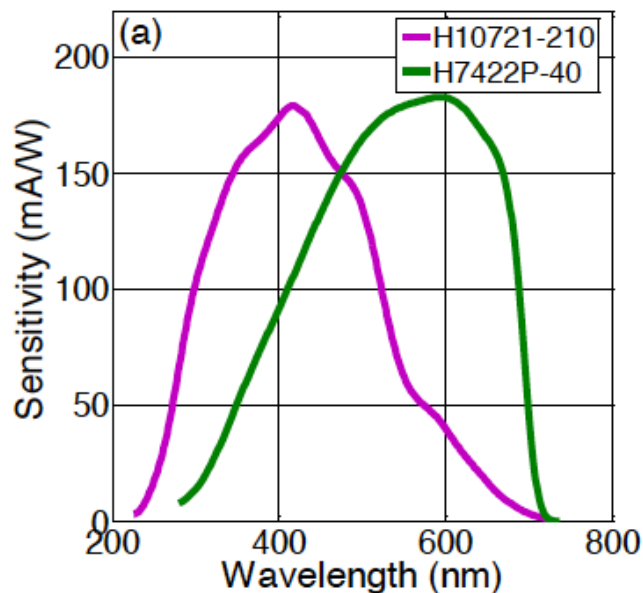The text underneath the figure in the reference sounds: "Cathode radiant sensitivity".

Figure 3

The figure clearly shows that:
the frequency of the incoming light has to be tuned to the receiving material

Einstein's expression $K_{max} = h(\nu - \nu_0)$ or $V_0 = (h/e)(\nu - \nu_0)$ has to be rejected.

Conclusion

Given the fact that an atom from which an electron escapes, generates of a photon as a short period of an electromagnetic wave with a well defined amount of energy, such a photon is reversely able to let an electron escape from an atom, so from a cathode to which the atom belongs, in order to create an electric current in the direction of the anode.
Consequently a photon will be emitted too, most likely of a different frequency than of the incoming one.

References

[1]   https://en.wikipedia.org/wiki/Photoelectric_effect
[2]   Why a photon is not a particle   https://vixra.org/abs/1505.0225
[3]   How Electro Magnetic Radiation Raises Temperature https://vixra.org/abs/2012.0059
[4]   Google for: "Tunable, Ultrafast Fiber-Laser between 1.15 µm and 1.35 µm "