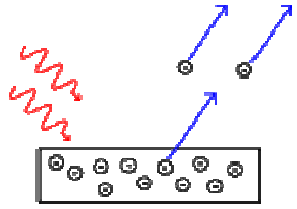
Answer on Question #38445-Chemistry-Inorganic Chemistry

Question

Explain the photoelectric effect and Compton effect with suitable example

Answer

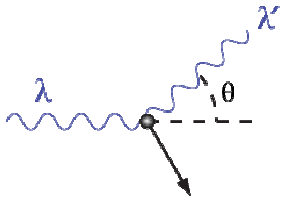
The photoelectric effect occurs when matter emits electrons upon exposure to electromagnetic radiation, such as photons of light. Here's a closer look at what the photoelectric effect is and how it works.



When a surface is exposed to sufficiently energetic electromagnetic energy, light will be absorbed and electrons will be emitted. The threshold frequency is different for different materials. It is visible light for alkali metals, near-ultraviolet light for other metals, and extreme-ultraviolet radiation for nonmetals. The photoelectric effect occurs with photons having energies from a few electronvolts to over 1 MeV.

At the high photon energies comparable to the electron rest energy of 511 keV, Compton effect may occur pair production may take place at energies over 1.022 MeV.

The Compton Effect is the phenomenon of the decrease in energy of photon when scattered by a free charged particle, e.g. an electron



A photon of wavelength λ comes in from the left, collides with a target at rest, and a new photon of wavelength λ' emerges at an angle θ. Energy and momentum are conserved, resulting in a reduction of both for the scattered photon.

The photoelectric effect demonstrates the result when a photon gives up all its energy after interaction with an electron while the Compton effect shows that the consequence after a photon gives up some of its energy after interaction with an electron. Fundamentally, in the Compton effect, a photon is elastically scattered by a charge which recoils due to conservation of energy and momentum whereas in the photoelectric effect, a photon is completely absorbed by a solid and an electron is ejected in the process. As such, the frequency of the scattered photon is considered in the Compton effect while it is not considered in the photoelectric effect.

These two effects are in reality the same, as they can be attributed to the quantum mechanics fact of wave-particle duality.