

Answer on Question #58651, Physics / Quantum Mechanics

The energy needed to remove an electron from metallic sodium is 2.28 eV. Does sodium show photo electric effect for red light having wavelength $\lambda = 678$ nm. What is cut off wavelength for photoelectric emission from sodium?

Find: $E_1 - ?$ $\lambda - ?$

Given:

$$A = 2,28 \times 1,6 \times 10^{-19} \text{ J}$$

$$\lambda_1 = 678 \times 10^{-9} \text{ m}$$

$$h = 6,626 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$c = 3 \times 10^8 \text{ m/s}$$

Solution:

Equation of external photoelectric effect:

$$\frac{hc}{\lambda} = A + \frac{mv_{\max}^2}{2} \quad (1),$$

where $\frac{hc}{\lambda}$ – energy of photon,

A – electron work function of the metal surface,

$\frac{mv_{\max}^2}{2}$ – the maximum kinetic energy of the electron

Conditions the exist of photoelectric effect:

$$\frac{hc}{\lambda} = A \quad (2)$$

Energy of photon:

$$E_1 = \frac{hc}{\lambda_1} \quad (3)$$

$$\text{Of (3)} \Rightarrow E_1 = 2,94 \times 10^{-19} \text{ J}$$

$$1 \text{ eV} = 1,6 \times 10^{-19} \text{ J}$$

$$E_1 = 2,94 \times 10^{-19} \text{ J}$$

$$E_1 = 1,84 \text{ eV}$$

$$A = 2,28 \text{ eV}$$

If $E_1 < A$ then sodium does not show photo electric effect for red light having wavelength $\lambda = 678$ nm.

$$\text{Of (2)} \Rightarrow \lambda = \frac{hc}{A} \quad (4)$$

$$\text{Of (4)} \Rightarrow \lambda = 545 \times 10^{-9} \text{ m}$$

Answer:

sodium does not show photo electric effect for red light having wavelength $\lambda = 678$ nm;
observed the photoelectric effect from sodium for wavelengths less than 545 nm ($\lambda < 545$ nm)

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