

The range of visible light is 4000Å to 7000Å. Will photoelectrons be emitted by a copper surface of work function 4.4 eV, when illuminated by visible light? Give the mathematical prove of your answer?

Solution:

$$A_f = 4,4eV = 4.4 \cdot 1.6 \cdot 10^{-19} = 7.049 \cdot 10^{-19}J$$

$$\lambda_1 = 400nm$$

$$\lambda_2 = 700nm$$

We can determine if the photoelectrons would be emitted by using a frequency of red edge:

$$\nu_{red} = \frac{A_f}{h},$$

Where h is a Planck's constant and $h = 6,67 \cdot 10^{-34}(J \cdot c)$

$$\nu_{red} = \frac{7.049 \cdot 10^{-19}}{6.67 \cdot 10^{-34}} = 1,0568 \cdot 10^{15}(Hz)$$

And the frequency of visible light is

$$\lambda_1 = \frac{c}{\nu_1}$$

$$\nu_1 = \frac{c}{\lambda_1} = \frac{3 \cdot 10^8}{400 \cdot 10^{-9}} = 0.75 \cdot 10^{15}(Hz)$$

$$\lambda_2 = \frac{c}{\nu_2};$$

$$\nu_2 = \frac{c}{\lambda_2} = \frac{3 \cdot 10^8}{700 \cdot 10^{-9}} = 0.4285 \cdot 10^{15}(Hz)$$

So we can see that

$$\nu_2 < \nu_1 < \nu_{red}$$

Answer: That means that the photoelectrons wouldn't be emitted from the surface.