Answer on Question 49878, Physics, Optics

Question:

Calculate the wavelength at which the energy of a photon becomes equal to the average thermal energy of atoms in a solid at room temperature.

Solution:

From the definition of the energy of the photon we have:

$$E = \frac{hc}{\lambda},$$

where E is the energy of the photon, h is the Planck's constant, c is the speed of the light and λ is the wavelength of the light.

The average thermal energy of atoms in a solid is $E = k_B T$, where k_B is Boltzmann constant, T is the temperature.

According to the condition of the question we equate both relationships for energy:

$$\frac{hc}{\lambda} = k_B T.$$

From this equation we obtain the wavelength at which the energy of a photon becomes equal to the average thermal energy of atoms in a solid at room temperature:

$$\lambda = \frac{hc}{k_B T} = \frac{6.626 \cdot 10^{-34} Js \cdot 3 \cdot 10^8 \frac{m}{s}}{1.38 \cdot 10^{-23} \frac{J}{K} \cdot 298.15K} = 4.8 \cdot 10^{-5} m = 48 \mu m.$$

Answer:

$\lambda = 48 \mu m.$