

1. A tungsten filament is 35 mm long and has a radius of 7.5 mm.
Calculate the current emitted from this filament at temperatures of 2400 °C and 2500 °C.

Solution

I think "current" is not the correct word in question.

We have according to the Stefan–Boltzmann's law

$$j^* = \varepsilon \sigma T^4$$

$$P = j^* A = A \varepsilon \sigma T^4$$

Where

$$A = 2\pi rL$$

$$T = 2400^\circ C \approx 2673K,$$

or

$$T = 2500^\circ C \approx 2773K$$

$$L = 35mm$$

$$r = 7.5mm$$

Where j^* is the emissive power, P is total power radiated from tungsten filament,

$\varepsilon \approx 1$ is emissivity, $\sigma = 5.67 \times 10^{-8} \frac{J}{s \cdot K^4 \cdot m^2}$ is Stefan-Boltzmann's constant,

Answer

If

$$T \approx 2673K$$

$$j^* \approx 2894535 \frac{J}{s \cdot m^2}$$

$$P \approx 4453 \frac{J}{s}$$

If

$$T \approx 2773K$$

$$j^* \approx 335266 \frac{J}{s \cdot m^2}$$

$$P \approx 5518 \frac{J}{s}$$