Answer on Question 50850, Physics, Electromagnetism

Question:

A fuse in an electric circuit is designed to open the circuit like a switch when the current exceeds a preset value. If a fuse is made of material that melts when the current density reaches $400\frac{A}{cm^2}$, what is the diameter of the wire needed to limit the current to $0.30A$?

Solution:

By the definition of the current density we have:

$$J = \frac{I}{A},$$

where J is the current density, I is the current flowing through the wire, A is the cross section area of the wire.

So, we can find the cross section area of the wire:

$$A = \frac{I}{J} = \frac{0.30A}{400\frac{A}{cm^2}} = 0.00075cm^2.$$

We know that $A = \pi r^2 = \frac{\pi d^2}{4}$, therefore from this formula we can obtain the diameter of the wire needed to limit the current to $0.30A$:

$$d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4 \cdot 0.00075cm^2}{\pi}} = 0.03cm = 3 \cdot 10^{-4}m.$$

Answer:

$d = 3 \cdot 10^{-4}m.$