Answer on Question #45990 – Physics – Electromagnetism

Question.

A nichrome wire is 1.0m long and 1.0mm2 in cross-sectional area. It carries a current of 4.0 A when a potential difference of 2 V is applied between its ends. Calculate the conductivity of the wire.

Given:

$l = 1\ m$

$A = 1\ mm^2 = 10^{-6}\ m^2$

$I = 4\ A$

$U = 2\ V$

Find:

$\sigma = ?$

Solution.

By definition the resistance R can be defined the following:

$$R = \rho \frac{l}{A}, where$$

ρ is the resistivity of material;

l is the length of material;

A is the cross-sectional area of material.

From other side the resistance can be defined from the Ohm's law:

$$R = \frac{U}{I}, where$$

U is the voltage applied;

I is the electric current.

We can equate these two formulas for the resistance and to determine the resistivity:

$$R = \rho \frac{l}{A} = \frac{U}{I} \rightarrow \rho = \frac{U}{I} \cdot \frac{A}{l}$$

And the conductivity σ is defined as the inverse of resistivity:

$$\sigma = \frac{1}{\rho} = \frac{I}{U} \cdot \frac{l}{A}$$

Calculate:

$$\sigma = \frac{4 \cdot 1}{2 \cdot 10^{-6}} = 2 \cdot 10^6 \, \Omega^{-1} m^{-1} = 2 \cdot 10^6 \, \frac{S}{m}$$

Answer.

$$\sigma = \frac{I}{U} \cdot \frac{l}{A} = 2 \cdot 10^6 \, \Omega^{-1} m^{-1} = 2 \cdot 10^6 \, \frac{S}{m}$$