Answer on Question #85545 - Physics - Electric Circuits

Find the ratio of the diameter of aluminium to copper wire, if they have the same resistance per unit length. Take the resistivity values of aluminium and copper to be 2.65× 10−8 Ω m and 1.72 × 10−8 Ω m respectively

Solution:

The resistance of wire

$$R = \rho \frac{l}{S},$$

where ρ- resistivity of the material;

l – length of wire;

$S = \frac{\pi d^2}{4}$ − cross-sectional area of wire, where d − diameter of wire[i].

The diameter of wire

$$d = \sqrt{\frac{4\rho l}{\pi R}}.$$

The ratio of the diameter of aluminium to copper wire, taking to account, that resistances and lengths of both wires are the same:

$$\frac{d_a}{d_c} = \frac{\sqrt{\frac{4\rho_a l}{\pi R}}}{\sqrt{\frac{4\rho_c l}{\pi R}}} = \frac{\sqrt{\rho_a}}{\sqrt{\rho_c}} = \frac{\sqrt{2.65 \cdot 10^{-8}}}{\sqrt{1.72 \cdot 10^{-8}}} = 1.24.$$

Answer: The ratio of the diameter of aluminium to copper wire is 1.24.