Answer on Question #51239, Physics, Solid State Physics

Task: Aluminium has three valence electrons per atom, an atomic weight of 0.02698 kg mol^{-1}, a density of 2700kgm^{-3}, and a conductivity of 3.54× 10^7 $\Omega^{-1}m^{-1}$. Calculate the relaxation time in Aluminium

Solution:

Given, Atomic weight=0.02698 kg mol^{-1}; density D=2.7*$10^3$$kgm^{-3}$; conductivity σ=3.54× 10^7 $\Omega^{-1}m^{-1}$; Avagadro number N_A=6.022*10^{23} mol^{-1}

$$\sigma = \frac{ne^2\tau}{m}$$

$$\mathrm{n} = (\text{number of free electroms} \cdot \mathrm{N_A} \cdot \mathrm{D})/(\text{Atomic weight}) = \frac{3 \cdot 6.02 \cdot 10^{23} \cdot 2.7 \cdot 10^3}{0.02698} m^{-3} \approx 18.08 \cdot 10^{28} m^{-3}$$

$$Thus, \tau = \frac{\sigma m}{ne^2} = \frac{3.54 \cdot 10^7 \cdot 4.48 \cdot 10^{-31}}{18.08 \cdot 10^{28} \cdot (1.6 \cdot 10^{-19})^2} = 0.34 \cdot 10^{-14} s$$

Answer: $\tau = 0.34 \cdot 10^{-14} s$