Charge Carrier Density

Consider a copper atom:

The diameter of a copper atom is about 0.25nm

This means that there will be 1 / 0.25nm = 4×10^9 copper atoms in 1 metre.

Consider a copper cube of sides 1m:

Theoretically, in this cube there must be $(4 \times 10^9)^3 = 6.4 \times 10^{28}$ copper atoms.

Assuming each atom has one free electron there are 6.4×10^{28} free charges per cubic metre – this is called the "charge carrier density" (n)

Worked example

Copper has a carrier density n = 6.4×10^{28} , each electron has a charge of 1.6×10^{-19}C

How much free charge would be in a cubic metre of copper?

Solution:

Charge carrier density = n = 6.4×10^{28}

Charge of electron = 1.6×10^{-19}C

Total free charge = $6.4 \times 10^{28} \times 1.6 \times 10^{-19}$C

= 1.024×10^{10}C