HW2-1 Soln)

$$\frac{\text{Volume}}{\text{atom}} = \frac{\text{valence} \times \text{e}}{\text{bulk density}} \times \frac{\text{mass trasferred}}{\text{current} \times \text{time}} .$$

$$\text{valence} = \frac{\text{Volume}}{\text{atom}} \times \frac{\text{bulk density}}{\text{e}} \times \frac{\text{current} \times \text{time}}{\text{mass trasferred}}$$

The volume per atom is

$$\text{V} = \frac{4\pi}{3}\left(\frac{\text{d}}{2}\right)^3 = \frac{\pi}{6}(2.6 \times 10^{-10})^3 = 9.2 \times 10^{-30}\text{m}^3$$

But we need to include the associated empty space around the atoms:

$$\text{V}_{\text{EFF}} = \frac{9.2 \times 10^{-30}\text{m}^3}{0.74} = 1.24 \times 10^{-29}\text{m}^3$$

The bulk density of copper is 8920kg/m^3.

Then,

$$\text{valence} = 1.24 \times 10^{-29} \times \frac{8920}{1.6 \times 10^{-19}} \times \frac{0.25 \times (60 \times 60)}{0.295 \times 10^{-3}} = 2.11 \rightarrow 2$$