CHAPTER 4.

4.1 Calculate the no. of vacancies in copper given Q and T.

$$n = \frac{4 \text{ atoms/unit cell}}{(3.6151 \times 10^{-8} \text{ cm})^3} = 8.47 \times 10^{22} \text{ atoms/cm}^3$$

$$n_v = n \exp\left(\frac{-Q_v}{RT}\right) = \left(8.47 \times 10^{22} \frac{\text{atoms}}{\text{cm}^3}\right)\left(\exp \frac{-20000 \frac{\text{cal}}{\text{mol}}}{(1.987)(353)}\right)$$

$$= 8.47 \times 10^{22} \exp(-7.4393)$$

$$= 4.97 \times 10^{19} \text{ vacancies/cm}^3$$

4.8. Calculate atm% of Sn in Cu.

$$8.772 \text{ g/cm}^3 = \frac{(x)(118.69 \text{ g/mol}) + (4-x)(63.54 \text{ g/mol})}{(3.7589 \times 10^{-8} \text{ cm})^3 (6.02 \times 10^{23} \text{ atoms/mol})}$$

$$280.5 = 55.15x + 254.16$$

$$x = 0.478 \text{ Sn atoms/cell}$$

$$\frac{.478}{4} = 11.95\%$$

4.35 Does manufacturing of steel into a car chassis involve plastic or elastic deformation. Elastic deformation occurs initially upon application of a force during pressing or shaping of steel and is the "recoverable" aspect of deformation but the final shape of the product is a result of plastic or permanent deformation.

4.38 Find the dislocation density represented by 240,000 miles

$$(240{,}000 \text{ mi})\left(5280 \frac{\text{ft}}{\text{mi}}\right)\left(12 \frac{\text{in}}{\text{ft}}\right)\left(\frac{2.54 \text{ cm}}{\text{in}}\right) = 3.86 \times 10^{10} \text{ cm}$$

If in a cubic cm then density of dislocations $= 3.86 \times 10^{10}$ cm/cm^3

4.53 Find the ASTM grain size no for 25 grains in an inch square if mag = 50x

For mag = 100x, ASTM grain size $N = 2^{n-1}$ ∴ at 50x, add a magnification factor of $\left(\frac{50}{100}\right)^2$

$(25)\left(\frac{50}{100}\right)^2 = 2^{n-1}$ $\ln 6.25 = (n-1)(\ln 2)$ $n = 3.6$

4-53 cont'd

$$25\left(\frac{50}{100}\right)^2 = 2^{n-1}$$

$$\log 6.25 = (n-1)\log 2$$

$$\boxed{n = 3.6}$$

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