

Crystal Systems

3.20 (a) The unit cell shown in the problem statement belongs to the tetragonal crystal system since $a = b = 0.35 \text{ nm}$, $c = 0.45 \text{ nm}$, and $\alpha = \beta = \gamma = 90^\circ$.

(b) The crystal structure would be called body-centered tetragonal.

(c) As with BCC, $n = 2$ atoms/unit cell. Also, for this unit cell

$$V_C = (3.5 \times 10^{-8} \text{ cm})^2(4.5 \times 10^{-8} \text{ cm})$$

$$= 5.51 \times 10^{-23} \text{ cm}^3/\text{unit cell}$$

Thus, using Equation 3.5, the density is equal to

$$\begin{aligned} \rho &= \frac{nA}{V_C N_A} \\ &= \frac{(2 \text{ atoms/unit cell})(141 \text{ g/mol})}{(5.51 \times 10^{-23} \text{ cm}^3/\text{unit cell})(6.023 \times 10^{23} \text{ atoms/mol})} \\ &= 8.49 \text{ g/cm}^3 \end{aligned}$$