Chapter 1

Problem Solutions

1.1

- (a) fee: 8 corner atoms × 1/8 = 1 atoms 6 face atoms × 1; = 3 atoms Total of 4 atoms per unit cell
- (b) bcc: 8 corner atoms × 1/8 = 1 atom 1 enclosed atom = 1 atom Total of 2 atoms per unit cell
- (c) Diamond: 8 corner atoms × 1/8 = 1 atom 6 face atoms × ½ = 3 atoms 4 enclosed atoms = 4 atoms Total of 8 atoms per unit cell

1.2

(a) 4 Ga atoms per unit cell

Density =
$$\frac{4}{(5.65 \times 10^{-4})^{1}} =$$

Density of Ga = 2.22x10° cm⁴

4 As atoms per unit cell, so that

Density of As = 2.22x10¹¹ cm⁻¹

(%)

8 Ge atoms per unit cell

Density =
$$\frac{8}{(5.65 \times 10^{-4})^5}$$
 \Rightarrow

Density of Ge = 4.44x10" cm"

1.3

(a) Simple cubic lattice; a = 2r

Unit cell vol = $\alpha' = (2r)' = 8r'$

I atom per cell, so atom vol. = (1) $\left(\frac{4\pi r'}{3}\right)$

Then

$$Ranio = \frac{\left(\frac{4\pi r^2}{3}\right)}{8r^2} \times 100\% \implies Ranio = 52.4\%$$

(b) Face-centered cubic lattice

$$d = 4r = a\sqrt{2} \implies a = \frac{d}{\sqrt{2}} = 2\sqrt{2}r$$

Unit cell vol $= a' = (2\sqrt{2}r)' = 16\sqrt{2}r'$

4 atoms per cell, so atom vol. = $4\left(\frac{4\pi r^3}{3}\right)$

Them

$$Ratio = \frac{4\left(\frac{4\pi r^3}{3}\right)}{16\sqrt{2} r^3} \times 100\% \implies Ratio = 74\%$$

(c) Body-centered cubic lattice

$$d = 4r = a\sqrt{3} \Rightarrow a = \frac{4}{\sqrt{3}}r$$

Unit cell vol. =
$$a' = \left(\frac{4}{\sqrt{3}}r\right)'$$

2 atoms per cell, so atom vol. = $2\left(\frac{4\pi r^2}{3}\right)$

There is

$$Ratio = \frac{2\left(\frac{4 Rr^3}{3}\right)}{\left(\frac{4r}{\sqrt{3}}\right)^2} \times 100\% \implies Ratio = 6.8\%$$

(d) Diamond lattice

Body diagonal = $d = 8r = a\sqrt{3} \Rightarrow a = \frac{8}{\sqrt{3}}r$

Unit cell vol.
$$= \alpha' = \left(\frac{8p}{\sqrt{3}}\right)'$$

8 atoms per cell, so atom vol. $8\left(\frac{4\pi^2}{3}\right)$

Them.

$$Ratio = \frac{8\left(\frac{4\pi r^2}{3}\right)}{\left(\frac{8r}{\sqrt{3}}\right)^2} \times 100\% \implies Ratio = 3.4\%$$

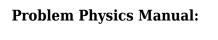
8.4

From Problem 1.3, percent volume of fcc atoms is 74%; Therefore after coffee is ground,

Volume $= 0.74 \text{ cm}^3$

Problem Physics Manual

N Colangelo



Problem Physics Manual Book Review: Unveiling the Power of Words

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