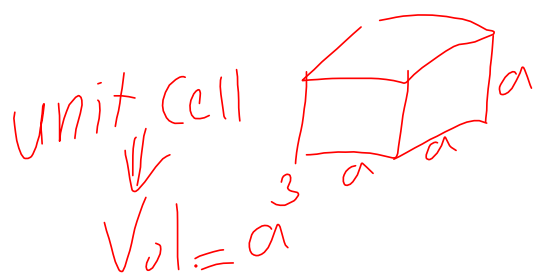


$$\text{atom} \rightarrow \text{sphere} \Rightarrow \text{Vol} = \frac{4\pi}{3} R^3$$



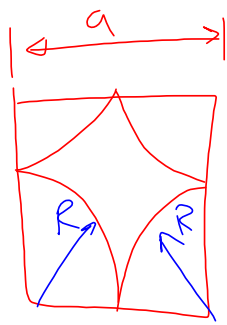
a = unit cell dimension

↓
atomic Radius
atomic Dimen.

Case 1 8 corners $\times \frac{1}{8}$ atom vol.
= 1 full atom inside unit cell

$$\text{APF} = \frac{1 \times \frac{4\pi}{3} R^3}{a^3} \Rightarrow R = f(a)$$

or $a = f(R)$



Side of unit cell

$$a = 2R \Rightarrow R = \frac{a}{2} = 0.5a$$

$$0.52 \Rightarrow 52\%$$

$$\text{BCC} \quad \frac{1}{8} \times 8 + 1 = 2 \Rightarrow \boxed{n=2}$$

$$\boxed{4R = \sqrt{3} a}$$

$$\text{APF} = 68\%$$

$$\text{FCC} : \boxed{n = 4}$$

$$6 \times \frac{1}{2} + 1 = 4$$

$$\boxed{4R = \sqrt{2} a}$$

$$\text{APF} = 74\%$$

① $R = ?$ $\underbrace{IR} \Rightarrow FCC \Rightarrow n=4$
 \Downarrow
 $4R = \sqrt{2}a$

S, A, NA
Know

$$\rho = \frac{n \cdot A}{V_c \cdot N_A}$$

4

3

FCC

$$R = \frac{\sqrt{2} a}{4}$$
$$4R = \sqrt{2} a$$

The diagram shows a handwritten derivation. At the top left, the density formula $\rho = \frac{n \cdot A}{V_c \cdot N_A}$ is written in blue ink. Above the numerator, a red checkmark is next to the number 4, indicating $n=4$. Below the denominator, a red checkmark is next to the symbol N_A . A red arrow points from the V_c term down to the lattice constant a , with a red checkmark and the number 3 next to it, indicating $V_c = a^3$. To the right, the atomic radius R is given as $R = \frac{\sqrt{2} a}{4}$. A red arrow points from this equation down to the final relationship $4R = \sqrt{2} a$. The word "FCC" is written in red between the a^3 and $4R = \sqrt{2} a$ equations.

$$\begin{aligned} \text{Nano} &= 10^{-9} \\ R &= 1.36 \times 10^{-8} \frac{\text{cm}}{100} = 1.36 \times 10^{-8} \times 10^{-2} \text{ m} \\ &= 1.36 \times 10^{-10} \text{ m} \left(\frac{\text{n}}{10^{-9}} \right) \\ &= 1.36 \times 10^{-1} \text{ nm} \\ &= \boxed{0.136 \text{ nm}} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad R &= 0.143 \text{ nm} \\ &= 0.143 \times 10^{-9} \times 100 \text{ cm} \\ \boxed{R} &= 0.143 \times 10^{-7} \text{ cm} = 1.43 \times 10^{-8} \text{ cm} \end{aligned}$$

$\rho, A, N_A \Rightarrow \text{Known} \checkmark$
FCC or BCC?

$$\rho = \frac{n \cdot A}{V_c \cdot N_A}$$

↓
a³ ?

Assume FCC $\Rightarrow n=4$, $4R = \sqrt{2} a$

Find $\rho \rightarrow$ compare with the given

BCC $\rightarrow n=2$, $4R = \sqrt{3} a$

Compare \rightarrow matches

Imperfections in Solids

$$N_V = N \cdot \exp\left(-\frac{Q_V}{k \cdot T}\right)$$

1) Two material: m_1 & m_2

$$C_1 = \frac{m_1}{\sum m = m_1 + m_2} \times 100\%$$

$$C_2 = \frac{m_2}{m_1 + m_2} \times 100\% \times \frac{g}{g}$$

Q? 3 material

$$C_1 = \frac{m_1}{m_1 + m_2 + m_3} \times 100\%$$

C_2

C_3

2) atom %

$\frac{n}{\sum n}$ ← No. of moles

$$n = \frac{m}{A}$$

↳ This is NOT
No. of atoms/unit cell

3)

Composition Conversion C'' 

Applications in Diffusion
will be covered

Q

$$N_V \text{ ? / m}^3$$

$$T = 900^\circ\text{C} + 273 \Rightarrow \text{K}$$

$$Q_V = 0.98 \text{ eV/atom} \Rightarrow \lambda = \dots \text{ eV/atom}$$

the second one

$$\rho, A, N_V \Rightarrow \text{Given}$$

$$N_V = N \exp\left(-\frac{Q_V}{K \cdot T}\right)$$

$$\frac{N_A \cdot \rho}{A}$$

$$N_V = 3.52 \times 10^{18} \text{ Vacancies/cm}^3$$

$$= \frac{3.52 \times 10^{18}}{10^6} \text{ cm}^3$$

$$= 3.52 \times 10^{18} \times 10^6 / \text{m}^3$$

$$= 3.52 \times 10^{24} \text{ Vac./m}^3$$

$$\underline{Q2} \quad n = \frac{m}{A}$$

Zn & Cu \Rightarrow A: Given

$$\left. \begin{aligned} C_1 &= \frac{m_1}{\sum m} \times 100\% \\ C_2 &= \frac{m_2}{\sum m} \times 100\% \end{aligned} \right\}$$

$$C_1\% + C_2\% = 100\%$$