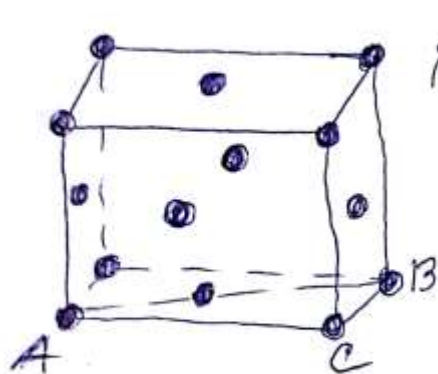


Aluminum metal crystallizes in a face-centered cubic unit cell. The volume of the cell is 0.0622 nm^3 . what is the volume of a single aluminum atom?

Solution:

$$V_{\text{cell}} = 0,0622 \text{ nm}^3$$

a face-centered cubic unit cell:



$$\text{Packing density} = \frac{V_{\text{atoms}}}{V_{\text{cell}}}$$

$$V_{\text{cell}} = a^3, \quad AC = a,$$

$$AB = 4r, \quad r - \text{radius of Al-atom}$$

$$AC = a\sqrt{2}$$

$$\text{then } 4r = a\sqrt{2} \Rightarrow r = \frac{a\sqrt{2}}{4}$$

$$N_{\text{atoms}} = 8 \cdot \frac{1}{8} + 6 \cdot \frac{1}{2} = 4 - \text{number of atoms per cell.}$$

$$P.d = \left(\frac{4}{3} \pi \left(\frac{a\sqrt{2}}{4} \right)^3 \cdot N_{\text{atoms}} \right) / a^3 = 0,74$$

$$V_{\text{atoms}} = V_{\text{cell}} \times P.d. = 0,0622 \text{ nm}^3 \cdot 0,74 = 0,046028 \text{ nm}^3$$

$$V_{\text{atom}} = \frac{V_{\text{atoms}}}{N_{\text{atoms}}} = \frac{0,046028 \text{ nm}^3}{4} = 0,011507 \text{ nm}^3 \sim 0,0115 \text{ nm}^3$$

$$\underline{\text{Answer:}} - V_{\text{atom}} = 0,0115 \text{ nm}^3$$