Radius Ratio rule

Void	r_+/r_-	range	CN (+)
Tetrahedral	0.225	[0.225, 0.414)	4
Octahedral	0.414	[0.414, 0.732)	6
Cubical	0.732	[0.732, 1)	8

$\frac{r_+}{r_-} = 2 \Rightarrow \frac{r_-}{r_+} = 0.5$ [0.414 – 0.732)

→ Octahedral void

Note:

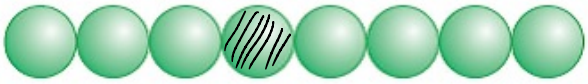
① $P \uparrow \Rightarrow CN \uparrow$

② $T \uparrow \Rightarrow CN \downarrow$

Close packing in crystals:

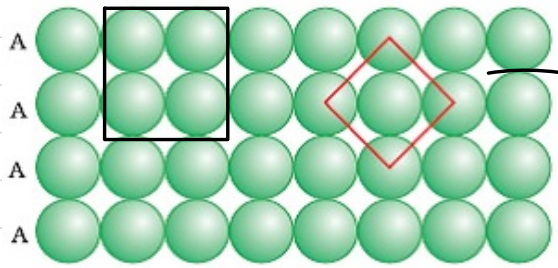
① 1-D Close packing:-

CN = 2



② 2-D Close packing (Close packing of layers)

ⓐ Square close packing:- AAA..... type



CN = 4

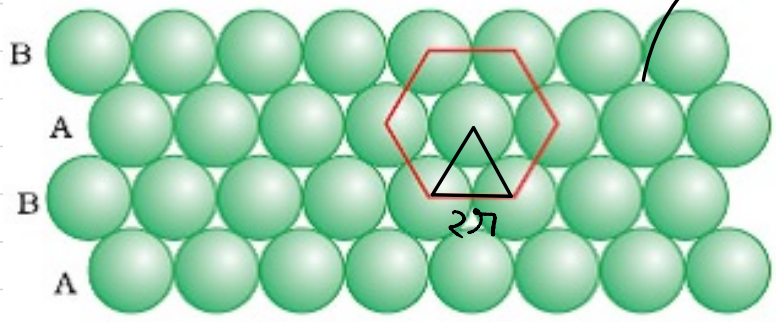
→ Square planer void

Pf of Layer

$$= \frac{4 \times \frac{4}{3}\pi r^3}{4r \times 4r \times 2r} = \frac{\pi}{6} = 0.524$$

$$\text{2-D pf} = \frac{4 \times \pi r^2}{4r \times 4r} = \frac{\pi}{4} = 0.785$$

ⓑ Hexagonal Close packing:- CN = 6



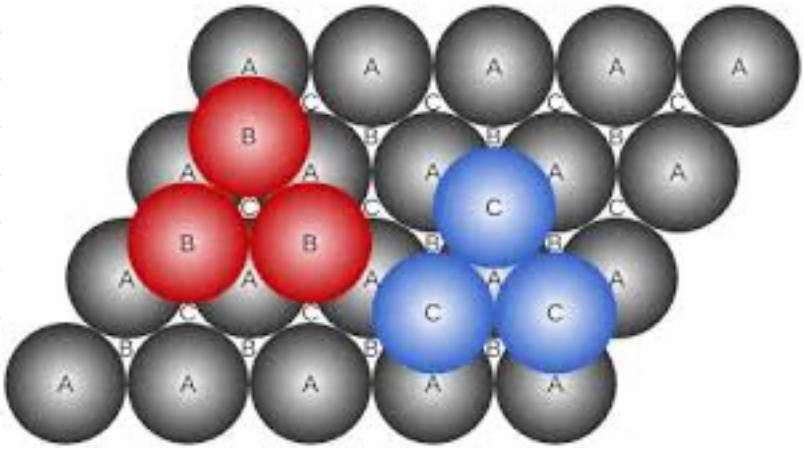
→ Triangular void

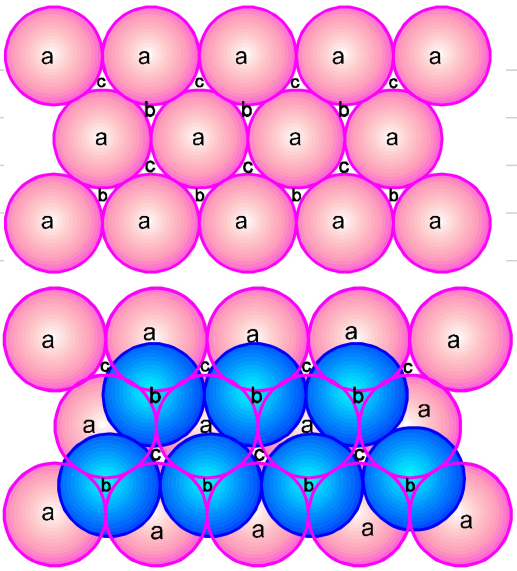
$$\text{Pf of Layer} = \frac{3 \times \frac{4}{3}\pi r^3}{\left(\frac{\sqrt{3}}{4} \times 4r^2\right) \times 6 \times 2r}$$

$$= \frac{\pi}{3\sqrt{3}} = 0.604$$

$$\text{2-D pf} = \frac{3 \times \pi r^2}{\left(\frac{\sqrt{3}}{4} \times 4r^2\right) \times 6} = \frac{\pi}{2\sqrt{3}} = 0.906$$

Close packing b/w layers (or 3D close packing)

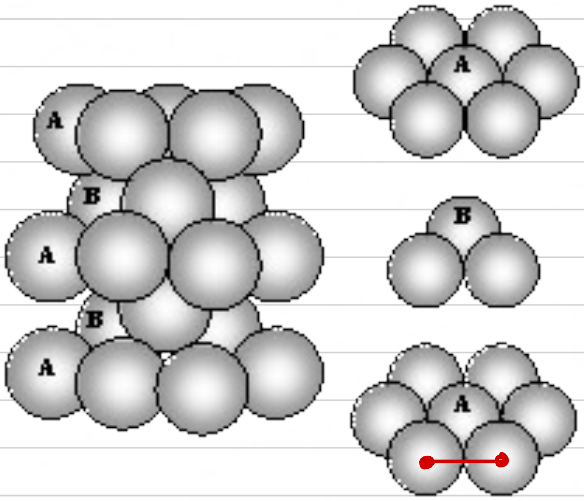


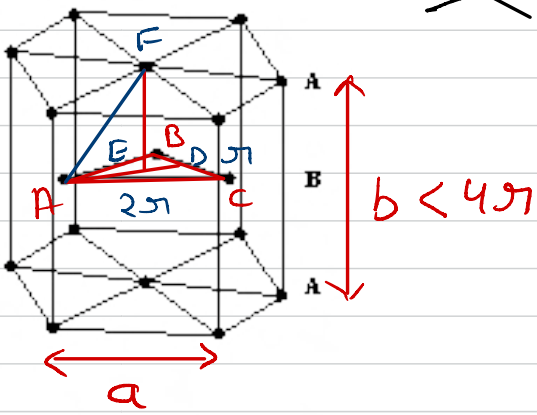


A, B = tetrahedral
C = Octahedral

(1) ABAB..... type (or hexagonal Close Packing)

hcp arrangement of 3-D





(1) Effective No of particle (z) $= 3 + 2\times\frac{1}{2} + 12\times\frac{1}{6}$

$= 6$

(2) CN $= 3 + 6 + 3 = 12$

(3) $a = 2r$

$AD = \sqrt{(AC)^2 - (CD)^2}$

$= \sqrt{4r^2 - r^2} = r\sqrt{3}$

$AF = 2r$

$AE = \frac{2}{3}AD = \frac{2r}{\sqrt{3}}$

$(FE) = \sqrt{(AF)^2 - (AE)^2} = \sqrt{4r^2 - \frac{4r^2}{3}}$

$= 2r\sqrt{\frac{2}{3}}$