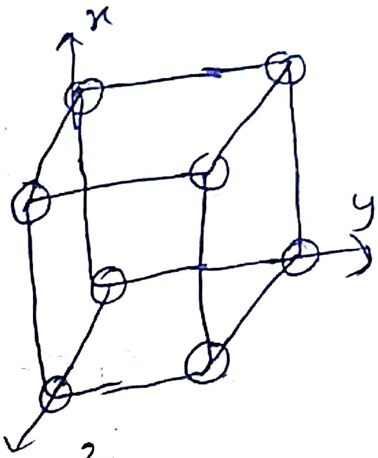
CO 1 Home Assignment - I

2100031070

1) compute the atomic fractions of SC, BCC & FCC?

Sol: APF for simple cubic:-

APF = $\frac{\text{volume occupied by atoms}}{\text{volume of unit cell}}$



$= \frac{\frac{4}{3}\pi r^3}{a^3} \times z$

$z = 8 \times \frac{1}{8}$

$= 1$

$a = 2r$

$= \frac{\frac{4}{3}\pi r^3}{(2r)^3} \times 1$

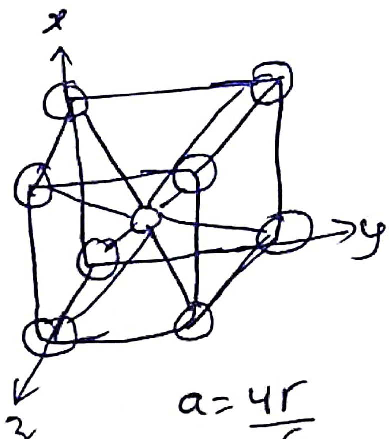
$= \frac{\cancel{4}\pi \cancel{r^3}}{\cancel{8}_2 \times 3\ \cancel{r^3}}$

$= \frac{\pi}{6} = 0.52$

APF in simple cube = 52%

void% in SC = 48%

b) APF for BCC:-



$APF = \frac{\frac{4}{3}\pi r^3 \times z}{a^3}$

$= \frac{\frac{4}{3}\pi r^3 \times 2}{\left(\frac{4r}{\sqrt{3}}\right)^3}$

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

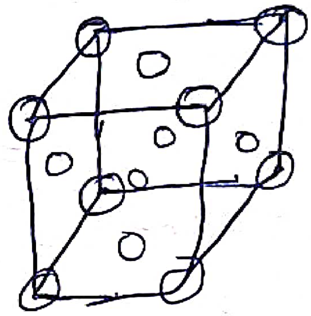
$z = 2$

$$\frac{4\pi r^3 \times 2 \times 8\sqrt{3}}{3 \times 64 \times r^3} \qquad = \frac{\sqrt{3}\pi}{8} = 0.68$$
$$8$$

APF % in BCC = 68%

void % = 32%

c) APF for FCC:-



$$APF = \frac{\frac{4}{3}\pi r^3 \times Z}{a^3}$$

$$= \frac{\frac{4}{3}\pi r^3 \times 4}{\left(\frac{4r}{\sqrt{2}}\right)^3}$$

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

$Z = 4$

$$= \frac{\pi}{3\sqrt{2}} = 0.74$$

APF in FCC = 74%

void % = 28%

② Illustrate seven crystals systems with lattice parameters conditions

Sol:

Crystal system	lattice constant	Interficial Angles	P	I	F	C
cubic	$a=b=c$	$\alpha=\beta=\gamma=90^\circ$	✓	✓	✓	✗
Tetragonal	$a=b\neq c$	$\alpha=\beta=\gamma=90^\circ$	✓	✓	✗	✗
orthorhombic	$a\neq b\neq c$	$\alpha=\beta=\gamma=90^\circ$	✓	✓	✓	✓
monoclinic	$a\neq b\neq c$	$\alpha=\gamma=90^\circ,$ $\beta\neq 90^\circ$	✓	✗	✗	✓
Triclinic	$a\neq b\neq c$	$\alpha\neq\beta\neq\gamma=90^\circ$	✓	✗	✗	✗
rhombohedral	$a=b=c$	$\alpha=\beta$ $\gamma\neq 90^\circ$	✓	✗	✗	✗
Hexagonal	$a=b\neq c$	$\alpha=\beta$ $\gamma=120^\circ$	✓	✗	✗	✗

③ Differentiate primitive & non-primitive unit cells.

Sol:

primitive unit cell	non primitive unit cell
1) smallest repeating unit in a crystal lattice maintains overall symmetry of the structure	1) Large unit cell that may contain more than one lattice point

2) contains only one lattice point around its corners	2) contains more than one point, which ma locate at corners, faces centres.
3) Has a simple & basic shape often a cube	3) can have more complex irregular shape based on arrangement of atoms
4) more efficient in terms of space utilisation	4) less efficient in terms of space utilisation.

④ Explain the procedure to designate plane given by miller indices & give its important features.

A) Procedure:-

1) Determine the co-ordinates of the intercepts made by the plane along the 3 crystallographic axis.

2) Express the intercepts as multiples of unit cell dimensions or lattice parameters along the axis.

3) Determine the reciprocals of these numbers

4) Reduce these reciprocals into the smallest whole number by multiplying each with their LCM to get the smallest whole number.

5) Enclose the smallest whole number in (.

6) This give the miller indices (h,k,l) of the plane.

Features:-

1) If a plane is parallel to any of the coordinate axis then its intercepts will be infinity.

2) All the parallel equidistant planes have the same miller indices

3) miller indices define a set of equidistant parallel planes.

4) If the miller indices of two planes have the same ratio then the planes are parallel to each other.

5) If (hkl) are the miller indices of a plane then the plane cuts the axis into h, k & l equal parts.

5) Discuss line defects & Explain burger vector?

2100031704

A) 1) Line Defects:-

Line Defects also known as dislocations, are irregularities (or) disruption that occurs along a line within the crystal lattice of a materila. There are mainly two types:

1) Edge dislocations
2) Screw dislocations

2) Burger vector:-

The burger vector (denoted as b) is a vector that describes the magnitude & direction of the lattice distortion caused by a dislocation. the burger vector is perpendicular to the dislocation line. It represents the closed loop that one would follow to return to the same lattice position.