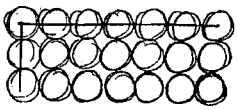
MATERIAL SCIENCE

Based on arrangement of atoms, solid materials are of two types.

Solid Materials

Crystalline Material

$T_{Al} = 660°C$



→ In crystalline materials atoms are arranged in regular periodic manner

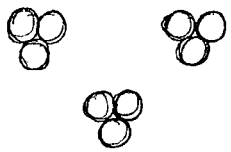
→ The crystalline materials have higher in strength becoz of more no of bonds.

→ The crystalline materials are ~~an~~ isotrophic or unisotrophic in nature i.e, The material properties are different in different directions.

→ The crystalline materials have high & sharp melting point temperature

e.g. All metals, some of carriers. None of polymers.

Non-Crystalline Material [Amorphous Material]



→ In Non-crystalline material atoms are alligned in irregular manner with more void space.

→ The non crystalline material have lower in strength becoz of less no. of bonds

→ The non-crystalline materials all isotrophic in nature i.e, the material properties are same in all the directions.

→ The non crystalline Materials have low & range of melting point Temperature

e.g. plastic, rubber, glass, peat.

Note:- Ceramics are compounds of both metal & Non metal.

i) The crystaline ceramics are formed by slow cooling of liquid material eg. Quartz.

ii) The Non-crystaline ceramics are formed by fast cooling of liquid material eg. Glass.

ceramic

$BaTiO_3$
$PaZrO_3$
$MnFe_2O_4$
SiO_2
WC
TiC
Al_2O_3

exp 1

i/p - Liquid silica

↓ slow cooling rate

Quartz

exp 2

i/p - Liquid silica

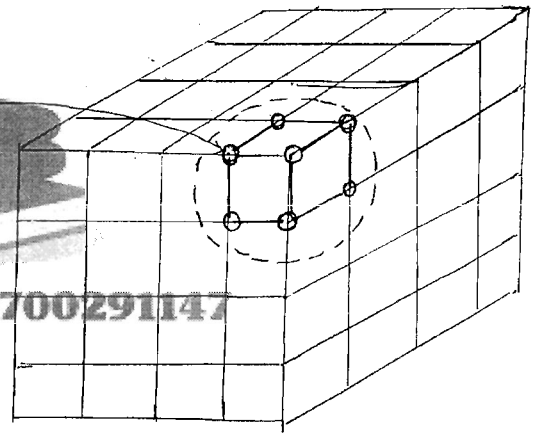
↓ fast cooling rate

Glass (Non crystalline)

Unitcell

Shape :- parallelopied.
(sets of parallel faces)

Smallest no of atoms are arranged in a repeatitive manner.



Space Lattice
(one cubic block)

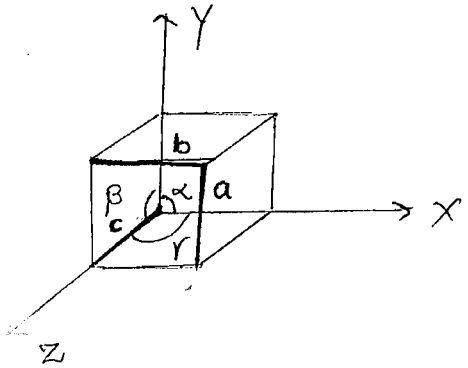
& one square face is unit cell.

Representation

a, b, c ⇒ Lattice parameter

α, β, γ ⇒ Interfacial angle.

$\eta_{max} = 6$.



The maximum ~~per~~ no of independent parameter required to define a unitcell is 6

Bravis Lattice systems (Types of Unitcells)

Total no of lattice systems = 14 ***

Basic (or) primary lattice systems = 7

i) Cubic system

$a = b = c$

$\alpha = \beta = \gamma = 90^\circ$

$n = 1 (a)$

The no of independent parameter required to define a cubic system $n = 1$.

ii) Triclinic system

$a \neq b \neq c$

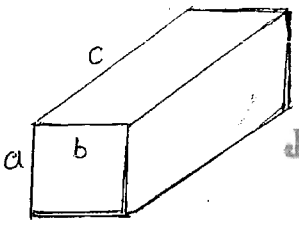
$\alpha \neq \beta \neq \gamma \neq 90^\circ$

$n = 6$

The triclinic system is the most complex type lattice s/s. That requires all the 6 lattice parameter to define the system.

iii) Tetragonal System

(RTC BUS)



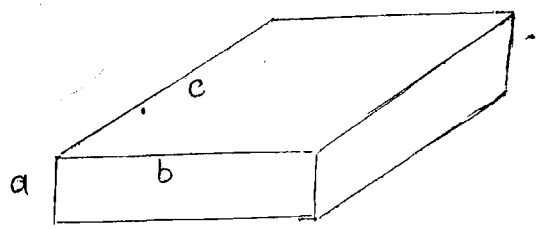
$a = b \neq c$

$\alpha = \beta = \gamma = 90^\circ$

$n = 2 (a, c)$

iv) Orthorohombic system

(Match Box)

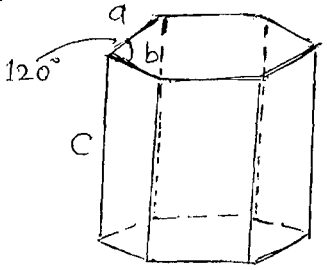


$a \neq b \neq c$

$\alpha = \beta = \gamma = 90^\circ$

$n = 3 (a, b, c)$

v) Hexagonal system



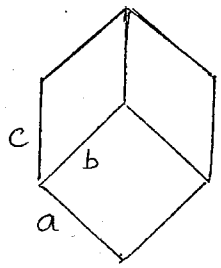
$a = b \neq c$

$\alpha = 120^\circ$

$\beta = \gamma = 90^\circ$

$n = 2 (a, c)$

vi) Rhombohedral System



$a = b = c$

$\alpha = \beta = \gamma \neq 90^\circ$

$n = 2 (a, \alpha)$

vii) Monoclinic system

$a \neq b \neq c$

$\alpha \neq \beta = \gamma = 90^\circ$

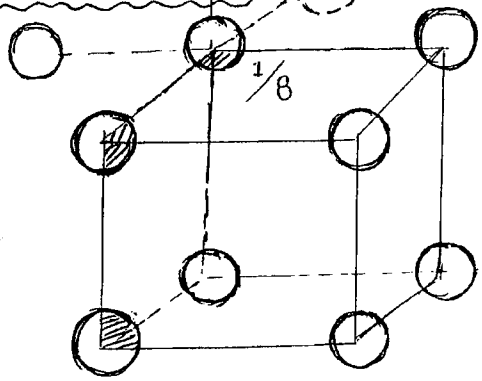
$n = 4 (a, b, c, \alpha)$

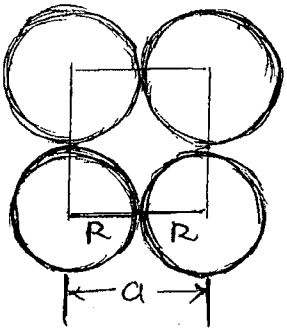
e.g.

List I	List II
i) Tetragonal	a) $a = b = c$; $\alpha = \beta = \gamma$
ii) Monoclinic	b) $a \neq b = c$; $\alpha \neq \beta = \gamma$
iii) Rhombohedral	c) $a = b \neq c$; $\alpha = \beta = \gamma$
iv) Hexagonal	d) $a \neq b \neq c$; $\alpha \neq \beta = \gamma$

Types of crystal structrueture.

i) Simple cubic structure (sc) (cs)





(1) N = 8 atoms

(2) $n = \frac{1}{8} \times 8 = 1$ atom

(3) Rel (a & R)

$a = 2R$

(4) Bond Length = a (or) 2R