HindPhotostat

GET IT ON Google Play

Hind Photostat & Book Store

Best Quality Classroom Topper Hand Written Notes to Crack GATE, IES, PSU's & Other Government Competitive/ Entrance Exams

MADE EASY
ESE GS PRELIMS PAPER-1
Topper Handwritten Notes
Basic of Material Science
By-Suneel Tiwari Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

Visit us:-www.hindphotostat.com

Courier Facility All Over India
(DTDC & INDIA POST)
Mob-9311989030

Material Science

1. Introduction
2. Atomic structure + Chemical Bonding
3. Crystallography
4. Electrical Properties of Materials
5. Magnetic Properties of Materials
6. Mechanical Properties of Materials
7. *Ceramics
8. *Polymers
9. *Composites
10. *Phase Diagram and alloys. → Theory Book.

Telegram ⇒ t.me/anunaad22

Anunaad.... let's be in resonance.

Suneelkumar3004 → Telegram channel

Ch-01 Introduction

Material Science

- It involves investigating the relationship that exist b/w the structures and properties of material.
- Material science does not deal with the behaviour of engineering components such as machines, buildings and vehicle facilities etc., instead it deals with the study of properties of materials with which these components are made.

Material

- Material can be defined as something that consists of matter.
- It is the stuff with the help of which something can be made.
- Engineering materials are mainly classified as:-
  (1) Metals and Alloys
  (2) Ceramics and glasses
  (3) Organic Polymers
  (4) Composites.

Structure of Materials

- It relates to the arrangement of it's internal components.
- Structure can be classified as:-

(1) Nuclear Structure
- It tells us about the no. of neutrons and protons into the nucleas of an atom.

- Nuclear structure is studied with the help of nuclear spectroscopic techniques such as Nuclear Magnetic Resonance (NMR) OR Mossbaver studies.

(2) Electronic Structure

- It deals with the arrangement of electrons in the various orbits of atom.

(3) Crystal Structure

- It tells us about the arrangement of atoms in the crystal.
- In a crystal atoms are arranged in regular and periodic manner.
- The smallest group of atoms by repeating which in all the crystallographic directions, the crystal structure can be developed, this smallest group of atoms is k/a unit cell.

(4) Microstructure

- It is observed under the optical microscope which can magnify a structure upto 1500 times without loss of resolution.
- structures obtained by using a microscope with a much higher resolution such as electron microscope, which can magnify a structure upto 10^6 times are k/a Substructure.

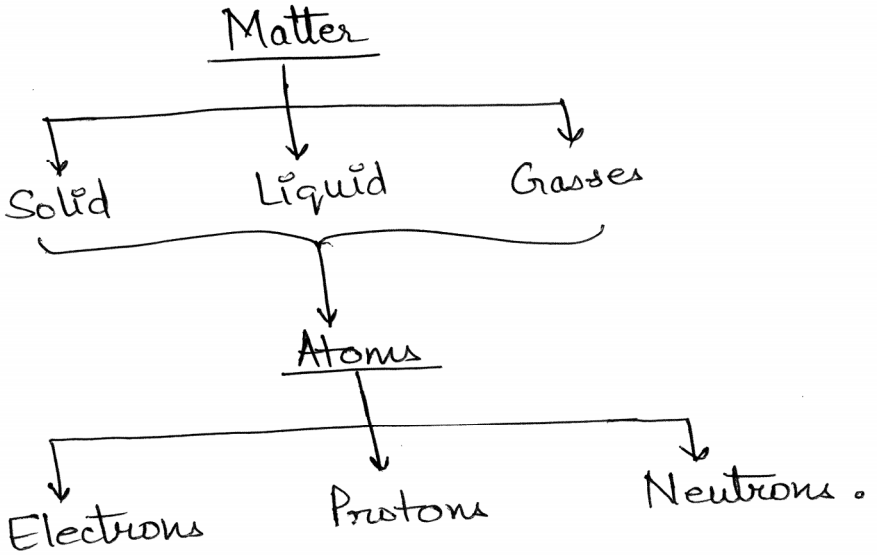
(5) Macrostructure

- It can be observed with naked eye.
- The internal symmetry of crystalline material may reflect in a external form of a crystal.

→ Property of a Material

- A property is a material character / attribute in terms of kind and magnitude of response to a specific imposed excitation.
- Properties of solid materials can be classified as :-
  (1) Mechanical Property
  (2) Electrical Property
  (3) Magnetic Property
  (4) Optical Property
  (5) Thermal Property
  (6) Detriorating Property of Material.

Ch-02 Atomic Structure & Chemical Bonding



- Matter is made up of very tiny and indivisible structures K/a Atoms.
- Atoms can neither be created nor be destroyed.

Electrons

- -vey charged particles
- charge = -1.6×10^{-19} Coulomb $= -q$
- Mass = 9.1×10^{-31} kg
- $-q$

Protons

- +vey charged particles.
- charge = $+1.6 \times 10^{-19}$ C $= +q$
- Mass = 1.67×10^{-27} kg
- $+q$

Neutrons

- Electrically neutral particles
- charge = 0
- Mass = 1.67×10^{-27} kg

Magnitude of Electron charge = q
$= 1.6 \times 10^{-19}$ C

→ **Atomic Number (Z)**

- It is no. of protons or no. of electrons in an atom.

→ **Atomic Mass Number (A)**

- The no. of protons and neutrons in the nucleus of an atom is k/a Atomic Mass Number.

→ **Atomic Mass Unit (amu)**

- It is defined as 1/12 of mass of a carbon atom.

$C = 6p + 6n + 6e^- = 12$ amu

$1p = x$

$1p = x$

$$6x + 6x + \frac{6x}{1850} = 12 \text{ amu}$$

(Neglect)

$x \simeq 1 \text{ amu} \simeq$ mass of a proton

$$\boxed{1 \text{amu} \simeq 1.67 \times 10^{-27} \text{ kg}}$$

→ Mole

- It is an SI unit.
- 1 mole is the amount of substance that contains as many particles or entities as their are atoms in 12g of carbon.-12.

$$\boxed{1 \text{ mole} = 6.023 \times 10^{23} \text{ atoms}}$$

→ Avagadro Number (N_A)

- Avagadro proposed that equal volumes of gasses at the same temperature and pressure should contain equal no. of molecules.
- The no. of atoms / molecules in a mole is termed as Avagadro Number.

$$\boxed{N_A = 6.023 \times 10^{23} \text{ atoms/mol}}$$

→ Isotopes

- Atoms having same atomic number but different atomic mass number (A) are k/a Isotopes.

Ex: ${}_1H^1$, ${}_1H^2$, ${}_1H^3$

${}_6C^{12}$, ${}_6C^{14}$.

Stability $\propto \frac{1}{\text{Energy}}$

→ Isobars

- Atoms having same Atomic Mass No. (A) but different Atomic No. (Z) are k/a Isobars.

Ex: $_{18}Ar^{40}$, $_{20}Ca^{40}$.

→ Isotones

- Atoms having same no. of neutrons but different Atomic No. and different Atomic Mass no.

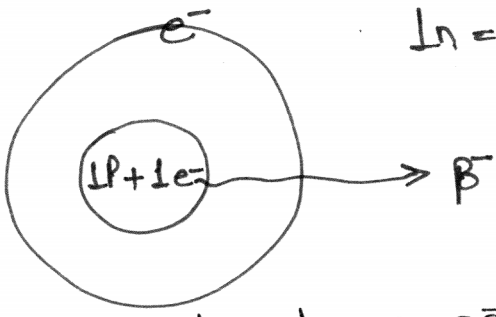
Ex: $_{17}Cl^{37}$, $_{19}K^{39}$ ⇒ 20 neutrons.

→ Comparison of α, β and γ rays

(1) Alpha (α) rays:

- α-particle consist of 2 protons + 2 neutrons. (It is an active the nucleus).
- Emitters of α-particle are heavy element.
- α-particle has mass equal to 4 amu.
- It is +vely charged particle. (Charge = +2e)
- α-particles have highest ionization power.
- α-particles / rays travel with very slow speed.
- They have least penetration power, they cannot penetrate even the outer layer of human skin.

(2) Beta Rays (β)



$1n = 1p + 1e^-$

- β- particles are extremely energetic electrons coming out of the nucleas of a radioactive elements.
- These are having negligible mass.
- These are negatively charged particle.

  Charge = $-q$
- These are having less ionisation power than α- particle.
- These travel almost with the speed of light.
- They can easily penetrate human skin but they can not penetrate thin metal sheets.

(3) γ-rays

γ ..... UV VIBGYOR IR

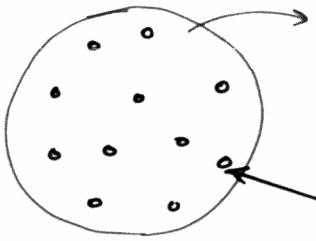
$\longleftarrow$ frequency

- The waves arising from the high frequency end of the electromagnetic spectrum are k/a γ-rays.
- They are massless and chargeless (neutral).
- They have zero ionization power.
- They travel with the speed of light.

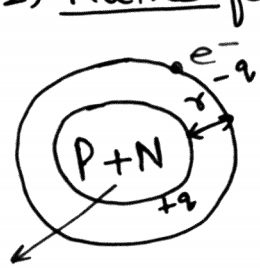
- They have highest penetration power, they can penetrate even thick layer of concrete.

→ Atomic Theories

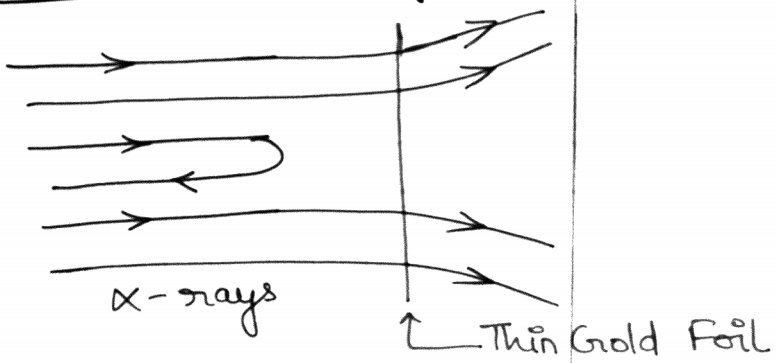
(1) Thomson's Atomic Model



(2) Rutherford's Nuclear Model of Atom



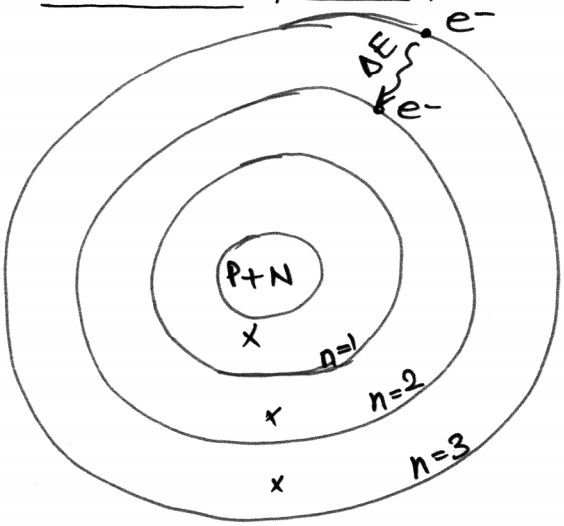
$$F = \frac{1}{4\pi\varepsilon_0} \frac{(+q)(-q)}{r^2}$$



- On the basis of his famous α-particle scattering experiment rutherford proposed the nuclear model of an atom.
- Acc. to this model, the +ve charge and most of the mass of an atom is concentrated in extremely small region.
- This very small portion of an atom is k/a Nucleus.
- Electrons which are negatively charged particles move around the nucleus in similar paths as the planets move around the sun.

(3) Bohr's Model for Hydrogen Atom

- **Postulates / Assumptions :-**



$\nu \propto \Delta E$

$mvr = \frac{nh}{2\pi}$

$h \rightarrow$ planck's const.

$n = 1, 2, 3, 4 \ldots$

Bohr's Model is based on following postulates :-

(1) The e^- in Hydrogen atom can move around the nucleus in a circular path of fixed radius and energy.

These paths are called orbits / stationary states / Allowed energy states.

(2) An e^- can move only in those orbits for which it's angular ~~moment~~ momentum is integral multiple of $h/2\pi$.

$$\boxed{mvr = \frac{nh}{2\pi}}$$

(3) When an e^- jumps from an orbit of higher energy to another orbit of lower energy then energy is released in the form of radiations and vice-versa.

The amount of energy released / absorbed is the difference of energies in the two orbits i.e $\boxed{\Delta E = h\nu}$