

Adsorption

- (i) Accumulation of molecular species at the surface rather than in the bulk of a solid or liquid.
- (ii) Surface phenomenon
- (iii) Concentration on the surface of adsorbent different from that in bulk.

Adsorbate	Adsorbent
Molecular species which concentrates at the surface.	Material on the surface of which the adsorption takes place.

Types

Physisorption

- Adsorption when accumulation of gas on the surface of solid occurs due to weak van der Waals' forces.
- Non-specific
- Depends on nature of adsorbate.
- Reversible
- Increases with increases in surface area.
- Low enthalpy of adsorption.

Chemisorption

- Adsorption when gas molecules or atoms are held to surface by chemical bonds.
- Higher specific
- Irreversible
- Increases with increase of surface area
- High enthalpy of adsorption

Features

- When $\Delta H = T\Delta S$, $\Delta G = 0$, equilibrium is attained.
- $\Delta G, \Delta H$ and ΔS are negative.
- Extent of adsorption increases with surface area.

Adsorption Isotherm

Adsorption isotherm means to express variation in the amount of adsorbent with pressure at constant temperature

Freundlich Adsorption Isotherm: Empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

$$\frac{x}{m} = kp^{1/n} \quad (n > 1)$$

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

Applications

Production of high vacuum, gas masks, control of humidity, separation of gases, chromatography, indicators Sorption

Colloids

Heterogeneous system where one substance is dispersed (dispersed phase) in another substance called dispersion medium.

Purification

Dialysis
Electro-dialysis
Ultrafiltration

Preparation

Bredig's Arc method
Peptization
Chemical methods

Based on nature of interaction

Lyophilic: Liquid loving
Lyophobic: Liquid-hating

Based on Physical State

Sol : Solids in liquids (Paints)
Gel: Liquids in solids (cheese)
Emulsion: Liquid in liquids
Aerosol: Liquid in gas

Based on Types of Particles of Dispersed Phase

Multimolecular : Large number of atoms/ molecules aggregate (size 1-1000 nm)
Formed by molecules of large size.
Macromolecular : Low concentration behave as normal Associated: Range electrolytes at high concentration as colloids

Catalyst

Substances which accelerate the rate of reaction and remain chemically and quantitatively unchanged after the reaction are known as catalyst and the phenomenon is called catalysis

Homogenous Catalysis

Reactants and catalyst are in same phase.
(oxidation of SO_2 to SO_3 by Na as catalyst)

Heterogenous Catalysis

Reactants and catalyst are in different phase.
(oxidation of SO_2 to SO_3 by Pt as catalyst)

Mechanism

- Diffusion of reactants to surface of catalyst
- Adsorption of reactants molecules on the surface of catalyst.
- Chemical reaction on the surface of catalyst through formation of intermediate.
- Desorption of products creating surface for further reaction.
- Diffusion of products away from catalyst surface.

Shape Selective

Catalytic reaction that depends upon pore structure of catalyst and size of reactant and product molecules.
(Zeolites)

Enzyme Catalysis

Enzymes that catalyse many life processes in bodies of plants and animals are termed as Biochemical catalysts and phenomenon is known as Biochemical catalysis
(Inversion of sugar, Conversion of milk into curd)

Mechanism

Step 1 : Binding of enzyme to substrate to form an activated complex $E + S \rightarrow ES^*$

Step 2 : Decomposition of activated complex to form product $ES^* \rightarrow E + P$

Uses in Industry

Manufacture of nitric acid Ostwald's process (platinised asbestos, 573 K)	Manufacture of ammonia Haber's process (Fe + Mo, 200 bar, 723-773 K)
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Colligative Properties

Values of colligative properties are of small order in comparison to values shown by true solutions.

Tyndall Effect: When a beam of light is passed and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This process is Tyndall effect.

Electrophoresis : Movement of colloidal particles toward electrode in an electric field.

Colour : Depends on wavelength of light scattered by colloidal particles.

Brownian Movement: Zig-zag movement of particles.

Application of Surface Chemistry

- Purification of drinking water
- Medicines
- Tanning
- Cleansing action of soaps detergents
- Rubber industry
- Industrial Products.