CONCEPT MAP

SURFACE CHEMISTRY

Adsorption

Surface phenomenon

- Substance adsorbed → adsorbate.
- Substance on which it is adsorbed – adsorbent.
- Spontaneous, exothermic, lowers entropy.
- Reverse of adsorption → desorption.
- Adsorption of gases on metal surface → occlusion.

Types

- **Physisorption**
  Molecules held by weak van der Waals forces
  - low heat of adsorption (20-40 kJ mol^{-1}).
  - Non-specific.
  - Forms multimolecular layer.
  - Reversible.
- **Chemisorption**
  Molecules held by strong chemical bonds.
  - High heat of adsorption. (40-400 kJ mol^{-1}).
  - Specific.
  - Forms unimolecular layer.
  - irreversible.

Factors affecting adsorption

- **Surface area** ∝ adsorption.
- **Nature of gas absorbed :** Critical temp of gas ∝ van der Waals forces ∝ adsorption.
- **Temperature :** Le Chatelier principle :
  Temperature ∝ adsorption
- **Freundlich Adsorption Isotherm :** Plot of x/m vs P at const. T. $\frac{x}{m} \propto P$
- **Langmuir adsorption isotherm :** Plot of $P/x/m$ vs P assuming formation of monolayer of adsorbate.

Colloidal State

A heterogeneous system, particle size of 1 nm to 100 nm. The phase in which is scattered → dispersed phase.

- Dispersion medium

Classification

Based on affinity of dispersed phase particles for the dispersion medium

- **Lyophilic Colloids** (Intrinsic colloids)
  Have greater affinity. *e.g.* gum, starch, gelatin, rubber, etc.
  - Reversible sols.
  - Highly stable due to high hydration in solution.
- **Lyophobic Colloids** (Extrinsic colloids)
  Very little or no affinity *e.g.* metals, their sulphides, etc.
  - Irreversible sols.
  - Unstable → easily precipitated

Based on the type of particles of the dispersed phase

- **Multimolecular Colloids**
  Formed by the aggregation of a large number of atoms or molecules held by weak van der Waals forces. *e.g.* sols of Au, S, etc.
- **Macromolecular Colloids**
  Are molecules of large size. *e.g.*, polymers like rubber, nylon, polythene, starch, etc.
- **Associated Colloids**
  Behave as strong electrolytes at low concentration but at higher concentration exhibit colloidal state properties. Due to micelle formation occurs at Kraft temperature (T_K and critical micelle concentration (CMC). Have non-polar hydrophobic long hydrocarbon chain R (tail) and polar hydrophilic COO^- (head).
  e.g. cationic detergent → cetyl (trimethyl) ammonium bromide, $CH_3(CH_2)_{15}(CH_3)_3N^+Br^-$.

Properties

Heterogeneous, stable, filterable, low colligative properties, Tyndall effect (scattering of light), Brownian movement (zig-zag movement), Electrophoresis, Electro-osmosis, coagulation or flocculation Hardy-Schulze rule : Coagulating power ∝ (valency of ion)^4.

Emulsions

Dispersed phase and dispersion medium are liquids (immiscible).

Emulsifiers → stablize them *e.g.*, soaps.

- **Types**
  - Oil in water : milk
  - Water in oil : Cream, butter
- **Properties**
  - All colloidal properties.
  - Demulsification by adding electrolyte or chemical distruction of emulsifying agent.

Catalysis

- **Homogeneous catalyst, reactants and products are in same phase.**
- **Heterogeneous in catalyst different phase.**