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# Lecture # 21

Course: Nanotechnology &  
Nanostructures

Instructor: Dr. Zohra Kayani

**Topic: Modification of  $\text{Fe}_3\text{O}_4$   
Magnetic Nanoparticle**

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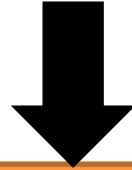
- Modification of Fe<sub>2</sub>O<sub>3</sub> magnetic nanospheres
- Need to modify
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- The Method of modification of Fe<sub>2</sub>O<sub>3</sub> Nanoparticles
- Physical immobilization
- Covalent conjugation
- Biologically mediated specific interaction

# Modification of $\text{Fe}_3\text{O}_4$ Magnetic Nanoparticle

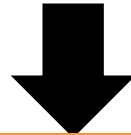
*Why we need to modify the  $\text{Fe}_3\text{O}_4$  Magnetic Nanoparticles?*

Because of the high surface energy, the naked  $\text{Fe}_3\text{O}_4$  nanoparticles are generally unstable and aggregate easily which strongly affects their dispersion into aqueous medium

# *Need to modify*



To overcome such limitations



Add some chemical and biological material



To improve



Dispersibility



Biocompatibility



Stability

# The reagents employed for modification of $\text{Fe}_3\text{O}_4$ nanoparticles :

- surfactants (such as oleic acid(OA), alkane phosphonic acids)
- polymers
- starch, albumin
- Liposomes
- ethyl



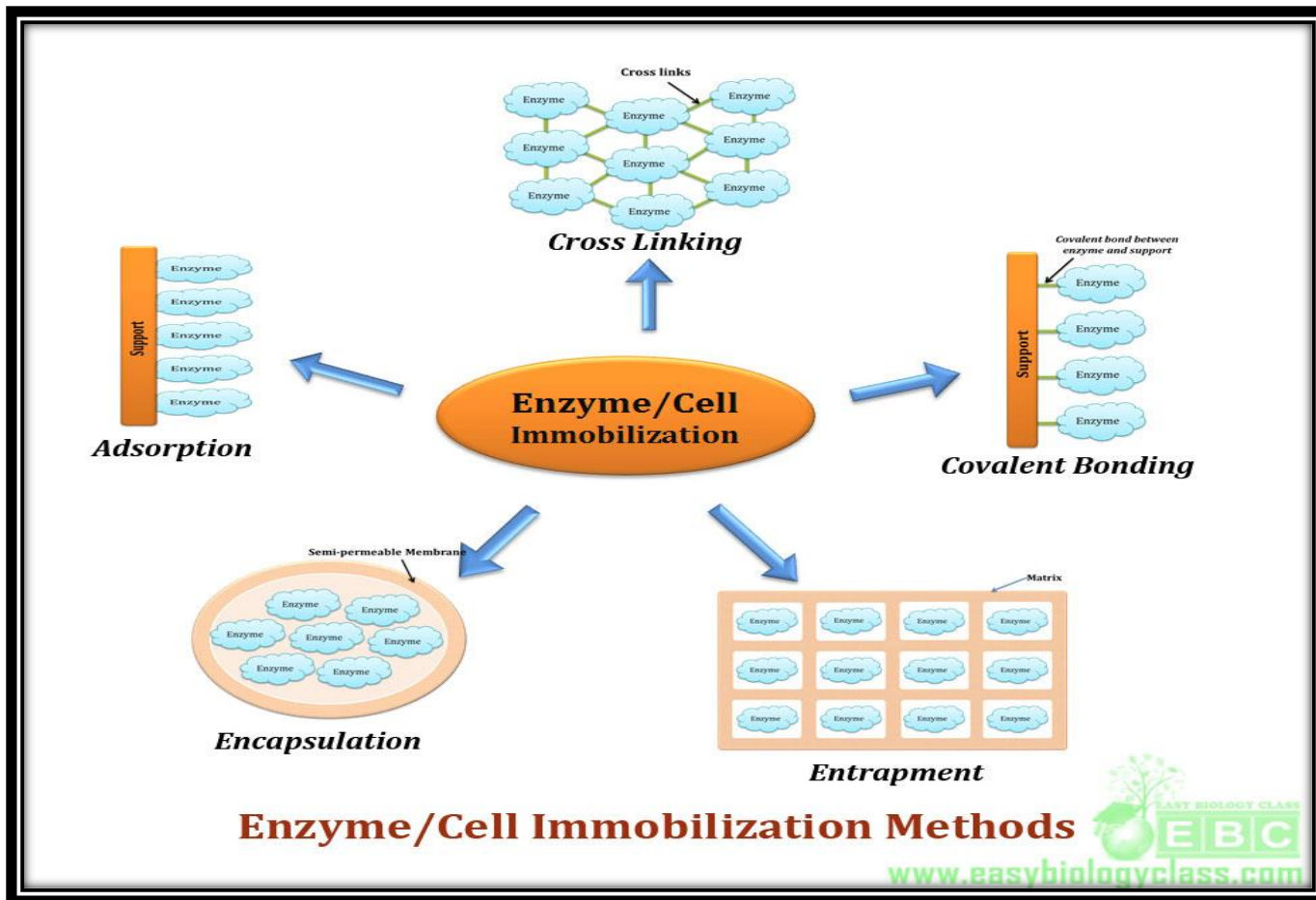
# The methods of modification of $\text{Fe}_3\text{O}_4$

- Physical immobilization
- Covalent conjugation
- Biologically mediated specific interaction



# Physical immobilization

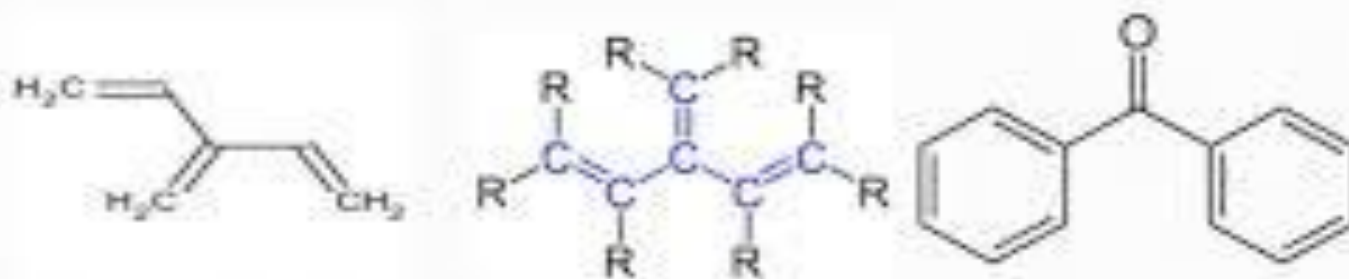
The commonly employed techniques for immobilization of enzymes are—adsorption, entrapment, covalent binding and cross-linking.



# Covalent conjugation

## Cross-conjugation

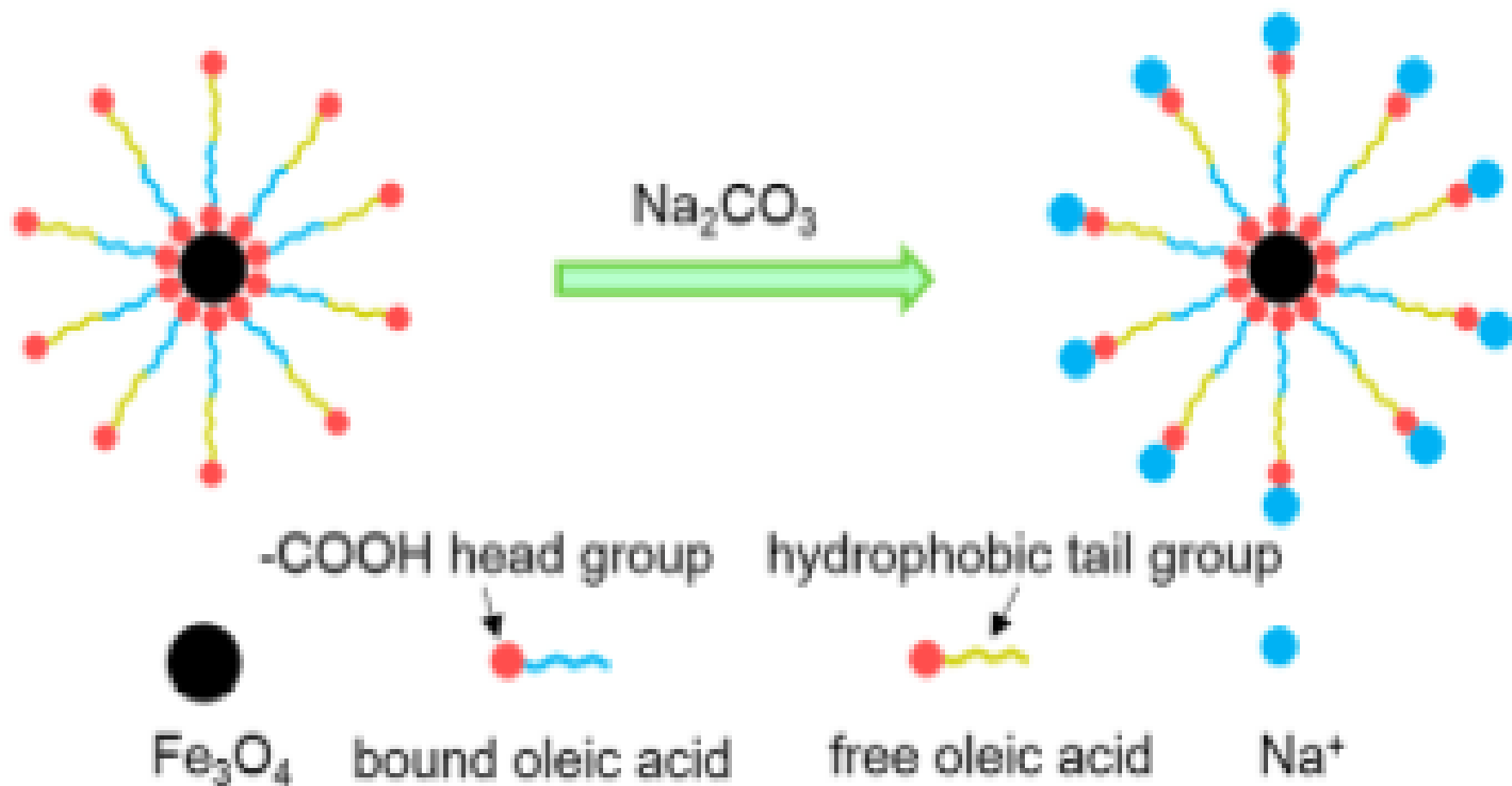
- ❑ Special type of conjugation.
- ❑ Three pi-bonds are present, out of which two are not conjugated with each other although each is conjugated with the third i.e. Interruption of the strict alteration of single bond and double bond.



# Representation for interaction of oleic acid (OA) modified Fe<sub>3</sub>O<sub>4</sub> nanoparticles

- Interaction of oleic acid (OA) modified Fe<sub>3</sub>O<sub>4</sub> nanoparticles with sodium carbonate
- OA is chemically bound to Fe<sub>3</sub>O<sub>4</sub> nanoparticles by the carboxyl head group (-COOH) and the hydrophobic tail group is free, making it non-dispersible in aqueous medium.
- The hydrophobic tail in turn interacts with the free OA via hydrophobic interactions. The formulation is stabilized in aqueous medium by ionization of the carboxyl head group of free OA by sodium carbonate, wherein Na<sup>+</sup> interact by ionic interactions with COO<sup>-</sup> group of free OA.

# Diagram is listed below



## Why we use $\text{Fe}_3\text{O}_4$ Nanoparticles as Magnetic particle?

Because  $\text{Fe}_2\text{O}_3$  have many application in different field:

1. Protein Immobilization
2. Bioseparation
3. Food Analysis
4. Environmental Treatment
5. Biomedical Usage

Thank  
you

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