
بسم الله الرحمن الرحیم

Lecture # 22

Course: Nanotechnology & Nanostructures

Instructor: Dr. Zohra Kayani

Topic:Applications of Fe_3O_4 Nanoparticles:

List of Contents:

- Application of Fe_2O_3 nanoparticles
- Protein Immobilization
- Bioseparation
- Food Analysis
- Environmental Treatment
- Biomedical Usage

Applications of Fe3O4 Nanoparticles:

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

- Targeted Drug Delivery
- Biosensor
- Magnetic Resonance Imaging
- Hyperthermia
- Tissue Engineering

Protein Immobilization

•Protein immobilization serves as a very effective tool to solve the difficulties encountered in the catalytic application of free enzymes:

1. such as poor stability
2. hard recovery.

• Fe_3O_4 nanoparticles have been intensively utilized to realize this objective due to its unique:

• magnetic performance

•various practical

•economical biocatalysts

•improved stability

•reusability.

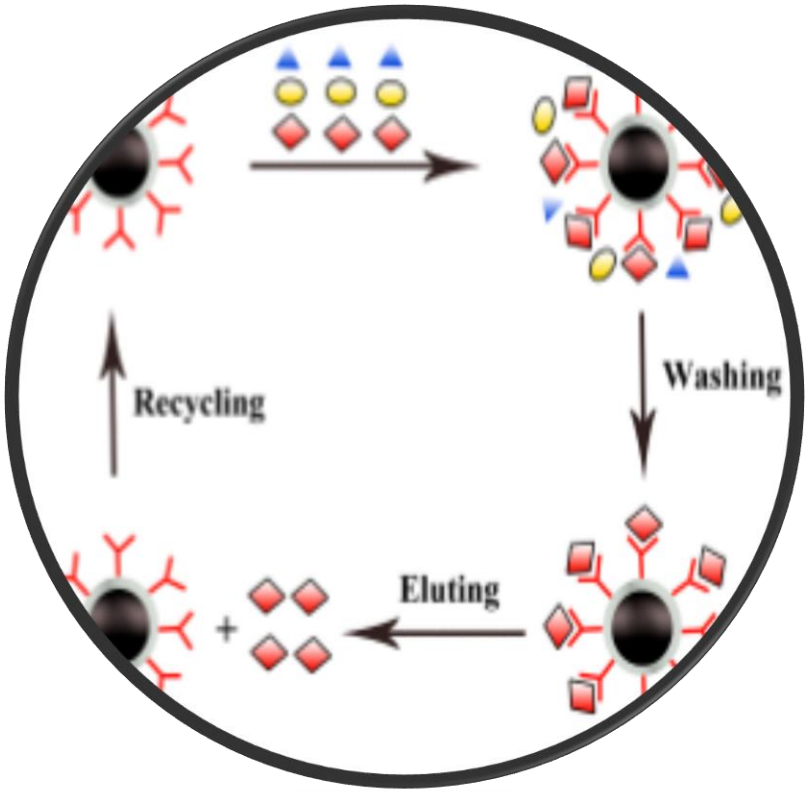
Bioseparation

•Magnetic separation is a commonly used technique for polypeptide/protein separation and cell separation.

•Magnetic separation possesses several advantages:

• such as timesaving

• gentle



Environmental Treatment

Fe2O3 is used to environment treatment due to:

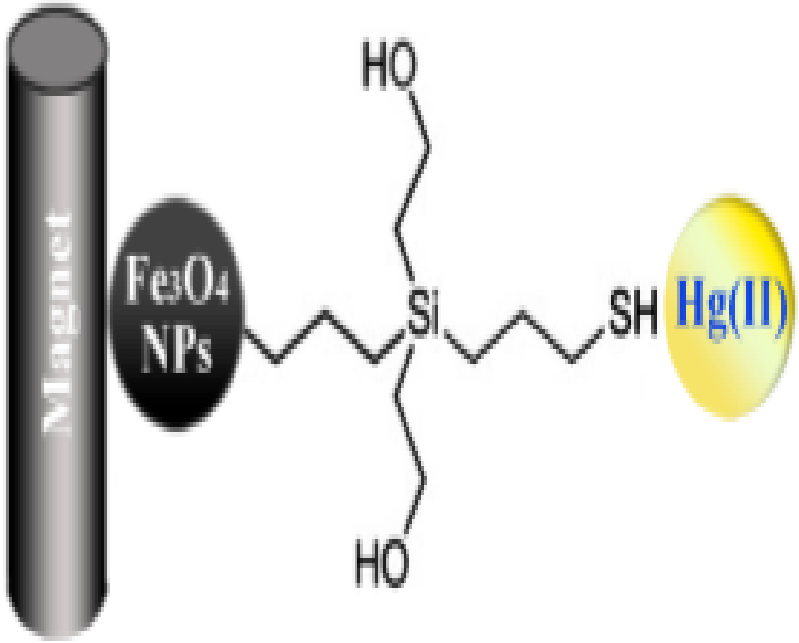
- the extremely small particle size
- high surface-area-to-volume ratio
- more important the Magnetism

Fe_3O_4 nanoparticles have been widely used and have shown promising performance in environments treatment including:

- pollutant removal
- toxicity mitigation.

Pollutants generally adsorb to the surface of Fe3O4 nanoparticles through interactions including:

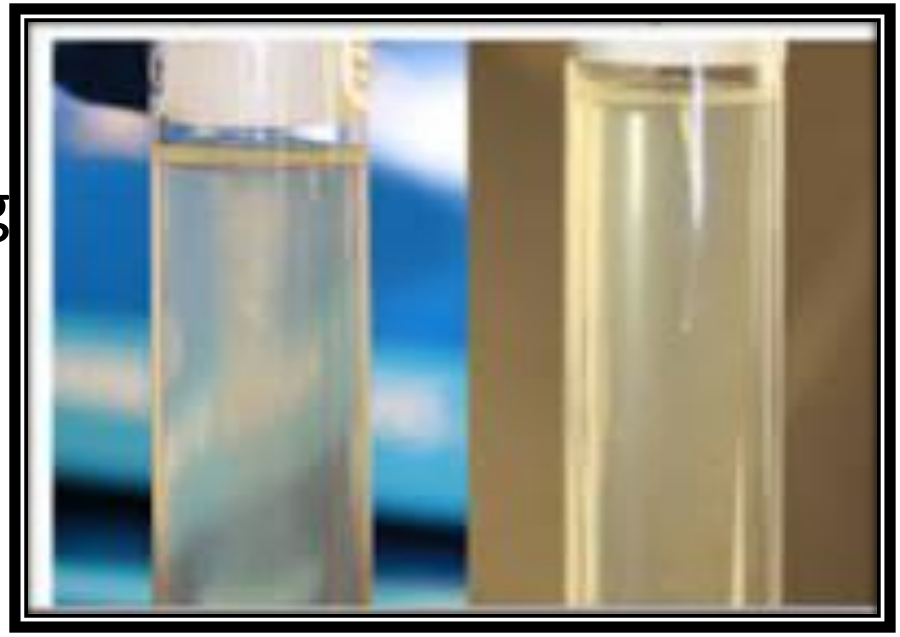
Physical adsorption
- ion-exchange
- Chemical bonding (complexation and/or chelation)
- Hydrogen bonds
- van der Wall forces.



Biomedical Usage

Fe_3O_4 nanoparticles with appropriate surface properties have been widely used for numerous biomedical and bioengineering applications such as:

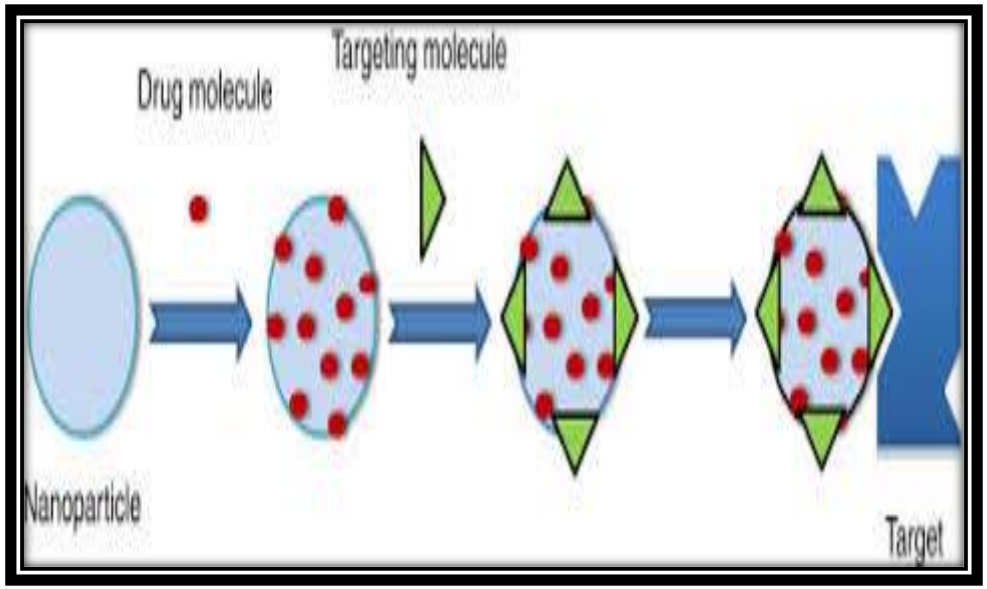
- targeted drug delivery
- Biosensor
- magnetic resonance imaging
- hyperthermia
- tissue engineering
- magnetofection



Targeted Drug Delivery

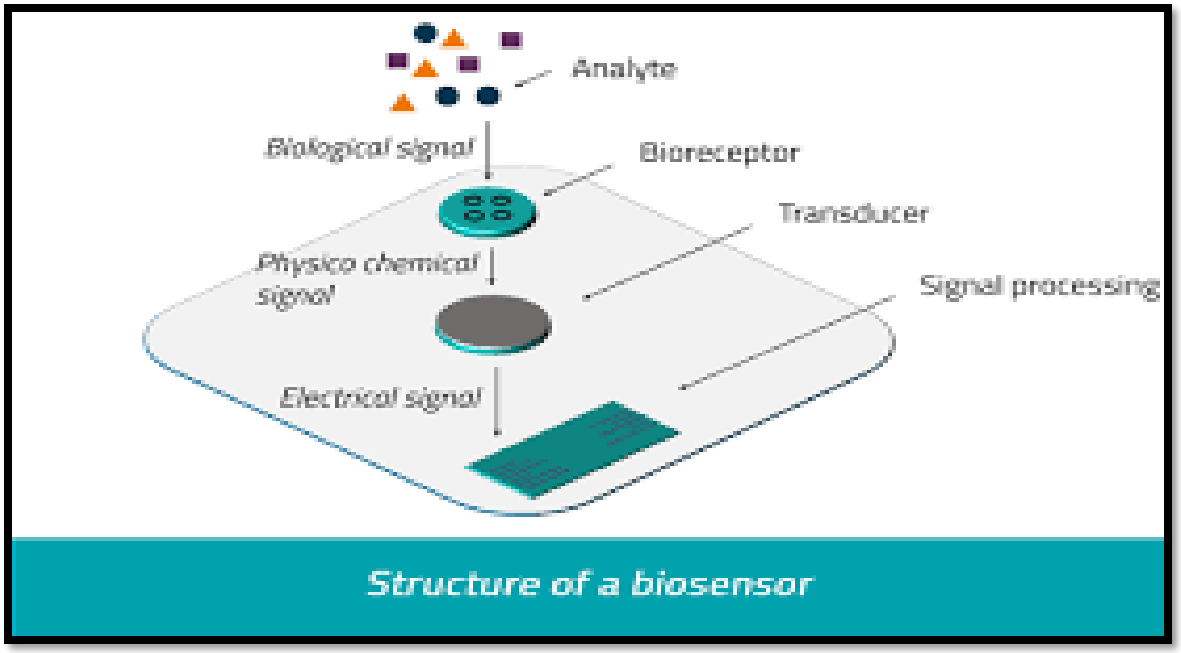
Fe_3O_4 nanoparticles with proper surface modification and conjugated targeting ligands/molecules have become a major research focus for drug delivery applications

- Due to the unique capabilities (e.g., superparamagnetism and biocompatibility)
- the negligible side effects



Biosensor

Fe3O4 nanoparticles based bioanalytical sensors could be fabricated by coating Fe3O4 nanoparticles with materials such as a fluorescent one, a metal, silica, or a polymer.



Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is a commonly used non-invasive medical imaging technique in clinical medicine:

•to visualize the structure and function of tissues

•which is based on the behavior alignment

Hyperthermia

•Magnetic induction hyperthermia means the exposition of cancer tissues to an alternating magnetic field, in which heat is generated due to magnetic hysteresis loss.

•Cancer cells exposed to magnetic particles will heat up to a temperature higher than 43 °C, at which the cancer cells are destroyed whereas the normal cells can survive.

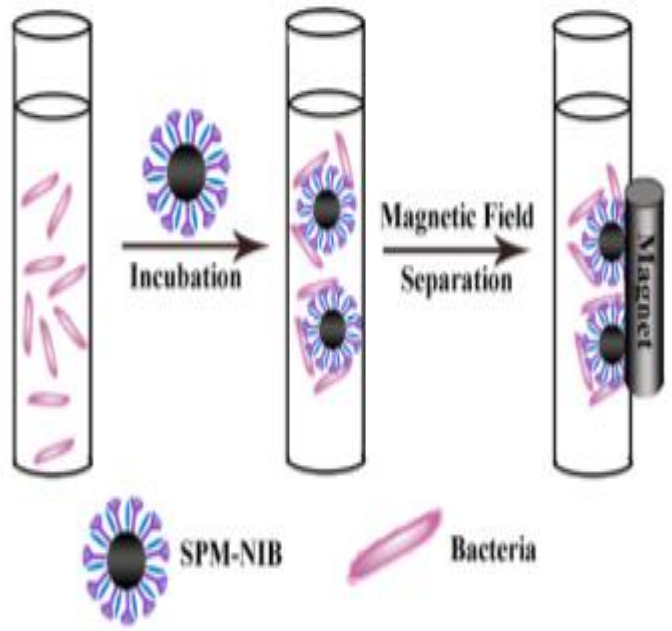
Tissue Engineering

•Tissue engineering is a promising technology for overcoming the organ transplantation crisis and the fabricated tissue equivalents may also be used to screen the effects of drugs and toxins. The three-dimensional constructs (scaffolds or hydrogels) functioning

•similarly as under in vivo conditions was developed T he cells generally isolated from a tissue biopsy, cultured in vitro, subsequently seeded into the three dimensional constructs.

Food Analysis

•Magnetic nanoparticles such as Fe_3O_4 are of special interest for food analysis not only because the unique properties such as low toxicity, good biocompatibility, large specific surface area, high capacity for charge transfer




Thank you