
بسم الله الرحمن الرحيم
By: Mr. High Sky
www.mrhighsky.deviantart.com

Subject: Nanotechnology & Nanostructures (Lecture # 17 (1))

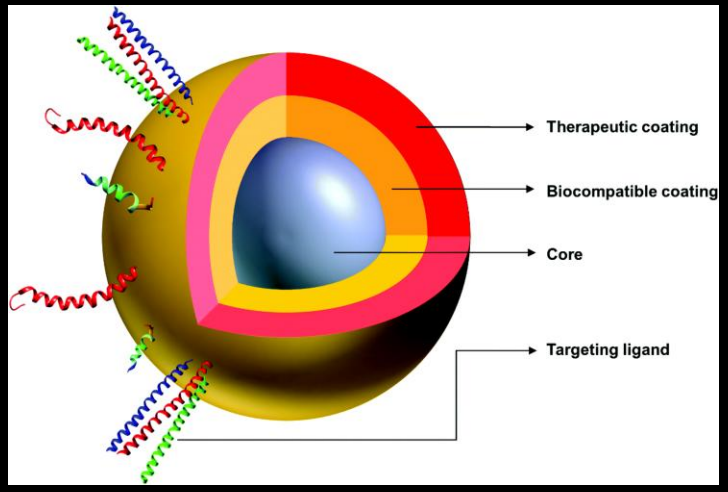
Prof Dr. Zohra Nazir Kayani

Physics Department
LAHORE COLLEGE FOR WOMEN, UNIVERSITY, LAHORE

Lecture # 17
Part (1)

Superparamagnetic Iron Oxide Nanoparticles (SPION)

A material is superparamagnetic if it is made of very small single-domain non-interacting magnetic grains dispersed in some non-magnetic medium.



Requirements

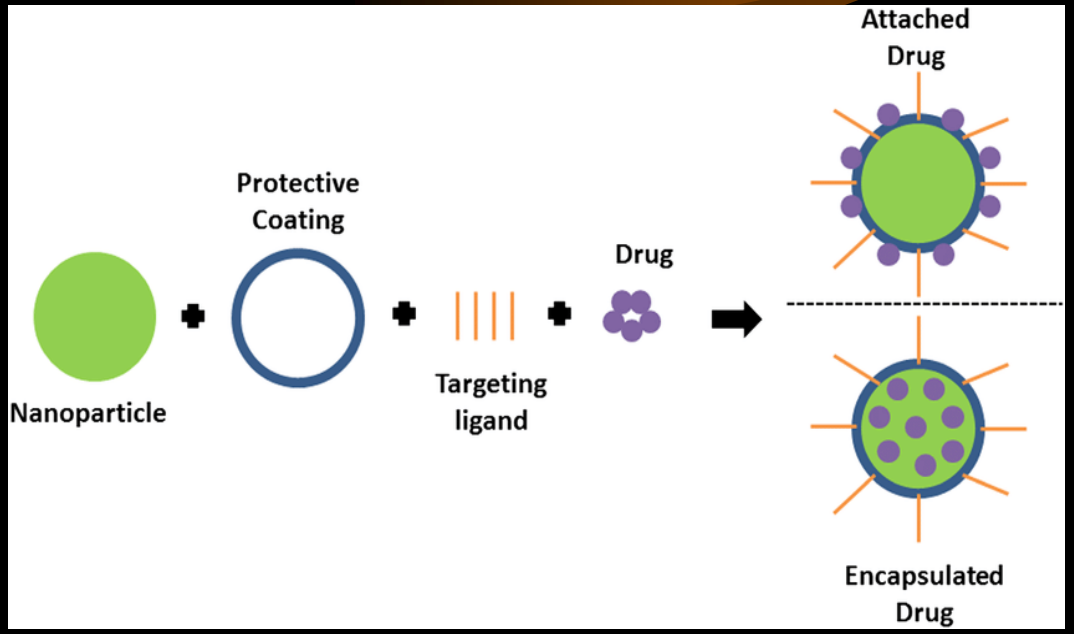
- All the biomedical and bioengineering applications require that these nanoparticles have high magnetization values and Size smaller than 100 nm with overall narrow particle size distribution, so that the particles have uniform physical and chemical properties.

A multi-legged mini-robot made for drug delivery

“The robot is fabricated with a silicon material called polydimethylsiloxane (PDMS) embedded with magnetic particles, which allows it to be remotely controlled by applying electromagnetic force. Increasing the frequency increases the speed”

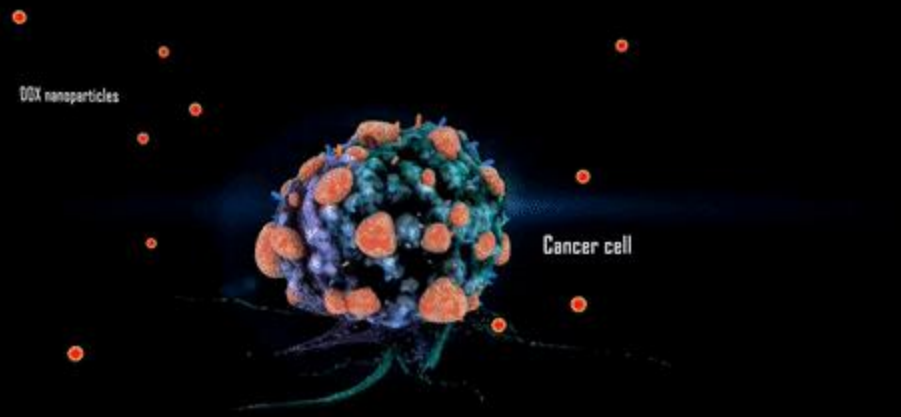
Surface coating of the magnetic particles

These applications need special surface coating of the magnetic particles, which has to be not only non-toxic and biocompatible but also allow a targetable delivery with particle localization in a specific area.

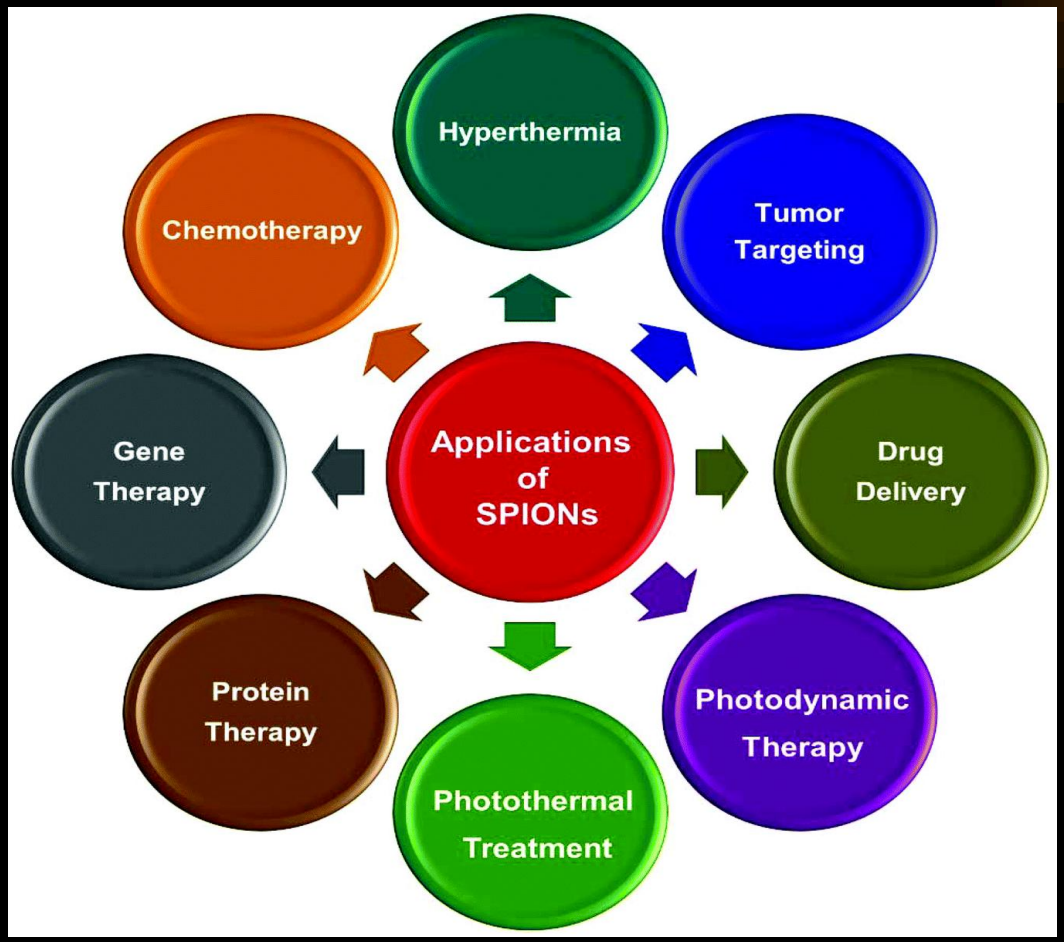


•Nature of surface coatings and their subsequent geometric arrangement on the nanoparticles determine not only the overall size of the colloid but also play a significant role in biokinetics and biodistribution of nanoparticles in the body.

• The types of specific coating, or derivatization, for these nanoparticles depend on the end application and should be chosen by keeping a particular application in mind, whether it be aimed at inflammation response or anti-cancer agents.



Applications

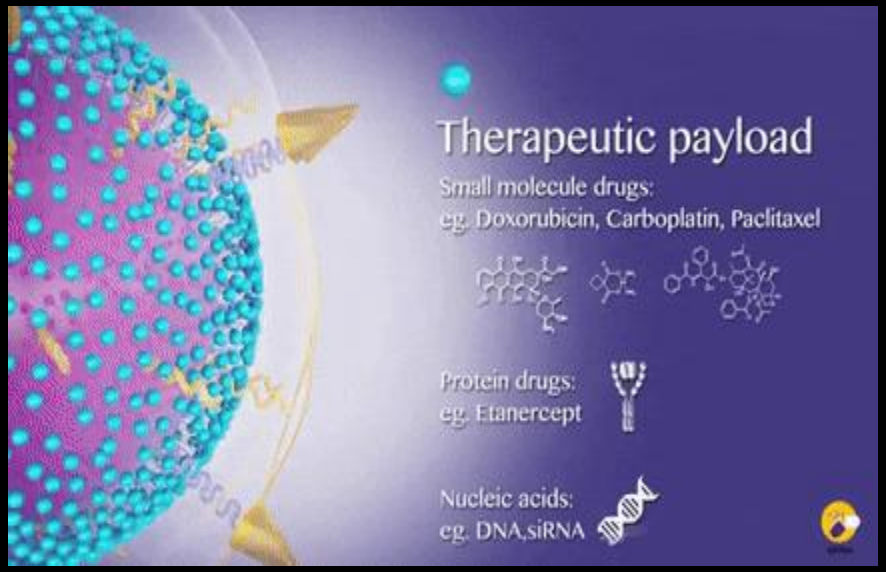


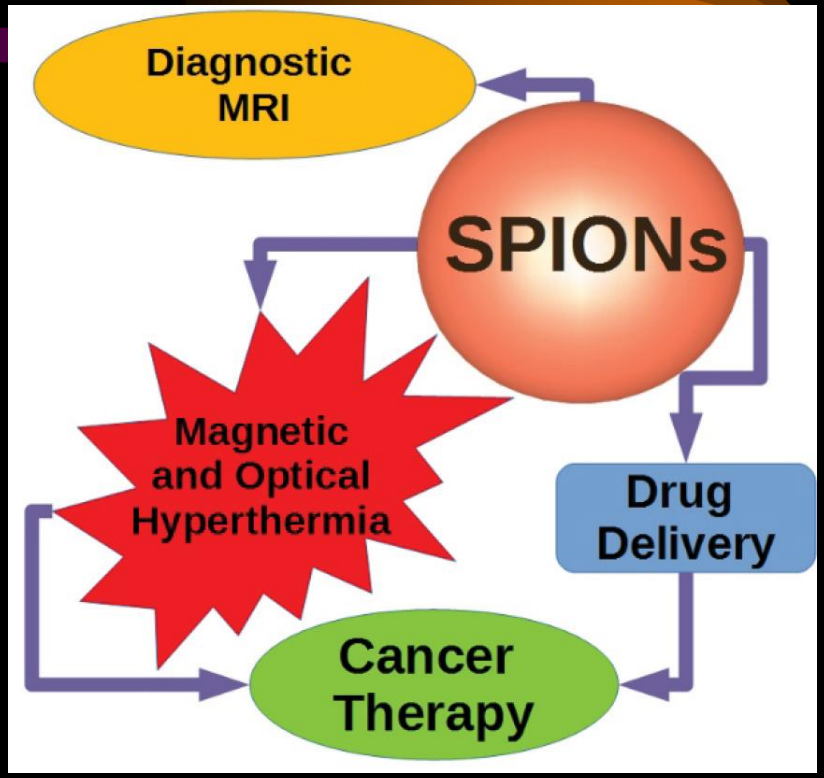
Applications

1. Magnetic nanoparticles can bind to drugs, proteins, enzymes, antibodies, or nucleotides and can be directed to an organ, tissue, or tumour using an external magnetic field or can be heated in alternating magnetic fields for use in **hyperthermia**.

Applications

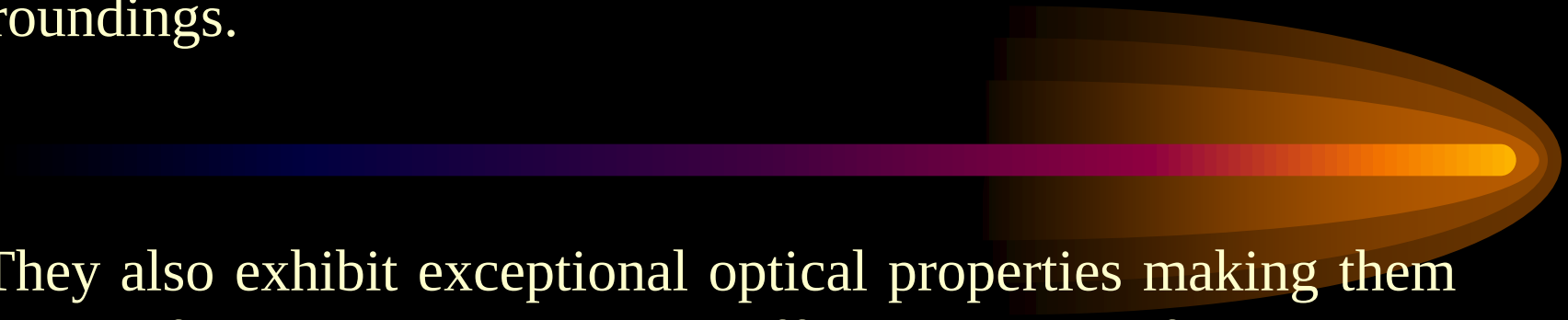
2. They are used in diagnosis and therapeutics due to their unique properties of small size, large surface area to volume ratio, high reactivity to the living cells, stability over high temperatures and translocation into the cells, *etc*.





Applications

3. They are available in different sizes and shapes due to their ability to react and agglomerate with other nanoparticles in their surroundings.



4. They also exhibit exceptional optical properties making them capable of producing quantum effects suitable for imaging applications. Most commonly studied metal nanoparticles include gold, silver, titanium oxide and iron nanoparticles.

Applications

5. Gold being inert and relatively less cytotoxic is extensively used for various applications including drug and gene delivery.