

## Lec.8

## Nanotechnology

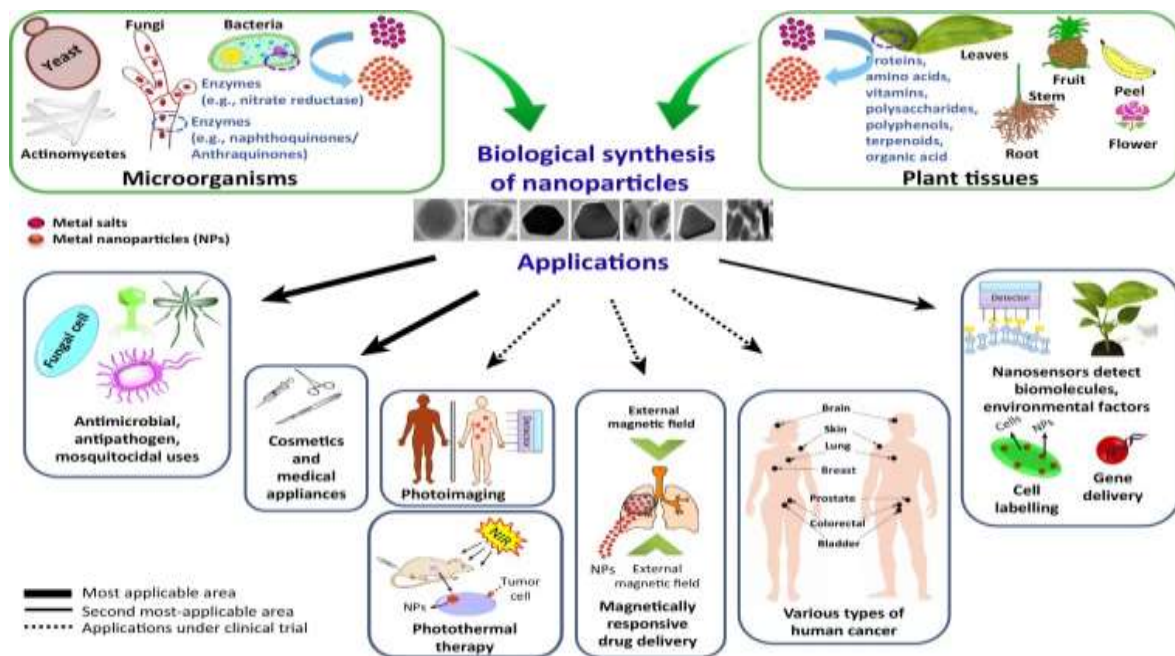
### Application of nanoparticles in medicine

**Nanomedicine** is defined as the application of nanotechnology to health, and hence is virtually synonymous with **nanobiotechnology**.

Quantitative detection devices for early diagnosis and for therapy monitoring will have a wide influence in patient management, in improving patient's quality of life and in lowering mortality rates, in diseases like cancer and Alzheimer's disease.

The following applications as being close to or on the market:

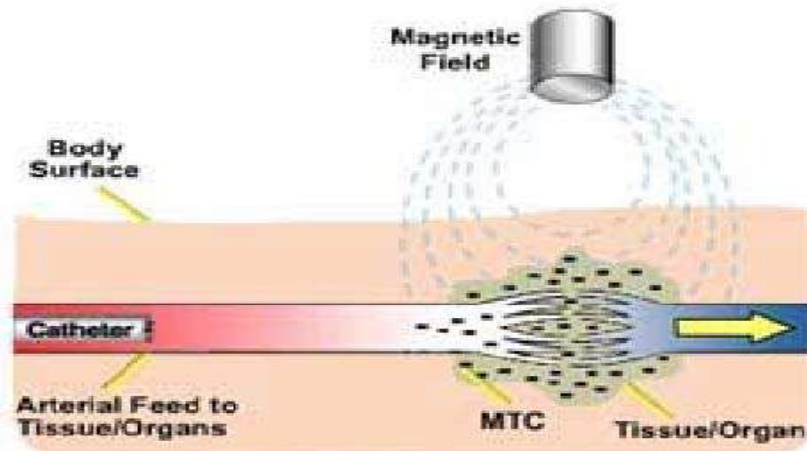
- Sensors for medical and environmental monitoring and for preparing pure chemicals and pharmaceuticals.
- Light and strong materials for defense, aerospace, automotive, and medical applications.
- Lab-on-a-chip diagnostic techniques.
- Sunscreens with ultraviolet-light absorbing nanoparticles.



## Drug delivery

Over the last few decades, the applications of nanotechnology in medicine have been extensively explored in many medical areas, especially in drug delivery, by loading drugs into nanoparticles through physical encapsulation, adsorption, or chemical conjugation.

The aim of drug delivery is to encapsulate a therapeutic agent to disguise its properties until it reaches its target and is released.



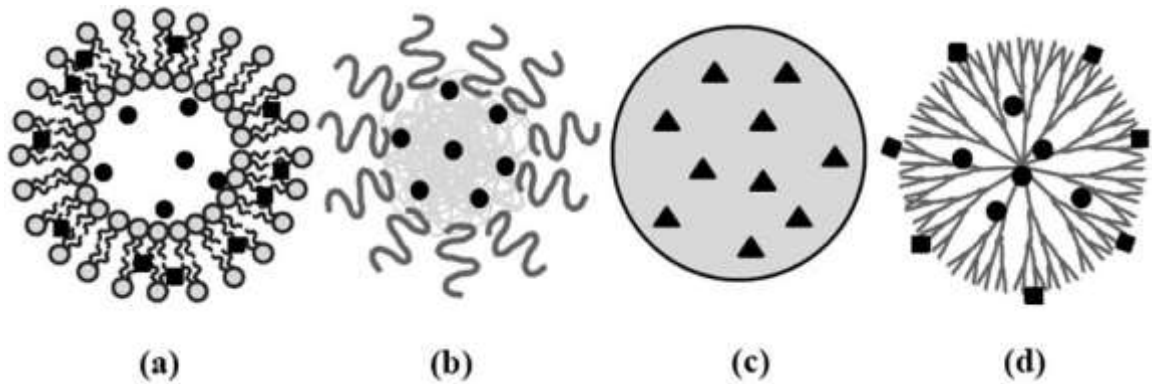
## Antimicrobial application of nanoparticles

### -Effects of Antibacterial Nano-Silver

- Anti-itch Treatment, Eczema, Athlete's Foot Treatment, Medicine Containers.
- Germ Free Products, Germicide, Antibacterial Products, Antibiotics.
- Rhinitis Treatment, Cold Medicine.

## LIPOSOMES FOR ANTIMICROBIAL DRUG DELIVERY

Liposomes are spherical lipid vesicles with a bilayered membrane structure consisting of amphiphilic lipid molecules. After extensive studies on their fundamental properties including lipid polymorphisms, lipidprotein and lipid-drug interactions, and mechanisms of liposome disposition in 1980s, the application potential of liposomes as a drug delivery vehicle was thoroughly recognized and started being transferred to practice. In 1995, Doxil (doxorubicin liposomes) became the first liposomal delivery system approved by the Food and Drug Administration (FDA) to treat AIDS. Liposomal drug delivery system can be made of either natural or synthetic lipids.



Schematic illustration of four nanoparticle platforms for antimicrobial drug delivery: (a) liposome, (b) polymeric nanoparticle, (c) solid lipid nanoparticle, and (d) dendrimer. Black circles represent hydrophobic drugs; black squares represent hydrophilic drugs; and black triangles represent either hydrophobic or hydrophilic drugs

## Biosensors

An alternative approach is to develop sensors so tiny that they can be semi permanently implanted inside the body, where they can continuously monitor their surroundings.

New fields of nanotechnology are both components of the biosensor are excellent candidates for the application of nanotechnology.

The glucose sensor follows the classic biosensing design: a recognition element to capture the analyte (glucose) mounted on a transducer that converts the presence of captured analyte into an electrical signal.

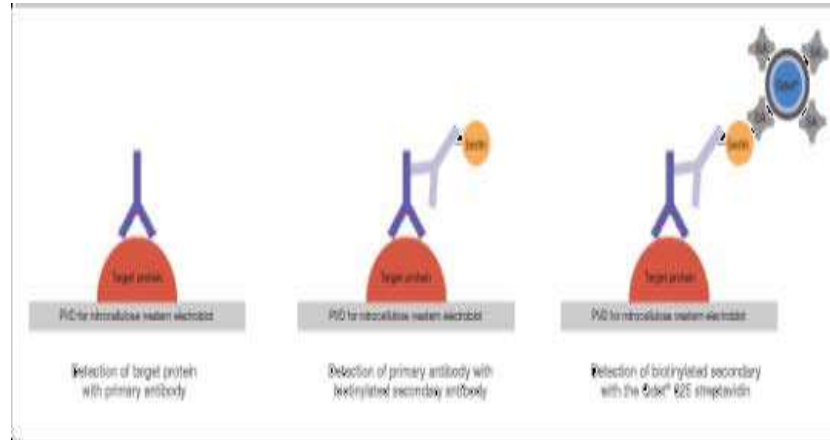
The recognition element is typically a biological molecule, the enzyme glucose oxidase, hence (if small enough) this device can be categorized as both nanobiotechnology and bionanotechnology.

## Automated diagnosis

Diagnosis is essentially a problem of pattern recognition: an object (in this case, the disease) must be inferred from a collection of features.

This is an example of indirect nanotechnology:

The practical possibility depends on the availability of extremely powerful processors, based on chips having the very high degree of integration enabled by nanoscale components on the chips.



**Nano robotics** are the technology of creating machines of robots at or close to the microscopic scale of a nanometer.

Using special bacterium-sized "assembler" devices, nanotechnology would permit on a programmable basis exact control of molecular structures that are not readily manipulated by natural molecular machines and molecular techniques presently available.

With nanotechnology, atoms will be specifically placed and connected, all at very rapid rates, in a fashion similar to processes found in living organisms.

### **Nanotechnology and Cancer**

Nanotechnology has the potential to enable cancer research and improve molecular imaging, early detection, prevention, and treatment of cancer.

#### **1-Molecular imaging and early detection:**

Nanotechnology can have a clear-changing impact on the ability of clinicians to spot cancer in its earliest stages.

Detection of biomarkers using nanotechnology may help researchers with molecular imaging of malignant lesions and allow doctors to see cells and molecules that are undetectable through conventional imaging.

Additionally, photoluminescent nanoparticles may allow oncologists to discriminate between cancerous and healthy cells.

### **Nanomagnetics for Cancer Detection**

- -Early cancer detection
- -Development of nanomagnetic sensor
- -Use magnetic nanoparticles to ‘tag’ proteins indicative of cancer.

### **2-Prevention and control**

Proteomics and Bioinformatics will enable researchers to identify markers of cancer susceptibility and precancerous lesions.

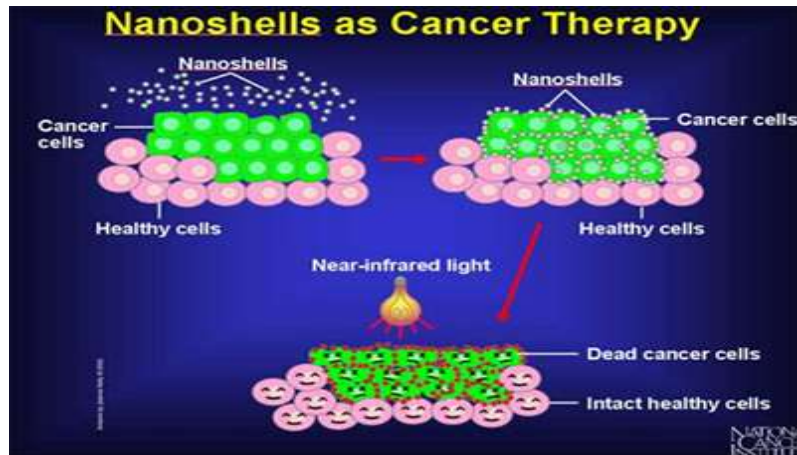
Nanotechnology will then be used to develop devices that indicate when those markers appear in the body and deliver agents to reverse premalignant changes or kill those cells that have the potential to become malignant.

### **3- Cancer treatment**

Nanoscale devices can contain both targeting agents and therapeutic payloads to produce high local levels of a given anticancer drug, particularly to tumors deep within the body that are difficult to access.

Nanoscale devices also develop new approaches to therapy, to combine a diagnostic or imaging agent with a drug, and to determine whether the drug acted on its target.

“Smart” nanotherapeutics may provide clinicians the ability to time the release of an anticancer drug or to deliver multiple drugs sequentially in a timed manner or at several locations in the body.



## Prostheses and implants

Nanotechnology also has applications in tissue engineering to help a person who needs new bones, teeth, or other tissues. That technique based on biological nanostructures is viable.

Biomimetic nanostructures start with a predefined nanochemical or physical structure. A nanochemical structure may be an array of large reactive molecules attached to a surface, while a nanophysical structure may be a small crystal.

Researchers hope that by using these nanostructures as seed molecules or crystals, a material will keep growing by itself. Other groups want to apply nanostructured materials in artificial sensory organs such as an electronic eye, ear, or nerve.