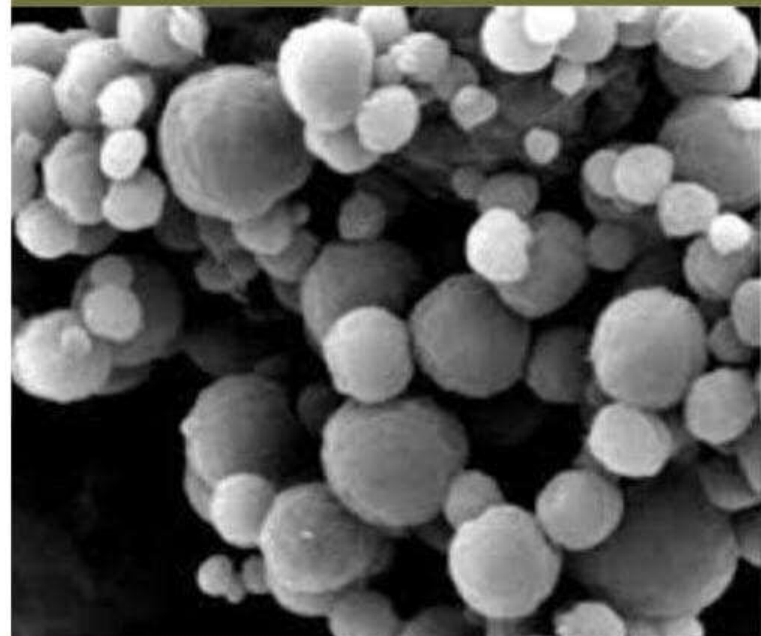
كلية الصيدلة - جامعة بغداد
وحدة التعليم المستمر

Advanced Characterization of Nanoparticles for Drug Delivery



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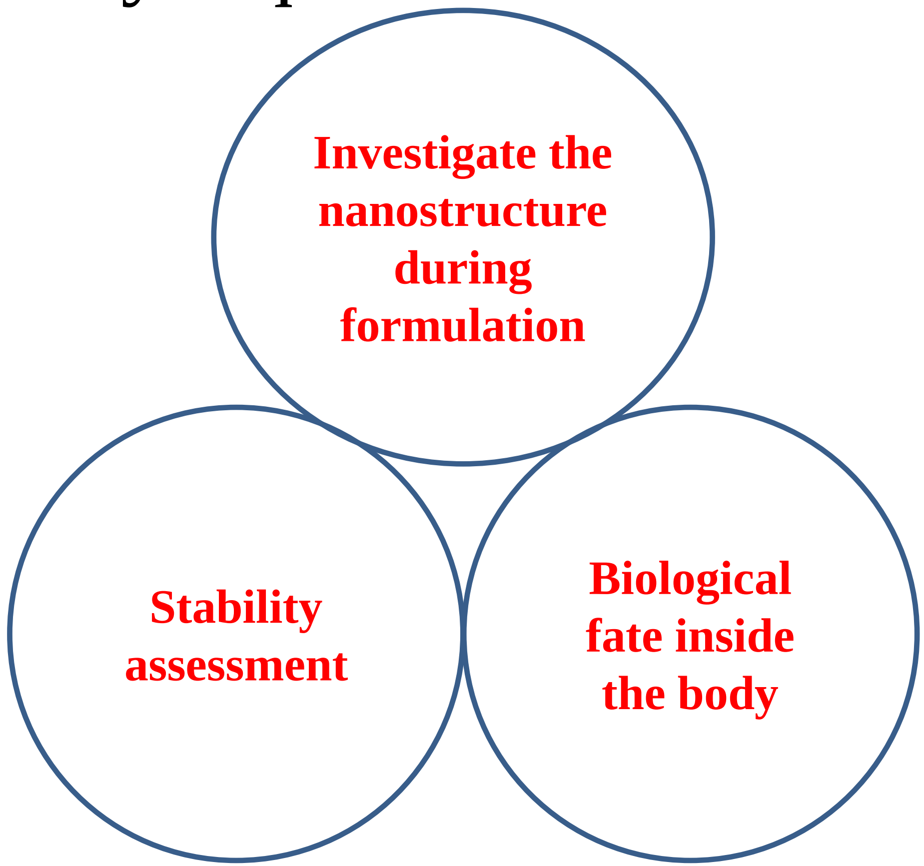
الثلاثاء 12-4-2022
الساعة الحادية عشر صباحا
قاعة الرازي

Advanced Characterization of Nanoparticles

- Nano particular drug delivery approach has opened up new prospects to deliver wide range of synthetic and bio molecular therapeutics more efficiently into the body.
- Accordingly, characterization of these formulations is very important as it related to the success of this delivery approach.

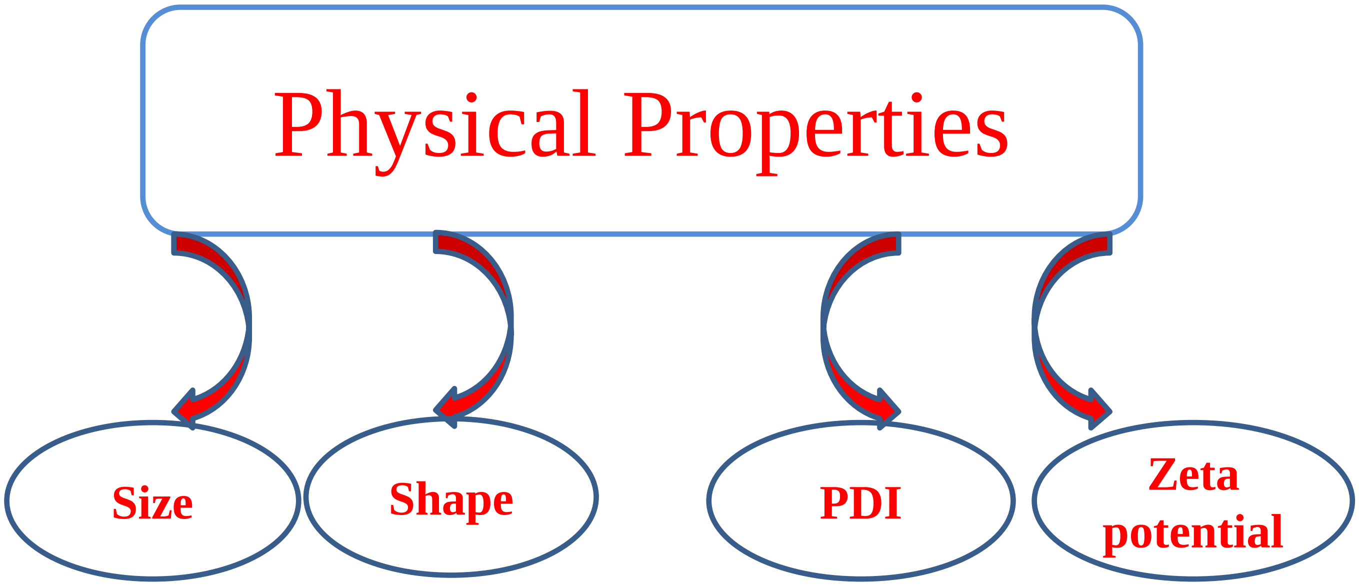
Advanced Characterization of Nanoparticles

- The nanostructure properties characterization is generally required for these reasons:



Advanced Characterization of Nanoparticles

- Physical properties of the nanoparticles are the determinants of their behavior



Particle Size Determination

- Nanoparticles exhibit size-dependent properties
- Nanoparticles size and distribution influence drug loading, stability ,drug release from the nanoformulation, in-vivo drug distribution ,toxicity ,drug targeting and cellular uptake

Particle Size Determination

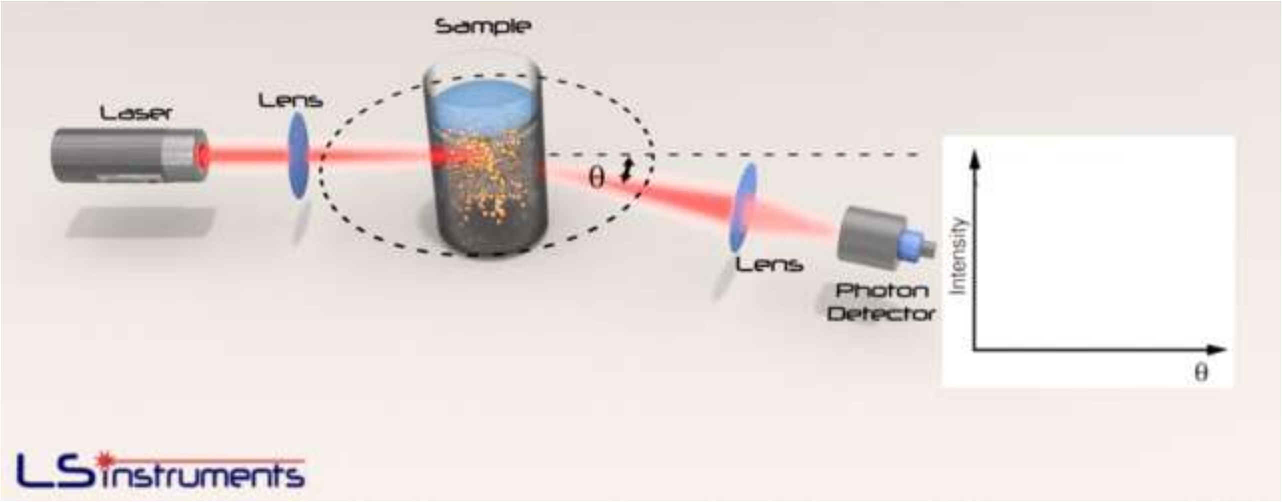
- The size of nanoparticles can be measured by many trending methods.
- The selected method depends on the information required, as certain methods can measure related parameters such as shape and PDI.
- Out of many techniques , dynamic light scattering (DLS) is the most common technique used for evaluation particle size and distribution.

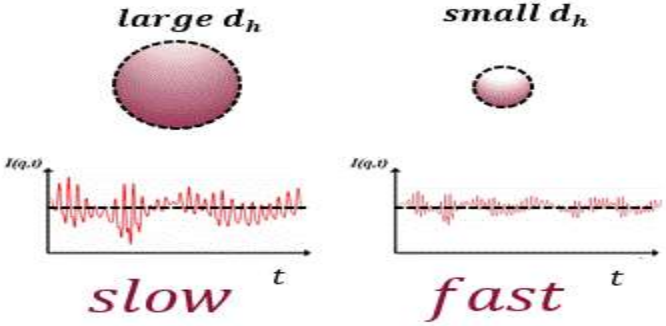
DLS Principle

- The measurement of particle size is based on the random changes in the intensity of their light scattering from a suspension or solution

- Colloidal particles in the sample are under Brownian motion within the dispersing solvent which give fluctuating response with respect to the light intensity as the particles change their positions continuously

DLS Principle





DLS Principle

- The Brownian motions of the particles is quantified by diffusion coefficient

- This coefficient depends on the size of the particles; the smaller the particles, the faster are their motions

- Temperature and viscosity also can affect diffusion coefficient

DLS

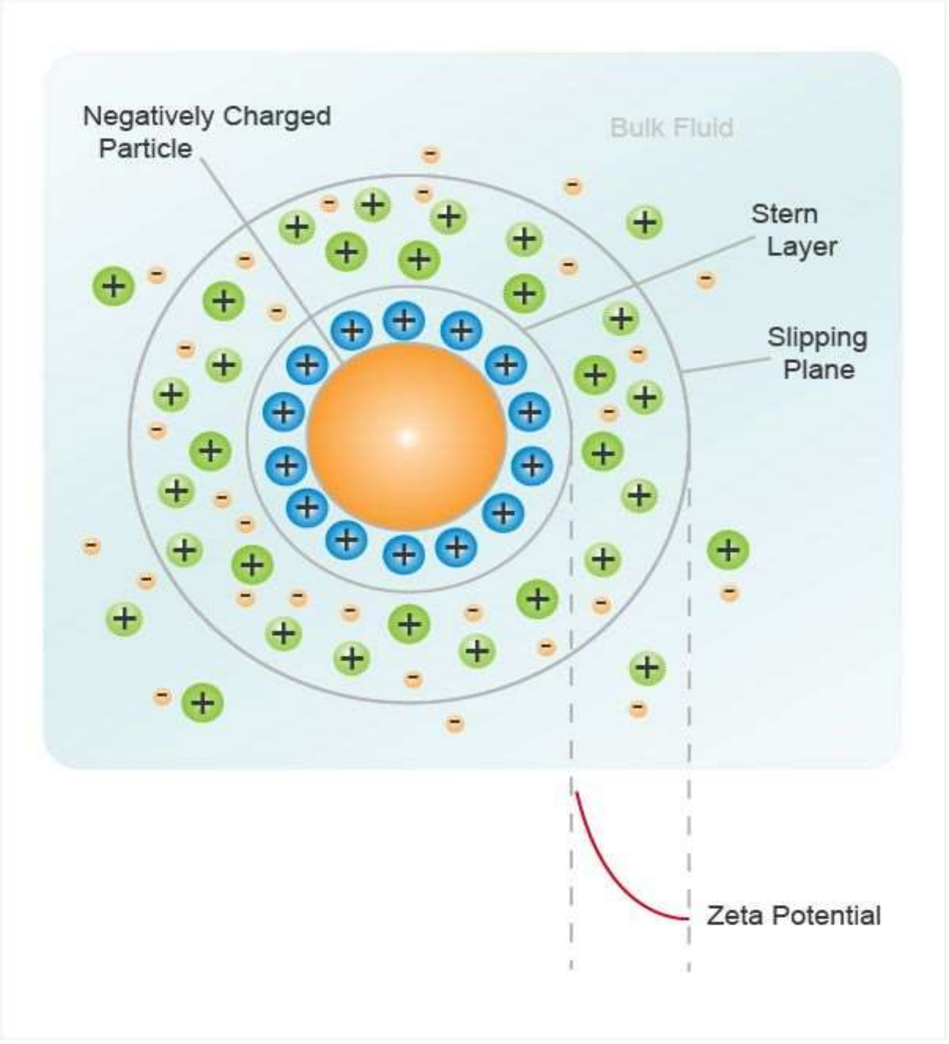
- The measured hydrodynamic diameter of the particles include the metal core, surface coating, and any solvent molecules tightly associated to the surface.
- Dynamic light scattering cannot depict the shape of particles and give no information about single particle.
- Other parameters can be measured by DLS is polydispersity index and zeta potential.

Polydispersity Index (PDI)

- Population of nanoparticles in a formulation is always polydispersed in nature and the results by DLS are reported in the form of homogeneity and heterogeneity of the particle size distribution
- A small value of PDI (<0.1) represents a homogeneous population of the particles while a value >0.3 is regarded as a higher heterogeneous population
- DLS technique cannot classify the particles with a wide variation in their sizes ,as the signals of the smaller particles are lost due to the intensity of the larger particles(Its focus on large particles)

Zeta Potential

- The zeta potential of a nanoparticle is generally used to characterize the surface charge of the nanoparticles.
- It exhibits the electrical potential of particles.

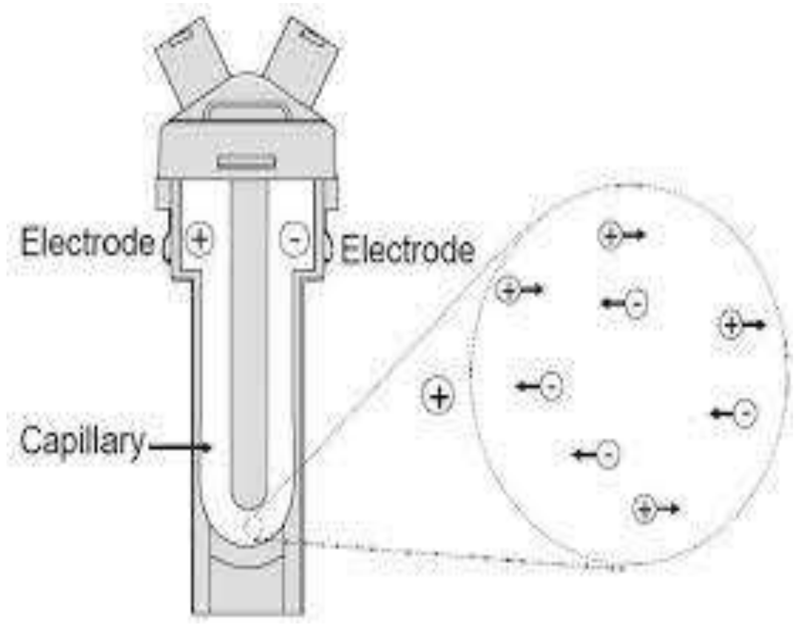


Zeta Potential Determination by DLS

- Electrophoretic light scattering is the technique used to measure the electrophoretic mobility of particles in dispersion.
- A dispersion is introduced into a cell containing two electrodes and electrical field is applied to the electrodes
- Particles with net zeta potential will migrate towards the oppositely charged electrodes with velocity related to its zeta potential

Zeta Potential Determination by DLS

- Zeta-potential in range of greater than +25 mV or less than -25 mV gives more degree of stability to the nano particular formulation, as this range will allow particles to stay in dispersed form for longer periods.



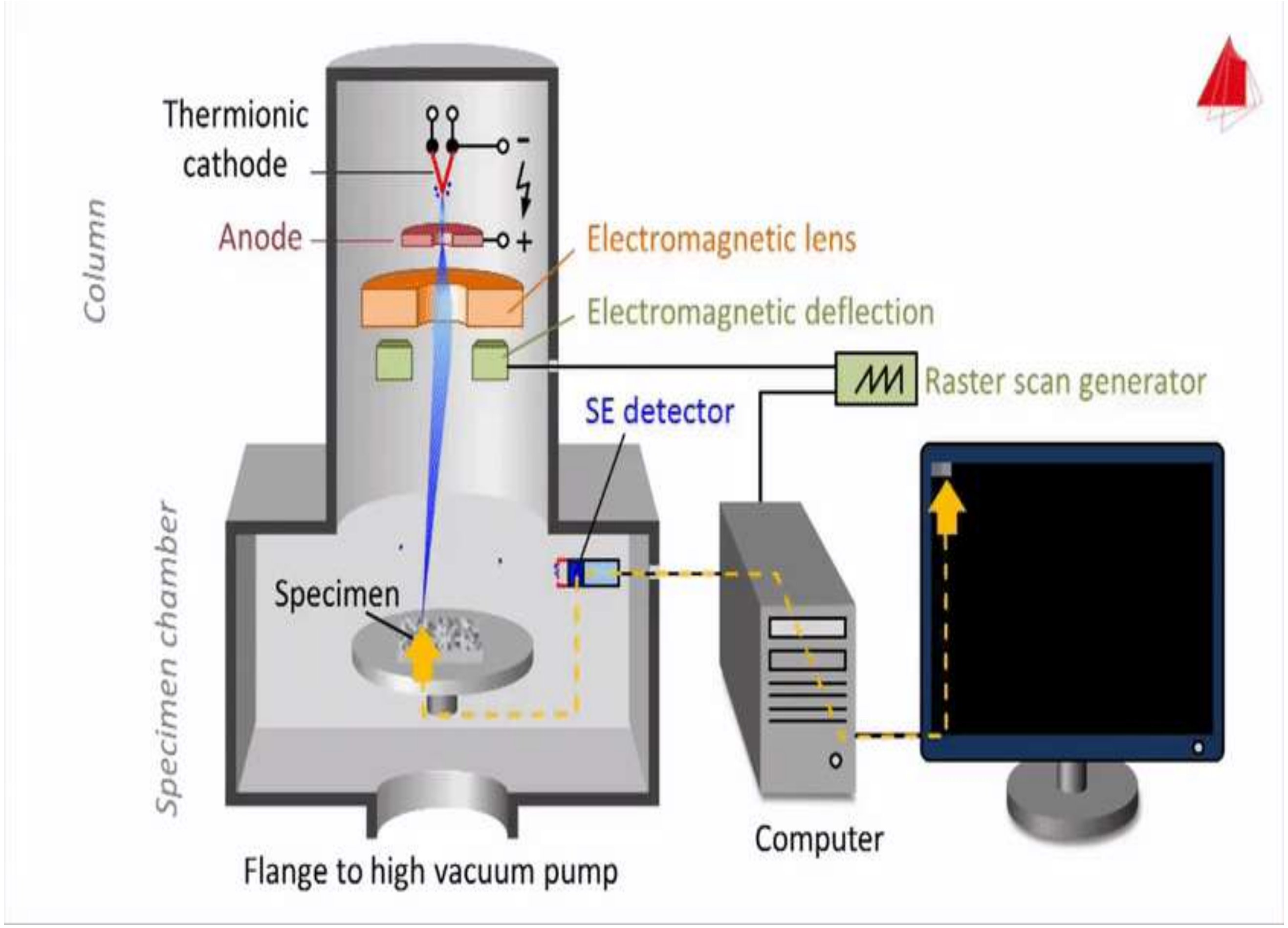
Important Points about DLS Measurements

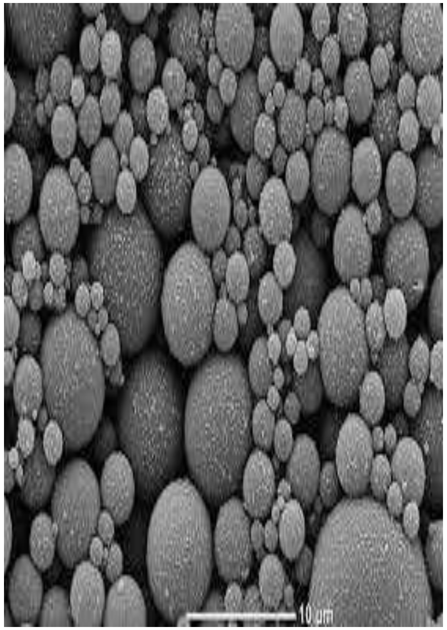
- The dispersion of NPs is carried out generally by a vortex mixing or a probe/bath sonicator.
- An optimum range of energy must be used in order to disperse the NPs, so that they do not get ruptured or agglomerate later
- In DLS, maintaining a proper dilution factor plays an important role in the measurement, the dispersant with high viscosity might interfere with the detector causing faulty results

Scanning Electron Microscope (SEM)

- Particles surface morphology of the formulation generally determined by scanning electron microscopy technique
- Scanning electron microscopy is a type of electron microscope that images a sample by scanning it with a high-energy beam of electrons
- The electrons interact with the atoms that make up the sample producing signals that contain information about the sample's surface topography

SEM


Thermionic cathode
Anode
Electromagnetic lens
Electromagnetic deflection
Raster scan generator
SE detector
Column
Specimen chamber
Specimen
Computer
Flange to high vacuum pump

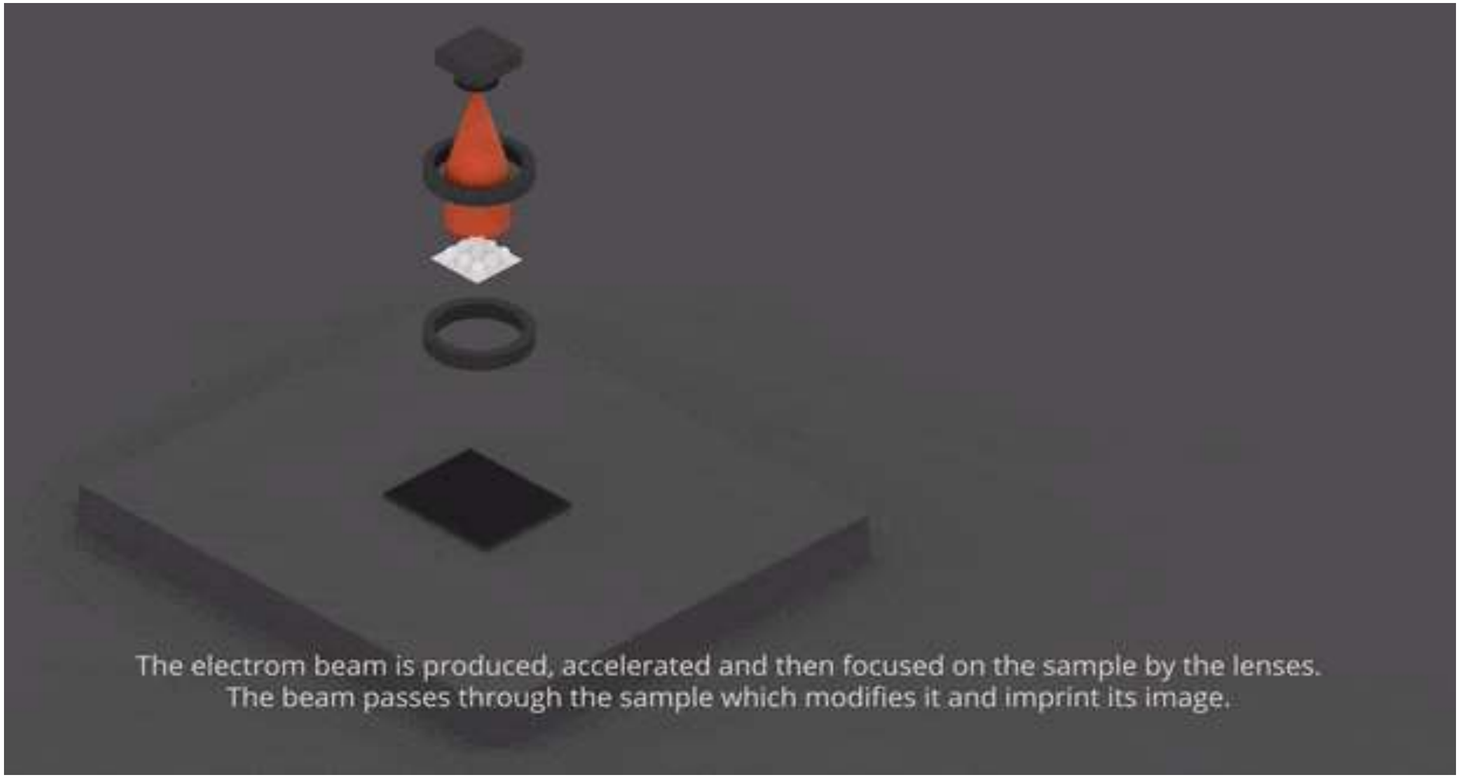


SEM

- SEM micrographs yield a characteristic three-dimensional appearance useful for understanding the surface structure of a sample.
- A wide range of magnifications is possible, from about 10 times to more than 500,000 times
- Sample preparation especially for biological sample is time consuming , besides being expensive , the sample should be dehydrated which may distort the features

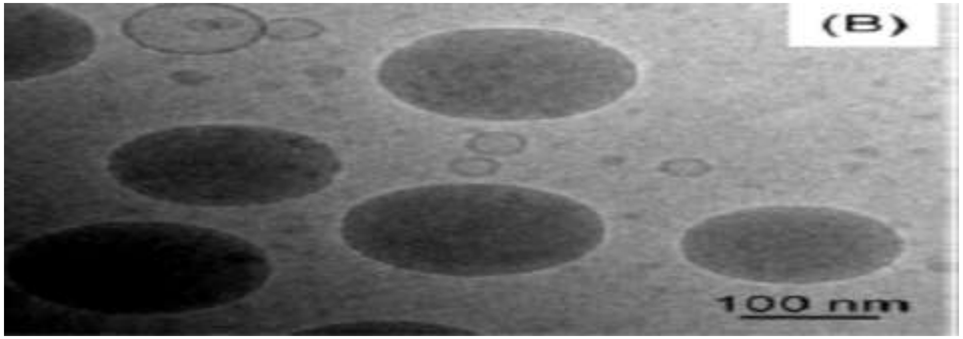
Transmission Electron Microscope (TEM)

- TEM has the same principle as light microscope ,it uses electrons instead of light



TEM

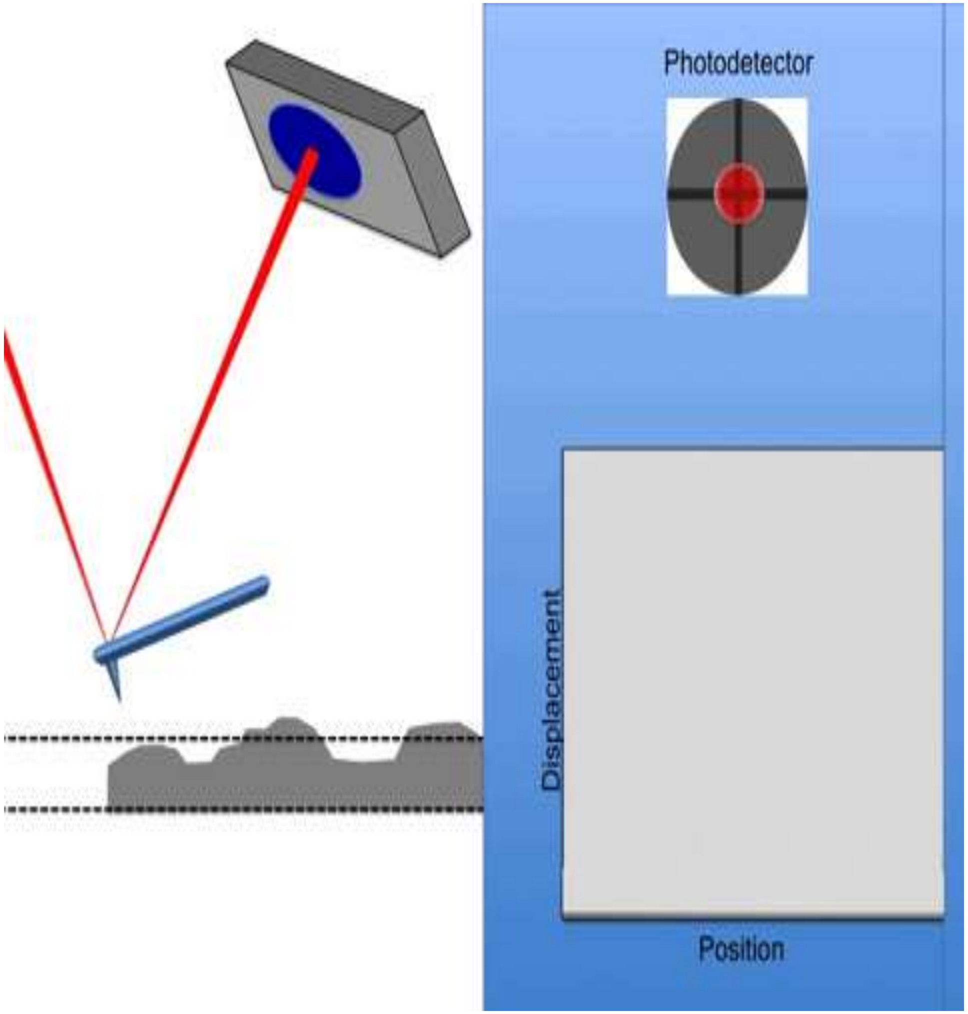
- Images appear darker where more material is deposited and lighter where there is no material.



- It can give the most accurate estimation of particle size, morphology as the beam of electron pass through sample and measure only the particle core, but the field view is not good as SEM

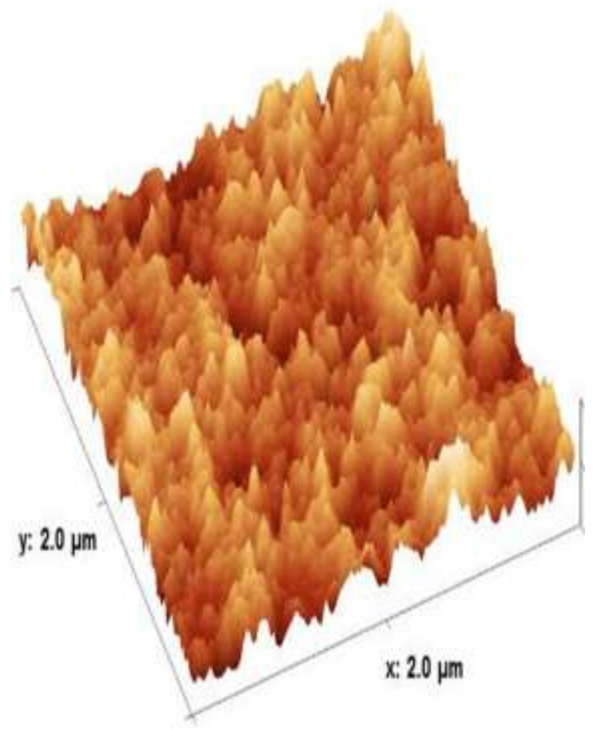
Atomic Force Microscope

- AFM have an important feature of being able to present three dimensional and topographical image specimen which is carried out by a metal tip attached to a cantilever.



Atomic Force Microscope

- High resolution 3D images can be obtained , and can be used for conductive and non conductive materials.
- It is expensive method , and biological samples may affected by the generated heat or subjected to damage by continuous contact with the tip




Thanks for
Listening