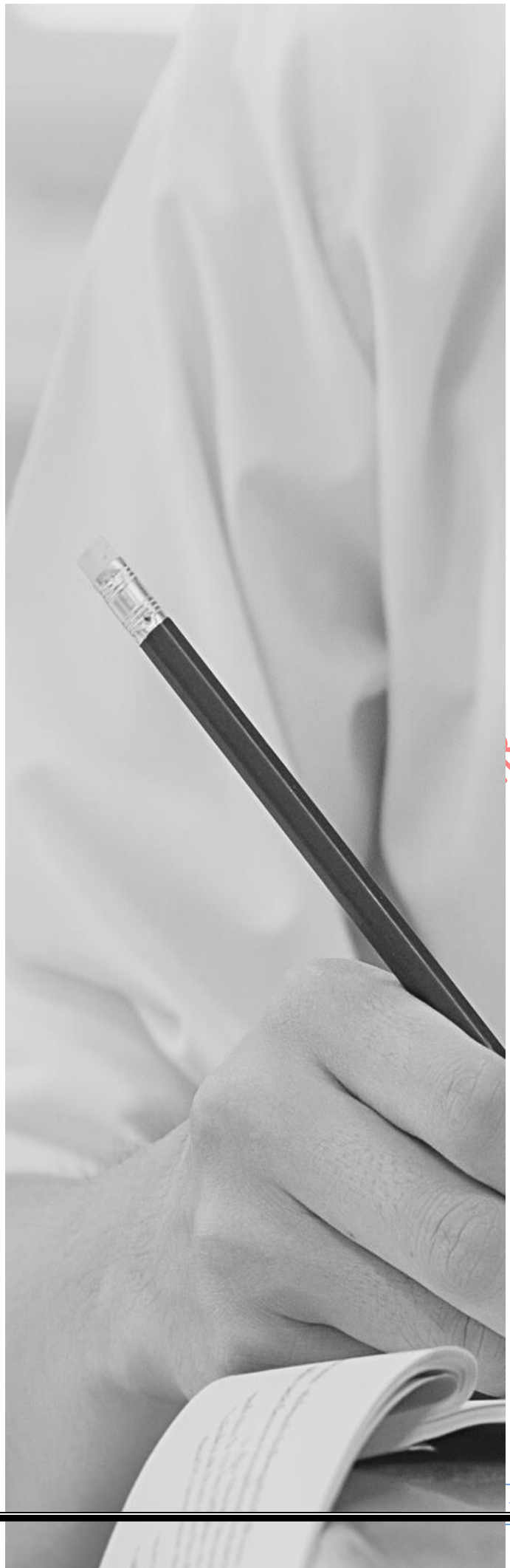

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Lect.6.

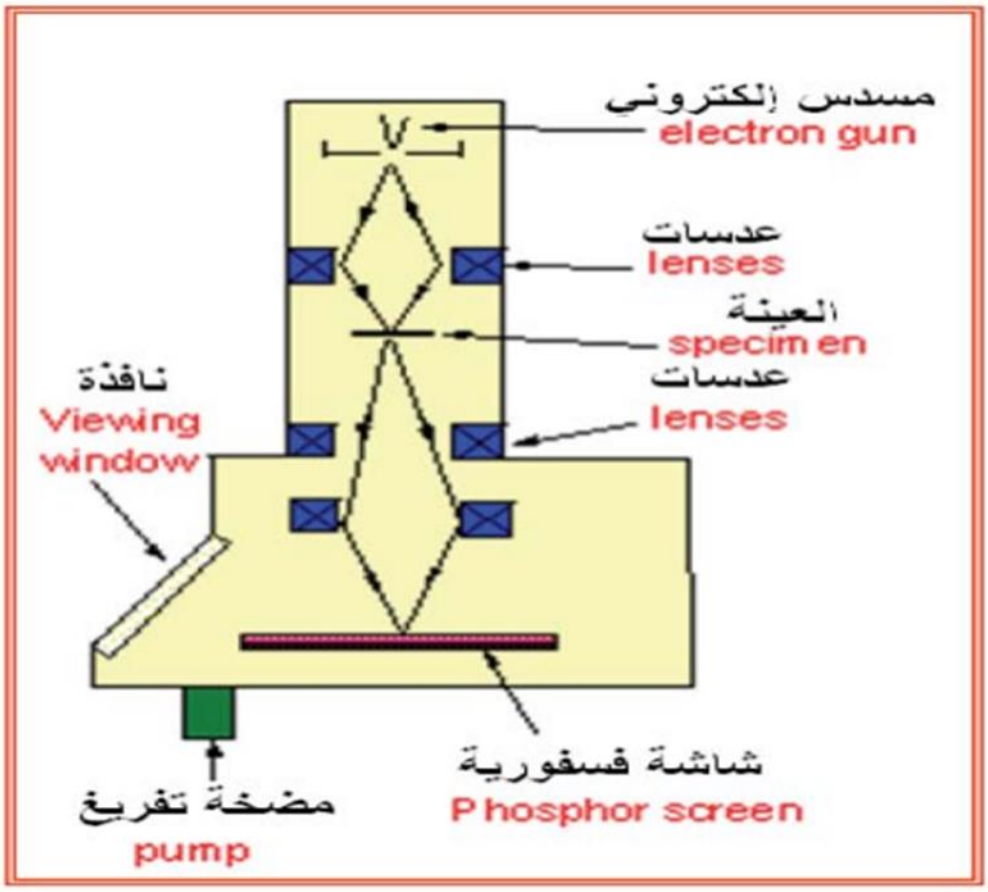
Types of Nano microscopes

There are four types of Nano microscopes

1-Transmission Electron Microscope

Abbreviated as TEM, the transmission electron microscope is a very powerful tool for materials science.

A high-energy beam of electrons shines through a very thin sample, and interactions between electrons and atoms can be used to observe features such as crystal structure.



Fig(1) Transmission Electron Microscope

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2-Scanning EltecronMicroscope (SEM)

It is a type of electron microscope that produces images of a sample by scanning it with a focused beam of electrons.

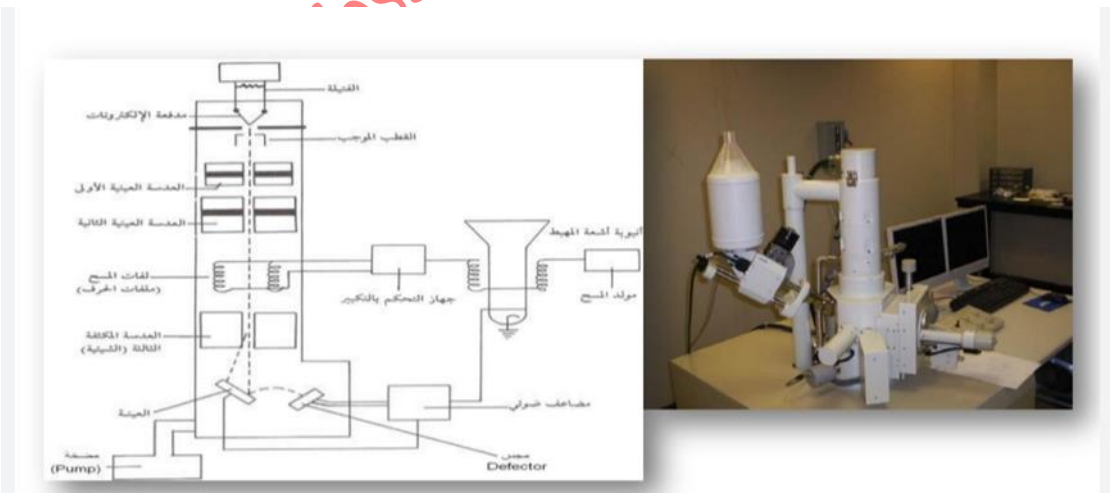
Electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition.

The electron beam is generally scanned using raster scanning and the location of the beam is combined with the signal to produce an image.

The most common scanning electron microscope technique is to detect secondary electrons emitted by atoms excited by an electron beam.

The number of secondary electrons that can be detected depends, among other things, on the topography of the sample.

By scanning the sample and collecting the secondary electrons that are emitted using a special detector, an image is created that displays the surface topography.



Lect.6.

3- Scanning Tunneling Microscope (STM)

scanning tunneling microscope) (STM), The magnification power of the scanning tube microscope is approximately one hundred million times, and a computer is connected to it that analyzes the information received to it to show an image of the sample in its three dimensions.

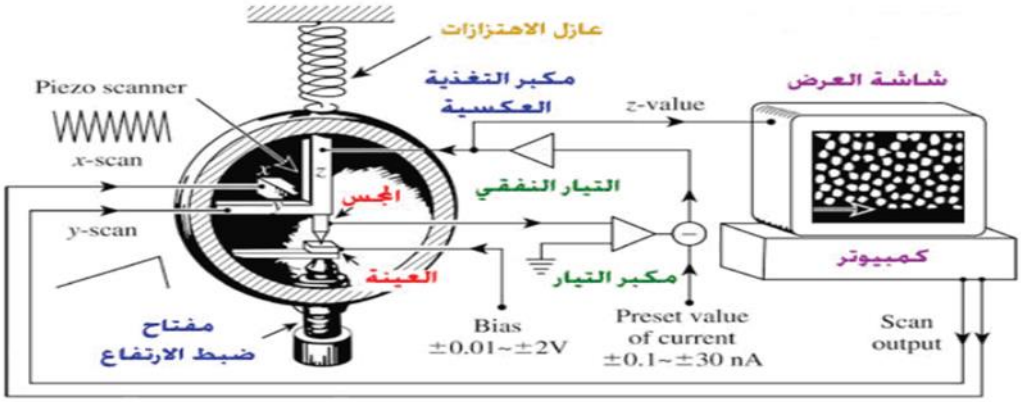
This microscope is known as a scanning tunneling microscope.

The scanning tunneling microscope is one of the basic devices in the science of nanotechnology, as it helps in studying materials at the atomic level, and in constructing and examining nanostructures.

The idea of its work is based on the principle of quantum tunneling

When the tip of the electrically conductive probe approaches the surface to be examined, a potential difference is applied between the surface and the tip of the probe, allowing electrons to pass through a tunnel between them known as tunneling current.

The tunneling current depends on the position of the probe on the surface, the applied potential difference, and the local electronic density of the sample.



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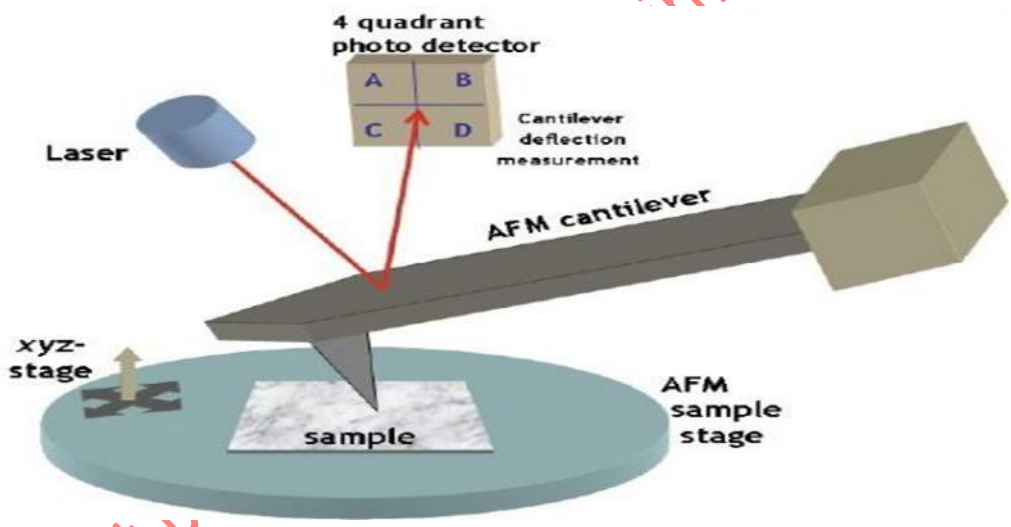
4- Atomic Force microscopy(AFM)

The atomic force microscope or scanning force microscope is one of the probe microscopes The survey has a very high resolution and has an analysis capacity of up to parts of Nanometer, through which three topographical images can be obtained Dimensions of the studied sample.



Lect.6.

Definition of x-ray

X-rays (X-rays) are a type of electromagnetic wave.

They are similar to light, but with a shorter frequency

They travel in straight lines emanating from their source and do not deviate from their direction when they pass through magnetic and electric fields.

Therefore, they are not electrically charged particles.

X-rays, along with gamma rays, are considered ionizing radiation, which is why there is concern about the dangers of X-rays, unlike ultraviolet, infrared, and even radio waves, which are considered non-ionizing.

It has a wavelength of 10 to 01.0 nanometers, meaning that .its ray energy is between 120 eV and 120,000 eV.

The energy of X-rays is determined according to its wavelength from the relationship:

$$E = h\lambda$$

Lect.6.

X-ray diffraction(XRD)

X-ray diffraction (XRD) is a widely used analysis method to evaluate the crystallinity and structure of solid samples.

What is screening XRD

X-ray diffraction (XRD) is a widely used analysis method to evaluate the crystallinity and structure of solid samples.

In this technique, the phenomenon of crystal X-ray diffraction results from a scattering process in which the X-rays are scattered by the electrons of the atoms in the sample without changing the wavelength.

Lect.6.

Scherrer equation

The Scherrer equation, in X-ray diffraction and crystallography, is a formula that relates the size of sub-micrometer crystallites in a solid to the broadening of a peak .in a diffraction pattern.

It is often referred to, incorrectly, as a formula for particle size measurement or analysis. It is named after Paul Scherrer

It is used in the determination of size of crystals in the form of powder.

The Scherrer equation can be written as:

D =(K*λ)/(β*Cos(θ).

K = is a dimensionless shape factor, with a value close to unity.

nm = λ 1.547

β=FwHM\57

Cosθ=2 θ\2

n= D\d

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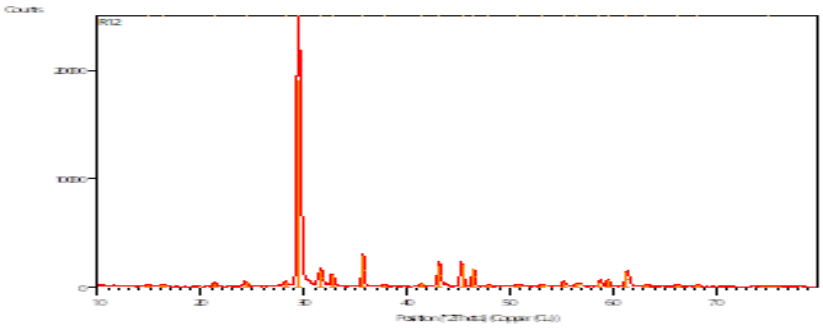

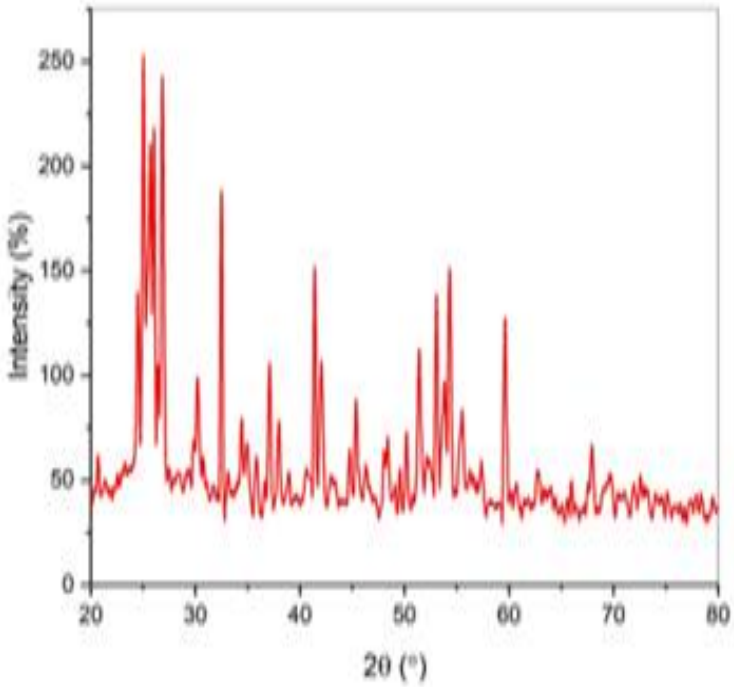

Fig (XRD)

Lect.6.

Pos. [°2Th.]	Height [cts]	FWHM Left [°2Th.]	d-spacing [Å]	Rel. Int. [%]	Tip Width	Matched by
14.8683	165.36	0.2952	5.95841	0.87	0.3542	
16.2277	130.45	0.5904	5.46220	0.69	0.7085	
21.2334	272.73	0.1968	4.18447	1.43	0.2362	
24.3702	481.20	0.3936	3.65251	2.53	0.4723	
28.3113	449.10	0.3444	3.15238	2.36	0.4133	
29.3733	19034.79	0.3936	3.04078	100.00	0.4723	
31.6863	1474.79	0.4428	2.82389	7.75	0.5314	
32.6992	1082.24	0.2460	2.73870	5.69	0.2952	
35.7282	2923.04	0.2952	2.51316	15.36	0.3542	
37.7940	123.39	0.2952	2.38041	0.65	0.3542	
41.4577	230.77	0.2952	2.17812	1.21	0.3542	
43.2487	1970.48	0.3444	2.09198	10.35	0.4133	
45.4444	2056.78	0.3936	1.99589	10.81	0.4723	
46.4631	1660.64	0.2952	1.95447	8.72	0.3542	
47.9355	110.34	0.5904	1.89782	0.58	0.7085	
50.7555	186.16	0.4920	1.79880	0.98	0.5904	

.Table(XRD).