Tikrit University
College of Veterinary Medicine.

Reem.S.Najm 2025\3 \3

Subject name: Special Material(Nano).

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Lect.4.

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:

$E = h\lambda$

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Lect.4.

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.

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Lect.4.

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:

$D = (K*\lambda)/(\beta*Cos(\theta)$.

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

The shape factor has a typical value of about 0.94, but varies with the actual shape of the crystallite.

λ=1.547 nm

β=FwHM\57

Cosθ=2 θ\2

n= D\d

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Lect.4.

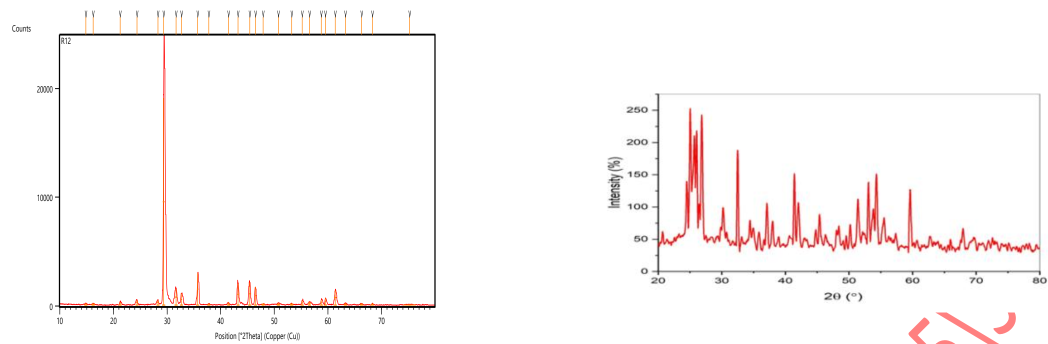

Fig (XRD).

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).

Lec.4.

(AFM)Atomic force microscopy

Atomic force scanning (AFM) is a sample scanning microscope capable of imaging low and high altitudes (surface topography) that has received much attention today, especially in the field of nanostructures.

The special advantage of this analysis (AFM) compared to SEM is the appropriate ability to measure surface roughness, especially nanometer roughness.

Another application of AFM analysis is to measure the thickness of Nano scale coatings.

This microscope is capable of imaging all surfaces including non-conductive surfaces and performs imaging in both contact and non-contact modes.

Therefore, to understand the surface structure of Nano mass sample such as films, thin films and lithographic electrical components.

(AFM)) It is used in the field of nanotechnology to know and map the topography of Nano-sized surfaces. Also called scanning force microscope.

It has become used in other measurements, such as measuring the elasticity of Nano- and micro-particles and cells. It has also become used in measuring the adhesion energy between chemical molecules, Nano- and micro-particles and cells as well.

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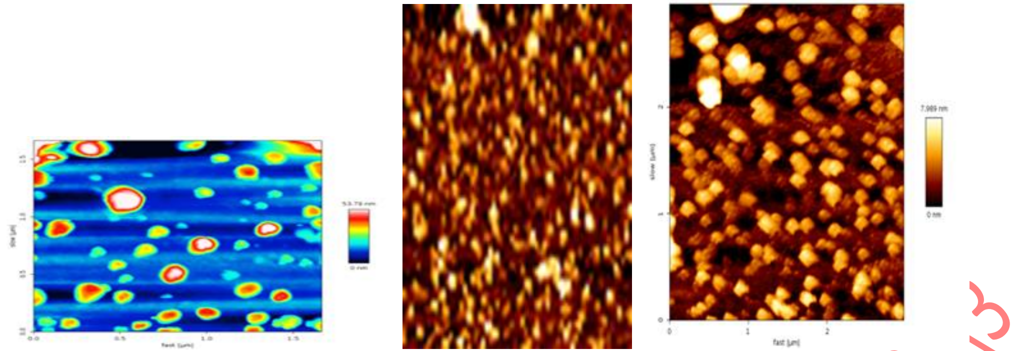

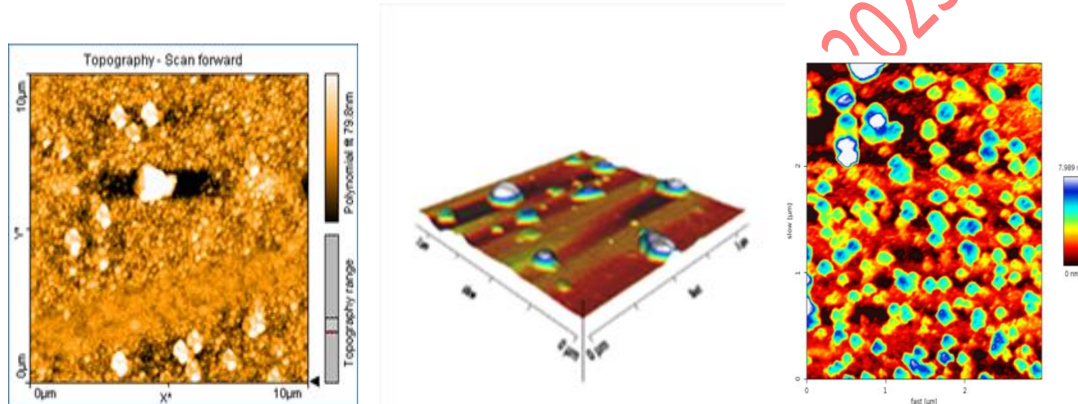

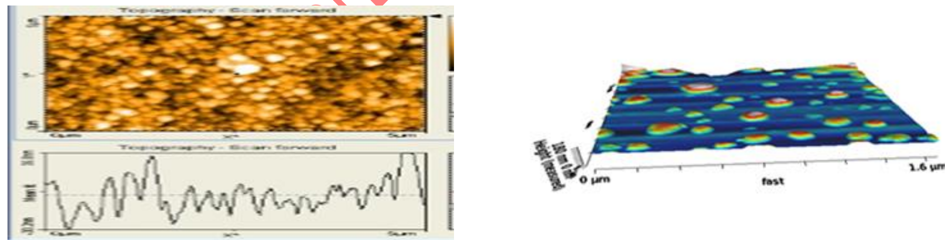

(Fig of AFM)