study the structural properties of polyaniline films /Multi-walled carbon nano-tube *

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Abstract:

In this research we study the structural properties of pure polyaniline films and doped with carbon nano-tube. The study included the preparation of films on the rules of the glass and then conducted the tests, infrared , X-ray diffraction and AFM. In this study found that polyaniline was randomly , when you add carbon nano-tube, it can not happen interaction between them, but be attending together. The results of the tests (**AFM**) of the all films are uniform granular surface morphology. The roughness, root mean sequare and average grain diameter, they were increasing with increased of doped ratio. The method of films preparation are made by spin coating technique.

Key words: structural properties; Polyanilin; thin films; Carbon nanotubes
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1-Introduction:

Conjugated polymers such as polyaniline (PANI), are the most interesting because of its excellent chemical stability . They are easy to prepare in the form of large area thin films and able to storage the charge throughout the entire size[1,2,3]. The chemical composition of polyaniline consists of vinyl ring with a (N-H Group) on both ends of the loop itself,As in Figure (1) [4, 5].

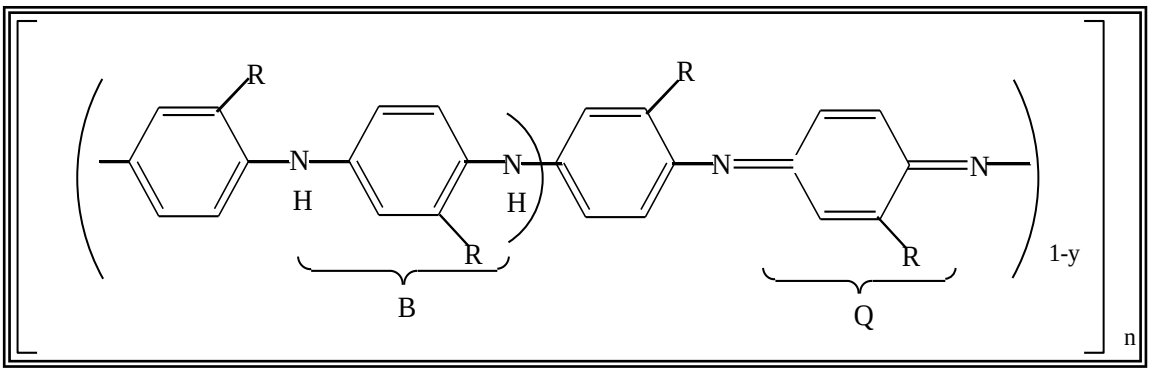


Figure (1) the general formula of polyaniline

So the (PANI) can exist with different Structures depends on the value of (Y) (the degree of oxidative stress) in the general formula[6]. The temperature has a significant effect on the polymers preparation , as conducting polymerization degree in low-lying temperature leads to the formation of polymer with a high conductivity compared with polymers preparation at high temperatures [7,8]. The mechanical properties of poly Aniline be weak Also it features properties Photoelectric could be using in industrial applications, for example the light-emitting diodes [9,10].

2-practical part :

2.1- Preparation of films :

Were prepare films by depositing material on the pieces of glass using a method (Spin coating method).) after Cleaned it well.

2.2- Prepare the solution used for doped:

It has been added carbon nano-tube to the polymer By certain percentages, that the films thickness is 48 nm.

2.3- Diagnostic tests:

2.3.1- FTIR Diagnos:

Using IR spectroscopy in the study of the structures of polymers , through knowledge of the active groups of the polymer which linked to some of the groups with the compound and the disclosure of the type bond that bind molecules article, It has been by using Vertex 70 from bruker company, at Babylon University / College Basic Education, Department of General Science.

2.3.2- XRD:

This method is adopted to study the crystal structure of various materials, whether powder or thin films, It was the diagnosis using a device with the following specifications:

Target: Cu

Wave Length: 1.54060 (A)

Voltage: 40.0 (kV)

Current: 30.0 (mA)

2θ (Rang): 10-70

-Atomic Force Microscope (AFM):

Atomic force microscope (AFM) is an instrument that extremely high-resolution type of scanning probe microscopy, where through which to

look at the surface of a very high accuracy from (100 μm to less than 1μm)[11]. AFM is used for surface imaging technology to obtain information about The morphology of the film, such as, standardization, and distribution of grain or defect Forming a film on any surface, such as insulation or procedure without Damaging the surface. It has been investigated a wide range of materials using This technology, including semiconductors, polymers, metals and composites[12] . This device is present in the laboratory at the Department of chemistry / College of Science/ University of Baghdad.

3- Results and Discussion:

3.1 – FTIR:

Figure(2) illustrates the frequency of the bonds of effective aggregates sites for pure polyAniline film. The emergence of a summit in the (3153.61 cm^{-1}), this indicates the presence of C-H Aromatic is an important feature of the reference to the polyAniline, the emergence of values between (1487-1566.20 cm^{-1}) these values back to the presence of Yle group C = C Aromatic ringed in the polyAniline. When vaccination with carbon nano-tube as in Figure (3) are seeing the emergence of value at 3210 cm^{-1}, and this is clear evidence of a C-H Aromatic attributable to polyAniline this corresponds to approximately the same value that appeared when you reference the value of which (3153.61 cm^{-1}), as in Figure (2),The emergence of value at(2958.80 cm-1) this returned to CH3 in carbon nanotubes, as referred to in the basic material ,as in Figure(4) , The emergence of value at 2927.94 cm^{-1} returning to Yle group CH2 in carbon nanotubes and also the emergence of value at(2779.42 cm-) returning stretchable (CH) in carbon nanotubes, he emergence of values between (11635.64- 1486cm^{-1}) evidence of a C = C Aromatic attributable to polyAniline.

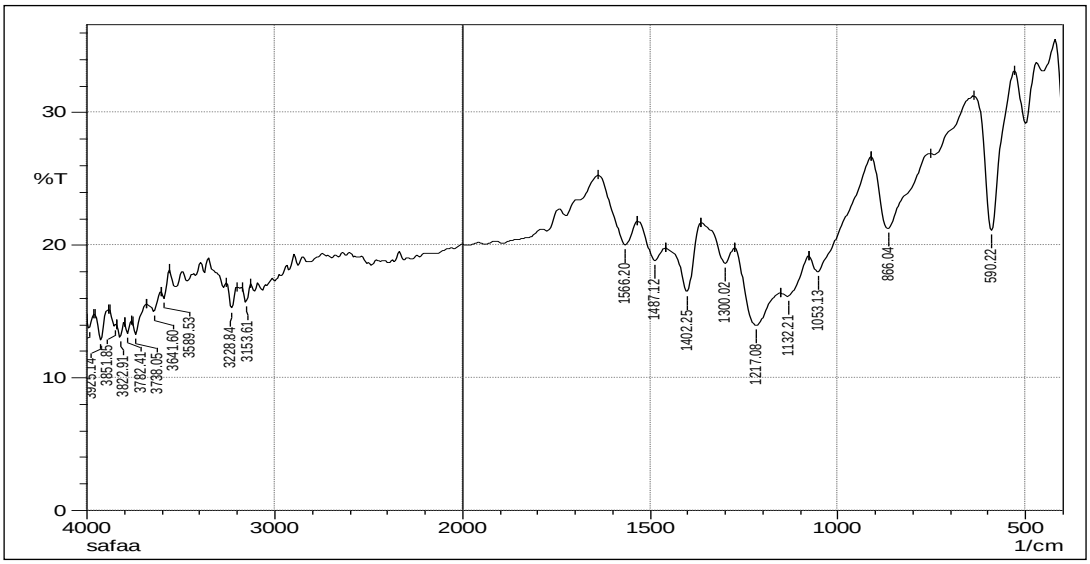


Figure (2) FTIR for pure polyaniline

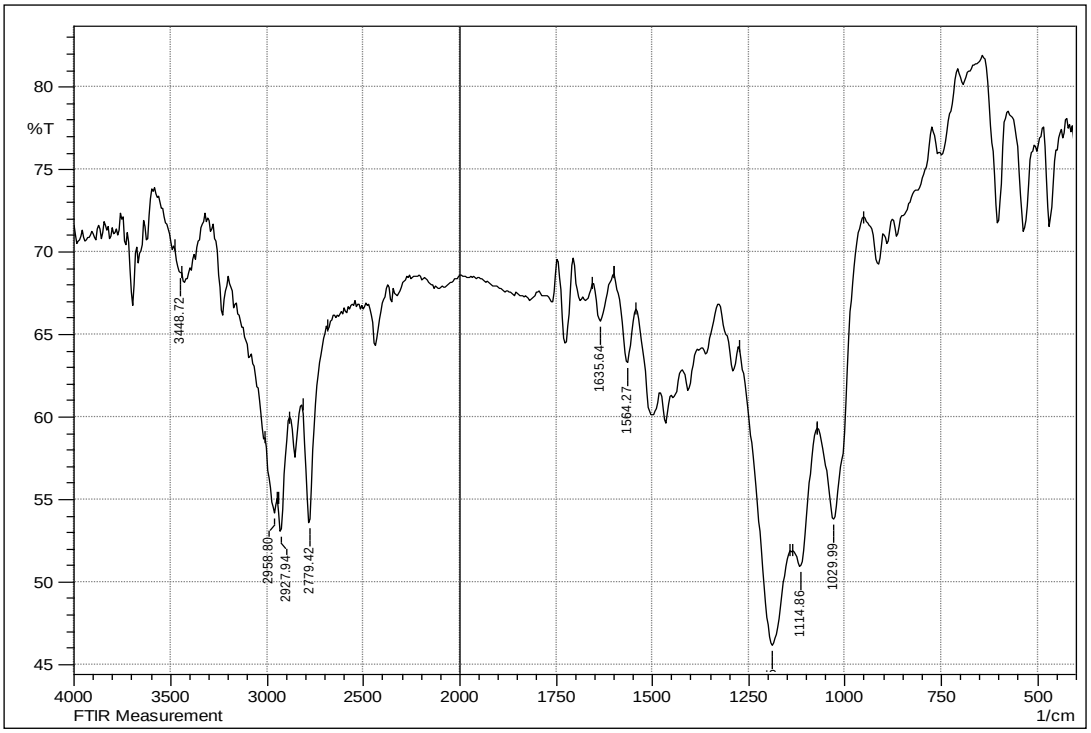


Figure (3) FTIR for polyAniline / MWCNTS

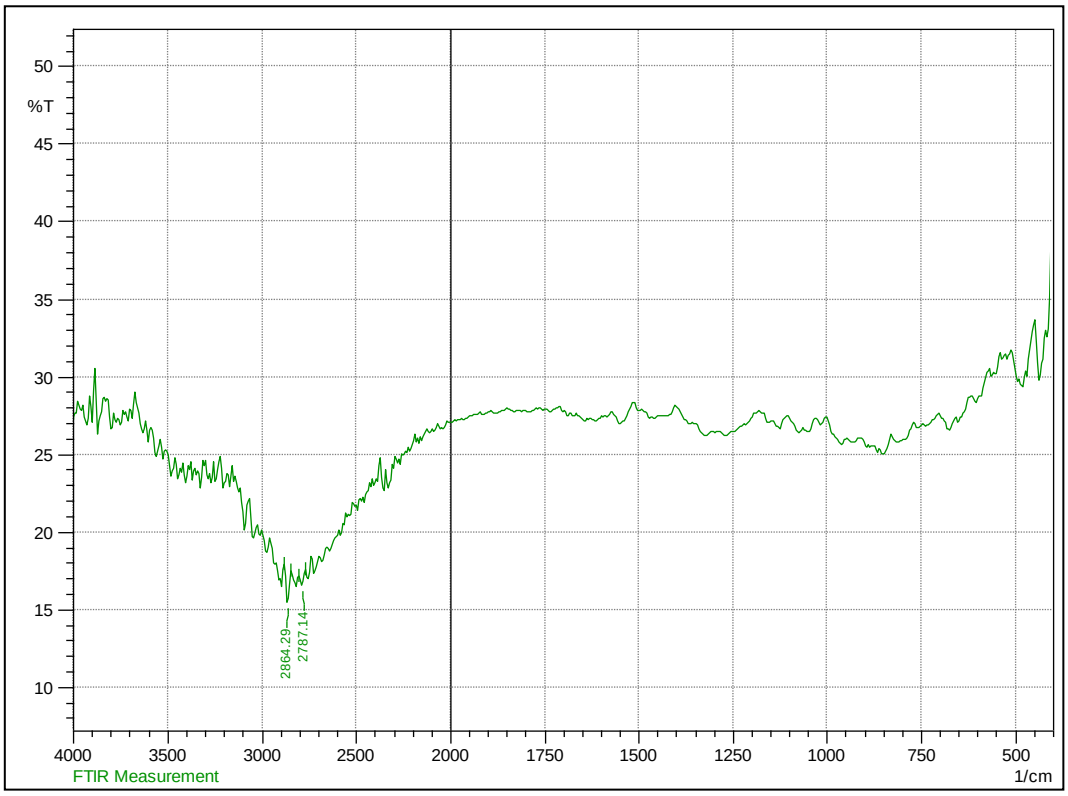


Figure (4) FTIR for carbon nanotubes (MWCNTS)

These results indicated to the presence of each of the polyAniline and carbon nano-tube which indicates to Their presence together.

3.2 XRD:

Figure (5) which represents the X-ray diffraction of pure poly Aniline , appears broad summit at (250) which shows that the poly Aniline is (Amorphous) while figure(6) represents X-ray diffraction of the poly-aniline doped by Carbon nanotubes with ratio 1% ,where notes the

appearance of two peaks at (5^0-30^0) . An angle (5^0) shows the diffraction for the parallel levels in the polymeric chain, an angle (30^0) shows the diffraction of the levels orthogonal.

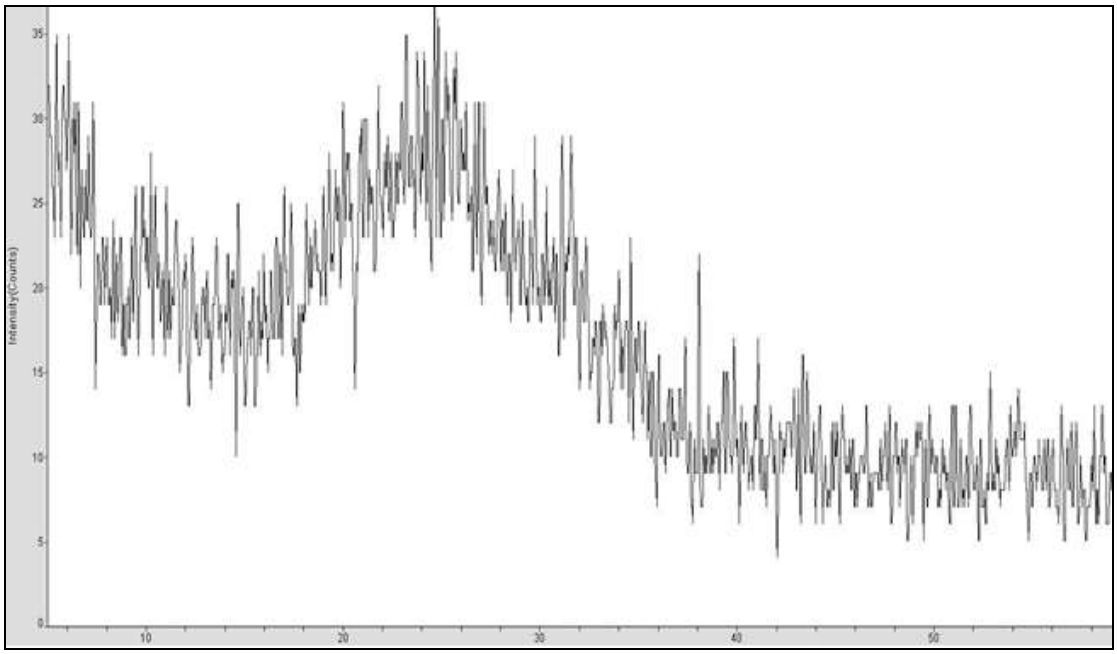


figure (5) X-ray for pure polyaniline

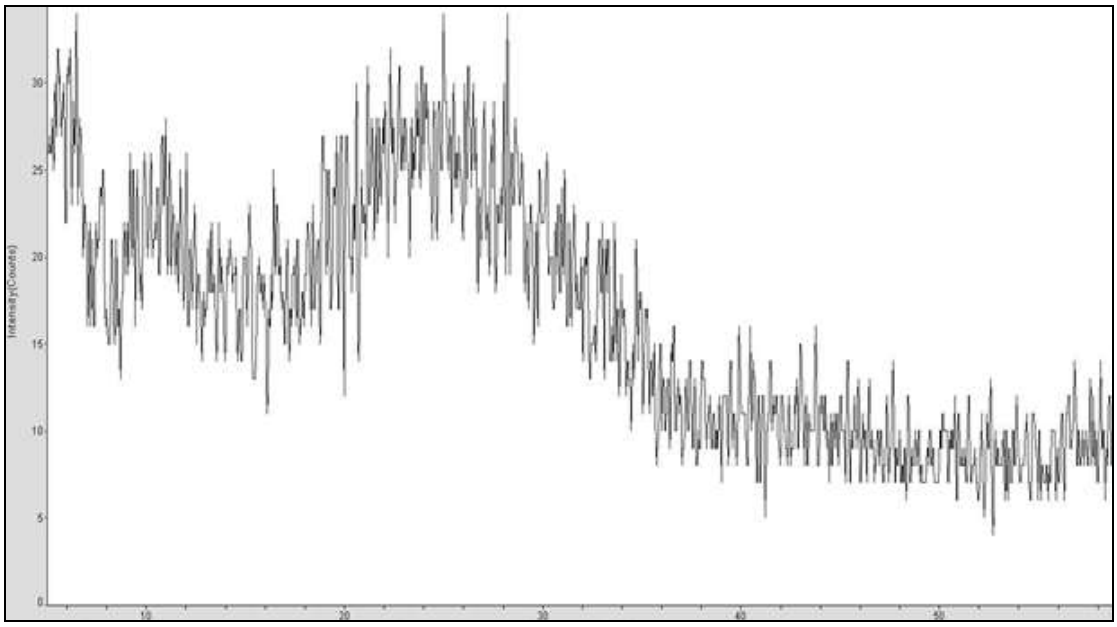
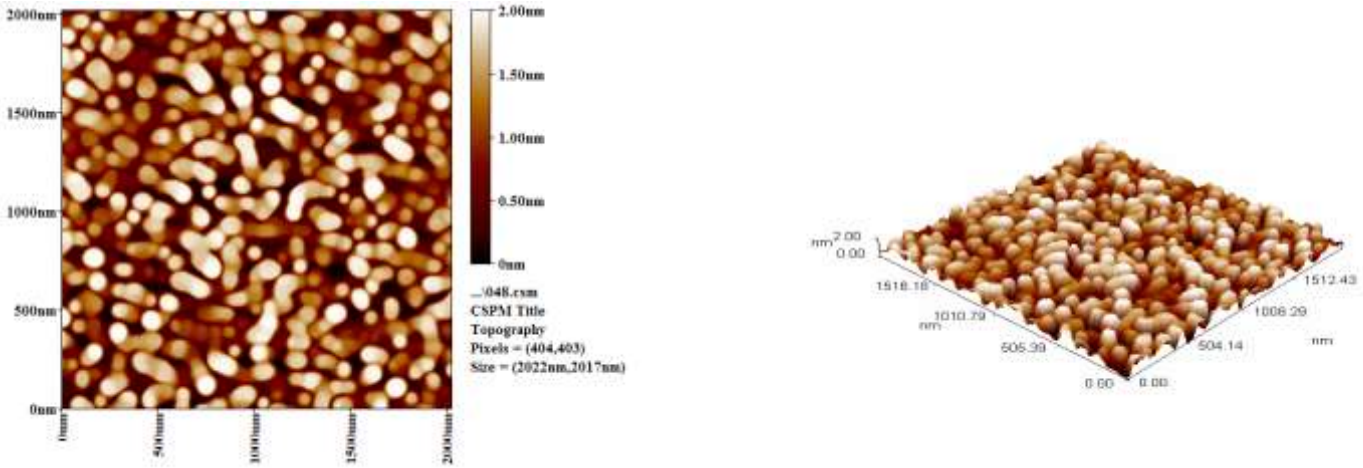


figure (6) X-ray for polyaniline / MWCNTS

3.3- AFM

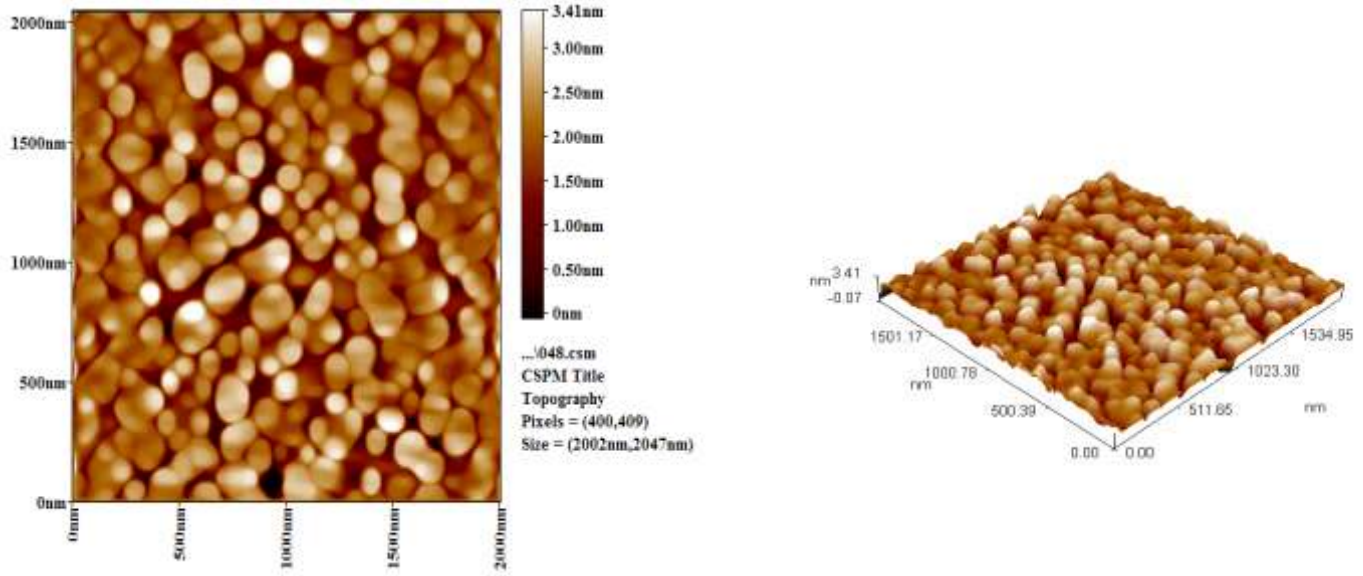
The results of the tests (**AFM**) of the nano films for pure (PANI) and doped with different ratio of(MWCNTS) films which prepared by spin coating which showed a uniform granular surface morphology, as in figir (7,8,9,10) . Where we note that the roughness increased with increasing the ratio of doped. As well The root mean sequare (RMS) increased with increasing of ratio of doped, the average grain diameter also It exhibits

the same behavior . as in table (1). This is consistent with the findings of the researchers (13, 14).



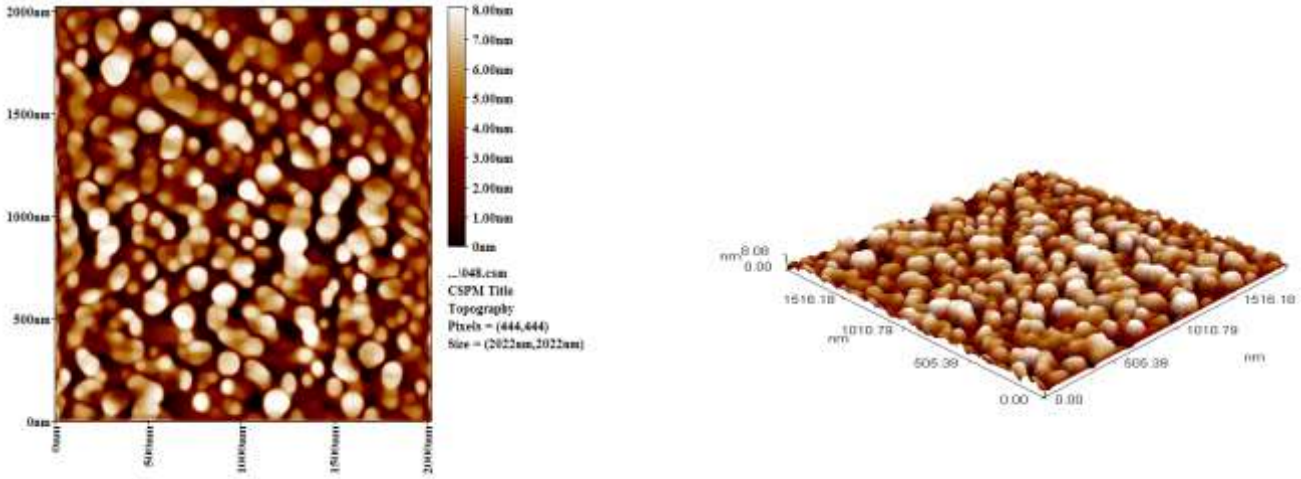
(a) **(b)**

Fig.(7) AFM images of pure PANI nano films for (a) 2-D and (b)3-D



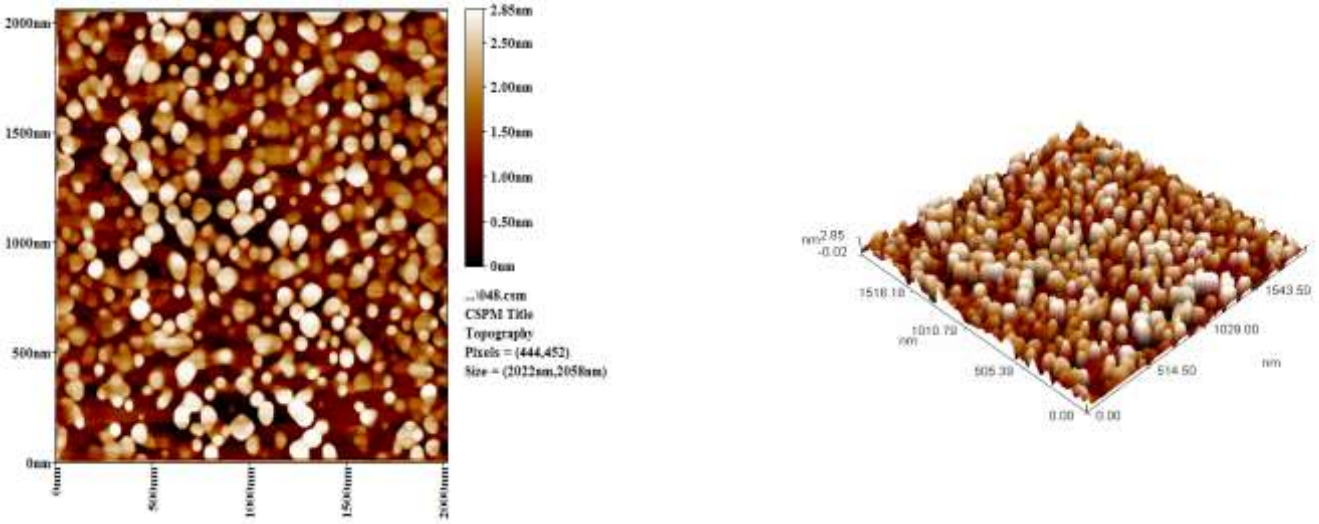
(a) **(b)**

Fig (8) AFM images of PANI/ MWCNTS with ratio 1% for (a) 2-D and (b) 3-D



(a) **(b)**

Fig (9) AFM images of PANI/ MWCNTS with ratio 3% for (a) 2-D and (b) 3-D



(a) **(b)**

Fig (10) AFM images of PANI/ MWCNTS with ratio 5% for (a) 2-D and (b) 3-D

Table (1) Morphological characteristics of PANI/MWCNTS nano films deposited at different doping concentration

Sample	PANI/CNTS(wt%)	Roughness average Sa (nm)	Root mean square Sq (nm)	Average diameter (nm)
1	0	0.47	0.45	79.7
2	0.01	0.48	0.63	83.66
3	0.03	2.02	2.34	83.17
4	0.05	0.717	0.82	62.04

4. Conclusions

The summarized results from this work are the following:

1. It is found through a study that these polymers possess random installation.
2. The addition of carbon nano-tube does not change the installation of the polymer but are attending together.
3. all films are uniform granular surface morphology.

5-References :

1. A. Rudge, J. Davey, I. Raistrick and S. Gottesfeld, J. Power Sources., 89 , 47 (1994).
2. T. Shoa, J. D. Madden, C. E. Fok and T. Mirfakhrai, Adv. Sci. Tech., 26 , 61 (2008).
3. H.S. ABDULLA , A.I.ABBO , " Optical and Electrical Properties of Thin Films of Polyaniline and Polypyrrole ", Int. J. Electrochem. Sci., 7, PP.10666 – 10678 (2012).

4-A. C. Diarmind and W.S. Huang, J. Synth. Met-18,P 285,(1987).

5- J. STEJSKAL , R. G. GILBERT , "Polyaniline. Preparation Of A Conducting Polymer ", Pure Appl. Chem., Vol. 74, No. 5, pp. 857–867, (2002).

6- A.J.Epstin "Electrical Conductivity in Conjugated polymers Application". Norwich, New York : Plastics Design Library. PP.1-9, (1999).

7- J. Wojturski, J. Stejskul, O. Quadrat, P. Kratochril, and P. Sata,

J.Croatica" Chemical Acto, Scienlipic Paper", 71,P. 873.(1998).

8-Asia H. Al-Mashhadani*, Hamma R. Humud, ThikraKh. Aubais," The Effect of Gamma Irradiation on the Energy Gap of Polyanniline Thin Films Prepared by Non-thermal Plasma Jet",Asian Journal of Applied Science and Engineering, Volume 3, No 2/ (2014) .

9-D.P. Halliday J.M. Egylestons P. n. Adams, E.R. Holl and A.P. Monkmon, vkissn 0963-3308 ,160. P. 13/1.(1995).

10-D. C. Trivedi, in H.S. Lalwa (Ed.), Handbook of Organic Conductive Molecules and Polymers, John Wiley & Sons, New York (1997).

11- S. Sarid, "Scanning Force Microscopy", Oxford, U.K., Oxford University Press, (1994).

12- 2- C. R. Blanchard, “Atomic force Microscopy”, Chemical Educator, vol.1, No.5, ISSN 1430-4171,(1996).

13- Estabraq T. Abdullah**,** et al, " Synthesis and Characterization of PANI and Polyaniline/Multi Walled Carbon Nanotube Composite", International Journal of Application or Innovation in Engineering & Management Volume 4, Issue **9, (2015**).

14- Kareema M. Ziadan an dHanaa H. Inayh "Preparation and Characterization of Nanocompocite Conducting Polymers (PANI-DBSA/MWNCT)" Chemistry and Materials Research Vol.8 No.8, (2016).