



# MORPHOLOGY AND STRUCTURAL ANALYSIS OF PENTACENE THIN FILM

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## ABSTRACT

This paper describes the Morphological and structural analysis of Pentacene thin film using SEM and XRD measurement technics. Pentacene is a P-type material used for the fabrication of thin film transistors.

**Keywords=** SEM, XRD, FESM

## 1 INTRODUCTION

Organic semiconductor materials are widely used for the fabrication of thin film transistor. They shows high potential for the production of efficient devices. They can be used as active layers for different types of thin film transistor. They can also be used as optoelectronic devices.

In this study we used pentacene an aromatic hydrocarbon and its optical and structural characteristics are measured first. It is a very promising material and the study of the optical properties may lead to electrical properties. We analysed the samples using scanning electron microscopy (SEM), and X-Ray diffraction (XRD) analysis.

## 2. EXPERIMENT

Pentacene coated with different thickness on a glass substrate and studied two samples with thickness 100nm and 200nm. We investigated the thin film by field emission scanning electron microscope (FESEM). SEM analysis is done to study the surface analysis. Using FESEM we studied the size and shape of the particles.

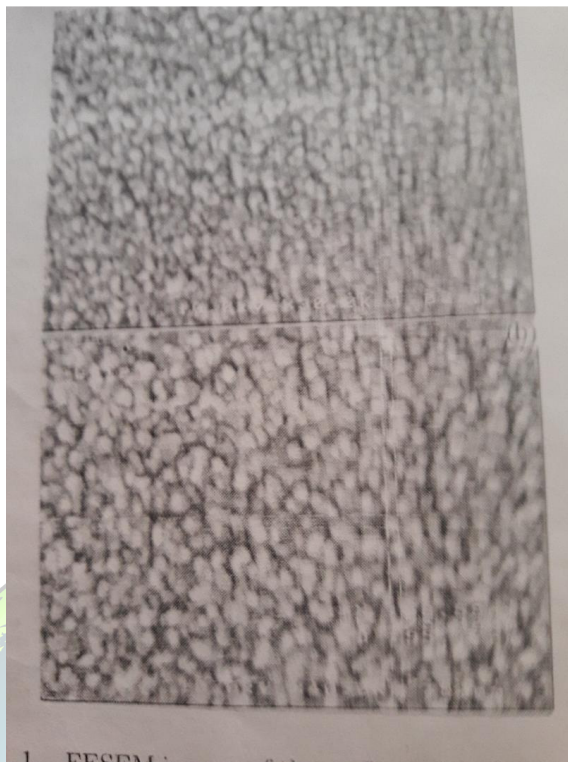
Next we analysed the thin film using X-Ray diffraction image. The XRD pattern is shown below. We also studied the optical properties using UV/V spectrometer.

## 3. RESULTS AND ANALYSIS

### a. FESEM Analysis

Field Emission Scanning Electron Microscopy (FESEM) provides topographical and elemental information at magnifications of 10x to 300000x with virtually unlimited depth of field. FESEM images of pentacene thin films with different magnifications are shown below. The morphology of the surface of thin film can be studied using FESEM. Field Emission SEM (FESEM) produces clear, less electrostatically distorted images with spatial resolution down to 1 1/2 nanometers –three to six times better

It is of uniform distribution of almost round shaped particles. It is observed that the average size of the particle is 70-90nm range.



#### b. X-Ray Diffraction Analysis

The X-ray diffraction pattern of the pentacene thin film is shown in figure. The XRD microscope indicates the configuration of alpha form with the plane (102)) as the preferred orientation. Eventhough more than one peaks available in the pattern the angle  $2\theta$  of 19.067 and hkl values of ( 102) is the strongest one and can be selected. The X-ray diffraction data for pentacene is shown in the table. The mean crystalline size can be calculated by Scherrer's formula

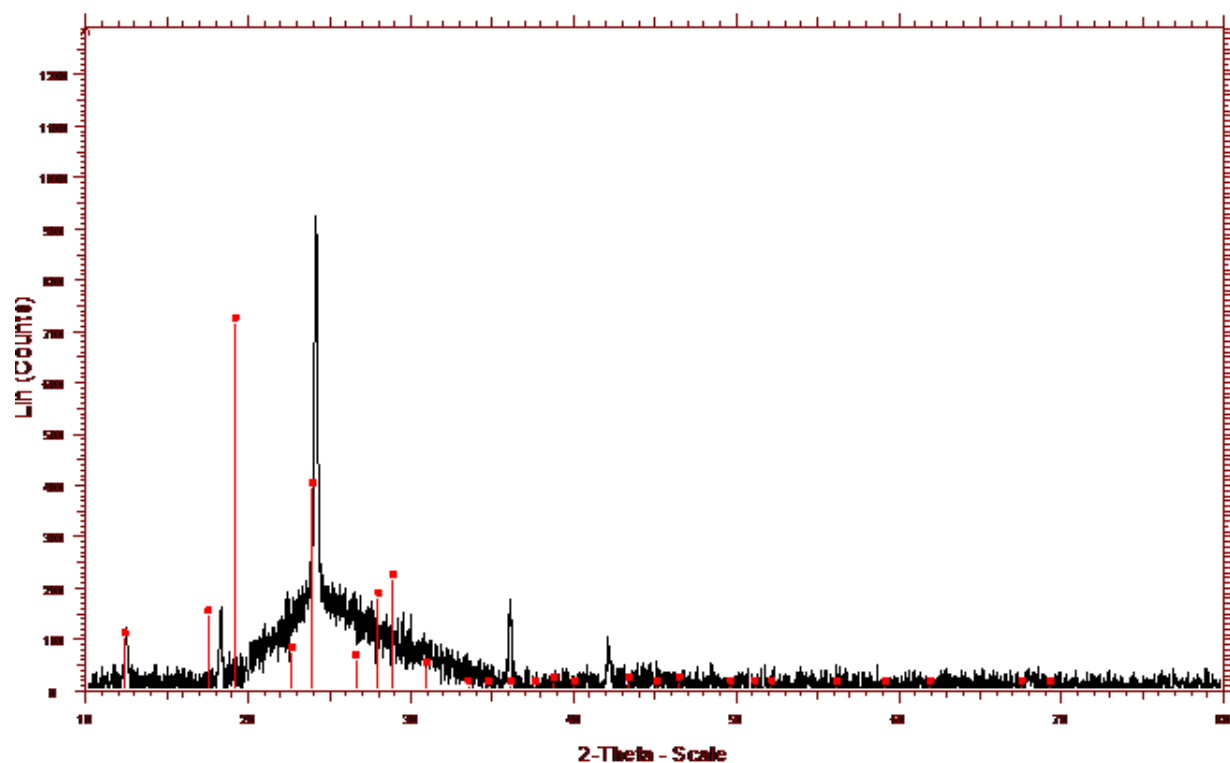
$$L = k\lambda/\beta_0 \cos\theta$$

Where  $\lambda$  is the x-ray wave length (1.540 Å),  $\beta_0$  is the full width at half maximum (FWHM) of the most intense peak in radiations,  $\theta$  is the Bragg's angle and ks is the Scherrer's constant = 0.9.

The mean crystalline size was calculated to be about 80 nano metre which is the best estimated image obtained from FESEM images.

$$\alpha = 76.62, \beta = 88.74, \gamma = 63.85, z=2.$$

$$\text{Molecular weight} = 278.35, \text{volume(CD)}=637.78, D_x=1.449.$$



General		Comments		Authors		Additional		Subfiles	
Cell Parameters					Crystal Data				
Latt.:		Anorthic (triclinic)			Molecular weight :		278.35		
S.G. :		P-1 (2)			Volume [CD] :		637.78		
a:	6.316	alpha:	76.62		Dx :		1.449		
b:	7.788	beta:	88.74		Dm :				
c:	14.91	gamma:	63.85		I/Icor:				
a/b:	0.81099	Z:	2						
c/b:	1.91448								



2th	I	h	k	l	Comments
6.003	65	0	0	1	
12.232	14	0	0	2	
17.443	20	1	0	1	
19.067	100	-1	0	2	Strongest line.
22.526	10	1	1	3	
23.810	55	1	2	0	
26.539	8	1	-1	1	
27.902	25	-1	1	3	
28.823	30	2	1	1	
30.862	6	2	2	0	
33.498	1	-1	0	5	
34.715	1	-2	-2	2	
36.101	1	1	3	3	
37.588	1	2	1	4	
38.766	2	1	1	6	
40.022	1	1	2	6	
43.385	2	3	2	1	
45.092	1	2	3	5	
46.459	2	3	2	3	
49.642	1	-2	2	1	
51.161	1	1	1	8	
52.166	1	2	-2	1	
56.178	1	0	-4	1	
59.179	1	-1	3	7	
61.936	1	-2	3	3	
67.583	1	-1	2	10	
69.348	1	0	5	0	

#### 4. CONCLUSION

FESEM images and XRD micrographs were studied to investigate the morphology of the samples. THE XRD micrograph indicates the configuration of pentacene with the (102) plane as preferred orientation . FESEM image shows the shape and size of the particles.

#### 5. REFERENCE

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