EVIDENCE OF NANOSTRUCTURE IN MULTILAYER CdSe THIN FILMS

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"The Lord is my strength and my shield; my heart trusts in HIM, and I am helped. My heart leaps for joy and I will give thanks to HIM in song".

Psalms 28:7
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CONTENTS

ACKNOWLEDGMENT

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

ABSTRAK

CHAPTER ONE: INTRODUCTION

1.1 Introduction

1.2 Objective of the present work

CHAPTER TWO:

BACKGROUND THEORY AND LITERATURE REVIEW

2.1 Introduction

2.2 Deposition techniques of thin films

2.3 Growth of vacuum-deposited thin films

2.3.1 Factors affecting film growth

2.4 Diffraction of x-rays

2.4.1 Determination of crystal size

2.4.2 Stress formation

2.4.3 Crystallographic form

2.4.4 Crystal structure

2.5 Optical properties of CdSe
2.5.1 Transmission and reflectance at normal incidence

2.5.2 Characteristic energies

2.6 Nanostructured materials

2.6.1 Density of states

2.6.2 Electron states of an ideal nanocrystal

2.7 Review on CdSe thin films

2.7.1 Structural properties

2.7.2 Band structure and optical properties

2.7.3 Dielectric constant and refractive index

2.7.4 Absorption processes

2.7.5 Lattice absorption

2.7.6 Nanostructure study on CdSe nanocrystallites

2.7.7 Band structure of CdSe quantum crystallites

2.7.8 Broadening of absorption spectra

CHAPTER THREE: EXPERIMENTAL TECHNIQUES

3.1 Introduction

3.2 Dual source evaporation system for physical vapour deposition method

3.3 Sample preparation

3.4 X-ray diffraction

3.5 SEM and EDX

3.6 Image processor

3.7 Tolansky technique

3.8 Transmission spectroscopy
### CHAPTER FOUR:

**THIN FILM PREPARATION AND STRUCTURAL STUDIES**

- 4.1 Introduction ........................................... 66
- 4.2 Thin film preparation ..................................... 66
- 4.3 Structural analysis ....................................... 68
- 4.4 SEM and image analyzer ................................... 69
- 4.5 EDX microprobe analysis .................................. 77
- 4.6 X-ray diffraction ......................................... 84
- 4.7 Discussion on structural analysis ......................... 91

### CHAPTER FIVE: OPTICAL STUDIES

- 5.1 Introduction ............................................. 95
- 5.2 Optical transmission ...................................... 96
- 5.3 Measurement of thickness of samples ................. 98
  - 5.3.1 Correction for order number m .................... 99
  - 5.3.2 Thickness using Tolansky technique ............. 101
- 5.4 Dispersion of refractive index ......................... 104
- 5.5 Single oscillator model and characteristic energies 106
- 5.6 Determination of band gap energy ..................... 110
- 5.7 Quantum size effects .................................. 115
- 5.8 Determination of effective mass of the polycrystalline CdSe film 118
- 5.9 Discussion on optical properties ...................... 121
- 5.10 General discussion ................................... 125
CHAPTER SIX:

CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK ----- 129

6.1 Conclusions -----129

6.2 Suggestions for further work -----131

LIST OF PAPERS PRESENTED FROM THIS WORK ----- 132

REFERENCES: ----- 133
LIST OF TABLES

Table 2.1: ASTM X-Ray powder data file for single crystal CdSe
(a) hexagonal structure
(b) cubic structure

Table 4.1: Thickness of each layer in the CdSe multilayer films

Table 4.2: Physical parameters used in sample preparation

Table 4.3: The result of sample S4-6 using the image analyser

Table 4.4: EDX output showing percentage of elements present in each sample

Table 4.5: Comparison of relative proportions of Cadmium and Selenium

Table 4.6: 20 values from XRD, the lattice constant d, elastic strain e and stress S for the multilayer CdSe thin films

Table 4.7: Peak position of <111> planes, lattice constant d, grain size Dg and percentage of crystallinity for CdSe multilayer thin films derived from x-ray diffractograms

Table 5.1: Values used in the determination of order number and thickness for sample S4-6

Table 5.2: Thickness of samples using envelope method and Tolansky technique

Table 5.3: Thickness of samples by Tolansky method and corrected for envelope method

Table 5.4: Oscillator strength Eo, dispersion energy Ed, plasma energy Ep, and number of valence electrons Nv, of some of the CdSe samples.

Table 5.5: Fundamental band gap Eg, the deviation from the bulk CdSe Eg value ΔEg and the spin-orbit split-off band gap energy Δo of some CdSe samples

Table 5.6: Ds from the first derivative of absorption co-efficient and Dx from X-ray diffraction.
LIST OF FIGURES

Figure 2.1: Complete steps in the formation of a thin film
Figure 2.2: Diffraction of x-ray along the plane of crystal
Figure 2.3: Strain for expanding and contracting d – values
Figure 2.4: Tetrahedral sites for a compound (a) wurtzite (b) zinc blende
Figure 2.5: Crystal structures - (a) zinc-blende (b) wurtzite
Figure 2.6: System of an absorbing thin film on a thick finite transparent substrate
Figure 2.7: (a) Transmission spectrum showing envelope method (b) Interference free spectrum
Figure 2.8: The energy characterization dependent of density of states
Figure 2.9: Variation of density of states with reduced dimensionality
Figure 2.10: Brillouin zone of (a) the zinc blende lattice and of (b) the wurtzite lattice
Figure 2.11: Energy band diagram of (a) wurtzite and (b) zinc blende structures of CdSe
Figure 2.12: Dispersion of refractive index $n$ in the region of absorption edge for CdSe where curves 1,2 and 3 are at liquid helium, liquid nitrogen and room temperature respectively and $a$ and $b$ in the figure denotes $E_{el}$ and $E_{lc}$.
Figure 2.13: Allowed optical transitions for direct gap semiconductors for the $E$ versus K plot. (1) Excitation from the valence band to higher-lying conduction bands, (2) excitation across the band gap, (3) exciton formation (4) excitations from imperfections, (5) free-carrier excitation.
Figure 2.14: Transmission spectra of a CdSe layer deposited at $60^\circ$ and after air heating at successively higher temperatures (marked on the figure) for ~ 20 h at each temperature.
Figure 2.15: Linear absorption spectra of CdSe nanocrystals with different mean particle diameters at 10K.
Figure 2.16: Optical density versus photon energy for CdSe-QD samples with different average radius $<R>$ at room temperature.
Figure 2.17: Scheme of band structure for (a) zinc-blende-type and (b) wurtzite-type semiconductors.

Figure 2.18: Absorption spectra of a CdSe-QD sample with $<R> = 2.0$ nm at 1.8 and 300 K respectively.

Figure 3.1: The schematic diagram of the vacuum evaporator

Figure 3.2: Schematic diagram of the vacuum chamber

Figure 3.3: Diffractometer beam path in θ/2θ mode

Figure 3.4: Schematic diagram of scanning electron microscope

Figure 3.5: (a) Schematic diagram of Tolansky technique and (b) fringes as observed in travelling microscope

Figure 3.6: Optical system of JascoV-570

Figure 4.1: Bar chart representing the cluster size distribution with the number of crystallites for typical samples (a) S1-6 (b) S2-5 (c) S3-4 (d) S4-5

Figure 4.2: Histogram of samples (a) S4-6 and (b) S7-5 showing the variation of cluster size with the number of clusters estimated using image analyzer.

Figure 4.3a: SEM micrograph of a typical CdSe sample which is rich in Cadmium.

Figure 4.3b: SEM micrograph of a typical CdSe sample which is rich in Cadmium.

Figure 4.3c: SEM micrograph of a typical CdSe sample which is rich in Cadmium.

Figure 4.4a: SEM micrograph of a typical CdSe thin film which is rich in Selenium.

Figure 4.4b: SEM micrograph of a typical CdSe thin film which is rich in Selenium.

Figure 4.4c: SEM micrograph of a typical CdSe thin film which is rich in Selenium.

Figure 4.5a: SEM micrograph of a typical CdSe thin film which has equal atomic contents of Cadmium and Selenium.

Figure 4.5b: SEM micrograph of a typical CdSe thin film which has equal atomic contents of Cadmium and Selenium.

Figure 4.6: EDX output from computer of some of the CdSe multilayer thin films.
Figure 4.7: XRD diffraction pattern of CdSe thin films, which are more crystalline in nature

Figure 4.8: XRD diffraction pattern of CdSe multilayer thin films, which are less crystalline in nature

Figure 4.9: SEM micrograph and XRD spectrum of samples S3-3

Figure 5.1: Transmission spectra for CdSe thin films with interference fringes (at room temperature)

Figure 5.2: Transmission spectra of samples having no interference fringes in the non-absorption region (at room temperature).

Figure 5.3: Plot of $l/2$ versus $n/\lambda$ to determine the order number and thickness for sample S4-6.

Figure 5.4: Correlation between the thickness of the films using envelope method and Tolansky technique

Figure 5.5: The variation of refractive index with wavelength for some typical CdSe samples

Figure 5.6: Graph showing the Cauchy's relationship for some CdSe samples

Figure 5.7: Plot of $1/(n^2-1)$ versus $E^2$ for some of CdSe samples.

Figure 5.8: Graph showing the plot of $(\alpha E)^2$ versus $E$ to determine the value of $E_g$ by extrapolating the straight line portion along the energy axis

Figure 5.9: The variation of absorption coefficient $\alpha$, as a function of energy

Figure 5.10: First derivative of absorption coefficient $d\alpha/dE$ versus energy $E$, for some of the CdSe samples.

Figure 5.11: $E_g$ versus radius of the crystallite using optical transmission measurements

Figure 5.12: The correlation showing the variation of $E_g$ against $D_o$ and $D_x$

Figure 5.13: (a) Graph showing the variation of energy versus $\frac{1}{D_o^2}$ and

(b) the variation of energy versus $\frac{1}{D_x^2}$
Figure 5.14: (a) Graph showing the variation of percentage of transmission as a function of wavelength and (b) incident photon energy E

Figure 5.15: Variation of $E_g$ with the thickness of samples

Figure 5.16: $E_g$ versus percentage content of Cadmium present in the samples

Figure 5.17: Percentage of crystallinity versus $E_g$ of the films

Figure 5.18: Variation of grain size with the thickness of samples

Figure 5.19: Grain size versus percentage of crystallinity of samples
ABSTRACT

Cadmium Selenide multilayer thin films have been prepared using physical vapour deposition method. Alternate layers of Cadmium and Selenium are deposited on unheated glass substrates. Morphological study of the samples has been done using SEM micrographs with a magnification of 5000. The EDX analysis gives the quantitative atomic percentage content of elements present in the samples. It is found that the high Cadmium content in the samples increased the crystallinity. From XRD measurements, it is evident that many films are polycrystalline in nature with a peak corresponding to <111> plane orientation of the zinc blende structure. The lattice constant of the samples has been determined and it varies from 3.442 to 3.551 Å and the resultant strain varies from -1.9 to 1.2 %. The size of the crystallites has been determined using 'full width at half maximum' values by substituting them in Scherrer's equation. The size of the crystallites varies from 4 to 28 nm. In the optical studies, the absorption coefficients are calculated from the refractive indices of the film. These are differentiated as a function of photon energy and the extrema, which vary between 1.71 to 2.36 eV correspond to the band gap energy of the films. The blue shift in the optical band gaps can be explained using the quantum confinement effect proposed by Brus. Using the magnitude of the shift in energy, the size of the crystallites is calculated to be between 4.4 to 22 nm, which is correlated with the crystallite size determined using x-ray diffraction studies. The transmission spectra have broadened excitonic peaks along the absorption edge. The structural and optical studies give ample evidence for the presence of nanoclusters in the multiplayer CdSe thin films.
ABSTRAK

Lapisan nipis Cadmiun Selenida telah disediakan dengan menggunakan kaedah fizikal enapan wap. Lapisan Cadmium dan Selenium disusun secara berselang-seli di atas substrat kaca yang tidak dipanaskan. Kajian morfologi terhadap sampel-sampel telah dilakukan dengan mikrograf SEM pada pembesaran 5000. Penganalisis EDX memberikan jumlah peratusan kandungan unsur-unsur dalam sampel. Didapati, penghabluran sampel akan meningkat dengan kehadiran Cadmium. Analisis belauan sinar-X menggunakan bahawa kebanyakan lapisan nipis adalah terdiri daripada polihablur dan mempunyai puncak yang sama dengan orientasi satah \( <111> \) struktur zink blende. Nilai pemalar kekisi dikira dan bernilai antara 3.442 hingga 3.551 \( \text{A} \) menghasilkan terikan antara \(-1.9 \text{ hingga 1.2\%}. \) Saiz hablur dapat ditentukan dengan menggunakan kaedah “lebar penuh pada separuh maksimum” (full width at half maximum) dengan memasukkan nilai-nilai tersebut ke dalam persamaan Scherrer. Saiz hablur-hablur adalah di antara dan 4 hingga 28 nm. Nilai pekali penyerapan yang dikira dengan menggunakan indeks biasan ini kemudiannya dikerbedakan sebagai fungsi tenaga foton dengan nilai ekstremum diantara 1.71 dan 2.36 eV yang sepadan dengan nilai tenaga jurung jalur bagi sampel tersebut. Daripada pemerhatian yang dibuat didapati terdapat anjakan biru jurung tenaga bagi sampel yang kaji, dan dapat diterangkan dengan kesan lindungan kuantum sepetimana yang dicadangkan oleh Brus. Magnitud anjakan biru digunakan untuk mengira saiz hablur yang bernilai antara 4.4 ke 22 nm, dan nilai ini dibandingkan dengan saiz kumin hablur yang ditentukan menggunakan belauan sinar-X. Spektrum penghantaran mempunyai puncak

xiv
eksiton lebar pada pinggiran penyerapan. Kajian struktur dan optik telah memberikan cukup bukti terdapatnya kelompok dengan hablur bersaiz nanometer yang mengubah sifat fizik filem nipis multilapisan CdSe.