

**Ain Shams University
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Physics Department**

**STUDY OF SOME OPTICAL AND STRUCTURAL
PROPERTIES FOR ZINC SULFIDE THIN FILMS**

PREPARED BY SPRAY PYROLYSIS

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Zinc Sulfide Thin Films Prepared by Spray Pyrolysis**

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TABLE OF CONTENTS

Abstract	
Summary	
Chapter I	
Introduction	1
1.1 Material properties.....	1
1.2 Thin solid films deposition technique	2
1.3 Some application zinc sulfide.....	3
Chapter II	
Literature Survey	5
CHAPTER III	
EXPERIMENTAL TECHNIQUE AND MEASUREMENTS	27
3.1 The used technique	27
3.2 Physical aspects of spray pyrolysis	27
3.3 Spray pyrolysis set-up	28
3.4 Substrate cleaning	32
3.5 Solution preparation and film formation.....	33
3.6 Spray pyrolysis deposition parameters.....	35
3.6.1 Substrate temperature and deposition time.....	35
3.6.2 The nozzle distance.....	35
3.6.3 Carrier gas and solution flow rates	35
3.6.4 Impurity incorporation and its concentration.....	36
3.7 Physical measurements	36
3.7.1 Structural Measurements	36
3.7.2 Optical Measurements.....	37
3.7.3 The electrical measurements.....	41
3.7.3.1 The electrical resistivity	41
3.7.3.2 Hall measurements.....	44

CHAPTER IV	46
RESULTS AND DISCUSSION.....	46
4.1 Structural studies	46
4.1.1 Effect of substrate temperature and phase identification	46
4.1.2 Effects of deposition time.....	49
4.1.3 Preferred crystallographic orientation.....	49
4.1.4 Effect of heat treatment	55
4.1.5 The effect of incorporated cadmium	65
4.1.6 Effect of heat treatment on $Zn_{1-x}Cd_xS$ thin films	75
4.2 Optical properties	78
4.2.1 Film Thickness.....	78
4.2.2 Transmission and reflection.....	82
4.2.3 Determination of energy gap	87
4.2.4 Determination of the Optical Constants α , n and k	89
4.3 Electrical properties	100
4.3.1 Film resistivity	100
4.3.1.1 Effect of deposition time.....	100
4.3.1.2 Effect of substrate temperature	100
4.3.1.3 Effect of incorporated cadmium.....	103
4.3.2 Hall coefficient, carrier concentration and their mobilities...	103
4.3.3 Effect of annealing	107
4.3.3.1 Effect of annealing on electrical properties of ZnS ... films.....	107
4.3.4 The effect of annealing on the electrical properties of $Zn_{1-x}Cd_xS$ thin films	109
4.3.5 The activation energy	111
Conclusion	119
References	121
Arabic summary	

LIST OF TABLES

	<i>Page</i>
Table 3.1 The currently used solvents with their surface tension and viscosity values.	33
Table 3.2 The main specifications for UV-3101 PC spectrophotometer.	38
Table 4.1 Data of X-ray diffraction pattern of ZnS.	53
Table 4.2 The values of lattice parameters and grain size at different substrate temperature.	54
Table 4.3 Data of X-ray diffraction pattern of $Zn_{0.9}Cd_{0.1}S$	66
Table 4.4 The optimum concentration (x) of Zn for solar cell application at different preparation techniques for $Zn_xCd_{1-x}S$ thin films.	74
Table 4.5 The thickness of as-deposited pure ZnS films.	81
Table 4.6 The electrical parameters of $Zn_{1-x}Cd_xS$ thin films for different concentration of cadmium (x).	107
Table 4.7 The values of the activation energies corresponding to low and high temperatures ranges in $Zn_{1-x}Cd_xS$ films.	118

LIST OF FIGURES

	<i>Page</i>
Fig. 2.1 Description of the deposition process initiated with increasing substrate temperature.	8
Fig. 3.1 Schematic diagram of the spray process.	28
Fig. 3.2 Schematic diagram of the spray system.	29
Fig. 3.3 Schematic diagrams of some commonly employed nozzles.	30
Fig. 3.4 Schematic diagram of the spectrophotometer.	37
Fig. 3.5 The current-voltage relationship between the metal electrode and film material.	41
Fig. 3.6 Electrical resistivity measuring circuit.	42
Fig. 3.7a Holder for Hall voltage and sheet resistance measurements.	44
Fig. 3.7b The sample between the magnet poles.	44
Fig. 4.1 X-ray diffraction pattern of ZnS films prepared at different substrate temperatures and constant deposition time 40 minutes.	46
Fig. 4.2 Peak profile for ZnS films prepared at different substrate temperatures and constant deposition time 40 minutes.	49
Fig. 4.3 The crystallite size of ZnS films as a function of substrate temperatures.	50
Fig. 4.4 X-ray diffraction pattern of ZnS films prepared at different deposition time and constant substrate temperature 773°K.	51
Fig. 4.5 The crystallite size of ZnS films as a function of deposition time.	52

		Page	1
Fig. 4.6	X-ray diffraction pattern of ZnS films annealed in argon atmosphere at different temperatures for 2h.	55	
Fig. 4.7	X-ray diffraction pattern of ZnS films annealed in argon atmosphere for different times and constant temperature 773°K.	56	
Fig. 4.8	The crystallite size of ZnS films as a function of annealing temperatures in argon atmosphere.	58	
Fig. 4.9	The crystallite size of ZnS films as a function of annealing time in argon atmosphere.	59	
Fig. 4.10	X-ray diffraction pattern of ZnS films annealed in air atmosphere for different times and constant temperature 773°K.	60	
Fig. 4.11	Effect of annealing time in air atmosphere on the intensity and the relative change of the FWHM of the (111) reflection.	61	
Fig. 4.12	X-ray diffraction pattern of ZnS film annealed in hydrogen atmosphere for one hour at temperature 773°K.	63	
Fig. 4.13	X-ray diffraction pattern of $Zn_{1-x}Cd_xS$ films prepared at substrate temperature 723°K for 40min. for different composition (x).	65	
Fig. 4.14	Dependence of the lattice parameter a on the composition of $Zn_{1-x}Cd_xS$ thin films.	68	
Fig. 4.15	Dependence of the lattice parameter c on the composition of $Zn_{1-x}Cd_xS$ thin films.	69	
Fig. 4.16	Variation of axial ratio (c/a) as a function of composition (x) in $Zn_{1-x}Cd_xS$ films.	71	
Fig. 4.17	The hexagonality of $Zn_{1-x}Cd_xS$ films as a function of composition (x).	72	

	<i>Page</i>
Fig. 4.18 X-ray diffraction pattern of $\text{Zn}_{0.25}\text{Cd}_{0.75}\text{S}$ films annealed in argon atmosphere at different temperatures for 3h.	75
Fig. 4.19 X-ray diffraction pattern of $\text{Zn}_{0.25}\text{Cd}_{0.75}\text{S}$ films annealed in argon atmosphere at different times and constant temperature 673°K.	76
Fig. 4.20 X-ray diffraction pattern of $\text{Zn}_{0.25}\text{Cd}_{0.75}\text{S}$ films annealed in air atmosphere at different times and constant temperature 773°K.	78
Fig. 4.21 X-ray diffraction pattern of $\text{Zn}_{0.25}\text{Cd}_{0.75}\text{S}$ films annealed in hydrogen atmosphere for one hour at temperature 773°K.	79
Fig. 4.22 The variation in thickness with deposition time for ZnS films at different substrate temperatures.	80
Fig. 4.23 Transmission and reflection versus wavelength for pure ZnS film and glass substrate.	83
Fig. 4.24 Transmittance and reflectance versus wavelength for pure ZnS films prepared at various substrate temperature.	84
Fig. 4.25 Transmittance and reflectance versus wavelength for $\text{Zn}_{1-x}\text{Cd}_x\text{S}$ films with various compositions.	85
Fig. 4.26 Variation of $(\alpha h\nu)^2$ with photon energy for ZnS films prepared at different substrate temperatures.	87
Fig. 4.27 Variation of $(\alpha h\nu)^2$ with photon energy for $\text{Zn}_{1-x}\text{Cd}_x\text{S}$ films for different compositions.	89
Fig. 4.28 Energy gap of $\text{Zn}_{1-x}\text{Cd}_x\text{S}$ films as function of composition.	90

	<i>Page</i>
Fig. 4.29 Absorption coefficient versus wavelength for ZnS films prepared at different substrate temperature.	92
Fig. 4.30 Absorption coefficient versus wavelength for $Zn_{1-x}Cd_xS$ films.	93
Fig. 4.31 Refractive index versus wavelength for ZnS films prepared at different substrate temperature.	95
Fig. 4.32 Extinction coefficient versus wavelength for ZnS films prepared at different substrate temperatures.	96
Fig. 4.33 Refractive index versus wavelength for $Zn_{1-x}Cd_xS$ films.	98
Fig. 4.34 Extinction coefficient versus wavelength for $Zn_{1-x}Cd_xS$ thin films.	99
Fig. 4.35 The change in resistivity with the deposition time for ZnS films prepared at constant substrate temperature 748°K.	101
Fig. 4.36 The change in resistivity with the substrate temperature for ZnS films prepared at constant deposition time 20 min.	102
Fig. 4.37 The change in resistivity with cadmium concentration in $Zn_{1-x}Cd_xS$ films prepared at constant substrate temperature 723°K and spray time 50 min.	104
Fig. 4.38 The carrier concentration and their mobility versus Cd concentration in $Zn_{1-x}Cd_xS$ films prepared at constant substrate temperature 773°K and spray time 40 min.	105
Fig. 4.39 The change in resistivity with the annealing time for ZnS films annealed at constant temperature (773°K) in argon, air and hydrogen atmospheres.	108

	<i>Page</i>
Fig. 4.40 The change in resistivity with the annealing temperature for ZnS films annealed at constant time 3h in argon atmosphere.	110
Fig. 4.41 The resistivity variation with cadmium concentration for as-deposited $Zn_{1-x}Cd_xS$ films and annealed at constant temperature 773°K for 2h in air, hydrogen and argon atmospheres.	112
Fig. 4.42 The carrier density versus the Cd concentration for as-deposited $Zn_{1-x}Cd_xS$ films and annealed at constant temperature 773°K for 2h in air, hydrogen and argon atmospheres.	113
Fig. 4.43 The variation in mobility versus cadmium concentration for as-deposited $Zn_{1-x}Cd_xS$ films and annealed at constant temperature 773°K for 2h in air, hydrogen and argon atmospheres.	114
Fig. 4.44 Variation of dark current versus temperature of ZnS thin films for different substrate temperatures.	115
Fig. 4.45 Variation of dark resistance versus temperature of $Zn_{1-x}Cd_xS$ for different compositions.	117

ABSTRACT

Zinc sulfide is a transparent semiconductor with a wide band gap of about 3.6 - 3.7 eV. ZnS thin films are extensively used in industry for various purposes such as filters, photoelectric cells, etc...

In the present work, the spray pyrolysis technique is used which has many advantages over the conventional technique used in thin film preparation. It is simple, easy to construct and operate, needs no vacuum and economic. It allows mass production of large area thin layer coating at low cost.

The purpose of this work is to present a basic study of the spray deposition technique with regard to ZnS coatings, significant variables are the substrate temperature, carrier gas flow rate, the deposition and dopant type and its concentration.

The dependence of structural, electrical and optical properties of pure and incorporated cadmium zinc sulfide thin films deposited on glass substrate will be correlated with the spray parameter.

SUMMARY

In the present work structural, electrical and optical properties of pure and incorporated cadmium zinc sulfide thin films deposited on glass substrate have been investigated.

Zinc sulfide is a semiconductor with a wide band gap of about 3.6-3.7 eV which makes it suitable as transparent material in the visible region. ZnS thin films are extensively used in industry for various purposes such as filters, photoelectric cells, etc.

Zinc sulfide incorporated cadmium to form ternary compounds ($0 \leq x \leq 1$) are of considerable interest, for example, in heterojunction solar cells.

It has been shown that the low efficiency of a CdS / Cu₂S ($y \geq 1.996$ for chalcosite) solar cell might be due to the mismatching of lattice constants and electron affinities of the two components. A detailed model of CdS / Cu₂S solar cell heterojunction has been demonstrated to examine the design limit of this material combination cells. The results indicated that the attainable conversion efficiency of CdS / Cu₂S solar cell is roughly 10%, as compared to a theoretical limit of 16%, if no losses occurred. A similar analysis of a cell using Cd ZnS in place of CdS, yields an attainable efficiency of 15% and a theoretical efficiency of over 26%.

Also, the use of Zn CdS in place of CdS should permit greater open-circuit voltage and short circuit current.

The films were prepared by using a non-conventional preparation technique. It is called spray pyrolysis technique. It permits deposition on either insulating or conducting substrates

with a high degree of control over both the dimensions of the coating and their physical properties.

The use of spray pyrolysis techniques, has many advantages over the conventional techniques used in thin film preparation. It is simple, easy to construct and operation, needs no vacuum and economic. It allows mass production of large area thin layer coatings at low cost.

In the present work, zinc cadmium sulfide thin films are prepared by spraying a solution with any particular composition by mixing a convenient Cd and Zn salt solutions with a right proportion prior to spray. Therefore, no Zn gradient is expected to be along the substrate or perpendicular to it since all the spray droplets, which deposit on the substrate leading to the formation of the alloy films by pyrolytic decomposition have the same Cd : Zn ratio.

The prepared film is controlled by many parameters such as: substrate temperature, deposition time, solution concentration, gas and solution flow rates and doping material. These parameters influence the structural, optical and electrical properties of the prepared ZnS films.

Therefore, much experiments were done to get the proper conditions such as gas and solution flow rates, the distance between the nozzle and substrate and the solution concentration for pure ZnS films which give a homogeneous and good appearance films. These conditions are kept constant all over the work.

A matrix of substrate temperatures ranging from 573-773 K° and spray time ranging from 10-60 minutes was made to obtain pure and incorporated cadmium with different concentration zinc sulfide thin solid Films.