Ain Shams University
University College for Girls
Physics Department

STUDY OF SOME OPTICAL AND STRUCTURAL PROPERTIES FOR ZINC SULFIDE THIN FILMS PREPARED BY SPRAY PYROLYSIS

Presented

By

Amaal Moustafa Gomaa

B.Sc. (1991)

For Partial Fulfillment for Requirements of M.Sc. (Physics)

Supervisors

Prof. Dr.
AIDA EL BIALY
Physics Department
University College for Girls
Ain Shams University

Prof. Dr.
HASSAN HASSAN AFIFY
Prof. of Physics
National Research Centre

Late Dr. MOHAMED ADEL REYAD
Assistant Prof. of Physics
National Research Centre

1997

Thesis For M.Sc. in Physics

Submitted By

AMAAL MOUSTAFA GOMAA

Title Of Thesis

Study of Some Optical and Structural Properties for Zinc Sulfide Thin Films Prepared by Spray Pyrolysis

THESIS ADVISORS	(Signature)
Prof. Dr. AIDA EL BIALY Physics Department University College for Girls Ain Shams University	(A. B. El Bialy)
Prof. Dr. HASSAN HASSAN AFIFY Physics Department National Research Centre	(Hassan H. Afify)
Late Dr. MOHAMED ADEL REYAD Assistant Prof. of Physics National Research Centre	( )

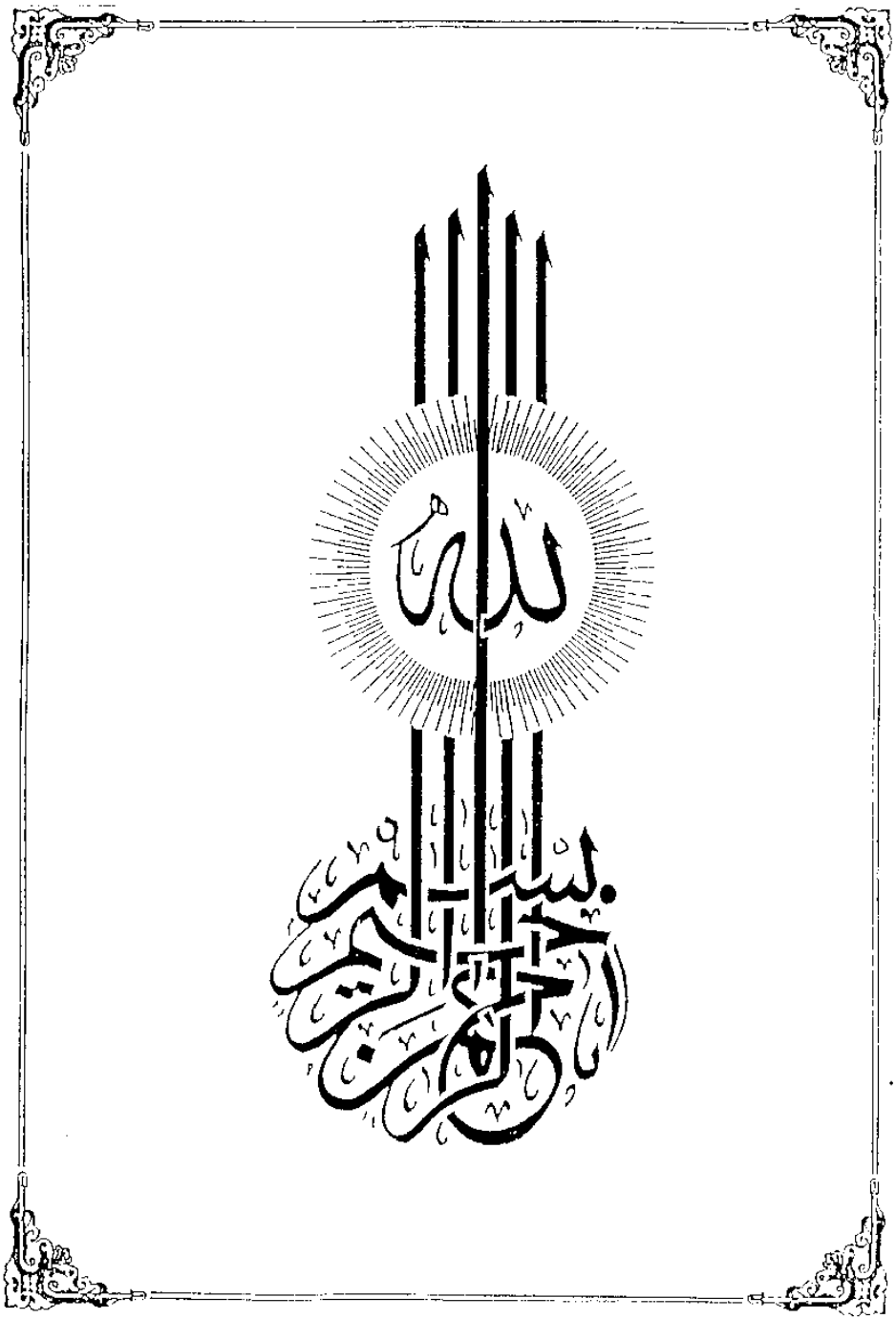
Date of Research : / / 1997

Approval Stamp :

Approval of Faculty council

Date of Approval : / / 1997

Approval of University Council



ACKNOWLEDGEMENTS

I kneel humbly to GOD thancking HIM for showing me the right path, without His help my efforts would have gone astray.

I wish to express my deep gratitude and thanks to :

1-Prof. Dr. AIDA EL BIALY, Physics Department, University College for Girls, Ain Shams University.

2-Prof. Dr. HASSAN HASSAN AFIFY, Physics Department, National Research Center.

3-Late Dr. MOHAMED ADEL REYAD, Assistant Prof. of Physics National Research Center.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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.

SUMMERY

In the peresent 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 suitables as transparent material in the visible region. ZnS thin films are extensively used in industry for various proposes such as filters, photoelectric cells, etc.

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

It has been shown that the low efficiency of a CdS / Cu_yS ($y \geq 1.996$ 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 / Cu_2S 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 / Cu_2S solar cell is roughly 10%, as compared to a theoritical limit of 16%, if no losses occured. A similar analysis of a cell using Cd ZnS inplace of CdS, yields an attainable efficiency of 15% and a theoretical efficieny 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 permit 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 appearence films. These conditions are kept constant all over the work.

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