# ELECTROLUMINESCENT EFFECT OF ZINC SULPHIDE IN EPOXY RESIN



by

#### MALEE BANCHUNE

B.Sc. (Hons.), Chulalongkorn University, 1962.

006961

Thesis

Submitted In partial fulfillment of the requirements for the Degree of Master of Science

in

The Chulalongkorn University Graduate School
Department of Physics

May, 1966

(B.E. 2509)

Accepted by the Graduate School, Chulalongkorn University in partial fulfillment of the requirements for the Degree of Master of Science.

	ean of the Graduate School
Thesis Committee	itanyaratane Chairman
Inhungayo.	Gazujanjin Berananda
Pailon	Berananda
O. 1:	
Thesis Supervisor. Philippys.  Date. 28 April 1966	L'amonjo
Date 28 April 19.66	······



#### ABSTRACT

The construction of electroluminescent cells using ZnS phosphor mixed with cured epoxy resin in the proportion of 1:1 by volume, was described.

The cells constructed were applied with A.C. voltage of which frequencies lay between 60 to 20,000 cycles per second. It was found that the light emitted by the cells were blue-green and the intensity increased as the voltage applied was increased until the electrical breakdown of the cells occurred. It was also found that the light output was a function of frequencies applied. For each constant value of the voltage applied, there was a maximum output at one frequency.

# The same of the sa

#### ACKNOWLEDGMENT

The author wishes to express her deep gratitude to Mr.Bhiyayo Panyarjun, her adviser who suggested this interesting topic and thanks for frequent advice and valuable discussion during the course of the work.

High appreciation is extended to Mr.Paitoon Beranonda and Dr.Bhinyo Chareonkul, the Senior-Lecturers of the Physics Department, Chulalongkorn University for their assistance and interesting discussion.

She is indebted to the staff of Chemistry Department for supplying chemical materials and for preparing the transparent electrodes which are carried out at their laboratory.

She gratefully acknowledge Professor Peng Somanabandhu, Head of the Physics Department, for his interest in this work.

## TABLE OF CONTENTS

	Page
ABSTRACT	iii
ACKNOWLEDGMENT	iv
LIST OF TABLES	vii
LIST OF ILLUSTRATIONS	viii
I INTRODUCTION	1
II THEORY	4
2.1 Luminescence	4
2.2 Excitation and Emission	6
2.3 The Zinc Sulfide Phosphors	11
2.3a. The Principle of Charge Compensation;	
Coactivators	11
2.3b. The Nature of the Luminescence	
· Centers in Impurity-Activated Zinc	
Sulfide Phosphors	13
2.4 Mechanisms of Electroluminescence	15
2.4a. The Gudden-Pohl Effect	15
2.4b. The Destriau Effect	16
2.5 Dependence of Brightness on Voltage	
and Frequency	19
III EXPERIMENTAL EQUIPMENT AND PROCEDURE	21
3.1 Transparent Electroconductive Coatings	
on Glass	21
3.2 Construction of Electroluminescent	
Coll	22

	Page
5.3 Brightness Measurement	23
3.4 Expclimental Procedure	25
IV EXPERIMENTAL RESULT AND DISCUSSIONS	27
4.1 Dependence of Brightness on Frequency	27
4.2 Dependence of Brightness on Voltage	27
4.3 Discussions	27
BIBLIOGRAPHY	57
VTMA	58

### LIST OF TABLES

TABLE		Page
1-1	Materials in which Electroluminescence has	
	been Observed	3
4 - 1	Arbitary Units Brightness Dependence on	
	Frequency of Electroluminescent Cell No. I	29
4 - 2	Arbitary Units Brightness Dependence on	
	Frequency of Electroluminescent Cell No. II	30
4 - 3	Arbitary Units Brightness Dependence on	
	Frequency of Electroluminescent Cell No. III	31
4 - 4	Arbitary Units Brightness Dependence on	
	Frequency of Electroluminescent Cell No.IV	32
4 - 5	Arbitary Units Brightness Dependence on	
	Voltage of Electroluminescent Cell No. I	33
4 - 6	Arbitary Units Brightness Dependence on	
4	Voltage of Electroluminescent Cell No. II	34

# LIST OF ILLUSTRATIONS

Figure		Page
2.1	The Ground State G and an Excited State A of a	
	Luminescence Center	8
2.2	Energy of the Ground State G and of an Excited	
	State A as Function of a Configurational	
	Coordinate q	10
2.3,2.4	Schematic Representation of the Electronic	
	Levels in a Zinc Sulfide Phosphor	14,1
3.1	Schematic View of Electroluminescent Cell	22
3.2	Block Diagram of the Measuring System	23
3.3	The Apparatus	24
4.1	Colour of Electroluminescent Cell Changes	
	with Frequency	28
4.2	Brightness Dependence on Frequency Applied	19
	to Electroluminescent Cell No. I	35
4.3	Brightness Dependence on Frequency Applied	12
	to Electroluminescent Cell No. II	36
4.4	Brightness Dependence on Frequency Applied	
	to Electroluminescent Cell No. III	37
4.5	Brightness Dependence on Frequency Applied	
	to Electroluminescent Cell No. IV	38
4.6a.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No. I at Frequency	
	20.000 c.p.s.	39

Figure		Page
4.66	Brightness Dependence on Voltage Applied to	1000
	Electroluminescent Cell No. I at Frequency	
	5,000 c.p.s	40
4.6c.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No. I at Frequency	
	500 c.p.s	41
4.6d.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No. I at Frequency	
	50 c.p.s	42
4.7a.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No II at Frequency	
	20,000 c.p.s	43
4.7b.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No. II at Frequency	
	5,000 c.p.s	44
4.7c.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No. II at Frequency	
	500 c.p.s	45
4.7d.	Brightness Dependence on Voltage Applied to	
	Electroluminescent Cell No. II at Frequency	
	50 c.p.s	46
4.8a.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
A A	No. I at Frequency 20,000 c.p.s.	47

Figure		Page
4.86.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
	No. I at Frequency 5,000 c.p.s	48
4.8c.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
	No. I at Frequency 500 c.p.s	49
4.8d.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
	No. I at Frequency 50 c.p.s	50
4.9a.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
	No. II at Frequency 20,000 c.p.s	51
4.96.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
	No. II at Frequency 5,000 c.p.s	5.2
4.9c.	Brightness Dependence on the Inverse Square Root	
San I	of Voltage Applied to Electroluminescent Cell	
	No. II at Frequency 500 c.p.s	53
4.9d.	Brightness Dependence on the Inverse Square Root	
	of Voltage Applied to Electroluminescent Cell	
	No. II at Frequency 50 c.p.s	5.4
	[20 - Cold Value (1977) - 10 - 10 - 10 - 10 - 10 - 10 - 10 - 1	