

CONTENTS

S. No		Page No
I	INTRODUCTION	1
1.1	Essentials of solar cells	2
1.2	Role of thin films in solar cells	3
1.3	Applications of metal oxide thin films	5
	1.3.1. Solar cells	
	1.3.2. Electrical conductors	
	1.3.3. Transparent electrical conductors	
	1.3.4. Electrical insulators	
	1.3.5. Optical films	
	1.3.6. Reflector coatings	
	1.3.7. Hard and wear-resistant coatings	
	1.3.8. Electrically active films	
	1.3.9. Magnetic storage media	
	1.3.10. Corrosion protective coatings	
	1.3.11. Solid film lubricants /low friction coatings	
	1.3.12. Free-standing structures	
	1.3.13. Base coating for electroplating	
1.4	General methods for the preparation of thin film	12
	1.4.1. Physical Vapour Deposition (PVD) method	
	1.4.1.1. Thermal evaporation	
	1.4.1.2 Electron beam evaporation (EBE)	
	1.4.1.3. Pulsed laser evaporation	
	1.4.1.4. Molecular Beam Epitaxy (MBE)	
	1.4.1.5. Ion plating	
	1.4.1.6. Sputtering	

1.4.2. Chemical deposition method	
1.4.2.1. Chemical vapour deposition	
1.4.2.2. Spray pyrolysis	
1.4.2.3. Electrolessdepositon	
1.4.2.4. Electrodeposition	
1.4.2.5. Screen printing	
1.4.2.6. Chemical Bath Deposition (CBD)	
1.5 Theoretical aspects of various studies	24
1.5.1. Structural studies	
1.5.2. Optical absorption studies	
1.5.3. Resistivity studies	
1.5.4. Morphological studies	
1.6 General properties of metal oxides	30
1.6.1. Zinc oxide	
1.6.2. Copper oxide	
1.6.3. Tin oxide	
1.6.4. Cobalt oxide	
<i>References</i>	
II LITERATURE SURVEY AND SCOPE OF THE PRESENT INVESTIGATION	36
2.1. Introduction	36
2.2. Earlier Work on ZnO thin film	37
2.3. Earlier Work on Cu ₂ O thin film	48
2.4. Earlier Work on SnO ₂ thin film	54
2.5. Earlier Work on Co ₃ O ₄ thin film	59
2.6. Scope of the present investigation	62
<i>References</i>	

III	EXPERIMENTAL DETAILS	77
3.1	Materials used	77
	3.1.1. Zinc oxide thin film	
	3.1.2. Copper oxide thin film	
	3.1.3. Tin oxide thin film	
	3.1.4. Cobalt oxide thin film	
3.2	Selection of the substrate	78
3.3	Cleaning method	78
3.4	Preparation of zinc oxide, (ZnO) thin film	79
	3.4.1. Effect of substrate contact time on film thickness	
	3.4.2. Effect of pH on film formation	
	3.4.3. Effect of temperature on film formation	
3.5	Preparation of cuprous oxide (Cu ₂ O) thin films	82
	3.5.1. Effect of substrate contact time on film thickness	
	3.5.2. Effect of pH on film formation	
	3.5.3. Effect of temperature on film formation	
3.6	Preparation of tin oxide (SnO ₂) thin films	83
	3.6.1. Effect of substrate contact time on film thickness	
	3.6.2. Effect of pH on film formation	
	3.6.3. Effect of temperature on film formation	
3.7	Preparation of cobalt (III) oxide (Co ₃ O ₄) thin films	85
	3.7.1. Effect of substrate contact time on film thickness	
	3.7.2. Effect of pH on film formation	
	3.7.3. Effect of temperature on film formation	
3.8	Characterization techniques	87
	3.8.1. X-ray diffraction analysis	
	3.8.2. FT- IR studies	
	3.8.3. Scanning electron microscopy studies	
	3.8.4. Thin film thickness measurements	
	3.8.5. Nature of thin films	
	3.8.6. Electrical resistivity measurements	
	3.8.7. Optical Studies	
	3.8.8. Optical band gap studies	

References

IV	RESULTS AND DISCUSSION	106
4.1	Zinc Oxide Thin Film	106
	4.1.1. Mechanism of zinc oxide thin film formation	
	4.1.2. Effect of subtract contact time on film thickness	
	4.1.3. Effect of pH on ZnO thin film formation	
	4.1.4. Effect of temperature on ZnO thin film formation	
	4.1.5. Structural studies	
	4.1.6. FT- IR studies	
	4.1.7. Surface morphology study	
	4.1.8. Nature of ZnO thin film	
	4.1.9. Electrical resistivity measurements	
	4.1.10. Optical studies	
	4.1.11. Optical band gap studies	
4.2	Cuprous Oxide Thin Film	124
	4.2.1. Mechanism of copper oxide thin film formation	
	4.2.2. Effect of subtract contact time on film thickness	
	4.2.3. Effect of pH on Cu ₂ O thin film formation	
	4.2.4. Effect of temperature on Cu ₂ O thin film formation	
	4.2.5. Structural studies	
	4.2.6. FT- IR studies	
	4.2.7. Surface morphology study	
	4.2.8. Nature of Cu ₂ O thin film	
	4.2.9. Electrical resistivity measurements	
	4.2.10. Optical studies	
	4.2.11. Optical band gap studies	
4.3	Tin Oxide Thin Film	139
	4.3.1. Mechanism of SnO ₂ thin film formation	
	4.3.2. Effect of subtract contact time on film thickness	
	4.3.3. Effect of pH on SnO ₂ thin film formation	
	4.3.4. Effect of temperature on SnO ₂ thin film formation	
	4.3.5. Structural studies	
	4.3.6. FT- IR studies	

- 4.3.7. Surface morphology study
- 4.3.8. Nature of SnO₂ thin film
- 4.3.9. Electrical resistivity measurements
- 4.3.10. Optical studies
- 4.3.11. Optical band gap studies

4.4 Cobalt Oxide Thin Film 157

- 4.4.1. Mechanism of Co₃O₄ thin film formation
- 4.4.2. Effect of substrate contact time on film thickness
- 4.4.3. Effect of pH on Co₃O₄ thin film formation
- 4.4.4. Effect of temperature on Co₃O₄ thin film formation
- 4.4.5. Structural studies
- 4.4.6. FT- IR studies
- 4.4.7. Surface morphology study
- 4.4.8. Nature of Co₃O₄ thin film
- 4.4.9. Electrical resistivity measurements
- 4.4.10. Optical studies
- 4.4.11. Optical band gap studies

References

V SUMMERY AND CONCLUSION 178

LIST OF PUBLICATIONS 185