

CONTENTS

<u>SUBJECT</u>	<u>PAGE</u>
ABSTRACT.	
<u>CHAPTER (I) THEORETICAL CONSIDERATIONS.</u>	
INTRODUCTION	1
1.1-FUNDAMENTAL PROCESSES	
OF GAS DISCHARGE	2
1.1.1- GAS PROCESSES	2
1.1.1.1- Ionization Processes	2
a- Electron-Atom Collision	2
b- Electron-Excited Atom Collision	3
c- Positive Ion-Atom Collision	3
d- Photo-Ionization	4
e- Auto-Ionization	4
1.1.1.2- De-Ionization Processes	6
i) Recombination	6
ii) Attachment	6
1.1.2- ELECTRODE PROCESSES	7
1.1.2.1- Incidence of Positive Ions	7
1.1.2.2- Incidence of Metastable and Normal Atoms	7
1.2- THE DC (COLD CATHODE) GLOW	
DISCHARGE	9
1.2.1- I-V CHARACTERISTIC CURVE OF	
THE GAS DISCHARGE	9
1.2.2- THE REGIONS OF THE GLOW DISCHARGE	10

1.2.2.1- The Cathode Fall Region	11
1.2.2.2- The Negative Glow Region	13
1.2.2.3- The Positive Column Region	13
1.2.3- THE EFFECTIVE PARAMETERS ON THE GLOW DISCHARGE	14
1.2.3.1- Effect of The Gas Pressure	15
1.2.3.2- Effect of Electrode Separation	15
1.2.3.3- Effect of The Discharge Current	15
1.2.3.4- Effect of The Gas Used	16
1.2.3.5- Effect of Cathode Material	16
1.3- PLASMA SPUTTERING	17
Introduction	17
1.3.1- Sputtering Techniques in Low Temperature Plasma	17
1.3.2- The DC Glow Discharge Technique (Cathodic Sputtering or Diode Sputtering)	18

CHAPTER (2) A REVIEW OF PREVIOUS WORK..... 19

CHAPTER (3) DIAGNOSTIC TECHNIQUES.

3.1-THEORETICAL BASIS OF SPECTROSCOPIC PLASMA DIAGNOSTIC TECHNIQUES	28
INTRODUCTION	28
3.1.1- Plasma Models	29
3.1.1.1- The Local Thermal Equilibrium (LTE) Model	29
3.1.1.2- The Steady State Corona Model	31
3.1.1.3- The Time Dependent Corona Model	34

3.1.1.4- The Collisional-Radiative (C-R) Model	35
3.2-SPECTROSCOPIC METHODS OF MEASURING	
THE ELECTRON ENERGY	36
Introduction	36
3.2.1- The Ratio of Two Lines Intensities	36
a- If Plasma is in LTE Model	36
b- If Plasma is in Steady-State Corona Model	38
3.2.2- The Ratio of a line to Continuum Intensity	41
3.2.3- The Ratio of Two Parts of Continuum Intensity	41
3.2.4- Determination of the Degree of Ionization	42
3.3- ELECTRICAL PROBE TECHNIQUES	45
Introduction	45
3.3.1- Single Probe Method	46
3.3.2- Double Probe Method	48
3.3.3- Determination of the Electron Temperature	50
3.3.3.1- Single Probe	50
3.3.3.2- Double Probe	50
3.3.4- Determination of the Plasma Density	53
3.3.4.1- Double Probe Method	53
3.3.4.2- Single Probe Method	54
3.4- DETERMINATION OF PLASMA POTENTIAL	56
3.4.1- Floating Probe Method	56
3.4.2- Single Probe Method	56
i- The I-V Characteristic Method	56
ii- Graphical Method	57

<u>SUBJECT</u>	<u>PAGE</u>
iii- The Electron Current Derivative Method	58
3.5- INVESTIGATION OF THE ELECTRON	
ENERGY DISTRIBUTION	60
3.5.1- The Electron Current for Both Maxwellian	
And Non-Maxwellian Distribution	60
i- For Maxwellian Velocity Distribution	60
ii- For Non-Maxwellian Distribution	61
3.5.2- Methods of Determining the Second Derivative	63
3.5.2.1- Graphical Differentiation	64
3.5.2.2- Superposition of An Alternating Potential	65
 <u>CHAPTER (4) EXPERIMENTAL APPARATUS.</u>	
INTRODUCTION	68
4.1- THE DC MAGNETRON SPUTTERING UNIT	68
4.2- THE VACUUM SYSTEM	69
4.3- ELECTRICAL CIRCUIT OF THE SYSTEM	70
4.4- ELECTRIC PROBES AND THEIR	
ELECTRICAL CIRCUITS	70
4.4.1- Single Probe	70
4.4.2- Double Probe	71
4.5- THE MONOCHROMATOR	72
 <u>CHAPTER (5) EXPERIMENTAL RESULTS AND DISCUSSION.</u>	
INTRODUCTION	73
5.1- ELECTRICAL CHARACTERISTICS	
OF THE GLOW DISCHARGE	73

SUBJECT**PAGE**

5.1.1- The Current-Voltage (I_a - V_a) Characteristic Curves of The Glow Discharge	73
5.1.2- Effect of Gas Pressure on Discharge Voltage	74
5.1.3- Potential Distribution Measurements	75
5.1.4- The Electric Field Distribution	76
5.2- ELECTRON ENERGY DISTRIBUTION	
MEASUREMENTS	78
Introduction	78
5.2.1- Cathode Fall And Negative Glow Region	81
5.2.2- Positive Column Region	86
5.3- ELECTRON TEMPERATURE	
MEASUREMENTS	
5.3.1- Single Probe Measurements	87
5.3.1.1- Cathode Fall Region	88
5.3.1.2- Negative Glow Region	88
5.3.1.3- Positive Column Region	89
5.3.2- Double Probe Measurements	90
5.3.2.1- Cathode Fall Region	91
5.3.2.2- Negative Glow Region	92
5.3.2.3- Positive Column Region	92
5.3.3- Electron Temperature Distribution Along the Discharge	95
5.4- PLASMA DENSITY MEASUREMENTS	97
a- Single Probe Method	97
b- Double Probe Method	100
5.4.1- Cathode Fall Region	100

SUBJECT**PAGE**

5.4.2- Negative Glow Region	101
5.4.3- Positive Column Region	102
5.4.4- Electron Density Distribution Along the Discharge	104
5.5- THE SPECTROSCOPIC MEASUREMENTS	105
Introduction	105
5.5.1- The Spectra of The Ar And He-Glow Discharge	106
5.5.2- Electron Temperature Measurements Using Spectroscopic Technique.....	107
5.5.2.1- T_e Assuming The Plasma in "LTE" Model	107
5.5.2.2- T_e Assuming The Plasma in Steady State Corona Model	108
5.5.3- The Degree of Ionization	112
5.5.4- Plasma Modeling	113
GENERAL CONCLUSION	115
REFERENCES .	
ARABIC SUMMARY .	

SUBJECT**PAGE**

5.4.2- Negative Glow Region	101
5.4.3- Positive Column Region	102
5.4.4- Electron Density Distribution Along the Discharge	104
5.5- THE SPECTROSCOPIC MEASUREMENTS	105
Introduction	105
5.5.1- The Spectra of The Ar And He-Glow Discharge	106
5.5.2- Electron Temperature Measurements Using Spectroscopic Technique.....	107
5.5.2.1- T_e Assuming The Plasma in "LTE" Model	107
5.5.2.2- T_e Assuming The Plasma in Steady State Corona Model	108
5.5.3- The Degree of Ionization	112
5.5.4- Plasma Modeling	113
GENERAL CONCLUSION	115
REFERENCES.	
ARABIC SUMMARY.	