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**MODELLING OF SPACE CHARGE EFFECTS  
IN THE ELECTRICAL DISCHARGE  
OF NITROGEN GAS LASER**

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## **ABSTRACT**

A computer model for the simulation of a nitrogen gas discharge has been built and studied. This model was based on the fluid description of the discharge plasma. The Phoenical SHASTA Flux-Corrected Transport (FCT) algorithm is used for the solution of the fluid equations and its accuracy has been tested.

The distribution of the local electrical field was calculated by the Poisson equation. The internal discharge current was calculated by Sato's equation. The motion of the charge particles was taken into account. The electrical discharge behavior was simulated by the circuit equation and solved using the fourth order Runge-Kutta method (RK-4).

The simulation was conducted for the cases of uniform and non-uniform electrical fields. Some important electrical discharge properties, i.e. the gap voltage, the discharge current and also the dynamic gap resistance have been studied. The theoretical results obtained are in very good agreement with the model of Fitzsimmons.

Results are reported for space and time variations of the electrical field distribution and charged particles densities. The cathode sheath formation due to the space charge effects and its influences on the electrical discharge properties have been studied. The contribution of the ion bombardment as the secondary emission properties has been investigated. Some external parameters affecting the space charge effect such as the gas pressure and spark gap properties have been also studied.

## **ABSTRAK**

Satu model komputer untuk mensimulasikan nyahcas bagi gas nitrogen telah dibina dan dikaji. Model ini adalah berdasarkan sifat bendalir plasma dalam nyahcas. Suatu algoritma bernama Phoenical SHASTA Flux-Corrected Transport (FCT) telah digunakan untuk menyelesaikan persamaan bendalir dan ketepatannya telah diuji dalam kajian ini.

Taburan medan elektrik telah diselesaikan oleh persamaan Poisson. Arus nyahcas dalaman telah dikira oleh persamaan Sato. Pergerakan zarah berasas telah diambil kira kesannya. Ciri nyahcas elektrik juga disimulasikan oleh persamaan litar dan diselesaikan oleh kaedah Runge-Kutta peringkat empat (RK-4).

Kajian terhadap taburan medan elektrik secara seragam dan tidak seragam telah dijalankan. Ciri-ciri nyahcas elektrik seperti voltan nyahcas, arus nyahcas dan juga rintangan dinamik telah dikaji. Keputusan jangkaan secara teori ini telah bersetuju terhadap model Fitzsimmons sebelum ini.

Keputusan variasi terhadap ruangan dan masa bagi taburan medan elektrik dan ketumpatan zarah berasas telah dilaporkan. Pembinaan lapisan katod yang disebabkan oleh kesan cas ruangan serta pengaruhannya terhadap nyahcas elektrik telah dikaji. Sumbangan perlanggaran ion sebagai proses pemancaran sekunder telah dikaji. Beberapa parameter yang menyebabkan kesan cas ruangan seperti tekanan gas dan ciri spark gap juga selesai dikaji.

## **CONTENTS**

<b>ACKNOWLEDGEMENTS</b>	ii
<b>ABSTRACT</b>	iii
<b>ABSTRAK</b>	iv
<b>CONTENTS</b>	v

### **CHAPTER 1 INTRODUCTION**

1.1 Background Of The Study	1
1.2 Objective Of The Research	2
1.3 Outline Of The Report	3

### **CHAPTER 2 LITERATURE REVIEW**

2.1 Introduction	4
2.2 Nitrogen Laser	4
2.3 Fast Electrical Discharge Pumping Method	5
2.3.1 Capacitor Transfer Circuit	6
2.4 Electrical Breakdown In Gaseous Medium	7
2.4.1 Townsend Breakdown Mechanism	8
2.4.2 First And Second Townsend Coefficients	8
2.4.3 Space Charge Effect And Plasma Streamer Formation	9
2.4.4 Cathode Sheath Formation	11
2.5 Modeling The Plasma In The Gas Discharge	12
2.5.1 Plasma With Resistive And Inductive Effects	12
2.5.2 The Resistance Of The Discharge Under Uniform Electrical Discharge	13
2.6 The Fluid Behavior Of The Plasma	14
2.6.1 Continuity Equations In Physics	15
2.6.2 Requirement For Finite-Difference Algorithms	16
2.6.3 The Principles Of Flux-Corrected Transport (FCT) Algorithm	17

2.6.3.1	Introduction	18
2.6.3.2	Positivity And Accuracy	18
2.6.4	The Basic Idea Of Flux-Corrected Transport (FCT)	20
2.6.4.1	The Transport Stage	21
2.6.4.2	The Antidiffusion Stage	22
2.7	Discharge Current Induced By The Motion Of The Charged Particles	25

### **CHAPTER 3                  METHODOLOGY AND NUMERICAL SIMULATION**

3.1	Introduction	30
3.2	Circuit Equations	30
3.2.1	Fourth-Order Runge-Kutta Method (RK-4)	32
3.2.2	Numerical Solution Of The Circuit Equations	32
3.3	The Study Of The Electrical Field	35
3.3.1	Uniform Electrical Field	35
3.3.2	Non-Uniform Electrical Field	35
3.3.3	Poisson Equation	36
3.4	Local Electrical Field Between The Elongated Parallel Plates	36
3.4.1	Simulation Of The Electrical Field Variation	39
3.5	Phoenical LPE SHASTA Flux Corrected Transport	39
3.5.1	Diffusion Coefficients And Low Phase Errors	39
3.5.2	Numerical Solution Of Phoenical LPE SHASTA Flux-Corrected Transport	40
3.6	Townsend Ionization Process In The Discharge Medium	41
3.6.1	Fluid Equations With Source Term	42
3.6.2	Numerical Solution Of The Source Term In The Fluid Equation	43
3.6.3	Boundary Condition Of The Fluid Equation	44
3.6.4	Initial Setting Of The Swarm Parameters	45
3.7	Sato's Equation As The Solution Of The Discharge Current	46
3.8	Numerical Algorithm	46

**CHAPTER 4            RESULTS AND DISCUSSIONS**

4.1 Solution Of The Continuity Equation Using The FCT algorithm	49
4.2 The Fluid Equation With The Source Terms	53
4.3 The Characteristics Of The Electrical Discharge Under Uniform Electrical Field Simulation	55
4.4 The Study Of Non-Uniform Electrical Field	60
4.4.1 The Distribution Of The Charge Carriers And The Local Electrical Field Variation Under The Space Charge Effect	60
4.4.2 The Important Role Of The Ion Bombardment Process As The Secondary Emission Effect In The Breakdown Process	66
4.4.3 The Space Charge Effects And The Electrical Discharge Characteristics	71
4.5 The Influence Of The External Electrical Discharge Circuit	73
4.5.1 The Spark Gap Properties.	73
4.6 The Influence Of Gas Pressure	78

**CHAPTER 5            CONCLUSION**

5.1 Conclusion	81
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**REFERENCES**

83
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