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 berasaskan 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 bercas 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 electrik 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 bercas 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.