Abstract

Glow discharges are used in a large number of applications, and it is one of the most common plasmas used in industry. The most important application of glow discharges is probably in microelectronic industry, and material technology. Studies were conducted on the effect of various parameters such as driving voltage, pressure and interelectrode gap length on the fundamental properties of the glow discharge plasma using the XPDP1 simulation code developed by UC Berkeley. The XPDP1 code is a one-dimensional bounded electrostatic simulation code for parallel-plate capacitively coupled plasma system, with an external coupled circuit which may include R, L, and C elements, as well as AC, DC, and ramped current and voltage sources. The code is employing the Particle-in-Cell (PIC) model for particle kinetics simulation and Monte Carlo collision (MCC) model for particle collisions simulation.

The basic parameters in the simulations were selected based on the system and experimental work by Safaai [3] in Plasma Research Laboratory, University of Malaya. Good agreement with the experimental data was obtained from the simulation. Further investigation of some of the plasma characteristics which were not measured experimentally were also presented. The applications of the simulation model to other types of glow discharge including RF powered discharges were also investigated.

The profiles of various plasma parameters were collected from the simulation result, and the structure and behavior of the glow discharge were clearly identified and

observed. Electron heating mode transition was observed in the case of low pressure (0.5 Torr). The electron energy distribution evolved from Druyvesteyn type to Maxwellian type when the heating mode changed from collisional ohmic heating to collisionless stochastic heating.

Abstrak

Nyahcas berbara telah digunakan dalam pelbagai bidang, dan ia adalah salah satu plasma yang paling biasa diguna dalam industri. Kegunaan yang paling penting bagi nyahcas berbara adalah dalam industri mikroelektronik, dan teknologi bahan. Kajian telah dibuat atas kesan oleh pelbagai parameter seperti voltan, tekanan dan jarak antara dua elecktrod ke atas ciri-ciri dasar plasma nyahcas berbara, dengan menggunakan model XPDP1 yang dikembangkan oleh penyelidik di UC Berkeley. XPDP1 ialah satu model simulasi plasma terbatas elektrod selari satu dimensi, digabung dengan litaran elektrik luar termasuk unsur R, L, dan C, dan dikuasai dengan sumber AC, DC dan punca. Kod simulasi plasma ini menggunakan "Particle-in-Cell (PIC)" model untuk kinetik zarah dan "Monte Carlo collision (MCC)" model untuk simulasi perlanggaran di antara zarah.

Parameter asas dalam simulasi adalah ditentukan berdasarkan sistem and kerja eksperimen dari Safaai [3] di Makmal Penyelidikan Plasma, Universiti Malaya. Kesetujuan yang baik di antara teori dan hasil eksperimen telah didapatkan dari simulasi, dan model simulasi ini melanjutkan penyelidikan ke atas tingkah laku nyahcas berbara dalam pelbagai keadaan.

Pelbagai butir-butir plasma telah dikutip dari hasil simulasi, dan struktur dan tingkah laku nyahcas berbara telah dikenali dan diperhati dengan jelas. Peralihan mod pemanasan elektron diperhati dalam kes tekanan rendah (5 Torr). Taburan tenaga

elektron didapati bertukar dari jenis Druyvesteyn kepada jenis Maxwellian dalam alihan mod pemanasan dari pemanasan ohmic kepada pemanasan stochastic.

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