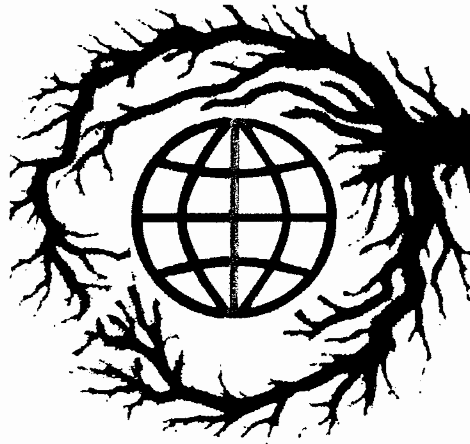
INTERNATIONAL HIGH VOLTAGE WORKSHOP 2000



Newport Beach, California
April 10-12, 2000

Martin Gundersen and Daniel Goebel, Co-Chairs

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Investigation of High Voltage Low Gas Pressure Glow Discharge in Direct-Current (DC) Plasma Immersion Ion Implantation

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We have developed a new direct current (DC) plasma immersion ion implantation (PIII) technique by using a conducting grid (grounded or biased) positioned between the plasma source and sample chuck. In addition to retaining the large area and parallel processing advantages of PIII, the implantation energy and dose uniformity can be improved. The absolute implantation voltage and efficiency can also be enhanced. The main advantage is, however, the reduction of the cost of PIII equipment as the expensive high voltage modulator can be substituted with by a DC power supply. We have investigated DC PIII by particle-in-cell (PIC) simulation and experiments. The biggest problem we have encountered so far is high voltage, low gas pressure glow discharge.

In this work, we investigate the glow discharge process in DC PIII in details. The influence of the high voltage, gas pressure, plasma density, and distance between the grid and target will be discussed. The high voltage, low gas pressure glow discharge process in DC PIII is quite complex, and our objective is to identify the optimal experimental conditions to achieve higher impact energy and ion dose uniformity.

[1] on one-year sabbatical leave as Royal Society Kan Tong Po Visiting Professor in the City University of Hong Kong

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