ICOPS 2000

IEEE Conference Record – Abstracts

The 27th IEEE International Conference on Plasma Science

New Orleans, Louisiana, USA
June 4 – 7, 2000

Sponsored by:
The Plasma Science and Applications Committee
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4P15

Long-Pulse Plasma Immersion Ion Implantation Using a Grounded Conduction Grid

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The use of a grounded conducting grid positioned between the plasma source and sample chuck has been shown theoretically to allow direct current (DC) plasma immersion ion implantation (PIII). In addition to retaining the large area and parallel processing advantages of PIII, the implantation energy monotonicity and dose uniformity can be improved. In this work, we investigate the PIII process with the conducting grid in the long pulse mode, as pure DC PIII has some limitations and is not required in many applications. We experimentally measure the sheath expansion process and plasma stabilization time and determine the optimal instrumental parameters in this mode of operation. For example, our data show that the following conditions: H_2 pressure = 5×10^{-4} Torr, RF power = 1kW, pulse width = 500μs, and frequency = 1kHz can yield good results. We also measure the impact energy and dose distributions, and observe that the power and time efficiency can be substantially improved using long-pulse PIII compared to conventional short-pulse PIII. Our experimental results further indicate that DC plasma implantation is very hopeful.

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

4P16

Plasma Characterization of a Plasma Doping System for Semiconductor Device Fabrication

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Plasma characterization in a plasma doping system for semiconductor ion implantation is carried out. The target to be implanted is placed directly in the plasma and then biased to a negative potential to accelerate the positive ions into the target. A wafer bias of up to -5 kV with BF_3 and N_2 source gases are used to implant boron and nitrogen ions into 200 mm-diameter Silicon wafers. Hiden ion mass and energy analyzer is used to measure the ion species and energies during the plasma doping. Langmuir and emissive probes are used to determine the doping plasma conditions such as plasma density and electron temperature, which are related to the dose. Preliminary Hiden data show that BF^+ and BF_2^+ are the major ion species for the plasma doping.