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3D06

2-D Model Of a Large Area Inductively Coupled, Rectangular Plasma Source for CVD

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2-D MODEL OF A LARGE AREA, INDUCTIVELY COUPLED, RECTANGULAR PLASMA SOURCE FOR CVD*

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A novel design for an inductively coupled, rectangular plasma source is described. The design encompasses several key issues of large area thin film growth by CVD: structural integrity; electrostatic screening; substrate temperature control; and maximal growth surface. A test reactor has been utilized to grow diamond films over ~ 1800 cm² at 13 MHz and ~ 1 Torr pressure with 45 kW coupled power. The design is readily scalable to larger areas. To analyze the axial plasma uniformity, a 2-D simulation model is presented. The electromagnetic coupling, non-equilibrium plasma chemistry, and multi-species diffusion are self-consistently treated. In this 2-D approach, the slotted Faraday screen behaves as a diamagnetic medium in transmitting the magnetic field. Results are compared with experimental data for the hydrogen plasma extent, electron, and gas temperatures. Neutral gas thermal conduction and hydrogen recombination dominate the energy deposition to the wall, and in turn govern the plasma length. A tradeoff between quality and growth area is predicted for the reactor as the pressure is decreased.

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3D07

Particle-in-cell and TAMIX simulation of the hydrogen plasma immersion ion implantation ion-cut process

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Particle-in-cell and TAMIX simulation of the hydrogen plasma immersion ion implantation ion-cut process

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Silicon-on insulator (SOI) is an attractive material compared with bulk silicon substrate for high speed, low power, low voltage complementary metal oxide semiconductor (CMOS) integrated circuits. A bond-cut process, commercially referred to as Smart-Cut™ developed by SOITEC, has provided excellent SOI wafers. One of the critical steps of Smart-Cut is to implant a fairly high dose of hydrogen into the wafer to form a plane along which the wafer can crack. Conventional beam-line ion implantation can be replaced by plasma immersion ion implantation (PIII) to achieve a higher throughput and lower cost. For hydrogen PIII/bond-cut, the co-existence of H^+, H_2^+, and H_3^+ in the plasma tends to spread the implanted hydrogen profile that cracking may not occur uniformly. Hydrogen plasma immersion ion implantation (PIII) into a 200 mm diameter silicon wafer placed on top of a cylindrical stage has been numerically simulated by the particle-in-cell (PIC) method. The plasma consists of three hydrogen species H^+, H_2^+, and H_3^+ in different ratio. The retained dose and sputtering loss are calculated by TAMIX. The highest retained dose is found for the H^+ ion whereas half of the hydrogen atoms are not retained when H_3^+ is implanted. The combined effect of the three species show a maximum non-uniformity in the retained dose of 11.5% along the radial distance. The depth profile is shallower at the edge, but within a 6.375 cm radius, the depth profile is fairly uniform with the difference less than 5%.