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Steady-State Direct-Current Plasma Immersion Ion Implantation Using an Electron Cyclotron Resonance Plasma Source

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Plasma immersion ion implantation (PIII) has been demonstrated to be an excellent technique in many microelectronics applications, e.g. fabrication of silicon-on-insulator (SOI), formation of shallow junctions, etc. However, high-voltage PIII is very difficult because under a high sample bias voltage, the plasma sheath is quite thick thereby requiring a large vacuum chamber. Besides, the power efficiency is very low, and the required high-voltage power modulator is also prohibitively expensive. We have developed a new direct-current (DC) plasma immersion ion implantation (PIII) technique by using a conducting grid positioned between the plasma source and sample chuck. In order to decrease the working gas pressure and increase the plasma density, an electron cyclotron resonance (ECR) plasma source was used in our experiment. In this paper, the experimental parameters and results pertaining to DCPIII using an ECR plasma source will be described. The uniformity of the ion dose and the energy monotonicity will be discussed. Our experimental results indicate that DCPIII is a new and potential technique for many microelectronics applications.

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