[VI-2]

Plasma source ion implantations for shallow p^+/n junction

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Plasma source ion implantation is a new doping technique for the formation of shallow junction with the merits of high dose rate, low-cost and minimal wafer charging damage. In plasma source ion implantation process, the wafer is placed directly in the plasma of the appropriate dopant ions. Negative pulse bias is applied to the wafer, causing the dopant ions to be accelerated toward the wafer and implanted below the surface.

In this work, inductively coupled plasma was generated by anodized Al antenna that was located inside the vacuum chamber. The outside wall of Al chamber was surrounded by Nd-Fe-B permanent magnets to confine the plasma and to enhance the uniformity. Before implantation, the wafer was pre-sputtered using DC bias of 300 V in Ar plasma in order to eliminate the native oxide. After cleaning, B_2H_6 (5 %)/H_2 plasma and negative pulse bias of -1 kV to 5 kV were used to form shallow p^+/n junction at the boron dose of 1×10^{15} to 5×10^{16} #/cm^2. The as-implanted samples were annealed at 900 ℃, 950 ℃ and 1000 ℃ during various annealing time with rapid thermal process. After annealing, the sheet resistance and the junction depth were measured with four point probe and secondary ion mass spectroscopy, respectively. The doping uniformity was also investigated. In addition, the electrical characteristics were measured for Schottky diode with a current-voltage meter.