

Mechanism for phosphorus deactivation in silicon-based Schottky diodes submitted to MW-ECR hydrogen plasma

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Abstract: Current work reveals the deactivation mechanism of phosphorus in silicon-based Schottky diodes. Microwave plasma power (P) was fixed at 650 W to observe the variation in different operational parameters of diodes such as initial phosphorus concentration, flux and hydrogenation temperature (TMWH) and process time (t). The analysis of variation in concentration of phosphorus by hydrogenation has been carried out by capacitance–voltage (C–V) measurements to monitor the doping activation/deactivation. The results clearly show that the atomic species H+H is dominant in the reactors MW-ECR plasma. Therefore, the rates and depth of neutralization were obtained in the low phosphorus-doped silicon sample. The H becomes H⁰ and prefers an interaction with another H⁰ instead of gaining an electron to become a negative ion. The hydrogenation temperature study indicates that the deactivation rate of phosphorus is achieved in a complex manner. Indeed, as the hydrogenation temperature increases, deactivation of phosphorus also increases till saturation at 250 °C. At higher temperature, lower or even no phosphorus–hydrogen complex exists due to their thermal dissociation. The same behavior was confirmed by long hydrogenation.

Keywords : MW-ECR plasma, Hydrogenation, phosphorus deactivation, C–V measurement