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Study of Fork Marks on Sapphire Wafers in Plasma Enhanced Chemical Vapor Deposition Tool

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Abstract : Thin film thickness uniformity is crucial to get consistent film etch rate and device yield across the wafer. In the capacitive-coupled parallel plate PECVD system; the film thickness uniformity can be affected by many factors such as the heater temperature uniformity, the spacing between top and bottom electrode, RF power, pressure, gas flows and etc. In this paper, we studied how the PECVD SiN film thickness uniformity is affected by the substrate electrical conductivity and the RF power coupling efficiency. PECVD SiN film was deposited on 150-mm sapphire wafers in 200-mm Lam Sequel tool, fork marks were observed on the wafers. On the fork marks area SiN film thickness is thinner than that on the non-fork area. The forks are the wafer handler inside the process chamber to move the wafers from one station to another. The sapphire wafers and the ceramic forks both are insulator. The high resistivity of the sapphire wafers and the forks inhibits the RF power coupling efficiency during PECVD deposition, thereby reducing the deposition rate. Comparing between the high frequency and low frequency RF power (HFRF and LFRF respectively), the LFRF power coupling effect on the sapphire wafers is more dominant than the HFRF power on the film thickness. This paper demonstrated that the SiN thickness uniformity on sapphire wafers can be improved by depositing a thin TiW layer on the wafer before the SiN deposition. The TiW layer can be on the wafer surface, bottom or any layer before SiN deposition.

Keywords : PECVD SiN deposition, sapphire wafer, substrate electrical conductivity, RF power coupling, high frequency RF power, low frequency RF power, film deposition rate, thickness uniformity
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