

CsX⁺ CLUSTER METHOD FOR PHOSPHORUS PROFILE MEASUREMENT IN THE POLY Si/SiO₂ SYSTEM

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Phosphorus-doped polysilicon is employed in a wide variety of integrated-circuit applications. It is used for gate-electrodes and interconnections in MOS integrated circuits. For optimizing the fabrication process and the electrical performance of MOS devices, fine control of the phosphorus content in the poly Si/SiO₂ system is important.

Especially, heavily phosphorus-doped poly Si/SiO₂ system requires SIMS technique to investigate the distribution of phosphorus. There are two serious problems for quantitative analysis by SIMS. One is the matrix effect in the poly Si/SiO₂ interface, the other is the reproducibility of measurement of phosphorus content within the poly Si layer by High Mass Resolution(HMR). We have applied both of HMR and CsX⁺ cluster method to determine the phosphorus distribution profile at the poly Si/SiO₂ system. We have found that CsX⁺ cluster method is useful to get phosphorus profile view of the reproducibility in the poly Si layer. Additionally our results reveal that phosphorus is piled up near the poly Si/SiO₂ interface region as precipitation layer by detecting CsX⁺ cluster, which is confirmed by using Transmission Electron Microscopy(TEM). The yield of CsX⁺ is constant in spite of the presence of SiO₂ layer. It means that the matrix effect could be reduced effectively in the SiO₂ layer utilizing the CsX⁺ cluster method. However, the ionization yields of CsSi⁺ and CsP⁺ are found to increase simultaneously in the phosphorus pile up region of the poly Si layer. We ascribe it to the matrix effect associated with the electron affinity difference between phosphorus and oxygen.

References

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