DOSE LOSS AND DIFFUSION IN BF2 IMPLANTED SILICON DURING RAPID THERMAL ANNEAL

Omer Dokumaci[1], Paul Ronsheim[1], and Suri Hegde[1]

[1]IBM SRDC
2070 Rt 52
Hopewell Junction, NY 12533
USA

As the devices are scaled down, shallower junctions are needed to prevent short channel effects in sub-0.1 um devices. We investigated boron diffusion and dose loss after BF2 implantation and rapid thermal anneal (RTA). A layer of screen oxide was grown on silicon with a rapid thermal oxidation (RTO) process. The oxide thickness varied between 15A to 75A. 15A oxide thickness served as a control. BF2 was implanted at energies 5 and 12.5 keV at a dose of 1.5e15 cm^{-2}. The implanted boron dose in silicon varied from approximately 25% to 100% with respect to the initial dose. With these conditions, it was possible to study the boron dose loss as a function of screen oxide thickness and the amount of boron implanted in the oxide. The samples were annealed in an RTA system between 950C and 1050C for various times. Implanted and annealed boron profiles were obtained by SIMS after the screen oxide was etched. After a 1000C anneal, all the samples had dose loss during diffusion. This is unlike arsenic which shows dose gain in some conditions at 1000C. For the 5 keV implant, the dose loss was around 45% for the thinner oxides whereas it dropped to 30% for the 75A of oxide. This shows that dose loss percentage decreases as the amount of implanted boron in the oxide increases. For the high energy implant, the dose loss percentage was around 40%, which is slightly lower than that of the low energy implant. The dose loss does not seem to depend significantly on the energy. Also, for the high energy implant, the oxide thickness does not make a difference in dose loss percentage although the implanted dose in oxide varied between 0% and 30% of the total dose. The results will be further discussed in the light of process simulations taking into account transient enhanced diffusion and dose loss.