Improved Ion Source Stability Using H_2 Co-gas for Fluoride Based Dopants

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Abstract Fluoride based gases are commonly used in the ion implantation. Gases such as GeF_4 and SiF_4 are used as pre-amorphization species and BF_3 is used for high dose BF_2 and ^{11}Boron p-type implants. These can be a productivity challenge for conventional ion implanters used for semi-conductor device applications. As device geometries continuously shrink, there is a trend to deliver higher beam currents at lower energies, with a corresponding reduction in particles and metal contamination.

A major issue is the ion source and extraction electrode discharging which is commonly referred to as glitching. This unintended interruption in the beam transport results in the ion beam sweeping or modulating and is typically associated with an increase of particles transported to the wafer. When this beam instability occurs for an extended period of time, the wafer must be re-implanted in the area which was under dosed. When the instabilities reach an unacceptable level the tool must be removed from production and the source components re

Formation of WF_6 in a high temperature vacuum environment (arc chamber) permits the halogen cycle to promulgate which further shortens source life and stability. Controlling the amount of free F^- can translate into reduced glitching, wafer repaints, improved source life and metal contamination.

II. EXPERIMENTAL

The design of experiments was conducted in two parts using the same tool where a baseline test without the co-gas was performed and after rebuilding the source and electrode the only variable changed was the addition of a previously optimized hydrogen co-gas flow. The GSD 200 E2 was used to conduct the tests using

IV. CONCLUSION

High dose p-type

can be observed, as shown in Figure 3. Even though it can be filtered by the bending magnet it has the tendency to move down the beam line possibly pushed along by the beam or by pressure differentials and it then may deposit onto the wafer as surface contamination. The introduction of the hydrogen reducing co-gas not only stabilizes beam performance (reduced glitching) by the factor of ~50 glitches over hundreds of hours from Test A and B, as shown in Fig. 4 where glitches with co-gas stays fairly stable over a long period of wafer counts. Also, the trace amount of refractory tungsten metal is reduced by a factor of 5 when the co-gas is introduced. Figure 5 Test A shows the interior of arc chamber where the repeller has heavy deposits of tungsten indicating excessive halogen cycle (high formation of WF_6) where Test B with H_2 co-gas shows that the repeller has a slightly eroded surface indication minimal formation of WF_6. Both tests had equal run times with all the same settings except H_2 co-gas.