IMPLANTATION OF N and P TYPE CLUSTER IONS FOR SHALLOW JUNCTION FORMATION

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One of the challenges in forming *ultra-shallow junctions* is the low productivity of conventional implanters at the low energies required. The cause of this low productivity is Child's Law, which states that the maximum extracted beam current follows an $E^{3/2}$ dependence. An attractive solution is the use of cluster ions containing n dopant atoms. With clusters, the beam is extracted at higher energy, thus increasing the maximum current limit. The energy is distributed evenly among the atoms upon impact with the silicon substrate, providing a low energy implant. Cluster ions provide an n^2 enhancement in extracted current compared to monomers.

The SemEquip ion source produces cluster ion beams for all of the traditional dopants. It will be shown that the arsenic tetramer (A_{s4}) and decaborane ($B_{10}H_x$) are particularly attractive for the formation of N and P type shallow junctions. Data will be presented showing equivalent implant profiles for clusters and the associated monomers. It will also be shown that high brightness, low noise and high stability beams of these species are generated. Beams from the SemEquip ion source also allow for more precise control of implant angle and are compatible with production implant systems. Thus, the SemEquip ion source enables the use of ion implantation at the extremely low energies required for *ultra-shallow junction* formation.