N AND P-TYPE CLUSTER FORMATION AND NEGATIVE ION PRODUCTION IN THE SEMEQUIP ION SOURCE

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The problems associated with extracting low-energy ion beams, such as the space charge effects governed by Child's Law, have traditionally been mediated by utilizing molecular ions such as BF_2^+ which allow a higher extraction energy for a given boron projected range. Recent developments[1,2] using large clusters and molecules such as decaborane have been of keen interest to the ion implant community. These large, heavy assemblies of atoms have the added advantage that they, unlike BF_2^+, incorporate multiple boron atoms. This proposed use of clusters is timely, since as devices continue to shrink, and required implantation energies continue to scale with the device dimensions, first boron, and then the n-type dopants such as As and P, are increasingly difficult to transport without a significant reduction in implanted dose rate.

We will present data obtained with a newly-developed electron impact ion source that favors cluster formation. Spectra are presented for both positive and negative ions of decaborane, as well as the n-type clusters of the n-type dopants As and P. We have also demonstrated production worthy beam currents of these clusters. Secondary Ion Mass Spectroscopy of implanted silicon samples has been performed to confirm the atomic content of the clusters, and to characterize the as-implanted depth profiles. We believe that these developments will help ion implantation continue to thrive as the premier doping process as IC manufacturing continues to plunge deeper into the nanoworld.

1. D. Takeuchi,et al. "Shallow junction formation by polyatomic cluster ion implantation", Nucl. Instrum. and Meth. B 121, 345, (1997).
2. D.C. Jacobson et al. "Decaborane, an alternate approach to ultra low energy ion implantation", Ion Implantation Technology-IIT2000 International Conference, Alpbach, Austria, September.