A Multi Techniques Approach to Characterize Ultra Shallow Junctions For sub 45 nm CMOS Devices

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ABSTRACT

In order to achieve the requirements for P+/N junctions for <45nm ITRS nodes, ultra low energy and high dose implantations are needed. Different challenges have then to be faced. Plasma Immersion Ion Implantation (PIII) [1] efficiency is no more to proove for the realization of Ultra Shallow Junctions (USJ) in semiconductor applications: this technique allows getting ultimate shallow profiles (as implanted) due to no lower limitation of energy and high dose rate. But as the junction depth decreases and the ion implanted dose increase new characterization methods need to be developed to achieve real concentration in the first nanometer of the junction.

This paper presents physico-chemical characterizations of junctions realized with B2H6, BF3 or AsH3 PIII as implanted or followed by different annealing processes, with aim to obtain ultra shallow junctions.

In order to fully characterize these junctions, different Dynamical SIMS ([2-5] and figure 1) and TOF SIMS methodologies have been investigated and compared to ARXPS, TEM and Atom Probe experiments.

This full characterization allows evidencing the features that need to be taken into account in order to choose the best and fastest characterization mean. The features pointed out are the high concentration level (above the dilute limit), the etching and oxidation effects, the contamination effect. Moreover it allows to better understand the properties of the shallow junctions investigated.

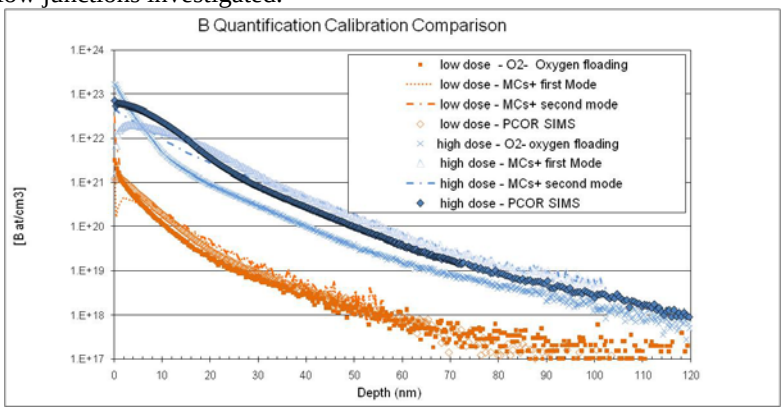

FIGURE 1. Boron PIII implant : D SIMS profile comparison.

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