AN 457

Mapping Capability of Low Energy X-ray Emission Spectrometry (LEXES)

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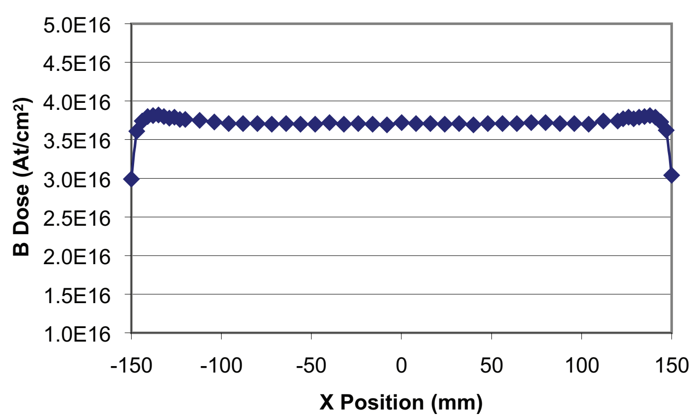
Introduction

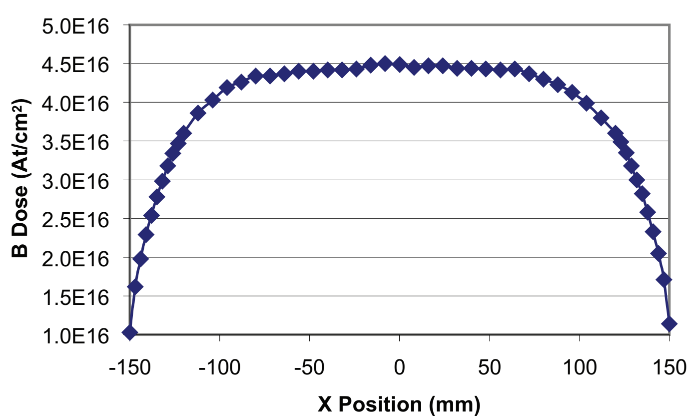
Ion implantation is widely used in the fabrication of electronic devices. One important aspect of implantation is the need to provide a uniform implant across a wafer. Uniformity can be measured using 4-point probe resistivity; however, this requires annealing of the wafer to electrically activate the dopant. As a result the dopant map is a convolution of the ion implant uniformity and the uniformity of the annealing process. In the past, implant dose uniformity of unannealed wafers may have been determined by measuring a handful of locations across the wafer using SIMS. Generally, the wafer needed to be cleaved to make measurements at the locations of interest. LEXES can provide high precision dose measurements at multiple locations (line scans or maps) and can be performed without breaking the wafers.

Discussion

The LEXES technique utilizes an electron beam to probe the wafer. Characteristic x-rays are emitted from the implanted species and are analyzed using wavelength dispersive spectrometers (WDS). The use of these spectrometers provides better sensitivity and energy resolution than energy dispersive spectrometers used in EDS. The measured x-ray intensities are converted to dose (atoms/cm^2) using appropriate standards. Multiple locations can be rapidly analyzed in order to generate line scans or maps across a wafer.

Below are the results of boron line scans across two different 300 mm wafers. In the first case, the relative standard deviation (rsd) of the boron dose is 4%. In the second case, the rsd of the boron dose is 28%. The rsd of the boron doses are 1% and 20%, respectively when the four edge points are not included in the calculation, (radii points at +/-147mm and +/-150mm). Repeated measurements performed at a single location on each sample demonstrate a rsd of ~0.5%.





A boron map has been generated by acquiring 49 points across the wafer measured in case 2.