

GRAZING INCIDENCE X-RAY ABSORPTION APPLIED TO THE CHARACTERISATION OF AS SHALLOW IMPLANTS IN SI

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Grazing Incidence X-ray Fluorescence Analysis (GIXRF) is devoted to elemental analysis and depth profiling of near surface layers and thin films by acquisition of the angular dependence of the X-ray Fluorescence Radiation in the total reflection region and up to a few multiples of the critical angle. When implemented at synchrotron radiation sources the technique can also be exploited for the acquisition of X-ray Absorption spectra. The activation (and deactivation) of arsenic ultra shallow junctions in silicon was studied by means of Extended X-ray Absorption Fine Structure in order to correlate the local structure of the dopant with the electrical activation. Samples were doped with a nominal fluence of $1 \times 10^{15} - 3 \times 10^{15}$ atoms/cm², implanted at 2 keV, and annealed by rapid thermal treatments, laser submelt treatments, and a combination of both. Secondary ion mass spectrometry has been employed to measure the depth profile and the total retained fluences. The percentage of substitutional arsenic has been obtained by least-squares fits of the measured x-ray absorption spectra with simulated spectra of relaxed structures of the defects obtained by density functional theory. A good agreement with Hall effect measured electrically active dose fraction has been obtained and a quantification of the population of the different defects involved has been attempted.