Soft X-Ray Induced Characterization Of Ultra Shallow Junction Depth Profiles and Activation

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ABSTRACT

Soft X-ray induced characterization methods including Grazing Incidence and Grazing Exit X-Ray Fluorescence Analysis (GIXRF and GEXRF respectively) as well as Near Edge X-ray Absorption Fine Structure (NEXAFS) have been adopted to the characterization of ultra shallow junction implantations into silicon.

To determine implantation depth profiles, GIXRF uses the in depth changes of the X-ray standing wave field intensity dependent on the angle between the sample surface and the primary beam [1]. Additionally, implantation depth profiles were derived from GEXRF measurements, where the exit angle of the excited fluorescence radiation was selected with a von Hamos type spectrometer [2].

For the evaluation of the suitability of NEXAFS on the characterization of electrical activation of thermally treated ultra shallow junction implantations, measurements at the boron K-edge have been conducted. The results obtained are in line with sheet resistance measurements.

Arsenic, Boron and Aluminum implanted Si wafers with nominal fluences between $1x10^{14}$ cm^{-2} and $1x10^{16}$ cm^{-2} and implantation energies between 0.5 keV and 50 keV have been used to compare SIMS analysis with synchrotron radiation induced GIXRF and GEXRF analysis in the soft X-Ray range. The GIXRF measurements have been carried out at the laboratory of the Physikalisch-Technische Bundesanstalt at the electron storage ring BESSY II using monochromatized undulator radiation of well-know radiant power and spectral purity [3]. The GEXRF measurements were obtained at the ID21 beamline of the ESRF in Grenoble.

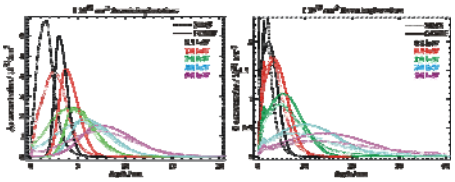

FIGURE 1. Comparison of the As and B depth distributions for implantation energies between 0.2 keV and 5 keV as determined by GIXRF and SIMS.

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