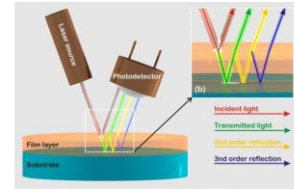
θmetrisis Film Metrology Specialists

ThetaMetrisis APPLICATION NOTE #008

Film Thickness mapping by White Light Reflectance Spectroscopy (WLRS) and FR-Mapper



Goal: The characterization of film thickness uniformity over large areas.

Means & Methods: FR-Basic is combined with FR-Mapper for fast and accurate measurement of film thickness on pre-defined points over large areas. All measurements were performed with an FR-Basic tuned to operate in the 540-1000nm spectral regime while the sample was fixed on an FR-Mapper. The reflection probe had an active spot size of 0.5mm in diameter. The samples were 4inch Si wafers coated with SiO_2 (thermal or TEOS) and Si_3N_4 (LPCVD)/ SiO_2 (thermal). For the reference measurements, a highly reflective Al coated mirror (NT01-913-533, Edmund Optics) was used.

Results: In fig. 1 the scanned area (red) over the Si wafer (blue) is shown. Intentionally, the center of the 6x6cm^2 scanned area is shifted towards the bottom-left corner. In fig. 2a thickness values for TEOS SiO_2 are shown. Film thickness was measured in steps of 2mm in both axes (961 measurements in total). The mean thickness value was calculated to be 635.07nm with standard deviation of 4.24nm. Minimum thickness found to be 623.13nm and maximum thickness 641.35nm. In fig. 2b, the film thickness values for thermally grown SiO_2 (wet oxidation) for the same scanned area are shown. Thickness was measured in steps of 2mm in both axes (961 measurements in total). The mean thickness value was calculated to be 697.29nm with standard deviation of 0.93nm. Minimum thickness found to be 697.22nm and maximum thickness 701.32nm. Film thickness variation is certainly smaller in thermally grown SiO_2 and furthermore film thickness gradient presents a radial symmetry which is not the case for TEOS films. In fig. 3 film thickness values in a Si_3N_4/SiO_2 stack are illustrated.

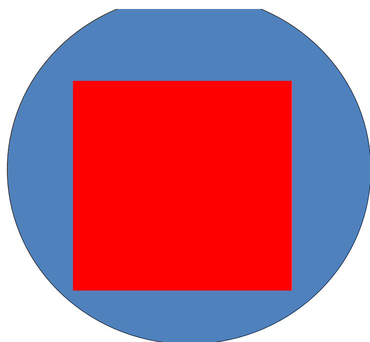
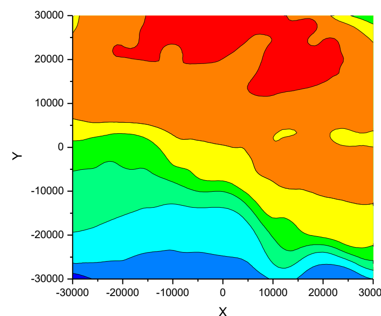


Figure 1: Layout of the area where the film thickness is measured.



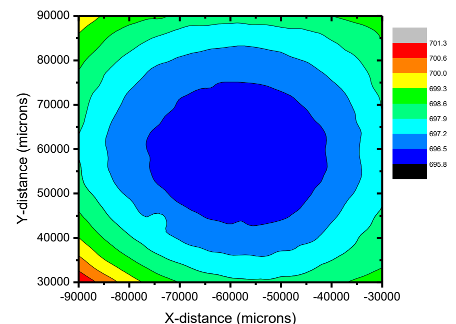
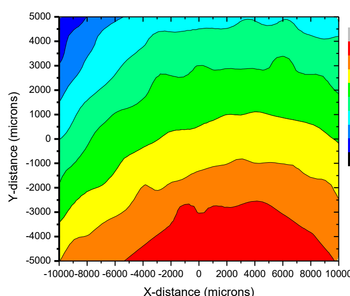


Figure 2: Thickness values of thermally grown silicon dioxide (left) and TEOS deposited (right)



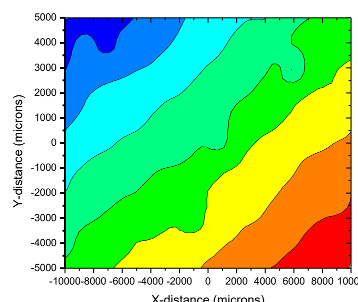


Figure 3: Thicknesses of LPCVD Si_3N_4 (left)/ thermal SiO_2 (right) bilayer on Si.

Conclusions: FR-Mapper is connected to FR-Basic and is successfully in film thickness mapping of single and multi-layers.

For further information please contact us at info@thetametrisis.com or sales@thetametrisis.com
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