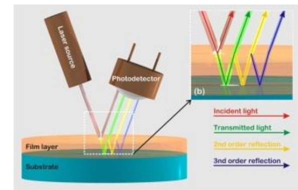
ThetaMetrisis APPLICATION NOTE #024

Fast & Accurate mapping of film coatings on Si wafers



Introduction:

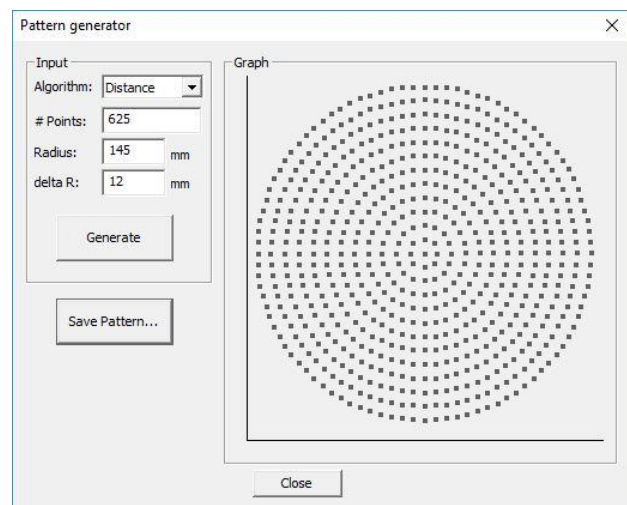
Thickness uniformity and optical characterization (n&k) of thin and thick films across a wafer is a critical parameter during the fabrication of ICs and MEMS. Film deposition control results in high quality patterning and ensures the performance of the devices after the photolithography steps. Apart from the essential need of thin film inspection during the first steps of semiconductor development, it is required in the final stages as well, where Advanced Packaging (a coating is being applied on top of the IC to protect it from physical damage and corrosion) is being performed.

Here, a ThetaMetrisis FR-Scanner was used for thickness mapping of two commercial photoresists deposited on 300mm Si wafers for Advanced Packaging applications.

FR-Scanner is a dedicated tool for the automatic characterization of single or multiple coatings on Si and other substrates with size up to 450mm with benchmarking performance in terms of accuracy and speed.

Means & Methods:

Samples under investigation were 300mm Si wafers, each one coated with different commercial photoresist. The photoresists used were: HD8820 and PW1000T with a BARC coating. All measurements performed using a FR-Scanner tool operating at the **spectral range of 370-1020nm**, able to measure extremely fast and reliably thickness of coatings from **12nm up to 90um**.

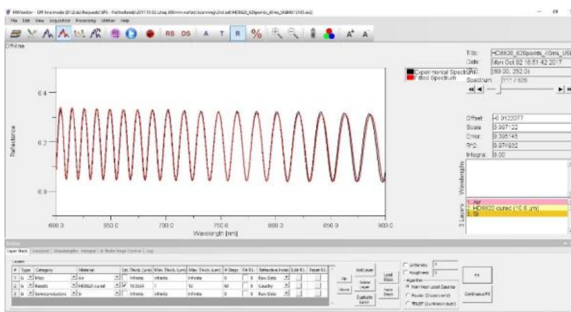


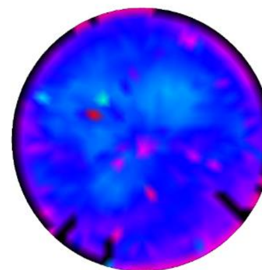
The tool scans the wafers in very high speed by rotating the chuck and by moving linearly the optical head on top (polar scanning) and without bending of the reflection probe which is of paramount importance for accurate measurements. The pattern generated through FR-Monitor included 625points in (R,Θ) positions as shown in the image at the right, and each scan lasted approximately **1min and 30sec** (**to time to accomplish both scanning and thickness measurements**).

Results:

In the images bellow, typical obtained reflectance spectra (black line) and fitted reflectance spectra (red line), as seen on the FR-Monitor software, of all samples on random points, are illustrated along with the mapping profiles of each wafer.

HD8820





Average Thickness =
10.701 um

Standard Deviation =
0.173

Qualified Samples =
551/625 (88.4%)

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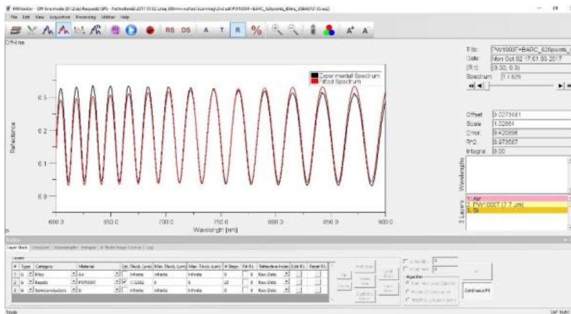
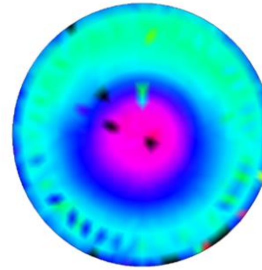
PW1000T + BARC





Average Thickness = **7.243 um**

Standard Deviation = **0.194**

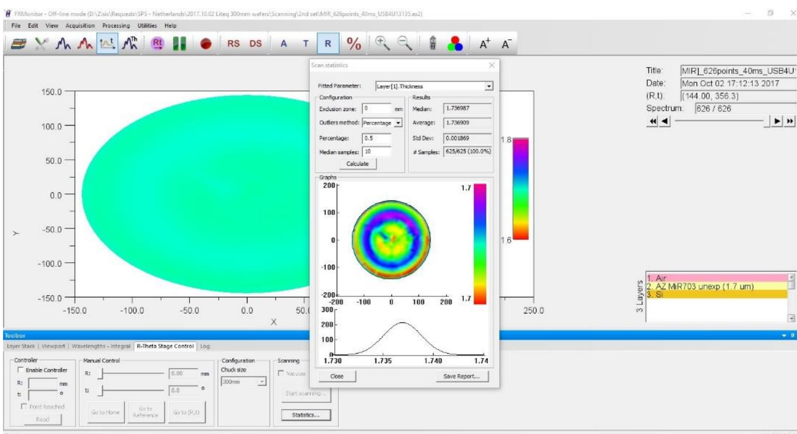
Qualified Samples = **615/625 (98.4%)**

After scanning, a report that includes statistical analysis with various parameters to edit, and thickness mapping imaging can be exported though the software.

For the calculation of the statistics parameters and the representation of the point distribution, some points can be excluded, according the statistics calculation parameters. These excluded points are considered as “extreme” points, which can alter the statistics in the unwanted way, so the user can exclude them. For example, in the mapping profile of photoresist HD8820, 551 of 625 points are included in that range, so the qualified region of the wafer represents the 88.4% of its total area, indicated with color in the 2D graphs. In the mapping profile of PW1000T+BARC, 614 of 625 point are included in that range, so the qualified region of the wafer represents the 98.4% of its total area.

Conclusions:

The thickness of various films coated on 300mm Si wafers was measured using a FR-Scanner. In addition, the films were successfully characterized by means of thickness measurements, thickness mapping over the wafer area and statistical analysis of the thickness uniformity.



Screenshot of the FR-Monitor software

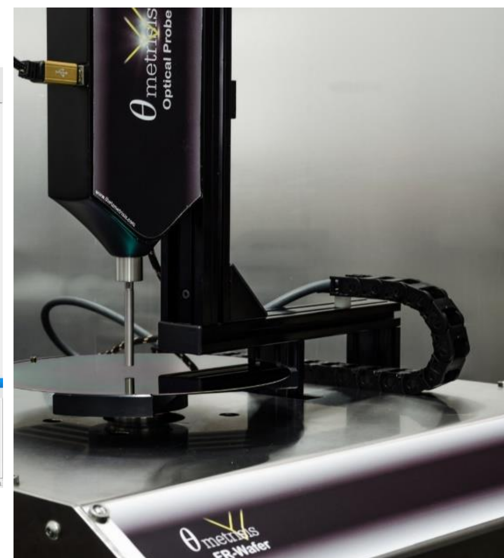


Image of FR-Scanner

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