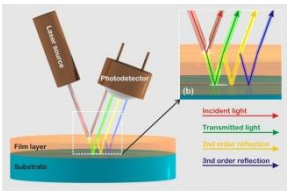
ThetaMetrisis APPLICATION NOTE #039

Fast and accurate determination of photoresist's contrast curves



Introduction: Nano-fabrication using lithographic processes (193nm, EUV, EBL, etc.) involves a wide range of materials, technologies and associated processing steps in order to produce well-defined nano-structures. Photoresist's lithographic contrast curve is one of the most commonly used parameters for process optimization. The contrast curve of a photoresist is the remaining resist film thickness after development as a function of the logarithmically plotted exposure dose [1].

Means and Methods: In this application note, a negative resist has been exposed under various exposure doses with an EBPG-5000+ e-beam tool operating at 100KeV, generating an array of a 100x100µm squares, each one corresponding on different exposure dose. Thickness measurements of the remaining resist film after the development step were measured on each square using the FR-µProbe microspectrometer tool (Figure 1). In the inset image, three different developed photoresist areas can be seen (number on top indicates the exposure dose) and the area of the thickness measurement (black square), which corresponds to 25µm^2.

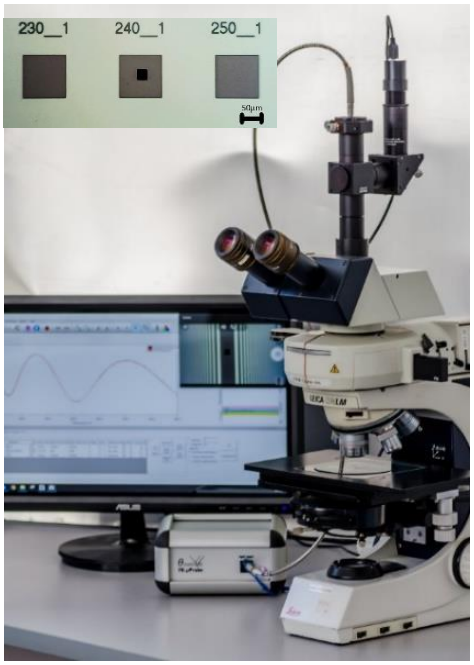


Figure 1. ThetaMetrisis FR-uProbe

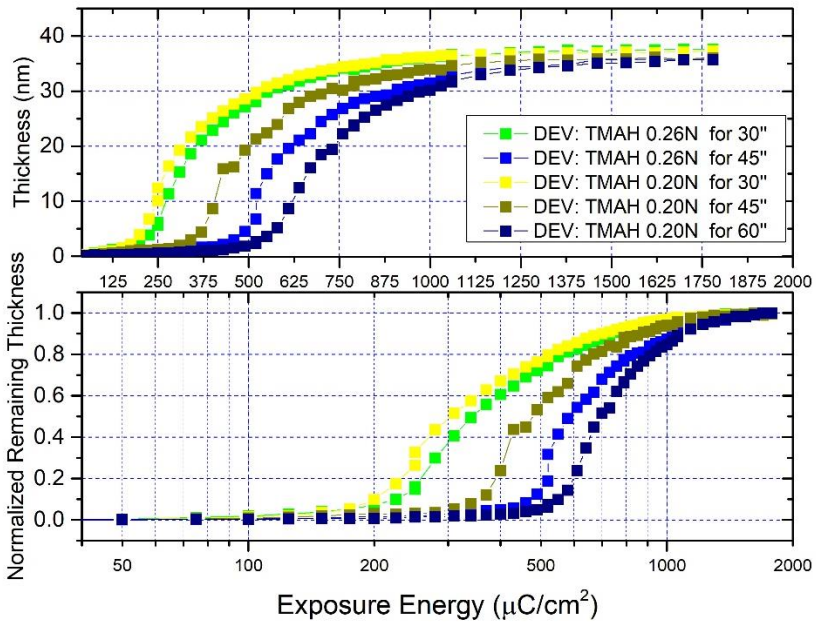


Figure 2. (top) Actual thickness measurements of the thickness of a negative versus exposure energy (linear), **(bottom) c**ontrast curve of the same data.

The obtained thickness values, as seen in **Figure 2 (top)**, plotted against the (logarithmic) exposure dose, **Figure 2 (bottom)**, for five different developers using different concentration of the developer solvent, or/and different developed time. From these data the lithographic contrast is calculated to be employed in simulation tools and to further optimize the lithographic process.

Concussions: ThetaMetrisis' **FR-uProbe** tool is a unique powerful tool for the local measurement of thickness(es) of layers with spot size down to 2µm. Thanks to its modular design can be attached on any trinocular optical microscope enhancing this way the microscope capabilities without any effect on its performance.

[1] R. Fallica, R. Kirchner, Y. Ekinci, and D. Mailly, "Comparative study of resists and lithographic tools using the Lumped Parameter Model," J. Vac. Sci. Technol. B, Nanotechnol. Microelectron. Mater. Process. Meas. Phenom., vol. 34, no. 6, p. 06K702, 2016