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solutions for science

Referenced Spectral Ellipsometry (RSE)

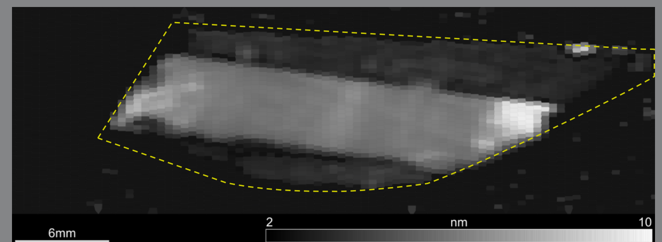
Ellipsometry is a very sensitive optical method which has been used for about a hundred years to derive information about surfaces. It makes use of the fact that the polarization state of light may change when the light beam is reflected from a surface. If the surface is covered by a thin film (or a stack of films), the entire optical system of film & substrate influences the change in polarization. It is therefore possible to deduce information about the film properties, especially the film thickness.

The nanofilm_RSE is a special type of ellipsometer, whereby the sample is compared to a reference. By that, the ellipsometric difference between sample and reference can be measured. Due to the arrangement of the reference, none of the optical components need to be moved or modulated during measurement and the full, high resolution spectrum can be obtained in a single-shot measurement. This way 100 spectral measurements per second are acquired. In combination with a synchronized x-y-stage a large-field film-thickness-map of the sample can be measured within a few minutes.

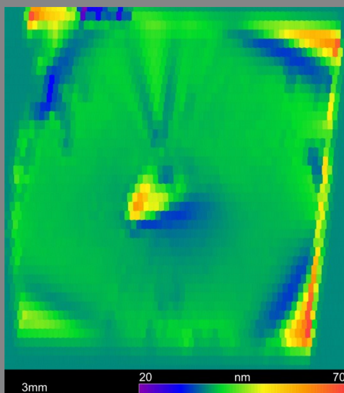
NANOFILM_RSE

A piece of physisorbing plastic foil as shown on the upper sample was removed from the lower one. The foil should be removable without any residues.

The ellipsometric measurement clearly shows the shape of the removed stripe – obviously some invisible residues remained. Problems in deposition processes may occur due to such contaminations.



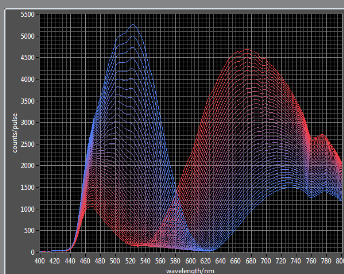
Residues of a physisorbing plastic foil



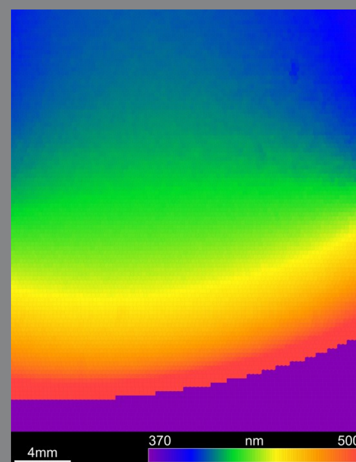
The silicon substrate was coated with polystyrene in a spin-coating-process. The film-thickness-map was acquired within 1:50 min with the nanofilm_RSE.

The graph in the lower left shows the spectral variation due to increasing film-thickness (thin to thick from blue to red).

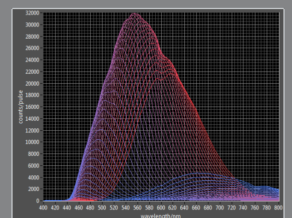
In the lower right a typical fit of the optical model is shown. The blue points show the spectral raw data, the green curve the fit. Live-fitting is possible due to a LUT-implementation.



Spin-coated polystyrene on silicon



Film-thickness-variations of a SiO_2-coated 5"-wafer. The mean 400nm-thickness increases up to 500nm at the border. The measured field of 25x35mm using 8800 spectra was mapped within 5:40min. The second picture shows the spectral variation from low (blue) to high (red) film-thickness.



Film-thickness-map of a SiO_2-coated 4"-wafer

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Technical Specifications

Instrument Type	Referenced Spectral Ellipsometer
Angle of Incidence	Fixed 60° or 70°
Spectral Range	450-900 nm, 1.2 nm resolution
Data Rate	100 full spectra per second, continuous
Spot Size	50x100 µm microspot at AOI=60°
Film-Thickness-Resolution	typ. 0.1 nm
Film-Thickness-Reproducabilty	typ. <0.4 % standard deviation
Light Source	110 mW supercontinuum laser, class 3b, $M^2 = 1.1$
Detector	2048-channel Czerny-Turner spectrometer, 16 bit, 100 Hz
Polarizing Optics	Two high quality Glan-Thompson prisms, motorized, 0.001° resolution
Alignment	Two-axis horizontal alignment of instrument head and two-axis horizontal sample alignment
X-Y-Z-Positioning	Motorized X-Y-Stage with 100 mm range, max. 14 mm/s, motorized Z-positioning in instrument head with 40 mm range
Data Processing	LUT-based data processing for evaluation of optical parameters like film-thickness
Software	Including control software for easy access to motorized components, spectrometer and all measurement parameters; including modeling software
PC	Ready to use PC running on Windows 7 ®, pre-installed control and modelling software,
Power Supply	100-240 V, 50/60 Hz
Environmental Conditions	Operating temperature range: 15-30 °C Humidity: 20-80 %RH

Technical specifications are subject to change without prior notice.

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