Beam Cutter

Imaging Ellipsometry on transparent substrates with beam cutter

Application

In case of measurements on transparent substrates (e.g. glass, mica, etc.) one part of the incident beam is reflected on the top side of the substrate, the other part of the beam is transmitted into the substrate, where it is reflected on the bottom of the substrate. Both reflected beams interfere on the CCD-camera of the ellipsometer if the beam diameter is larger then the substrate thickness.
The beam reflected from the bottom side is laterally perturbed by inhomogeneous domains in the substrate (fig. 2a) and by inhomogeneous optical properties of the bottom side, e.g. roughness and dust. Thus, the image quality of the upper reflected beam is decreased when interference with the bottom reflected beam occurs. For that reason, it is favourable to record the upper reflected beam without interference. The interference causes noise in the spectrum (fig.1a), which makes data fitting and evaluation of the optical properties almost impossible.
The noise decreases the sensitivity of the ellipsometric observables delta and psi on the optical properties (e.g. thickness, refractive index) of a thin film on the substrate.

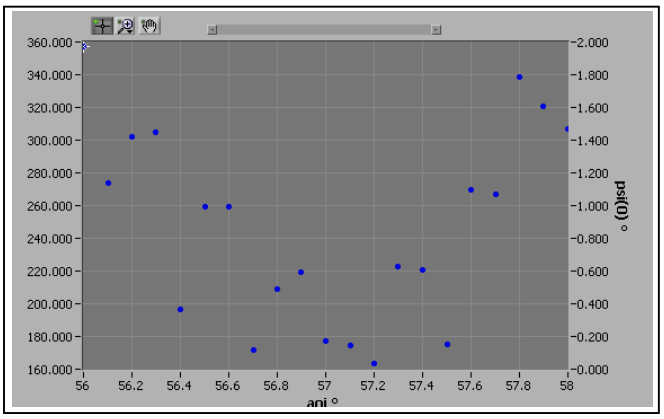

Fig.1a: Psi data from AOI-spectrum **without** beam cutter

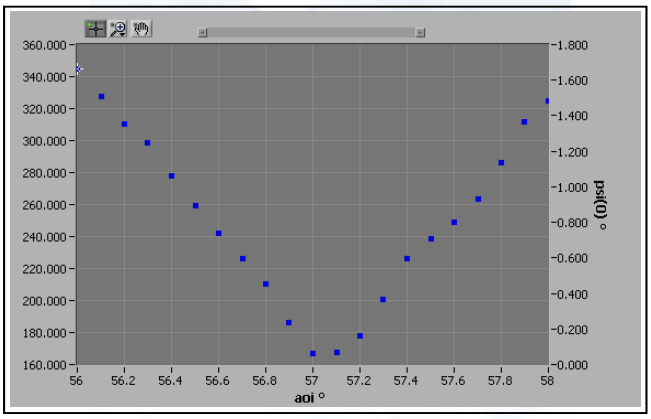

Fig.1b: Psi data from AOI-spectrum **with** beam cutter

Solution:

Nanofilm's beam cutter can be put half into the beam, close before the beam meets the sample, in order to generate a dark area where the bottom side reflected beam is cut off. (lower half of fig. 2b)
The beam cutter should be in parallel to the surface of the sample. The distance from beam cutter to sample ought to be as small as possible, typically 0.1 mm. The region of interest (ROI) over which the delta and psi in averaged should be placed within the shadowed (lower half) area of the image.

Nanofilm Surface Analysis
a division of Halcyonics GmbH
Anna-Vandenhoeck-Ring 5
37081 Goettingen

Tel.:+49(0)551/99960-0
Fax:+49(0)551/99960-10
email: info@nanofilm.de
www.nanofilm.de

Beam Cutter

Example:
Substrate: Mica plate, 0.25 mm thick, flat on top and bottom sides but with domains with varying refractive index in the plate.

Layer:
Thin organic film on top of the mica substrate.

Evaluation:
The ROI (region of interest) is set into the lower half of fig. 2b. Delta/psi are recorded as angle of incidence spectrum. The fit on the spectrum gives in particular film thickness d = 4.0 ± 0.2 nm, refractive index n = 1.48 ± 0.01 of the organic film, and refractive index n = 1.6251 ± 0.0001 of the substrate.
It would be impossible to obtain thickness and refractive index of such a thin organic film on the substrate through a measurement suffering from the interference with the reflection on the bottom side. If the beam cutter is omitted the domain walls of fig. 2a were easily be misunderstood to represent an inhomogeneous film. In fact it is seen in fig. 2b that the film is homogeneous.

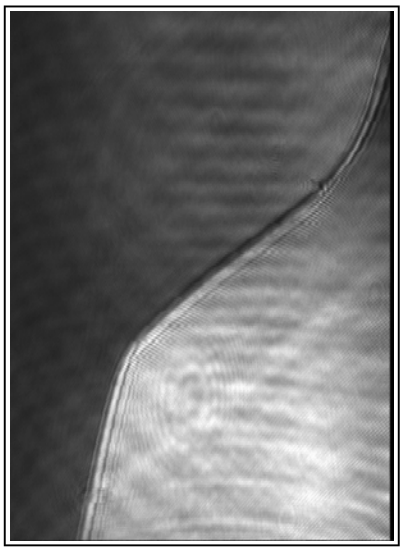

Fig.2a

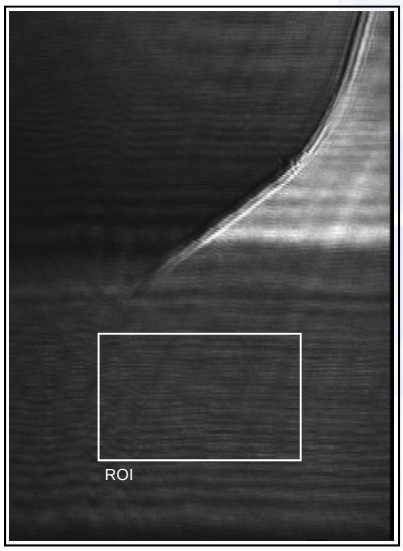

Fig.2b

Fig.2a/b: Organic film on mica plate, ellipsometric contrast image, without beam cutter (fig.2a) a domain wall inside the mica plate or on the bottom side of the mica plate is visible; with beam cutter the lower half of image (fig.2b) does not reflect the domain wall where the upper half still does.

Features:
- precise adjustment in all necesarry room directions
- easy handling
- manually switched into the beam

Nanofilm Surface Analysis
a division of Halcyonics GmbH
Anna-Vandenhoeck-Ring 5
37081 Goettingen
Tel.:+49(0)551/99960-0
Fax:+49(0)551/99960-10
email: info@nanofilm.de
www.nanofilm.de