Ellipsometry Overview

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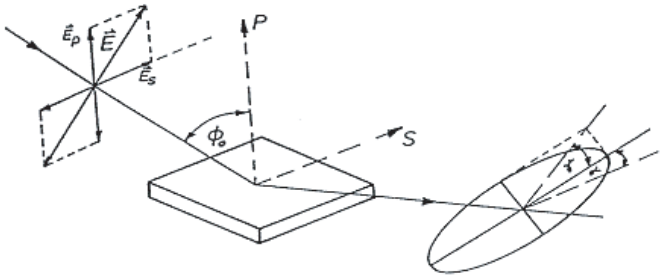
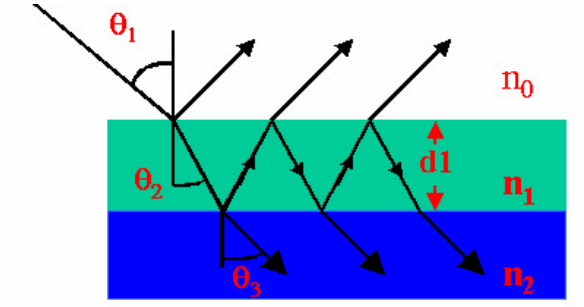
Ellipsometry is a very sensitive measurement technique that uses polarized light to characterize thin films, surfaces, and material microstructure. Usually the polarization of light changes upon reflection. These changes are measured by an ellipsometer and interpreted on the basis of model calculations.



The change in the state of polarization is the direct consequence of interference within the layer system. It is captured by the so called ellipsometric angles Δ and Ψ.



What information can be obtained?

- Thicknesses with an accuracy in the sub-nm range
- Optical constants
- Orientation of molecules
- Mass coverage at surfaces

The data acquisition is sufficiently fast that the kinetics of adsorption processes can be studied. Ellipsometry is a versatile technology that has been used for over a century. The measurements are non-destructive and many sample work, even liquid-liquid interfaces are accessible.

Ellipsometry can be used for a broad range of applications, common research areas are:

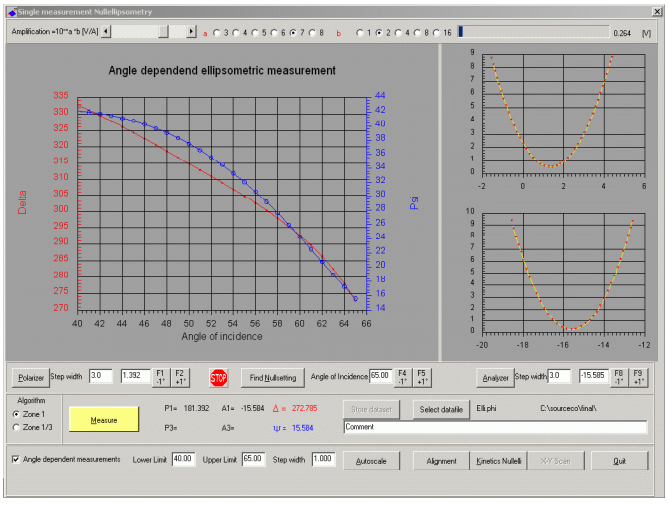
- Assessment of scaling laws
- Ion distribution
- Photochemistry
- Adsorption isotherms
- Adsorption kinetics
- Corrosion
- Characterization of thin films
- Glass transition in confined geometries
- Determination of optical constants
- Swelling experiments

Multiskop - ellipsometry module

The Multiskop performs ellipsometric measurements in a variety of different modes:

- Multi-zone measurements
- Angle dependent ellipsometric reflection scans
- Kinetic runs

The instrument and the software have been designed by scientists who are using these techniques in their own research. This ensures an ergonomic layout of the control and data evaluation software. The user receives an on-line control about all decisive parameters as illustrated in the following screenshot:

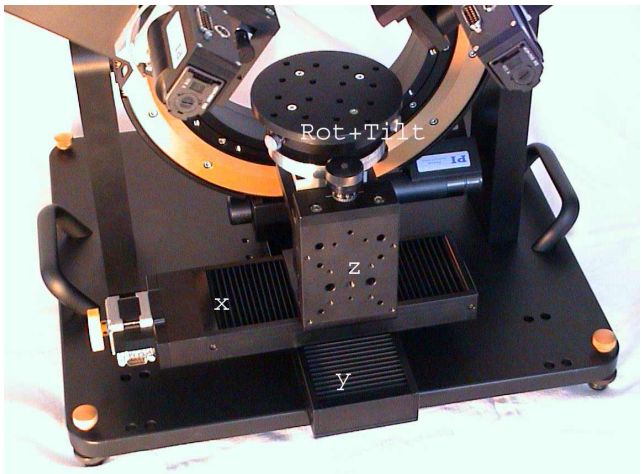


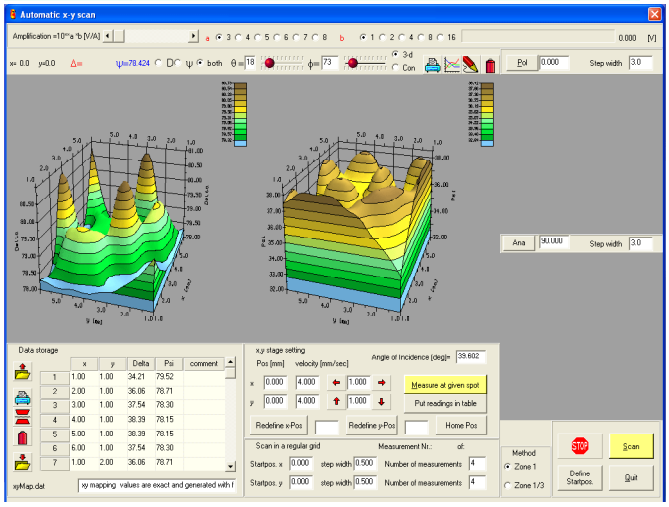
The kinetic mode offers the possibility to record additional experimental parameters which may refer to temperature, surface tension, humidity or pH value. The external parameters are simultaneously recorded with the ellipsometric angles Δ and Ψ.

Accessories

The Multiskop comes with many useful accessories. The following list only some selected items.

Automated x,y sample stage allows to scan big surface area. The analysis yields the topography of the surface.

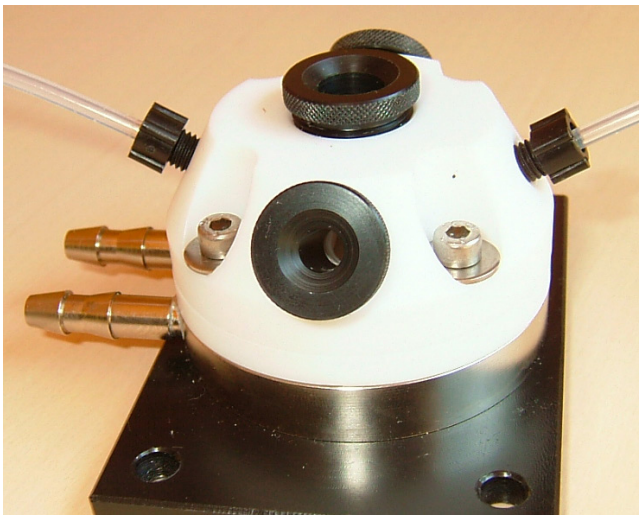




Adsorption cells: The design of a proper cell is not trivial and requires some experience. It is important that the cell windows do not influence the measurement. The following has to be considered:

- The beam should hit the windows at normal incidence because the state of polarization remains then unchanged.
- Birefringence of the cell windows (thermal and mechanical) stress must be avoided.
- Multiple reflection should be avoided.

All these requirements are met by our adsorption cell with windows fixed at a certain angle of incidence. The chamber is made of Teflon. The cell can be hooked up to a thermostat and a peristaltic pump.



Angle dependent measurements are not feasible in this arrangement. An interesting design has been reported in *J. Benjamins, B. Jonsson, K. Thuresson, T. Nylander New Experimental Setup To Use Ellipsometry To Study Liquid-Liquid and Liquid-Solid Interfaces Langmuir 2002, 18, 6437-6444.* The experimental problems have been overcome by fixing tubes on laser and detector-arm of the Multiskop. In this arrangement angle dependent measurements are feasible, the beam remains perpendicular to the cell window. This design is advantageous if the solvent has a low vapour pressure.