



Advanced Metrology for Porous Thin Film Engineering

EP

Thin Film Ellipsometric Porosimeter

SOPRALAB 55 avenue de l'Europe - 92400 COURBEVOIE - France
Phone: +33 1 46 49 67 00 Fax: +33 1 42 42 29 34 Contact: sales@sopralab.com
www.sopralab.com



Fast & non-contact nanoporous thin film qualification

For emerging materials encountered in:

- Semiconductor industry: used as Ultra Low K where sealing, morphology of the porous network, diffusion barrier integrity and integration capabilities are critical
- Optical Coatings: to engineer the sought optical indices and sustain high energy density
- Catalysis: as nanocatalyzing large surface areas
- Membranes: as nanofilters, fuel cell exchangers
- Sensors: based upon functionalization properties

Accessible Datas

- Pore diameter from 0.5 nm to 70 nm
- Open porosity
- Pore size distribution (PSD)
- Surface area
- Diffusion profile and Lateral diffusion coefficients
- Permeability of barrier layers
- Pore killers detection
- Layer optical properties (n,k)
- Thickness variation
- Young's Modulus
- Chemical reactions by extension of spectral range (FTIR)

Unique features

- Porous thin film measurement ranging from 50nm to several μm
- Non contact, non destructive, no sample preparation
- Use of polar or non polar adsorptives (e.g. methanol, toluene, IPA, water...)
- Graded and multilayer porosity
- Automated Mapping on large surfaces (option)
- Local measurement of PSD, sub-millimeter spot size
- Measurement on patterned sample (Visualization option)
- Mechanical information for thin film integration
- Internal contact angle in the pores (surface energy determination in pores)
- Information on plasma damage, decarbonization, clean, repair, ageing



Visualization option

Patented Ellipsometric Porosimetry Technology under IMEC licence

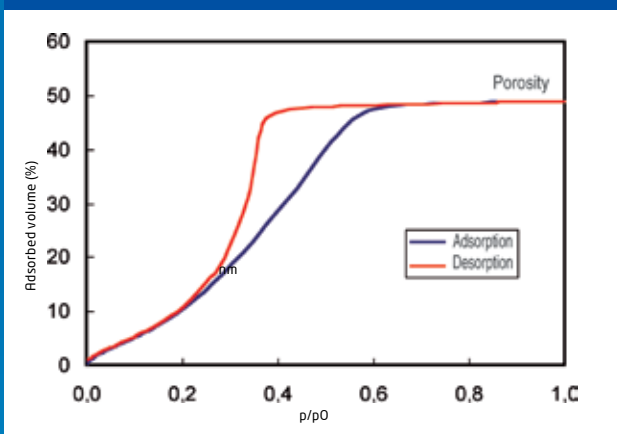
Principle / Applications

SOPRALAB has developed a tool that couples a Spectroscopic Ellipsometric measurement with an adsorption tool. As the Ellipsometric Porosimeter (EP) is inspired by the traditional adsorption setups (BET, BJH apparatus), the true revolution is that the amount adsorbed during the experiment is not obtained by a weighing process or by the measurement of a differential pressure, **but through the change of the optical properties (refractive indices) of the porous material.**

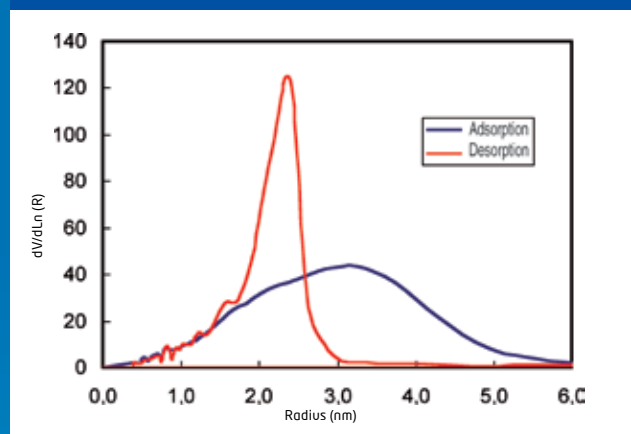


This original measurement device, allows a **non-destructive** and **direct** characterization of thin films in the thickness range of 50 nm to a few micrometers, no matter the substrate used for the deposition; **it does not require any preparation or scratching of the film.** Porosity and **Pore Size Distribution (PSD)** are determined from Adsorption/Desorption isotherms using Kelvin and/or Dubinin-Radushkevitch equations.

Adsorption and Desorption Isotherms

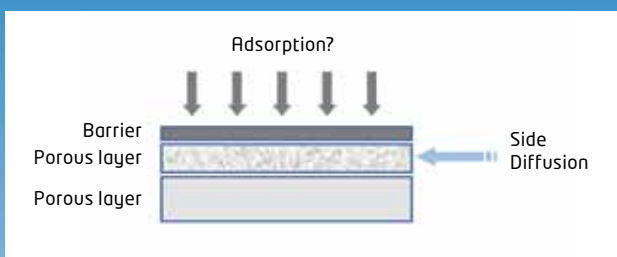


Pore Size Distribution

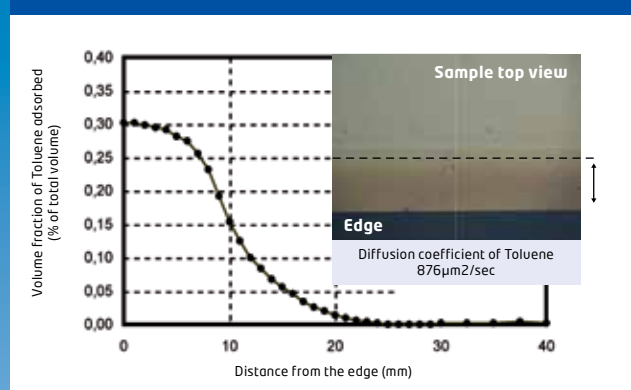


Lateral diffusion phenomenon can be studied for sealed porous thin films (option).

Pore killers and efficiency of sealing layers are determined thanks to a CCD camera on live acquisition during the diffusion experiment (option).



Lateral diffusion



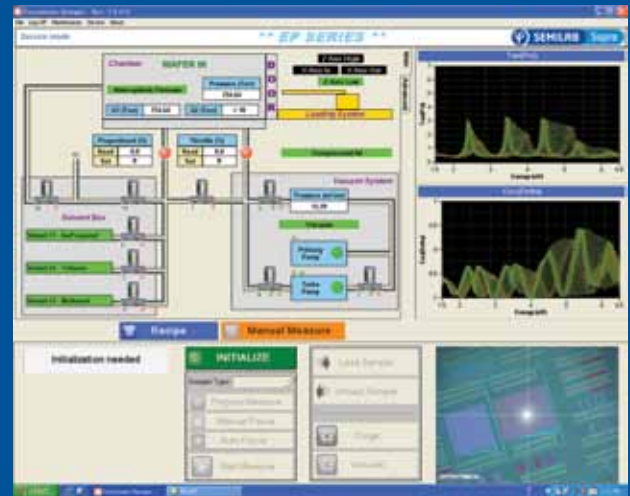
Young's Modulus can be calculated by taking into account the change of thickness due to the capillary forces during the adsorption/desorption sequence. Without damaging the film, one can access a key parameter for porous thin film integration in advanced semiconductor devices.

User Interfaces

SOPRALAB Porosimeter Manager is an easy to use, compact software module that allows the user to perform entire adsorption/desorption measurements at precise points on the sample.

Its features consist of:

- Automatic loading/unloading and positioning of sample (latter by wafer option)
- Standard Spectroscopic Ellipsometric measurements
- Creation of recipe sequences for entire adsorption/desorption process
- Automatic repeatability
- Real time display of ellipsometric values $\tan(\Psi)$ and $\cos(\Delta)$ over the entire spectral range
- Real time images with optional camera acquisition
- Creation of lateral diffusion recipes
- User defined access levels from operator to engineer



Specifications

- Tool probe is qualified using NIST 120 nm SiO_2 traceable sample
- Porosity repeatability: $\pm 1\% 3\sigma$
- Pore size repeatability: ± 0.4 nm on diameter 3σ (for 2nm pores diameter)
- Porous film thickness from 50 nm up to 5 μm (Accuracy on SiO_2 120nm: 0.9 nm)

	EP5	EP12	PS-2500
Pore size detection Spot size Sample configuration Measurement time Adsorptives Facilities	0.5-70 nm (pore diameter) 1.2 x 0.8 mm Single and multi-layers 20 minutes minimum to 1 hour maximum / point on sample IPA (Iso Propanol), Methanol, Toluene and Water... 1286 mm x 1398 mm, 6 bar compressed air, 2000 W max		
Sample size Mapping capabilities Pore killer detection	2 mm to 300 mm No Optional	2 mm to 300 mm Yes (2 mm edge exclusion) Yes	
Wafer loading	Manual loading	Semi-automatic loading	Loader + Open Cassette or FOUF 200/300 mm

Publication

Determination of Pore Size Distribution in thin Films by Ellipsometric Porosimetry
Published in J. Vac. Sci. Technol. B 18(3), May/June 2000 - p. 1385 - M.R. Baklanov et al.

