SENTECH Erfolg durch Leistung

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SE 500adv
Combined Ellipsometry Reflectometry
CER Ellipsometer

Product description

- Unambiguous and fast thickness measurement of transparent films
- Ultra high precision of ellipsometric measurements
- Analysis of complex layer structures

It has never been easier to apply ellipsometry to real-world samples.

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1 General description

The CER ellipsometer is a high performance tool to measure n, k, and thickness of single layers, multiple layers, and bulk material. The combination of reflectometry and ellipsometry is used to analyze thin films at the same measuring spot.

The ultra-high precision of the **SE 500adv** allows the determination of thickness and refractive index of thin films especially of native oxides on wafers.

The CER principle extends the thickness range for transparent layers up to 20 µm (depending on photometer option), resoles ambiguities in the thickness order of transparent films, improves the accuracy of ellipsometric measurements and provides an alternative measurement technique in comparison with multiple wavelength ellipsometers.

The **SE 500adv** can be operated as discrete wavelength ellipsometer, as CER ellipsometer, or as film thickness probe and offers as a result a maximum of flexibility never reachable by standard ellipsometers.

1. Operated as **ellipsometer**

Single and multiple angle measurements can be performed to determine optical parameters and film thickness of up to three layers using one wavelength at 632.8 nm.

2. Operated as **film thickness probe**

The thickness of a transparent or weakly absorbing layer is measured by white light reflection method under normal incidence. The optical parameters of the layer must be known. The software allows the handling of multiple layers stack. The optional available FTPadv Expert software allows the measurement of optical constants of films as well.

3. Operated as **Combined Ellipsometry Reflectometry ellipsometer**

The cyclic thickness period for transparent layers is automatically determined. The accuracy of the refractive index in first cyclic thickness orders is strongly increased (i.e. for thin layers / see our patent). Cauchy coefficients can be determined for transparent layers.

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2 Technical Specifications

Ellipsometer:

wavelength:	632.8 nm HeNe laser (< 1mW)
precision of Ψ, Δ: (defined as standard deviation of 30 measurements at 90° position)	0.002°, 0.02°
long term stability: (measured over 1 hour at 90° position)	$\delta\Psi = \pm 0.01°$ $\delta\Delta = \pm 0.1°$
precision of film thickness:	0.01 nm for 100 nm SiO_2 on Si
precision deviation of refractive index:	5×10^{-4} for 100 nm SiO_2 on Si
total thickness range for transparent layers:	up to 6 µm
total thickness range for weakly absorbing layers (polysilicon):	up to 2 µm
number of layers	default: 1-3 layers on layer stack or substrate
measuring time:	120 ms ….. 1.5 s (depending on measuring mode)
retarder:	highly stabilized retarder, superior precision close to 0° and 180° values of Δ
diameter of laser beam:	1 mm
angle of incidence:	manual goniometer 40° - 90°, set in steps of 5°
sample alignment:	auto collimating telescope (ACT) for sample tilt and height adjustment <u>Option:</u> Auto focus

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sample stage:	fixed (z, tilt) samples stage for wafers up to 150 mm diameter, Options 360° rotation unit, vacuum chuck x-y stages • 50 mm x 50 mm, motorized • 150 mm x 150 mm manual or motorized • 200 mm x 200 mm motorized
set-up and service:	Automatic calibration of the ellipsometer at 90°, service mode including self-test,
maintenance:	Automatic internal maintenance programs for checking the correct working of most parts of the ellipsometer
PC	State of the art HP PC with mouse, keyboard, monitor, LAN, OS Windows 7 Professional, TFT-LCD monitor
software:	SENTECH's user friendly SE400advanced ellipsometer software; Predefined applications (recipes) allow for ease of use: e.g. - dielectric layers on Si - dielectric layers on GaAs - organic layers on Glass - native oxide on Si - native oxide on GaAs Standard Measurement Modes *Single angle of incidence* (at any single angle between 40 and 85 degrees, 5 deg step) • ψ,Δ on any sample • optical constants of bulk material (substrate) n_s,k_s • single films, film thickness at a given refractive index n • single films, film thickness and refractive index n • double layer, two thicknesses, film thickness 1 and film thickness 2 *Multiple angles of incidence* (any set of angles out of 40-85 deg, 5 deg step) • any layer of single or out of multiple layer: absolute film

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thickness at a given refractive index n
- any layer of single or out of multiple layer: film thickness, refractive index n
- any layer of single or out of multiple layer: film Thickness, refractive index n and absorption k

Material library includes:
Dielectrics, weakly absorbing films, crystalline and amorphous Semiconductors, Metals, Organics (polymers, resists), Glass, Quartz and more

Film Thickness Probe:

principle:	White light interference at normal incident,
spectrometer:	Photometer with photodiode array detector
spectral range:	450 nm to 920 nm
measurement time:	Min. 30 ms, typical 300 ms for one spectra (including accumulation of 10 spectra for data averaging)
accuracy	1 nm (typ. for 400 nm SiO_2/Si)
precision (1 σ)	0.3 nm (typ. for 400 nm SiO_2/Si)
thickness range:	20 nm to 25000 nm,
spot size:	80 µm
software:	SENTECH's application framework for optical measurement instruments, including: FTP measurement software for recipe oriented operation, measurement of reference sample, dark signal and sample, display of measured and fitted spectra, display of thickness result and status report. Definable user levels for access restrictions and log in, printed protocol of results, large and extendable library for optical material properties, Measurement of film thickness of the upper layer on a substrate or a layer stack on a substrate, fit mode and Fast Fourier Transformation (FFT) mode available, Data statistics, For more and detailed information and specifications

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please see our FTPadvanced brochure.

CER ellipsometer:

principle	FTP and ellipsometer measurement are done one after the other at the same measuring point
measuring time:	typical 1 s
calculation:	the thickness determined by FTP is used as starting parameter in the ellipsometric calculation, (this resolves the ambiguity in the film thickness orders for transparent films)

3 Further Options:

SE 400-1	Micro spots
SE 403	SIMULATION software
SE PSV	Vacuum chuck in lieu with standard sample stage
SE PSD	Rotational element with quick lock
SE PXY	Manual x-y stage, 50 mm travel length
SE 14	Motorized mapping stage (50 mm sample diameter)
SE 15	Motorized mapping stage (150 mm sample diameter)
SE 16	Motorized mapping stage (200 mm sample diameter)
SE 20	Liquid cell
SE AF	Auto focus option in combination with mapping option
SE -61	Camera option in lieu of the ACT
FTPadv Expert	Expert software for FTP for measurement of thickness and optical constants
SE 405	Preparation for later mapping upgrade