SENTECH Erfolg durch Leistung

***SENTECH* Instruments GmbH**

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Product Description

SENresearch Spectroscopic Ellipsometer
DUV-NIR range - SE 850 DUV
Spectral Range: 190nm ... 2500nm

- **Measurement of Refractive Index, Absorption and Film Thickness**
- **Ultimate Solution for High Speed combined with High Performance**
- **Measurement of the entire spectral range by one click within seconds**
- **Highly sensitive, Low Noise, TE cooled, DUV enhanced detection system**
- **Highly sensitive and low noise FT-IR instrument based ellipsometry in the NIR spectral range**
- **STEP SCAN ANALYZER measuring mode combined with super-achromatic compensator and polarizer tracking for most accurate and complete sample analysis**
- **SPECTRARAY II - comprehensive software for spectroscopic ellipsometry including sophisticated multiple angle, multiple sample, and combined photometric data analysis, programmable customer interface and advanced reporting**
- **Easy operation for both, experts and beginners**
- **SENTECH material library and sample applications for efficient modeling**

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The SE 850DUV is the top of the line of SENTECH's SE 8xx series spectroscopic ellipsometers. It is the ideal tool for thin film and material characterization from DUV to NIR.
The SE 850DUV is based on the Step Scan Analyzer (SSA) principle and a high performance multiplex detection, dedicated to fit perfectly SENTECH's goal of fast and accurate measurements of refractive index, absorption and film thickness.

The SE 850DUV is a high performance spectroscopic ellipsometer, based on fast diode array detection in the DUV/VIS spectral range and fast interferometer modulated detection in the NIR spectral range. Applying FT-IR spectroscopy in the NIR spectral range not only adds speed, high resolution and high signal to noise ratio, but provides automatic wavelength calibration as well. The SE 850 is characterized by both fast data acquisition and full spectral resolution.

The DUV concept is designed for low stray light, high DUV sensitivity and best S/N ratio even for low reflecting samples.

The operation of the SE 850DUV is extremely user friendly. The entire ellipsometric spectrum between 190 nm and 2500 nm or a user defined spectral range can be measured by just one click and the results are displayed in a few seconds. The transition between DUV, UV/VIS and NIR is seamless due to a sophisticated, automated channel switching concept.

The computer controlled stabilized dual light source comprises a Deuterium lamp for the DUV, Halogen tungsten lamp for the VIS and a Halogen lamp (part of the FT-IR spectrometer) for the NIR spectral range. The detection system for the DUV-VIS spectral range is based on a DUV enhanced grating spectrograph with a DUV sensitive CCD. The detector head is sealed and TE cooled to ensure a low dark signal. A modulated light of a FT-IR instrument is used for the ellipsometric measurements in the NIR spectral range.

The use of high grade broadband polarizer prisms with outstanding extinction ratio and acceptance angle guarantees best transmission and polarization in the entire spectral range from 190 nm to 2500 nm.

The SE 850DUV ellipsometer setup actually contains two measurement setups: Polarizer – Sample – Analyzer (PSA) and Polarizer – Compensator – Sample – Analyzer (PCSA) assuring the measurement of the degree of polarization and to compensate for depolarization effects caused by non-uniform samples, rough surfaces, limited spectral resolution and focusing angle. Using a super-achromatic compensator the ellipsometric angle Δ can be measured in the whole range from 0 - 360 degrees with extreme accuracy and ultimate precision. Additionally the compensator is highly stabilized against changes of the environmental temperature to provide lowest drift and lowest measurement error even at Delta around 0 deg.

The SE 850DUV data acquisition can be tuned for highest measurement accuracy for each individual application. The polarizer position is computer controlled and can be set to dedicated values according to the optical response of the sample (polarizer tracking).

Precise sample alignment is vital for highly accurate ellipsometric measurements. The SE 850DUV features the Auto Collimating Telescope (ACT) for the tilt and an optical microscope for the focus of the sample.

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Smooth operation of the instrument is guaranteed by SENTECH's controller concept. While the software runs on a state of the art PC under Windows XP the complete hardware is separately controlled by its own embedded microcontroller.

The operation of SPECTRARAY II is very intuitive and satisfies the demands for ease of use and multiple user operation. The scripting capability makes it very flexible to automate routine measurements, to tailor it for dedicated applications and to control third party hardware like sensors, heaters or a cryostat.

The SE 850DUV comprises the mechanical setup with a manual goniometer for multiple angle measurements, the optical components, the optical fibers, the FT-IR instrument, an electronic rack, a desktop PC with Windows XP, and the SENTECH **SpectraRay II** software. Light sources and detectors are coupled to the optical arms of the ellipsometer by optical fibers.

The WINDOWS based **SpectraRay II** operating software includes a large integrated package of modeling, simulation, and fit programs in order to support the customer for successfully processing even complex tasks.

Technical Specifications

General:

Spectral Range:	190 nm to 1700 nm optional: 190 –2500 nm	
Spectral resolution	DUV-VIS: Better than 0.8 nm per pixel NIR: 32 cm^{-1} – 1 cm^{-1}	
Sample size:	6", optional 8" and 300 mm, Maximum substrate thickness 7 mm	larger and /or thicker samples on request
Substrate:	opaque or transparent	
Layers:	Software allows for an unlimited number of layers to be analyzed	The practical number of layers, that can be measured depends on the sample. More than three layers is possible for almost all samples
Measurement time:	UV/ VIS: minimum time for full ψ / Δ spectra from a sample is about 5 seconds NIR: minimal 30 s, typical 120 s	

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Optical, electrical and mechanical Components:

Light source:	DUV-VIS: Computer controlled dual light source comprising a Deuterium light source for the DUV, Halogen Tungsten light source for the VIS including automated switches. NIR: FT-IR spectrometer with Halogen lamp.	
Lifetime of lamps:	More than 1000 hours	
motorized Polarizer / Analyzer:	High grade broadband MgF_2 Rochon prisms, Extinction Ratio 10^{-6} Step Scan Analyzer Principle	Computer controlled Analyzer (SSA) and polarizer (polarizer tracking)
Angular resolution:	better than 0.01°	SENTECH uses StepScan Analyzer which results in an effective angular resolution of better than 0.01°
Measurement Spot:	Manually variable beam diameter from 4 mm to 1 mm	
Spectral Discrimination:	The detection is based on the Step Scan Analyzer (SSA) principle where no parts are moving during a measurement: The reflected light is analyzed at discrete analyzer (no rotating analyzer) positions with an optical multichannel analyzer, consisting of a grating and high performance multiplex detector. For the NIR a Fourier Transform Infrared (FT-IR) Spectrophotometer is used. Applying FT-IR spectroscopy adds speed, high resolution and a high signal to noise ratio. It provides automatic wavelength calibration as well	
Detector	DUV-VIS: Grating spectrometer, DUV blazed grating, back thinned FFT CCD, TE cooled, high order cutoff filters, controller with PC interface, computer controlled integration time. NIR: Si / InGaAs sandwich photodetector (700 nm - 1700 nm) Si / InGaSbAs sandwich photo detector (700 nm - 2500 nm)	
Sample stage:	150 mm stage, Fine tuned independent height- and tilt adjustment,	optional: vacuum chuck

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		x-y: • 50 mm x 50 mm, manual or motorized, • 150 mm x 150 mm motorized, • 200 mm x 200 mm motorized, • 300 mm r, ϑ stage, motorized. Other stages on request, sample holder for transmission measurements
Goniometer:	Mechanical Goniometer variable from 40° to 90° , set in 5° steps accuracy better than 0.02 °	Optional: Computer controlled, continuously variable angle from 40° to 90°, min. step width 0.002°, Extended angle range on request.
Sample alignment:	Auto collimating Telescope and optical microscope for sample alignment (focus and tilt)	optional: • CCD camera to observe the measuring area
Controller:	Modular unit with benchtop ellipsometer optics and goniometer. Separate rack contains light source, ellipsometer controller with electronic boards and microcontroller unit , spectrophotometer	
Computer:	State of the art desktop PC, 15” TFT-Monitor, Keyboard, Mouse, Windows XP Operating system	
Output device:	Inkjet printer compatible	Software interface to export and import spectroscopic data. optional Network card
Power requirements:	Rated voltage:115/230 VAC auto select (100-132 VAC or 207-264 VAC), Rated frequency: 50-60 Hz, Rated power: 600 W.	Other common line voltages available
Environment:	Cleanroom (Class 100) compatible	

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Data acquisition and analysis software:

Spectroscopic Measurements:

SPECTRARAY II operating and analysis software comprises

- System Calibration
- Automatic setting up of optical components
- Hands off execution of user defined tasks.
- Spectral display in all standard energy (cm^{-1}, eV) or wavelength (Å, nm) units
- lifelike monitoring of sample response, online representation of ψ and Δ

Measurement output:

- Ellipsometric angles ψ; Δ, tan ψ, cos Δ, Fourier coefficients s1, s2 vs. energy of wavelength (related to sample position, angle of incidence
- Dielectric function vs. wavelength
- Refractive index, extinction coefficient vs. wavelength
- Multiple angle spectra measurement, graphics and fitting
- Degree of polarization
- Data clipping to selected wavelengths and angles without changing original data
- Merge function for combining sets of different wavelength ranges
- Combine function for combining sets of different data in one file
- Reduction of data as modulo or average
- Extract angle traces from multiple angle data

Modelling, Simulation and Fit:

SPECTRARAY II is able to fit any multilayer structure (single film, layer stack, periodical groups of stacks) for ψ, Δ; tan ψ, cos Δ and Fourier coefficients, transmission, reflection etc.. This includes anisotropic substrates and layers.

- easy to handle material library which is user expandable
- dispersion relations for layers: fixed dielectric constant, file (data table), 2D table, Cauchy, absorbing and transparent Sellmeier, Schott glass, Drude-Lorentz model (oscillators), Lorentz, Urbach, Leng oscillator, Tauc-Lorentz oscillator, super lattices, Forouhi-Bloomer, polynomial dispersion, Afromovitz- and Tanguy formula for III-V compounds, user defined free dispersion formula

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	• each layer can be a homogeneous layer, an interface, a roughness, a homogeneous growing layer, an index gradient (effective medium approximations: Maxwell-Garnett, Bruggeman, Lorentz-Lorenz, Clausius-Mossotti) • Material gradients can be linear, exponential, error function, Gaussian (symmetrical or asymmetrical) or parabola like. • Fast, Regressive fitting algorithms for optical models to measured data • Simultaneous Graphical display of experimental and simulated data • Presentation graphics
Fit of composite data	The fit algorithm does not only allow to fit measured data but also to import externally measured transmission and reflectivity spectra as well. The fits can be based on multiple measurements (Ψ,Δ, R, T) and different samples with same layer material.
Fit parameters:	Customer defined, depending on the model. There is no principle limit for the number of fit parameters, which could be e.g.: film thickness, refractive index, extinction coefficient, constituent fractions, incident angle, composition profile, temperature and time.
Fit statistics	Fit error and correlation matrix are calculated.
File management functions:	The software is based on Windows XP platform and provides full file management functions
Customized user interface	SPECTRARAY II includes a software package to develop user defined measuring and operation routines based on an easy to use script language.

Optional Items:

SE 800-2	Computer controlled goniometer, precision 0.01°
SE 800-3	Micro spot option, 200 µm spot diameter in the UV/VIS
SE 800-61	Video camera for alignment in lieu of eyepiece, frame grabber, microscopic image
SE 800-PXY	Manual x-y stage with 50 mm travel
SE 800-PSV	Vacuum chuck in lieu of standard sample stage

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SE 800-PSD	Rotational element with quick lock in lieu of standard sample stage
SE 800-PST	Sample holder with quick lock for transmission measurements
SE 800-14	Mapping of sample, x = 50 mm, y = 50 mm sample stage, (including vacuum chuck) extensive mapping software to define scan raster and to display scans in various ways
SE 800-15	Mapping of sample, x = 150 mm, y = 150 mm sample stage, (including vacuum chuck) extensive mapping software to define scan raster and to display scans in various ways
SE 800-16	Mapping of sample, x = 200 mm, y = 200 mm sample stage, (including vacuum chuck) extensive mapping software to define scan raster and to display scans in various ways
SE 800-17	Mapping of sample, r, ϑ - stage for 300 mm wafers, 150 mm travel length (including vacuum chuck), extensive mapping software to define scan raster and to display scans in various ways
SE 800-AF	Autofocus option in combination with SE 800 mapping option
SE 800-51	License for additional **SpectraRay II** software to a SENTECH spectroscopic ellipsometer
SE 800-5A	**SpectraRay** anisotropic analysis software, license for dongle
SE 800-30	Film Thickness Probe FTPadvanced