

SENDIRA Infrared Spectroscopic Ellipsometer

Spectral range: 400 cm^{-1} ... 6000 cm^{-1}

Product description



- Horizontal sample stage
- Motorized variable angle of incidence
- Sample mapping capability
- Purged IR optics for low water vapor concentration
- **SpectraRay/3** comprehensive ellipsometer software

1 General description

SENTECH infrared spectroscopic ellipsometer **SENDIRA** is an ideal tool for IR spectroscopic analysis of bulk materials, films, layer stacks and sample surfaces. The **SENDIRA** covers the infrared spectral range from 1.7 μm to 25 μm (6000 cm^{-1} to 400 cm^{-1}) with FTIR precision and high resolution. The **SENDIRA** provides detailed chemical, mechanical, electrical and optical information on complex layer systems. With the **SENDIRA** the investigation of new layer materials like organic conductors, OLEDs and polymers in the spectral range of vibrational spectroscopy offers excellent results. The **SENDIRA** is operated through **SpectraRay/3** and it is an excellent research tool but it can be used effectively in quality control as well. Substrates up to 200 mm diameter can be investigated.

The high performance FTIR ellipsometer **SENDIRA** is based on SENTECH's long experience in infrared ellipsometry and extends the SENresearch spectroscopic ellipsometers into the infrared spectral range. The **SENDIRA** has a horizontal sample stage which allows easy operation without clamping or sucking of the samples. A range of mapping stages to automatically scan full wafers and samples is optional available.

The external beam of an FTIR is used as radiation source and by this offers a maximum of flexibility. The measurement spot on the sample can be adjusted by means of a field aperture. As the **SENDIRA** only requires the external beam of the FTIR, the spectrometer can still be used as a standalone tool.

The FTIR ellipsometer system is pre-aligned and ready to use. The angle of incidence can be changed using a computer controlled, automatic goniometer.

The **SENDIRA** measures the ellipsometric angle Δ in the entire range from 0° to 360° with high precision. The **SENDIRA** comprises the purged infrared optics including retarder, the motorized goniometer, the sample stage, a PC and the control electronics, SENTECH's **SpectraRay/3** software for data acquisition, library based modeling, simulation and spectral fitting and in the standard configuration an Agilent Cary 660 FTIR spectrometer to be functional in the MIR spectral range. Accurate sample alignment is a critical item in ellipsometry. The **SENDIRA** is equipped with an auto collimating telescope (ACT) for most accurate height and tilt alignment. Many additional useful options complement the standard configuration of the **SENDIRA**.

2 Technical Specifications of the SENDIRA

Spectral range: nominal MIR:	400 cm ⁻¹ to 6000 cm ⁻¹
Mechanics of the ellipsometer:	Sample stage with horizontal sample platform Height and tilt adjustment Polarizer, analyzer and retarder units Goniometer Auto collimating telescope (ACT)
Angle of incidence:	Automatic goniometer (resolution <0.005°) Step width 0.01°
Measurement spot:	Depending on the angle of incidence and the settings of the field aperture, Typical sizes: 4 mm x 10 mm @ 70 deg Adjustable from 1 mm ... 10 mm
Sample thickness:	0...10 mm, others on request
Sample stage and sample alignment:	150 mm sample platform (200 mm optional), Fine tuned independent height- and tilt adjustment vacuum chuck (optional) <u>x-y Mapping (optional)</u> 50 mm x 50 mm motorized, 100 mm sample platform <u>r-Theta- Mapping (optional):</u> <ul style="list-style-type: none">• 150 mm motorized other stages on request
Principle of operation:	PSC(SA) Polarizer P: MIR KRS-5 Sample S Compensator C: MIR KBr Step scan analyzer SA (as polarizer)
Computer:	State of the art PC, monitor, DVD drive, mouse, keyboard, Windows 7. The computer is used to control the SENDIRA, to start the measurement and to calculate and interpret the ellipsometric spectra.
Controller:	The controller contains the electronics rack for driving the ellipsometer. It connects to the ellipsometer by a standard 3 m cable set and to the PC via a TCP/IP network cable.
FTIR spectrometer:	Commercial Agilent Cary 660 MIR FTIR including the operation software (connected to PC by USB cable and

connector). This allows the FTIR to be operated independently from the ellipsometer software. Operated as ellipsometer the external beam of the FTIR spectrometer is used.

- MIR spectral range: 400 cm^{-1} ... 6000 cm^{-1}
- Spectral resolution: 32 cm^{-1} , 16 cm^{-1} , 8 cm^{-1} , 4 cm^{-1} , 2 cm^{-1} or 1 cm^{-1}
- TE cooled DLaTGS detector (on ellipsometer receiver arm)
Range: 10,000 - 400 cm^{-1} (KBr window)
- Linearized MCT (Mercury Cadmium Telluride) detector (optional)
Range: (high sensitivity) 10,000 – 700 cm^{-1} (wide band)

Software:

SENTECH SpectraRay/3 software will operate both, the FTIR spectrometer and the ellipsometer, from the same software desktop. An ellipsometric measurement cycle consists of the collection of single beam spectra at certain angle settings of the step scan analyzer. From these single beam spectra the ellipsometric angles $\Psi(\lambda)$ and $\Delta(\lambda)$ are calculated.

Software for data acquisition, library based modeling, simulation and spectral fitting

- Automated system calibration
- Communication with the FTIR spectrometer
- Measurements of Ψ and Δ spectra
- Spectral display (in nm, eV or cm^{-1})
- Interpretation and simulation of data
- Multiple measurements can be assigned to the model of the sample ($\Psi, \Delta, R, T, \dots$)
- Multiple samples with separate measurements can be fitted

Extensive data-handling

- Usage of multiple data tables or models in fits
- Data trim in columns and rows
- Reduction of data as modulo or average
- Data clipping to selected wavelengths and angles without changing original data
- Smoothing of data
- Merge function for combining sets of different wavelength ranges
- Swapping rows and columns
- Extract angle traces from multiple angle spectra
- Combination of single measurements or data to tables
- Extensive import/export functions: ASCII, CSV, SPC, other

ellipsometric devices, and huge FTIR device support

- easy to handle modeling based on a material library, which is expandable by the user
- able to fit any multilayer structure (single, periodic)
- each layer can be a homogeneous layer, an interface, a roughness, a homogeneous growing layer, an index grating (effective medium approximations: Maxwell-Garnett, Bruggeman, Lorentz-Lorenz)
- dispersion models: fixed dielectric constant, file, Cauchy, amorphous semiconductors, absorbing and transparent Sellmeier, Schott glass, Drude – Lorentz, Tauc-Lorentz, Cody-Lorentz, Leng, relaxed Lorentzian, super lattices, Forouhi-Bloomer, polynomial dispersion, user defined free dispersion formula
- uniaxial anisotropic films
- point by point fits
- remote scripting to allow remote operation from Visual Basic or other ActiveX capable programming languages
- powerful macro language (interpreter)
- 2D (measured curves) / 3D presentation graphics (mapping plots)
- automatic measurements and fits: for predefined standard applications a complete measurement and fit cycle can be performed with one command by macros
- analysis of biaxial anisotropic layer stacks (optional)

size and weight

Width x depth x height 1500 x 650 x 650 mm
~ 100 kg for whole instrument including FTIR instrument

power requirements

Rated voltage 115/230 VAC auto select (110-132 VAC or 207-264 VAC)
Rated frequency 50-60Hz
Rated power 600W

3 Configurations and Options

SENDIRA-14	50 mm x-y mapping option, 150 mm sample platform
SENDIRA-DTGS	TE cooled DLaTGS detector for using the FT- IR as a standalone tool, KBr window
SENDIRA-MCT	Linearized MCT detectors, 10.000 – 700 cm ⁻¹
SE AFT	Auto height and tilt adjustment