

ANALYTICAL INSTRUMENTS

Simpler, Faster and More Accurate Analytical Measurements



KGC

EMPOWERING FUTURE
THROUGH RESEARCH & INNOVATION

INTRODUCTION

Welcome to our 2020 - 2021 edition of Product Catalog. We would like to thank you for your continue support and encouragement. Throughout this challenging time, we have grown and transform our business to be more efficient and effective. This will enable us to offer better service and more competitive pricing to our customers.

Our new edition of catalog comes with a easy reference features where we categorized the products into different usage categories, i.e. Advanced Material, Renewable Energy, Bio-Process, Gauge Calibration, Membrane Technology, 3D scanner and others. This will facilitate the users to quickly access to the equipment specification required, and options available to them in term of measuring range or equipment complexity.

In our new catalog, we have also added the equipment to do research in renewable energy like solar cell, fuel cell, flow cell, lithium ion batteries, and membrane technologies. In synergy with our advanced material equipment, we have also added the equipment for material characterization especially in the area of rare earth research and magnetic properties. In line with the manufacturing industry footsteps, the equipment on 3D scanning and 3D printing also have been added in to expand the tools in the research and development for industry 4.0.

To our current customers, we believed our partnership will be strengthen for the years to come. The new catalog will also create new opportunities to build new relationship with new customers.

Lastly, I would like to thanks our staffs for their dedication and sacrifice in supporting the management for a brighter future.

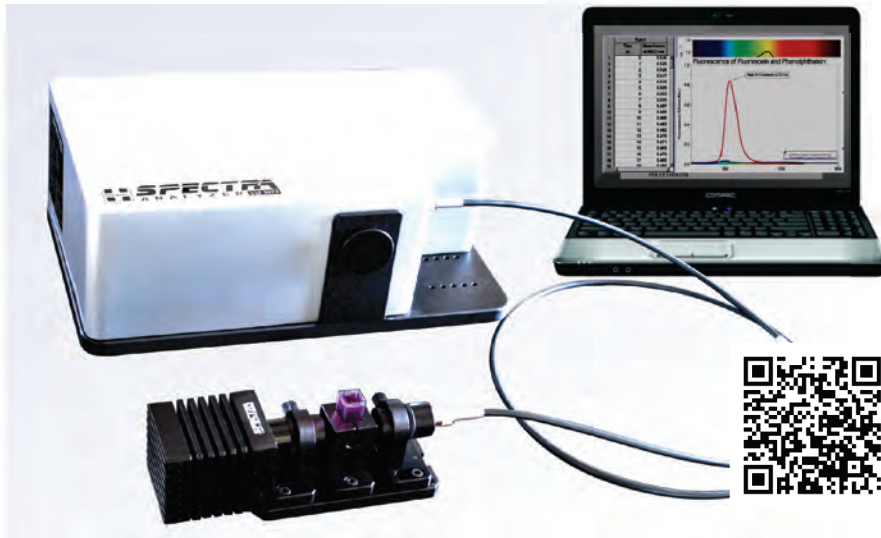
Patrick Tan
Director
KGC (Group of Companies)

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CCD Spectrophotometer / fluorometer - Spectra Analyte Plus

MODEL : HO-SP-SCCD2080FC



Applications

- ▶ Measure absorbance, transmittance, fluorescence etc
- ▶ Perform equilibrium studies of absorbance vs. time or absorbance vs. concentration
- ▶ Perform colorimetric measurements
- ▶ Measure emissions of gas discharge tubes, flame tests or other light sources.

Application areas include chemistry/ biochemistry, medicine, environmental monitoring. For instance, they are used to measure chlorophyll fluorescence to investigate plant physiology.

HOLMARC has developed cost-effective high-performance fiber optic coupled UV/VIS CCD spectrophotometer instrument that allows analysts to collect a full wavelength spectrum absorbance, transmittance or intensity in less than one second. Standard interface to the spectrophotometer is USB 2.0 compatible with 16-bit extended dynamic range. Spectra Analyte Windows-based spectral acquisition and analysis software is supplied along with the instrument.

The device use high-quality optics and single-piece aluminum optical bench. This design allows continuous stable operation of the instrument. It uses dual spectrum of deuterium and halogen lamp as light source. Emerging light goes through a high-quality diffraction grating, then the diffracted light is collected and sorted by the CCD array detector.

The standard sensor arrays used in the spectrometer is Toshiba TCD1304DG B/W board-level line CCD camera, based on a single-line, 3648-pixel CCD chip. The array driver electronics designed and developed by Holmarc ensures sensitive and stable operation. UV spectrophotometer models use windowless CCD to increase the UV sensitivity down to 200nm. It helps the signal sensitivity below 380nm to get improved (~20-50% more) in general.

Spectra Analyte UV-VIS spectrophotometer can also be used as fluorometer or in combination with spectrophotometer. Fluorometer is a device used to measure parameters of fluorescence : its intensity and wavelength distribution of emission spectrum after excitation by certain spectrum of light. It can quantitatively measure the fluorescence spectra of many compounds such as chlorophyll, fluorescein, GFP, and more.

For the accessories please see the next page.

SPECIFICATIONS

Model	HO-CT216-UV	HO-CT216-4065	HO-CT216-2010	HO-CT216-3010	
Wavelength Range	200 ~ 400nm	400 ~ 700nm	200 ~ 1000nm	320 ~ 1,050nm	Photometric
Resolution*	0.25nm	0.29nm	1nm	0.9nm	
Optical Platform	Czerny-Turner / Concave				Transmittance Range : 0 to 199.9% Resolution : 0.5% Absorbance Range : 0.300 to 1.99A Resolution : 0.01A Concentration Range : 300 to 1999 Concentration Resolution : 0.1/1
Effective Spectral Range	200 to 1050nm				
Input Fiber Connector	SMA 905				
Input Fiber NA	0.22				
Stray Light	<0.06% @ 532nm (<0.1% overall)				
Detector	Toshiba TCD1304AP Linear CCD Array				
Pixel Number	3648				
Pixel Size	8x200µm				
Pixel Well Depth	100,000electron				
Signal-to-noise Ratio	1,000:1(at full scale)-				
A/D Resolution	16 bit				
Integration Time	0.1 to 6,500 ms				
Frame Rate	up to 138 fps				
Trigger Input	Optional				
PC interface	USB 2.0				
Software	Spectra Analyte Includes DLL libraries and SDKs for easy custom application development				Fluorescence attachment provided on request. Please specify the wavelengths of interest.

CCD Spectrophotometer - Spectra Nano Analyte NV16

MODEL : HO-SP-NV16

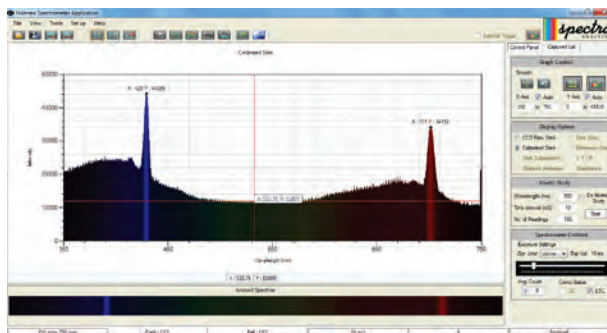


HOLMARC continues to dominate spectrophotometric equipment with the revolutionary design of the Spectra Nano Analyte spectrophotometer. It is a compact and low cost visible (380-800nm) spectrophotometer integrated with 10mm path length cuvette holder.

These instruments can be used for measuring wavelengths from 380nm to 700nm and analyze results in full color. Nano Analyte can be directly connected to computer USB port. Only one step calibration is required for the photometric experiments. It analyzes full-wavelength spectrum within one second with CCD sensor.

Applications

Determine peak wavelength to collect data on solution concentration for studies of Beer's law or to monitor rates of reaction.
Collect a full wavelength spectrum to measure absorbance and transmittance.
Conduct enzyme kinetics experiments.
Perform equilibrium studies of absorbance vs. time or absorbance vs. concentration.



How Spectra Nano Analyte NV16 Works

Nano Analyte NV16 employs spectral LED to transmit light through a solution containing the sample. The transmitted light then passes through a diffraction grating and the diffracted light is sorted and collected by the CCD array detector.

Accessories for Fiber optic coupled Nano Analyte NV16 & Spectra Analyte Plus

Fiber Optic Dip Probe

Nv16 spectrophotometers when fiber optic coupled, extend their capabilities as dip probes to facilitate analysis while lending themselves for real-time monitoring of kinetic reactions.

The probe body is built entirely in stainless steel (SS 316) and lined with quartz or glass. Length of the fiber optic cable can also be configured to meet customer needs.



Flow Through Cells



Our Fiber optic flow through cells are ideal for demanding applications including process control, chromatography and for monitoring reactions in remote locations. The flow through cell is built entirely of stainless steel (SS 316) and lined with quartz or glass, the flow through cell is virtually maintenance free.

Small size and variable length of fiber optic cable allows the flow through cell to be mounted just about anywhere.

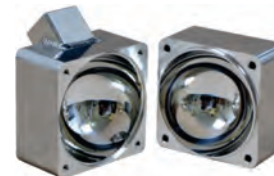
Fiber Optic Reflectance Probes

Reflectance Probes are ideal for measuring the absorption characteristics of solid surfaces, powdered substrates and liquids.



Integrating Spheres for Reflectance Measurements

Fiber optic coupled integrating sphere for uniform, diffused illumination and total reflectance measurements of samples are available. They are suitable for solid surface analysis, color analysis and for the measurement of samples of varying gloss texture.



Cuvette holder with fiber collimator unit



Fiber optic coupled cuvette holders are for standard 10 mm path length cuvettes. They are designed to work in UV-VIS-NIR spectral range. These cuvette holders have two terminals and one slot for transmittance /absorbance measurements.

BioLAB VIS-300 UV-Vis Spectrophotometer

Compact single beam optics with full range scanning

System Features

- ✓ Compact Design
- ✓ Large LCD and friendly interface make the operation extremely easy.
- ✓ Precise measurements over a wide photometric range.
- ✓ Step scan function provides reliable peak assignment of samples with sharp or narrow absorption peaks.
- ✓ User-friendly graphical interfaces
- ✓ Excellent signal-to-noise ratio for the entire UV to NIR spectral range.



HOLMARC's BioLAB series UV-Vis spectrophotometer is a high-performance, reliable, and exceptional value instrument. Unlike other entry level spectrophotometers, it employs classic Czerny - Turner monochromator design, normally available only with advanced models, which ensures low stray light. Micro-stepping drive simplifies the mechanical complexity, reduces maintenance and improves longevity. 1200 lines/mm blazed

holographic grating is used as the dispersion element providing high wavelength resolution. It also employs a sigma delta ADC of 16 bit resolution for photometric measurements, a resolution higher than most of the spectrophotometers available in this price range. Large LCD and friendly interface make the operation extremely easy. It is used to plot absorbance v/s wavelength graph. The data can then be analyzed for peaks and valleys. These models also feature PC control functions based on Holmarc 's Spectra PhotoANALYTE software which allows users for photometric measurements, spectrum scanning, quantitative determination, data processing etc.

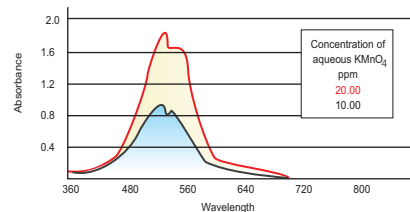
Photometric mode measures the absorbance or transmittance at a single wavelength or at multiple wavelengths. Spectrum mode obtains sample spectra using wavelength scanning. Changes in the sample can be tracked using repeated scans. Quantitation mode generates a calibration curve from standard samples and uses it to calculate the concentrations of unknown samples. Kinetics mode measures the change in absorbance as a function of time and thereby obtains enzymatic activity values. Time scan mode measures the change in absorbance, transmittance or energy as a function of time.

Model	BioLAB VIS 300
Bandwidth	2nm
Optical System	C-T monochromator, 1200 l/mm holographic grating
Wavelength Range	350 ~1100nm
Photometric Method	Transmittance, Absorbance, Concentration
Wavelength Accuracy	±0.8nm
Wavelength Repeatability	±0.2nm
Absorbance Range	-2 ~ 2Abs
Photometric Accuracy	±0.002A (0 ~ 0.5A), ±0.004A (0.5 ~ 1A), ±0.3% T
Photometric Repeatability	≤0.001A (0 ~ 0.5A), ≤0.002A (0.5 ~ 1A), ±0.1% T
Stray Light	≤0.05% T
Baseline Straightness	±0.002A
Detector	Si-Photodiode
Light Source	Quartz Halogen Lamp
Cell Holder	Two-position 10mm standard cuvette holder
Display	320 × 240 pixel graphic LCD
Control Mode	Stand alone or PC control
Dimensions (LxWxH) mm	310x235x108

Scanning range between 350-1100nm for VIS-300 Model
 Selectable scan Wavelength Interval of 1 to 50nm
 Live absorbance plot during scanning
 Plot browser to read absorbance values at each wavelength
 Analyzer to find out absorbance and wavelength of peaks and valleys

Spectra PhotoANALYTE

- ▶ Powerful Software for Photometry
- ▶ Spectrum scanning
- ▶ Photometric measurement
- ▶ Quantitative determination
- ▶ Powerful data processing abilities
- ▶ Printing report



Glass, quartz cuvettes and Holders

Custom Glass Cuvettes

We manufacture quartz cells and cuvettes of custom specifications for spectrometer, spectrophotometer, colorimeter and other instruments.

cuvette holder

The cuvette holder unit is manufactured for various cuvette sizes and applications. Some cuvette holders are equipped with SMA fiber connectors and collimators.

We hold expertise in designing and manufacturing custom models. Wide variety of accessories (optional) can be included in one BioLab VIS300 model such as test tube holder, long path cuvettes holder and multiple cell holder, depending upon the varying application needs of the customer.

Spectrophotometer

UV-VIS-NIR

Model : HO-SP-3480& HO-SP-1911



Holmarc's HO-SP-3480 & HO-SP-1911 are entry level spectrophotometers suitable for education, research and industrial applications. Unlike other entry level spectrophotometers, it employs classic Czerny - Turner monochromator design, normally available only with advanced models, which ensures low stray

light. It uses 1200 lines/mm blazed holographic grating as the dispersion element providing high wavelength resolution. It also employs a sigma delta ADC of 16 bit resolution for photometric measurements, a resolution higher than most of the spectrophotometers available in this price range. A graphics LCD screen is used to plot an absorbance v/s wavelength graph. The data can then be analyzed for peaks and valleys.



Customized accessories are available to address individual application requirements. In a spectrophotometer, the amount of light passing through the sample cell is measured by a photometer. The photometer delivers a voltage signal to the processing unit. The signal changes as the amount of light absorbed by the liquid changes. According to Beer's law, the amount of light absorbed by a medium is proportional to the concentration of the absorbing material or solute present. Thus the concentration of a colored solute in a solution can be determined in the lab by measuring the absorbance of light at a given wavelength.

Specifications

Wavelength

Range : 380 to 1100nm (Model : HO-SP-3480)
: 190 to 1100nm (Model : HO-SP-1911)

Resolution : 1 nm
Accuracy : ± 1 nm
Spectral bandwidth : 2 nm

Transmittance

Range : 0 to 100%
Resolution : 0.1 %
Accuracy : ± 1 %
Noise Level : < 1 %
Stability : 1% /Hr after warm-up

Absorbance

Range : 0 to 2A
Resolution : 0.001A

Concentration

Range: 0 to 999
Selectable resolution 1, 0.1, 0.01 or 0.001
Calibration with 1 or 2 known standards
Direct factor entry
10 method memory
Readout : 320 x 240 Pixel Graphics LCD

PC Interface : RS232 (Optional)
Light Source : Quartz Halogen Lamp 20W & 20W Deuterium/Quartz Halogen Lamp

Spectrum

Any range between 380 and 1100nm for Model : HO-SP-3480 & 190-1100 for Model : HO-SP-1911
Selectable scan wavelength interval of 1 to 50nm
Live absorbance plot during scanning
Plot browser to read absorbance values at each wavelength
Analyzer to find out absorbance and wavelength of peaks and valleys
Input Voltage : 230V 50Hz

Input Power : < 50W
Size : 530(w) x 330(d) x 175(h) mm
Weight : 27Kgs(Approx)

Scanning Mode Features

- ▶ Wavelength range between 380 and 1100nm for Model : HO-SP-3480 and 190-1100nm for Model : HO-SP-1911
- ▶ Selectable scan wavelength interval 1 to 50nm
- ▶ Live absorbance plot during scanning
- ▶ Plot browser to read absorbance values at each wavelength
- ▶ Analyzer to find out absorbance and wavelength of peaks and valleys

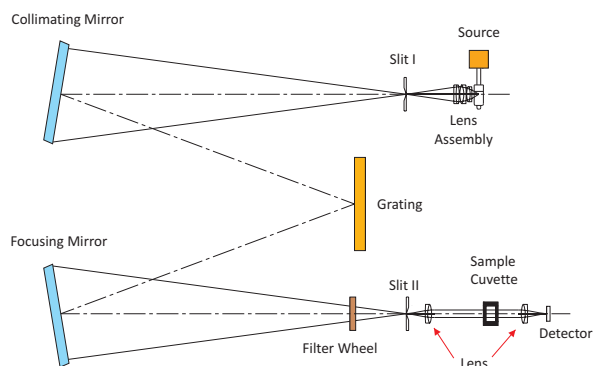
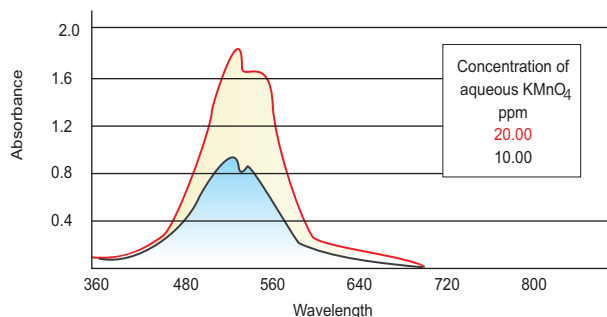


Fig. Optical Layout of Spectra HO-SP-3480 Spectrophotometer



HOLMARC **UV VIS NIR** DOUBLE BEAM DUAL DETECTOR

Spectrophotometer

UV2-1911D

Spectra UV-Vis Double Beam Dual Detector
Scanning Research Spectrophotometer
With 4 Cell Holder

System Features

- ✓ Compact Design
- ✓ Large LCD and friendly interface make the operation extremely easy.
- ✓ Precise measurements over a wide photometric range.
- ✓ Step scan function provides reliable peak assignment of samples with sharp or narrow absorption peaks.
- ✓ User-friendly graphical interfaces
- ✓ Excellent signal-to-noise ratio for the entire UV to NIR spectral range.



HOLMARC's UV2-1911D Spectra UV-Vis Double Beam Scanning Spectrophotometer has excellent performance blazed holographic grating and optimized CT-type monochromator to reduce stray light and widen the photometric range.

UV2-1911D's large LCD screen displays the menu and makes the device easier to use. This instrument ensures high sensitivity, reduced noise, and ultra-low stray light. This spectrophotometer is rugged, reliable, affordable, and maintenance free. UV-VIS Double Beam UV2-1911D Spectrometer's enhanced transmission and full reflection makes this double beam instrument precise with minimum noise. Additionally, this instrument can be interfaced with a computer and a printer to display the photometric and spectral data on the PC monitor. Holmarc's Spectra Photometric Analyte software can be used along with the instrument for wide range of uses and applications.

Model : UV2-1911D Technical Specifications

Optical system : CT Dual beam
Wavelength range : 190 nm – 1100 nm
Spectral bandwidth : 1nm
Wavelength display : 0.1 nm resolution
Stray light : $\leq 0.12\%T$ (220nm NaI, 340nm NaNO₂)
Wavelength accuracy : +0.2nm
Wavelength reproducibility : +0.1nm
Photometric system : Dual beam, dynamic feedback direct ratio recording system
Optical system : C-T monochromator, 1200 l/mm holographic grating
Photometric method : Transmittance, absorbance, energy and concentration
Photometric range : -0~2.0 Abs
Photometric accuracy : +0.002Abs (0~0.5Abs)
+0.004Abs (0.5~1.0Abs)
+0.15%T (0~100%T)
Photometric reproducibility : +0.001Abs (0~0.5Abs)
+0.002Abs (0.5~1.0Abs)
+0.15%T (0~100%T)
Baseline flatness : ± 0.002 Abs (200-1100nm)
Baseline stability : 0.001Abs/30 min
Scanning speed : 1nm to 1400nm/min - Selectable
PC interface : RS-232 or USB
Photometric noise : ± 0.001 Abs (500nm, 30 min warmup)
Light source : Deuterium lamp and Tungsten Halogen lamp with auto selection system.
Detector: Hamamatsu Silicon photodiode
Software support: Spectra PhotoANALYTE
Display : Digital LCD display
Sample chamber : 4 cell sample holder/chamber

A variety of accessories are included such as test tube holder, temperature control holder, long path length cuvette holder & multiple cell holder, to enhance different application needs. Please contact us.

Spectra PhotoANALYTE

- ▶ Spectrum scanning
- ▶ Photometric measurements
- ▶ Kinetic measurements
- ▶ Quantitative determination
- ▶ Multi component analyses
- ▶ Powerful data processing
- ▶ Printing report

Photometric mode measures absorbance or transmittance at a single wavelength or at multiple wavelengths. Spectrum mode obtains sample spectra using wavelength scanning. Changes in the sample can be tracked using repeated scans. Quantitation mode generates a calibration curve from standard samples and uses it to calculate concentration of unknown samples. Kinetics mode measures the change in absorbance as a function of time, and thereby obtains enzymatic activity values. Time scan mode measures the change in absorbance, transmittance, or energy as a function of time.

Accessories for UV2-1911D

4 Cell Automatic Reference / Sample Holder
Optical Glass Cuvettes (10mm) - 8 No.s
Quartz Cuvettes (10mm) - 2 No.s
Dust cover
Instruction manual
Power cable and PC cable
Software CD
Quartz Halogen Lamp
CD of installation and how to use the UV2-1911D

Optional Accessories

- a, Integrating Sphere
- b, Thinfilim & Powder Sample Holder
- c, Peltier Kinetic Test System
- d, Flow Through System
- e, Variable Angle Reflection Measurement Unit



Absorption / Transmission / Reflection Spectroscopy

HOLMARC $\theta/2\theta$ Spectrophotometer
Models: HO-SPA-1990P & HO-SPA-3411D

SPA216 Series
HOLMARC Theta 2 Theta ADVANCED SPECTROPHOTOMETER
Automated Goniometer tool for Variable Angle Spectroscopy

The graph shows % Reflectivity on the y-axis (0 to 100) and Angle of Incidence on the x-axis (0 to 90 degrees). Two curves are plotted: a red curve labeled 'I' and a green curve labeled 'II'. The red curve starts at approximately 4% reflectivity at 0 degrees and rises to 100% at 90 degrees. The green curve starts at approximately 15% reflectivity at 0 degrees and rises to 100% at 90 degrees. A vertical dashed line is drawn at an angle θ_n .



Reliable measurement techniques for optical characterization of thin film is a must for any laboratory. HOLMARC's Theta 2 Theta Spectrophotometer is a useful tool for characterizing absorption, transmission, and reflectivity of a variety of materials such as pigments, coatings, windows, and filters. Automated Theta 2 Theta goniometer tool is used for measuring absolute reflectance and transmittance of samples at different angles for characterization of the optical or

electronic properties of materials. Reflectance measurements can identify the color of a sample or examine differences between objects for sorting or quality control.

SPA216 Series spectrophotometer gives precise measurements of spectral parameters such as reflection, transmission, and optical density in all spectral range of UV, VIS and NIR. Spectral transmission and reflection measurements at any desired angle with a resolution of 0.5° can be carried out with this spectrophotometer. Two models are available for angular photometric measurements HO-SPA-1990P & HO-SPA-3411D. HO-SPA-1990P is a scientific grade photometer equipped with high sensitive photo multiplier tube. Model : HO-SPA-3411D uses Si Photo diode as detector. Angles for illumination and measurement can be set independently. The system is provided with motorized polarizer and analyzer to generate polarization curve of the sample at various angles.

Model	HO-SPA-3411D	HO-SPA-1990P
Bandwidth	1nm	0.5nm
Optical system	C-T monochromator, 1200 l/mm holographic grating	
Wavelength range	340 ~ 1100nm	190 ~ 900nm
Photometric method	Transmittance, Absorbance, Concentration	
Wavelength accuracy	$\pm 0.5\text{nm}$	
Wavelength repeatability	$\pm 0.1\text{nm}$	
Absorbance range	-2 ~ 2Abs	
Photometric accuracy	$\pm 0.002\text{A}$ (0 ~ 0.5A), $\pm 0.004\text{A}$ (0.5 ~ 1A), $\pm 0.3\% \text{T}$	
Photometric repeatability	$\leq 0.001\text{A}$ (0 ~ 0.5A), $\leq 0.002\text{A}$ (0.5 ~ 1A), $\pm 0.1\% \text{T}$	
Stray light	$\leq 0.05\% \text{T}$	
Baseline straightness	$\pm 0.002\text{A}$	
Detector	Si-Photodiode	PMT
Light source	Quartz Halogen Lamp	Deuterium/Halogen
Cell holder	Two-position 10mm standard cuvette holder	
Theta 2 Theta measurements	Goniometer for Angular Measurements Type : Theta 2 Theta Measuring Stage Sample Holder : Up to 50x50mm size, Custom Size Available Angular Measurement Range : $30^\circ - 180^\circ$ Positioning Resolution : 0.5°	
Control Mode	PC control (Software : PhotoANALYTE-G)	
Dimensions (LxWxH) mm	606x352x135	606x352x230

SPA216 Series Spectrophotometer Features

- ▶ Specially designed for optical characterization
- ▶ Ideal for reflectance, transmission, absorption and optical density measurements.
- ▶ Design optimized for low stray light.
- ▶ Interchangeable holders for solid, liquid and thin film samples.
- ▶ Wide range of accessories such as polarizers, filters etc

Spectra PhotoANALYTE-G

- ▶ Powerful software for Photometry
- ▶ Spectrum scanning
- ▶ Photometric measurements
- ▶ Quantitative determination
- ▶ Multi component analyses
- ▶ Powerful data processing abilities
- ▶ Printing report

The software developed for this instrument has facilities for setting up and calibration in addition to scanning and manual readout. Scanning is possible for a desired wavelength range too. This feature can save time whenever full wavelength range scan is not necessary. The software stores and displays the data acquired on MS Excel sheet. This helps to plot graph with ease whenever required.

We hold expertise in designing and manufacturing custom models. Wide variety of accessories (optional) can be included in model such as test tube holder, long path cuvettes holder and multiple cell holder, depending upon the varying application needs of the customer.



Variable Angle Laser Ellipsometer

Model : HO-ED-P-06



Ellipsometry is a very sensitive optical technique which provides unequalled capabilities for thin film metrology. Ellipsometry exploits phase information and polarization state of light and so can achieve angstrom level resolution. The main advantages of ellipsometry are its non-destructive character, high sensitivity and wide measurement range. The optical parameters like thickness and refractive indices of a thin film can be determined precisely by this technique.

In the ellipsometer model no: HO-ED-P-06, a circularly polarized light is made incident on the test substrate and the reflected light which is linearly polarized is analyzed for polarization changes.

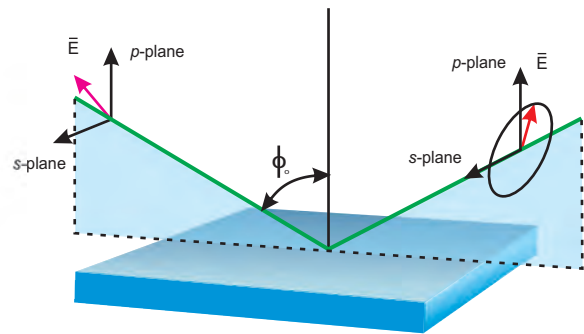


Fig. Schematic diagram of ellipsometer operation

The instrument consists of two concentrically rotating arms around a precisely graduated disc fixed to a heavy base. A laser source is held on one arm and the detector assembly on the other arm. The graduated disc has 1° scale and 0.1° resolution achieved through a vernier. Power supplies for laser source and detector are placed separately. Polarizer, analyzer and quarter wave plate are held in precision rotary stages in the optical path with precise graduations having 0-360° range and 0.1° resolution. Glan-Thompson Prisms are used for both polarizer and analyzer.

Sample is placed on a precision micrometer driven vertical stage with height adjustment range of 10 mm and resolution 0.01 mm. Incident angle for laser source can be adjusted between 30° and 90°. For null method, detector can be replaced with a miniature screen for visual determination of null point, if required.

As shown in the Fig., randomly polarized laser light (532nm) passes through a polarizer which changes the polarization of light from random polarization to linear polarization. The linearly polarized light then passes through a quarter-wave plate (set the fast axis at 45 degree) which changes the polarization state from linear to circular. After reflection from the sample thin film, the circularly polarized light becomes linearly polarized and an analyzer measures the degree of polarization.

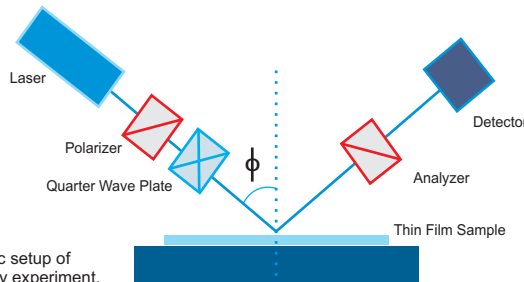


Fig. Schematic setup of an ellipsometry experiment.

Specifications :

Measurement Range	1 nm ~ 300 nm
Incident Angle	30° ~ 90°, Error ≤ 0.1°
Rotation Range	
Polarizer	0° ~ 360°
Quarter-Wave	0° ~ 360°
Resolution	0.1 degree
Laser	DPSS (532nm, 5mW)
Laser Arm	
Rotation Range	70 degree (from horizontal plane)
Main Scale Division	1 degree
Resolution	0.1 degree
Detector	
Type	Si Photodiode
Active area	5.8 x 5.8 mm
Detector Arm	
Rotation Range	70 degree (from horizontal plane)
Main Scale Division	1 degree
Resolution	0.1 degree
Sample Holder	
Height Adjustment Range	10 mm
Drive Resolution	10 microns
Tilting Range	+/- 2 degree

Variable Angle Spectroscopic Ellipsometer

Model : HO-SE-01

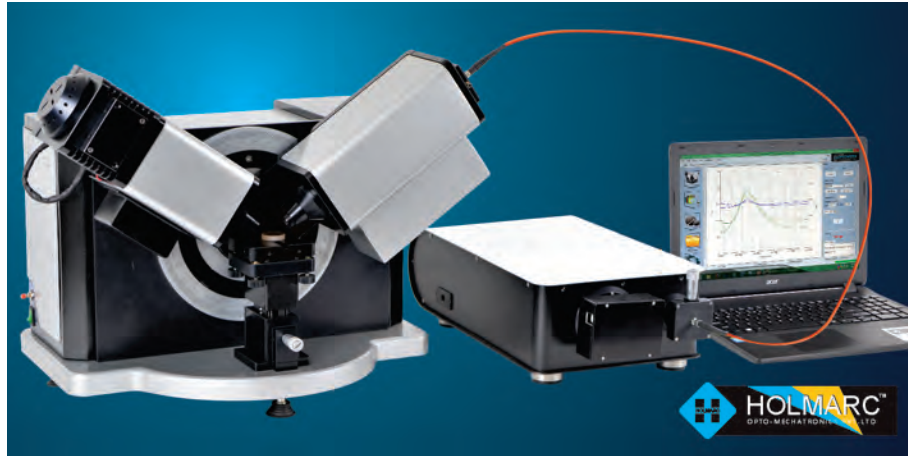


Spectroscopic Ellipsometer is widely used for thin film analysis and measurements.

Holmarc's spectroscopic ellipsometer incorporates Rotating Analyzer Ellipsometry technology to characterize thin film samples. It uses a high speed CCD array detection to collect the entire spectrum. It measures films from nanometer thickness up to tens of microns and the optical properties from transparent to absorbing materials. It accurately measures optical constants like refractive index, film thickness and extinction coefficient.

Our standard system comes with Quartz-Halogen lamp for visible through IR range. Our spectroscopic ellipsometer software allows the user to measure and analyze multilayer thin films and complex thin film structures.

An autocollimator, Z stage and tilt platforms are provided for sample alignment. XY motorized stage and motorized rotation stages are provided as an optional feature for mapping thin film uniformity.



http://www.holmarc.com/variable_angle_spectroscopic_ellipsometer.php

Principle of Ellipsometry

Ellipsometry is a highly sensitive technique for thin film analysis. The principle relies on the changes of the polarization state of light while reflecting from a surface.

To characterize the polarization state, corresponding to the direction of the electric field of the electromagnetic wave; two directions are chosen as reference, p-direction (parallel) and s-direction (perpendicular). The reflected light has phase changes that are different for p-direction and s-direction. Ellipsometry measure this state of polarization;

$$p = \frac{r_p}{r_s} = \tan \Psi e^{i\Delta}$$

Where Ψ and Δ are the amplitude ratio and phase shift of the p and s components respectively. Since ellipsometry is measuring the ratio of two values, it is very accurate and reproducible.

Features:

- ▶ Non-destructive and non-contact technique
- ▶ Analysis of single and multilayer samples
- ▶ Accurate measurements of ultra-thin films
- ▶ Software for measurement, modeling and automatic operations.
- ▶ Uniform measurement sensitivity for (Ψ , Δ)

Specifications :

Spectral Range: 450 – 800nm
 Detector: Line CCD Camera
 Resolution: 2nm
 Light Source: Halogen Lamp
 Incident Angle : 50 – 75 degree (Resolution: 0.1 degree, Automated operation)
 Thickness Measurement Range: 0.1nm - 10micron
 Resolution of film thickness: 0.01nm
 Resolution of measured R.I.: 0.001
 Sample alignment: Semi-automated (optical detection) with manual 10mm height adjustment and tilt
 Sample stage features: X -Y translation over 150 x 150mm (optional)
 Measurable film parameters: Refractive index, extinction coefficient, absorption coefficient and film thickness
 Software Features:
 Acquisition and analysis of psi, delta and reflectance at different wavelengths and angles
 User extendable materials library
 Data can be saved as an Excel or text file
 Advanced mathematical fitting algorithm
 Extraction of thickness and optical constants
 Parameterized models
 Multilayer thickness measurement



Ellipsometric Solutions

Need Customization for measurements. HOLMARC's experienced support engineers will be glad to help you. Call us at +91 484 2540075 or send us a mail to mail@holmarc.com or sales@holmarc.com.

Holmarc can provide custom spectroscopic ellipsometers to fit a wide variety of applications.

Magneto Optic Ellipsometry Automated Thin film Test Station (Magnetic Materials Characterization)

Model : HO-A216MOE-PH

Features:

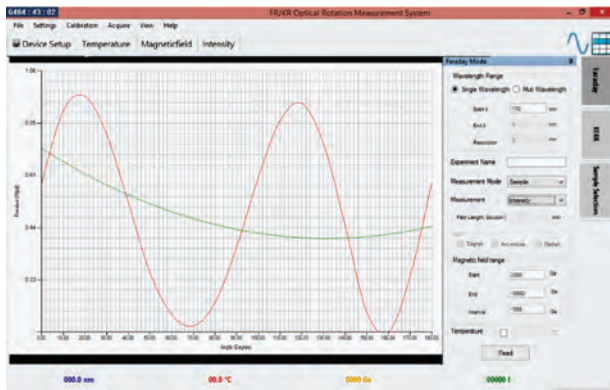
- Fiber optic coupled spectrometer**
- 350-900nm Measurement Range,**
- Fully automatic control,**
- Magnetic field detection & feedback facility,**
- Ellipsometric Measurements,**
- Reflection, Transmission &**
- Absorption measurements under Magnetic field**

Holmarc has introduced a new innovative high sensitivity and high magnetic field Spectroscopic ellipsometric measuring equipment utilizing the VIS-NIR wavelengths. HOLMARC A216 test station provides standardized testing solution to fit wide ranging optical rotation measurement applications. The modular hardware design allows user to take automatic liquid, solid and thin film sample measurements under magnetic and no magnetic field

Designed for magneto optic material research and testing including magnetic characterizations of ferromagnetic and ferrimagnetic films and materials. Measurement include magnetic hysteresis loops of ultrathin magnetic films and multilayers, Ellipticity measurements, Thin film thickness measurement of dielectric materials, Refractive index, Delta and psi measurements etc. System can be operated in Polar, Longitudinal and Transverse configurations.

Instrument is designed for measurement in the wavelength range of 380nm to 845nm using a high sensitive photo multiplier tube made by hamamatsu. It is an extremely flexible test station based on HARS. Any magnetic thin film, crystal or solutions having magnetic field dependency can be measured.

It can be used to measure magnetic properties of magnetic thin films and nano-magnet arrays. Thin film thickness measurements under uniform magnetic field applied to the sample provides user to characterize each class of materials.



Model : HO-A216MOE-PH Software window



Performance:

- Measuring Wavelength Range : 350-900nm**
- Spectral Bandwidth : 1nm (Variable band pass up to 10nm)**
- Max. magnetic field: 17,500 Gauss**
- Min. Field Detection : 1 Gauss**
- Magnetic field preciseness: ±0.05%**

Measuring Optical Properties

- | | |
|------------------------|--------------------|
| Film Thickness | Molar Refractivity |
| Refractive Index | Photon Energy |
| Absorption Coefficient | Canonical Momentum |
| Optical Conductivity | Kinetic Momentum |
| Phase velocity | Group Velocity |
| Group Index | Psi - Delta |
| Brewsters Angle | Epsilon 1 & 2 |

Slits for Multi Channel Spectroscopy



MODEL: HO-SL10U-2SMA

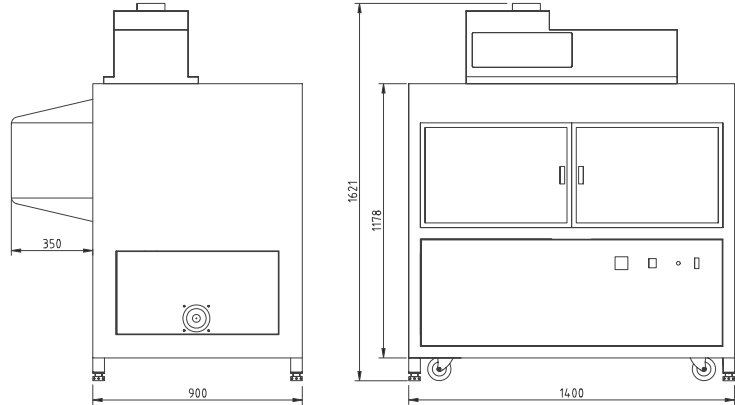
Designed for Multi-channel Process - Photometry application. Multi-channel spectrometers are used to monitor or measure multiple samples or sources simultaneously.

Combine up to 10 spectrometer channels in one slit is possible. All channels can be fully configurable to your needs. It can be designed to single sensor multi channel or multi sensor multi channel configuration. Please discuss your need with our engineers.

Model : HO-A216MOE-PH

Technical Specifications:

- Light source : Spectra Halogen, Deuterium/Halogen or Xenon Arc Lamp
- Spectrometer : Czerny-Turner Type
- Wavelength Range : 350-900nm
- Collimating & Focusing mirror : 50mm dia, 300F
- Optical Grating : 1200 l/mm
- Spectral dispersion : 2.6nm/mm
- Grating Size : 50X50mm
- Absolute Diffraction Efficiency : 45 - 65%
- Slit Width : 0~3mm Continuously Adjustable
- Resolution : 0.1nm
- Wavelength Accuracy : 0.2nm
- Wavelength Repeatability : 0.1nm
- Stray Light : 10^{-3}
- Reciprocal of Linear Dispersion : 2.7mm
- Half-Width of Spectral line : 0.2nm @ 586nm
- Polarization analysis method: Rotation analyzing method
- ARMS : Stepper Motor Controlled Auto Positioning
- Spot Diameter : 1-5mm
- Thin film Holder Sample size: 1-12mm
(Custom Holders can be provided on request)
- Cuvette : 10mm Path length Quartz Cuvette
- Sample chamber option : High / low temperature sample holder
- Sample Feeding Unit : Stepper Motor Controlled Auto Positioning System
- Electro Magnet Unit : PC Controlled Constant current operation
- Cooling : Water cooled
- Max. magnetic field : 1.75 Tesla @ 12mm pole gap
- Min. Field Detection : 1 Gauss
- Magnetic field preciseness: $\pm 0.05\%$
- Field detection: Hall probe based (PC based field measurement)
- Feed back of magnetic field: Hall element
- Chiller : 5~25°C Chilled water (for cooling electromagnet)
- Volume: 2 L/min.
- Power supply for Electro Magnet : Bi-Polar type (Max. $\pm 90V/5A$)
- Power supply for Electro Magnet : 2.5kVA AC220V 50Hz
- Control unit : 1kVA AC220V 50Hz
- Software: Spectra ORMS software



Models used in the software

- 1.Constant Value Model
- 2.Entered Value Model
- 3.Cauchy's Coefficients Model
- 4.Sellmeier's Coefficients Model
- 5.Combination of Cauchy & Sellmeier Model
- 6.Drude Coefficients
- 7.Lorentz-Drude Coefficients
- 8.Brendel-Bormann Coefficients
- 9.Adachi Coefficients
- 10.Cauchy Lorentz Coefficients
- 11.Amorphous Dispersion Coefficients
- 12.Cauchy Absorption Coefficients
- 13.Sellmeier Lorentz Drude Model Coefficients
- 14.Cauchy Urbach Coefficients

Material Library

- Aluminum with Lorentz-Drude Model
- Beryllium with Lorentz-Drude Model
- Borofloat
- CaO
- Chromium with Lorentz-Drude Model
- Cu₂ZnSnS₄ with Adachi model
- Cu₂ZnSnSe₄ with Adachi Model
- Gold(Au) with Brendel-Bormann Model
- ITO with Cauchy Absorption Model
- ITO with DrudeModel
- KBr(K Microscopic Slide)
- MgF₂ with Sellmeier Model
- NBK7
- Nickel with Lorentz-Drude Model
- Naf 66 with Combination Eqn
- PMMA PCBM with Cauchy-Lorentz Model
- Palladium with Lorentz-Drude Model
- Platinum with Lorentz-Drude Model
- PMMA with Amorphous Dispersion Model
- Si with Cauchy Model
- Silver (Ag) Empirical model
- SiO₂ with Cauchy Model
- SiO₂ with Sellmeier Model
- SnO₂ F (FTO) with Sellmeier Lorentz Drude Model
- Ta₂O₅ with Cauchy Model
- TiO₂ with Amorphous Dispersion Model
- TiO₂ with Cauchy Model
- Titanium with Lorentz-Drude Model

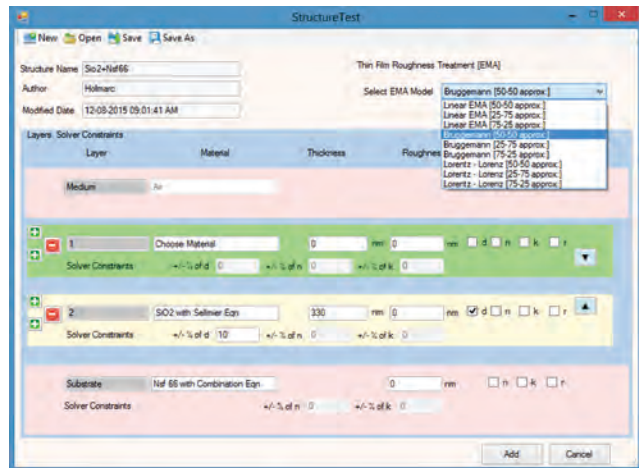
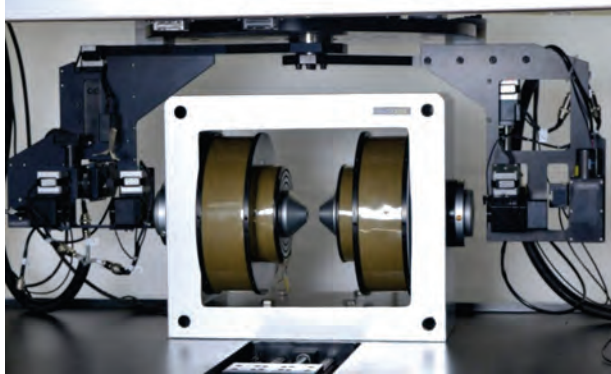


Fig. Layer Selection Software Window



The optical activity of transparent substance under an external electric field can also be investigated with addition of HV power supply on this unit.

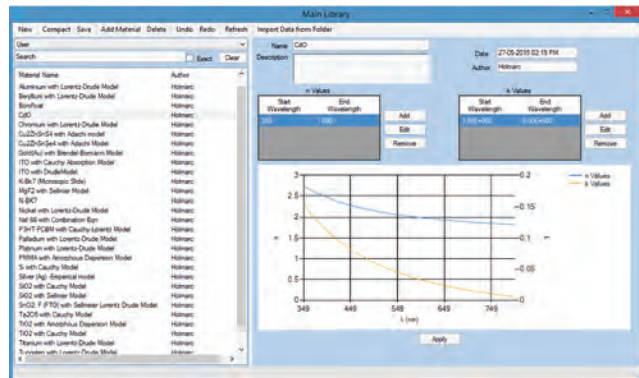


Fig. Material Library Software Window

Digital Polarimeter

Model : HO-DP-500

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Holmarc manufactures automatic digital polarimeters for industry and research with robust performance and efficiency. Symmetric angular oscillation optical null technique by Faraday Modulation is implemented in our polarimeters to achieve high resolution and repeatability. Operation is simple: place the sample filled tube in the automatic Polarimeter and press READ button. Measurement is displayed on the soft colour LCD display of the instrument.

The Polarimeter is used for determining the optical rotation of substances. By measuring optical rotation, the concentration, content, purity etc of the sample solution can be found out. Polarimeter has become one of the most useful instruments in research laboratories of sugar industry, pharmaceutical industry, oil refining, food industry, chemical industry as well as basic research in universities and R&D organizations.

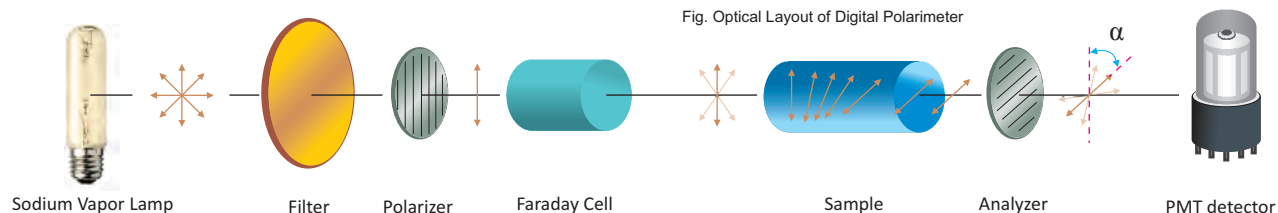
Major modules in our Polarimeter include light source, Interference filter, polarizer, Faraday modulator, sample chamber, analyzer and Detector. Unpolarized light from the light source (Sodium vapour lamp) passes through an interference filter and polarizer so that a fixed wavelength polarized light comes out. This polarized light enters the Faraday Modulator and then passes through the sample cell. The modulated light which passed through the sample cell enters a second polarizer, known as the "Analyzer", which detects the angle of rotation. Finally, the light falls on a photomultiplier tube which converts the light intensity to an electric signal.

Specifications

Light source	: LED
Optical wavelength	: 589 nm
Measuring range	: $\pm 90^\circ$
Resolution	: 0.009 Deg.
Repeatability	: 0.018 Deg.
Accuracy	: 0.027 Deg.
Measuring modes	: Optical Rotation, Specific rotation, Concentration, Optical Purity & Sugar Scale.
Sample chamber	: Accepts sample cells up to 200mm Length
Principle	: Symmetric angular oscillation optical null principle
User interface	: 5 inch Touch Screen Display and PC Software
Software	: Spectra P Analyte
Detector	: Silicon Photo Diode (Hamamatsu)
Power requirement	: AC100- 230 V 50 Hz



Optical rotation is directly proportional to path length; the longer the tube, the greater the overall accuracy. Holmarc's Polarimeter accepts tubes up to 200mm long. A 200mm sample tube offers twice the sensitivity compared to measuring the same solution in a 100mm sample tube. Different types of sample tubes are available up to 200mm length.



Spectroscopic Polarimeter

Model : HO-ASP-500



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Holmarc manufactures high quality automatic polarimeters for industry and research with robust performance and efficiency. Symmetric angular oscillation optical null technique by Faraday Modulation is implemented in our polarimeters to achieve high resolution and repeatability.

In HO-ASP-500 a quartz halogen lamp with high spectral resolution monochromator is incorporated as light source. The measurements can be performed over wide range of analytical wavelengths from 380-850nm by using quartz halogen lamp. Also the wavelength accuracy is better compared to the normal interference filters. Our high quality optical system improves the light collection and flexibility of the system. All adjustments on the device are made via an easy to use touch screen .The sample parameters can be customized for different applications.

Holmarc offers full line of accessories for Polarimeter. Temperature control and temperature compensation can be incorporated to eliminate the variation of results with temperature. Wide range of polarimeter sample cells are available. Center cup tubes and continuous flow through cells can also be supplied as optional accessories for custom applications.

Specifications

Light source : Quartz halogen lamp
 Detector : PMT
 Monochromator : Czerny-Turner
 Grating : Blazed holographic
 Wavelength range : 380-850nm
 Bandwidth : 1nm
 Positioning accuracy : +/-0.25nm

Optical Rotation

Measuring range : $\pm 90^\circ$
 Resolution : 0.009 Deg.
 Repeatability : 0.018 Deg.
 Accuracy : 0.027 Deg.
 Sugar Scale Range : $\pm 259^\circ Z$
 Resolution : $\pm 0.01^\circ Z$
 Repeatability : $\pm 0.1^\circ Z$
 Accuracy : $\pm 0.1^\circ Z$

Principle of operation : Symmetric angular oscillation optical null principle.

Measuring modes : Optical Rotation, Specific rotation, Concentration, Optical Purity & Sugar Scale.

Sample chamber : Accepts sample cells up to 200mm Length

Temperature Control Unit (Optional)
 Type : Peltier Based
 Temperature range : 15° - 75° Celsius
 Temperature accuracy: +/-0.5%

PC Interface : RS232

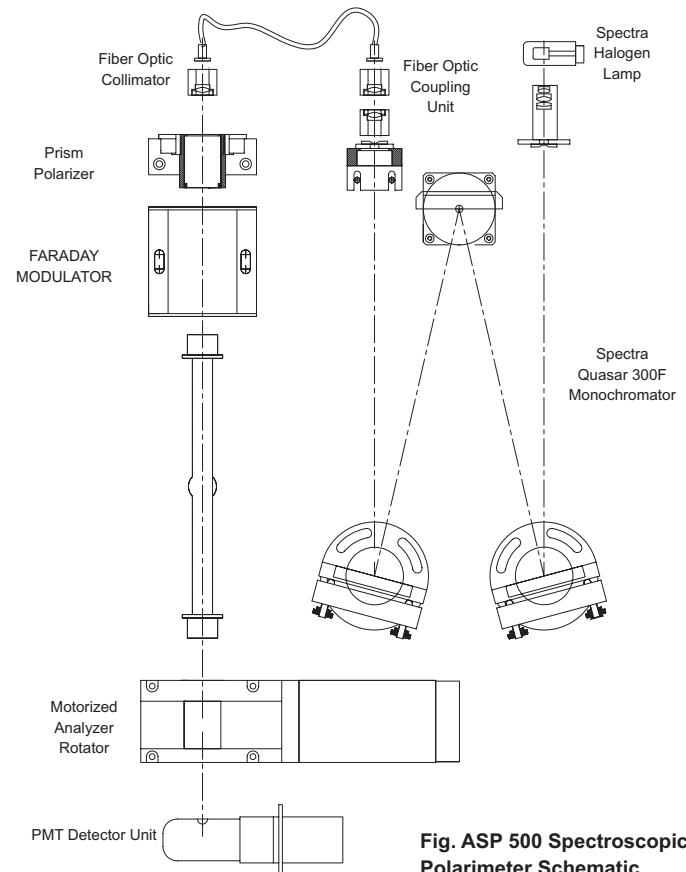


Fig. ASP 500 Spectroscopic Polarimeter Schematic

Automatic Refractometer

Model : HO-AR-1700

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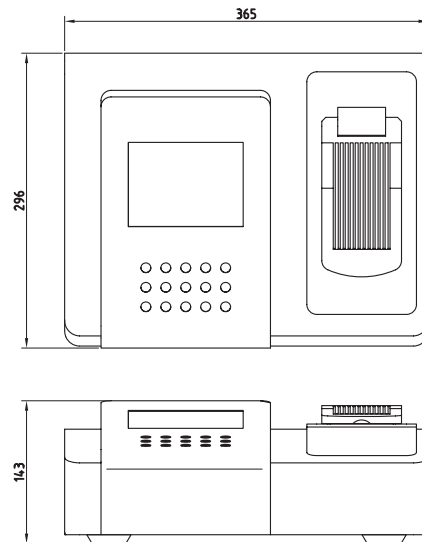
AR-1700 Automatic Refractometer from Holmarc is a compact instrument used for measuring refractive index and brix at the digital, automatic level. The AR-1700 Automatic Refractometer features exceptional accuracy, automatic temperature compensation, a wide reading range and simple and fast operation. It offers outstanding flexibility to provide accurate readings for a variety of applications.

The refractive index measurement is easy, fast and non-destructive and can be used to identify and characterize materials. The sample is placed on the measuring prism and is irradiated by a 589nm (Na D-line) LED. The shadow line is detected with a high-resolution linear array CCD and hence the refractive index is obtained using internal software and is displayed. Degrees Brix (symbol °Bx) is the sugar content of an aqueous solution. It is the most commonly used refractometer scale for measuring solids dissolved in water; it corresponds directly to the refractive index scale. Temperature correction or control is necessary in refractometers because refractive index varies with temperature. In Holmarc's refractometer automatic temperature compensation (ATC) corrects readings over a range of temperatures for sucrose solutions. A temperature sensor is also integrated for the precise measurement of sample temperature.

The AR-1700 refractometer features an expanded refractive index reading range of 1.3200 to 1.6500 which enables the user to analyze a broad range of samples. The alphanumeric key pad and graphic display provide a means of entering and displaying prompts and data. Regardless of an instrument's specified accuracy, a refractometer's real world performance depends on how well the instrument is cleaned between samples. The AR-1700 addresses this issue by providing a very flat, easy to clean measurement surface with no corners or crevices that tend to trap samples causing contamination.

Specifications

Principle of operation	: Optical-Refracton Critical-Angle detection system
Refractive index	: 1.3200 - 1.6500
Resolution	: 0.0001
Accuracy	: +/-0.001
Brix	: 0-95%
Resolution	: 0.01%
Accuracy	: +/-0.5%
Optical Wavelength	: 589nm (Na D-line)
Light Source	: High Bright LED
Filter	: 589nm Interference Filter
Detector	: Toshiba Linear Array CCD
Display	: 5" LCD Touch Display.
Temperature Control	: Peltier Based 25°C Constant Temperature Control
Power Supply	: AC 230V/50Hz



HOLMARC TELEMICROSCOPE

- ▶ Long working distance
- ▶ Variable Magnification
- ▶ Superior image quality
- ▶ Easy to set
- ▶ Co-axial illumination
- ▶ Roll, Yaw rotation stages
- ▶ XY Micrometer Drive
- ▶ Thermal Analysis
- ▶ Crack Monitoring
- ▶ Stress Analysis
- ▶ Micro Level positioning of long distant objects

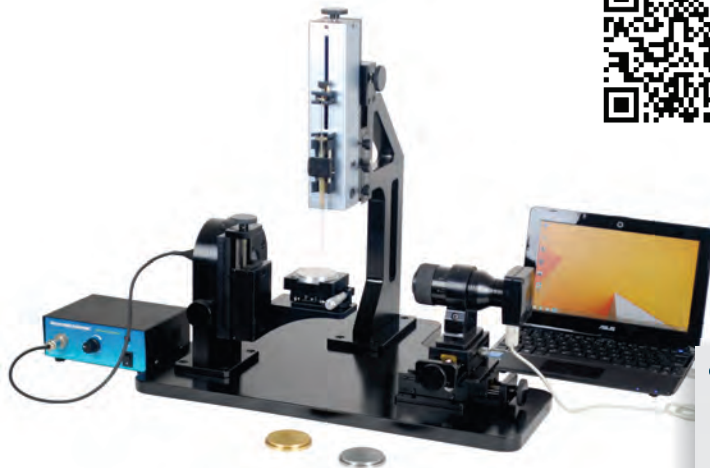
This Instrument is designed for imaging very small area from a distance of 200-2000mm. It allows microscopic imaging at a considerable distance from the object.

It can image a small area at unreachable places which cannot be measured with ordinary instruments. A typical application of the instrument is observing the sessile drops in furnaces. Another application is for temperature deformation studies of hot objects in the oven. The coaxial illumination in this unit helps for imaging the small parts at inaccessible areas which cannot be imaged by other methods



Contact Angle Meter

Model : HO-IAD-CAM-01



HOLMARC's Contact angle meter Model HO-IAD-CAM-01 is an entry level equipment for taking contact angle measurements. It has manual dispensing with CMOS interface for measuring contact angles of liquids on solid surfaces. The surface over which contact angle is to be measured is held in horizontal position to find out contact angle using sessile drop method. The equipment enables:

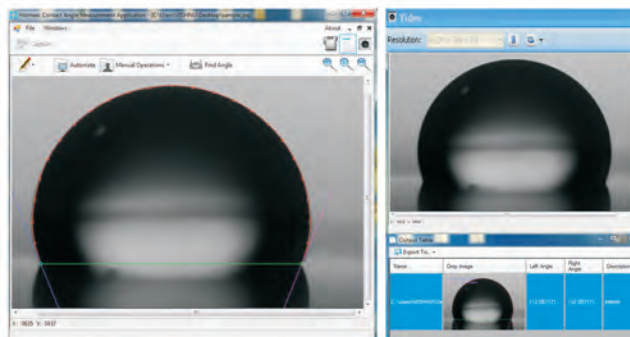
Static Contact angle measurements

The instrument uses sessile drop method which is the standard for quick and accurate wetting results for finding out Contact angles.

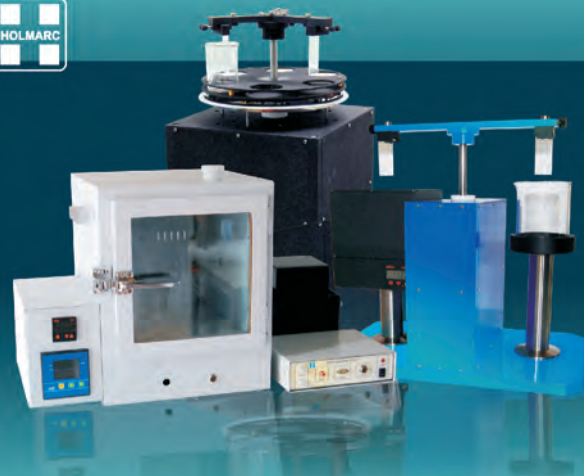
- State-of-art optics, precise opto-mechanics, high-resolution camera and associated electronics used in our instrument guarantee error free measurements. Manual dispensing of liquids is done in this equipment.
- Standard off the shelf syringes can be integrated from 0.4 to 20 mm, from any manufacturer.
- Compatible with glass ,plastic and SS syringes.

Technical Highlights

1. Warm light LED with variable intensity control ensures extreme low heat radiation.
2. Precise travel adjustment provided for Camera with optics assembly to fine focus the image.
3. Manual dispensing.
4. 50,100& 250 micro litre sample syringes provided with the system.
5. Precision height adjustment provided at the test base.
6. Vibration inhibiting solid construction for sharp drop images.
7. Powerful and user friendly windows software provided for image analysis.
8. Live image can be viewed on the PC monitor showing the droplet on the solid surface reassures the operator-regarding validity of the contact angle measurements.
9. Video processing enabled software.
10. Captured image and its angle measurement table can be saved for future reference.



Contact angle is the angle formed by a liquid at the phase boundary where a liquid, gas and solid intersect. The shape of the drop is controlled by the three forces of interfacial tension.



THIN FILM EQUIPMENTS



Holmarc Opto-Mechatronics Pvt. Ltd. is a diversified manufacturing company catering to the needs of industry, research. The product we manufacture for thin film research have been developed for university research activities over a period of eight years. Now we have standardized all these equipments for cost effective manufacture. All these products can be customized to suit specific applications. We welcome such requests from all our customers.

Visit us: www.holmarc.com

E-mail : sals@holmarc.com

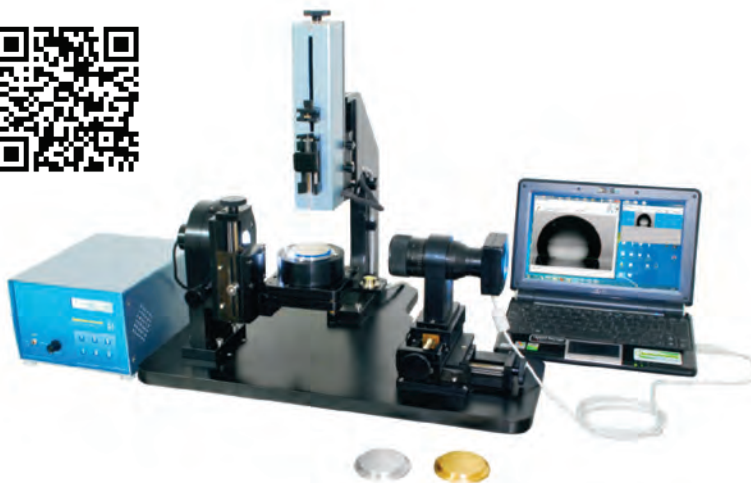
Ph.No. 91-484 2540075

Fax: 91-484 2540882

Contact Angle Meter With Rotatable Substrate Holder & Automated Dispenser

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Model : HO-IAD-CAM-01A



HOLMARC's Contact angle meter Model No: HO-IAD-CAM-01A is an analytical instrument for research as well as industrial application with motorized syringe pump for precise dispensing and camera interface for measuring contact angle of liquids on solid surfaces..The surface over which contact angle is to be measured can be tilted through +/- 180 degree from its horizontal position for finding out contact angle hysteresis.

The equipment enables:

Static Contact Angle Measurement

The instrument uses sessile drop method which is the standard method for quick and accurate wetting results for finding out Contact angles.

Advancing / Receding Angle measurement (Contact angle hysteresis)

To find out Contact angle hysteresis, the platform where the drop is placed can be tilted through an angle of ± 180 degrees. From the advancing and receding angle, Contact angle hysteresis can be calculated

Dynamic Contact Angle Measurement

Dynamic measurements are made by utilizing the motorized syringe dispenser in the system. Automated flow rate from $1 \mu\text{l} / \text{m}$ to $100 \mu\text{l} / \text{hr}$ is possible. Video capturing and image processing features are included in Holmarc's contact angle measurement software..

Technical Highlights

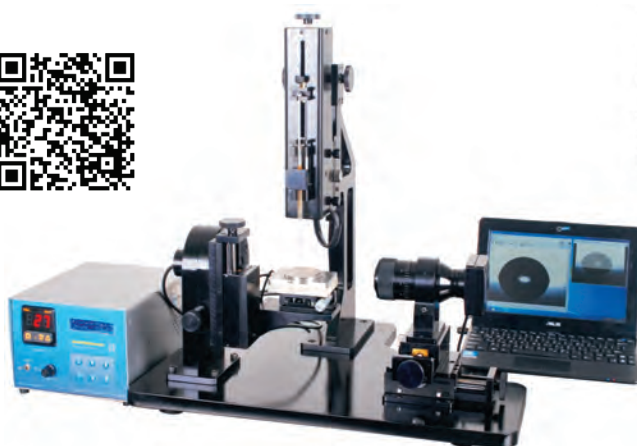
1. Warm light LED with variable intensity control ensures extreme low heat radiation.
2. Precise travel adjustment provided for CMOS with optics assembly to fine focus the image.
3. Manual and motorized syringe pump for precise micro litre dispensing
4. 50, 100 & 250 micro litre sample syringes provided with the system.
5. Precision height adjustment and angular displacement provided for the test base.
6. Vibration inhibiting solid construction for sharp drop images.
7. Powerful and user friendly windows software provided for image analysis.
8. Live image can be viewed on the PC monitor showing the droplet on the solid surface reassures the operator-regarding validity of the contact angle measurement.
9. Substrate can be rotated +/-180 degree from horizontal position.
10. Captured image and its angle measurement table can be saved for future reference.

Contact Angle Meter with Rotatable Substrate Holder , Automated Dispenser & Temperature Control

Model : HO-IAD-CAM-01B

HOLMARC's Contact angle meter Model: HO-IAD-CAM-01B is an advanced model with automated dispenser, rotatable substrate holder and temperature control. It is a dedicated research instrument. Motorized syringe pump for precise dispensing and camera interface for measuring contact angle of liquids on solid surfaces with temperature control feature (up-to 100 degree Celsius) for the substrate holder prove to be ideal for the study of contact angle variations with respect to temperature.

The surface over which contact angle is to be measured can be tilted through +/- 180 degree from its horizontal position for advanced contact angle study and to find out contact angle hysteresis. The equipment enables static & dynamic contact angle measurement and its variation with respect to temperature change.



- State-of-art optics, precise opto-mechanics, high-resolution camera and associated electronics used in our instrument guarantee error free measurements.
- Manual and motorized syringe pump for precise micro litre dispensing.
- Compatible with glass ,plastic and SS syringes.

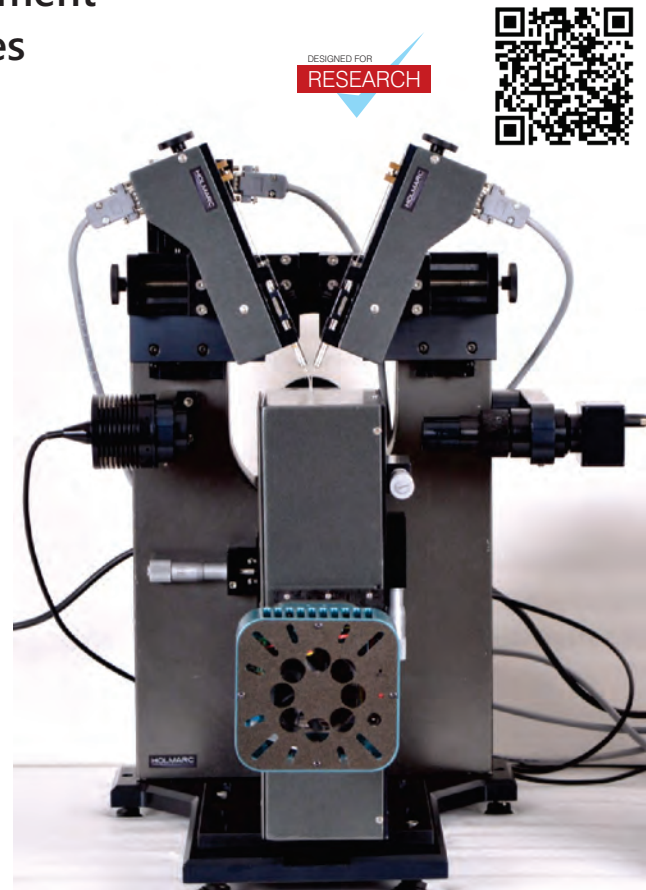
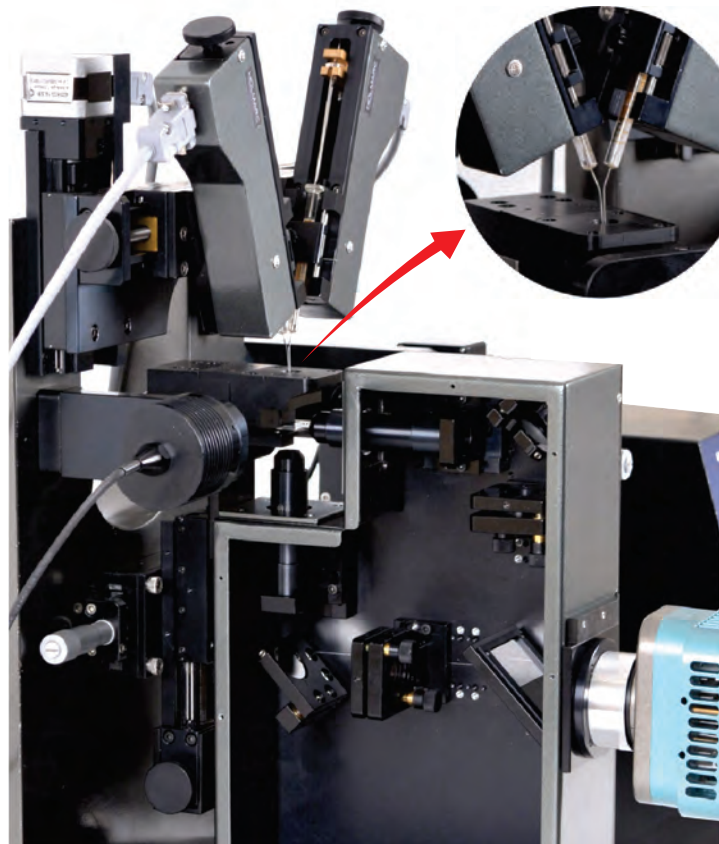
Contact Angle Measurement Instrument for Under-liquid low energy surfaces

Model : HO-IAD-CAM-LLE

Unlike the standard setup in which we use syringe to create and drop the liquid onto the surface, this unique instrument can be used to create two independent droplets inside a liquid bath. The droplet surface can be visualized from bottom and side-ways using a unique camera setup. In the pendant drop deposition technique, a needle containing the drop at its end is brought near the surface. On touching the surface the drop spreads and attains equilibrium and in the process the drop gets detached from the needle spontaneously.

This mechanism inevitably requires the condition that the drop-substrate surface energy is larger than the drop needle surface energy. Hence for surfaces, for which the corresponding drop-substrate surface energy is much smaller than the drop-needle surface energy, such simple steps, as discussed above, do not occur.

Using our instrument, one can generate a drop at the tip of a needle inserted inside the liquid bath, where the low energy substrate is present. Instead of bringing the drop closer to the substrate as we do in our standard contact angle meter, we take it away from the substrate so that the drop needle entity hits the liquid-fluid interface. Here this fluid can be air, or some other liquid whose film has been deliberately created on the liquid surface. The moment the drop-needle combination hits the liquid-fluid interface, the drop and the needle are subjected to different surface tension forces, thereby allowing them to get detached from each other. Consequently, the needle goes out of the liquid bath, whereas the drop remains at the interface.



Technical Highlights

- ▶ The motions are fully automated and can be controlled using dedicated software.
- ▶ The system includes dual Syringe pump, two 13.5mm W.D 10X objectives, zoom lens assembly, Image combining optics, 5mp USB camera, sample positioning stage, LED light source etc.
- ▶ The bottom & side profile views of the droplet are same in width and can be viewed in a single window.
- ▶ There are two backlight LED's provided along with the equipment., the top light LED and side light LED. They are integrated on the same unit which is detachable whenever required.
- ▶ The automatic retraction of syringe head (two syringes will move together) is possible in the equipment. The automated retraction speed max is 4mm/sec.
- ▶ The camera can be positioned at different angles to the needle assembly to get a view on entire drop/drops sitting inside the cuvette.
- ▶ X-Y translation for the substrate holder is provided in the equipment.
- ▶ Imaging area of our CMOS sensor is 5.70mm x 4.28mm (7.13mm diagonal) for bottom and side imaging.
- ▶ Provision to integrate your camera in the present equipment. Standard contact angle measurements can also be conducted and studied using this equipment.

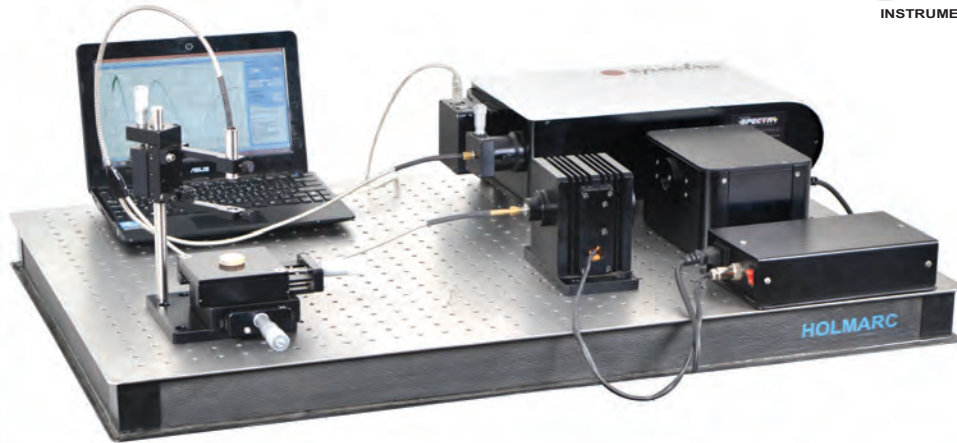


Thin Film Spectroscopic Reflectometer

Model : HO-HAI-TFR-01SP



DESIGNED FOR
RESEARCH



Features

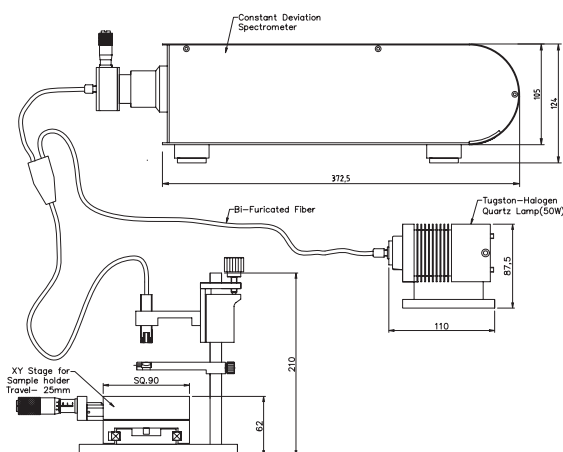
- Thickness range from 25nm to 35 μ m
- Wavelength range : 400nm - 850nm
- Spectra CT216 Spectrometer
- Spot size : 1mm
- Measurement of Single layers
- Measurement of Multilayer stack

Specifications

- Film Thickness range : 25nm - 35 μ m
- Reflectance Wavelength range : 400nm - 850nm
- Transmittance / Absorbance range : 0 - 100%
- Light source : Tungsten Halogen Quartz Lamp, 50W
- Detector : CCD linear array, 3648 pixels
- Spectrometer : Spectra CDS 215
- Precision typically for SiO₂ on NSF - 66 : \pm 1 nm
- Accuracy for same sample : \pm 20 nm
- Optical Power : 20 W
- Light spot size : 1 mm
- Optical fiber : Multimode Bi-furcated fiber with SMA fiber coupler
- Reference Sample : Polished NSF-66 and N-Bk7
- Standard Sample : SiO₂ thin film on NSF- 66 Substrate
- Measuring modes : Curve fitting / Regression Algorithms, FFT, FFT + Curve Fit
- Dispersion formulas : Cauchy's, Sellmeiers & Empirical Models
- EMA models : Linear EMA, Bruggemann, Maxwell Garnett, Lorentz - Lorenz models
- Material Library : Extendable Material user library
- PC Interface : USB

Thin Film Spectroscopic Reflectometer is a fundamental instrument used for thin film thickness analysis for industry & research. Holmarc's TFSR Model No: HO-HAI-TFR-01SP is able to analyze thin film's thickness, complex refractive index & surface roughness with high speed & repeatability. TFSR theory works with complex matrix form of Fresnel equations for reflectance & transmittance. Absolute reflectance spectroscopy is the principle behind Reflectometer; which is the ratio of the intensity of the reflected light beam (usually monochromatic) to the intensity of the incident beam. Light beam which normally incidents on the sample surface in turn reflect from top & bottom of the thin film surfaces which get interfere & is directed through Optical fiber to CCD attached spectrometer via computer. On the monitor we get spectrogram with interference oscillations directly proportional to thin film thickness.

Holmarc's Reflectometer can be used to analyze single, multi-layer, free standing & rough layer thickness of various stacks such as di-electric, crystalline, amorphous, metallic & absorbing samples. It also finds absolute transmittance & absorption directly. Roughness treatment is done with EMA modeling. It also finds Optical conductivity, molar Refractivity & Brewster's angle of sample under study.

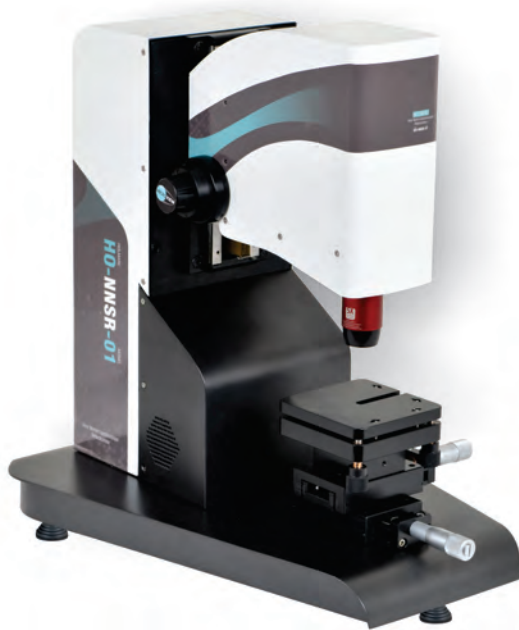


Features

- Analyze single and multi-layer films
- Fiber optic probe for reflectance measurement at normal incident angle
- CCD linear array image sensor for simultaneous measurement of reflectance at each wavelength
- User extendable materials library
- Data can be saved as an Excel or text file
- Advanced mathematical fitting algorithm
- FFT based thickness measurement
- Extraction of thickness and optical constants
- Parameterized models

Near Normal Spectroscopic Reflectometer

Model : HO-NNSR-01



Near Normal Spectroscopic Reflectometer is a fundamental instrument used for thin film thickness analysis for industry & research. Holmarc's NNSR (Model No: HO-NNSR-01) is able to analyze thin film's thickness, complex refractive index & surface roughness with high speed & repeatability. NNSR theory works with complex matrix form of Fresnel equations. Absolute

reflectance spectroscopy is the principle behind Reflectometer; which is the ratio of the intensity of the reflected light beam (usually polychromatic) to the intensity of the incident beam. Light beam which normally incident on the sample surface in turn reflect from top & bottom of the thin film which get interfered & is directed through optical fiber (Bi-furcated fibre) to CCD attached spectrometer via computer. On the monitor we get spectrogram with interference oscillations directly proportional to thin film thickness.

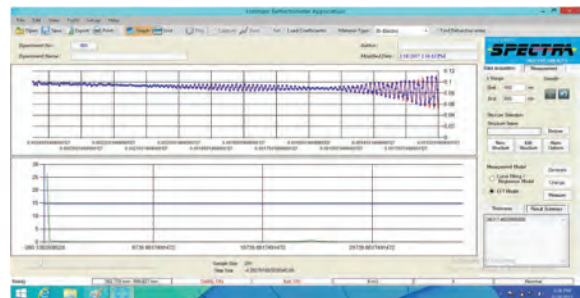
Features:

- ▶ Analyze single and multi-layer films (Indirect method)
- ▶ Fiber optic probe for reflectance measurement at normal incident angle.
- ▶ CCD linear array detector for absolute reflectance measurement.
- ▶ Levenberg - Marquardt curve - fitting algorithm for thickness measurement.
- ▶ FFT based Thick-layer thickness measurement standardized with PET films.
- ▶ Linear, Bruggemann & Maxwell Garnet approximation models for roughness measurements
- ▶ Absorption & Transmittance studies.
- ▶ Parameterized dispersion models such as Cauchy, Sellmimer, combination & drude for n & k values
- ▶ User extendable materials library
- ▶ Data can be saved as an Excel file for extraction of optical properties

Specification

Film Thickness Range : 25nm – 3.5 μ m
 FFT Thickness Range : 3500nm – 35 μ m
 Spectrometer wavelength range : 314nm - 940nm
 Reflectance wavelength range : 320nm - 940nm
 Light Source : Tungsten Halogen Quartz Lamp, 20 & 50W (customized)
 Detector : CCD linear array, 3648 pixels
 Transmission method : Bi-furcated fibre [Glass core & PMMA cladding]
 Precision for thin film stack : \pm <1 nm
 Accuracy for same stack : \pm <2 nm (without roughness)(compared with SEM)
 Spot size on sample : 120 micron with the 5X SLWPA objective
 Working Distance : 3 mm
 Optical fiber : Multimode Bi-furcated fiber with SMA
 Scanning : Manual(Micrometer controlled 15mm scanning)
 Reference Sample : Bare NSF66 / Bare Aluminum (customized) / Normal slide
 Dark Sample : N-Bk7 black coated / Al Mirror kept at 45° (customized)
 Standard Sample : SiO₂ thin film on NSF-66 Substrate / Bk7 substrate
 Measuring modes : Curve fitting / Regression Algorithms, FFT, FFT + Curve Fit
 Dispersion formulas : Cauchy, Sellmeier & Empirical Models
 EMA models : Linear EMA, Bruggemann, Maxwell Garnett models
 PC Interface : USB

Holmarc's Reflectometer can be used to analyze single, multi-layer, free standing & rough layer thickness of various stacks such as dielectric, crystalline, amorphous, metallic & absorbing samples. It also finds absolute transmittance & absorption directly for linear di-electric thin films. Roughness treatment is done with EMA modeling such as linear, Bruggemann & Maxwell garnet approximations. Manual scanning is provided for finding out roughness and uniformity of thin films. Without refractive index or any other optical properties, NNSR is able to find the thickness of thin/thick film and estimate its optical properties.



Near Normal Spectroscopic Reflectometer/Transmissometer

Holmarc's Model HO-NNSRT-02 Transmissometer / Reflectometer is a precision instrument designed to accurately measure the spectral transmissivity and reflectivity of a wide range of samples. Specifications are remain same as Model HO-NNSR-01. The system consists of two fiber optic coupled CCD spectrometers for transmittance and reflectance measurements. 30W fiber coupled quartz halogen lamp is used as the source. The sample stage is built on a rigid system for stability and is adjustable to accommodate a wide range of optics.

Model HO-NNSRT-02
 Wavelength Range : 350-950nm
 Spot size : 70 Micron
 XY Sample stage travel : 25x25mm
 (Motorized stages are available)





Laser Based Magneto-Optical Kerr Effect Setup (MOKE)

Model : HO-MOKE **LB215**

HOLMARC MOKE LB215 is an easy to use magneto-optical Kerr effect (MOKE) laser based system which provides a convenient way to obtain the changes in magnetic moment at different fields and temperatures. 408nm, 532nm and 650nm Diode lasers are used for the measurements.

Lock-in amplifier technique is employed in this instrument and the modulation is performed with an optical modulator. Sample is mounted in the center of the magnet with its surface either parallel or perpendicular to the field. The supplied high field, variable gap, dipole electromagnet allows the user to apply large fields (approx. 20,000 Gauss at 10 mm pole gap) in a longitudinal or perpendicular geometry to study hard magnetic materials. HOLMARC MOKE LB215 is supplied with ORMS software. It can manage data collection and data manipulation fast and accurate.

The magneto-optical Kerr effect is a well established technique to study magnetization properties. The effect is based on the fact, that the plane of polarization of light is rotated when the light is reflected from a magnetic material. The physical origin of MOKE is the magnetic circular dichroism effect: exchange and spin-orbit coupling in a magnetic material lead to different absorption spectra for left- and right-circularly polarized light. Measuring the change of polarization of reflected beam (often referred to as Kerr angle θ_{Kerr}) gives access to the magnetization state of the sample.

MOKE is particularly important in the study of ferromagnetic and ferrimagnetic films and materials. In this non-destructive surface sensitive technique, polarization-modulated laser light reflects from a magnetic surface in the presence of a sweeping magnetic field. Since light is an electromagnetic field, it's not surprising that the magnetic field of the sample interacts with the light to cause a very slight change in the light's polarization and ellipticity. We measure these changes in the light as an intensity change through nearly crossed polarizers, recording the intensity as a function of the applied magnetic field.

Using this instrument Polar, Longitudinal and Transverse Magneto-optic Kerr effect can be studied. Longitudinal and polar configurations are used as routine tools for the magnetic characterizations of films. A dedicated room-temperature set-up provides for quick acquisition of in-plane hysteresis loops. These hysteresis loops provide information on the magnetic anisotropy presence in the film, and in the case of multi layers on the coupling between the layers. In the longitudinal Kerr effect, measurements yields qualitative information regarding alignment of magnetic moments in the surface plane of the sample. Measurement of the magnetization component perpendicular to the sample surface can also be studied using this setup.

Basic Features:

High Sensitivity

The system uses an advanced signal processing technology to get very high sensitivity.

High Flexibility and Wide Range Magnetic Field

Specially designed electro magnets are able to apply high in-plane and out-of-plane magnetic field continuously tunable between zero to 20,000 Gs.

Easy to Operate

Variable temperature measurement or custom designs for special-purpose measurements and configurations can be made depending upon customer's demands.

Specifications:

Laser Wavelengths : 405nm, 532nm, 650nm Diode Lasers
Optical Rotation Sensitivity : 0.009 Degree(Kerr rotation angle)
Optical Rotation Resolution : 0.018 Degree
Ellipticity Measurement : ± 0.01 deg.
Optical Rotation Measuring range: ± 90 deg.
Spot size:0.1mm (Variable)
Electro Magnet Unit : PC Controlled Constant current operation
Maximum Magnetic field: 20,000 Gauss @ 10mm Pole Gap
Min. Field Detection : 1 Gauss
Magnetic field preciseness: $\pm 0.05\%$
Chiller : 5~25°C Chilling water (for cooling electromagnet)
Field detection: Hall probe based (PC based field measurement)
Feed back of magnetic field: Hall element
Sample chamber options : High / low temperature sample holder
Sample moving Stage : X, Y & Z axis Positioner with angular tilting
Travel : X, Y & Z (± 5 mm) with Positioning resolution of 10 Micron
Software: Spectra ORMS software

Sample Heating Cooling Options:

MODEL : HC 200

Temperature Range from RT to 200°C, PID thermo control
Setting resolution:0.1° C, Thermo sensor:Pt 100 Ohms

MODEL : NC 70

Sample holder for low temperature (Nitrogen CRYOSTAT)
Chamber to cool sample around to -70°C by liquid nitrogen.
Setting resolution: 1°C, Thermo sensor:Pt 100 Ohms

MODEL : TE 05

Heating/cooling method by TE cooler ,Temperature range, -5 to 40°C
Thermo control method: PID control, Thermo stability: $\pm 0.5^\circ\text{C}$

Spectroscopic Magneto-Optic Rotation Measurement System (Faraday Rotation Measurements)



Model : HO-VIS214ORMS

It is designed for Faraday rotation angle measurements in the range of wavelength 385nm to 845nm. Magnetic field dependency of Faraday rotation can be measured precisely with this equipment. Working of this Faraday Effect Measuring Equipment is based on the rotation analyzer method. Max. magnetic field of 15,000 Gauss can be generated at pole gap of 12mm. Optical rotation measurement resolution is ± 0.01 deg.

By using optional device, thermal dependence can be also measured. It is possible to evaluate thermal dependency property in the range of -70 to 300°C, as it is designed to mount heating chamber and cryostat. The software allows users to control the sample temperature and magnetic field.

Performance:

Optical Rotation Measurement Resolution : ± 0.009 Degree
(at transparence more than 20%)

Detecting sensitivity: 0.009deg.

Optical Rotation Measuring range: ± 90 deg.

Measuring Wavelength Range : 385nm -845nm

Spectral Bandwidth : 1nm (Variable band pass up to 10nm)

Max. magnetic field: 15,000 Gauss at 12mm pole gap

Min. Field Detection : 1 Gauss

Magnetic field preciseness: $\pm 0.05\%$

Measuring items:

OR Measurement of Thin film, crystal, fluids etc, having Faraday effect
Measurement Verdet Constant of Transparent Solids and Liquids
Magnetic field vs. Faraday rotation angle at a desired wavelength
Faraday rotation angle vs. Wavelength dispersion
Faraday rotation angle vs. Thermal dependence (Optional Feature)

Specifications:

Light source : Spectra 20W Quartz Halogen Lamp

Polarization analysis method: Rotation analyzing method

Cuvette : 10mm Path length Glass Cuvette

(Custom Holders can be provided on request)

Sample chamber options : High / low temperature sample holder

Sample moving Stage : X, Y & Z axis Positioner

Travel : X, Y & Z (± 5 mm)

Positioning resolution : 10 Micron

Angular resolution 0.1 deg.

Electro Magnet Unit : PC Controlled Constant current operation

Cooling : Water cooled

Max. magnetic field : 1.5 Tesla @ 12mm pole gap

Min. Field Detection : 1 Gauss

Field detection: Hall probe based (PC based field measurement)

Feed back of magnetic field: Feed back as the sensor of Hall element

Chiller : 5~25°C Chilling water (for cooling electromagnet)

Power supply for Electro Magnet : Bi-Polar type (Max. ± 90 V/5A)

Power supply for Electro Magnet : 2kVA AC220V 50Hz

Control unit : 1kVA AC220V 50Hz

Software: Spectra ORMS software



Features:

- Flexible and Adaptable Optical Layout**
- 385-845nm Measurement Range**
- 0.009 Degree Optical Rotation Resolution**
- Option for fully automatic control**
- Magnetic field detecting sensor**
- Magnetic field feedback facility**

Temperature Control Options:

A MODEL : HC 85

Sample chamber can be heated from room temperature to 200°C to measure temperature dependence property.

Temperature Range from RT to 85°C, PID thermo control

Setting resolution: 0.1° C

Thermo sensor: Pt 100 Ohms

B MODEL : NC 70

Sample holder for low temperature (Nitrogen CRYOSTAT)

Chamber to cool sample around to -70°C by liquid nitrogen.

Setting resolution: 1°C

Thermo sensor: Pt 100 Ohms

C MODEL : TE 05

Heating/cooling method by TE cooler

Temperature range, -5 to 40°C

Thermo control method: PID control

Thermo stability: ± 0.5 °C

When options are mounted on the equipment, max. magnetic field may be reduced.

Custom magneto-optical system can be supplied.
Special sample stages can be provided for precision movement of the sample about vertical and horizontal axes



Magneto Optic Spectrometer Spectroscopic Kerr/Faraday/ Ellipsometry Fully Automated Optical Rotation / Thin film Test Station



Model : HO-A216FR/KR-ORMS

Features:

- 380-850nm Measurement Range
- 0.009 Degree Optical Rotation Resolution
- Fully automatic control
- Magnetic field detecting & feedback facility
- MOKE Measurements
- Ellipsometric Measurements

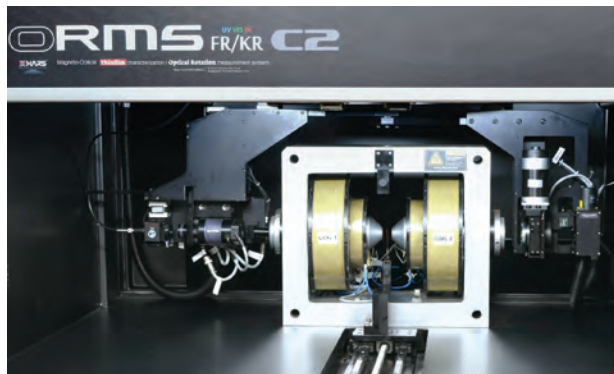
Performance:

- Optical Rotation Resolution : ± 0.009 Degree
- Detecting sensitivity: 0.009deg (at transpance more than 20%).
- Stability : 0.03deg (at transpance more than 20%).
- Ellipticity Measurement : ± 0.01 deg.
- Optical Rotation Measuring range: ± 90 deg.
- Measuring Wavelength Range : 380-850nm
- Spectral Bandwidth : 1nm (Variable band pass up to 10nm)
- Max. magnetic field: 11,000 Gauss @ 20mm Pole Gap
- Min. Field Detection : 1 Gauss
- Magnetic field preciseness: $\pm 0.05\%$



Holmarc has introduced a new innovative high sensitivity and high magnetic field Spectroscopic Faraday/Kerr effect measuring equipment utilizing the VIS-NIR wavelengths. HOLMARC A216 FR/KR test station provides standardized testing solution to fit wide ranging optical rotation measurement applications. The modular hardware design allows user to take automatic measurements of Faraday effect, MOKE & Ellipsometry in a single instrument.

Designed for magneto optic material research and testing including magnetic characterizations of ferromagnetic and ferrimagnetic films and materials. Measurement include magnetic hysteresis loops of ultrathin magnetic films and multilayers, Ellipticity measurements, Thin film thickness measurement of dielectric materials, Refractive index, Delta and psi measurements etc. System can be operated in Polar, Longitudinal and Transverse configurations.



Instrument is designed to effect Magneto-Optic Kerr and Faraday effect measurement in the wavelength range of 380nm to 845nm. It is an extremely flexible test station based on HARS. Any magnetic thin film, crystal or solutions having Kerr effect and Faraday effect can be measured.

Measuring items:

- OR Measurement of Thin film, crystal, fluids etc, having Faraday effect
- Measurement Verdet Constant of Transparent Solids and Liquids
- Faraday rotation / ellipticity angles.
- Polar Kerr rotation / ellipticity angles.
- Magnetic field vs. Faraday rotation angle property at a desired wavelength
- Faraday rotation angle vs. Wavelength dispersion property
- Faraday rotation angle vs. Thermal dependence property (Optional)

Measuring Optical Properties

- | | |
|------------------------|---------------------|
| Optical Rotation | Refractivity in Air |
| Film Thickness | Molar Refractivity |
| Refractive Index | Photon Energy |
| Absorption Coefficient | Canonical Momentum |
| Optical Conductivity | Kinetic Momentum |
| Phase velocity | Group Velocity |
| Group Index | Psi - Delta |
| Brewsters Angle | Epsilon 1 & 2 |

The magneto-optic Kerr effect (MOKE) measurements make use of rotation of polarization of light upon reflection from a magnetized film. It can be used to measure magnetic properties of magnetic thin films and nano-magnet arrays. Uniform magnetic field applied to the sample, changes polarization state and are measured with an incident linearly polarized light which in turn changes its initial polarization angle.

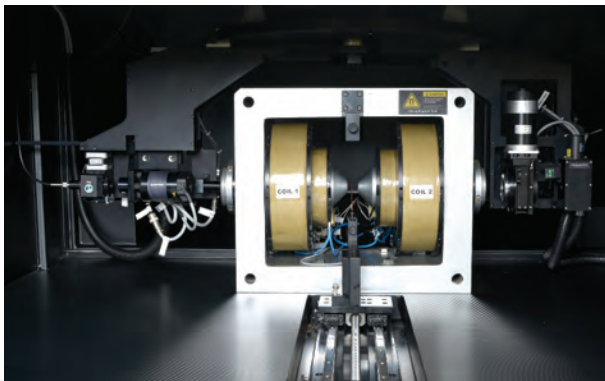
Temperature Control Options

- MODEL : HC 85**
Sample chamber can be heated from room temperature to 85°C to measure temperature dependence property.
- MODEL : NC 70** Sample holder for low temperature (Nitrogen CRYOSTAT) chamber to cool sample down to -70°C using liquid nitrogen.
- MODEL : TE 05**
Heating/cooling method by TE cooler Temperature range, -5 to 40°C

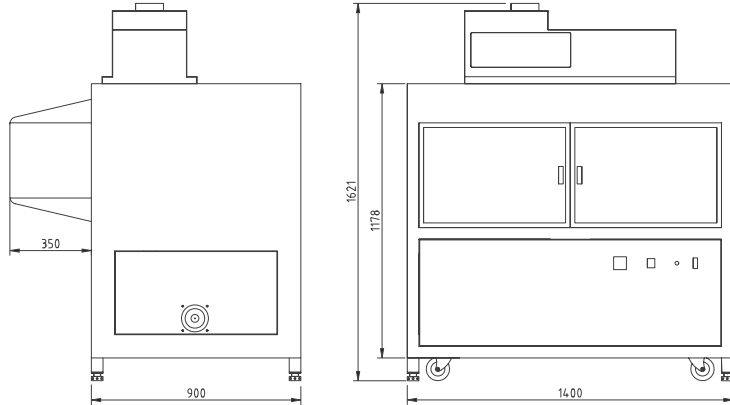
Model : **HO-A216FR/KR-ORMS**
Technical **Specifications:**

Light source : Spectra Deuterium/Halogen or Xenon Arc Lamp
Monochromator : Quasar 300F Czerny-Turner Type
Wavelength Range : 380-850nm
Collimating & Focusing mirror : 50mm dia, 300F
Optical Grating : 1200 l/mm
Spectral dispersion : 2.6nm/mm
Grating Size : 50X50mm
Absolute Diffraction Efficiency : 45 - 65%
Slit Width : 0-3mm Continuously Adjustable
Resolution : 0.1nm
Wavelength Accuracy : 0.2nm
Wavelength Repeatability : 0.1nm
Stray Light : 10^{-3}
Reciprocal of Linear Dispersion : 2.7mm
Half-Width of Spectral line : 0.2nm @ 586nm
Polarization analysis method: Rotation analyzing method
ARMS : Stepper Motor Controlled Auto Positioning
Spot Diameter : 1-5mm
Thin film Holder Sample size: 1-12mm
(Custom Holders can be provided on request)
Cuvette : 10mm Path length Quartz Cuvette
Sample chamber option : High / low temperature sample holder
Sample Feeding Unit : Stepper Motor Controlled
Auto Positioning System

Electro Magnet Unit : PC Controlled Constant current operation
Cooling : Water cooled
Max. magnetic field : 1.75 Tesla @ 12mm pole gap
Min. Field Detection : 1 Gauss
Magnetic field preciseness: $\pm 0.05\%$
Field detection: Hall probe based (PC based field measurement)
Feed back of magnetic field: Hall element
Chiller : 5~25°C Chilled water (for cooling electromagnet)
Volume: 2 L/min.
Power supply for Electro Magnet : Bi-Polar type (Max. $\pm 90V/5A$)
Power supply for Electro Magnet : 2.5kVA AC220V 50Hz
Control unit : 1kVA AC220V 50Hz
Software: Spectra ORMS software



The optical activity of transparent substance under an external electric field can also be investigated with addition of HV power supply on this unit.

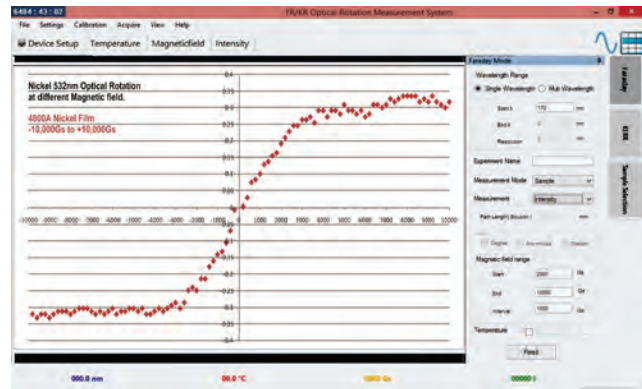


Models used in the software

- 1.Constant Value Model
- 2.Entered Value Model
- 3.Cauchy's Coefficients Model
- 4.Sellmeier's Coefficients Model
- 5.Combination of Cauchy & Sellmeier Model
- 6.Drude Coefficients
- 7.Lorentz-Drude Coefficients
- 8.Brendel-Bormann Coefficients
- 9.Adachi Coefficients
- 10.Cauchy Lorentz Coefficients
- 11.Amorphous Dispersion Coefficients
- 12.Cauchy Absorption Coefficients
- 13.Sellmeier Lorentz Drude Model Coefficients
- 14.Cauchy Urbach Coefficients

Material Library

- Aluminum with Lorentz-Drude Model
- Beryllium with Lorentz-Drude Model
- Borofloat
- CaO
- Chromium with Lorentz-Drude Model
- Cu2O-SnSe4 with Adachi Model
- Cu2O-SnSe4 with Adachi Model
- Gold(Au) with Brendel-Bormann Model
- ITO with Cauchy Absorption Model
- ITO with Drude Model
- KBr(K) (Macroscopic Side)
- MgF2 with Sellmeier Model
- N-BK7
- Nickel with Lorentz-Drude Model
- Naf 95 with Combination Eqn
- PCB with Cauchy-Lorentz Model
- Palladium with Lorentz-Drude Model
- Platinum with Lorentz-Drude Model
- PMMA with Amorphous Dispersion Model
- Si with Cauchy Model
- Silver (Ag) - Empirical model
- SiO2 with Cauchy Model
- SiO2 with Sellmeier Model
- SiO2 F (FTO) with Sellmeier Lorentz Drude Model
- Ta2O5 with Cauchy Model
- TiO2 with Amorphous Dispersion Model
- TiO2 with Cauchy Model
- Titanium with Lorentz-Drude Model



Model : **HO-A216FR/KR-ORMS** Software window

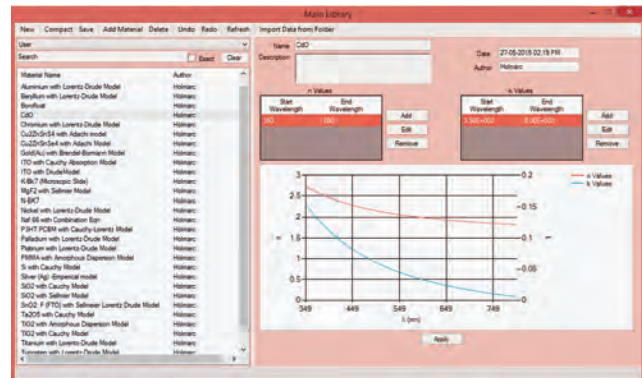


Fig. Material Library Software Window



Quantum Efficiency & IV Measurement System

Model : HO-SC-QEIV



The spectral responsivity or quantum efficiency (QE) is essential for understanding current generation, recombination, and diffusion mechanisms in photovoltaic devices. PV cell and module calibrations often require a spectral correction factor that uses the QE. The quantum efficiency in units of electron - hole pairs collected per incident photon is computed from the measured spectral response in units of amperes per watt as a function of wavelength.

Model HO-SC-QEIV is integrated with 300W Xenon lamp with housing, optics, power supply and an easy to use software with capability to measure dark and lighted IV characteristics of solar cell and quantum efficiency measurement (300nm-1600nm).

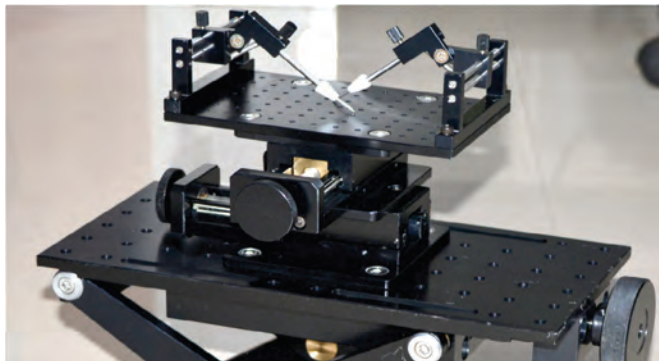
Features

- ▶ Measurement of the spectral response and quantum efficiency of a solar cell from 300 nm to 1600nm
- ▶ Measurement of dark and lighted IV characteristics of a solar cell using a four quadrant power supply
- ▶ 300 W Xenon Lamp with integrated power supply
- ▶ 300 F Quasar Monochromator (300-1600 nm) with order sorting filters.
- ▶ Flip mirror for the selection of measurement mode (Quantum efficiency or IV)
- ▶ 50mm beam diameter for lighted IV measurement
- ▶ Sample holder with manual X-Y positioning system to align the position of the light beam on the sample
- ▶ Sample size up to 50 mm
- ▶ Built-in optical chopper and lock in amplifier.
- ▶ LED bias light

System includes a sample stage, capable of accommodating samples up to 50 mm diameter and probes to contact the sample. Light is normally incident on the sample. Fixed frequency chopper and lock in amplifier are used for modulating the light at a frequency of 400Hz for measuring spectral response. Wavelength resolution of monochromator is 0.1nm. Illumination area can be adjusted using lens assembly system.

System consists of:

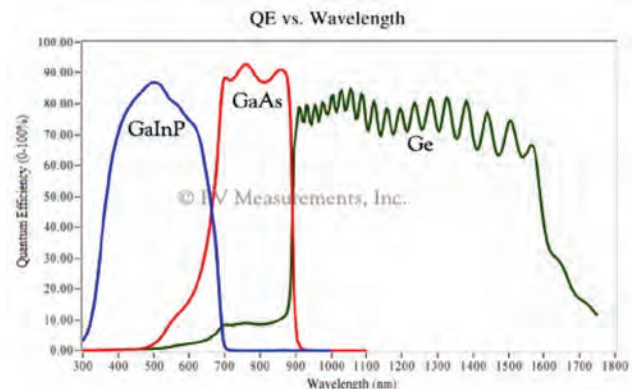
1. 300 W Xenon Lamp with integrated power supply
2. 300F Quasar Monochromator (300-1600 nm) with order sorting filters.
3. Selectable flip mirror assembly for quantum efficiency measurement / lighted I-V measurement. For lighted IV a collimated beam of 50 mm diameter is used.
4. Sample holding and x-y manual positioning unit arrangement helps to keep the sample horizontally.
5. Electronics to measure dark and lighted I-V Characteristics: Current range - 0.1 μ A to 0.75 A. Voltage range -5V to +5 V
6. Sample stage with vacuum chuck
7. Chopper and lock in amplifier.



Specifications

Wavelength Range: 300 nm – 1600 nm
 Wavelength Resolution : 0.1nm
 Light source: 300W Xenon arc lamp
 Chopper frequency: 400 Hz
 Bias light: 3W high bright LED
 Maximum beam/sample diameter: 50 mm
 Voltage range: 1 to -1 V
 Resolution: 5 mV
 Current range: 0.1 μ A to 0.75 A

It can also be used for characterization / measurement of the imaging systems (cameras) and other detectors in terms of linearity range, spatial non-uniformity of response (the variation of responsivity across the active area of a detector) etc. Detector characterization allows identification of the detector with the best performance for a particular application.



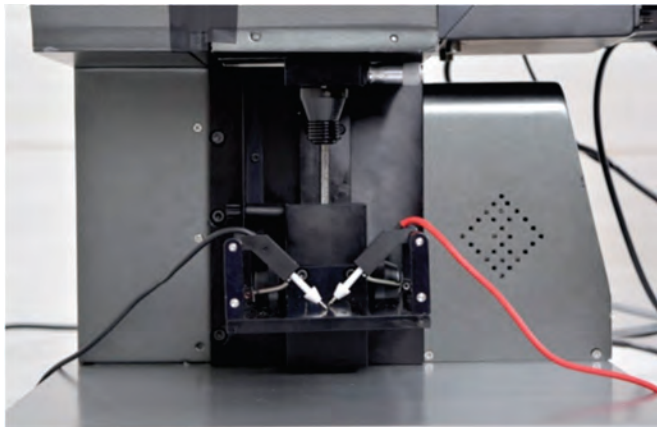
Spectral Response Measurement Apparatus

Model : HO-AE-SR18

Spectral response is the ratio of the current generated by the solar cell to the power incident on the solar cell or a detector. Spectral response measurement apparatus measures short circuit current of solar cell at selected wavelengths over a broad range of wavelengths.

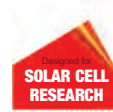
HOLMARC's Spectral response measurement system (Model : HO-AE-SR18) is capable of measuring the spectral response of any kind of photovoltaic devices, such as single or multi junction solar cells or sensors in an area up to 30mm². Measurements can be taken in the wavelength range from 340 to 1600nm at a resolution of 1nm. It is also possible to apply light or voltage bias up to 10V during the measurements. Current, normalized with respect to light power versus wavelength gives spectral response of the cell. Spectral response is directly related to external quantum efficiency. The measurements can be performed manually using onboard controls or automatically by interfacing to a computer.

Third party Source Measure Unit (SMU) should be used for the measurement of the current through, and also to apply the voltage to, the sample. Holmarc also supply a complete solar cell characterization system (Model : HO-SC-QEIV) which has internal source measure circuit to perform both IV and spectral response measurements.



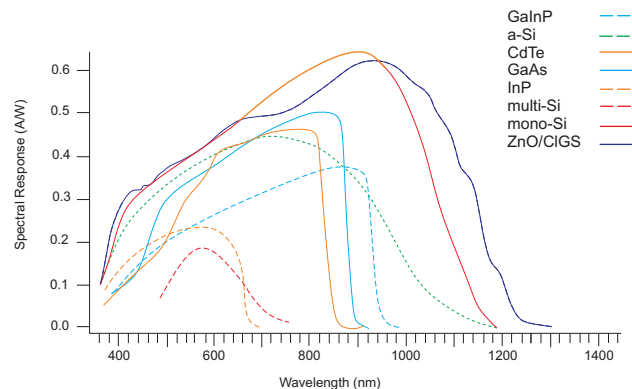
SPECIFICATION

Optical path	Czerny-Turner configuration
Scanning range	340-1600nm
Absolute diffraction efficiency	45-65%
Resolution	0.1nm (@546nm, 10µm slit width)
Wavelength accuracy	≤0.2nm
Wavelength repeatability	≤0.1nm
Stray light	≤10 ⁻³
Reciprocal of linear dispersion	2.7mm
Half-width of spectral line	≤0.2nm @586nm



Features:

- ▶ The system can be used in standalone mode.
- ▶ 20 x 4 line LCD, keyboard and PC software for user interface
- ▶ Plot browser to read spectral response at each wavelength
- ▶ Wavelength range between 340 and 1600nm
- ▶ Stepping motor scanning for precision wavelength positioning.



HOLMARC

Optics

PRECISION OPTICS FOR RESEARCH AND INDUSTRY

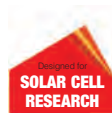
Website: www.holmarc.com
E-mail: holmarc@holmarc.com

Holmarc manufactures various precision optics such as lenses, mirrors, cubes, beam splitters, prisms etc. for research applications. All our optics are made from high quality optical glass.

Our thin film optical coating facility is well equipped with electron beam evaporation and thickness monitor. Holmarc is unique in its ability to design, prototype, and manufacture under one roof. We have well-developed optic fabrication facilities and thin film coating unit.

Contact us for assistance with your manufacturing needs.

Quantum Efficiency and Spectral Response Measurement System



Model: HO-SC-QE

The spectral responsivity or quantum efficiency (QE) is essential for understanding current generation, recombination, and diffusion mechanisms in photovoltaic devices. PV cell and module calibrations often require a spectral correction factor that uses the QE. The quantum efficiency in units of electron - hole pairs collected per incident photon is computed from the measured spectral response in units of amperes per watt as a function of wavelength. Model HO-SC-QE is integrated with 300W Xenon lamp with housing, optics, power supply and an easy to use software with capability to measure the spectral response and quantum efficiency of solar cell at the wavelengths from 400nm to 1200nm.

System includes a sample stage, capable of accommodating samples up to 50 mm diameter and probes to contact the sample. Light is normally incident on the sample. Fixed frequency chopper and lock in amplifier are used for modulating the light at a frequency of 400Hz for measuring spectral response. Wavelength resolution of monochromator is 0.1nm. Illumination area can be adjusted using lens assembly system.



Features

- ▶ Measurement of the spectral response and quantum efficiency of a solar cell from 400 nm to 1200nm
- ▶ 300 W Xenon Lamp with integrated power supply
- ▶ 300 F Quasar Monochromator (400-1200 nm) with order sorting filters.
- ▶ Sample holder with manual X-Y positioning arrangement to align the position of the light beam on the sample
- ▶ Sample size up to 50 mm
- ▶ Built-in optical chopper and lock in amplifier.
- ▶ LED bias light

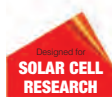
Specifications

Wavelength Range: 400 nm – 1200 nm
Light source: 300W Xenon arc lamp
Chopper frequency: 400 Hz
Bias light: 3W high bright LED
Maximum sample diameter: 50 mm



It can also be used for characterization / measurement of the imaging systems (cameras) and other detectors in terms of linearity range, spatial non-uniformity of response (the variation of responsivity across the active area of a detector) etc.

IV Measurement System for solar cell



Model: HO-SC-IV

Model: HO-SC-IV is integrated with 300W Xenon lamp with housing, optics, power supply and an easy to use software with capability to measure dark and lighted IV characteristics of solar cell. System includes a sample stage, capable of accommodating samples up to 50 mm diameter and probes to contact the sample. Light is normally incident on the sample. Illumination area can be adjusted using lens assembly system.

Features

- ▶ Measurement of dark and lighted IV characteristics of a solar cell using a four quadrant power supply
- ▶ 300 W Xenon Lamp with integrated power supply
- ▶ 50mm beam diameter for lighted IV measurement
- ▶ Sample holder with manual X-Y positioning arrangement to align the position of the light beam on the sample
- ▶ Sample size up to 50 mm

Specifications

Light source: 300W Xenon arc lamp
Maximum beam/sample diameter: 50 mm
Voltage range: 1 to -1 V
Resolution: 5 mV
Current range: 0.1 uA to 0.75 A



Conductivity Cell Measurement Setup

Model : HO-AE-CCM18

HOLMARC'S Model: HO-AE-CCM18 is a computerized conductivity setup to measure the conductivity of the semiconducting thin film samples by varying temperature in vacuum.

Temperature of the sample at the time of measurement can be set at a range of ambient to 150°C. The conductivity is measured at different points of temperatures, by applying a voltage range from 0 -300V and measuring the resulting current. A curve of current is recorded and plotted against temperature by the software. The process is carried out inside a vacuum chamber of up to 10⁻² mbar vacuum pressure. Rotary vacuum pump is supplied along with the instrument.

SPECIFICATION

Temperature range	.....	Ambient to 150°C
Sample holder diameter	.....	5cm (Suitable for standard laboratory glass slide)
Drive voltage	.....	0 to 300V
Measurement resolution	.....	0.1nA
Measurement accuracy	.....	1nA
PC interface	.....	RS232



HOLMARC NEW 20,000 Gauss

2T Water Cooled ELECTROMAGNET

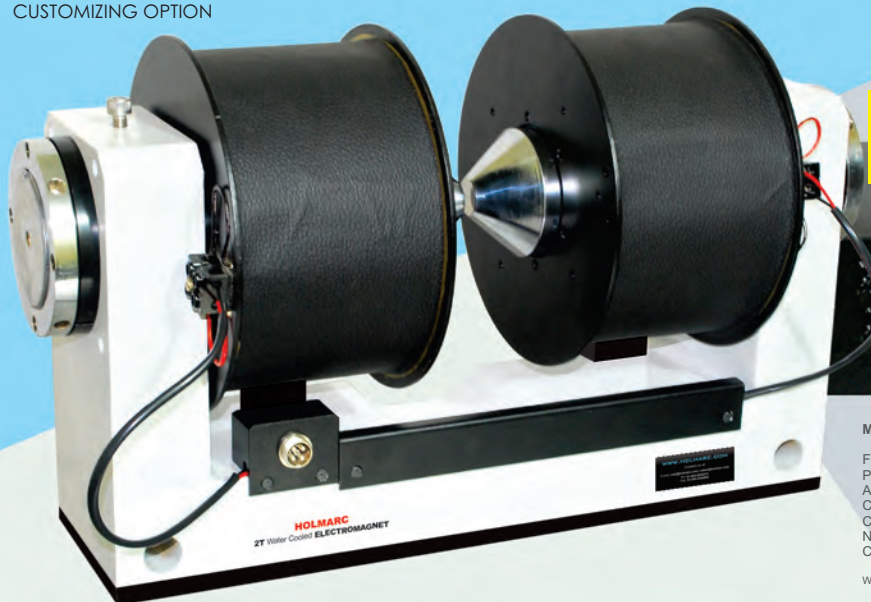
HIGH-PERFORMANCE LABORATORY MAGNET

- ▶ LEADSCREW POLE ADJUSTMENTS
- ▶ OPTIMIZED COIL DESIGN
- ▶ MODULAR CONSTRUCTION
- ▶ CUSTOMIZING OPTION

Typical Applications

- ✓ Vibrating Sample Magnetometers
- ✓ Permanent Magnet Calibration
- ✓ Transverse Pressing Magnetizer
- ✓ Nuclear Magnetic Resonance
- ✓ Magnetic Hysteresis Graphs
- ✓ Alternating Force Magnetometers
- ✓ Precision Magnetizing
- ✓ Zeeman Effect Studies
- ✓ Hall Effect Studies
- ✓ Electron Paramagnetic Resonance
- ✓ Magnetic Susceptibility Systems

CUSTOM
CONFIGURABLE



EM20

Magnetic Field Mapper
Refer Page : **350**

MODEL EM20T ELECTROMAGNET SPECIFICATIONS

Field Intensity : 20,000 Gauss (2T) with tapered pole pieces
Pole Diameter : 75mm, 20mm Tapered
Air-Gap : Adjustable from 0 to 40 mm
Coil Separation: 80mm
Construction: Soft iron.
Number Of Energizing Coils : Two
Cooling : Water-cooled for continuous operation

Water cooling is not required at energizing current below 30% of full value



Photodetector Characterization Setup

Model: HO-PDC-01

No detector has a constant spectral responsivity under all conditions of use. For instance, the responsivity of photodiode detectors falls off above a certain incident power level due to saturation effects. Full evaluation of a detector requires characterisation of such effects. This information allows the identification of the detector with the best performance for a particular application. Also, a detector to be used for calibration purposes should be fully characterised in order to evaluate the uncertainty of such calibrations.

In all cases the detector under test is compared with a standard detector of known spectral responsivity / quantum efficiency.



HOLMARC Model: HO-PDC-01 designed for characterisation/ measurement of the following detector parameters:

Linearity range: This is the range of incident radiant power levels over which the detector output varies linearly with incident power. (Laser-based methods is used for measuring saturation threshold of a detector).

Spatial non-uniformity of response: The variation of responsivity across the active area of a detector is determined by scanning a small spot of radiation at a selected wavelength over the surface.

Noise Equivalent Power (NEP): the incident radiant power at a specific wavelength and modulation frequency necessary to produce a signal-to-noise ratio of 1 at the detector output.

Temperature coefficient of response: the variation of responsivity with temperature

Detector shunt resistance: the slope of the current-voltage curve of a photovoltaic detector at zero-volt bias.

300F Monochromator is used to select a narrow wavelength band from a broad band quartz halogen lamp. Wavelength range of monochromator is between 200 - 2000 nm. The wavelength can readily be tuned continuously allowing measurement of spectral responsivity across the wavelength range for which the detector is used.

SPECIFICATION

Optical path	Czerny-Turner configuration
Scanning range	200-2000nm (UV requires Special Lamp) System comes with Quartz Halogen Lamp Which Wavelength Range is 350-2000nm For UV range less than 350nm special lamp is required
Resolution	0.1nm (@546nm, 10µm slit width)
Wavelength accuracy	≤0.2nm
Wavelength repeatability ..	≤0.1nm
Incident power levels	10 ⁻¹⁰ – 10 ⁻³ W range
Laser Wavelength.....	532nm
Chopper frequency.....	400 Hz
Maximum beam.....	15x10 mm
Voltage range.....	1 to -1 V
Resolution.....	5 mV
Current range.....	0.1 uA to 0.75 A



Solar Simulator - Xenon Lamp

Model: HO-SC-SS300

Solar simulator is one of the essential equipment for studying solar cells. The high color temperature(6000K) of the Xenon lamps is a close match to the solar temperature. This results in very similar solar spectra in the UV and VIS although the source has some Xe emissions lines in the near IR. The purpose of the solar simulator is to provide a controllable indoor test facility under laboratory conditions, used for the testing of solar cells, sun screen, plastics, and other materials and devices.

SPECIFICATION

- Spectral Match (fraction of ideal percentage) : 0.60 - 1.40
- Non-Uniformity of Irradiance : < ±10%
- Temporal Light Instability : ±2%
- Illumination Head Design : 360 Degree Continuous Rotatable
- Illumination Diameter : 50mm
- Shutter : Manual (Optional Motorized Shutter)



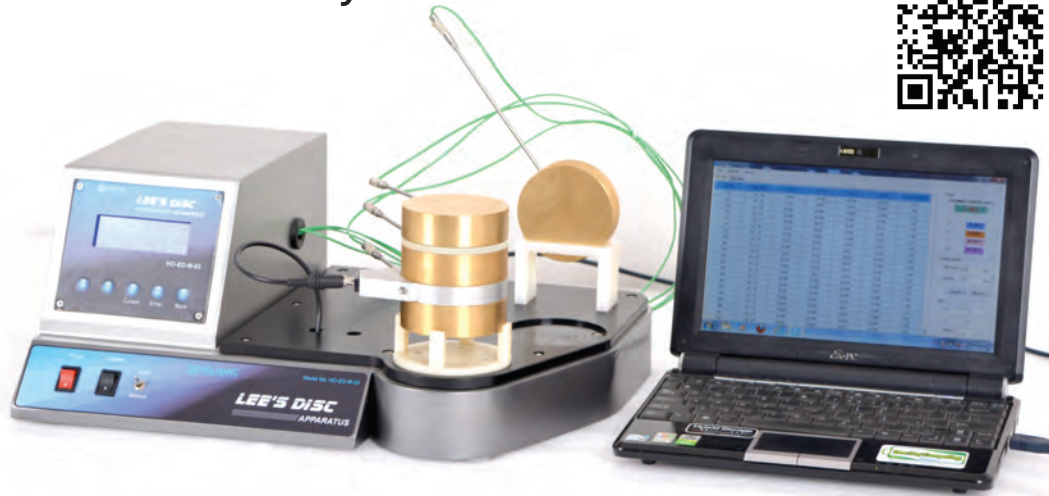
Lee's Disc - Thermal Conductivity Measurements



Model : HO-AE-LD18

Holmarc's Lee's Disc Apparatus (Model : HO-AE-LD18) is designed for the measurement of thermal conductivity in bad conductors.

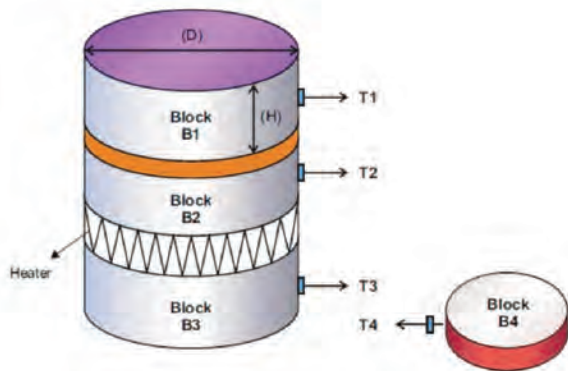
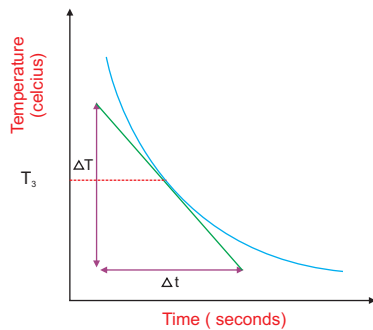
Thermal conductivity is the property of a material that indicates its ability to conduct heat. Conduction takes place if there exists a temperature gradient in a solid (or stationary fluid) medium.



Lee's Disc Apparatus comprises of a brass disc resting on another slab of the same dimension with special heating coil. Both metallic discs have radial holes for the sensitive thermistors. Material under test is placed in between two discs. The heater is turned on and the apparatus is left idle until the temperature gets stabilized. At this point the heat energy passing through the heat sample will be exactly equal to the heat flowing out of the lower block.

Maximum temperature the disc can achieve during the experiment is around 60 degree Celsius to make it safe for handling with even bare hands. Similarly, operating voltage for heating coil sandwiched between the discs is fixed as 50 V for safety. The temperature sensors used are highly sensitive and accurate with least count as low as 0.2 degree Celsius. Front panel is equipped with digital display and keyboard for user friendly operation.

This instrument provides the facility for performing experiments using different kinds of sample materials. The front panel includes LCD display and keyboard for readouts and settings.



Features:

- New and integrated design
- Different samples can be tested
- LCD display is provided for accurate measurement
- Manual mode, auto mode and PC mode are possible
- User friendly equipment

Electronic Speckle Pattern Interferometer (ESPI)

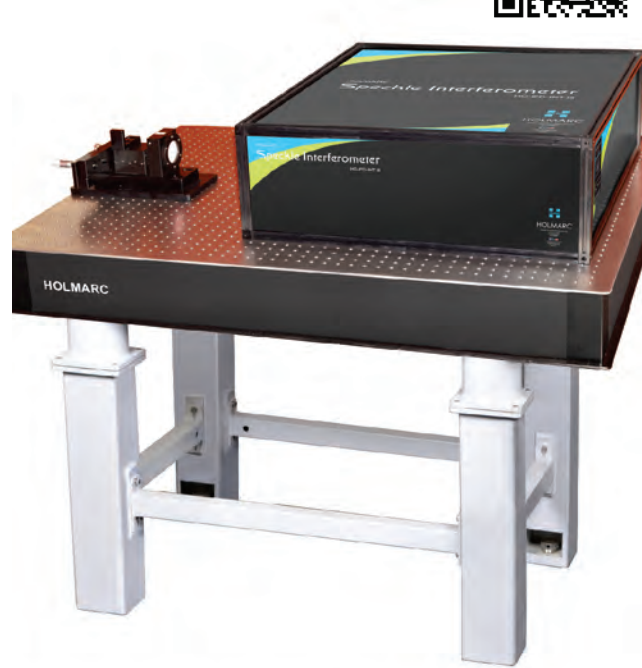
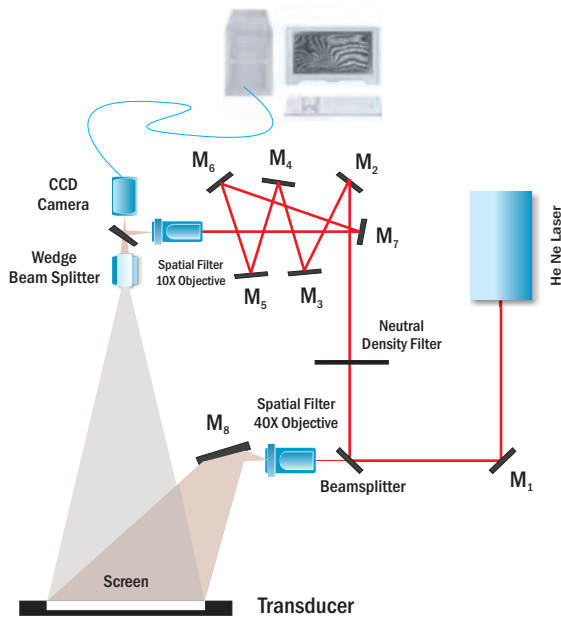
Model : HO-AE-ESP18

Electronic Speckle Pattern interferometry (ESPI) is a non-destructive optical method for studying surface deformations. It relies on the interference between diffusely reflected light from the test object and a reference beam.

This is one of the most sensitive interferometric technique, so that we can measure sub-micron level displacements either in plane or out of plane. The images before and after deformation are recorded by a CCD camera and analysed using an image analysis software. Deformation causes variations in the fringe pattern. These variations can be analyzed with the help of the software provided to find the deformations.

Features:

- Measurement under visible light is possible
- Non contact and full field measurements
- Object contour and displacement measurements



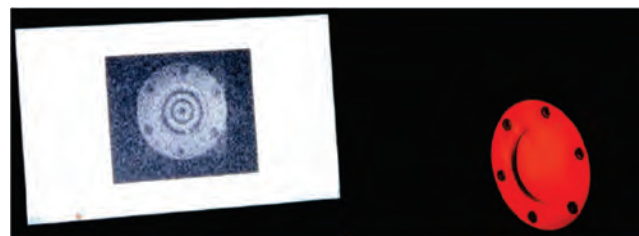
As this interferometer is highly sensitive to vibrational noises, Holmarc's ESPI comes with a Vibration isolation optical breadboard. A linearly polarized 632.8nm He-Ne laser with 5mW output power is used as the light source. A beam splitter splits the laser beam into two. The transmitted beam illuminates the test object uniformly via a spatial filter assembly while the reflected beam falls on a CCD as reference beam. The image of the illuminated test object is captured by zoom lens and CCD.

Our ESPI system allows the user to perform the Electronic Speckle Shearographic interferometry in the same system without disturbing the optical set ups and alignments. Holmarc's camera application software helps to capture and analyze the images.

SPECIFICATION

Laser	He-Ne 5mW @ 632.8nm.
Beam expander.....	20X microscope objective with pinhole.
Zoom lens	Nikon®
Camera	1/2.5" 5 MPC MOS Color
Software	Holmarc camera application software & image analysis software.
Optical Breadboard.....	1200mm x 900 mm size with vibration isolation support.

* Subject to availability



Scope of supply

Quantity

Optical Breadboard with vibration isolation support	1 no.
Spatial filter assembly(20X)	1 no.
Beam splitter with mount(50 x 50mm)	2 nos.
Mirror with mount(Dia 25 mm)	7 nos.
Test object mechanical loader	1 no.
Glass plate holder with mount	2 no.
Diffuser with mount(Material Float)	2 no.
Polarizer rotator with mount(Rotation 360°)	1 no.
Camera lens assembly with mount	1 no.
Glass plate(75 x 25mm)	1 no.
Helium neon laser(Wavelength 632.8 nm)	1 no.
Heater with control unit(Output power 200W)	1 no.
CCD Camera with mount	1 no.

HOLMARC
Speciality Instrument

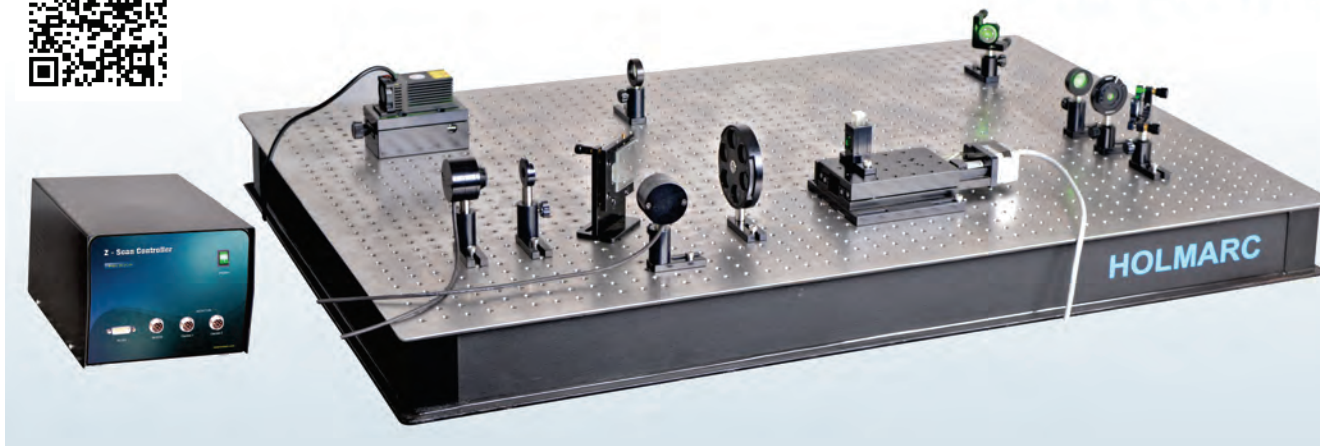
HARS
HOLMARC ADVANCED RESEARCH SYSTEMS & SOLUTIONS



Z - Scan Characterization Kit

Characterization of Transparent Optical Materials

Model : HO-IAD-ZS-01A



Items Included

1. Optical breadboard 1200x800mm with rigid support - 1no.
2. 532nm DPSS 100mw low noise CW Laser
3. Motorized precision linear translation stage and control electronics - 1no.
4. Variable beam splitter with mount - 1no.
5. Kinematic mirror mount with metallic mirror - 2nos.
6. Aperture wheel with selectable apertures of different sizes - 1no.
7. Achromatic Lens & Mount - 2no.s
8. Filter wheel unit with 6 various neutral density filters - 1no.
9. Variable aperture with mount - 1no.
10. 1mm Cuvette with Holder - 1no.
11. Si photodiode detector with mount - 2no.s
12. RS232 interface with optional USB to serial converter
13. Windows software interface
14. Black Screen - 3no.s

The Z-scan technique is a simple and popular experimental technique to measure intensity dependent non linear susceptibilities of materials. The Z-SCAN Characterization Kit is a simple implementation of the z-scan technique that can be used to characterize optical materials. In this method, the sample is translated along the axis of a focused Gaussian beam and the far field intensity is measured as a function of sample position. Analysis of the intensity versus sample position Z-scan curve, predicated on a local response, gives the real and imaginary parts of the third order susceptibility.

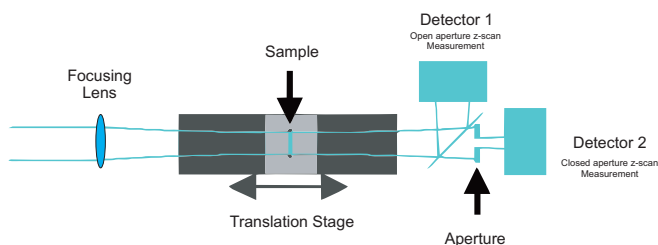
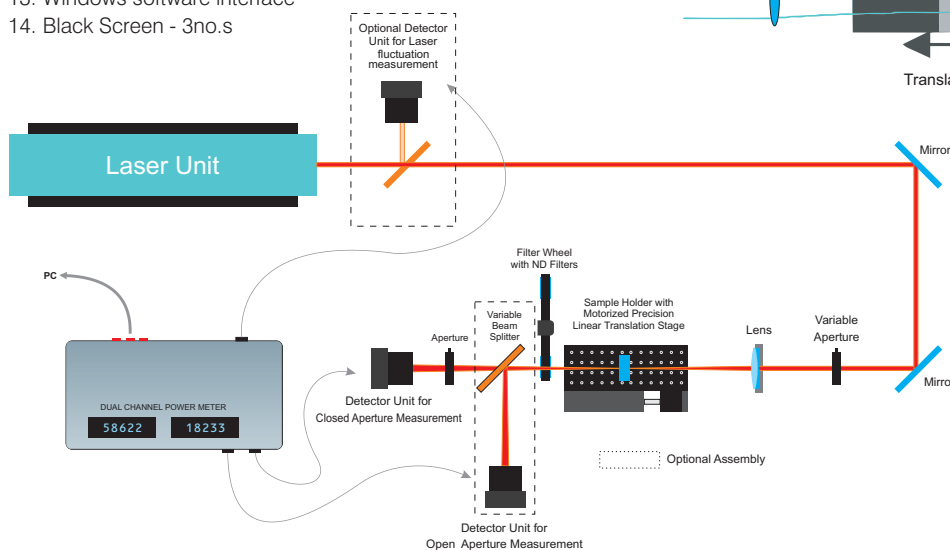


Fig. Z-Scan Standard open aperture and closed aperture z-scan



Standard open aperture and closed aperture z-scan measurement can be done with the setup. The two measurable quantities connected with the z-scan are nonlinear absorption (NLA) and nonlinear refraction (NLR). These parameters are associated with the imaginary and real part of the third order nonlinear susceptibility, and provide important information about the properties of the material.

Because of continuous product improvement, the various data listed are subject to change without notice. Please confirm before ordering.



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Schlieren Imaging System

MODEL : HO-SDIS-150 & HO-SDIS-200



- ✓ Wind tunnel research
- ✓ Fluid and air current flow
- ✓ Internal character of glass
- ✓ Flame analysis
- ✓ Ultrasound visualization
- ✓ Heat convection visualization

Holmarc schlieren system contains, two aluminized parabolic mirrors overcoated with silicon monoxide and mounted in gimbal mounts, pointed LED light Source, Knife edge adjuster and a 5MP USB3.0 digital camera. Camera is used for enabling a photographic record to serve as a permanent reference. For lower light intensities, a video camera and monitor combination may better enhance your total Schlieren system. Using video, your results are enlarged. Gimbal mounts for the parabolic mirrors eliminate unwanted linear beam translation during adjustment.

Schlieren imaging systems provide a powerful technique to visualize changes or non uniformities in refractive index of air or other transparent media. It is widely used in aeronautical engineering to photograph the flow of air around objects. Applications for the Schlieren system include: the determination of refractive index, wind tunnel research, fluid and air current flow, internal character of glass, flame analysis, sound velocity and the mass of microscopic particles.

Small scale unevenness that are commonly measured with interferometers or similar high sensitivity methods can also be tested with schlieren setups. Any inhomogeneities of the surface in a transparent material can be visualised with a schlieren setup. The small bumps or irregularities in the structure cause the same deviation of the light as in fluids.

Components

- Light source – Halogen or LED
- Parabolic mirrors – Mounted in Gimbal Mirror Mount, allows user to steer a beam in any direction desired.
- Knife edge – Adjustable in all three axis
- Plain mirror – First-surface to reflect the image to a convenient viewing location
- Viewing screen - 200mm dia diffused screen
- Imaging Unit - USB 2.0 5MP 1/2.5" CCD camera with Optical Zoom.

Standard Models & Mirror Size

- MODEL : HO-SDIS-150A : 150mm Dia. mirrors/1200mm focal length
- MODEL : HO-SDIS-150B : 150mm Dia. mirrors/1500mm focal length
- MODEL : HO-SDIS-200A : 200mm Dia. mirrors /1200mm focal length
- MODEL : HO-SDIS-200B : 200mm Dia. mirrors/1500mm focal length

Optional Features

Custom Sizes & Lens Based Schlieren Imaging System

Schlieren Imaging System is beneficial to use in fluid dynamics studies because they are sensitive to changes and do not interfere with flow. They are also used to study optical media and changes in refractive index within the material. Most commonly, schlieren systems have been applied to visualize diverse subjects such as striations in blown glass, inhalation in humans and animals, shock waves from a plane in flight, and heat emanating from a system

Another important schlieren application is heat convection visualization. Mainly energetic questions as the thermic flux in buildings are answered with the schlieren method. An interesting example are the agricultural tests of thermal convection as seen in figure. Even small scale thermic convection on plants has been possible to visualize.



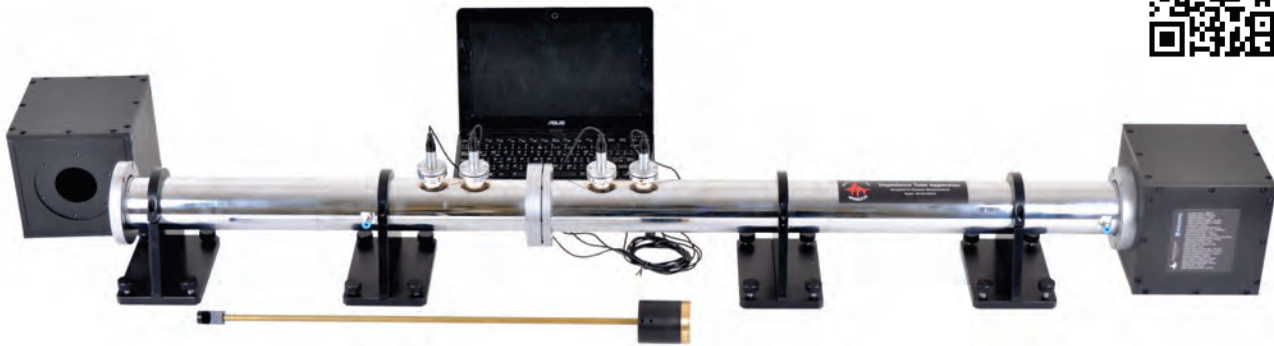
Airflow around the leaves of a corn plant is visualized using schlieren imager for agronomical research.

A model green house section with the heat convection produced by the sun light heat.

To visualize instantaneous density profiles, a short duration flash rather than continuous illumination can be used (Flash lights can be provided on request).

Impedance Tube Apparatus (Absorption Coefficients and Impedance)

Model : HO-AE-ITA17



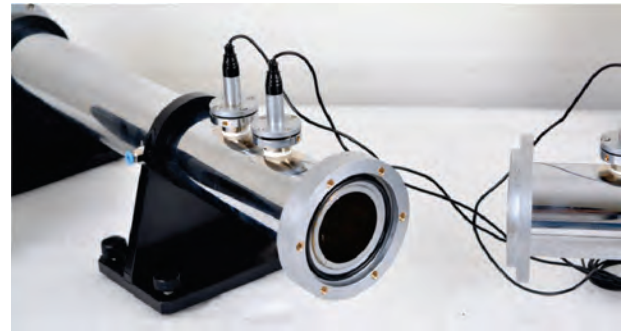
The impedance tube apparatus is commonly used to measure specific impedances, sound absorption coefficients (SACs), sound transmission losses (STLs) and acoustic properties (characteristic impedances, propagation wave numbers, effective densities, bulk moduli) of acoustic materials in normal incidence conditions.



Measurement techniques are based on ASTM standards. The experiment can be conducted by two microphones and four microphones. System consists of a solid brass tube containing a speaker at one end and the other end with the capability to hold a material sample, whose properties are to be measured. Pair of microphones, separated by finite distance is connected to this tube with the help of microphone holders. These microphones are connected to a digital signal analyzer via signal conditioners (pre-amplifiers) and a data acquisition system. A function generator is used to power the speaker in the impedance tube. Termination conditions differ based on whether to measure absorption or transmission loss. For absorption coefficient measurements, a rigid backing is used. For transmission loss measurement, a hollow tube of the same diameter as the upstream tube with a pair of microphone holders is used on the downstream of the test sample. Two different termination conditions (anechoic and rigid backing) are used during transmission loss measurements.

SPECIFICATION

Impedance tube length	700mm +300mm attachment
Inside diameter	50mm
Speaker frequency range	y Range : 80Hz to 18kHz
Signal generator	20Hz – 20kHz
Sweep in	Automated
Number of microphones	4
Sample holding unit	50mm standard, variable design
Sound wave analyzer	4 Channel integrated wave analyzer
Controls	PC automated measurements
Software	HOLMARC wave analyzer 4C



Sound-absorption ability of the sample is measured in the plane-wave impedance tube. The sound is generated by a loud speaker at one end of the tube and the sample is placed and sealed at the other end of the tube. The sound absorption co-efficient is the absorbed fraction of the energy of a plane sound-wave when incident on the sample material. The co-efficient describes the ability of the material to absorb sound in a given frequency band.

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