Agilent Cary Universal Measurement Accessory (UMA)

for the Agilent Cary 4000/5000/6000i/7000 UV-Vis and UV-Vis-NIR spectrophotometers

Technical Overview

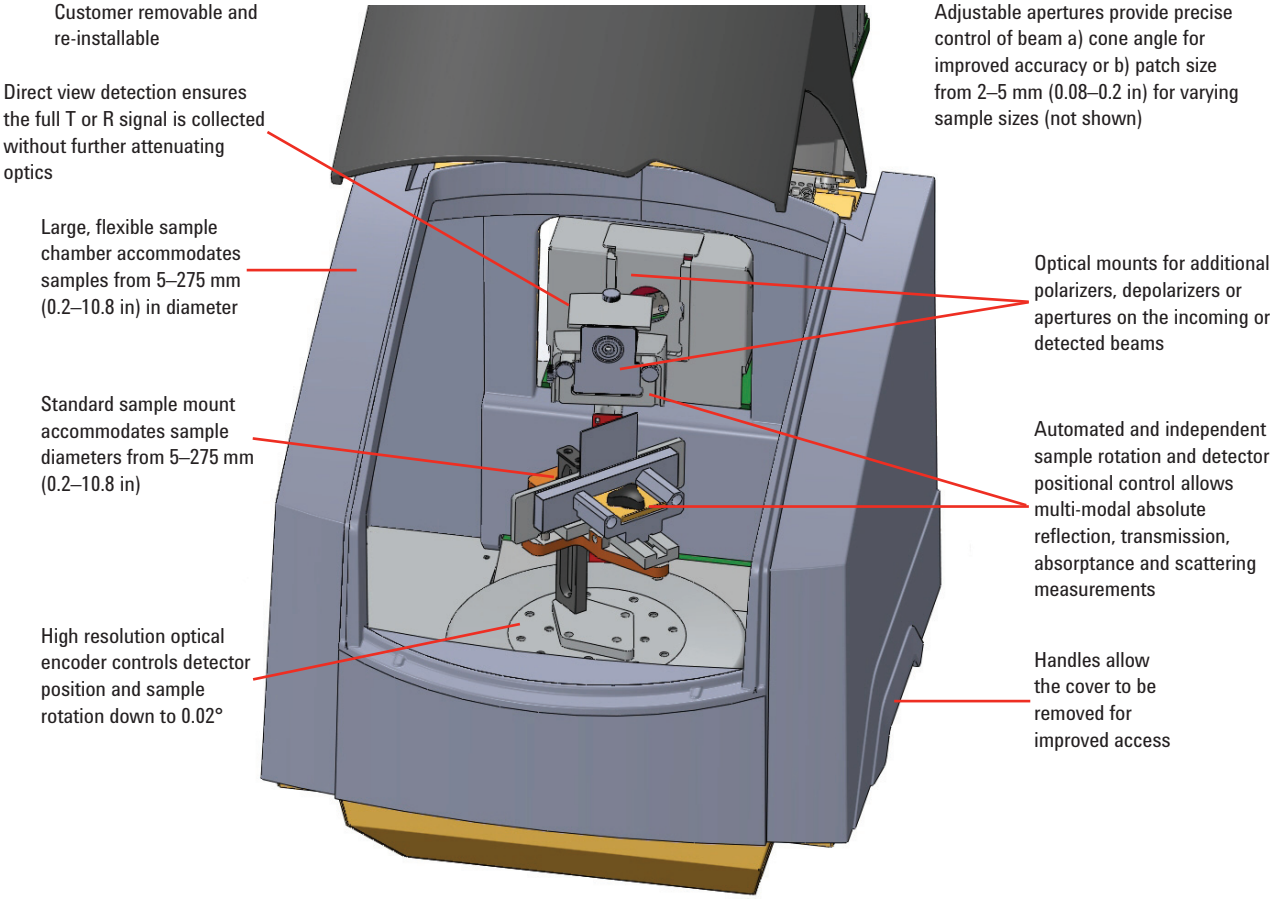
Introduction

The Cary Universal Measurement Accessory (UMA) provides the ability to automatically measure absolute specular reflectance, transmission and scattering at a wide range of angles and different polarizations, unattended. This accessory is unique to the materials market providing solutions to both research and QA/QC in the areas of thin films and coatings, optics, glass and solar. With the Cary UMA you can:

- **Gain deeper insights into sample characterization** in both research and QA/QC, supported by unprecedented data quality in terms of accuracy and precision.
- **Save time and money** by increasing your sample throughput in QA/QC verification during manufacturing.
- **Improve quality** of end product and reduce the financial risk of shipping faulty product through comprehensive, automated, unattended analysis.

The benefits arise from a range of key features including:

- Ability to move the detector and the sample independently of each other, providing a true multi-modal measurement system capable of absolute reflectance, transmission and scattering without moving the sample.
- High resolution optical encoder technology that ensures the sample and detector never lose position during data collection — even if the system is bumped accidentally.
- Wire grid polarizers that provide superior throughput across the wavelength range, and a large acceptance angle to ensure a high degree of polarization accuracy.
- Optical control of incoming and detected beam geometry. Incident beam angle (adjustable 3°–1° cone angle in 1° steps) and detected cone angle (adjustable 6° to 1° in 1° steps).
- A single baseline collect applies to all transmittance (T) and reflectance (R) measurements, at all angles, for a given polarization. This dramatically improves productivity by reducing total collection time.
- "Direct View" two-color Si/InGaAs detector that provides coverage in the UV-Vis and NIR range without using integrating spheres or light pipes that attenuate signal and can compromise data quality.
- A range of sample mounts accommodate a variety of sample shapes and sizes. Mount samples as small as 5 mm to large 8.5 in (216 mm) wafers in seconds using the standard sample holder supplied. Even greater sample mounting flexibility available with optional sample holders.
- Lock-down mechanism enables simple installation and removal of the UMA — with no re-alignment, enabling use of the Cary spectrophotometer with other accessories.



Cary Universal Measurement Accessory

Applications

The Cary UMA is a truly universal measurement accessory capable of performing a wide range of measurements. It is ideally suited to a wide range of applications such as those listed below.

Optics, thin films and coatings	Academic and industrial research	Glass	Solar
QA/QC coating quality	Optical constant measurements (refractive index, n and k)	QA/QC optical performance testing	QA/QC and development of parabolic trough and Fresnel reflectors
Film thickness control	Film thickness modeling/ measurement	Conformance to regulatory standards such as EN410, ISO9050 and EN13837	Photovoltaics — optimizing raw material and module efficiency at various stages of construction
Bulk optic performance and characterization	Nanocomposite bandgap measurements	Coated/composite properties (construction quality)	Coated silicon homogeneity
Coating uniformity	Characterizing fundamental scattering from Bragg grating surface plasmon polaritons	Optical robustness/longevity under environmental testing including temperature, light exposure, aging and physical abuse	Performance longevity and lowering PM costs under environmental explosure
Color/visual appearance	Diffuse scattering	Confirmation of final design intent	Optical constant confirmation; purity and surface finish

Specifications

Instrument	Cary 4000/5000/6000i/7000 UV-Vis and UV-Vis-NIR spectrophotometers	
Measurement modes	Absolute specular reflection at variable angle from 5–85° in 0.02° intervals	
	Direct transmission and variable angle transmission from 0–90° in 0.02° intervals	
	Diffuse scattering, reflection or transmission through independent sample rotation (360°) and detector positioning between 10–350° at 0.02° in intervals	
	Absorptance, A where A= 1–R–T at variable angle without moving the sample or beam onto the sample for improved productivity and greater accuracy.	
	Reflection/Transmission at single wavelength (read) or wavelength range (scan)	
Wavelength range	190–2800 nm	
Auto polarizer wavelength range	250–2500 nm	
Sample size	Diameter: 5 mm minimum–275 mm maximum 255 mm if detector slide mount is installed 235 mm if a depolarizer is mounted in detector slide mount	
	Maximum physical thickness: 30 mm using standard supplied sample holder	
Apertures	Incident beam: 1, 2 and 3 degrees	
	Detector: 1, 1.8, 2, 3, 4, 4.4, 5 and 6°	
Dimensions and weight	**UMA unit**	**UMA cover**
Packed (LxHxW) mm	1000 x 600 x 510	600 x 445 x 530
Unpacked (LxHxW) mm	882 x 412 x 404	520 x 365 x 450
Weight, packed	21.6 kg	14 kg
Weight, unpacked	14.2 kg	10 kg

Sample and detector angular coordinates

The UMA defines two separate angular co-ordinates to describe the position of the sample and detector with respect to the incident light beam. The angle of incidence, or sample angle, is defined as the angle formed between the normal to the surface of the sample and the incident beam when the sample is mounted in the sample holder. The sample can be driven fully through 360° however the range of sample angles provided by the UMA is typically from -90° <= Sample Angle <= +90° to help clearly define a T measurement from an R measurement. The angular resolution for setting the sample angle is 0.02°. Figure 1 shows both the sample and detector angular coordinates.

The detector angle is defined as the angle subtended at the center of the sample chamber by the incident beam and a line to the radial position of the detector. The detector angular range is from 10–180° on either side of the incident beam (similarly defined as ±angles). The resolution for setting the detector angle is also 0.02°.

NOTE: The detector angle is set at 2 x Sample Angle to measure specular reflectance. For example, to measure specular reflectance at 5°, you set the sample angle at 5° and the detector angle at 10°.

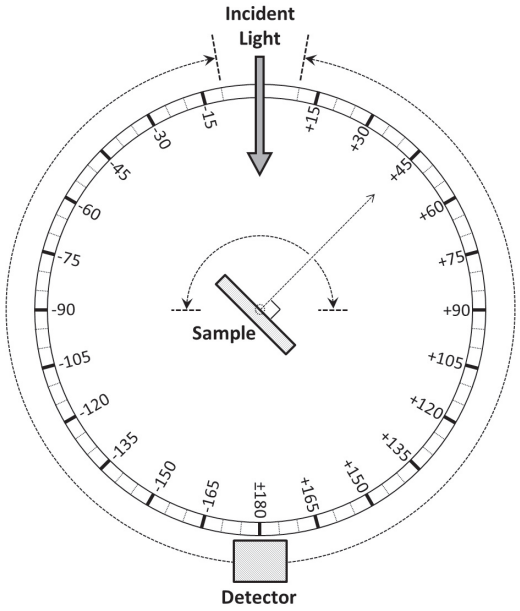


Figure 1. Sample and detector angle definitions settable at 0.02° intervals

Apertures

Apertures are used with the UMA to control the collimation of light incident on the sample. The UMA has two mounting positions for apertures that control collimation in the vertical plane and one mounting position for an aperture that controls collimation in the horizontal plane.

The level of collimation can be set independently in each of the horizontal and vertical planes at 1°, 2° and 3°. Setting an aperture of 1° provides the highest level of collimation which is best reserved for samples, such as bandpass filters, that are sensitive to variations in the angle of incidence.

As well as changing the vertical collimation, changing the vertical aperture selection also determines the height of the light patch at the sample. Using smaller apertures reduces the patch size, which can be particularly useful for small samples.

Apart from the apertures used to control the horizontal and vertical degree of collimation inside the UMA, there are a range of apertures available that may be inserted directly before the detector assembly to control the solid cone angle subtended by the detector at the sample. The apertures are marked with the solid angles that each subtend, and the range includes angles of: 1°, 1.8°, 2°, 3°, 4°, 4.4°, 5° and 6°. These detector apertures are typically employed for goniospectrophotometer scattering measurements where a well-defined detected reflected beam is required.

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The Measure of Confidence

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