Unrivaled. Precise. Consistent.

AGILENT CARY 4000/5000/6000i SERIES
UV-VIS-NIR SPECTROPHOTOMETERS

The Measure of Confidence

Agilent Technologies

AGILENT CARY 4000/5000/6000i SERIES UV-VIS-NIR

Agilent Technologies is your premier resource and partner for molecular spectroscopy. With the addition of the world-renowned Cary product line, encompassing FTIR, UV-Vis-NIR and Fluorescence, Agilent offers you a comprehensive range of molecular spectroscopy solutions.

Answers you can trust

The Cary 4000/5000/6000i Series UV-Vis-NIR spectrophotometers are unrivaled, precise and flexible, and are designed to meet your application requirements — now and in the future. With unsurpassed photometric accuracy and a wide range of flexible accessories, this research-grade series will ensure you stay at the forefront of your field.

Cary 4000 (175–900 nm)

The Cary 4000 sets the standard for photometric noise, range and linearity, providing excellent resolution across the UV-Visible spectrum. The Cary 4000 is ideal for challenging research applications in materials science, and is the industry leading solution for all biological research.

Cary 5000 (175–3300 nm)

The Cary 5000 combines PbSmart technology with the unparalleled optical design and performance of all Cary UV-Vis-NIR instruments. It requires only one detector to extend that performance into the NIR.

Cary 6000i (175–1800 nm)

The Cary 6000i with a high-performance InGaAs detector is optimized for the shortwave NIR, delivering superior resolution in the 1200–1800 nm region. No instrument can match the NIR performance of the Cary 6000i.

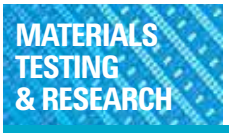
The superiority of the Cary 4000/5000/6000i instruments means they are often used as a primary reference spectrophotometer.

Molecular Spectroscopy Innovations

1947 First commercial recording UV-Vis, the Cary 11 UV-Vis	**1954** Release of the Cary 14 UV-Vis-NIR	**1969** First rapid-scanning fourier transform infrared spectrometer, the FTS-14	**1977** Release of the Cary 219 UV-Vis	**1979** First commercial diode-array spectrophotometer, the 8450A	**1989** Release of the acclaimed Cary 1 and 3 UV-Vis	**1995** Launch of the 8453A, the first small-footprint, full-featured diode-array
1997 Cary 50 Series released to coincide with 50th anniversary of Cary 11	**1999** Launch of the Cary Eclipse Fluorescence Series	**2000** First ATR chemical imaging system	**2002** Cary 4000/5000/ 6000i research grade UV-Vis-NIR series released	**2008** Launch of the 600 Series FTIR spectrometers, microscopes and imaging systems	**2011** Agilent offers out-of-lab FTIR solutions	**2011** Release of the Cary 60 UV-Vis

FOR YOUR APPLICATION

Agilent is committed to providing solutions for your application. We have the technology, platforms, and expert guidance you need to be successful.

	 MATERIALS TESTING & RESEARCH	 CHEM & PETROCHEM	 ENERGY & FUELS	 FOOD & AGRICULTURE	 BIOTECH & PHARMA
	ACADEMIA				
Common applications for the Cary 4000/5000/6000i	Thin film thickness analysis and anti-reflection coating analysis Analysis of novel nanocomposite materials Colour measurements and colour matching Optical density measurements, e.g. optical filters and safety eye wear	Spectro-electrochemical measurements, for e.g. reduction of CO_2 Measuring suspensions and highly scattering samples Analysis of heavy metals in water Quantitative analysis of strongly absorbing liquid media or suspensions	Analysis of the functionality of photoresists Measurement of oil yield in oil shale samples Analysis of the reflectance properties of solar cells Study of paints and effect of pigments in the automotive Industry	Assessment of crop condition, such as chlorophyll, water and dry matter content Quantitative analysis of additives QC applications	Measurement of turbid biological samples Characterization of intracellular biochemical pathways Analysis of potential sun blocking agents for sun cream and cosmetics
Common sampling techniques supported by the Cary 4000/5000/6000i	Variable/fixed angle specular reflectance accessory Double beam absolute specular reflectance accessory Diffuse reflectance accessory (internal and external) Praying mantis reflectance accessory Brewster angle holder Sample transport with film holder Rear beam attenuator	Fibre optic accessory Solid sample holder Polarizer/depolarizer attachment Rear beam attenuator Rapid mix accessory	Variable/fixed angle specular reflectance accessory Double beam absolute specular reflectance accessory Diffuse reflectance accessory (internal and external) Fibre optic accessory Brewster angle holder Sample transport with film holder	Peltier 6x6 multicell holder accessory Single cell peltier accessory (accurate temperature control) Cell holder for standard and specialized cells	Single cell peltier accessory (accurate temperature control) Peltier multicell accessory Diffuse reflectance accessory (internal and external) Peltier 6x6 multicell holder accessory Rapid mix accessory

precise

QUALITY AND PERFORMANCE BY DESIGN

Our proven record of optical design excellence and innovation ensures you get the right answer every time.

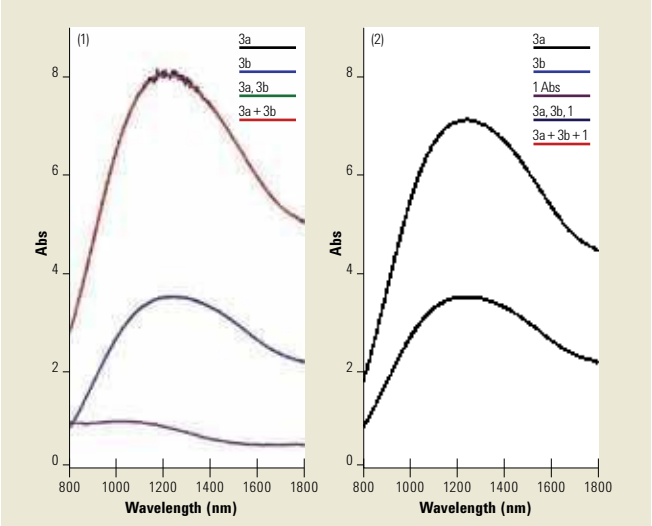
Distinctly better optics

The industry-leading design of the Cary optical systems sets them apart and delivers unmatched photometric range, accuracy, linearity and lower noise.

Control precision with S:N mode

Signal-to-noise (S:N) mode is a unique scanning mode available only on the Cary instruments that enables you to control the level of precision you want across the whole scan. It is particularly useful for samples that vary significantly in either in absorbance or %R across the wavelength range.

S:N mode reduces scanning times by over 50% as the system scans quickly in areas of high energy throughput and increases signal averaging when energy throughput is less.



Measure up to 8 Abs

The addition of two filters (1) for an absorbance maximum of 7.19 (1248 nm) and three filters (2) for an absorbance maximum of 8.10 (1208 nm) demonstrates the photometric range, accuracy and linearity of the Cary 6000i UV-Vis-NIR. (3a, 3b indicates two filters measured directly. 3a + 3b indicates mathematical addition of the two individual spectra.)

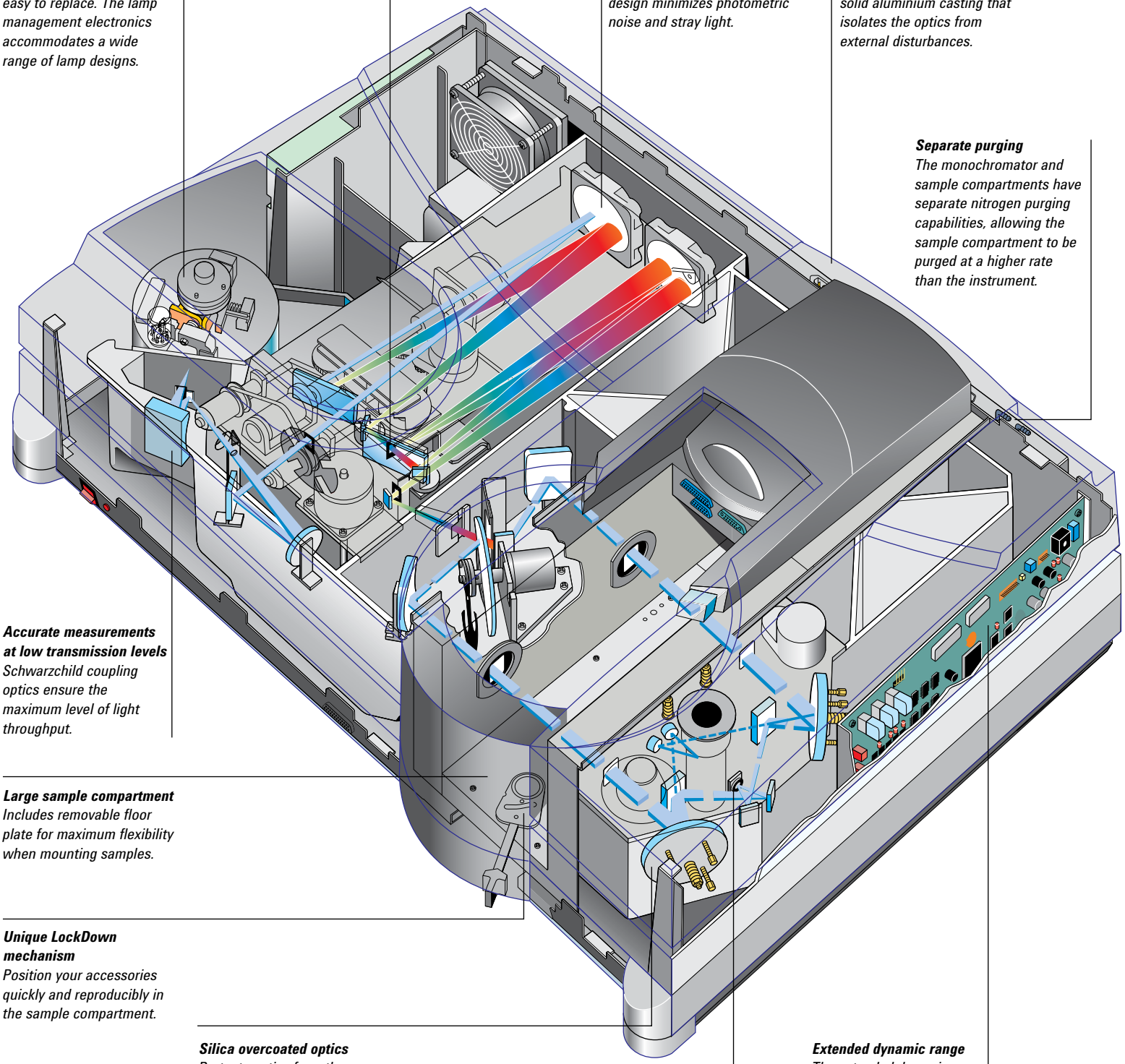
'Plug-and-go' lamp management
Lamps are pre-aligned and easy to replace. The lamp management electronics accommodates a wide range of lamp designs.

Flexibility
The slits can be fixed in the NIR as well as the UV-Vis.

Excellent resolution
The out-of-plane double Littrow monochromator design minimizes photometric noise and stray light.

Sealed optics
The Optical Isolation System incorporates a 'floating' solid aluminium casting that isolates the optics from external disturbances.

Separate purging
The monochromator and sample compartments have separate nitrogen purging capabilities, allowing the sample compartment to be purged at a higher rate than the instrument.



Accurate measurements at low transmission levels
Schwarzchild coupling optics ensure the maximum level of light throughput.

Large sample compartment
Includes removable floor plate for maximum flexibility when mounting samples.

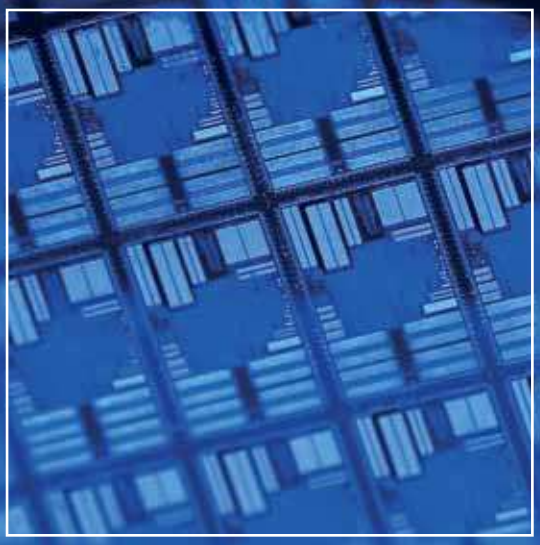
Unique LockDown mechanism
Position your accessories quickly and reproducibly in the sample compartment.

Silica overcoated optics
Protects optics from the environment and allows cleaning without damage to the reflective surface.

Superior detectors
A choice of PbS or InGaAs detectors provides flexibility in the NIR. Where other spectrophotometers need both a PbS and InGaAs detector to improve their performance in the NIR, the superiority of the Cary 5000 PbSmart detector means only one is required. The Cary 6000i short wavelength InGaAs detector enables measurements to be made up to 8Abs in the NIR.

Extended dynamic range
The extended dynamic range of the Cary instruments is a result of its advanced electronics design. With reference beam attenuation, the instruments can typically measure absorbances beyond eight.

consistent

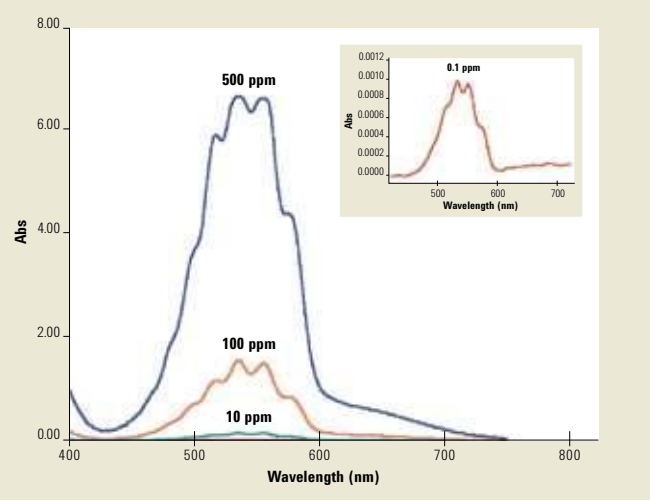


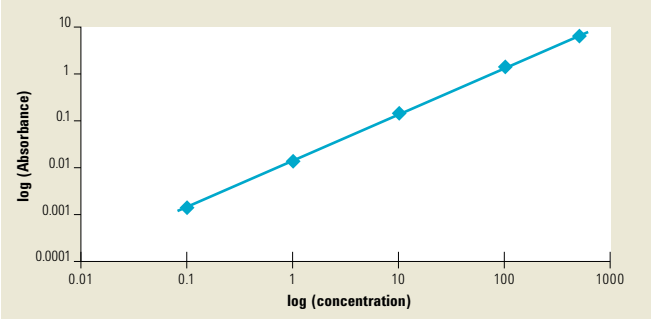
BE SURE OF YOUR ANSWERS

When you need to push the limits of photometric measurement, you can be sure that Agilent Cary spectrophotometers will be precise, consistent, and utterly reliable.

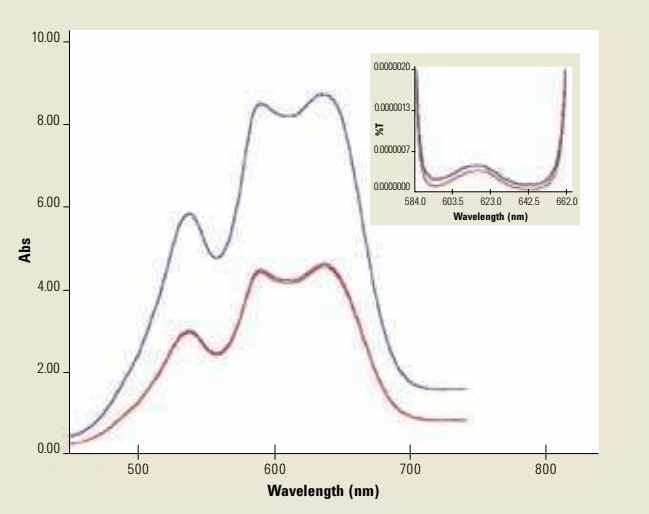
The widest range

Avoid time consuming sample and standard dilutions, and confidently measure the most challenging of samples.
The Cary 4000/5000/6000i Series UV-Vis-NIR provides the widest photometric range available, across the broadest wavelength range — with absorbances exceeding 8 from the UV-Vis to the NIR.





Wide dynamic range
Quantitative analysis of aqueous potassium permanganate (left) further demonstrates the excellent photometric accuracy and range. Measurement at 555 nm permits analysis from 0.1–500 ppm without dilution. The plot of Absorbance vs Concentration (above) highlights the wide dynamic range and inherent linearity (r2 = 0.999).

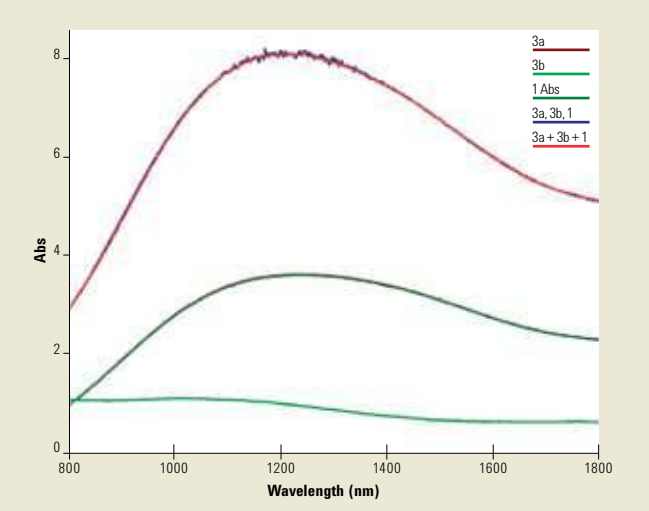


Superior photometric range and linearity in the UV-Vis
The addition of two blue filters demonstrates superior photometric range and linearity in the UV-Vis. The insert compares the spectral addition of the filters to their combined measurement, a difference of less than 8 x 10^{-8} %T.

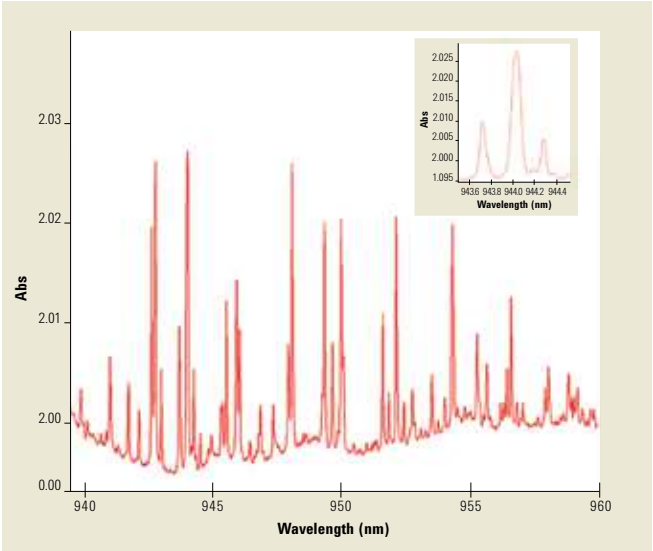
ADVANCED NIR PERFORMANCE FOR ADVANCED PHOTONICS

With an operating range from 175–1800 nm, the Cary 6000i is the instrument of choice for users needing to keep abreast of rapidly developing photonics and communications technologies.

As the successor to the world's first UV-Vis-NIR with InGaAs detection, the Cary 6000i offers unmatched NIR performance and the highest available spectral resolution in the NIR. The Cary 6000i can also be used as a primary reference spectrophotometer in the NIR, with photometric accuracy validation without the need for calibrated standards.



Superior photometric range and linearity in the NIR
The addition of three filters demonstrates photometric range and linearity in the NIR. The actual and predicted measurements show excellent correlation across the entire NIR wavelength range measured.



Fine resolution
A high resolution NIR scan of water vapour clearly resolves absorption bands around 940 nm which are barely visible on standard spectrophotometers. The Cary 6000i features a unique 600 lines/mm NIR diffraction grating optimized for InGaAs operation to achieve unsurpassed NIR performance.

YOU CAN DO IT ALL WITH A CARY

Agilent Cary 4000/5000/6000i Series UV-Vis-NIR spectrophotometers are complemented by a range of accessories and supplies designed specifically for your application needs.

Performance enhancing accessories

The vast range of accessories for Cary 4000/5000/6000i Series UV-Vis-NIR ensures you can handle the widest variety of sample sizes and types — from the smallest etalon to uncut sheet glass. The huge sample compartment accommodates most sample sizes, while the removable floor ensures even more flexibility is provided.

Accessories for solids, powders and pastes

- Brewster angle holder
- Internal and external diffuse reflectance accessories (DRA)
- Polarizer and depolarizer
- Powder cell kit
- Praying mantis DRA
- Sample transport accessory and film holder
- Solid sample holder
- Absolute, fixed and variable angle specular reflectance accessories (SRA)

Accessories for liquid samples

- Single and multi cell holders
- Peltier temperature control
- Cell holder for use with standard and specialized cells
- Temperature controller

Lock it down and walk away

The Cary 4000/5000/6000i Series UV-Vis-NIR features the unique LockDown mechanism that enables you to quickly and reproducibly position your accessories in the instrument. Confidently mount any accessory in the sample compartment in exactly the same place, time-after-time — and eliminate tools and time-consuming alignment procedures.

1 Insert accessory into the sample compartment

2 Position accessory over mounting holes

3 Flick the switch to lock the accessory down

Validate System Performance
Automate validation routines using standard internal components (e.g., mercury lamp) or expand your validation options with additional test modules.

Consumables for UV-Vis-NIR
Agilent's range of UV-Vis-NIR consumables includes cuvettes, flow cells and lamps.

WITH YOU AT THE LEADING EDGE

When you need to consistently and cost-effectively deliver the highest quality finished products and materials, innovative, reliable analytical solutions are essential to your success. Agilent provides unrivalled photometric range and linearity across the broadest wavelength range. Combined with the widest and most versatile sampling solutions no application is too difficult and no sample too challenging to measure.

Integrating spheres

The superior Cary InGaAs and PbSmart NIR detection systems also power Agilent's integrating spheres. Available in two diameters (150 mm or 110 mm), swap from PbS to InGaAs to solve the most challenging diffuse reflectance measurements.

Internal/external DRA-900 (to 900 nm)

Offering exceptionally low photometric noise, a wide photometric range and excellent linearity.

Internal/external DRA-1800 (to1800 nm)

A PMT/InGaAs DRA providing superior S:N performance for improved detection limits and increased scan rates.

Internal/external DRA-2500 (to 2500 nm)

The DRA PbS NIR detector is peltier cooled and optimized in real time, offering exceptional performance.

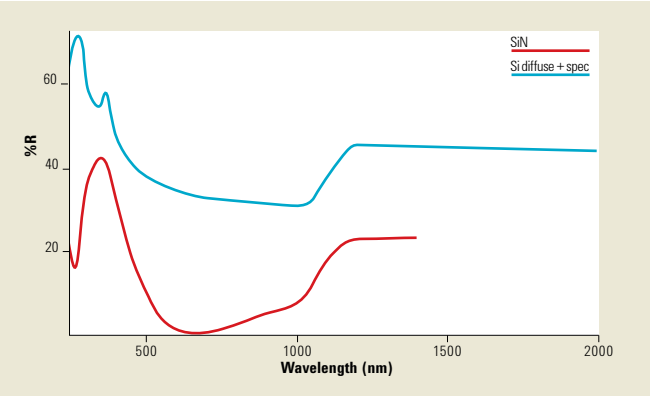
The diffuse reflectance accessory is ideal for measuring a wide range of solid and liquid samples.

versatile

SOLAR APPLICATIONS

For glass manufacturers, or those developing or manufacturing silicon-based or thin film solar cells, use the Cary 5000 with external DRA to:

- Measure the diffuse reflectance of silicon wafers and silicon nitride coatings in order to determine cell efficiency
- Accurately characterize solar cell materials such as silicon and thin film coatings



Diffuse reflectance measurements
Shown is the reflectance spectrum of a silicon wafer, in red, and the reflectance spectrum of a solar cell (silicon wafer + silicon nitride), in blue.

DRA for diffuse transmission measurements
The reflectance and transmission properties of solar cells are readily measured using the Cary 5000 with integrating sphere. In addition, the external DRA-2500 with small spot kit enables small areas of solar cells to be measured, as the focusing optics reduce the size of the beam image on the sample surface.

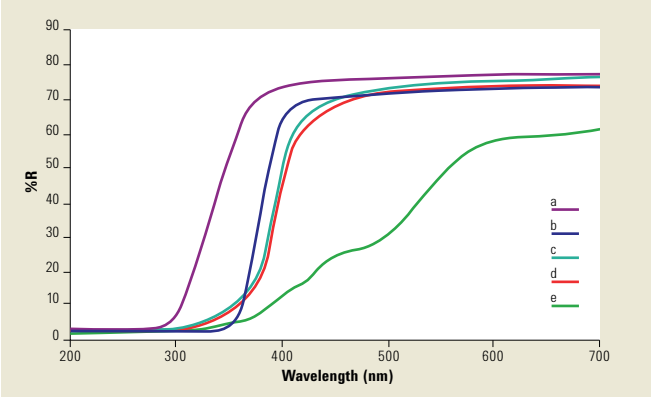
Use the VW SRA for measuring challenging antireflection coatings.

NANOCOMPOSITES & OPTICAL COMPONENT APPLICATIONS

Diffuse reflectance measurements of novel nanocomposites

For researchers developing next-generation electronic and photonic devices, use the Cary 4000/5000/6000i Series UV-Vis-NIR with praying mantis DRA to:

- Measure the diffuse reflectance of small samples and samples that must be horizontally mounted, making it an alternative to traditional integrating spheres
- Measure the properties of powdered nanocomposites, due to the sampling geometry and extended wavelength range of the praying mantis accessory

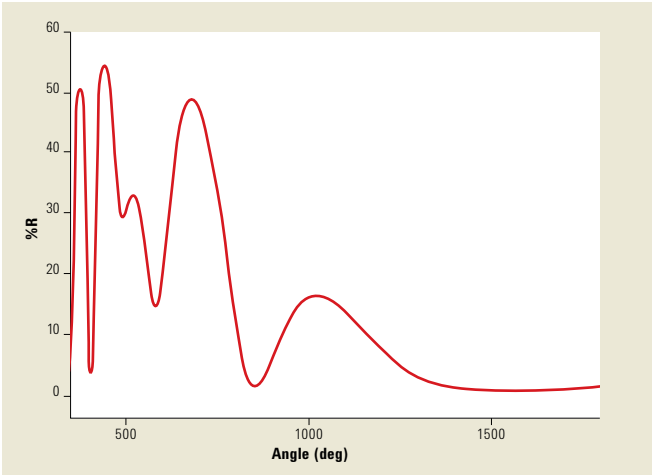


Diffuse reflectance measurements
The collected spectra provide extensive information that can be used for calculating and comparing the absorption edge and band gap energies of the novel nanocomposites and their precursors.

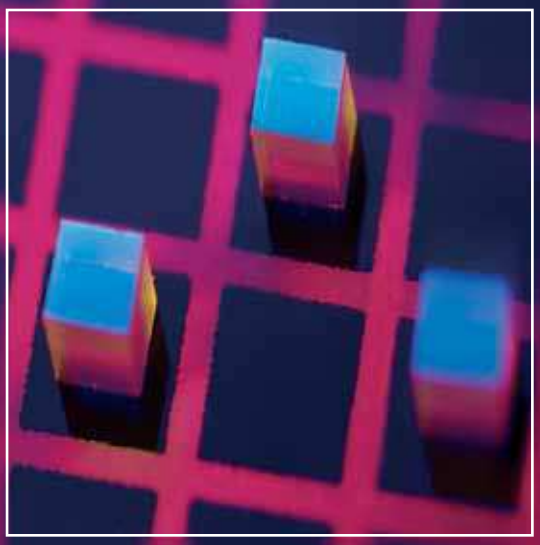
Reflectance measurements of anti-reflection (AR) coatings

Use the Cary 4000/5000/6000i Series UV-Vis-NIR with VW SRA or DRA to measure AR coatings in order to reduce reflectance, enhance contrast, and broaden the wavelength range of AR coatings.

- Measure challenging AR coatings and confirm that the designed gains in light throughput are achieved (VW SRA)
- Accurately characterize AR coatings on lenses or achromats (DRA)



Low reflectance measurements
Raw, unsmoothed spectrum of an AR coating illustrates the quality of low reflectance measurements when using the Cary 6000i and VW SRA.



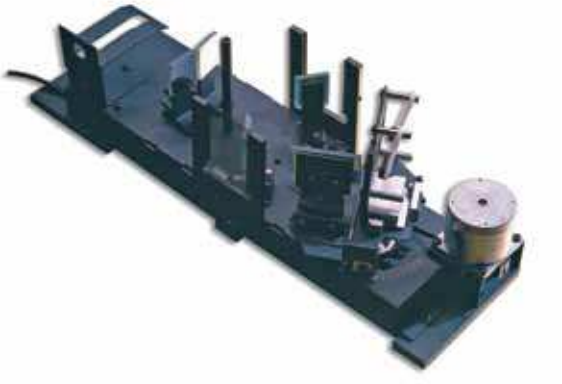
reliable

THIN FILMS APPLICATIONS

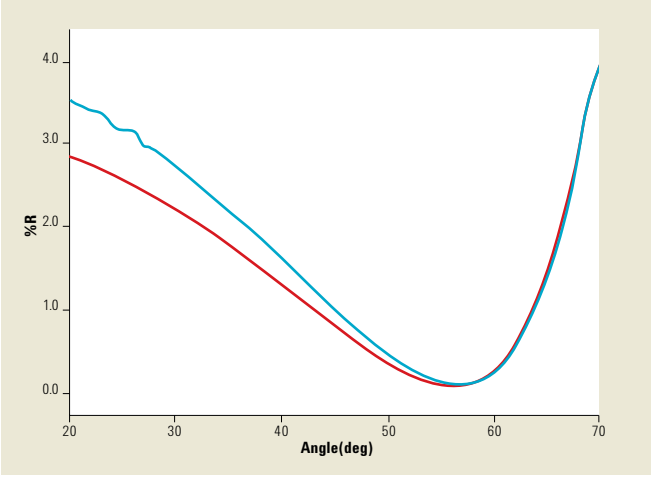
Thin Film Measurements

The Cary 4000/5000/6000i Series UV-Vis-NIR with variable angle specular reflectance accessory (VASRA) accurately measures the refractive index (RI) of lens coatings, antireflective coatings on glass, coated filters and mirrors. With the VASRA, the angle of incidence is automatically and accurately scanned under full PC control.

The sample is simultaneously translated so that the same region of the sample is measured at every angle of incidence.



The VASRA can be used for the characterization of thin films.



The refractive index of a sample has been calculated by measuring %R versus angle for coated and uncoated substrates. Using RI information, the film thickness can be easily calculated.

By satisfying the most demanding research applications, the VASRA gives production facilities the confidence to guarantee the quality of their optical components, reducing reject rates and maximizing profits.

The solid sample holder is designed for transmission measurements of filters, glass, textiles, and other solid samples.

The Brewster Angle Holder measures light transmission at differing angles of incidence to a solid sample.

FILTERS APPLICATIONS

Measurement of films/multiple filters

Use the Cary 4000/5000/6000i Series UV-Vis-NIR with motorized sample transport accessory and film holder to determine surface homogeneity and/or defect rates of films, gels, wafers or multiple filters.

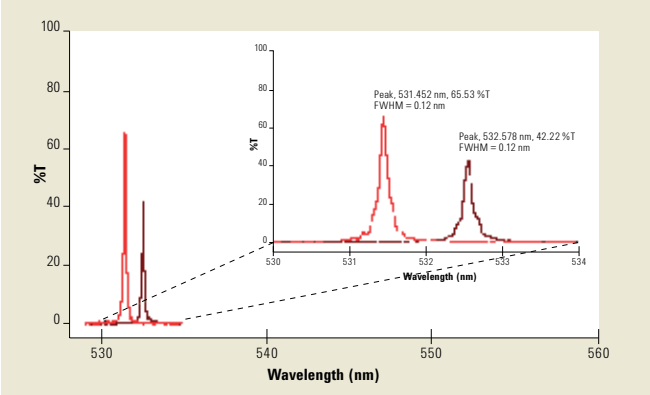
- Eliminates time-consuming, manual adjustments, reducing operational error and cost
- Accurate and reproducible sample positioning in the sample compartment
- Automated scanning capability is ideal for monitoring intra-sample homogeneity and detecting sample defects
- Able to accommodate multiple optical samples, making it ideal for fast QA/QC or accelerated R&D applications requiring inter-sample comparisons

Using the motorized sample transport and film holder accessory, the Cary spectrophotometer can be adapted for rapid measurement of sheets, films, gels, wafers or multiple filters

Sub-nm bandpass filter measurements

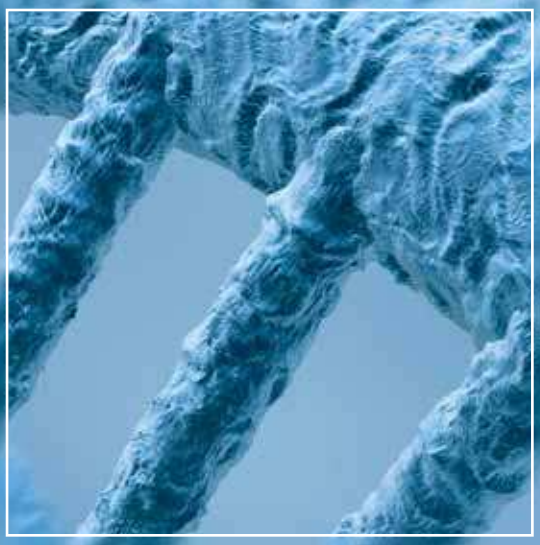
The Cary 5000 with solid sample holder can be used to accurately and fully characterize narrow bandpass filters.

- Sample mounting ensures optimum throughput
- A complete aperture kit for control of beam image size and solid angle.



Accurate peak wavelength, peak transmission and FWHM values were determined for a narrow bandpass filter by using two 1 mm apertures, (50 mm either side of the sample) in the front beam, and two 5 mm apertures (with rear beam attenuation) in the rear beam.

trusted

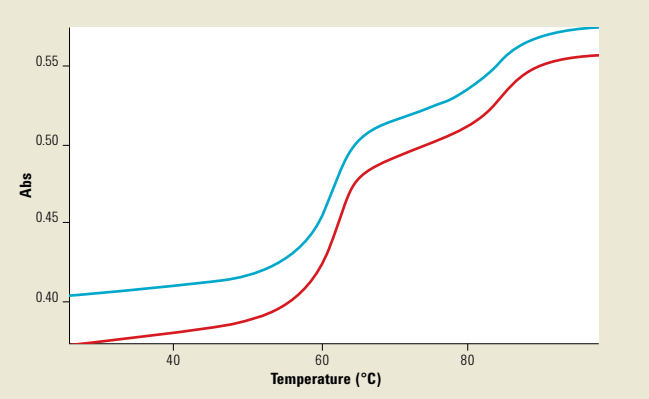


BIOTECH AND PHARMA APPLICATIONS

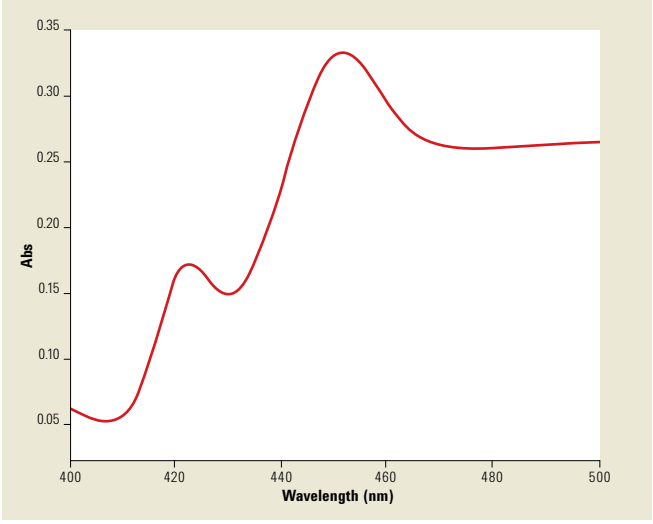
The Cary 4000 UV-Vis provides unrivalled optical performance and superior temperature control to measure the most challenging samples with the highest accuracy.

Complete IQ/OQ services

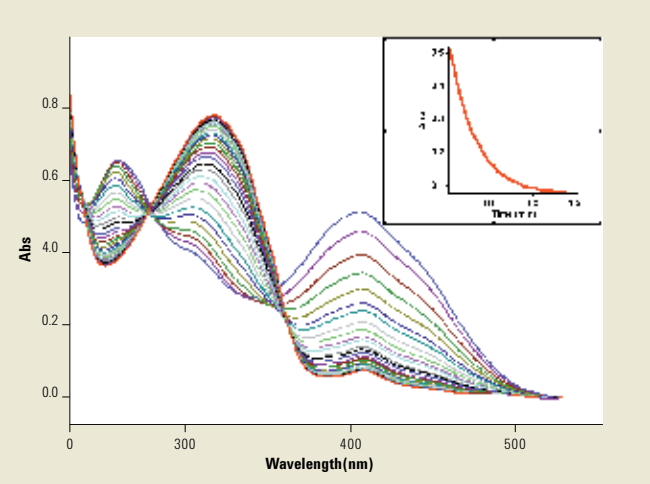
Agilent offers complete qualification services (IQ/OQ) for the Cary 4000/5000/6000i Series UV-Vis-NIR hardware, software and accessories.



Thermodynamic properties of DNA
The accurate, reproducible temperature ramping of the Cary 4000 enables detection of the minute changes in absorbance readings due to multiple transitions as the DNA unwinds. Shown is the 2nd transition state of the triplex DNA melt.



The reference spectrophotometer for turbid samples
Measuring the change in absorbance of turbid biological samples can be challenging as the inherent background absorbance of the sample may be over 4 Abs. The above demonstrates the superiority of the Cary 4000 UV-Vis for measuring the highly turbid Cytochrome P450, as the background absorbance (subtracted from the final spectrum shown above) measured over 4.5 Abs. The true absorbance of this sample is nearly 5 Abs where changes of <0.05 Abs are being detected.



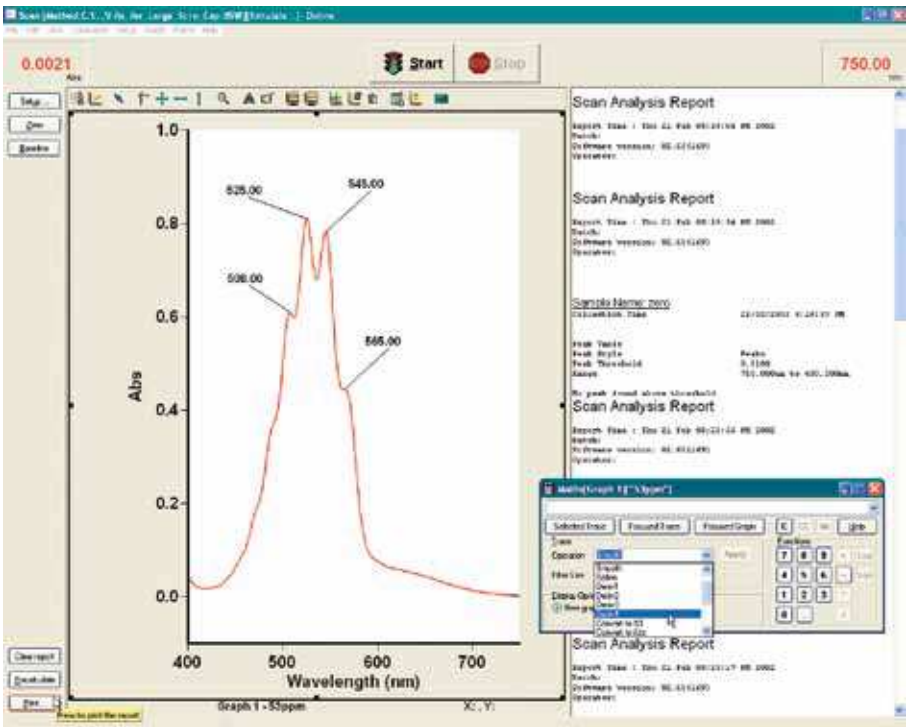
Obtain kinetics curves easily
With a mouse-click you can obtain a kinetics curve from a series of repetitive curves. The insert shows the kinetics curve at 410 nm.

DISTINCTLY BETTER SOFTWARE

User friendly, application focused software provides complete instrument control.

Software designed for real samples

The modular design of the Cary WinUV software means that it can be tailored to suit your analytical requirements — whether it's a materials science application using wavelength scanning measurements or life science applications requiring advanced enzyme kinetics or thermal control.



Advanced data processing
Use the spectrum calculator to apply mathematical operations, including addition, subtraction, division, multiplication, log and square root functions, to spectra. The calculator also features mean, normalization, smoothing, up to fourth order derivatives, integration and the Kubelka-Munk correction algorithm.

Enhanced graphics features
The graphics control module has automatic peak labelling, zoom, free and tracking cursor, multiple ordinate and abscissa formats, smart copy/paste and overlay modes, making spectral interpretation and presentation for publications a breeze.

Meet your application challenges
Use the powerful built-in Applications Development Language (ADL) to tailor the WinUV software to meet your most specific applications.

Trust Agilent to keep your lab running at peak productivity

Agilent's Advantage Service protects your investment in Agilent instruments and connects you with our global network of experienced professionals who can help you get the highest performance from every system in your lab. Count on us for the services you need at every stage of your instrument's lifecycle – from installation and upgrade to operation, maintenance and repair.

For customers who require full system validation, Agilent offers complete qualification services (Installation and Operational Qualification) for the Cary 4000/5000/6000i Series UV-Vis-NIR hardware, software and accessories.

And if ever your Agilent instrument requires service while covered by an Agilent service agreement, we guarantee repair or we will replace your instrument for free. No other manufacturer or service provider offers this level of commitment.