

McPHERSON

The Spectroscopy People for Over 60 Years

VUVAS-1000

Vacuum Ultraviolet Analytical Spectrophotometer

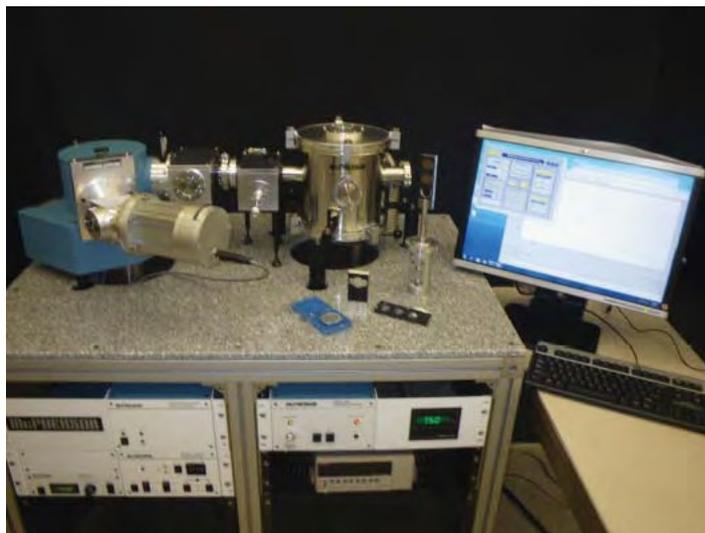
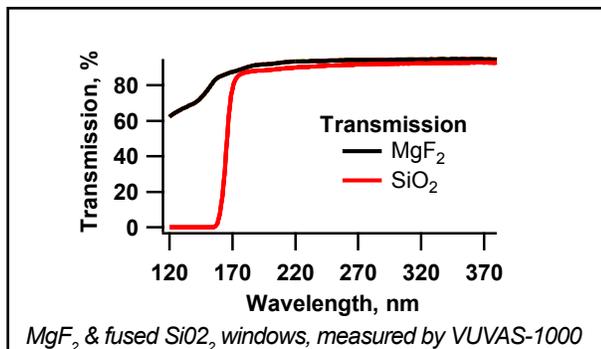
VUVAS - The Industry Standard VUV/UV Spectrophotometer

Do you test transmittance and reflectance in the Vacuum Ultraviolet? Do you provide optics, coatings, photo resist materials or substrates for use in the energetic vacuum region? Do you synthesize nanomaterials, phosphors, carbon nanotubes or whiteners? The **VUVAS-1000** directly measures reflectance and transmittance properties of vacuum ultraviolet (VUV) optical components.

The **VUVAS** system works from 120 to 380 nanometers with high throughput, strong signal levels and excellent reliability. The system uses a high throughput 0.2m focal length vacuum monochromator, focused Deuterium light source, multi-sample chamber, scintillated detectors, and an oil free vacuum pumping system.

The **VUVAS** is a highly stable single beam vacuum spectrophotometer. Accurate measurement of optical properties can be made over a wide angle range, from near normal incidence to seventy degrees.

The **VUVAS** comes complete with vacuum pumping or automatic purge-gas and gauge system. Easy to use **Spectrometer Control Software** (LabView™ based) controls automated parameters and signal recovery.



Fully-equipped VUVAS-1000 ready for measurement

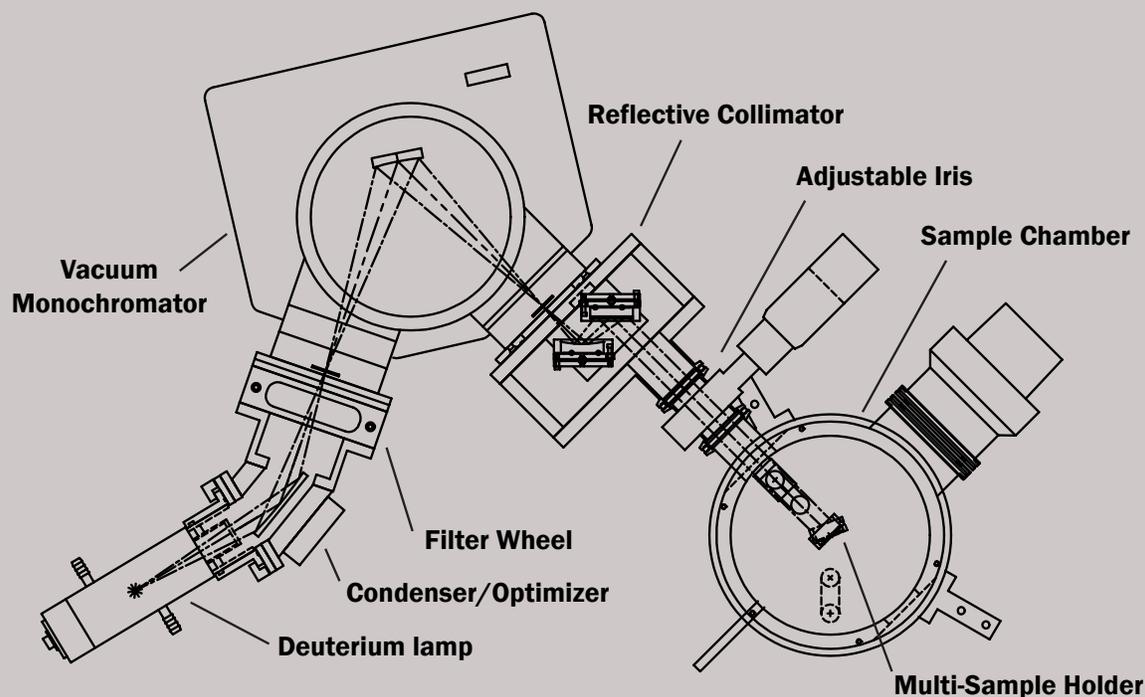
Quick Specifications

Wavelength Range	120 to 350 nm*
Sample Environment	10 ⁻⁵ torr vac. or N ₂
Wavelength Resolution	0.1 nm
Precision, RSD (@157nm)*	0.25%†
Precision, RSD (overall)*	<0.5%†
Stability (per hour)*	<1%†
Bandpass (adjustable)	1 to 8 nm
Calibration accuracy	0.1 nm
Wavelength reproducibility	0.05nm
Drive Step Size	0.00006nm
Measurement Beam	Collimated
Detector(s)	Scintillated R6095
Polarizer Mounting	Optional
Beam Scaling Iris	Optional
Detector Angle	10 to 180°
Sample Angle (AOI)	0 to 60°

*with deuterium lamp, other light sources available
†see discussion on next pages for clarification

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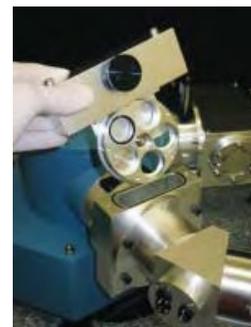
Schematic of Key Components in the VUVAS-1000 System



Operations Summary

The heart of the **VUVAS-1000** system is the McPherson 234/302 vacuum monochromator. Paired with a model 615 condenser/optimizer and ultra-stable deuterium lamp, the 234/302 creates monochromatic light of unparalleled brightness and spectral purity. A 5-position filter wheel is provided for order sorting - but this wheel can also hold 3 additional samples for quick transmission measurements!

A reflective collimator shapes light from the monochromator into a 1" diameter probe beam, while the user-adjustable vacuum iris allows the **VUVAS** to be used with smaller samples. The monochromatic probe beam is projected onto samples mounted in a multi-position sample holder (shown at bottom right), and collected via scintillated PMT directly behind (for transmission measurements) or at any angle from 10-180° for reflected or diffracted light. The detector and sample angle are independently controlled by easy-access handles above and below the sample chamber - motorized detector/sample rotation is also available.



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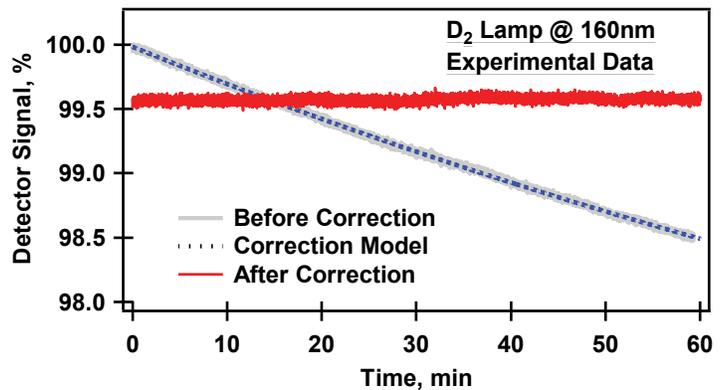
The Spectroscopy People for Over 60 Years

Our Specifications - Visualized and Explained A Single Number Often Hides the Full Story

Drift in the VUVAS-1000 System

As in all vacuum ultraviolet spectrometers, signal drift in the **VUVAS-1000** is dominated by optics aging. Although unavoidable, this drift is highly predictable, slows over time, and can be corrected for in-software to vastly increase the stability of long term experiments.

While **VUVAS-1000** systems exhibit a combined raw value of $<1\%/hr$ drift, applying drift correction reduces this to $\sim 0.01\%/hr$, comparable to the system noise level. Contact one of our application specialist to see how your measurements can be stabilized.



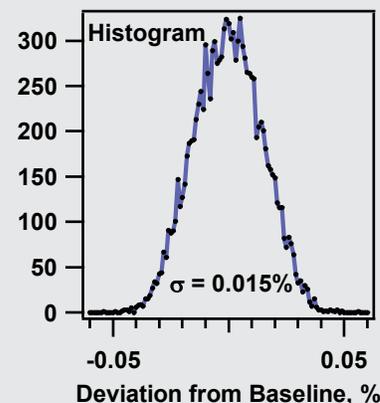
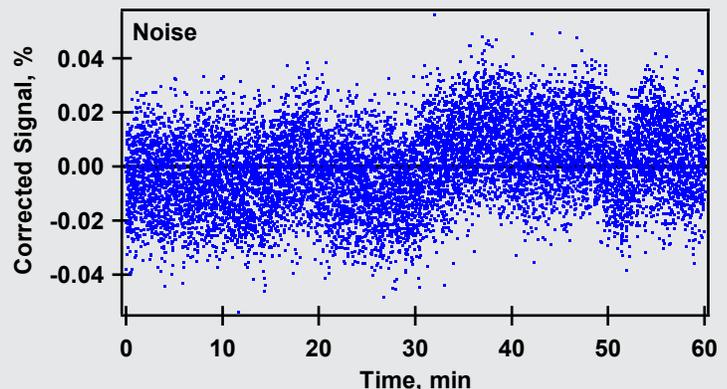
160nm deuterium lamp emission monitored by a VUVAS-1000 spectrophotometer. Automatic baseline correction (single exponential) applied to the measured signal easily removes $>99\%$ of 'drift'

Noise in the VUVAS-1000 System

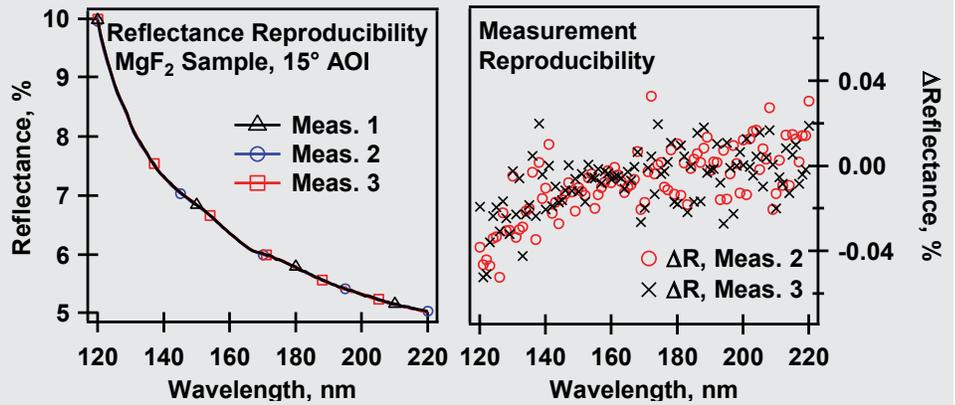
Quiet instruments, precise measurements
Noise in the **VUVAS-1000** is dominated by lamp flickering and PMT electrical fluctuations. As this noise is truly random, it cannot be removed by software algorithms. However this noise level is extremely low - typically $\sim 0.01\%$ RMS.

Analysis of residual noise in the **VUVAS** system shows normally distributed behavior, with a typical σ of 0.015% . This noise level is not normally visible on measured data, and generally will not be seen by the user under normal measurement conditions.

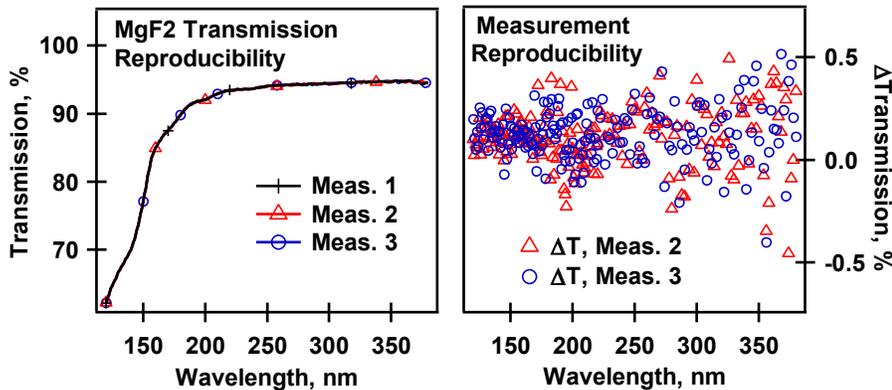
On the other hand, If you need to measure extremely low values of transmission or reflectance ($<<5\%$) with high precision, contact one of our application specialists - we have a system that fits your needs!



Reflectance Measurement
Industry Standard for VUV/UV Mirror Quality Control
 Measurement of reflectance with the **VUVAS-1000** is easy and highly repeatable. With the **VUVAS** sample chamber and holder, angle of incidence (AOI) can be varied from 0 to $>60^\circ$, while the detector orbits the sample from 10 to 180° , allowing for full characterization of reflector properties over a wide wavelength range. Both manual and motorized detector/sample motion are available.



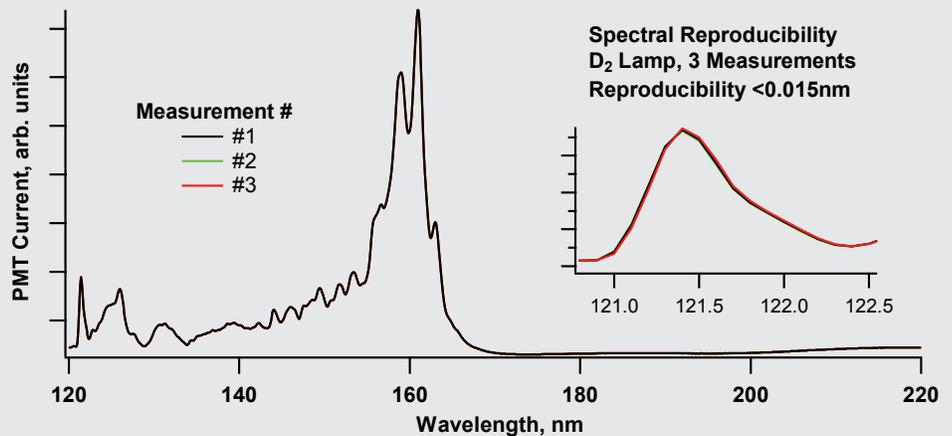
With proper measurement procedure, users can push reproducibility beyond our published spec. Left: 3 measurements of reflection from a MgF_2 . Right: uncorrected deviation from the first measurement. Further improvements can be gained by in-software correction.



Left: 3 measurements of transmission through a MgF_2 window. Markers traces, as variation is $<$ trace width. Right: uncorrected deviation from the first measurement. Further improvements can be gained by in-software correction.

Transmission Measurement
VUV/UV Transmission with amazing precision and stability
 Transmission measurements with the **VUVAS** are easy and reliable, thanks to our custom control software and easy sample change system. Foolproof, high S/N measurement down to 120 nm with low drift deuterium light source and patented McPherson energy optimizer/condenser.

Wavelength Measurement
Peerless resolution, accuracy and reproducibility
 Precision machining and assembly means years of trouble free operation with no loss of calibration. Further, all McPherson monochromators use a sine arm drive for grating rotation - this means the grating equation is built into the hardware. Factory calibration with mechanical backup wavelength readout means no spurious results, and no long-term wavelength drift.



3 scans of deuterium lamp emission spectrum, showing high repeatability, wavelength resolution, and dynamic range. Inset: magnified Ly- α lines.