PIKE TECHNOLOGIES

Specular Reflectance

Specular reflectance sampling represents a very important technique useful for the measurement of thin films on reflective substrates, the analysis of bulk materials and the measurement of mono-molecular layers on a substrate material. Often this technique provides a means of sample analysis with no sample preparation – keeping the sample intact for subsequent measurements.

VeeMAX III™
Variable Angle Specular Reflectance Accessory
Measurement of thin films and monolayers

10Spec™
Fixed 10 Degree Angle of Incidence
Near-normal sample reflectivity measurement

30Spec/45Spec™
Fixed 30 or 45 Degree Angle of Incidence
Thick films analysis

80Spec™
Fixed 80 Degree Angle of Incidence
Measurement of thin films and mono-molecular layers

AGA™
Advanced Grazing Angle Accessory
Thin films requiring precise spot size control

Absolute Reflectance Accessory
Measurement of optical surfaces, windows and metallic surfaces

Theory and Applications Included

PIKE Technologies, Inc., 6125 Cottonwood Drive, Madison, WI 53719
(608) 274-2721 · www.piketech.com · sales@piketech.com

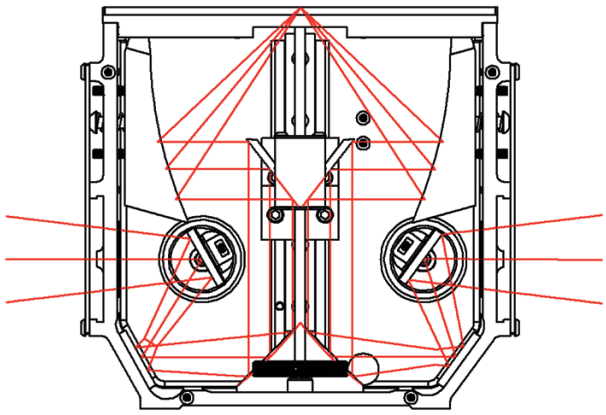
VeeMAX III –
The Ultimate Variable Angle Specular Reflectance Accessory

Features

- **Selectable angle of incidence – from 30 to 80 degrees in 1 degree increments**
- **Measurement of thin films and monolayers to relatively thick films**
- **Optimize specular reflectance results with selectable angle of incidence**
- **Integrated position for IR polarization – essential for monolayer analysis and study of polymer orientation**
- **Optional single reflection ATR crystals – see ATR section**
- **Motorized option with AutoPRO software for automated, high-precision experiments**
- **Sealed and purgeable optical design to eliminate water vapor and carbon dioxide interferences**

The PIKE Technologies VeeMAX III is a high-performance research-grade specular reflectance accessory. Its unique variable angle optical design (U.S. Patent No. 5,106,196) makes it a key accessory to analyze a wide range of samples. Typical VeeMAX III applications include depth profiling, analysis of monolayers and ultra-thin films, determination of polymer orientation and spectroelectrochemistry. From monolayers to relatively thick films, all experiments may be optimized by varying the angle of incidence from 30 to 80 degrees. Changing the angle is as easy as turning the angle selector on the front panel of the accessory.

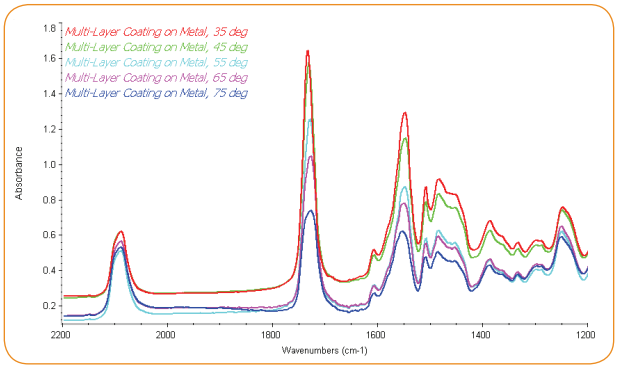
To make measurements, the sample is placed face down on the sampling surface. Designed for unrestricted access to the sampling area, large samples may be readily analyzed. Thanks to the optical design of this accessory and the quality of the optics, excellent throughput is realized even at high angles of incidence. All powered mirrors are diamond turned for optimal performance.



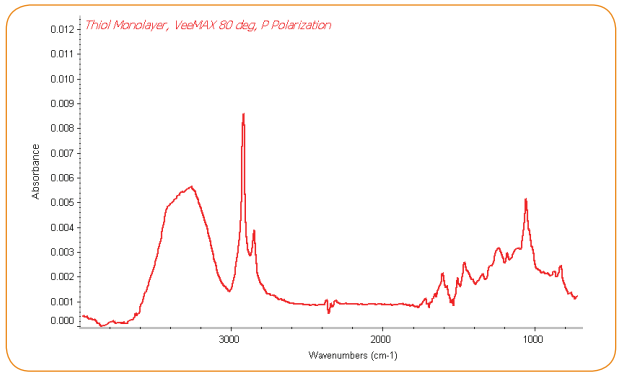
Proprietary beam path within the VeeMAX III specular reflectance accessory.

To suit different sample geometries, masks with 2", 5/8" and 3/8" apertures are provided. Another important design feature of the VeeMAX III is its enclosed optics for purging, which eliminates the need to purge the entire sample compartment. This significantly decreases sampling time. It is furnished with two polarizer mounts allowing the PIKE polarizer to be inserted into the accessory on either the source or detector side of the spectrometer. The polarizer setting dial is easily accessed while never breaking the purge when changing polarizer orientation.

To further expand on the versatility of the VeeMAX III, the accessory may be fitted with an ATR flat plate allowing for variable angle ATR experiments. Please see the ATR section of our catalog for complete configuration options.



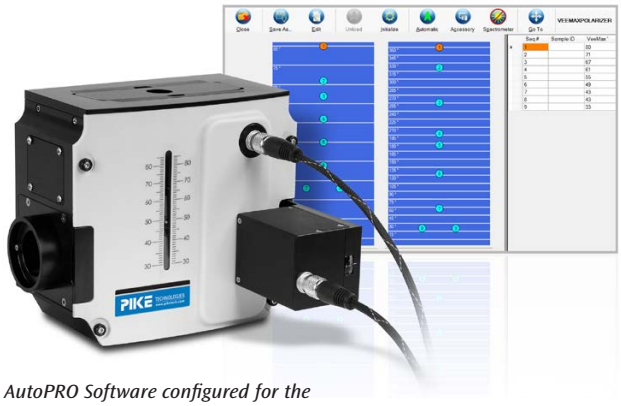
Optimization of the analysis of a multi-layered coating on metal substrate using the VeeMAX III.



FTIR spectrum of thiol monolayer measured using the VeeMAX III specular reflectance accessory set at 80 degrees angle of incidence, ZnSe polarizer and MCT detector.

An optional automated version of the VeeMAX III accessory is available. It features a servo motor with USB interface and PIKE Technologies AutoPRO software. Operation of the VeeMAX III can be integrated with the spectrometer software of most FTIR instruments, which allows the operator to precisely and reliably control a wide range of angles of incidence and data collection simultaneously from a computer keyboard. Automated sampling decreases operator error and increases workflow productivity. Other advantages of an Automated VeeMAX III accessory include

- Computer-controlled precision, accuracy and repeatability
- Synchronization of mirror position changes with collection of sample spectra
- Tailor-made, predefined experiments
- "Hands-free" operation



AutoPRO Software configured for the VeeMAX III with automated polarizer.

A spectroelectrochemical cell option for the VeeMAX III is also available. The cell allows for specular experiments using a flat IR window or CaF_2 prism, where the beam reflects off the working electrode or for ATR experiments where often the ATR crystal serves as the working electrode. Windows and ATR crystals are removable. The electrochemistry cell is equipped with a precision micrometer for electrode positioning.

Electrochemical Cell assembly for VeeMAX III.

Specifications

Optics	All reflective
Angle of Incidence Range	30 to 80 degrees
Sample Masks	2", 5/8" and 3/8"
Purge Sealing	Purge tubes and purge barb included
Dimensions (W x D x H)	177 x 92 x 162 mm (excludes baseplate)
FTIR Compatibility	Most, specify model and type
Spectroelectrochemical Vessel Dimensions	25 mm dia tapering to 19 mm, 25 mm tall
Spectroelectrochemical Vessel Volume	7.5 mL
Spectroelectrochemical Vessel Material	PTFE or PEEK

Ordering Information

Part Number	Description
013-11XX	VeeMAX III *Includes sample masks (2", 5/8" and 3/8"), gold substrate alignment mirror, FTIR base mount, and purge tubes*
013-12XX	Automated VeeMAX III *Includes controller, cabling, sample masks (2", 5/8" and 3/8"), gold substrate alignment mirror, FTIR base mount, and purge tubes*

Note: Replace XX with your spectrometer's Instrument Code. Click for List >

VeeMAX III Sampling Options

Part Number	Description
090-1000	Manual Polarizer, ZnSe
090-1200	Manual Polarizer, KRS-5
090-3000	Precision Manual Polarizer, ZnSe
090-3200	Precision Manual Polarizer, KRS-5
090-5000	Precision Automated USB Polarizer, ZnSe
090-5100	Precision Automated USB Polarizer, KRS-5

Note: Automated version includes PIKE Technologies AutoPRO software and controller. More polarizer options are found in the polarizer section of this catalog.

VeeMAX III Replacement Parts

Part Number	Description
013-4010	Specular Mask Set
300-0002	Gold Substrate Alignment Mirror, 1.25 x 3.0"

Note: Please contact PIKE Technologies for items not described in this list.

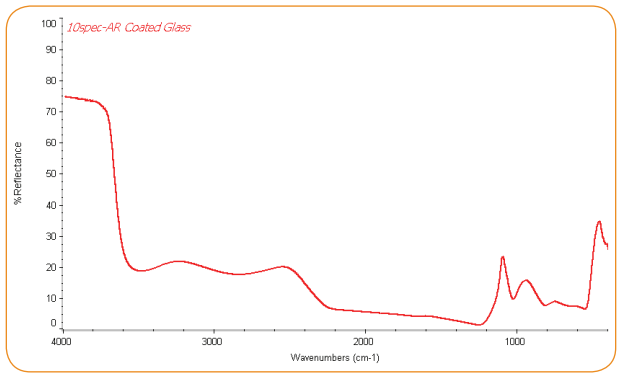
Spectroelectrochemical Configurations

Part Number	Description
013-3300	Electrochemical Cell – PTFE
013-3370	Electrochemical Cell – PEEK
160-5527	Prism, CaF_2, 60 degree
013-3360	Crystal Holder, 60 degree
160-1144	Flat Window, CaF_2, 20 x 2 mm
160-1304	Flat Window, ZnSe, 20 x 2 mm
013-3320	Flat Window Holder

Notes: The electrochemical configuration requires Electrochemical Cell and VeeMAX III specular reflectance accessory. Must select one or more windows. Choose appropriate window holder. More window types for specular reflectance measurements may be found in our listing of transmission windows, 20 mm x 2 mm. Electrodes supplied by the end-user. See VeeMAX III with ATR product sheet for full ATR crystal and configuration options.

10Spec –
Near-normal Sample Reflectivity Measurements

Standard 10Spec (above) and Extended Height 10Spec (left)



FTIR spectrum measuring the reflectively of glass with the 10Spec.

The PIKE Technologies 10Spec is an optimized specular reflectance accessory designed to make high-performance measurements of sample reflectivity. It produces a collimated beam to illuminate the sample area such that the reflectivity measurement is made at a uniform 10 degree angle of incidence and not an average of angles produced by a focused beam accessory design. At a near-normal angle, the polarization effects on reflectivity are minimized. The optics are enclosed to allow for purging.

The 10Spec is recommended to measure the reflectivity of glass. It may also be used to measure near-normal reflectivity of a wide variety of surfaces including military devices, reflecting optics, anti-reflective (AR) coated surfaces, and other reflecting and non-reflecting materials.

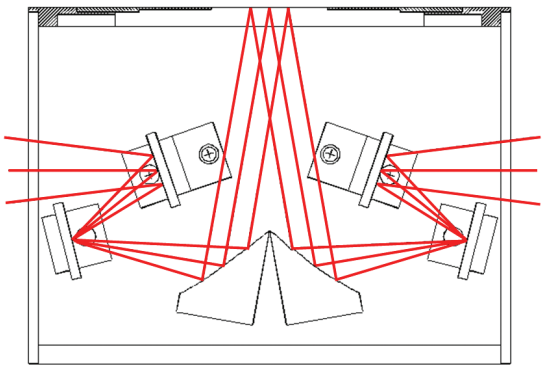
The 10Spec is available in two versions. The standard version is 118-mm tall whereas the Extended Height 10Spec is 205-mm tall, which positions the sample above the top of the FTIR instrument. The Extended Height 10Spec is designed to accommodate samples that are too large to fit within the confinements of the sample compartment.

Features

- Measure sample reflectance
- Fixed 10 degree angle of incidence
- Sample illumination using collimated beam precisely fixed at 10 degrees
- Sampling mask sizes of 2”, 5/8” and 3/8”
- Purge cover and purge tubes for removal of atmospheric interferences
- Extended Height 10Spec to accommodate large samples

Specifications

Optics	All reflective
Angle of Incidence	10 degrees
Sample Masks	2”, 5/8” and 3/8””
Purge Sealing	Purge tubes and purge barb included
Dimensions (W x D x H)	
Standard	159 x 90 x 118 mm (excludes baseplate)
Extended Height	159 x 90 x 205 mm (excludes baseplate)
FTIR Compatibility	Most, specify model and type



Beam path within the 10Spec specular reflectance accessory.

Ordering Information

Part Number	Description
010-10XX	10Spec – 10 Degree Specular Reflectance Accessory *Includes 3 sample masks (2”, 5/8” and 3/8”), gold substrate alignment mirror and FTIR base mount*
010-11XX	Extended Height 10Spec Accessory *Includes 3 sample masks (2”, 5/8” and 3/8”), gold substrate alignment mirror and FTIR base mount*

Note: Replace XX with your spectrometer’s Instrument Code. Click for List >

10Spec Replacement Parts and Sampling Options

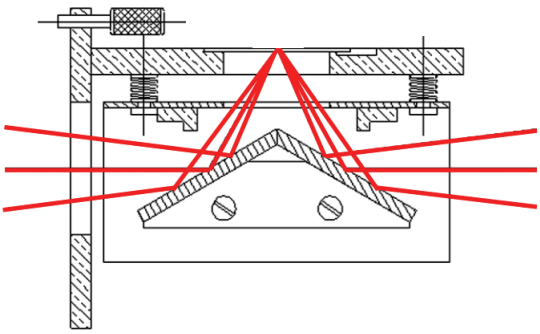
Part Number	Description
010-3010	Specular Mask Set
300-0002	Gold Substrate Alignment Mirror (1.25” x 3.0”)

30Spec and 45Spec –
Specular Reflectance for Thick Films

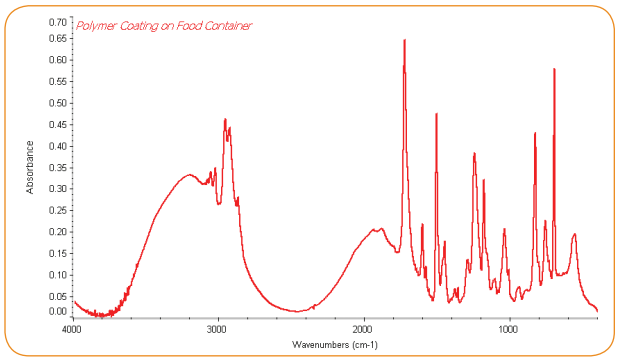
The PIKE Technologies 30Spec is ideal for the measurement of relatively thick films by specular reflectance. Samples are simply laid across the top of the accessory and the spectrum of the film is measured within a short time period. The 30Spec includes sample masks of 3/8", 1/4" and 3/16" to define specific sampling areas. The 30Spec provides high-quality FTIR spectra for identification of coatings and can also be used to measure coating thickness. IR throughput is high using the 30Spec due to its relatively simple optical design.

Features

- Measurement of thick films
- Measurement of film thickness by specular reflectance
- Fixed 30 degree angle of incidence
- Special version – 45Spec for 45 degree angle of incidence
- Sample masks to define sampling area
- Slide-mount design for easy installation of accessory – fits all FTIR spectrometers



Optical geometry for the 30Spec.



FTIR spectrum of polymer coating on a food container collected using the PIKE 30Spec.

Specifications

Optics	All reflective
Angle of Incidence	30 degrees or 45 degrees
Sample Masks	3/8", 1/4" and 3/16"
Dimensions (W x D x H)	51 x 96 x 77 mm
Mount	2" x 3" slide mount

Ordering Information

Part Number	Description
011-1000	30Spec – 30 Degree Specular Reflectance Accessory *Includes sample masks (3/8", 1/4", and 3/16"), alignment mirror and slide-mount*
011-4500	45Spec – 45 Degree Specular Reflectance Accessory *Includes sample masks (3/8", 1/4", and 3/16"), alignment mirror and slide-mount*

Note: The 30Spec and 45Spec are slide-mount accessories.

30Spec and 45Spec Sampling Options

Part Number	Description
011-2010	Sample Masks (3/8", 1/4", and 3/16")
300-0039	Aluminum Alignment Mirror

Note: Sample masks and alignment mirror fit both 30Spec and 45Spec.

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80Spec –
Grazing Angle Specular Reflectance for Thin Films

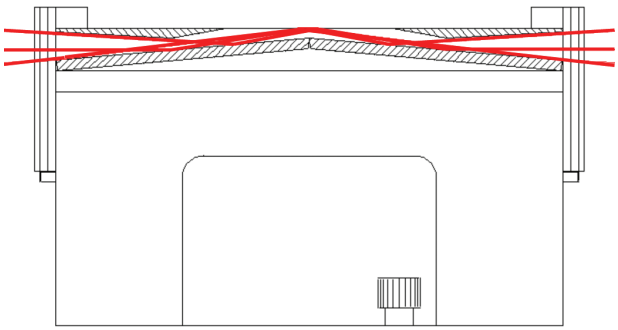
The PIKE Technologies 80Spec is ideal for the measurement of relatively thin films and mono-molecular layers by specular reflectance. Samples are simply placed face down across the top of the accessory and the spectrum of the film is collected. Generally the measurement of ultra-thin film samples, especially monolayers, is significantly enhanced by using p-polarized light, with the electric field vector perpendicular to the sample surface. The 80Spec includes polarizer mounts on both incoming and outgoing beams for positioning optional manual or automated IR polarizers from PIKE Technologies.

The 80Spec is available in two versions. The basic configuration features a flat sampling surface with fixed sampling port. This version is ideal for analysis of larger, uniform samples. The second version includes three sample masks to define smaller areas on a sample, and is recommended for smaller samples or for measurement of variations in thin film coatings.

Features

- Measurement of thin films and mono-molecular layers
- Fixed 80 degree angle of incidence
- Gold-coated reflective optics for highest throughput grazing angle analysis
- Dual polarizer mounts for incoming and outgoing IR beam
- Optional sample masks version to define unique sampling areas
- Baseplate mount design for stable operation and collection of high-quality spectra – fits all FTIR spectrometers

FTIR spectrum of an ultra-thin film on a reflective substrate using p-polarized IR beam.



Beam path within the 80Spec specular reflectance accessory.

Ordering Information

Part Number	Description
012-10XX	80Spec – 80 Degree Specular Reflectance Accessory *Includes a gold substrate alignment mirror, dual polarizer mount and FTIR base mount*
012-11XX	80Spec – 80 Degree Specular Reflectance Accessory with Sample Masks (*2", 5/8" and 3/8"*) *Includes a gold substrate alignment mirror, dual polarizer mount and FTIR base mount*

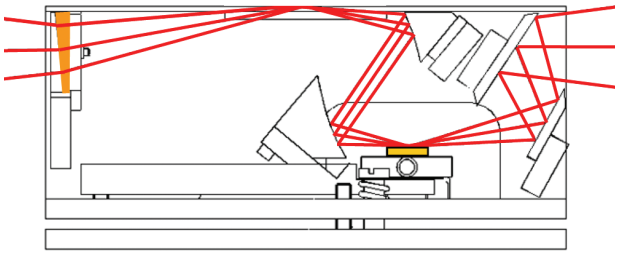
Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
For compact-size spectrometers, only one polarizer mount may be included due to sample compartment width restriction. Please contact PIKE Technologies prior to placing an order.

Replacement Parts and Options

Part Number	Description
010-3010	Specular Mask Set
300-0002	Gold Substrate Alignment Mirror, 1.25 x 3.0"
090-1000	Manual Polarizer, ZnSe
090-1200	Manual Polarizer, KRS-5
090-3000	Precision Manual Polarizer, ZnSe
090-3200	Precision Manual Polarizer, KRS-5
090-5000	Precision Automated USB Polarizer, ZnSe
090-5100	Precision Automated USB Polarizer, KRS-5

Note: For more polarizer options see the polarizer section of this catalog.

AGA – *Advanced Grazing Angle Specular Reflectance for Thin Films with Precise Spot Control*

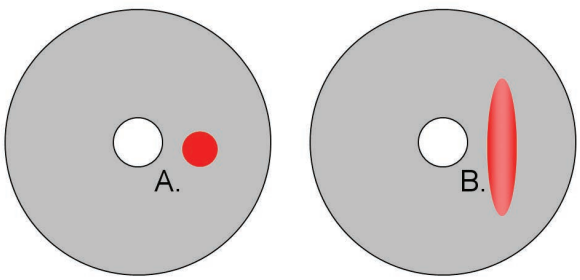


Beam path within the AGA – Grazing Angle Specular Reflectance Accessory.

Features

- **Quantitative measurement of small areas of thin films and mono-molecular layers**
- **Fixed 80 degree angle of incidence**
- **Measurement of lubricants on hard disks**
- **Sampling dimensions selectable from 1/2", 3/8", 1/4", 3/16" and 1/8" diameter**
- **Polarizer mount for optional polarizer**
- **Baseplate mount design for stable operation and collection of high-quality spectra – fits most FTIR spectrometers**
- **Spectral range 10,000–500 cm^{-1}**

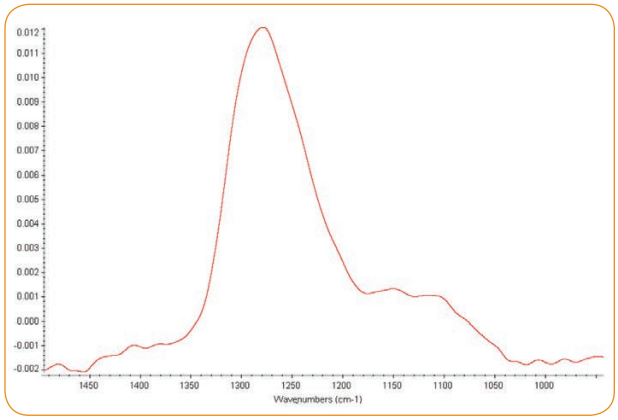
The PIKE Technologies AGA – Advanced Grazing Angle Specular Reflectance Accessory is a novel instrument designed for quantitative measurement of spatially defined areas of thin films on reflective substrates. Traditional grazing angle accessories produce a sampling area which is elliptical in shape and non-uniformly illuminates the sample area. This large asymmetrical sampling area causes problems when quantitative analysis are to be performed on small sample areas. The Advanced Grazing Angle (AGA) Accessory has been designed to overcome this deficiency.



Sampling image on a hard disk surface produced by (A) the spatially resolved AGA and (B) a traditional grazing angle accessory.

The size and shape of the illuminated spot on the sample is defined by the optics contained in the accessory. The AGA optical design uses primary imaging from one of five user-defined, slide-mounted pin mirrors selectable from 1/2" to 1/8".

The beam from the spectrometer is focused onto the pin mirror. The angle of incidence is equal to 80 degrees. The portion of the beam that is reflected from this mirror is imaged at unit magnification onto the sample, striking it at the same 80 degrees. Thus, the beam at the sample position is uniform and circular in dimension – providing excellent quantitative results for the defined sample area.



FTIR spectrum of an 18-angstrom thick lubricant on a hard disk measured in 15 seconds using an MCT detector.

Ordering Information

Part Number	Description
015-10XX	AGA – Grazing Angle Specular Reflectance Accessory *Includes 5 selectable spot sizes of 1/2", 3/8" 1/4", 3/16" and 1/8", gold substrate alignment mirror, polarizer mount and FTIR base mount*

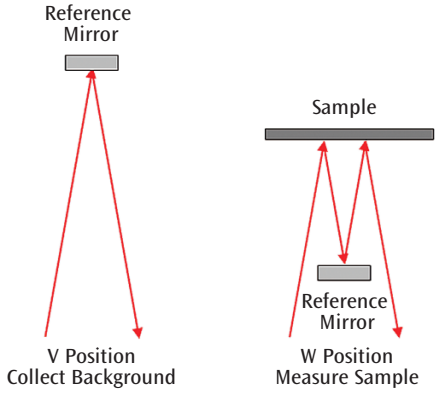
Note: Replace XX with your spectrometer's Instrument Code. Click for List >

Replacement Parts and Sampling Options

Part Number	Description
300-0002	Gold Substrate Alignment Mirror, 1.25 x 3.0"
090-1000	Manual Polarizer, ZnSe
090-1200	Manual Polarizer, KRS-5

Note: For more polarizer options see the polarizer section of this catalog.

Absolute Reflectance Accessory – *Measure Absolute Sample Reflectance*



Beam path for V and W positions for the PIKE Absolute Reflectance Accessory.

Features

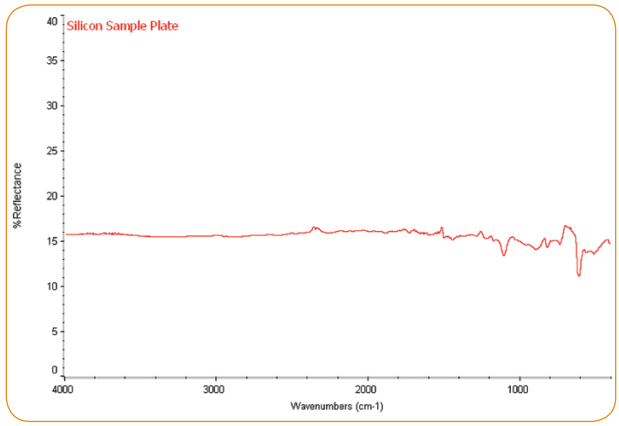
- **For the measurement of absolute reflectance of optical surfaces, windows and metallic surfaces**
- **Performance evaluation of optical elements**
- **Evaluation of test plates in medical, industrial and military applications**
- **Fixed 12 degree angle of incidence**

Sample reflectance is usually measured in comparison to a high-reflectance diffuse gold or specular gold mirror. The sample reflectance is measured and calculated against these standards that have 94–99% reflectance in the infrared region.

Absolute reflectance measurement has to be even more accurate than measured by other relative specular accessories. Unfortunately, no standards exist today that have guaranteed 100% reflectance, against which unknown samples could be compared. PIKE Technologies has developed an Absolute Reflectance Accessory which does not require reflectance standards due to its unique V / W optical arrangement. The beam in the V position reflects from the reference mirror. In the W position it is reflecting from the sample twice and the same reference mirror at 12 degrees. The absolute reflectance of a sample is the square root of the measured value at a given wavenumber or wavelength. The two configurations are easily selected by rotating the sample holder 180 degrees with its pinned-in-place mount and the sample is held by a quick-release mount.

Specifications

Optics	All reflective
Angle of Incidence	12 degrees
Optical Configuration	V / W
Purge Sealing	Purge tubes and purge barb included
Dimensions (W x D x H)	165 x 241 x 146 mm
Sample Holder Opening	Oval, 40 mm (W) x 22 mm (H)
FTIR Compatibility	Most, specify model and type



Spectrum of a silicon plate measured in the PIKE Absolute Reflectance Accessory.

Ordering Information

Part Number	Description
014-10XX	Absolute Reflectance Accessory *Includes V / W sample holder, gold substrate mirror and FTIR base mount*

Note: Replace XX with your spectrometer's Instrument Code. Click for List >

Replacement Parts and Sampling Options

Part Number	Description
300-0061	Gold Substrate Alignment Mirror (2" x 3")

Specular Reflectance – *Theory and Applications*

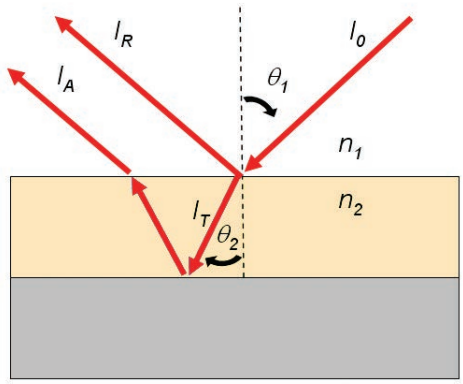
Specular reflectance sampling in FTIR represents a very important technique useful for the measurement of thin films on reflective substrates, the analysis of bulk materials and the measurement of mono-molecular layers on a substrate material. Often this technique provides a means of sample analysis with no sample preparation – keeping the sample intact for subsequent measurements.

The basics of the sampling technique involve measurement of the reflected energy from a sample surface at a given angle of incidence. The electromagnetic and physical phenomena which occur at and near the surface are dependent upon the angle of incidence of the illuminating beam, refractive index and thickness of the sample and other sample and experimental conditions. A discussion of all of the physical parameters and considerations surrounding the specular reflectance sampling technique is beyond the scope of this overview. We will present this technique from an applications-oriented perspective.

Types of Specular Reflectance Experiments

- Reflection-absorption of relatively thin films on reflective substrates measured at near-normal angle of incidence
- Specular reflectance measurements of relatively thick samples measured at near-normal angle of incidence
- Grazing angle reflection-absorption of ultra-thin films or mono-layers deposited on surfaces measured at a high angle of incidence

In the case of a relatively thin film on a reflective substrate, the specular reflectance experiment may be thought of as similar to a "double-pass transmission" measurement and can be represented as shown in the following illustration.

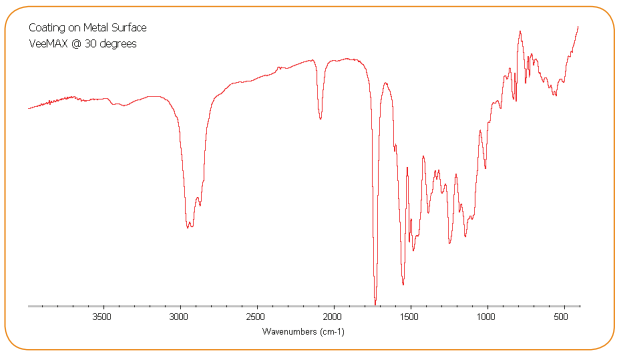


Beam path for reflection-absorption of a relatively thin film measured by specular reflectance.

The incident FTIR beam represented by I_0 illuminates the thin film of a given refractive index (n_2) and at an angle of incidence (θ_1). Some of the incident beam is reflected from the sample surface, represented by I_R at the incident angle (θ_1) and is also known as the specular component. Some of the incident beam is transmitted into the sample represented by I_T at an angle of θ_2 – calculated from Snell's Law.

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

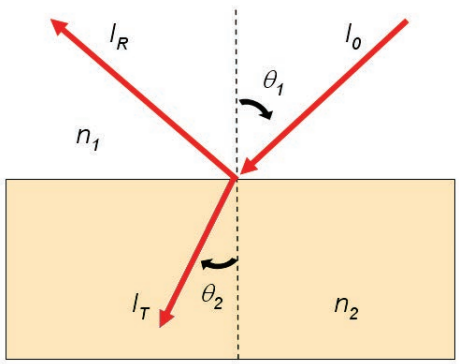
At the reflective substrate, the beam reflects back to the surface of the thin film. When the beam exits the thin film it has geometrically passed through the film twice and is now represented as I_A. Infrared energy is absorbed at characteristic wavelengths as this beam passes through the thin film and its spectrum is recorded. The specular reflectance spectra produced from relatively thin films on reflective substrates measured at near-normal angle of incidence are typically of high quality and very similar to spectra obtained from a transmission measurement. This result is expected as the intensity of I_A is high relative to the specular component (I_R).



Spectrum of thin film coating on a metal surface measured at 30 degrees angle of incidence using the VeeMAX III specular reflectance accessory.

For relatively thick samples, the specular reflectance experiment produces results which require additional considerations as the specular component of the total reflected radiation is relatively high.

Again, the incident FTIR beam represented by I_0 illuminates the sample of a given refractive index (n_2) and at an angle of incidence (θ_1). Some of the incident beam is reflected from the sample surface, represented by I_R at the incident angle (θ_1). Some of the incident beam is transmitted into the sample represented by I_T at an angle of θ_2. As predicted by Fresnel equations, the percent of reflected versus transmitted light increases with higher angles of incidence of the illuminating beam. Furthermore, the refractive index of the sample, surface roughness, and sample absorption coefficient at a given wavelength all contribute to the intensity of the reflected beam.



Beam path for a relatively thick sample measured by specular reflectance.

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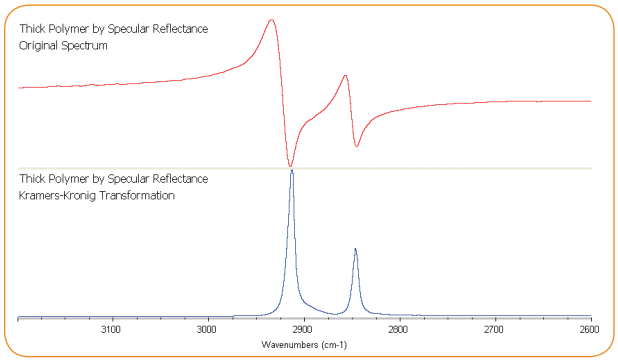
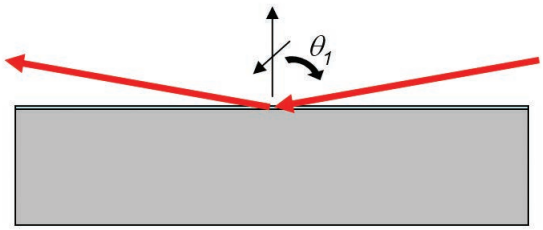
At wavelengths where the sample exhibits a strong IR absorption, the reflectivity of the sample increases. The superposition of the extinction coefficient spectrum with the refractive index dispersion results in a spectrum with derivative-shaped bands. This specular reflection spectrum can be transformed using the Kramers-Kronig conversion to a transmission-like spectrum as shown in the example below.



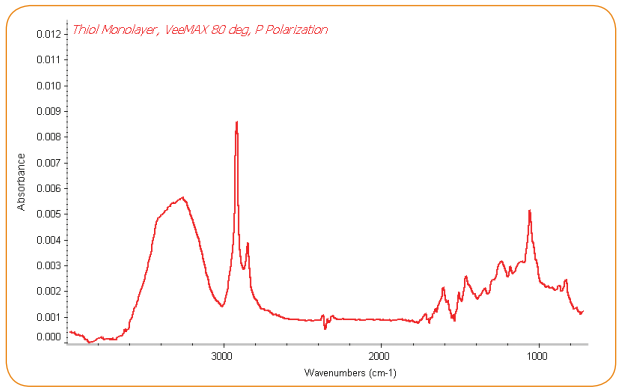
Spectrum (upper – original) of a relatively thick polymer sample measured at 30 degrees angle of incidence using the VeeMAX III; the lower spectrum has been transformed using the Kramers-Kronig software algorithm and is very similar to a transmission spectrum of the polymer polyethylene.

Our third application of specular reflectance is the measurement of relatively thin films and mono-molecular layers at grazing angle of incidence. At high angles of incidence, between 60 and 85 degrees, the electromagnetic field in the plane of the incident and reflected radiation is greatly increased relative to a near-normal angle of incidence. The perpendicular component of the electromagnetic field of the reflecting radiation is not enhanced.



Grazing angle specular reflection analysis produces a strong electromagnetic field oriented in the plane of the incident and reflected radiation.

Because of the orientation of the electromagnetic field at the surface for grazing angle measurements, the use of an IR polarizer greatly improves the sampling result. By collecting the spectrum at grazing angle of incidence with p-polarization, we only examine the enhanced portion of the electromagnetic field at the sample surface, thereby producing a stronger absorbance spectrum.



Grazing angle specular reflection analysis of a thiol mono-molecular layer deposited on a gold-surfaced mirror using the PIKE VeeMAX III at 80 degrees and p-polarization; the FTIR was equipped with an MCT detector.

Specular reflectance is a valuable FTIR sampling technique for the analysis of thin films on reflective substrates, for relatively thick films on reflective materials and for bulk materials where no sample preparation is preferred. PIKE Technologies offers a complete line of specular reflectance accessories to perform these analyses.

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The PIKE price list includes accessories that may be used with a variety of makes and models of spectrometers. Please specify the part number and description when ordering, including your instrument type and model number. Click here for a list of spectrometer and spectrophotometer instrument codes. When placing an order, substitute these codes for the final two digits (XX) in the accessory part number.

PIKE Technologies is continually extending the accessory product range. If you are unable to find a required item, please contact us to discuss your needs. We will be glad to assist.

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Products and prices are subject to change without notification.

FTIR and UV-Vis Instrument Codes

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ABB Bomem	
FTLA2000-100 (Arid Zone)	80
Michelson 100, MB Series	81
MB 3000	82
Agilent	
Excalibur™, Scimitar™, FTS, 600-IR Series	10
Excalibur™, Scimitar™, 600-IR Series with recognition	13
Analect (See Hamilton Sundstrand)	
Bio-Rad (See Agilent)	
Bruker Optics	
IFS™, Vector™, Equinox™ Series.	50
Tensor™, Vertex™ with recognition (Quick-Lock)	51
Buck Scientific	
M500	65
Digilab (See Agilent)	
Hamilton Sundstrand AIT	
Diamond 20	60
Horiba	
7000 Series	35
Interspectrum	
Interspec 200-X	90
Jasco	
300/600 Series	56
400	57
4000/6000 Series	58
JEOL	
Winspec™ Series	46
Lambda Scientific	
Lambda FTIR 7600	66
Lambda FTIR 8600	64
Lumex	
INFRALUM FT-02, FT-08	67
Mattson (See Thermo Electron)	
Midac	
M Series	30
Nicolet (See Thermo Electron)	
Oriel	95
Optical Table	99
PerkinElmer	
1700 Series	70
Spectrum™ GX, 2000	71
Spectrum BX / RX, 1600, Paragon 1000	73
Frontier, Spectrum One, 65, 100, 400 with recognition	74
Spectrum Two with recognition	75
Shimadzu	
8300, 8400 Series, IRPrestige™-21, IRAffinity-1s	15
IRPrestige™-21, IRAffinity-1s with recognition (QuickStart)	16
IRTracer™-100	18
IRTracer™-100 with recognition	19
Thermo Electron / Nicolet / Mattson	
Infinity, Galaxy, RS Series	20
Genesis™, Satellite, IR 300	21
Impact™ 400, Magna, Protege™, 500 / 700 Series	40
Avatar™, Nexus™, Nicolet™, iS™10, iS™50	40
Model 205/210	41
Nicolet iS™5	42
Avatar, Nexus, Nicolet Series with recognition (Smart)	47
Varian (see Agilent)	

UV-Vis Instrument Codes (XXX)

Agilent/Varian	
Cary 50	100
Cary 60	111
Cary 100, 300	110
Cary 4000, 5000, 6000i	120
Jasco	
600 Series	600
Optical Table	999
PerkinElmer	
Lambda 650, 750, 850, 950 and 1050	700
Lambda 25, 35, 45	730
Shimadzu	
1600 and 1700	200
1800 Series	210
2600	240
3600	220
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Evolution 300/600	400
Evolution 200	410

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PIKE TECHNOLOGIES

6125 Cottonwood Drive, Madison, WI 53719

(608) 274-2721 (Tel), (608 274-0103 (Fax)

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