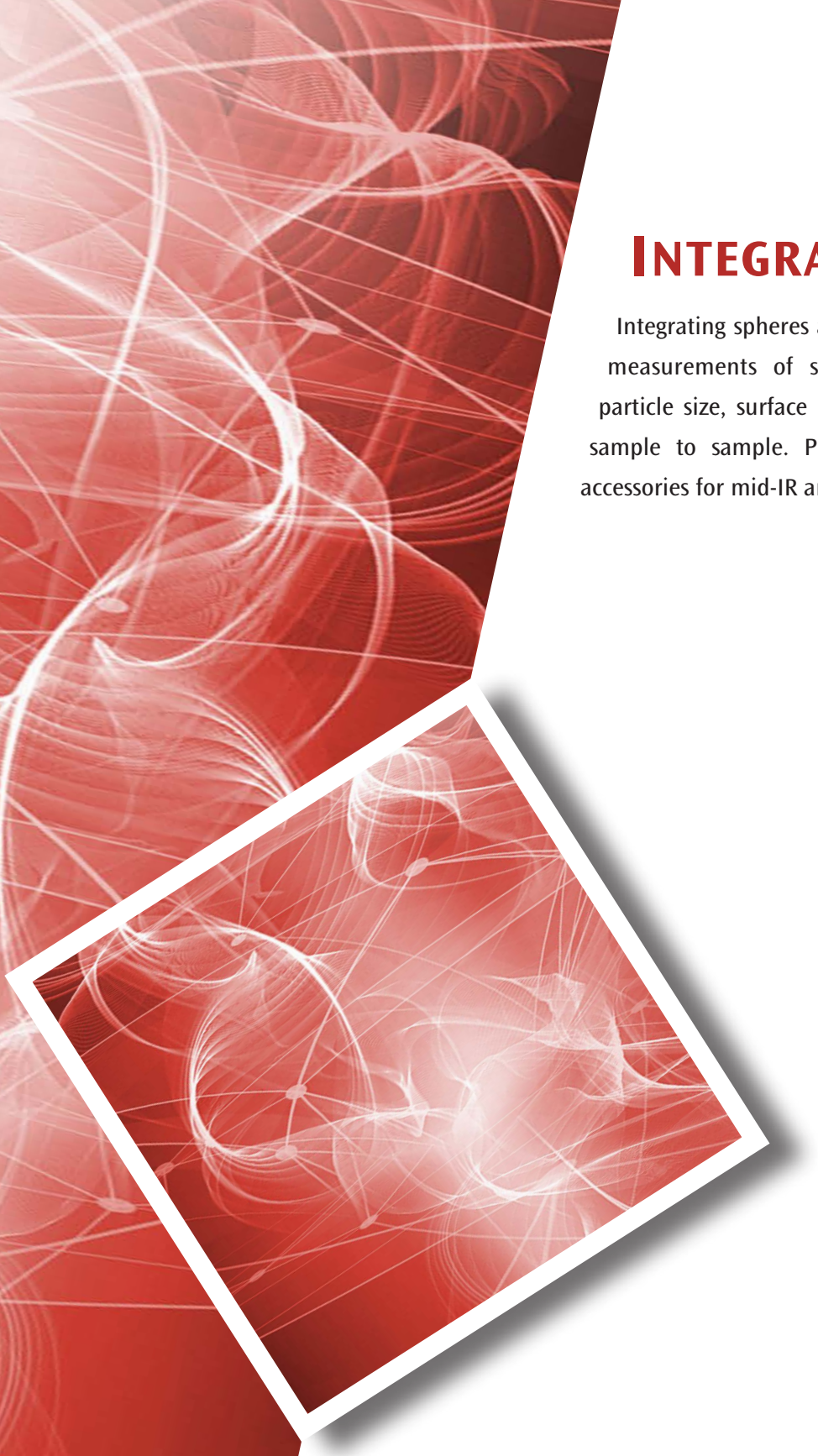
PIKE TECHNOLOGIES

Integrating Spheres

Integrating spheres are useful for qualitative and quantitative measurements of sample composition when morphology, particle size, surface roughness or sample flatness varies from sample to sample. PIKE Technologies offers fully integrated accessories for mid-IR and NIR applications.



Mid-IR IntegratIR™
Integrating Sphere Accessory
Advanced measurements in the mid-IR spectral region

External IntegratIR™
Integrating Sphere Accessory
For large-sized samples

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

Theory and Applications Included

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

Mid-IR IntegratIR – *Integrating Sphere*

Features

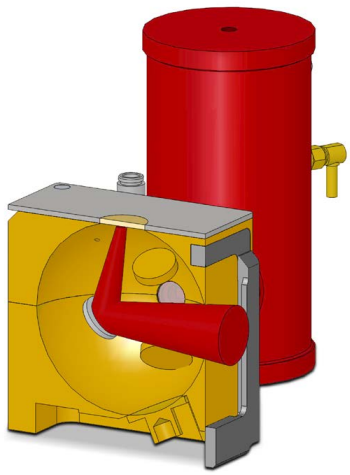
- 3-inch sphere – gold-coated, Lambertian scatterer for high-performance measurements
- 12-degree hemispherical diffuse reflectance measurement with specular exclusion port
- Diffuse transmission station for measurement of highly scattering samples in transmission mode
- Choice of integrated, high-performance detector MCT or DTGS for ultimate configurability
- Upward- and downward-looking optical configurations to accommodate a wide range of sample sizes and types
- In-sample-compartment design to minimize laboratory space requirements
- Configurations available for most FTIR spectrometers

The integrating sphere is very often an accessory of choice when studying reflectance properties of solids, analyzing light-scattering and/or highly absorbing samples and collecting spectra difficult to obtain with standard sampling techniques. PIKE Technologies offers mid-IR integrating spheres, designed for research and standard applications that require sensitivity and the ability to collect high-quality data from difficult to analyze samples.

The PIKE IntegratIR™ spheres are available in upward- and downward-looking configurations and are suitable for the measurements of absolute and relative diffuse reflectance of solids, powders and opaque liquids. Each feature a 3-inch diameter highly reflective gold-coated sphere. The accessory mounts in the sample compartment of the FTIR spectrophotometer, and uses a dedicated detector for maximum performance.

Gold-coated Lambertian finish sphere

Both upward- and downward-looking mid-IR spheres feature a 12-degree illumination of the sample, and offers a specular exclusion port. For the upward-looking sphere, reflectance samples are placed directly onto the sample port located on the top of the sphere. This sphere is ideal for large and/or thick solid samples. For powder samples, a standard ZnSe window is available. If preferred, a KBr window can also be used with the sample plate to minimize the reflection loss compared to the ZnSe.



Optical diagram of the upward-looking IntegratIR Sphere

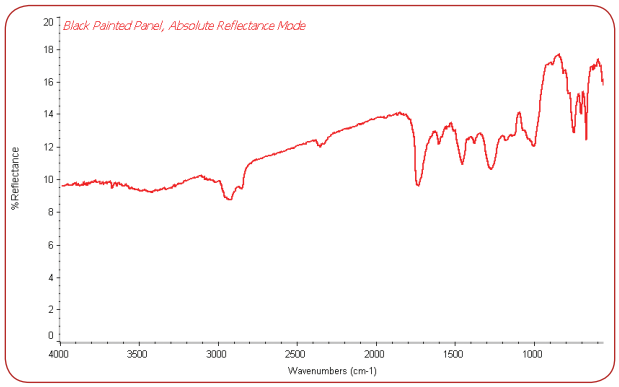
The downward-looking Mid-IR IntegratIR allows the sample to be placed underneath the sphere. This configuration is desirable for measurements of powders and particulate materials because the incidence beam strikes the sample directly, without passing through an IR transparent window.

For all spheres, the selection of light illumination onto the sample or onto the reference surface is done via a flipper mirror. This allows the background to be collected using either the substitution method or the Taylor method.

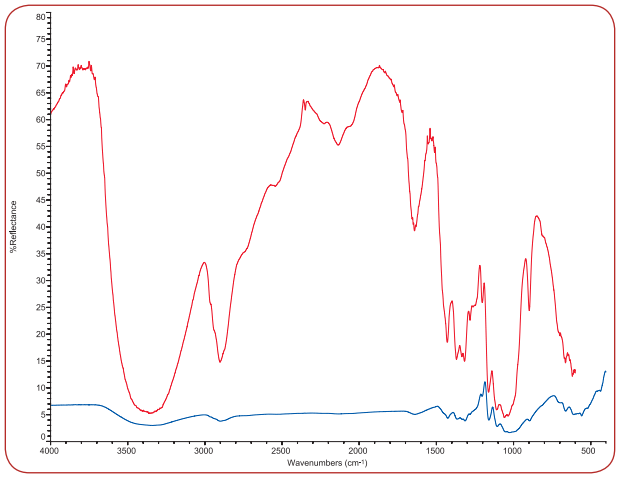
Diffuse transmittance of partially transmitting materials can be measured with either sphere. This is done by placing the sample on a standard 2 x 3" sample holder and sliding it in the mount located in front of the transmission port.

Downward-looking IntegratIR

A selection of mercury cadmium telluride (MCT) or deuterated triglycine sulfate (DTGS) detectors is offered with the IntegratIR spheres. This allows the accessory to be optimized for the application and sample type. The wide-band MCT is the commonly configured detector while the less sensitive DTGS is an option for users who require the convenience of a room temperature detector. The MCT detector is approximately 50 times more sensitive compared to the DTGS detector. The accessory comes with built-in detector electronics and interfaces with most FTIR spectrometers. All detectors are pinned in place and interchangeable. For those with both mid- and near-IR spectral capabilities on the FTIR spectrometer an InGaAs detector may be purchased for sensitive NIR diffuse reflectance or transmittance measurements.



Absolute reflectance spectrum of a painted black panel measured using the PIKE Mid-IR IntegratIR.



Comparison of transmission spectrum of paper collected using an integrating sphere or in transmission mode without a sphere.

Specifications

Optical Design	Upward- or downward-looking sample spheres
Angle of Incidence	12 degrees
Sphere Size and Surface	3" (76.2 mm) gold-coated Lambertian surface
Sample Port Size	20 mm
Specular Exclusion Port	Standard
Sphere Dimensions (W x D x H)	159 x 248 x 154 mm (excludes baseplate)
Sample Opening, Downward Sphere (W x D x H)	50.8 x 35.5 x 12.7 mm
Detector Choice	DTGS, MCT or InGaAs
Spectral Range, MCT Detectors	Wide-band: 5000–500 cm^{-1} Mid-band: 5000–650 cm^{-1} Narrow-band: 5000–800 cm^{-1}
Spectral Range, Extended DTGS Detector with CsI Window	5000–250 cm^{-1}
Spectral Range, InGaAs Detector	12,200–3850 cm^{-1}

Ordering Information

Part Number	Description
048-12XX	Mid-Infrared IntegratIR Integrating Sphere Accessory 12 Degree **Upward** Sample Positioning *Includes sphere, purge enclosure and tubing, diffuse gold reference and sample plate with ZnSe window*
048-11XX	Mid-Infrared IntegratIR Integrating Sphere Accessory 12 Degree **Downward** Sample Positioning *Includes sphere, purge enclosure and tubing, one diffuse gold reference and powder sample cup*

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
Your FTIR spectrometer must be capable of interfacing with an external detector.

Detector Choice for IntegratIR *(must select one)*

Part Number	Description
048-3350	Wide-band MCT Detector
048-3250	Mid-band MCT Detector
048-3150	Narrow-band MCT Detector
048-3450	DTGS Detector with CsI Detector Window
048-3550	InGaAs Detector

Notes: Detector includes preamplifier electronics. MCT detectors require liquid nitrogen for cooling.

Replacement Parts and Sampling Options

Part Number	Description
048-0108	Sample Plate with 20 x 2 mm ZnSe Window for Upward IntegratIR
048-0208	Sample Plate with 20 x 2 mm KBr Window for Upward IntegratIR
048-3000	Diffuse Gold Reference for Upward IntegratIR
048-3001	Diffuse Gold Reference for Downward IntegratIR
048-2020	Powder Sample Cup for Downward IntegratIR
048-2050	Sample Slide for Downward IntegratIR

Reflectance From All Perspectives

External Integrating Sphere – *Precise Reflectivity Measurements*

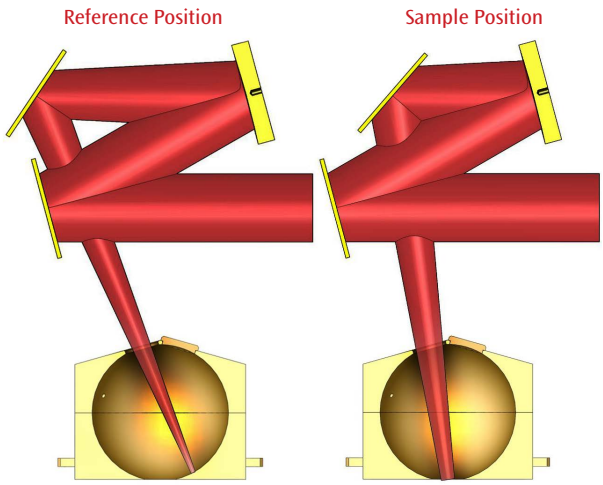
Features

- *Accommodates large-sized sample*
- *4 inch sphere – gold-coated, Lambertian scatterer for high performance measurements*
- *8 degree hemispherical diffuse reflectance measurement with specular exclusion port*
- *Manual external translation mirror to switch between the reference and sample position*
- *Integrated, high-performance MCT detector*
- *Utilizes external spectrometer beam to allow for the analysis of oversized samples positioned under the sphere*
- *Fully purgeable enclosure*

An integrating sphere is very often an accessory of choice when studying reflectance properties of solids, analyzing light scattering of highly absorbing samples and collecting spectra difficult to obtain with standard sampling techniques. The External Integrating Sphere Accessory, which utilizes the external beam of the spectrometer, is ideal for large samples due to the additional sampling space realized by positioning sample underneath the sphere for precise reflectivity measurements.

Low reflectivity measurement using the External Integrating Sphere Accessory.

The internal optics of the External Integrating Sphere focus light from the external beam of the spectrometer into a 4 inch gold-plated integrating sphere. A translation mirror is moved manually through a flipper lever located on the external enclosure of the accessory for precise movement between the sample and reference positions. In the sample position, incident light is 8° from normal. Specular reflection may be excluded by opening a port at the top of the sphere. Both the sample and specular ports are baffled from the detector port. The detector port is 90° from the sample port.



Optical diagram of the FT-IR external beam path for reference and sample positions.

Accurate measurement of both solid- and liquid-phase samples is possible with the 4" External Integrating Sphere. In particular, the accessory attaches to the side of the spectrometer, to accommodate measurement of very wide samples. By utilizing highly-accurate Taylor methodology for measurement, high-quality components, and sensitive MCT detection, the 4" External Integrating Sphere offers low-noise, highly accurate measurements for a wide range of samples.

Ordering Information

Part Number	Description
048-13XXL	Mid-Infrared External Integrating Sphere Accessory — Left *Includes sphere, purge enclosure and tubing.*
048-13XXR	Mid-Infrared External Integrating Sphere Accessory — Right *Includes sphere, purge enclosure and tubing.*

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
Accessory uses the spectrometer's external beam. Spectrometer must be equipped to accept an external detector.

Detector *(must select one)*

Part Number	Description
048-3360	Wide-Band MCT Detector for External Sphere
048-3260	Mid-Band MCT Detector for External Sphere
048-3160	Narrow-Band MCT Detector for External Sphere

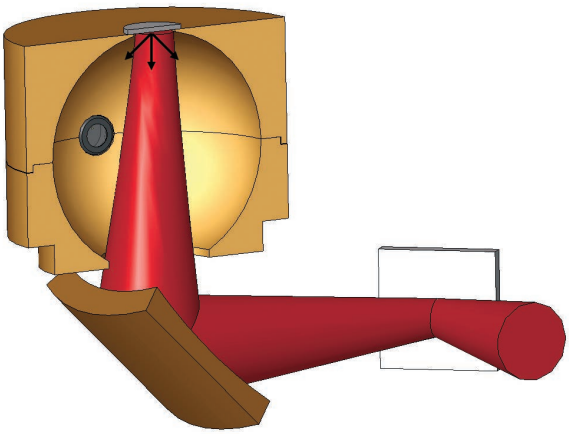
Options

Part Number	Description
048-3000	Diffuse Gold Reference

NIR IntegratIR – *Integrating Sphere*

Features

- Optimized 2” gold-coated integrating sphere with high signal-to-noise ratio
- Fully integrated InGaAs detector, detector electronics and transfer optics
- Optional automated transmission analysis stage for pharmaceutical analysis
- 10-mm horizontal sampling port for easy sample placement
- Excellent qualitative and quantitative NIR analysis tool
- Economical alternative to dedicated near-infrared analyzers
- Optional rotating stage for averaging of heterogeneous samples
- Spectral range 12,200–3850 cm^{-1}
- In-sample-compartment design, compatible with most commercial FTIR spectrometers



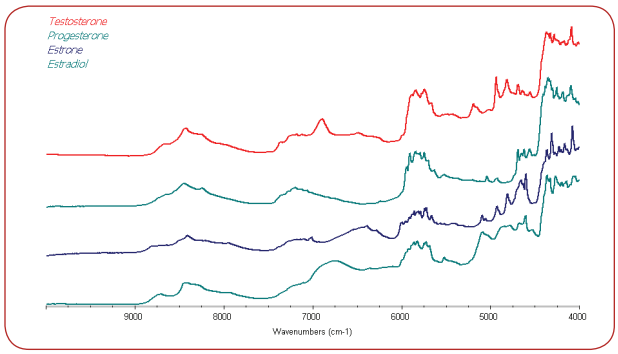
Optical diagram of the NIR IntegratIR.

The PIKE Technologies NIR IntegratIR™ is a near-infrared (NIR) integrating sphere for quantitative and qualitative measurements of a wide variety of solids and paste materials. The NIR IntegratIR collects reflected energy from a spherical perspective thereby capturing complete and quantitative response from the sample. Using near-infrared chemometrics, qualitative product identification and quantitative analysis may be performed on pharmaceutical, nutraceutical, chemical, polymer, textile, food, agricultural and other samples.

The NIR IntegratIR accessory features a 2” high reflectivity gold-coated integrating sphere and an extended range, high-speed, low-noise indium gallium arsenide (InGaAs) detector, transfer optics and interface electronics. The NIR IntegratIR fits into the sample compartment of most commercial FTIR spectrometers and its electronics interface as an external detector of the spectrometer. A 10-mm diameter horizontal sampling port makes the placement of samples onto the accessory easy. An optimized borosilicate window serves as a sampling port at the top of the integrating sphere. The window is bonded and sealed to protect the sphere from corrosive materials and contamination.

Sampling of tablets, packaging materials and plastics is easily accomplished by placing the sample directly on the window of the upward-looking sphere. Powders, creams, pastes or liquids containing reflective particles may be placed in disposable flat-bottom vials – eliminating the need for any sample cleanup. The vials may be held in place by a sample-positioning vial holder, resulting in more repeatable measurements.

High-quality spectra are produced quickly using the NIR IntegratIR – making qualitative and quantitative analysis of a wide variety of sample types efficient and reliable.



Qualitative analysis of steroids using the PIKE Technologies NIR IntegratIR. Samples are measured within glass vials.

For heterogeneous samples, PIKE Technologies offers a rotating stage for the NIR IntegratIR. With this option, one obtains an averaged result to eliminate variations in quantitative results for the chosen sample area.

Rotating stage for beaker

Rotating stage for petri dish

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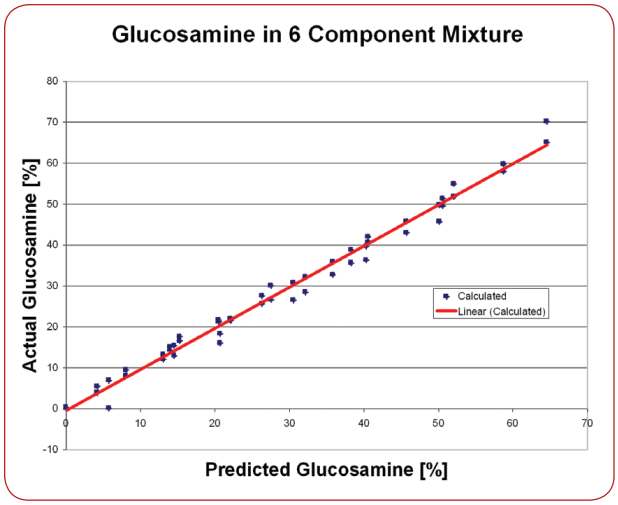


Quantitative measurement of active ingredient in a mixture of magnesium stearate, lactose, EMCOMPRESS®, cellulose and CAB-O-SIL®

The NIR IntegratIR comes complete with diffuse gold reference, sample holders and a removable general-purpose sample mounting plate. It is configured for each specific FTIR spectrometer and includes a pre-aligned mount for your instrument.

The NIR IntegratIR is a cost-effective, high-performance sampling option for laboratories with a standard FTIR spectrometer equipped with a near-infrared light source and beam splitter.

The optional transmission tablet analysis stage (below) for the NIR IntegratIR provides an automated tool for sampling 10 tablets of varying sizes. With this option you can measure formulation reproducibility or verify pharmaceutical composition.

NIR IntegratIR with optional transmission tablet analyzer

Ordering Information

Part Number	Description
048-60XX	NIR IntegratIR Integrating Sphere Accessory *Includes 2" diffuse gold-coated integrating sphere, InGaAs detector, detector preamplifier, diffuse gold reference, vial holder, and 25 glass vials.*

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
Your spectrometer must be capable of interfacing with an external detector.

Sampling Options

Part Number	Description
048-3000	Diffuse Gold Reference
048-3070	NIST Traceable NIR Reference Standard
048-3071	NIST Traceable NIR Reference Standard – Recertification
044-3010	Glass Vial Holder for 19-mm vials
048-2999	Glass Sample Vials, 19 x 65 mm (25 ea.)
048-0150	Rotating Stage for petri dish for heterogeneous samples *Includes 100 x 20 mm Petri Dish*
048-0151	Rotating Stage Adapter for 500 mL beaker
048-0060	Automated Transmission Tablet Analysis Stage for NIR IntegratIR *Includes 3 tablet plates for 7.5, 8.5 and 10-mm tablets*

Note: Please contact us for other options. Stage rotates counterclockwise.

Integrating Spheres – *Introduction and Theory*

Measuring Sample Reflectance

Reflectance sampling accessories rely upon a light beam coming from the spectrometer to be focused upon the sample. In order to achieve the best signal-to-noise ratio (SNR), the smaller the focus is, the easier it is to refocus the illuminated sample spot back onto the detector. In order to measure light reflected at a larger angle, optical designs will allow only a small area of the sample to be projected onto the detector. This arrangement serves well if the sample is microscopically homogeneous, but will result in a larger sample position error. When the sample is moved, the focused beam will see a different portion of the sample resulting in measurement-to-measurement differences. This is called insertion error because the spectrum will be slightly different each time the sample is inserted.

Some industrial or natural samples are inhomogeneous either because they are mixtures of different substances or because they have a particle size comparable to the probing beam diameter. Clearly, if the probing beam could be larger and the reflected light could all be collected, a more representative spectrum could be measured.

Some other samples develop a directional scattering. For example, fibers wound on a mandrel are highly oriented, not just macroscopically as parallel, unidirectional filaments, but also in many cases the molecules of the drawn fibers are oriented within the fiber itself. Such a sample, when placed in a reflectance accessory will generate different results depending on the angle from which the detector is "viewing" the sample. When the overall reflectance needs to be measured reproducibly, for example to measure the concentration of a minor ingredient in the sample, only isotropic optical systems, insensitive to such directionalities could be utilized.

Furthermore, in some cases, not just the reflectance in a small solid angle but the reflectance in all angles is sought. Most reflectance accessories measure at fixed or variable angles, narrower or wider collection angles, but there is a need for a device that uniformly collects all reflected light from a sample. In other words it measures the total reflectance of the sample.

Therefore the main reasons for using integrating spheres for the measurement of sample reflectance are the following:

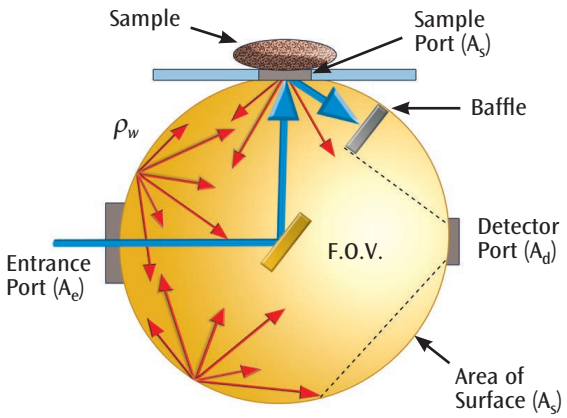
- Efficient measurement of combined diffuse and specular reflectance
- Uniform detection of reflectance even when the sample is inhomogeneous
- Isotropic detection of reflectance even on samples that reflect in preferred directions
- Reduction of polarization effects from the illuminating beam and the sample
- Measurement of absolute reflectance (with special integrating spheres)

All of the above concerns are addressed with integrating sphere based reflectometers.

Integrating Sphere Optics

Integrating spheres are highly reflective enclosures that are placed in close proximity to the sample, such that the reflected light enters the sphere, bounces around the highly reflective diffuse surface of the sphere wall and finally impinges upon the detector – usually part of the integrating sphere assembly. The name, integrating sphere, refers to one of the main functions of the device, namely that it spatially integrates the light flux, in our application the light reflected from a sample. In spite of the long history of engineering and development of the sphere, the applications and further developments continue to this day. Advances in the theory, detector and electronics development and most of all, new applications, drive the progress.

As the name implies, the main part of the device is a sphere with a very highly reflecting inner surface. The surface should approach the ideal Lambertian scatterer, which means that the light falling on the surface is evenly scattered in all directions and the scattered light intensity is proportional to the cosine of the angle of observation.



Optical geometry of an integrating sphere.

In an upward-sample-positioning sphere the infrared beam from the interferometer is directed through an entrance port onto the sample placed behind the sample port (shown above). Samples can be directly touching the sphere or separated from the sphere by a thin, infrared transparent window. The detector is placed close to the sphere, so that it can view the integrating sphere with a large solid angle. In order to improve the isotropy (non-directionality) of the detection, the detector is not directly in the line of sight of the sample. A small, also highly reflective and scattering baffle is placed in the sphere such that it blocks the first reflection of the sample from reaching the detector.

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A well-designed sphere has the sample close to the sphere geometry so that the sphere will collect close to the full available hemispherical reflectance (2π steradians). A window to separate the sphere and sample may be important in some cases, but it will place the sample a small distance from the sphere, thereby somewhat reducing the collected high-angle reflectance. The PIKE Technologies integrating spheres are coated with the highest possible reflective surface for the desired wavelength region. The coating of the surface of the sphere has to be uniform and close to being a perfect Lambertian scatterer. These characteristics allow the light falling in the sphere to be uniformly distributed over the entire surface of the sphere. It is also important how much of this light is actually collected on the detector surface.

Sphere Throughput

The throughput of a single sphere may be defined as a function of the hemispherical reflectance to the average spherical wall reflectance ratio. The closer the sphere surface is to ideal reflectance, the higher the throughput. The detector, the sample and the illumination require that a portion of the wall of the complete sphere be removed. Smaller cutouts for beam input and output result in higher energy throughput. Due to other considerations, such as reduction of light scatter from the edges of the sphere cutouts, called ports, these have to be optimized and cannot be too small.

The throughput can be expressed with these sphere design parameters:

$$\tau = \frac{A_d}{A_s} x \frac{\rho_w}{(1-\rho_{w,\,avg})}$$

Where A_d is the detector area, A_s is the sphere area, ρ_w is the sphere wall hemispherical reflectance, $\rho_{w,\,avg}$ is the average sphere wall reflectance.

The sphere throughput is higher if the light falling on the detector is increased by the multiple reflections of the light. Another way of looking at the integrating sphere is that it enhances the detector signal by collecting the light, and if the wall surface is reflective enough, bounce it around until it illuminates the detector. The factor that is used to express this gain is called the sphere multiplier (M), which is a function of the wall reflectance (ρ_w), the proportion of the total area of ports to the surface of the sphere (f).

$$M = \frac{\rho_w}{1-\rho_w(1-f)}$$

The brightness of the sphere (L_s), using the same amount of input light flux, is dependent on the wall reflectivity, the port-to-sphere surface ratio and the size of the sphere surface.

$$L_s = \frac{\Phi_i}{\pi A_s} \frac{\rho_w}{1-\rho_w(1-f)}$$

where Φ_i is the input light flux.

For the sphere the area of the sphere obviously depends on the sphere diameter, and thus the formula shows that a smaller sphere is brighter than one with a larger diameter.

$$L_s \sim \frac{M}{D^2}$$

The sphere diameter cannot be reduced too far however, because the sample diameter will also have to be decreased proportionally when the sphere is smaller. For typical spectroscopic applications the optimum sphere diameter is influenced by the beam size coming from the FTIR spectrometer and the typical sample size of 3–25 mm. Most integrating sphere modules use a 2–4 inch diameter sphere to accommodate the above design parameters. In a practical design, the openings of the sphere need to be kept around 5% for optimum throughput. Wall reflectance is usually between 95–99% and results in a sphere gain of 10–30.

Integrating Spheres for Mid-IR and NIR

Integrating spheres, although much more efficient than an optical system with an equivalent detector position, still have lower throughput than the direct imaging optics. In the visible and NIR spectral region, where there are very good sources and excellent, high-speed detectors are readily available, the SNR is usually not limited by the reduced light level. In the mid-IR spectral region, in order to utilize the above discussed advantages and benefits of integrating spheres, the reduced throughput needs to be offset by the use of the high sensitivity, cooled detectors, such as the liquid nitrogen cooled MCT detector utilized by PIKE Technologies. The near-infrared and mid-infrared measurements using integrating sphere optics have different analytical and measurement goals as well as different features. PIKE Technologies offers both mid-IR and NIR versions.

Ordering Terms, Contact Information and Guarantee

Part Numbers and Price

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.

Payment Terms

Purchase Order Number, cash in advance, MasterCard and Visa are acceptable. Payment is net 30 days, and shipments are FOB Madison, WI USA. Freight charges are prepaid and added to your invoice. If you wish to pay freight charges, please specify this on your order. Prepayment is required for international customers.

International Handling Fee

For orders placed from outside the United States or Canada, a handling fee of $40 will apply per order to cover the costs associated with the additional documentation and bank charges required for international shipments.

Ways to Order

Many products are available for purchase directly through our website. These items are marked on our website with a red shopping cart icon.

Please include the following information when placing an order: your name, phone number, product part number, quantity, ship to address, bill to address, purchase order number and spectrometer model on which the accessory will be used.

Orders may be placed via mail, phone, fax, e-mail or on our website. We accept Visa and Mastercard via phone and direct online purchases. For security purposes, do not send credit card information via e-mail. An electronic order form is available on our website (for P.O. Numbers only – do not use this form for credit card orders). There is no minimum order requirement. Please use the following addresses and phone/fax numbers when placing your orders:

PIKE Technologies, Inc.
6125 Cottonwood Drive
Madison, WI 53719
(608) 274-2721 (TEL)
(608) 274-0103 (FAX)
orders@piketech.com (E-MAIL)
www.piketech.com

Delivery

The delivery/shipment date is confirmed upon receipt of an order. Special requirements and custom accessories are subject to different lead times. Please contact us for price quotes and delivery information on these products.

Guarantee

All PIKE products are guaranteed to be free from defects in material and workmanship for a period of 12 months from the date of shipment. Should you be dissatisfied, or have any queries, please contact us immediately and we will promptly repair or replace the product at no charge.

Product Returns

Please contact PIKE to receive your Return Material Authorization (RMA) number if you wish to return any of our products. A restocking fee may apply. Customers are responsible for shipping charges for all returned products. For products under warranty, back-to-customer shipping charges will be covered by PIKE. Please do not return any products without obtaining the RMA number first.

Technical Assistance

PIKE Technologies offers comprehensive technical assistance. Please contact us via mail, phone, fax or e-mail with your questions.

International Distribution

PIKE Products are available worldwide. Call or send us an e-mail and we will provide you with an address of the sales office closest to your location. All exports are handled in accordance with the US Export Administration Regulations.

PIKE on the Web

Visit our web site to find out more information about new products, up-to-date PIKE news, pricing, and to see the latest copy of the PIKE Reflections Newsletter! www.piketech.com • info@piketech.com

Customer satisfaction is very important to all of us here at PIKE Technologies, Inc. We have hopefully made the ordering process very fast and easy for you. If you have any questions or concerns about our products or services, please don't hesitate to contact us. We will be happy to make adjustments to fit your needs.

Products and prices are subject to change without notification.

FTIR and UV-Vis Instrument Codes

When ordering a PIKE accessory, replace the XX or XXX portion of the product's part number with your spectrometer's instrument code below. For assistance, please contact a PIKE customer service representative at (608) 274-2721 or sales@piketech.com.

FTIR Instrument Codes (XX)

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
Thermo Fisher Scientific	
Evolution 300/600	400
Evolution 200	410

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