PIKE TECHNOLOGIES

Special Applications

PIKE Technologies offers several FTIR accessories specially designed for use in a dedicated sampling environment. Our semiconductor sampling accessories highlight our dedication to providing tools to ease and streamline FTIR sampling technology. If you have special sampling needs not shown in our catalog, please contact us – we may be able to help.

Vertical Wafer Accessory
Analysis of semiconductor wafers

MappIR™
Fully automated analysis of 200-mm semiconductor wafers

MAP300™
Fully automated analysis of 300-mm semiconductor wafers

TGA/FTIR Accessory
Identification and quantification of evolved gases from thermogravimetric analyzer

GC-FTIR Accessory
Identification of components separated in GC experiment

External Sample Module
Auxiliary sample compartment for added flexibility and custom applications

Photoacoustic Accessory
Non-destructive analysis

Introduction and Applications Included

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

Vertical Wafer Accessory –
For Analysis of Semiconductor Wafers

Features

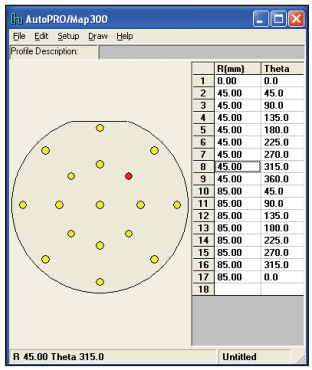
- **Transmission analysis of semiconductor wafers for carbon, oxygen and BPSG**
- **Manual and/or fully-automated operation**
- **R-theta (rotation/translation) motion control providing complete wafer analysis**
- **Contamination-free wafer mount**
- **6”, 5”, 4”, 3” and 2” wafer sizes**
- **Custom mounts and blanks**

PIKE Technologies offers the Vertical Wafer Accessory for analysis of semiconductor wafers. The Vertical Wafer Accessory is an in-compartment tool for transmission analysis of semiconductor wafers for carbon, oxygen and BPSG. The accessory accommodates wafers up to 6 inches (150 mm) in diameter. Wafers are secured in a demountable ring. Dimensional tolerances conform to SEMI standards. Delrin (hard polymer) mounting clips eliminate contact between the wafer and metal surfaces during the analysis. The clip mechanism facilitates convenient and repeatable wafer placement.

The wafer support ring may be rotated through 360° and translated laterally through a distance of over 3” (75 mm) to produce an R-theta motion covering the entire surface of the wafer. The ring may be rotated and translated manually or automatically under stepper motor control using PIKE Technologies AutoPRO software.

The automated system incorporates two precision stepper motors for rotation and translation of the plate. The motors are driven by the Motion Control Unit connected to a PC via USB. The operation is managed by PIKE AutoPRO software which provides full user programmability and an easy-to-learn “point-and-click” environment. Polar or Cartesian (X, Y) coordinates may also be used to define test points. The AutoPRO software allows complex test sequences to be set up, stored as methods and implemented with full flexibility. The Motion Control Unit features a smart power supply and operates at 85–265 VAC, 47–63 Hz. The data collection feature of AutoPRO is compatible with most FTIR software packages.

The PIKE Technologies Vertical Wafer Accessory requires minimum 3.5” beam height FTIR spectrometers. Please contact us for more product details.



	R(mm)	Theta
1	0.00	0.0
2	45.00	45.0
3	45.00	90.0
4	45.00	135.0
5	45.00	180.0
6	45.00	225.0
7	45.00	270.0
8	45.00	315.0
9	45.00	360.0
10	85.00	45.0
11	85.00	90.0
12	85.00	135.0
13	85.00	180.0
14	85.00	225.0
15	85.00	270.0
16	85.00	315.0
17	85.00	0.0
18		

Ordering Information

Part Number	Description
073-16XX	Vertical Wafer Accessory, Manual Version *Includes baseplate mount for your FTIR*
073-26XX	Vertical Wafer Accessory, Automated Version *Includes motion control unit and AutoPRO software*

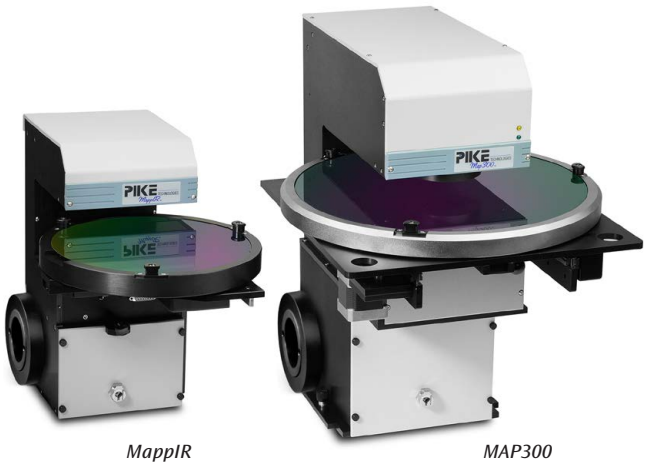
Notes: Replace XX with your spectrometer’s Instrument Code. Click for List >
Requires 3.5” beam height or greater in FTIR.

Options

Part Number	Description
073-3600	6” Wafer Mount, blank
073-3660	Additional Wafer Mount
073-3650	Insert to support 5” wafer
073-3640	Insert to support 4” wafer
073-3630	Insert to support 3” wafer
073-3620	Insert to support 2” wafer

Note: Contact PIKE Technologies for custom plates or options not described here.

MappIR and MAP300 –
For Automated Analysis of Semiconductor Wafers



MappIR *MAP300*

Features

- **Complete hardware and software package for automated, multi-position measurements and mapping of semiconductor wafers**
- **8-inch (200 mm) and 12-inch (300 mm) semiconductor wafer handling.**
- **Optional inserts for wafer sizes from 2 to 12 inches**
- **EPI, BPSG, oxygen and carbon determination**
- **Specular reflectance and transmission sampling – standard**
- **Purgeable accessory for removal of atmospheric interferences**
- **USB controller interface**

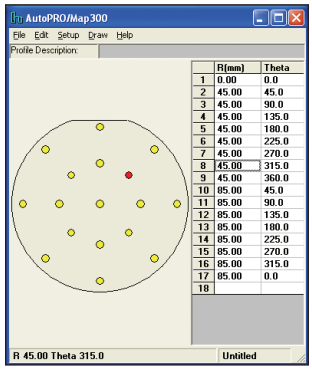
PIKE Technologies offers fully automated accessories for the analysis of semiconductor wafers. Our MappIR and MAP300 accessories provide for analysis of EPI, BPSG, oxygen and carbon in wafer sizes ranging from 2 to 12 inches (50 to 300 mm).

The MappIR and MAP300 have been developed to provide the semiconductor industry with affordable, automated tools for research and quality control of silicon wafers. The MappIR was developed for the analysis of 8-inch (200 mm) and smaller semiconductor wafers. The MAP300 is a larger version of this original design and it is capable of handling 12-inch (300 mm) wafer formats. The operation, electronics and software are identical for both systems.

The MappIR and MAP300 accessories mount in the sample compartment of the FTIR spectrometer. Semiconductor wafers are held in place by spring-loaded Delrin retaining clips and are never in contact with the aluminum stage of the accessory. A standard size slot for a vacuum or mechanical wand is provided for ease of wafer handling. Individual wafers are rotated and/or translated by stepper motors in a sequence pre-programmed by the system operator.

To minimize interferences of water vapor and carbon dioxide with infrared measurements, the optical path of the accessories is equipped with purging lines and can be purged with dry air or nitrogen. A wafer purge enclosure is offered as an option.

The accessories are controlled by AutoPRO software which provides a simple user interface for multiple point wafer analysis (mapping). Up to 320 points with 8-mm beam and 5-mm edge exclusion can be measured on a 12-inch wafer. The software provides ample flexibility in setting up various experiments.



Advantages of the AutoPRO Package

- Graphical and intelligent user interface for setting up mapping patterns
- Selection of wafer size, IR beam diameter and edge exclusion
- Operator-selectable or pre-defined multiple point maps
- Polar and/or Cartesian coordinates options
- Real-time display of the experiment status
- Ability to save and recall various experimental patterns
- COM-enabled interface for use with macros/scripting
- KLA and CSV file importer

Data collection and processing is provided by the spectrometer software. A number of FTIR manufacturers offer dedicated packages which fully integrate the accessory with the spectrometer. If such an option is not available, AutoPRO can be controlled by the spectrometer's program via macros. AutoPRO is Windows compliant and when run separately, it allows configuration, programming and control of the accessory.

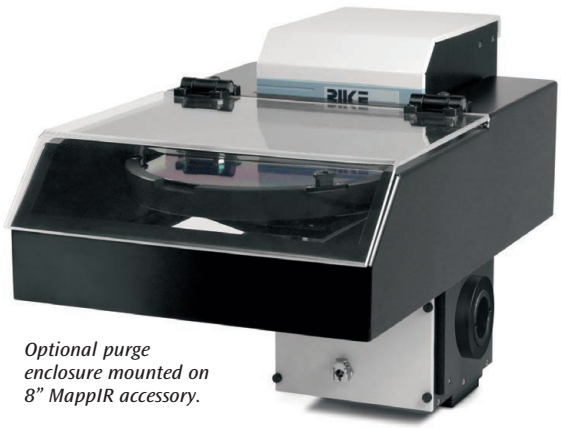
PIKE automated wafer accessories are compatible with most commercial FTIR spectrometers and software packages.

Ordering Information

MappIR and MAP300 Automated Semiconductor Wafer Accessories

Part Number	Description
016-28XX	MappIR Accessory for 8” Wafers *Includes wafer mount, motion control unit, AutoPRO software and mount for your FTIR*
016-29XX	Purge-Ready MappIR Wafer Accessory for 8” Wafers *Includes wafer mount, motion control unit, AutoPRO software and mount for your FTIR (order purge enclosure separately)*
017-28XX	MAP300 Accessory for 12” Wafers *Includes wafer mount, motion control unit, AutoPRO software, mount for your FTIR and insert to support 8” wafers*

Notes: Replace XX with your spectrometer’s Instrument Code. Click for List >
P/N 017-28XX is purge enclosure ready. Order optional purge enclosure separately.

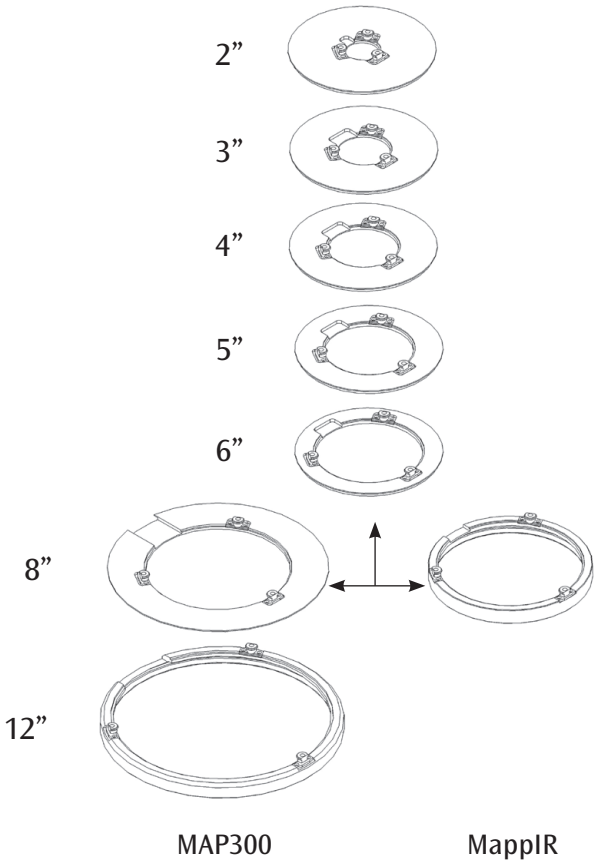


Optional purge enclosure mounted on 8” MappIR accessory.

Options for the MappIR and MAP300 Accessories

Part Number	Description
073-3880	Additional 8” Wafer Mount (MappIR only)
073-3800	Blank Support – for custom wafers (MappIR only)
017-3912	Additional 12” Wafer Mount (MAP300 only)
017-3980	Insert to Support 8” Wafer (MAP300 only)
073-3860	Insert to Support 6” Wafer
073-3850	Insert to Support 5” Wafer
073-3840	Insert to Support 4” Wafer
073-3830	Insert to Support 3” Wafer
073-3820	Insert to Support 2” Wafer
016-3000	Purge Enclosure for MappIR
017-3000	Purge Enclosure for MAP300

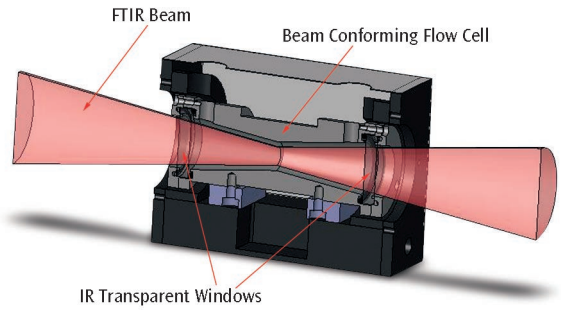
Notes: ***Purge enclosure will not fit with all spectrometer types.*** For more options or additional information, contact PIKE Technologies.



TGA/FTIR Accessory – *Identification and Quantification of Evolved Gases from Thermogravimetric Analyzer*

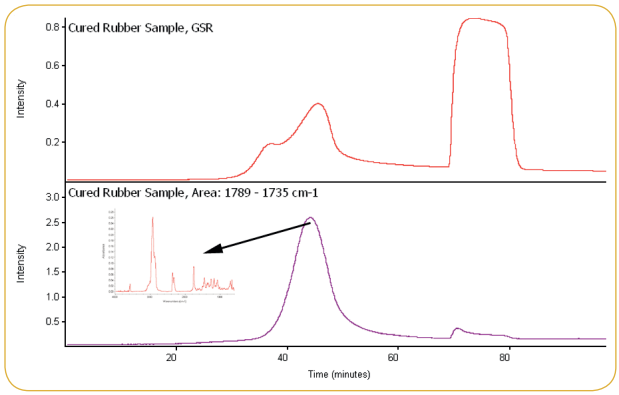
Features

- Gas cell design conforming to IR beam geometry – maximizes IR throughput with minimum cell volume
- 100-mm IR beam pathlength for maximized FTIR sensitivity
- Baseplate-mounted in your FTIR for flexible sampling
- Temperature control settable up to 300 °C for flow cell and transfer line
- User-changeable IR transparent windows to minimize cost of operation
- Heated, glass-lined stainless steel transfer line for inert transfer of TGA effluent



IR beam conforming optical design of PIKE Technologies TGA/FTIR Accessory.

The PIKE Technologies TGA/FTIR Accessory is designed to be an interface for evolved gas analysis from a thermogravimetric analyzer (TGA) to your FTIR spectrometer. Evolved gases from the TGA pass through a heated transfer line into the beam conforming flow cell in the FTIR sample compartment. As these evolved gases travel through the flow cell, FTIR spectra are collected and stored for further processing. Qualitative and quantitative measurements are doable from sample masses – typically in the low milligram range. The PIKE TGA/FTIR Accessory is compatible with most FTIR spectrometers and most TGA instruments.



TGA/FTIR data for cured rubber sample. Upper trace is the Gram-Schmidt reconstruct of the TGA evolved gases. Lower trace is a carbonyl reconstruction and an FTIR spectrum from this data set.

During the TGA analysis sample mass is lost through a combination of volatilization and degradation of the sample material. The heated TGA/FTIR system maintains the vapor state of the evolved gases throughout the FTIR analysis. Typical samples include polymers, epoxies, fibers and laminates for investigating deformulation, thermal stability or comparative study applications.

The FTIR spectrometer is set to collect spectra at 10-second intervals during the evolved gas analysis using the kinetics software package for your FTIR. With this software you can generate reconstructions of total IR response verses time or temperature (Gram-Schmidt) or specific IR band reconstructions to isolate points of unique component evolutions. FTIR spectra are extracted from the data set and an identification is made by comparing these unknown spectra to vapor phase spectral libraries.

Specifications

Temperature Range	Ambient to 300 °C
Accuracy	+/- 0.5%
Voltage	24 VAC
Sensor Type	3 wire Pt RTD (low drift, high stability)
Controllers	
Input Voltage	110/220 V, switchable
Output Voltage	10 A/24 VAC
Dimensions (W x D x H)	91 x 140 x 121 mm (excludes baseplate mount)

Ordering Information

TGA/FTIR Accessory Flow Cell

Part Number	Description
162-24XX	TGA/FTIR Accessory Flow Cell *Includes mount for your FTIR, exhaust line and high-temperature O-rings*

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
Complete accessory requires selection of IR transparent windows, heated transfer line and temperature controller. The TGA/FTIR accessory requires installation by a trained service representative – please consult with your FTIR manufacturer.

IR Transparent Windows for TGA/FTIR Accessory

(must select 2 or more)

Part Number	Description
160-1320	Window, KBr, 38 x 6 mm
160-1329	Window, ZnSe, 38 x 6 mm

Heated Transfer Line for TGA/FTIR Accessory

(must select one)

Part Number	Description
115-0001	Heated Transfer Line for Shimadzu TGA50 *Includes evolved gas port modifications*
115-0005	Heated Transfer Line for Mettler 851 TGA
115-0006	Heated Transfer Line for Mettler 851e/LF or TGA-DSC1/2/3 TGA
115-0007	Heated Transfer Line for TA Instruments Q600 TGA
115-0008	Heated Transfer Line for TA Instruments Discovery/Q5000R
115-0009	Heated Transfer Line for TA Instruments Q50/Q500 TGA
115-0010	Heated Transfer Line for TA Instruments 2050/2950
115-0011	Heated Transfer Line for Netzsch TGA
115-0012	Heated Transfer Line for PESTA6/4000 110V TGA
115-0013	Heated Transfer Line for SETARAM
115-0014	Heated Transfer Line for PESTA6/4000 220V TGA
115-0017	TGA Universal Transfer Line *Includes the following adapters; 1/8" to 1/8" union, 1/4" to 1/8" reducing union, 3-mm to 1/8" union, 6-mm to 1/8" reducing union and 6-mm PTFE ferrules*
115-0018	PTFE TGA Transfer Line, 230 °C max. *Recommended for TGAs with evolved gas ports made of ceramic or moving furnace heads*

Notes: We will need to know the make and model number of your TGA. Please consult your TGA supplier to ensure compatibility with evolved gas analysis. Contact PIKE Technologies about interfacing to other TGA instruments. Unless noted otherwise, all PIKE transfer lines are 1/8" OD, silica-lined stainless steel, 48" in length and offers a maximum temperature of 300 °C .

Temperature Controllers for TGA/FTIR Accessory

(must select one)

Part Number	Description
076-1120	Dual Digital Temperature Control Module
076-1130	4 Zone Digital Temperature Control Module for Shimadzu TGA

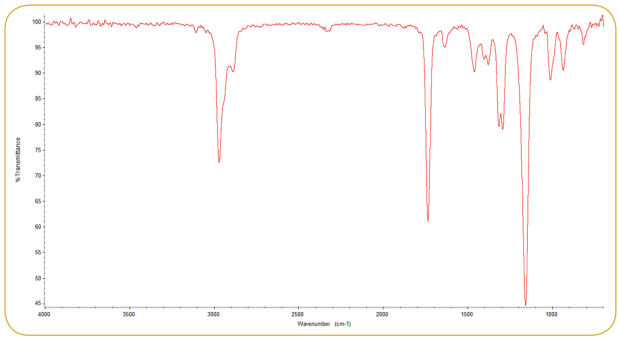
Note: These temperature controllers provide setting for the heated gas cell and the heated transfer line.

Replacement Parts and Options

Part Number	Description
162-2309	High-Temperature O-Rings, max temp 325 °C, (1 ea.)
162-2308	High-Temperature O-Rings, max temp 325 °C, (4 ea.)

Note: Gas cell requires 4 O-rings. For high-temperature purge tubes and other options, please contact PIKE Technologies.

GC-FTIR Accessory –
Combining GC Separation with Identification Power of FTIR



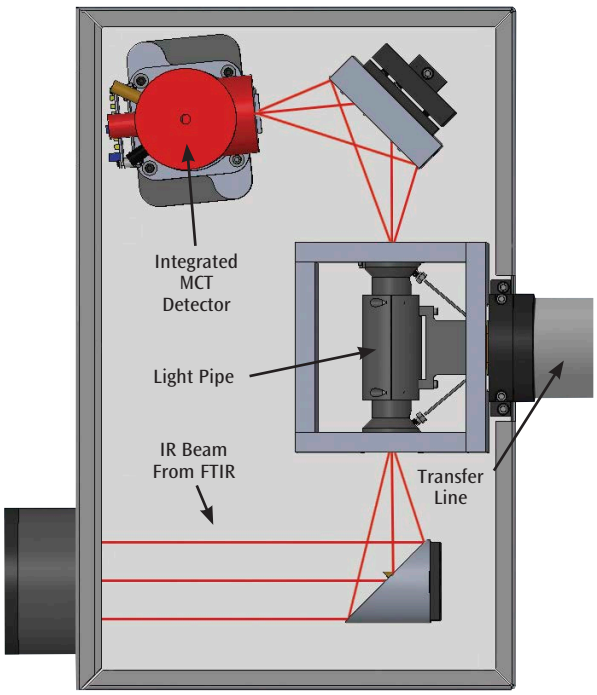
GC-FTIR data for IBMA.

Features

- **Isomer identification**
- **Secondary confirmation of GC-MS results**
- **120-mm IR beam pathlength for maximized FTIR sensitivity**
- **Temperature control settable up to 300 °C for flow cell and transfer line**
- **Purgeable module**

The PIKE Technologies GC-FTIR Accessory is an interface between the GC and the FTIR instruments. When fully installed, the sample pathway from the end of the GC column is diverted to a heated gas cell and back to the GC detector through the use of temperature controlled transfer lines. To maximize sensitivity, the light pipe is gold-coated and the accessory includes an on-board MCT detector.

Coupling gas chromatography with infrared spectroscopy provides an effective method of separating compounds as the sample moves through the GC column and identifying these compounds by spectroscopy. GC-FTIR is a preferred method for identifying isomers, which may be incorrectly identified using GC-MS. In addition, GC-FTIR may be used as a complementary analytical technique to confirm GC-MS results. Typical applications of GC-FTIR include the analysis of drugs, fragrances, and other organic compounds found in mixtures.



Optical geometry of the GC-FTIR Accessory.

Specifications

Dimensions (W x D x H)	51 x 45 x 27 cm
Weight	16 kg
FTIR Placement	Right or Left Side
Beam Height	Specific for FTIR
Detector Options	Yes
Purge	Purgeable
Light Pipe Diameter	1 mm
Light Pipe Pathlength	120 mm
Maximum Temperature	300 °C

Ordering Information

GC-FTIR Base Accessory *(must select external beam direction)*

Part Number	Description
140-10XXR	GC-FTIR Accessory, Right Side
140-10XXL	GC-FTIR Accessory, Left Side

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
GC-FTIR Accessory includes optics, mounting hardware, narrow-band MCT detector and detector electronics, heated gas cell and temperature controller. The GC-FTIR accessory requires installation by a trained service representative; please consult with your FTIR and GC manufacturer.

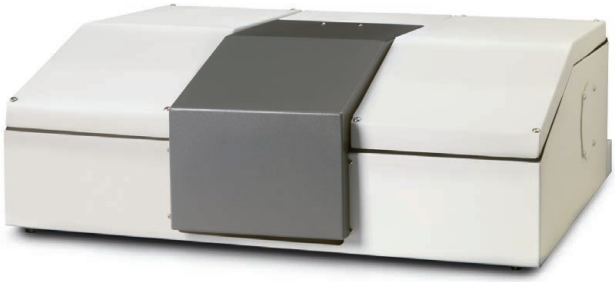
Transfer Line for GC-FTIR *(must select transfer line)*

Part Number	Description
115-0050	GC-FTIR Accessory Transfer Line

Replacement Parts

Part Number	Description
160-1135	Window, KBr, 13 mm x 2 mm (single)
160-1008	Window, KBr, 13 mm x 2 mm (6-pack)
140-2001	GC Graphite Window Gasket
140-2010	Ferrule for 0.25-mm coupling (5 ea.)
140-2015	Ferrule for 0.32-mm coupling (5 ea.)
140-2020	Ferrule for 0.53-mm coupling (5 ea.)

External Sample Module – *Extending Sampling Efficiency*



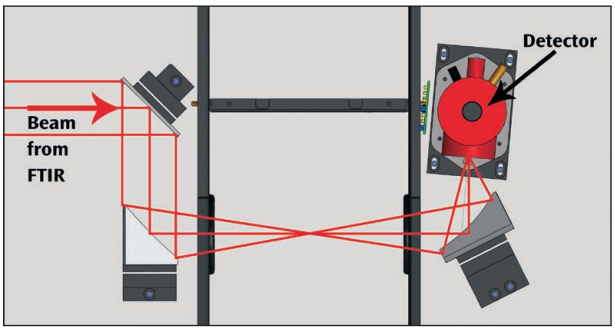
Features

- Utilizes external beam of FTIR – keeps main sample compartment free for general sampling
- Right and left external beam versions
- Full sized dimensions – for all sample compartment accessories
- Choice of integrated detector
- Ideal for heated applications or a difficult experimental setup – saving time and improving reproducibility
- Customizable configuration – removable sample compartment walls for specific optical layouts
- Vibration isolated design – providing highest spectral quality
- Compatible with most FTIR spectrometers
- 1" x 1" 10–24 hole grid

The External Sample Module from PIKE Technologies is a versatile sampling station for FTIR spectrometers. It provides an additional sample compartment to keep the main sample compartment of the FTIR free for routine sampling and also provides a location for a more complex sampling setup. Examples of experiments ideally suited to using the External Sample Module include a long-path gas cell, PIKE TGA/FTIR accessory, MappIR™ and the AutoDiff™ (PIKE's automated diffuse reflectance accessory). The sample compartment of the External Sample Module is full sized, and compatible with all PIKE Technologies accessories.

In addition to being a traditional sample compartment, the External Sample Module has a screw-hole grid for customized optical layouts with removable inner and outer walls.

The External Sample Module is compatible with either sealed and desiccated or purged FTIR spectrometers. It may be paired with most FTIR spectrometers with an external beam.



Optical geometry for right side External Sample Module

Specifications

Dimensions (W x D x H)	615 x 490 x 205 mm
Weight	28 kg
FTIR Placement	Right or Left Side
Beam Height	Specific for FTIR
Sample Compartment Size) (W x D x H	190 x 265 x 155 mm
Detector Options	DTGS, MCT, others inquire
Screw Hole Grid	1" OC, 1/4-20, sealed
Sample Compartment EFL	6"
Purge	Purgeable
Inner, Outer Walls	Removable
FTIR Compatibility	Most

Ordering Information

External Sample Module *(must select external beam direction)*

Part Number	Description
155-10XXR	External Sample Module, Right Side *Includes optics, mounting hardware, electrical cabling for FTIR, sample compartment windows, purge tubing and fittings to connect to purge gas*
155-10XXL	External Sample Module, Left Side *Includes optics, mounting hardware, electrical cabling for FTIR, sample compartment windows, purge tubing and fittings to connect to purge gas*

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
FTIR must be capable of interfacing with an external detector and have optics required for the external beam. Requires installation by your FTIR spectrometer provider. A conversion kit may be required to use your sampling accessory in the sample compartment – contact PIKE Technologies.

Detector for External Sample Module

(must select one or more)

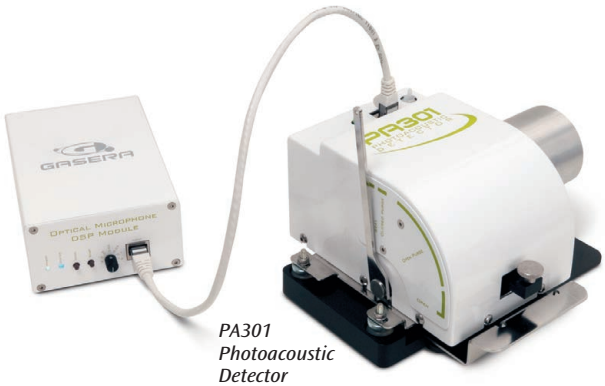
Part Number	Description
155-2010	DLaTGS Detector for External Sample Module
155-2020	MCT Detector (mid band) for External Sample Module
155-2030	MCT Detector (narrow band) for External Sample Module
155-2040	MCT Detector (wide band) for External Sample Module

Notes: Detectors for the ESM may be exchanged by the customer and are pin-mounted for easy exchange without alignment. Please ask us about other detector options.

Replacement Windows

Part Number	Description
160-1186	Window, KBr, 50 x 3 mm
160-5030	Window, BaF_2, 50 x 3 mm
160-1165	Window, NaCl, 50 x 3 mm

PA301 and PA101 – *Photoacoustic Accessory for Analysis of Difficult Samples and Depth Profiling*



PA301 Photoacoustic Detector

Features

- Versatile and rapid analysis of solid, semi-solid, liquid, and gas samples
- Ideal sampling technique for highly absorbing samples
- Requires no sample preparation and is non-destructive
- Depth probing capabilities
- Patented optical microphone based on cantilever sensor technology
- May be used in the NIR/MIR/FIR spectral regions

Photoacoustic spectroscopy (PAS) overcomes drawbacks that may occur with traditional spectroscopic sampling techniques due to the physical and chemical nature of the sample. PAS is ideal for the analysis of highly absorbing samples, layered polymers, fibers, and samples with varying surface roughness such as minerals and soils. The technique is non-destructive. Using PA technologies, Gasera accessories offer high sensitivity, good selectivity and fast response time for reliable analysis of gases, liquids, and solid materials. A dedicated gas analyzer and a multipurpose analyzer for solids, semi-solids, liquids, and fibers are available.

High sensitivity is achieved by using a patented cantilever pressure sensor that is over hundred times more sensitive compared to a membrane, which is used in conventional techniques. Gasera's patented cantilever-type pressure sensor is designed to significantly improve the sensitivity of photoacoustic spectroscopy. An extremely thin cantilever portion moves like a flexible door due to the pressure variations in the surrounding gas. The movement of the free end of the cantilever can be about two orders of magnitude greater than the movement of the middle point of the tightened membrane under the same pressure variation. This is because the cantilever only bends and does not stretch.

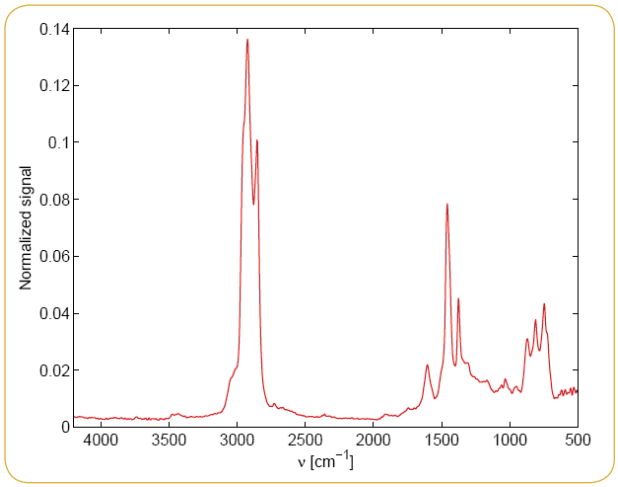
Data collection may be performed in rapid-scan mode optimized at 2.5 kHz or in step-scan mode with or without phase modulation. In rapid-scan or slow step-scan mode the thermal diffusion depth, defined as the length to decay 37% (1/e) of the original thermal wave amplitude, increases at longer wavelengths. For experiments performed in step-scan mode with phase modulation, the thermal diffusion depth may be linearized, eliminating the signal dependency on wavelength. Table 1 and 2 summarize thermal diffusion depths for rapid-scan and step-scan experiments for a typical polymer. For optimal performance, Helium purge gas is recommended.

Table 1: Thermal diffusion depth (L) in microns from PAS step scan without phase modulation and rapid scan sampling modes for a polymer with thermal diffusivity = 0.001 cm^2/s.

Frequency (Hz)	L, 6000 cm^{-1}	L, 3000 cm^{-1}	L, 1000 cm^{-1}	L, 400 cm^{-1}
5	92	130	224	355
10	65	92	159	251
25	41	58	100	159
2,500	4	6	10	16

Table 2: Thermal diffusion depth (L) in microns from PAS sampling in step-scan mode with phase modulation for a polymer with thermal diffusivity = 0.001 cm^2/s.

Phase Modulation Frequency (Hz)	L	Phase Modulation Frequency (Hz)	L
2	126	200	13
4	89	400	9
10	56	700	7
50	25	900	6



Heavy oil spectrum collected using the PAS301 (8 cm^{-1}, scan time 25 s)

PA101 is a low-volume gas analyzer having an internal gas volume of 30 mL. The absorption is measured directly by applying photoacoustic techniques. This makes the measurement free of drift. It is the key factor for the unbeatable stability and reliability without frequent background measurement. Typical low-volume applications are headspace analysis, synthesis and decomposition process analysis, and outgassing of materials measurements. Typical measurement concentration for PAS of the gas phase is in the sub-ppm region.

PA101 for gas analysis

Specifications

PA301	
Dimensions (W x D x H)	170 x 180 x 95 mm (excludes baseplate and fittings)
Weight	3.0 kg
Operational Conditions	
Temperature Range	15–35 °C
Humidity Range	Below 90% RH
Pressure Range	Ambient
Sample Cups	10 mm ID x 9 mm H 5 mm ID x 1 mm H
Purge Gas	He (preferred)
PA101	
Dimensions (W x D x H)	165 x 165 x 290 mm (excludes baseplate and fittings)
Weight	6.0 kg
Gas Cell Volume	30 mL
Gas Pressure	300–1500 mbar
Temperature	Ambient to 50 °C
Particulate Size	Less than 1 micron
Operational Conditions	
Temperature Range	0–45 °C
Humidity Range	Below 90% RH
Pressure Range	Ambient
Power Supply Unit for PA301 and PA101	
Input Voltage	100–240 VAC; 50–60 Hz
Input Power Max	30 W

Ordering Information

Photoacoustic Accessories

Part Number	Description
180-11XX	PA301 *Includes photoacoustic cell, digital signal processing unit, sampling cups and holders, carbon black reference, baseplate, KBr window and cabling*
180-10XX	PA101 *Includes photoacoustic cell for gas sampling, digital processing unit, baseplate, BaF2 window and cabling*
180-2010	Gas Flow Meter

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
PA301 and PA101 require the gas flow meter.

Options

Part Number	Description
180-2011	PAS301 Carbon Black Reference
180-2012	Sample Cups, small
180-2013	Sample Cups, large
180-2014	KBr, 19 x 2 mm
180-2015	BaF_2, 19 x 2 mm
180-2016	Si, 19 x 2 mm
180-2017	Quartz, 19 x 2 mm
180-2018	ZnSe, 19 x 2 mm
180-2019	CsI, 19 x 2 mm
180-2020	KBr, 14 x 2 mm
180-2021	BaF_2, 14 x 2 mm
180-2022	Si, 14 x 2 mm
180-2023	Quartz, 14 x 2 mm
180-2024	ZnSe, 14 x 2 mm
180-2025	CsI, 14 x 2 mm

Notes: PA301 uses one 19 x 2-mm window. PA101 uses one 14 x 2-mm window.

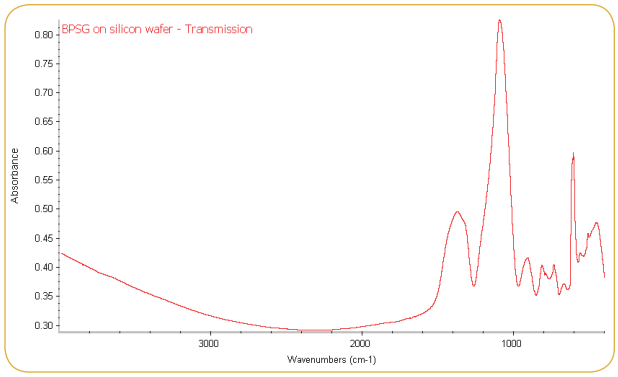
Semiconductor Applications – *FTIR Sampling Techniques Overview*

FTIR spectroscopy has established itself as a method of choice in several areas of industrial manufacturing. One of them is the quality control of semiconductor wafers. Here, the FTIR spectrometers are commonly used to measure Phosphosilicate glass (PSG) and Borophosphosilicate glass (BPSG) films, epitaxial film (EPI) thickness and interstitial oxygen and substitution carbon content.

Addition of boron and phosphorus to silicate glass during manufacturing improves the final product uniformity and reduces glass forming temperatures. Borophosphosilicate glass (BPSG) melts 100 °C lower than Phosphosilicate glass (PSG) and offers better flow characteristics. To maintain and optimize production processes, evaluation and verification of doping levels is required. FTIR allows simultaneous measurements of boron and phosphorus as well as the thickness of the glass in a quick and nondestructive procedure. The measurements are based on the interpretation of transmission spectra and quantification of boron, phosphorus and Si-O bands. K-matrix or Partial Least Squares (PLS) methods are used for concentration/thickness calculations.

The epitaxial film (EPI) is a grown crystal layer having the same crystallographic orientation as the substrate crystal wafer. The epitaxial film differs from the substrate base as it is modified with various additives. Accurate, fast and precise determination of the EPI film thickness is important in the manufacturing process since film thickness and uniformity play a critical role in etching time and device yield across the wafer surface. Specular reflectance is used in FTIR measurements of the epitaxial layer thickness. The infrared beam enters the EPI layer, reflects off the substrate surface and makes another pass through the film when exiting. The film thickness calculations are based on one of the following methods:

- **Interference measurements** – also called Constant Angle Reflection Interference Spectroscopy or CARIS. This method uses the interference fringe pattern obtained in the specular reflectance experiment.
- **Interferogram subtraction** – based on the measurement of the primary and secondary interferogram of the sample and subtraction of this signal from that of the reference material.
- **Second Fourier Transform** of spectral response data (CEPSTRUM). This method takes the difference of two spectral response curves and performs a second Fourier transform which provides signal intensity versus sample thickness information.



FTIR spectrum of BPSG on silicon wafer – transmission sampling mode.

Oxygen and carbon may be introduced to the molten silicon during the manufacturing process. These impurities can be trapped in the crystal lattice and affect final product characteristics. For these reasons, both need to be monitored and quantified. FTIR spectroscopy (transmission measurements) provides excellent means to perform this analysis. The application uses the absorption bands of Si-C and Si-O-Si to calculate concentration levels of substitution carbon and interstitial oxygen. Beer's law is typically used to determine their concentrations.

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

Helpful Links

Order Form

Quote Request Form

Application Notes

Visit our Website

Contact Us

PIKE TECHNOLOGIES

6125 Cottonwood Drive, Madison, WI 53719

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

www.piketech.com · sales@piketech.com