

Infrared Microscope

# AIM-9000





## Finally, a wide view on micro sample analysis

SHIMADZU AIMS to provide analysis systems for all users.

The system is automated to ensure all steps involved in micro analysis can be performed quickly and easily. All our accumulated know-how in micro analysis is concentrated in the AIM-9000 to strongly support analysts.

### Three steps for micro analysis





SHIMADZU

AIM-9000  
AUTOMATIC INFRARED MICROSCOPE



reddot award 2018  
winner

AIM-9000 Wins  
"Good Design Award 2017"

# A Series of Smooth Micro Analysis

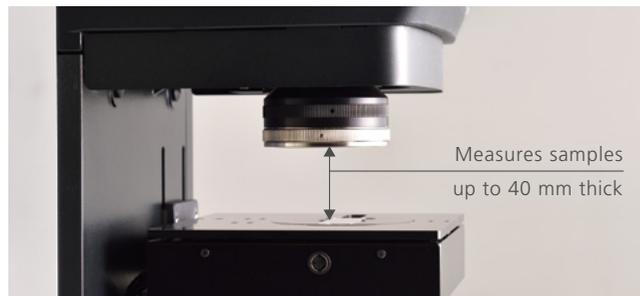
Load

## Load Sample

### Loading Samples Is Easy

Pressing the [Eject Sample] button makes it easy to load and remove samples by automatically lowering the stage and switching the objectives to expand space.

Furthermore, the lower Condenser mirror can be removed to enable reflectance/ATR measurements of samples up to 40 mm thick.



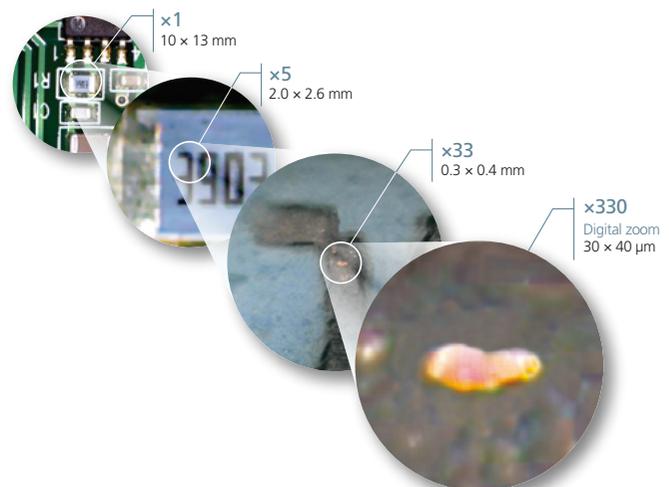
Observe

## Look for the Item to Be Measured

### Quickly Determine the Measurement Position — Wide-Field Camera\* and Microscope Camera —

Shimadzu's proprietary wide-field camera and microscope camera help observe samples efficiently. In addition to observing a large area up to 10 × 13 mm, the wide-field camera also supports variable digital zooming. Furthermore, by sharing positional information with the microscope camera, it achieves a digital zoom function capable of zooming to a magnification of about 330× for observing areas as small as 30 × 40 μm. (The microscope camera supports variable digital zoom magnifications up to 10×.)

\* The wide-field camera (P/N 206-32606-41) is optional.



Golden contamination adherent on metal plate

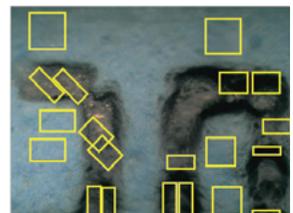


## Determine Where to Measure, and Measure Automatically

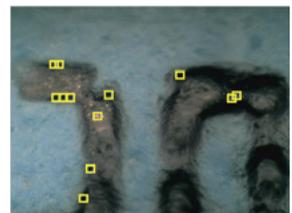
### Automatically Determine Measurement Positions — Automatic Contaminant Recognition System —

A function that automatically recognizes contaminants is included standard. The analyst simply clicks one button and the software automatically recognizes the contaminant. It even determines the optimal aperture size and angle instantaneously. Two modes are available: the standard mode and one optimized for extremely small areas. Users can choose the

best model for their application. The automatically determined measurement positions can either be measured without editing or the analyst can add or delete measurement positions. Sample images are stored into the measured spectra automatically. The sample and measurement positions can be easily identified later.



Standard



Micro



## Identify the Cause of Failures

### Automatic Identification of Contaminants — Contaminant Analysis Program —

The contaminant analysis program - the functionality for automatically qualifying contaminants - is included as a standard feature in LabSolutions™ IR software. Measured spectra using AIMsolution can be loaded directly into LabSolutions IR and analyzed.

The contaminant analysis program identifies measured contaminants with high precision using a spectral library for substances commonly detected as contaminants in combination with Shimadzu's proprietary identification algorithm (patent pending).

#### Contaminant Analysis Program Features



It includes spectra for over 550 inorganic substances, organic substances, and polymers commonly detected in contaminant analysis.



Searching for spectra, determining matches, and preparing reports are all automated.



It not only searches for spectra, but it also applies a special algorithm focused on spectral characteristics.



Even for contaminants that are mixtures, it searches for primary and secondary components and also displays the probability of candidate substances.

# Functionality That Is Simpler and More Convenient to Use

## › Perform Infrared Measurements Smoothly While Viewing Visible Images - Visible/Infrared Dual View System -

Infrared spectra can be measured while checking a visible image of the sample. Spectra can be measured while confirming the position of contaminants, which avoids the trouble of switching back and forth between the visible light and infrared light.

Used in combination with the tiling function, visible observations and infrared measurements can be performed anywhere within the stage operating range, eliminating the need to reposition the sample.

Image view of the visible light and infrared optical path

- Green light: visible light optical path
- Red light: infrared optical path



## › Visualize Components - Chemical Imaging\* -

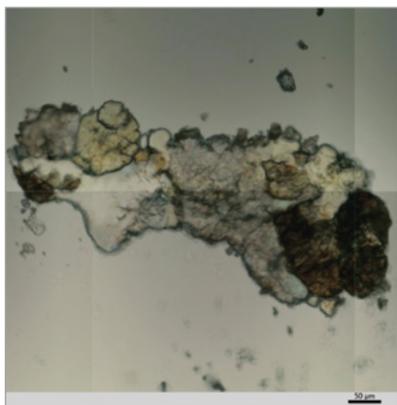
The invisible distribution of chemicals can be visualized based on peak height or area, multivariate analysis (PCR/MCR), or spectral similarity to target spectra.

### Chemical image of pharmaceutical powder

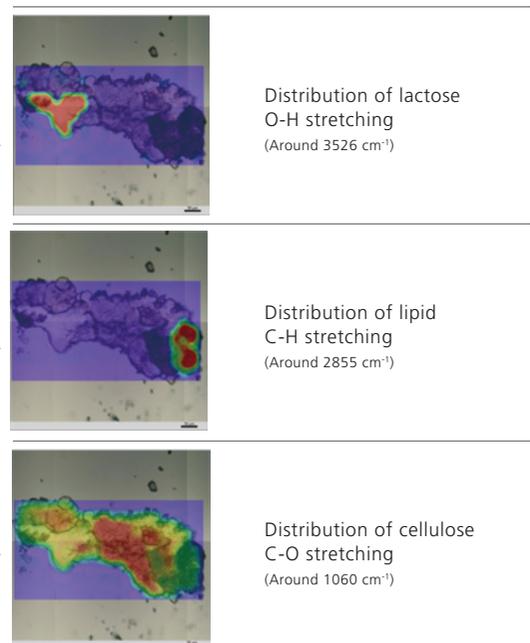
Pharmaceutical products were rolled with a diamond cell, then mapping measurement was performed.

Right figure represents the distribution of powder components, such as lactose, lipid, and cellulose.

Color display can be switched freely between single-color and multi-color.



Microscopic image of pharmaceutical powder



\* Visualizing chemicals requires an optional mapping program (P/N 206-32936-41).



## ➤ Perform Ultra Micro Analysis - Best-in-Class Signal-to-Noise Ratio -

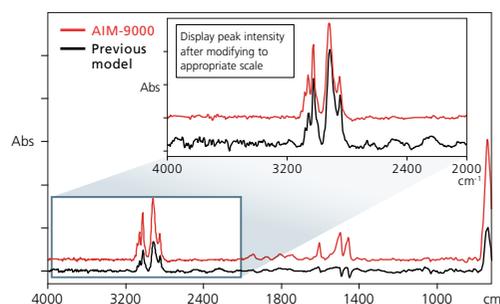
The AIM-9000 optimized for measuring extremely small areas. The AIM-9000 achieves 30,000:1 signal-to-noise ratios, the best in its class. Consequently, it can quickly obtain excellent spectra from even extremely small contaminants.

### Transmission measurement of polystyrene beads

A  $\phi 10\ \mu\text{m}$  polystyrene bead was measured by transmittance method. Low noise and a high-quality spectrum of a very small sample were obtained with only a small number of scans.



Sample : 10  $\mu\text{m}$  diameter polystyrene bead on BaF<sub>2</sub> window plate  
 Measurement Condition : Aperture size 15  $\times$  15  $\mu\text{m}$   
 Number of Scans : 40 (about 20 seconds)



## ➤ Perform High-Sensitivity ATR Measurement - Samples with High Refractive Index -

The Ge prism (P/N 206-32600-41) has an anti-reflective coating that provides high sensitivity.

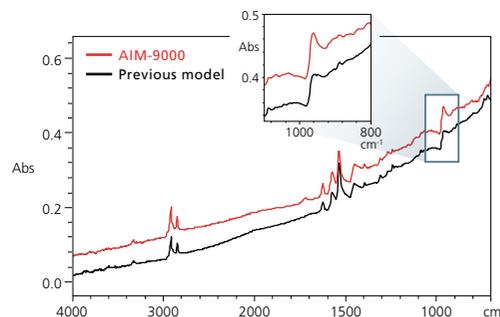
Due to a steeper incident angle for the infrared light, compared to the previous model, the AIM-9000 is able to acquire excellent distortion-free ATR spectra even when measuring samples with a high refractive index, such as black rubber.

### ATR measurement of black rubber

An acrylonitrilebutadiene rubber (NBR) with 50 wt% carbon was measured by Ge-ATR objective. A clear peak of C=C-H out-of-plane bending mode was obtained at 970  $\text{cm}^{-1}$ , which was strained by conventional ATR objective.



Sample : NBR with 50 wt% carbon content  
 Measurement Condition : Aperture size 50  $\times$  50  $\mu\text{m}$   
 Number of Scans : 20 (about 10 seconds)



## ➤ Fully Support Identification of Contaminants

### - Contaminant Library for LabSolutions IR and Thermal-Damaged Plastics Library\* -

#### Contaminant Library for LabSolutions IR (P/N 206-33179-91)

This unique library was created by Shimadzu especially for analyzing contaminants in tap water and food products. The library includes information about samples actually collected as contaminants and service parts commercially marketed for tap water applications. It also includes a collection of X-ray fluorescence profiles (PDF files). Consequently, it can significantly improve the precision of contaminant searches. Unlike previous libraries, this is a mixture library that covers the extensive knowledge and experience necessary for qualitative analysis.

#### Thermal-Damaged Plastics Library (P/N 206-33039-91)

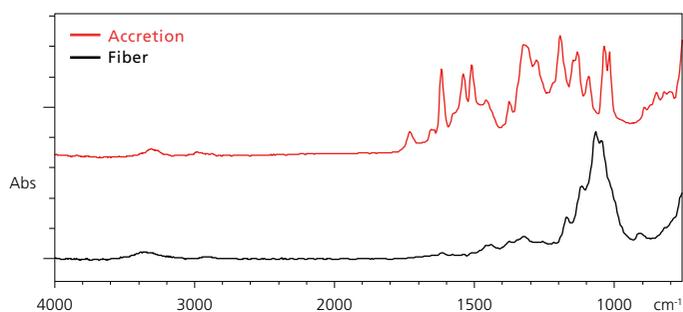
This unique library includes information about plastics that have degraded due to oxidation by heating. The library is especially useful for analyzing degraded contaminant substances, which are common.

\* Shimadzu created the library using spectra obtained by Hamamatsu Technical Support Center, Industrial Research Institute of Shizuoka Prefecture.

# Accessories

## ATR Objective (slide-on type) Ge prism: P/N 206-32600-41

The ATR objective uses a cone-type prism, with single reflection, 15× magnification and a 45-degree incident angle. The slide-on type prism makes it easy to switch back and forth between visible observation and infrared measurement. This ATR objective is especially effective in analyzing samples that do not transmit or reflect infrared light easily, such as paper and plastics, or extremely thin film, such as stains.



Spectra of contaminants on a textile identified as Phenolic resin

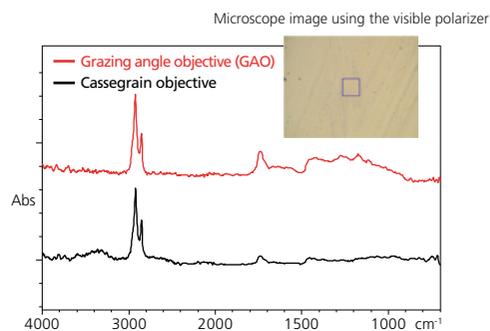
## ATR Pressure Sensor P/N 206-32603-41

This pressure sensor prevents prism damage due to excessive pressures applied during ATR measurements using an ATR objective. It can also be used to automate ATR measurement with pressure sensing.

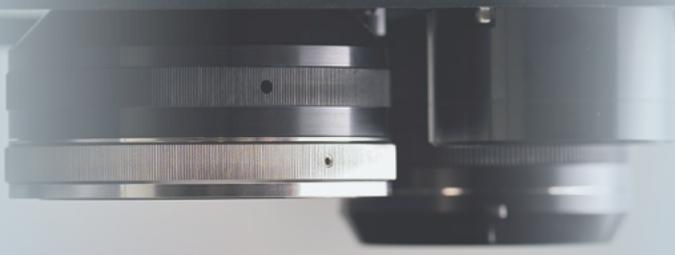


## Grazing Angle Objective (GAO) P/N 206-32602-41

The Grazing angle objective with 80-degree incident angle is effective for measurement of organic thin film with nm level on metal substrate. In the case of failure analysis, this objective is useful for measurement of samples on concave surfaces or stains on a metal surface.

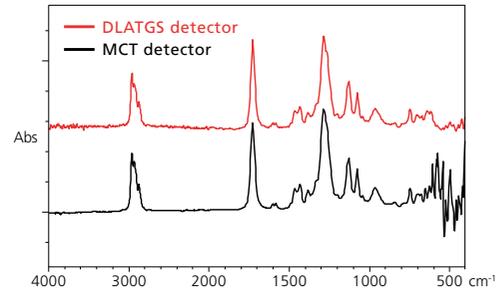


The infrared spectra of stains on the metal (oil film)



## DLATGS Detector P/N 206-32580-41

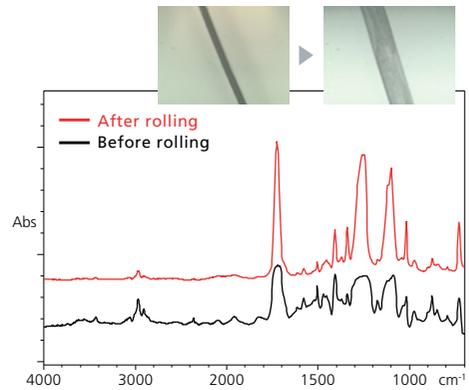
By adding this DLATGS detector to an AIM-9000 infrared microscope, infrared spectra can be obtained without liquid nitrogen. It is also possible to switch back and forth between the MCT and DLATGS detectors for measurements as needed. The DLATGS detector offers a wider wavenumber range (up to 400  $\text{cm}^{-1}$ ) than the MCT detector, but with lower sensitivity. Therefore, the MCT detector is used to measure micro samples less than 100  $\mu\text{m}$ .



The infrared spectra of polyvinyl chloride (PVC)

## Diamond Cell CII P/N 208-92289-01

This diamond compression cell is used to compress micro samples very thin for direct measurement under the microscope. It can be used for samples such as plastics and fibers. This CII cell features a large thin window plate made of artificial diamond (1.6 mm diameter). A type-B cell that uses natural diamond is also available.



The infrared spectra of a single fiber

## Micro Vise Holder P/N 206-33293

This holds various types of samples for microscopy. It ensures positive holding of samples of a difficult shape or measurement of a sample at a user-selectable angle. Measurement with a polarizer, with the sample under tensile load, provides information on the molecular orientation.

## Infrared Polarizer P/N 206-32605-41

This accessory is useful for researching the orientation characteristics of samples, or increasing sensitivity with Grazing Angle Objective measurements. The infrared polarizer can be used by inserting it into the microscope from the side.

## Visible Polarizer P/N 206-32540-41

This accessory is useful for visible observation of samples that are normally difficult to observe using visible light. Using the properties of polarized light can make samples easier to see.



## › Hardware Validation

The AIMsolution measurement program also features a Validation Program to check and confirm the performance of Shimadzu Fourier Transform Infrared (FTIR) spectrophotometers and the Shimadzu AIM-9000 Infrared Microscope. Polystyrene film is used to verify the performance of the instrument in accordance with the Japanese Pharmacopoeia (JP), the European Pharmacopoeia (EP), and the Chinese Pharmacopoeia (ChP). This checks the basic performance of the instrument and provides reliable data.

Items conforming to the Japan Pharmacopoeia, the European Pharmacopoeia, and the Chinese Pharmacopoeia are inspected

- Shape and intensity of power spectra
- Following items of polystyrene film spectrum
  - Resolution
  - Wavenumber accuracy
  - Wavenumber repeatability
  - Transmittance (absorbance) repeatability
  - Peak separation function\*

\*: Peak separation function is the inspection item of the Chinese Pharmacopoeia.

The validation program conforms with the Japan Pharmacopoeia, the European Pharmacopoeia, and the Chinese Pharmacopoeia. Validation can be done automatically using a NIST standard film with traceability etc. The results can also be printed out in the format shown below.

```

=====SHIMADZU AIM9000 Validation Report/PS16=====
Overall Judgment : Pass   Approved by : _____ Date : _____

FTIR Instrument : IRTracer100   Inspected by : Shimadzu
Serial No. : AAA   Date/Time : 2013-10-10 08:02:49
Temperature : 25

AIM Instrument : AIM-9000   Relative Humidity : 40
Serial No. : BBB

Sample name : Polystyrene   Cumulative number : 45
-----
1 Power spectrum
Wavenumber      Measured      E      Standard      Judgment
cm-1
-----
4000.0          24.08          0.65          Pass
4000.0          24.07          21.63          Pass
3000.0          41.71          43.25          Pass
At Maximum      66.50          50.00          Pass
100.0           11.45          0.65          Pass
                                           Judgment : Pass
-----
2 Resolution
Wavenumber      Measured      Measured      Standard      Judgment
Wavenumber      %T            %T
-----
2870.0          2870.1          30.81
2850.0          2849.9          12.52
Peak depth      24.39          18.00          Pass
1889.0          1888.4          14.24
1883.0          1883.6          15.78
Peak depth      18.40          12.00          Pass
                                           Judgment : Pass
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# Infrared Microscopy Regulatory Support

## Shimadzu Complies Fully with Regulations for Measurements Made Using Infrared Microscopes

By combining proven LabSolutions IR software and AIMsolution software for controlling the infrared microscope, a highly reliable regulatory compliant software system was created.

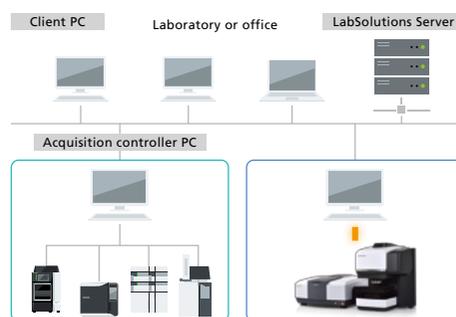
Login from LabSolutions IR and acquire the data from AIMsolution. The acquired data is automatically transferred to LabSolutions IR and registered in the database. Measured data processing and analysis are executed with LabSolutions IR.

### Reliable LabSolutions Software

In addition to LabSolutions IR, which provides basic functionality, Shimadzu also offers LabSolutions DB IR and LabSolutions CS IR to meet the requirements of ER/ES regulations.

#### › LabSolutions DB IR

LabSolutions DB IR allows for secure data management by integrating a data management function with LabSolutions IR. Compliant with ER/ES regulations, the software is optimally configured for customers using a PC. It is recommended for facilities that do not require network connections and want to be ER/ES compliant.



#### › LabSolutions CS IR

LabSolutions CS, which is freely accessible to the analysis network, can be connected to IR, eliminating the need for connecting a PC to the instrument. Since all the data are managed on a server, LabSolutions CS IR can be read from any personal computer on a network. With terminal service, LabSolutions IR can be controlled from a client PC without installing LabSolutions IR on it. It is recommended for facilities that have a large number of users, manage data in a database, and want to be ER/ES compliant.

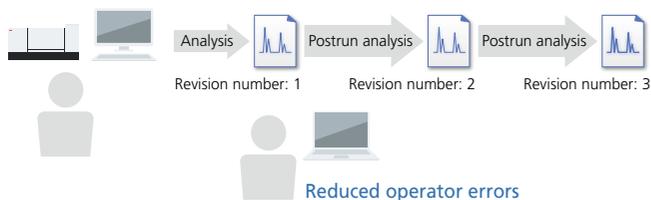
Name	LabSolutions IR	LabSolutions DB IR	LabSolutions CS IR
	AIMsolution	AIMsolution DB/CS	
Data management method	Measured data files are saved and managed in folders on the PC.	Measured data files are saved and managed in the LabSolutions database.	
Data references	The software references files on drives or in folders on the PC.	The software references files in the database.	
LabSolutions database	Unavailable	Available (The database resides on a local PC)	Available (The database resides on a server)
User administration	Only LabSolutions IR can be used.	Available	
Rights group administration			
Project administration			
Standalone/network	Only standalone can be used.	Only the standalone configuration can be used.	Only databases on the network can be used. LabSolutions IR data can be viewed using the database manager on a PC set up for viewing purposes. Note that LabSolutions IR must be installed on the PC used for viewing.
Data backup	Performed on a file-by-file basis using Windows® Explorer.	Performed for each database.	
Mapping program	Available	Unavailable	



## › Database Management Prevents Mistakes

With LabSolutions DB IR and CS IR, the analysis data are managed securely by the database. Overwriting, deletion and other mistakes typical of data file management do not occur.

In addition, when postrun analysis is performed using the acquired data, postrun analysis data revision numbers are automatically assigned, preventing the accidental overwriting of raw data.



## › Solid Security

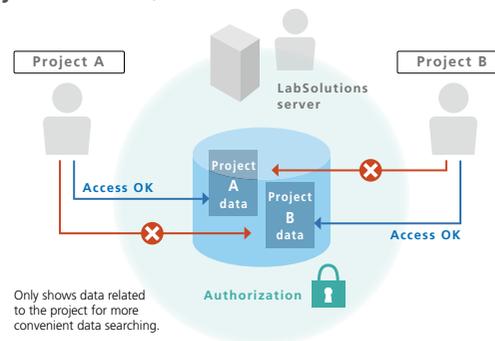
An audit trail to ensure the reliability of data and document e-mail transmission functions when any event occurs in the system can be set up. User accounts are managed using passwords, where password length, complexity and term of validity must satisfy specified requirements. It is also

possible to set lockout functions to prevent illegal access, and set a registered user's deletion and change. In addition, a box can be selected to prevent overwriting a data file, and outputting an item to a report can also be performed.

## › Pertinent Information Managed for Every Project

LabSolutions DB IR and CS IR provide a project management function enabling management suited to tasks and system operations. This function enables equipment and user management, security policy, and data processing to be set on a project by project basis, thereby improving the efficiency of data searches and management tasks.

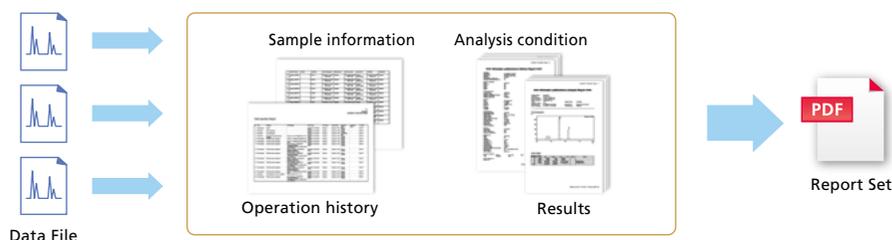
Management can be suited to tasks!



## › Visualization of the Sequence of Analysis Operations

Creating a report set\* provides visibility of the individual analytical operations involved in the overall analytical process. When analytical operations are visible, it is easier to check for operating errors, which helps improve the efficiency and reliability of checking processes.

\* Report sets include test methods and test results for a series of samples analyzed, and also a corresponding operation log (a record of all operating events from login to logout), which is automatically extracted from the data and summarized in a single report.

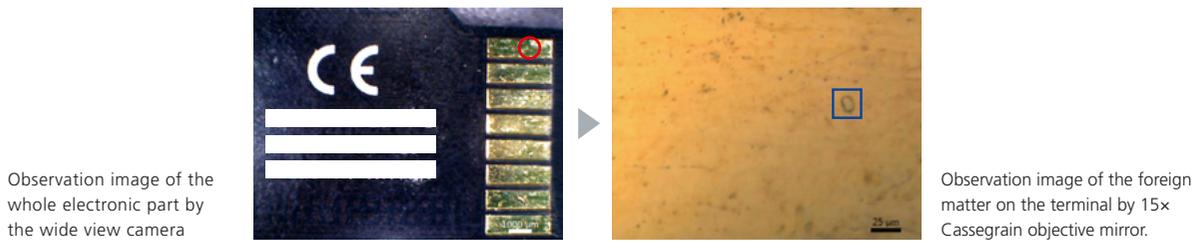


# Application Examples in Specific Fields

## > Electrical and Electronic

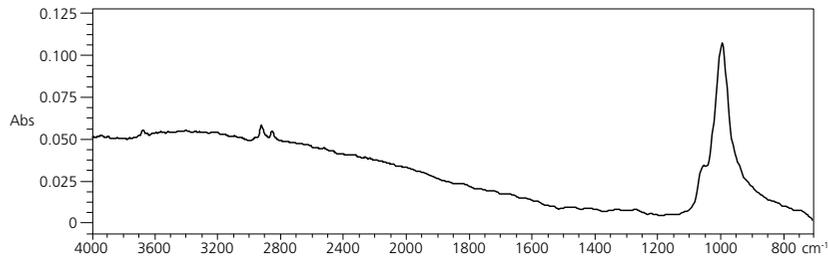


This is an analysis example of foreign matter attached to the terminal of an electronic part. By using a wide view camera, observing the entire part and deciding where to measure can be smoothly done. When a good spectrum is difficult to obtain by reflection measurement, such as a thin stain or small alien substance, ATR spectroscopy (Ge prism) is effective.



Observation image of the whole electronic part by the wide view camera

Observation image of the foreign matter on the terminal by 15× Cassegrain objective mirror.

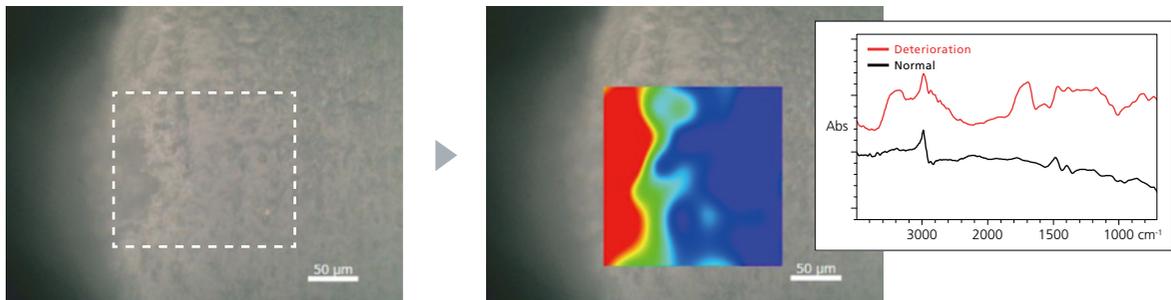


Spectrum of the foreign matter acquired by reflection spectroscopy. It is estimated to be silicate. Identified as Silicate

## > Machinery and Transportation



This is an example of resin parts exposed to sunlight for a long period. By measuring the infrared spectrum of the component cross section, the progress degree of the degradation about depth direction from the surface can be visualized.



This sample had been exposed to the sunlight from the left side.

Imaging in the area of the C = O peak indicating oxidation degradation



## > Pharmaceutical and Life

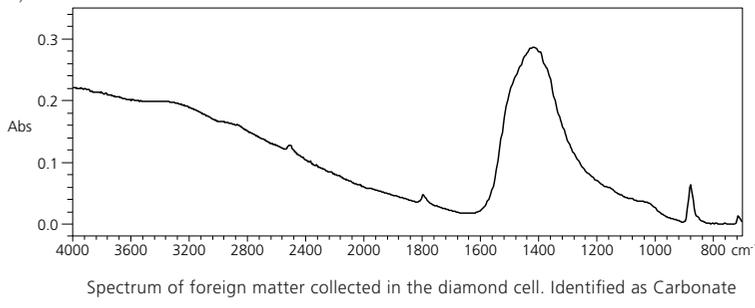


This is an analysis example of foreign substances adhering to the surface of a pharmaceutical tablet. By being taken to a diamond cell and rolled, transmission measurement can be performed to various shaped samples.



Observation image of the tablet surface approximately 8 mm in diameter with the wide view camera (2x zoom)

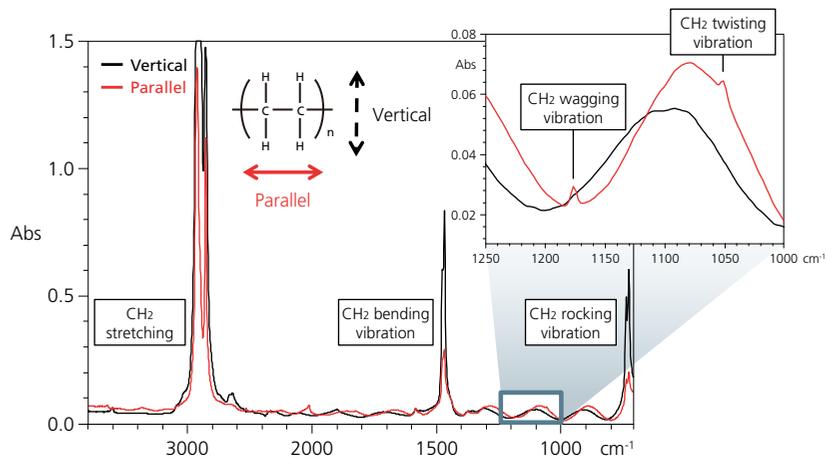
Observation image of the foreign matter on the diamond cell by 15x Cassegrain objective mirror.



## > Petroleum and Chemical



This is the polarizing analysis of a film. By using the infrared polarizer, polarization property and orientation of the film can be evaluated.



## Specifications

### Hardware

<b>Measurement Mode</b>	Transmission/reflection/ATR
<b>Optical System</b>	15x Cassegrain objective 15x Cassegrain condenser
<b>MCT Detector</b>	Wavenumber range: 5,000 to 700 cm <sup>-1</sup> (narrow band) 5,000 to 650 cm <sup>-1</sup> (middle band) Liquid nitrogen monitoring function
<b>TGS Detector (Option)</b>	Wavenumber range: 4,600 to 400 cm <sup>-1</sup> Automatically switches between detectors, if equipped with multiple detectors
<b>Supports for Observation and Measurements</b>	Auto Focus Automatic adjustment function for Condenser mirror Automatic ATR measurement (with purchase of pressure sensor)

<b>Options</b>	Wide-field camera (independent illumination from four directions) ATR objective (Ge) ATR pressure sensor Grazing angle objective (GAO) Micro vise holder Infrared polarizer Visible polarizer
<b>Installation Conditions</b>	Environmental requirements for performance warranty: 15°C to 30°C with max. 70%RH (and no condensation) Site requirements: 10°C to 35°C with max. 70%RH (and no condensation) Or max. 60%RH when 30°C is exceeded
<b>Power Voltage</b>	100/120/220/230/240 V AC
<b>Power Requirements</b>	85 VA

### Software

<b>Computer Requirements</b>	OS: Microsoft® Windows® 7 Professional 64bit Microsoft® Windows® 10 Pro 64bit RAM: 8 GB or more Monitor resolution: Min. 1920 x 1080 pixels
<b>Measurement Support Functions</b>	Automatic aperture setting (automatic contaminant recognition system) Zoom function (max. 330x digital zoom) Multi-image tiling Up to 60 aperture settings can be specified on microscope or tiled images.
<b>Validation</b>	Japanese Pharmacopoeia European Pharmacopoeia Chinese Pharmacopoeia Confirmation of aperture size
<b>Option</b>	Mapping program

<b>Data Processing</b>	<ul style="list-style-type: none"> <li>• Baseline correction (zero/3-point/multi-point)</li> <li>• Advanced ATR correction</li> <li>• Atmospheric correction</li> <li>• Kramers-Kronig analysis</li> <li>• Differential analysis</li> <li>• Mapping chemicals based on calculation formula</li> <li>• Mapping chemicals based on principal component analysis</li> <li>• Mapping chemicals based on similarity to reference spectra</li> <li>• Spectral search</li> <li>• Pasting spectra and images into other applications</li> </ul>
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## Examples of Combined Systems



IRTracer™-100 + AIM-9000



IRAffinity™-1S + AIM-9000



This product is certified as Shimadzu's Eco-Products Plus.

Reduced power consumption by 55% compared with conventional Shimadzu's products.

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