SIGIS 2

- Long Distance Identification, Visualization and Quantification of Gases

Innovation with Integrity

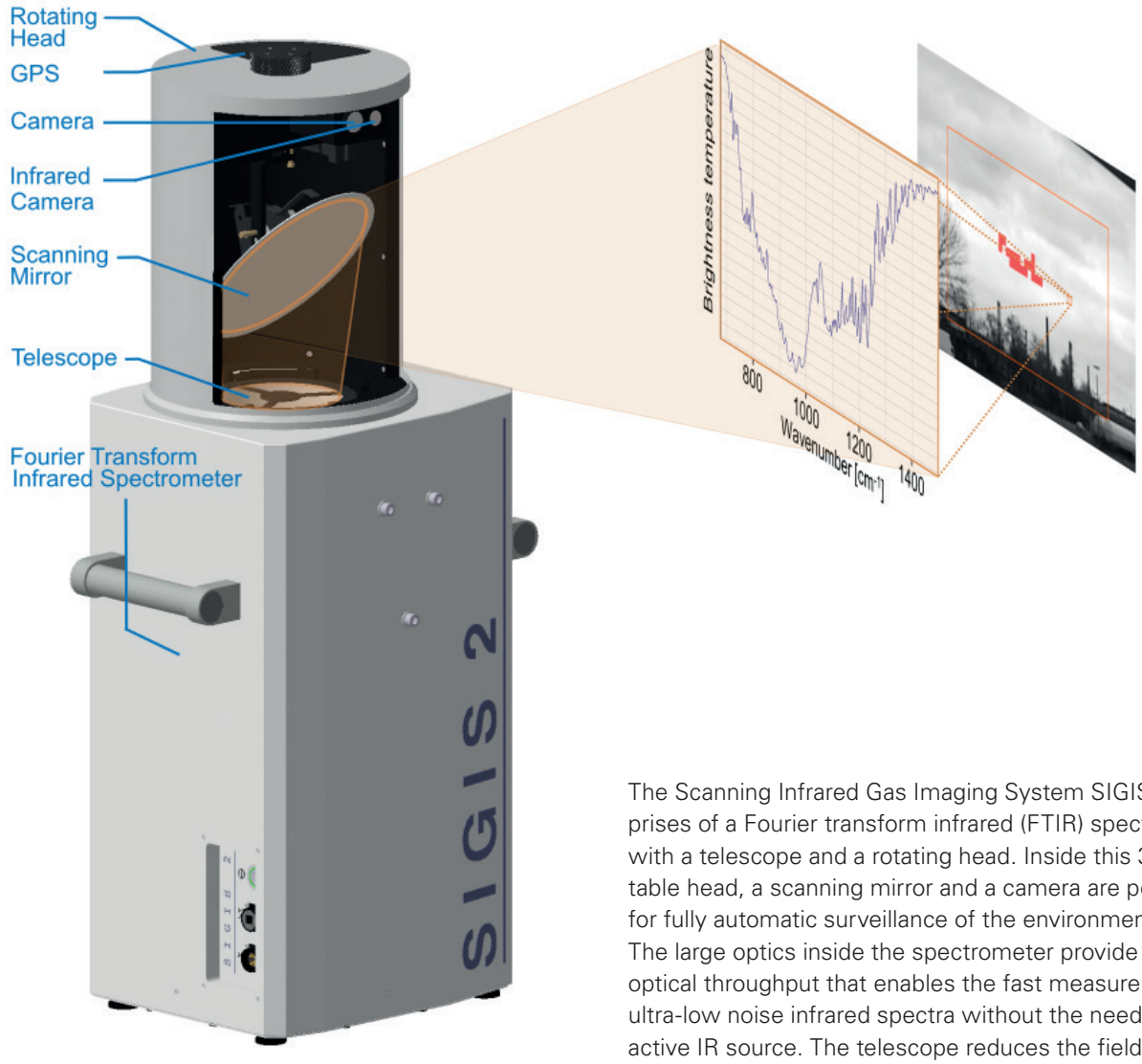
FTIR

The SIGIS 2 is a scanning imaging remote sensing system based on the combination of an infrared spectrometer with a single element detector and a scanner system. It allows automatic identification, quantification and visualization of gas clouds from long distances. The system measures a selected area and visualizes a chemical image overlaid on a video image as a result of the automatic analysis. SIGIS 2 systems are applied in industrial facility surveillance, environmental applications, atmospheric research, and volcanology and are part of the equipment of emergency response forces around the world. Since the SIGIS 2 is a passive remote sensing system, no external light sources or reflection optics are needed.

Key Features

- Scanning Gas Imaging System
- Automatic real-time identification and quantification of target compounds like ammonia
- Passive long-range detection (telescope), no external light sources or reflection optics necessary
- Low detection limits due to high optical throughput and lowest noise
- Compensation of atmospheric gases and interfering compounds
- No calibration to target gas necessary, automatic radiometric calibration
- Large real-time spectral library and an extended offline library available (TICs and CWAs)
- Ready for continuous surveillance (24/7)
- Video- and infrared cameras for day and night vision
- Automatic upload of data to a server
- 360°-surveillance
- Comprehensive software package available. Easy to use, also by non-experts

SIGIS 2

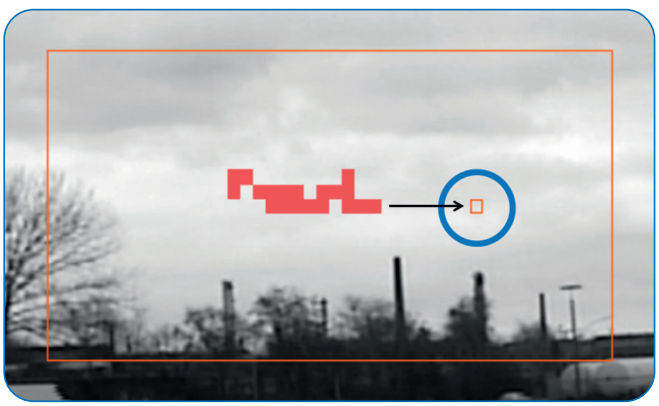


Scanning Infrared Gas Imaging System SIGIS 2 with a schematic illustration of its working principle.

The Scanning Infrared Gas Imaging System SIGIS 2 comprises of a Fourier transform infrared (FTIR) spectrometer with a telescope and a rotating head. Inside this 360° rotatable head, a scanning mirror and a camera are positioned for fully automatic surveillance of the environment.
The large optics inside the spectrometer provide high optical throughput that enables the fast measurement of ultra-low noise infrared spectra without the need of an active IR source. The telescope reduces the field of few to 10 mrad to enable long range detection. This corresponds to a field of view of 10 x 10 m at one kilometer distance for each measurement spot.

The selected area is rapidly scanned point-by-point (small orange square in right-hand side image) by the scanning mirror and a full infrared spectrum is measured in each measurement position.

The result of the spectral analysis is overlaid on the scene image. The red color in the example on the right hand side indicates identification of a compound.



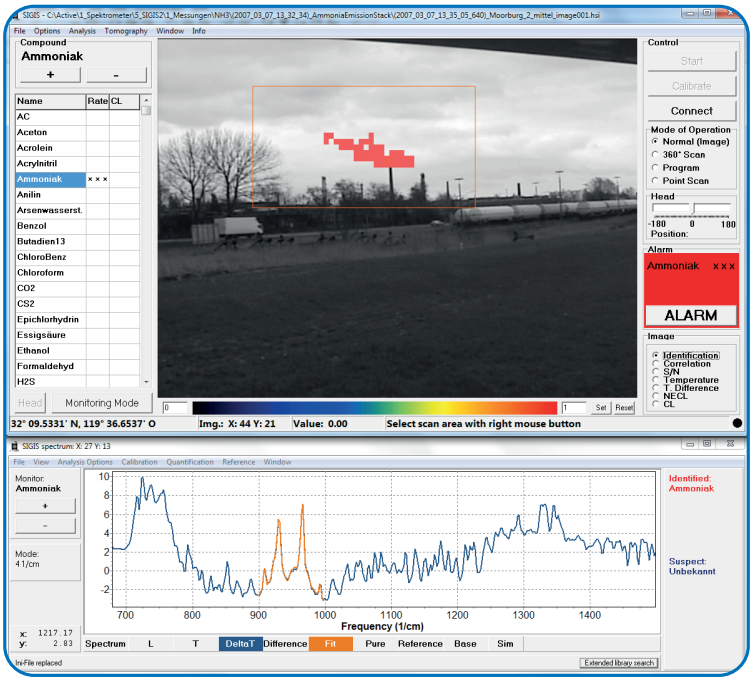
OPUS RS

To measure a certain area of interest a selection is made directly in the video image inside OPUS RS. The selected area is scanned and in each scanning mirror position an infrared spectrum is measured.

The measured spectra are analyzed automatically and an alarm is generated in case a target compound is identified. The position of identification is indicated by an overlay of the analysis result on the scene image. The compound can easily be located and the analysis result can be interpreted intuitively: In the example shown on the right, the measurement of ammonia in the exhaust of an industrial smokestack is demonstrated. The red area in the image shows the positions of ammonia identifications.

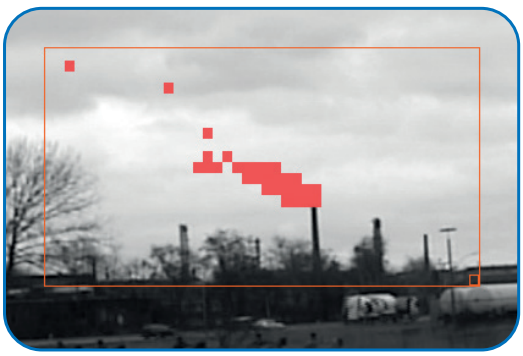
For a detailed analysis, the measured spectrum and the corresponding fit of each measurement spot can be further investigated within the software OPUS RS.

However, no knowledge about interpretation of spectra is required as the analyses is automated.

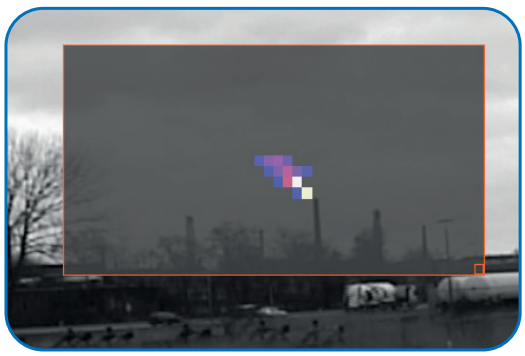


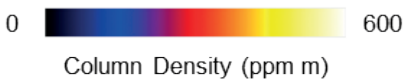
Software package OPUS RS (OPUS Remote Sensing) for automatic and continuous surveillance of selected measurement areas and detailed analysis of the measured spectra.

Identification



Quantification





The identification of compounds within OPUS RS bases on a mathematical fitting procedure: A physical model spectrum is fitted to the measurement and the coefficient of correlation between the compound's measured signature and a spectral library reference is calculated. If the coefficient of correlation and the measured signal strength are above defined thresholds, the compound is identified. The spectral quantification within OPUS RS yields the compound's column density in the units ppm x m. If the size of the gas cloud is known (e.g. by triangulation with two systems) the gas concentration can also be determined in ppm.

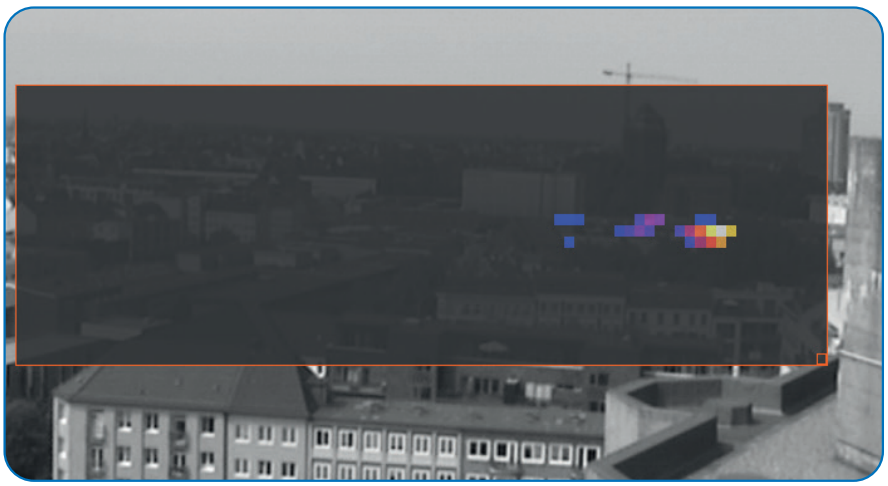
Application

Due to its capability to automatically detect and quantify gases even in a continuous 24/7 measurement mode, the SIGIS 2 can cover a broad range of applications. Among these are the surveillance of industrial facilities, environmental and atmospheric applications and academic research, such as in volcanology as well as the detection of gases for safety and security applications.

As such the SIGIS 2 is also part of the equipment of emergency response forces around the world to detect and visualize potentially harmful gases released at disasters or accidents as well as to observe high-profile events, such as political summits or international sports events to prevent chemical threats or to enable a quick emergency response.

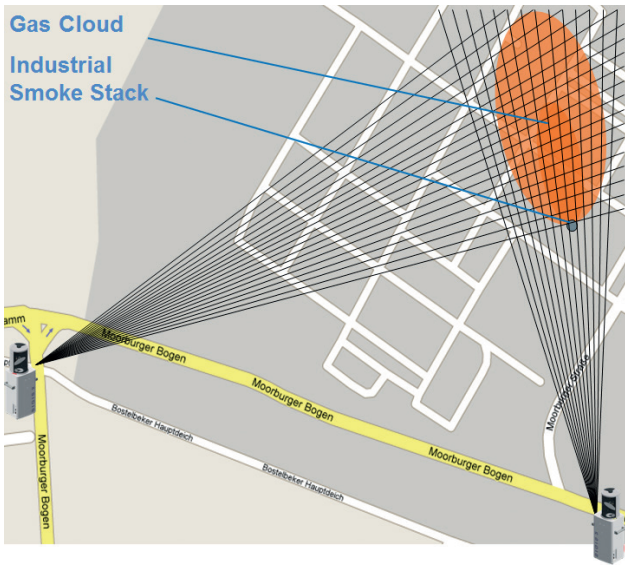
Identification

Quantification



Ammonia is often used as cooling agent in absorption refrigerators. The pictures show the localization of an ammonia cloud that is released from refrigerators of a warehouse. Shown are the identification of ammonia (upper image) and the corresponding quantification (lower image).

Tomography

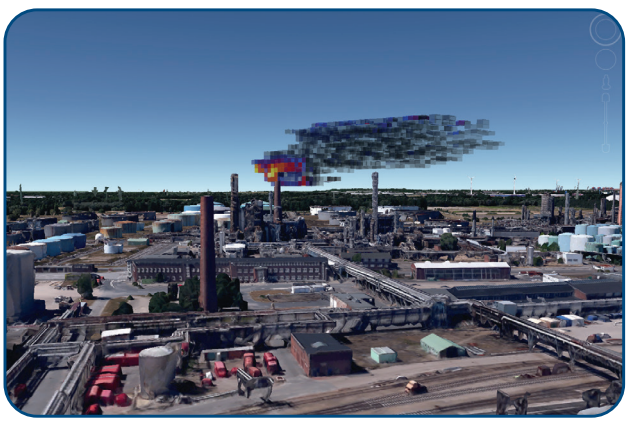


Measurement setup with two SIGIS 2 systems around a potential release point to determine the 3-dimensional distribution of a gas cloud.

By measuring a gas cloud with two SIGIS 2 systems under an angle, as shown in the picture on the left, a three-dimensional cloud model can be derived within OPUS RS by means of a tomographic reconstruction.

The cloud position, as well as its dimensions can be calculated and gas concentrations can be determined from the column densities.

The 3-dimensional cloud model derived in OPUS RS can also be opened in a geographic information system (GIS), such as Google Earth™ for further visualization.



3-Dimensional distribution of an ammonia cloud around an emission stack calculated from the tomographic reconstruction of the simultaneous measurement of the cloud with two SIGIS 2 systems (viewed in Google Earth™, light colors indicate high concentrations, dark colors low concentrations).
Left: Ammonia distribution as observed from South-East.
Right: Ammonia distribution as observed from the West.

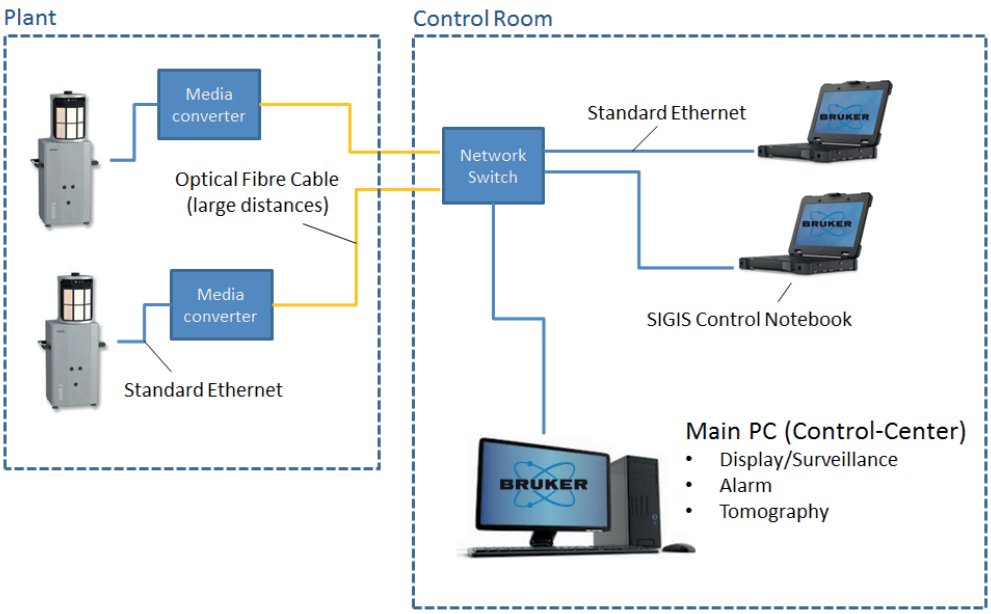
Plant Surveillance with SIGIS 2

Industrial plants can be observed by one or multiple SIGIS 2 systems for the fast detection of leakages and disaster prevention.

To operate the systems from a remote control-center the systems can be connected using fiber optical cables to span large distances.

If several SIGIS 2 systems are used for the simultaneous surveillance of a large industrial facility, the single systems can be integrated via a dedicated local network.

In the exemplary setup shown below, all information can be accessed through a main PC in the plant control-center. Optionally, the data can also be automatically uploaded to a server.



Schematic setup for the plant surveillance with two SIGIS 2 systems.

The control software OPUS RS offers a monitoring mode for plant operators. It is equipped with a simplified user interface for automated 24/7 surveillance with locked system settings and a history of recent events. Preselected measurement positions (defined by a supervisor) are scanned periodically in a dedicated program mode.

Occurred alarms are logged, can be re-viewed and acknowledged by the supervisor.

The measurement data is held available for further reporting and archiving until programmed cleanup.

Monitoring mode in the control software OPUS RS.
Left: Compounds list.
Right: Alarm log to report the latest occurred alarms.

SIGIS 2 for Mobile Applications

The SIGIS 2 is part of the equipment of emergency response forces around the world to identify and visualize potentially harmful gases at disasters or accidents or to observe high-profile events, such as political summits or international sports events.

Due to its ruggedized construction and special shock absorbing mounts the SIGIS 2 can be operated in helicopters and motor vehicles.

Additionally to toxic industrial compounds (TICs) also chemical warfare agents (CWAs, optional) can be detected and visualized from long distances.

Permanent installation of a SIGIS 2 system in an emergency vehicle of the German Federal Office of Civil Protection and Disaster Assistance (BBK).

The system can be elevated (motorized) to look out of the roof of the vehicle for 360° view coverage. The SIGIS 2 system can be operated from the emergency truck control station.

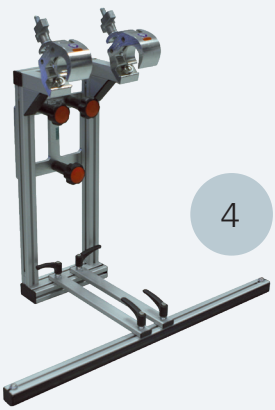
SIGIS 2 systems are also used for the surveillance of high-profile events such as international sports events.

SIGIS 2 at a DFB cup final in the Olympic stadium in Berlin.

1

2

3



4

Accessories:

(1) To optimize the line of sight, a tripod for elevated and levelled positioning is available.

(2) Mobile power supply for field operation of more than six hours. Can also be used as uninterruptible power supply (UPS).

(3) For the secure vehicle integration a shock mount frame is available.

(4) A ladder mount enables mounting the SIGIS 2 on aerial ladders of fire emergency trucks.

Specifications

System

▪ Interferometer	Modified Michelson interferometer (Bruker RockSolid™ interferometer) with cube corner mirrors
▪ Scanner	Azimuth-elevation scanning mirror
▪ Radiometric calibration	Two reference sources, automatic
▪ Display	Overlay of scene image and results of spectral analysis

Performance

▪ Area of surveillance (Field of regard)	360° x 30° (larger angle on request)
▪ Field of view (telescope)	10 mrad (corresponding to 10 x 10 m at 1 km distance)
▪ Spectral range	680 – 1500 cm^{-1} (others on request)
▪ Maximum spectral resolution (max. optical path difference OPD)	0.5 cm^{-1} (OPD=1.8 cm)
▪ Spectral rate	16 spectra/s ($\Delta\sigma$ = 4 cm^{-1}, two-sided interferograms)
▪ NEΔT (single scan, $\Delta\sigma$ = 4 cm^{-1}, t=44 ms, typical)	20 mK
▪ Cameras for scene image	Video camera and infrared camera for night vision
▪ Video camera resolution	768 x 576 px (10 x optical zoom)
▪ Infrared camera resolution	640 x 512 px

IT

▪ PC	Ruggedized notebook computer
▪ Software	Real-time identification and imaging software OPUS RS

Portability

- Transportation case (road case)
- Vehicle integration with shock mount
- Tripod for elevated and levelled positioning

Power

▪ Voltage	110/230 V AC or battery operation
▪ Power consumption (measurement)	< 100 W typical
▪ Calibration	20 Wh typical
▪ Battery supply runtime	6 h typical

Physical Characteristics

▪ Mass	~ 65 kg
▪ Size	~ 1190 x 580 x 365 mm^3

Environmental

▪ Operating temperature	0° C to 49° C (-20° C to 49° C optional)
▪ Storage temperature	-30° C to 70° C

Know How meets Service

Bruker Optics is the leading manufacturer and worldwide supplier of Fourier Transform Infrared, Near Infrared and Raman spectrometers for various industries and applications. For years, we set new standards on the market when it comes to precision and efficiency, ergonomics and ease of operation, consulting and services.

Highest Quality from a Renowned Company: Always more than you expect

We are never satisfied with the common market standards. This is where our own research and development departments play a major role: here new ideas are turned into innovative products - in more precision, advanced user comfort and unrivalled reliability. To us, it is obvious that these highest demands are also valid for our production process. High quality materials, careful workmanship and, if necessary, especially developed production processes and test routines ensure the quality that is common to all Bruker Optics spectrometers. No matter which new products we design, we place the very highest demands on them all.

Worldwide on-site: We are there where you need us.

Bruker's competence is there where our customers need it - from the very first contact. Our application specialists are scientists and engineers who know infrared spectroscopy and spectrometers as well as the customers applications. With service centers all over Europe, North and South America, Asia and Oceania an efficient global technical support is guaranteed. This includes professional instructions regarding your application as well as qualified and fast after sales service and, if desired remote diagnostics.

Plenty of time for personal consultation and customer service guarantee a sustainable and efficient solution.

Bruker

Our success stems from our commitment and dedication to provide you the proper analytical tool you require to solve a demanding research problem or run daily quality control routine procedures.

Related Bruker Optics Instrumentation

HI90 Hyperspectral Imaging System

The HI 90 is a high performance imaging Fourier transform spectrometer based on a focal plane array detector that allows for real-time identification, quantification and visualization of gas clouds from long distances. Each pixel of the array records an interferogram from the corresponding field of view. A spectrum is obtained by Fourier transformation and contains the infrared signature of the scene.

EM 27 Remote Sensing FTIR

The EM 27 is a ruggedized remote sensing system providing high performance Spectroscopy in the field. The EM 27 can easily be deployed in the field for various air monitoring applications. Emissions from smoke stacks, waste disposal and hazardous emissions from chemical accidents can be observed with an operating range of typically several kilometers.

OPS Open Path Air Monitoring System

The open path air monitoring system allows identification and quantification of airborne pollutants and atmospheric gases. Infrared radiation is modulated by an interferometer and transmitted to an array of retroreflectors positioned at a distance of typically several hundred meters. Typical applications include air monitoring at industrial, construction or municipal sites and high-precision quantification of atmospheric gases.

MATRIX-MG Series

The MATRIX-MG Series represents high performance FTIR gas analyzers in a compact and rugged housing designed for the automated, high precision and real-time monitoring of gas concentrations in many different process applications. The target gas is measured in a gas cell for high sensitivity automated compound analysis.

Technologies used are protected by one or more of the following patents:
US 5923422

Bruker Optics is ISO 9001 and ISO 13485 certified.

Laser class 1

www.bruker.com/optics

Bruker Scientific LLC
Billerica, MA · USA
Phone +1 (978) 439-9899
info.bopt.us@bruker.com

Bruker Optics GmbH & Co. KG
Ettlingen · Germany
Phone +49 (7243) 504-2000
info.bopt.de@bruker.com

Bruker Shanghai Ltd.
Shanghai · China
Tel.: +86 21 51720-890
info.bopt.cn@bruker.com