



Product Overview

- Infrared and Raman Spectrometers

• Bruker Optics

Bruker was founded in 1960 with nuclear magnetic resonance (NMR) products. Advances in scientific computing technology used for the Bruker NMRs, along with the pioneer work of Professor Ludwig Genzel (1922-2003), director of the Max Planck Institute in Stuttgart, Germany, led Bruker in a new direction: Fourier Transform Infrared Spectroscopy.

Bruker launched its very first FT-IR spectrometer, the IFS series, and entered the field of vibrational spectroscopy in 1974. The 'Genzel' interferometer and many other unique options available on IFS series have instantly set standards in FT-IR spectroscopy. Since then, Bruker's vibrational spectroscopy product line has been continuously expanding with instruments suitable for both analytical and research applications.

Today, Bruker Optics is a part of the Bruker Corporation and offers FT-IR, FT-NIR, Raman, TeraHertz and spectrometers as well as imaging spectrographs for various markets and applications. Bruker Optics R&D and manufacturing centers are in Ettlingen, Germany, with supporting technical centers and offices throughout Europe, North and South America and Asia.

Whether it's a high-end research system, a life sciences tool, a routine quality control instrument or a process analyzer, Bruker Optics offers a wide variety of innovative analytical tools for all your demanding needs. The countless innovations found on our products, delivering unmatched analytical power, represent our philosophy: think forward.



Early IFS Series with 'Genzel' interferometer set many standards in research FT-IR.



Bruker Optics products are manufactured in Ettlingen, Germany.

Bruker Optics Product Line

- FT-IR spectrometers and microscopes
- FT-NIR spectrometers
- Raman spectrometers and microscopes
- Vacuum FIR/THz spectrometers
- Gas analysis and remote sensing systems

● Commitment to quality and innovative instrumentation

Commitment to Quality

Engineered with unprecedented quality, our dedication to product excellence is a benefit we offer to all our customers.

Bruker offers comprehensive validation solutions.



Drop test ensures product durability standards.



All our products are final tested before their delivery to our customers.

Vibration test on process instruments provides assurance on stability.



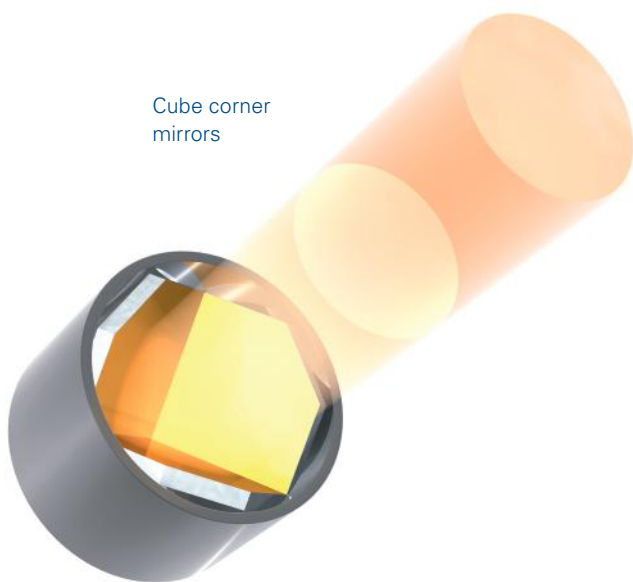
Fully Digital Data Acquisition

The data acquisition on Bruker spectrometers is based on unique dual-channel delta-sigma ADCs with true 24-bit dynamic range, which are integrated into the detector preamplifier electronics. This technology minimizes noise pickup which leads to spectra with outstanding signal-to-noise characteristics.

RockSolid™ Interferometers

Many Bruker spectrometers utilize cube-corner mirrors in its well-proven RockSolid™ interferometers, incorporating dual retro-reflecting cube-corner mirrors in a double pendulum arrangement. The inherent optical properties of the cube corner mirrors avoid effects of mirror tilt; the unique optical and the rugged mechanical design using space-proven, wear-free flex-pivot bearings located in the center of mass, eliminate mirror shear. The combination of these features results in spectrometers and analyzers with outstanding reliability, stability and insensitivity to vibration as well as thermal effects.

Cube corner mirrors



ALPHA II

The FT-IR spectrometer ALPHA II is the advancement of its very successful predecessor. The ALPHA II combines outstanding quality with compactness and user convenience. With its integrated touch panel PC and its intuitive OPUS Touch software, FT-IR spectroscopy has never been easier. Technical innovations increase the ALPHA II's performance and robustness even further. The fully integrated design of the ALPHA II makes it perfect for efficient routine analysis and the quality control of industrial products.



ALPHA II with touch panel operation.

INVENIO®

INVENIO is Bruker's smart next generation and fully upgradeable FT-IR platform for efficient high performance analysis from routine to advanced research applications. Thanks to its unmatched degree of customization INVENIO can be configured for almost any analytical task and application.

Benefit from countless innovations such as 5x MultiTect™ detector technology, automatic beam splitter exchange with amazing accuracy, additional Transit™ sample chamber, Bruker FM technology for simultaneous mid & far infrared, superior signal to noise ratio, intuitive touch panel option and state-of-the-art SoC electronics.

No matter if you use standard FT-IR accessories, specialized modules or time resolved techniques: INVENIO makes your analytical tasks pleasantly easy. Meanwhile, instrument performance is permanently monitored to ensure reliable and reproducible results.

Additionally, INVENIO includes fully automated instrument qualification tests (OQ/PQ) per cGMP and allows to be used compliant with 21 CFR part 11.



Typical INVENIO routine configuration with integrated ATR and touch panel as e.g. used for many QC applications.



Example for advanced INVENIO research configuration with PLII photoluminescence module and Hyperion FT-IR microscope.

- Most comprehensive FT-IR product line;
from the most compact to the highest in resolution



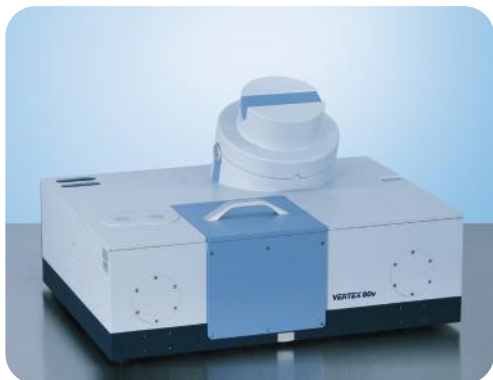
VERTEX Series

The VERTEX Series is built on a fully upgradeable optics platform that is designed with the utmost flexibility in mind. Multiple input and exit ports allow users to connect various external and internal accessories and components to customize the instrument based on applications. VERTEX spectrometers share a wide range of features and utilize well-proven RockSolid™ and UltraScan™ interferometer designs.

The unique BRUKER FM technology for INVENIO R and VERTEX 70v enables the measurement of complete mid to far IR spectra in a single step without a gap.



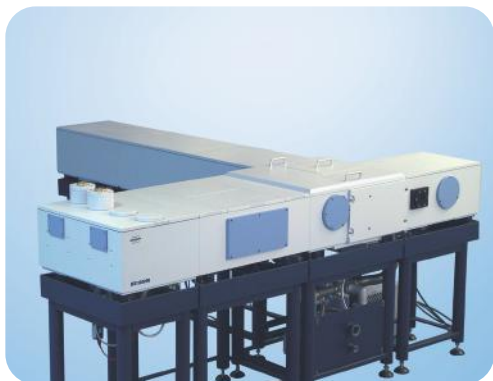
FT-IR



Vacuum Optics

With the vacuum models, peak sensitivity in the mid-, near-, and far-IR regions is obtained without masking weak spectral features by atmospheric absorptions. The VERTEX 80v as gold standard of FT-IR spectroscopy provides unique options: the automatic beam-splitter exchange unit allows for automatic spectral range selection without venting the vacuum optics.

Moreover with the unique verTera extension, the VERTEX80v becomes the world's first hybrid FT-IR/CW THz spectrometer.



IFS 125 HR Series

The IFS 125HR is built for performance with each instrument component optimized to approach the theoretical limit of sensitivity. It offers the highest spectral resolution available down to better than 0.008 cm^{-1} , a resolving power of up to 10^6 and the widest wavelength range from 5 cm^{-1} in the far-IR/THz to $50,000 \text{ cm}^{-1}$ in the UV. The spectrometer is dedicated mainly to ultra-high resolution vapor phase measurements, and frequently applied to atmospheric research.

• Gas Analysis and Remote Sensing

The Bruker gas analysis and remote sensing systems allow the fully automatic identification and quantification of gas compounds. Target gases can be analyzed inside a gas cell using the Gas Analyzers OMEGA 5 or the MATRIX-MG Series as well as from far distances with the remote sensing systems. In addition, HI 90 and SIGIS 2 are imaging spectrometers that add mapping capabilities to the Bruker Optics instrument portfolio.

OMEGA 5 The Versatile Gas Analyzer

OMEGA 5 is a rackmounted FT-IR based Gas Analyzer for the fully automated quantification of gas compounds. The gas is analyzed inside the multi-reflection gas cell of 5 m optical path length. In combination with the Gas Analysis software OPUS GA, OMEGA 5 allows for high-precision and real-time monitoring of gas concentrations even in complex gas mixtures without the need for gas calibrations.



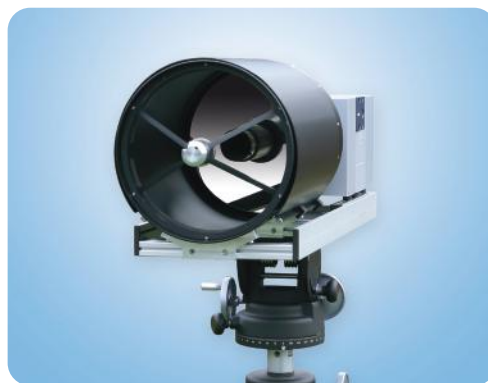
MATRIX-MG Series Gas Analyzers

The MATRIX-MG Series comprises high performance FT-IR gas analyzers in a rugged housing for the fully automated quantification of gas compounds. Various gas cell options with different optical path lengths (10 cm, 2 m, 5 m and 26 m), many different detector options and a large range of accessories allow the perfect configuration of the MATRIX-MG to basically any gas application. The influence of interfering gas compounds is automatically compensated by the Gas Analysis software OPUS GA.



OPS Open Path Air Monitoring System

The open path air monitoring system is an active remote sensing system allowing for the 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. The reflected radiation is analyzed for the target compounds. Due to the large spectral range, a wide range of compounds can be quantified simultaneously. Typical applications include air monitoring at industrial, construction or municipal sites and high-precision quantification of atmospheric gases.



● Fully automated identification of gas compounds



EM 27 Remote Sensing FT-IR

The EM 27 is a ruggedized passive 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.

The EM 27 SUN features a solar tracker for measurements of atmospheric gases by solar absorption spectroscopy. The tracker is controlled using an innovative camera-based feedback system (Camtracker). The outstanding tracking accuracy is the basis for high-precision quantification.



SIGIS 2 Scanning Imaging Remote Sensing System

SIGIS 2 is a scanning imaging remote sensing system that allows rapid identification, quantification and visualization of gas clouds from long distances. The system maps a predefined area and results of the analysis are visualized by a video image that is overlaid with a chemical image. The SIGIS 2 is part of the equipment of emergency response forces around the world. In addition, SIGIS systems are applied in environmental applications, atmospheric research, volcanology, and industrial facility surveillance.



HI 90 Hyperspectral Imaging System

Atmospheric and environmental research, volcanology, industrial surveillance and homeland security outline the wide range of applications of the HI 90 Hyperspectral Imaging System.

The HI 90 is ideally suited for real-time identification, quantification, and visualization of gas clouds with high spatial resolution. Algorithms based on the combination of image processing and spectral analysis are implemented in the operating software. The system may also be used in a range of imaging applications for solids and liquids.

**Gas Analysis
&
Remote
Sensing**

• Raman

BRAVO

BRAVO is the next-generation handheld Raman spectrometer designed for material verification and identification. New technologies like the patented fluorescence mitigation SSE™ and DuoLaser™ provide state of the art performance in a handheld format to address the largest variety of materials.

Measurements can be done directly through transparent packaging material, which paves the way for a cost efficient 100 % material control. The acquired data is evaluated on-board and an instantaneous analysis result is presented, which can be automatically reported to database systems. During operation the user is guided through sophisticated workflows available on a large touch screen display offering a smartphone-like operation.



With the validation package for BRAVO, Bruker offers the dedicated handheld Raman solution for the pharmaceutical industry combining outstanding performance with ease of use, all in compliance to current pharmaceutical regulations.

MultiRAM and RAM II

The MultiRAM is a stand-alone FT-Raman spectrometer and the RAM II an FT-Raman module that can be coupled to INVENIO and VERTEX series multirange FT-IR spectrometers. For ultimate flexibility, both can accommodate a second laser and detection system, automated polarization accessory, and fiber optic coupling ports. The large sample compartment offers a high degree of flexibility with the possibility to insert a variety of accessories and to implement customized solutions – only to mention for example are the motorized

sample stage, low/high temperature stages or automated sample changers.

The possibility to couple these Raman systems to the FT-Raman microscope RamanScope III and/or dispersive Raman microscope Senterra II is unique and enables to analyze samples in the low μm scale with visible to NIR excitation. A dedicated configuration, named PL II, is available to use the module for photoluminescence (PL) applications e.g. in the area of semiconductor quality control and material research.



MultiRAM



RAM II coupled to INVENIO FT-IR

• Photovoltaics & Semiconductor QA/QC

Based on decades of experience Bruker offers dedicated QA/QC solutions and highest performance FT-IR R&D instruments for semiconductor quality control. FT-IR benchtop spectrometers are ideally suited e.g. for room temperature Carbon and Oxygen quantification in Silicon or the

analysis of thin layers. With unique analysis systems such as CryoSAS or low temperature NIR PL, e.g. shallow impurities in Silicon can be quantified down to the low ppta level. The new SiBrickScan is the first commercial system for Oxygen analysis in complete Si ingots.



CryoSAS: Low Temperature Silicon QC

CryoSAS is a unique automated low temperature analyzer for high sensitivity QC of solar and electronic grade Silicon. It quantifies Carbon, Oxygen and shallow impurities (B, P, As etc.) according to international ASTM/SEMI standards, is easy to operate and does not require cryogenic liquids. Compared to e.g. old fashioned wet chemical methods, the analysis is much more sensitive, faster and destruction free fulfilling all requirements of modern quality control.



Low Temperature Photoluminescence for Silicon QC

Low temperature NIR photoluminescence enables the quantification of shallow impurities (e.g. B, P) in single crystal Silicon, according to ASTM/SEMI MF1389. Combining the unmatched VERTEX80 sensitivity and a dedicated Si photoluminescence module including cryostat, detection limits less than 1ppt are achievable. Various options such as cryostat automation, 2nd excitation laser, calibration samples and dedicated Si PL QC software are available.



SiBrickScan (SBS): Oxygen Analysis in Silicon Ingots

SiBrickScan (SBS) is the first and only dedicated FT-IR system for the quantification of interstitial Oxygen in complete Silicon ingots, resulting in a concentration profile along the longitudinal axis. Accessing this information without sawing wafers or test samples is a major and cost saving advantage. SBS reaches detection limits < 2ppma and is available for different shapes and sizes of single crystal or poly crystalline Silicon Ingots.

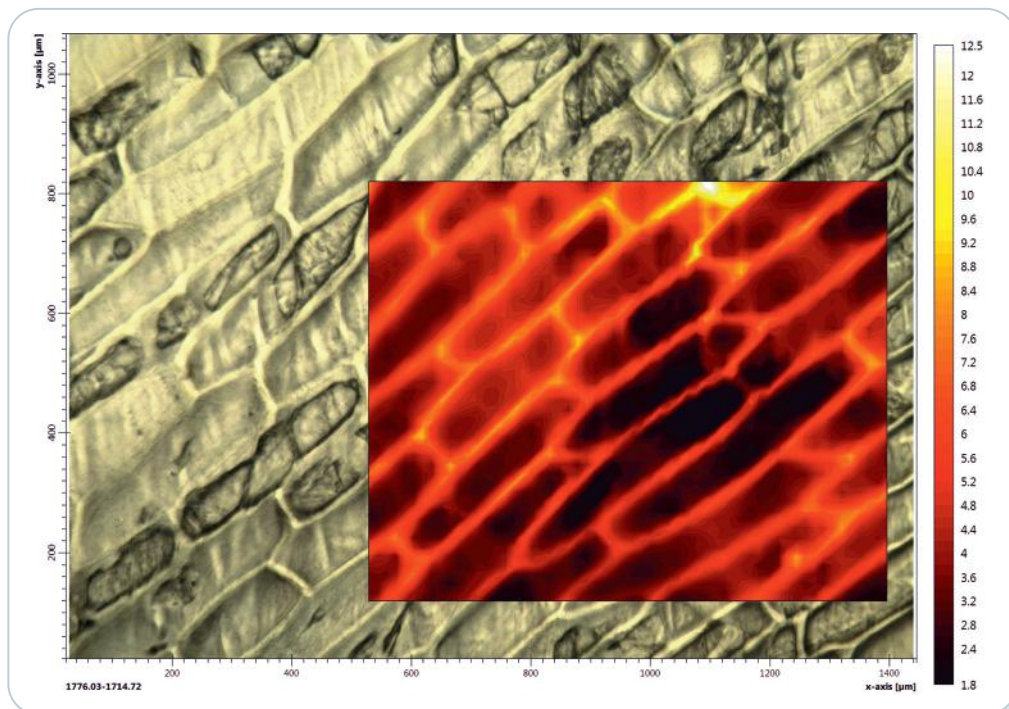
Raman

**Photovoltaics &
Semiconductor
QA/QC**

• FT-IR & Raman Microscopy

Sample visualization is the important first step in the analysis of almost any sample. Infrared and Raman spectroscopy are versatile and powerful analytical techniques that can be applied to micro analysis. Bruker's FT-IR and Raman microscopes are built on state-of-the-art optical microscopy

platforms that provide optimal visual inspection and also feature chemical imaging and mapping. Areas of application include material science, forensics, pharmaceuticals, battery research, mineralogy, failure analysis, content uniformity, sample homogeneity and quality control.



LUMOS II

The FT-IR microscope LUMOS II offers outstanding visual and spectral data quality and features full automation of all measurement modes: transmission, reflection and ATR. Bruker's exclusive Focal Plane Array (FPA) detector technology allows you to experience detailed imaging at amazing speed.

LUMOS II allows you to take full advantage of FT-IR microscopy's full potential. The OPUS IR software supports beginners and experts with smart assistance whenever needed. Glide effortlessly through measurement, evaluation and reporting.



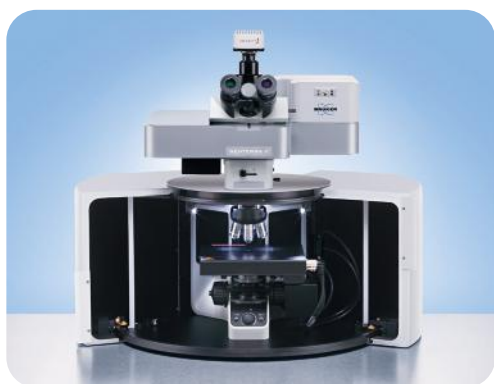
● Effectiveness in failure analysis and research



Left: HYPERION II with Laser Imaging (coupled to INVENIO). Right: HYPERION II with FPA (no spectrometer shown).

HYPERION II

The HYPERION II FT-IR microscope gives users full control over their experiments by providing dedicated objectives for low and high magnifications, specialized sampling accessories, spectral range extensions (FIR, NIR/VIS) and a comprehensive selection of detectors for single point (MCT) measurements and FT-IR (FPA) or IR Laser (QCL) imaging. Whether it's microplastics you are looking at, tissue samples, pharmaceutical formulations or material science, the HYPERION II gives you every last bit of spectral information from your sample. HYPERION II can be coupled to INVENIO and VERTEX Series spectrometers.



SENTERRA II for efficient and productive Raman microscopy.

SENTERRA II

The SENTERRA II defines a new level of spectroscopic performance and user friendliness in the class of compact Raman microscopes. It combines excellent sensitivity with high resolution and state-of-the-art imaging performance.

User convenience and a straightforward, intuitive workflow are key strengths of the SENTERRA II. Whether routine user or longstanding expert it offers the perfect amount of instrumental intelligence at the right time. While the operator is guided by the software through the Raman microanalytical workflow, all relevant hardware changes are performed automatically.

When sample fluorescence is a problem, the SENTERRA II can be combined with the FT-Raman microscope RamanScope III forming a unique hybrid system.

A 4th excitation laser in the near infrared (1064nm) reduces the occurrence of unwanted fluorescence to a minimum.

**Raman
Microscopy**

• FT-NIR

Discover the Flexibility of Near Infrared Spectroscopy

Choosing the best possible sampling method is crucial when solving a specific analysis task. Near-Infrared Spectroscopy (NIR) is an ideal technique for both on-line and laboratory analysis. It offers several advantages over traditional methods, including the ability to make measurements remotely over fiber optics, rapid results and multiplexing capability.

NIR spectroscopy has largely replaced a number of wet chemical analysis methods. With the fiber optics and the integrating sphere sampling techniques, NIR spectroscopy does not require any sampling preparation. It is a fast and precise tool for the non-destructive analysis of liquids, solids and paste-like materials, saving costs by reducing time and reagent use.

Analysis of food, feed and agricultural products.



Dedicated solutions for the analysis of pharmaceuticals.



For the chemical and petrochemical industry.



TANGO

Faster, simpler, more secure - with TANGO your NIR analysis speeds up. TANGO has exactly what users require of an FT-NIR spectrometer suitable for industrial use: robustness, high precision and straightforward operator guidance.

The proven FT-NIR technology by Bruker was combined with an easy-to-use touch screen operation and a small footprint, perfect for those laboratories with limited space.

- The choice for quality control in the laboratory and at-line



MPA II

The new FT-NIR spectrometer MPA II is designed to meet the demands of today's and tomorrow's quality control. It combines outstanding flexibility and high performance with an easy-to-operate interface.

The MPA II offers everything you need for the analysis of liquids, semi-solids, solids, powders and tablets.



Sample Compartment, with sample heater and automated background capability, allows easy measurements of liquids in cuvettes or disposable vials.



Integrating Sphere for measuring solids and semi-solids in diffuse reflection. An optional sample rotator assures a high reproducibility for heterogeneous samples.



Fiber Optic Probes for measuring samples directly in containers, e.g. in the warehouse. Up to two different probes can be connected for solids and liquids.



Transmission Unit with optional sample wheel, e.g. for the automated analysis of vials or solid samples such as tablets in transmission and vials in reflection.

FT-NIR

• Process Analytical Technologies

Process Analytical Technologies

Today, many companies are not only striving to manufacture high quality products, but also to increase production efficiency by installing the analytical systems directly into their production plants. This improves process verifiability and gives the company the opportunity to optimize material use.

Bruker's technology base includes FT-IR and FT-NIR spectroscopy. This allows us to offer a choice of analytical solutions based on application or sampling point. The robust design of our spectrometers enables use in tough conditions in the production plant.

Our application and development support ensures your success, a staff of dedicated engineers and chemists participate in every phase of a project from feasibility studies to installation, calibration, training service and support.

- The Industry's most comprehensive range of solutions based on vibrational spectroscopy
- At-line, on-line, in-line real-time process monitoring
- Various sampling in-situ and non-contact sampling probes and accessories
- Process-ready, rugged instruments that can be customized and run with a wide range of communication protocols
- Dedicated process software, and validation solutions

FT-NIR Measurement Heads and Probes

A wide range of fiber optic probes is available for the MATRIX-F series – from immersion probes for liquids to reflection probes for solid materials. For contactless measurements, Bruker offers emission heads which collect the reflected light from the sample, also as fully ATEX certified version for gas and dust Ex-zones.

Process ready,
rugged
instruments.



Immersion, flow
cell and non-
contact fiber optic
probes.



Professional
installation &
integration.



Process Applications

For many years, vibrational spectroscopy has been used in a wide range of industries. Fast measurements and high information content allows the simultaneous analysis of many different parameters with high precision.

- Chemical: hydroxyl value, acid number, saponification value, iodine number, moisture content, homogeneity, ...
- Pharmaceutical: quality control of incoming goods, reaction control, mixing and drying processes, coating quality, ...
- Petrochemical: octane- and cetane number, distillation-, flash- and cloud point, aromatic content, PIONA analysis, ...
- Polymers: density, viscosity, cross-link density, end group analysis, stabilizer or monomer content, ...
- Food & Beverage: protein, fat, moisture, sugars, salt content, iodine value, acidity, dry matter, amino acids, ...

- At-line, on-line & in-line process monitoring and control



MATRIX-F FT-NIR Spectrometers

The award winning MATRIX-F FT-NIR spectrometers allow direct measurement in process reactors and pipelines, leading to a better understanding and control of the process. Its innovative design provides consistent high-quality results, less downtime and direct method transfer.



MATRIX-MF FT-IR Spectrometers

Utilizing the information-rich mid-IR region in both laboratory and process environments, the MATRIX-MF is a process-ready spectrometer that is ideal for real-time monitoring and analysis of chemical and biological reactions.

• Bruker Optics

Applications Consulting

Whether it's a routine quality control application or a sophisticated research project, our customer oriented application experts can help you find the right tool or method to achieve your goal. Bruker Optics staffs their applications laboratories around the world with spectroscopists who have expertise in customer applications. Our goal is to provide customers with prompt, efficient and knowledgeable support throughout the operating life of your system.

Training Courses

Bruker Optics offers training courses worldwide to familiarize new users with our instruments and to tutor our more experienced users on the latest techniques. The training courses are scheduled at our facilities in the US and Europe, or they can be tailored to fit your own specific requirements and availability. Experienced, factory-trained specialists present the comprehensive lectures, which include hands-on training.

Bruker Customer Service & Support

Bruker Optics' experienced service & support team will provide you with the product expertise and guidance required to provide assistance according the regulatory ISO 13485 Medical Device Management.

Additionally, we offer a variety of service & support features on our portfolio to cover your individual needs. Our maintenance and service agreements offer you immediate access to service and support resources, and protect you from the risk of restriction in system usage.

Covered by one or more of the following patents: DE102004025448; DE19940981.
Additional patents pending.

**Bruker Optics is ISO 9001
and ISO 13485 certified.**

Laser class 1 product.

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