INVENIO® X

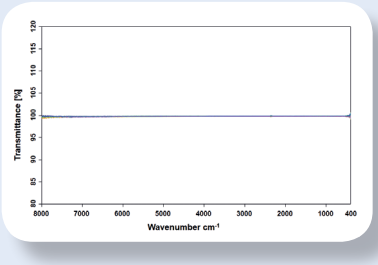
- The fully automated advanced R&D Spectrometer

Innovation with Integrity

FTIR

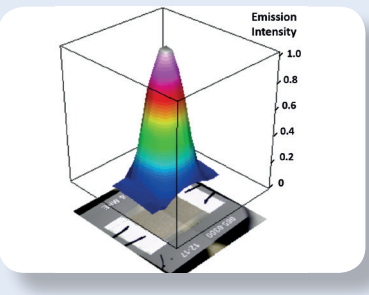
INVENIO X marks a new standard of advanced FTIR R&D spectroscopy and completes the next generation INVENIO platform. The innovative INTEGRAL™ interferometer with integrated beam splitter changer is the perfect counterpart of the pioneering MultiTect™ technology. Together with additional DigiTect™ and Transit™ channel detector positions up to 7 internal software controlled detectors are accessible, covering the complete FIR to VIS/UV range. INTEGRAL™ meets MultiTect™ - A new era of truly automated FTIR spectroscopy begins.

Highest BMS Changer Accuracy



The innovative INTEGRAL™ interferometer with automatic beamsplitter changer wheel provides highest accuracy and reproducibility. In a series of 100 measurements using MIR DTGS and KBr beamsplitter (BMS), after every measurement the BMS changer was automatically moved to another BMS and back to KBr again, starting the next measurement. The resulting 100 perfectly reproducible spectra prove the exceptionally high precision of the automatic BMS changer. The above diagram shows this unique reproducibility by 10 representative so-called 100% lines, one after each 10th beamsplitter exchange plus comparison versus initial 100% line.

Emission Microscopy

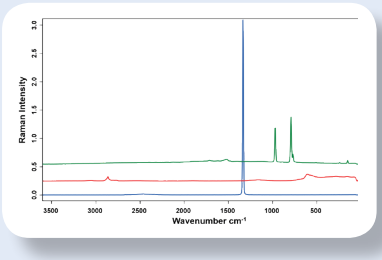


Emission profile of a MIR diode (1x1 mm²) measured using the Hyperion microscope coupled to an INVENIO spectrometer. Outstanding spatial resolution of Hyperion microscope combined with utmost sensitivity of INVENIO featuring the optical direct emission beam path bypassing the sample compartment is exclusively obtainable from Bruker.

Step into the Future. Explore the Unknown.
Accomplish Your Mission X.

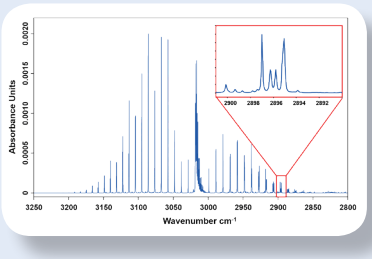
• INVENIO - Made for You

FT-Raman



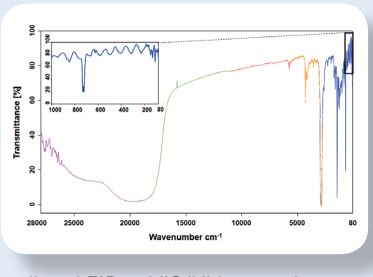
Raman spectra of diamond (blue curve), glass stone (red curve) and moissanite (green curve) measured with INVENIO and the RAM II FT-Raman module, using an excitation power of 450 mW or 200 mW and 8 cm^{-1} spectral resolution. The three minerals can be easily identified and clearly differentiated.

Gas Spectroscopy



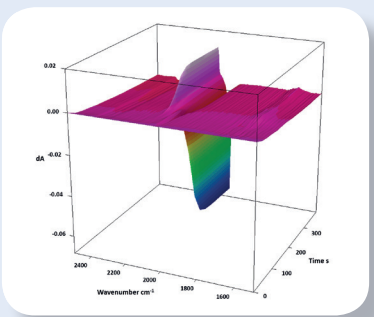
High resolution spectrum of CH_4 at room temperature and under normal pressure with a spectral resolution of 0.085 cm^{-1}, showing the P-, Q-, R-branches and the well-resolved isotope rotational lines.

Automated Range from FIR to VIS/UV



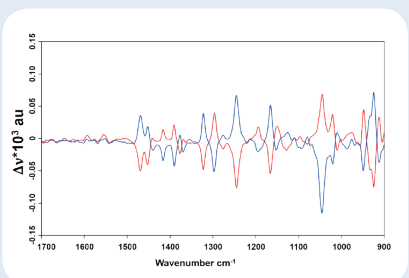
Broadband FIR to VIS/UV transmittance of a red packaging foil, demonstrating the unmatched level of INVENIO X automation. 5 RT MultiTect™ detectors (FIR and MIR DTGS, InGaAs, Si and GaP diodes) and 3 beamsplitters (solid state, KBr and Quartz) installed in the INTEGRAL™ interferometer´s automatic BMS changer were applied. In combination with the internal MIR and tungsten sources, the entire spectral range from 80 cm^{-1} to 28,000 cm^{-1} was covered fully automatically. The FIR (blue) baseline modulation is caused by multiple internal reflection inside the sample and allows to determine the sample thickness.

Rapid Scan Combined with Spectroelectrochemistry



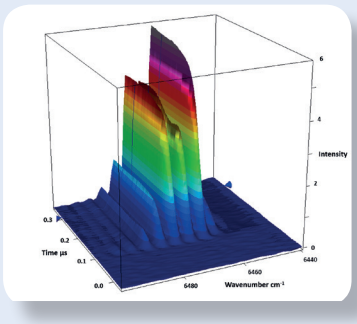
The 3D plot shows the oxidation of a ferrocyanide solution at potentials ranging from -0.3 V to 0.8 V. The change of the two characteristic bands during the whole oxidation process from getting startet until equilibrium has been recorded with rapid scan, which enables a temporal resolution of better than 15 ms.

Vibrational Circular Dichroism (VCD)



1R(+) camphor (blue curve) and 1S(-) camphor (red curve) have been measured using a PMA 50 polarisation modulation module coupled to an INVENIO spectrometer. The extremly weak VCD bands (< 10^{-5} au) are detected with outstanding SNR and a perfectly flat base line.

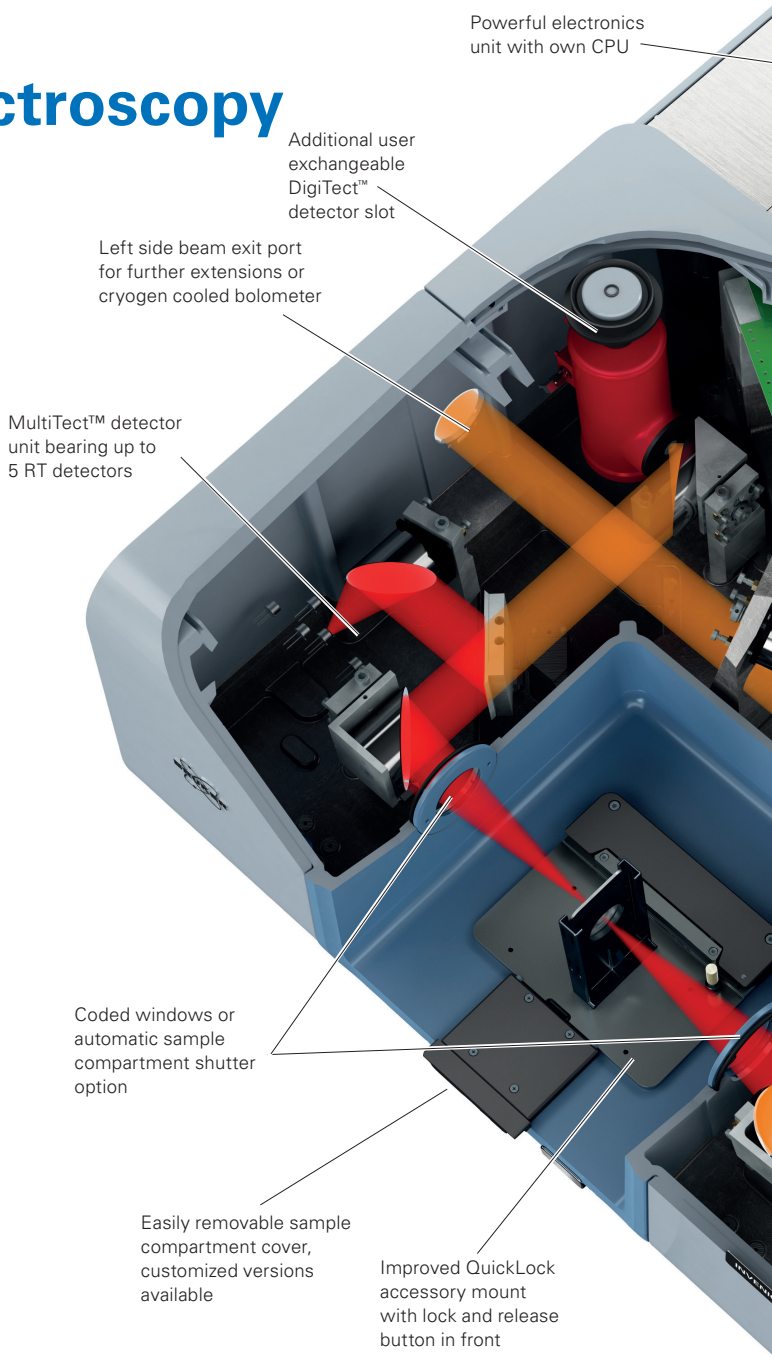
Step Scan TRS



The OPUS 3D plot shows the switch-on of a MIR laser diode within 100 ns. The matchless temporal resolution in ns range is achievable independently of the rather high applied spectral resolution of 2 cm^{-1} to clearly resolve all laser modes.

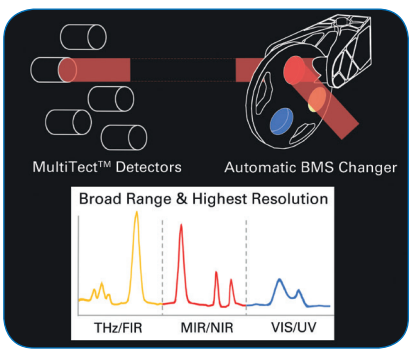
For the Love of Spectroscopy

- Novel wear-free and actively aligned INTEGRAL™ interferometer with integrated automatic 3-position beamsplitter changer and <0.085 cm^{-1} resolution
- Innovative 5x MultiTect™ detector technology
- User exchangeable DigiTect™ detector slot
- Transit™ channel with board level MIR detector for quick transmittance or reflectance results
- Fully digitized signal processing using dual channel 24-bit dynamic range ADC
- Easy in-field upgrade for near IR, far IR and VIS/UV spectral ranges
- Fully automated multispectral FIR to VIS/UV measurements by unique combination of INTEGRAL™ and MultiTect™ technology
- OPUS software for operation and evaluation
- Integrated touch panel option with dedicated OPUS-TOUCH R&D software for user friendly handling
- 3 exit and 2 input beam ports software selectable
- Superior Rapid Scan, Slow Scan and Step Scan performance for modulated and time resolved spectroscopy
- Compatible with all VERTEX and INVENIO accessories and external modules
- Optional direct emission beam path bypassing the sample compartment
- Sample compartment cover can be removed and attached within 3 s, customized versions available
- Sealed and desiccated optics bench, optionally purgeable
- Elegant LED light bar indicating instrument status

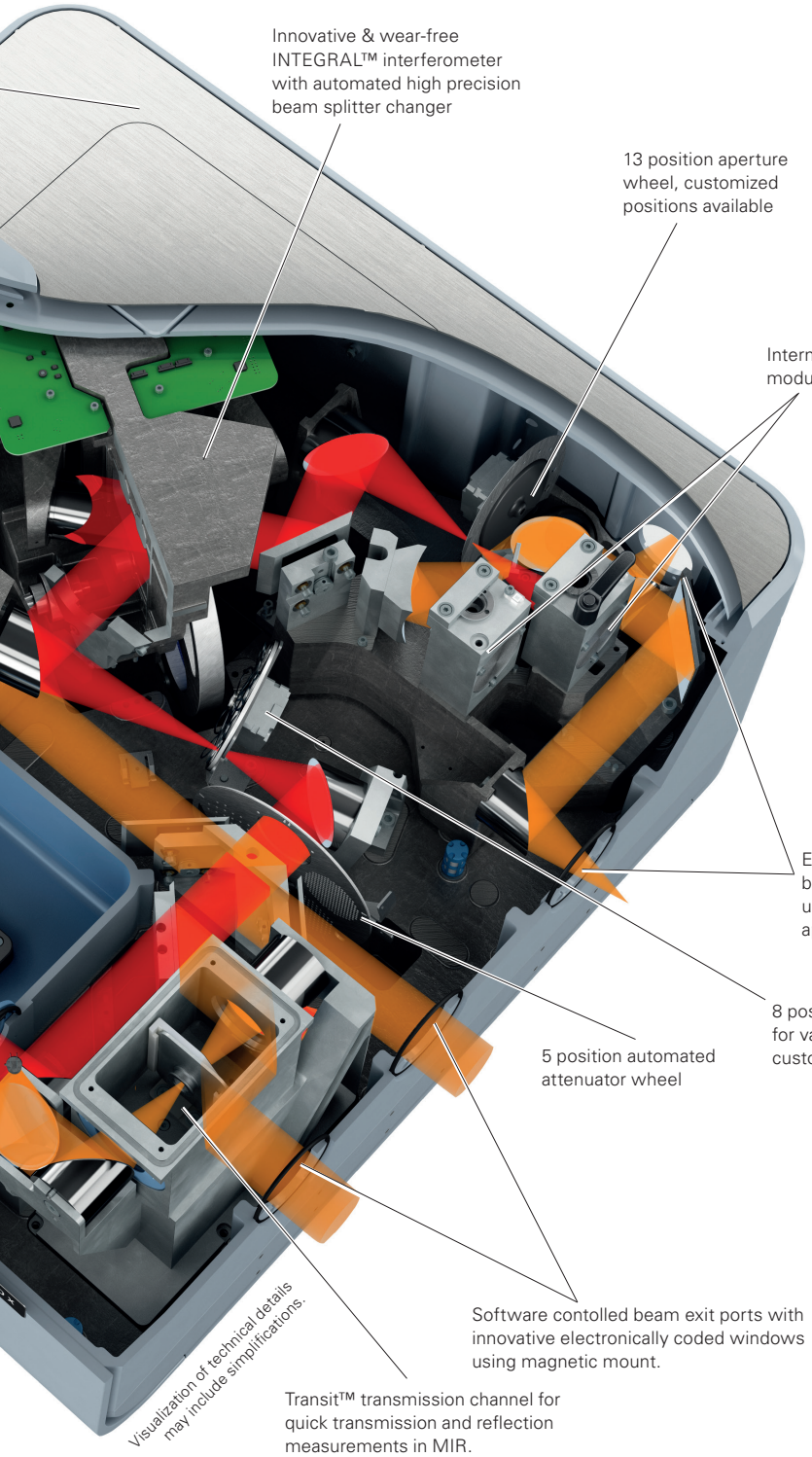


Additional DigiTect™ detector slot for liquid N_2 cooled, fast, high gain and other detectors.

Sufficient space, even for bulky accessories in QuickLock™ mount with lock and release button in front.



MultiTect™ meets INTEGRAL™ enabling fully automated multispectral range FTIR spectroscopy.



MultiTect™ Detector Technology

Incredible but true! Bruker's innovative MultiTect™ detector technology enables automatic control of up to 5 room temperature detectors at once. All room temperature FTIR detectors, such as DTGS, InGaAs, Si diode or GaP, can be configured for the MultiTect™ detector unit, covering the entire spectral range from FIR to UV/VIS. An additional DigiTect™ user exchangeable detector position for MCTs or other special detectors is available.

Transit™ Measurement Channel

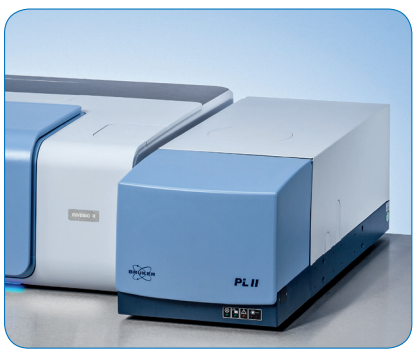
INVENIO can be optionally configured with a second transmission channel for fast and convenient mid IR measurements, such that bulky research setups in the main compartment don't have to be removed. Pellet holders, a magnetic holder for films, clamp holders for different kinds of flat samples, small gas cells and most liquid cells are applicable in the Transit™ channel which includes a dedicated MIR DTGS board level detector. Together with MultiTect™ and DigiTect™ technology, INVENIO can be equipped with up to 7 software selectable internal detectors.

Source Options

Up to two internal and two external software selectable sources can be installed simultaneously covering the complete spectral range from FIR to UV/VIS. The standard internal MIR source with the CenterGlow™ technology provides improved signal intensity and stability. Using the right or rear side input port, the source radiation will be directed through the aperture and filter wheel of the instrument. This is important for emission measurements or source characterization with highest resolution.

Transit™ channel for quick mid IR transmittance results without occupying the main sample compartment.

The optional touch panel offers an intuitive workflow as well as advanced R&D software features.



PL II photoluminescence module for analysis of e.g. semiconductors at room or low temperature.

INVENIO - Accomplish Your Mission X

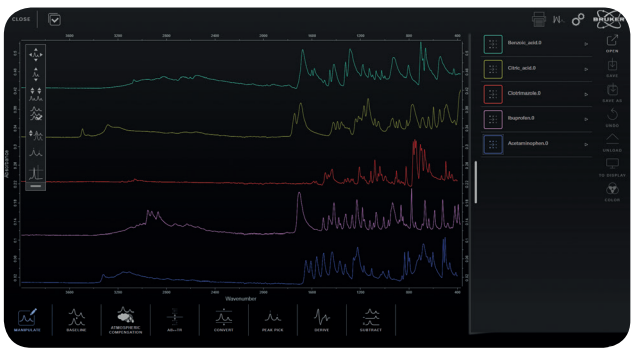
Unique INTEGRAL™ Interferometer

Each INVENIO X is equipped with the novel INTEGRAL™ interferometer including an automatic 3-position beam splitter (BMS) changer. The wear-free interferometer benefits from highly accurate cube-corner mirrors and an actively aligned smoothly running BMS changer wheel, providing optimum performance with better than 0.085 cm^{-1} resolution.

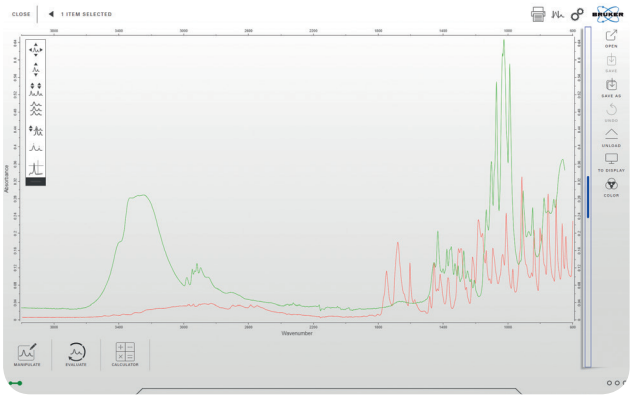
INVENIO X is available with a wide variety of beam splitter combinations to cover the entire range from 15cm^{-1} to 28,000cm^{-1}. With up to 7 software selectable internal detectors, automatic 3-pos. BMS changer and multiple software controlled source options, INVENIO X is by far the multispectral range R&D spectrometer with the world's highest degree of automation. Thus INVENIO X is perfectly optimized for advanced R&D tasks, covering the entire spectral range from FIR, through MIR, NIR to VIS/UV, without the need to manually exchange any optical component.

Integrated Touch Panel

The integrated touch panel is optionally available, to handle R&D standard tasks. A dedicated OPUS-TOUCH R&D software is installed on the panel PC for simplified work flow and intuitive operation. In case of high-end R&D applications a desktop PC can be connected. Or a powerful tablet computer can be used to control the instrument via network and all measurements and data processing can be done remotely, e.g. in the office.



Spectra display with OPUS-TOUCH evaluation and manipulation functions (dark user theme).



Spectra display with OPUS-TOUCH evaluation and manipulation functions (light user theme).

Spectral resolution

The spectral resolution of INVENIO X is better than 0.085 cm^{-1}, which fulfills the requirements for almost any measurement. No matter if condensed phase samples such as solids or liquids, or low temperature crystalline samples, or even gaseous samples, INVENIO can handle them.

Intelligent Next Generation Spectrometer

The innovative instrument design of INVENIO offers many further great features, such as enhanced QuickLock in the sample compartment for easy accessory exchange, electronically coded windows and sample holders for automatic recognition, 8 pos. filter wheel for validation and customer specific optical filters, and automated internal 5 pos. attenuator wheel for high sensitivity detectors or to attenuate external sources or lasers. The state-of-the-art electronics unit with its own CPU is powerful and provides many future options.

Furthermore, the optics of INVENIO X are readily prepared for multiple spectral range upgrades, such that the corresponding optical components can be upgraded in field. INVENIO X is the completion of the INVENIO spectrometer platform for routine, entry-level R&D and advanced R&D applications. It starts a new era of full-automatic multiple spectral range FTIR spectroscopy and sets the new standard for next generation intelligent R&D FTIR spectrometers.

One Platform, All Possibilities

For Advanced Applications

The sample compartment of INVENIO is compatible with a broad spectrum of sampling devices, such as transmission, ATR, IRRAS, specular & diffuse reflectance, integrating sphere and many more. However, when certain applications need experimental setups that are too complex for the sample compartment, or if more than one application shall be carried out alternately, or simply to keep the internal sample compartment free for more routine like measurements, external accessories and modules are available. INVENIO offers up to 3 output and 2 input beam ports for multiple external accessories, such as PL II Photoluminescence module, RAM II FT-Raman module, Thermogravimetric Analysis (TGA), Hyperion series FTIR microscopes, HTS-XT high-throughput screening unit, PMA 50 module for VCD or PM-IRRAS experiments or XSA external sample cabinet. With all these extension possibilities INVENIO has the power to deal with almost any analytical task addressable via FTIR technique.

FTIR Microscopy

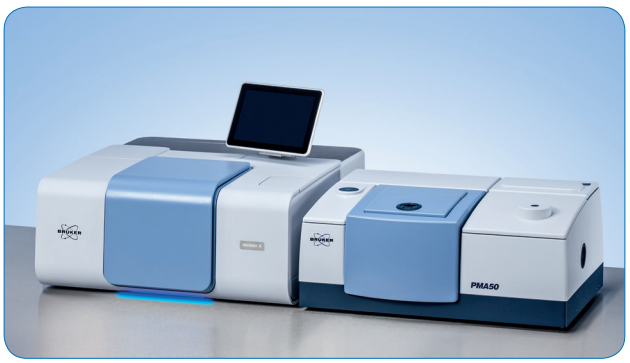
Featuring fully automated infrared chemical imaging, crystal-clear sample viewing and a wide variety of IR and visible objectives, the HYPERION series microscopes provide all you need to conduct most sensitive microanalysis easily and efficiently. The spectral range of HYPERION can be extended from mid to near IR and even to the visible range up to 25,000 cm^{-1}. Combining HYPERION and INVENIO even microscopy emission measurements of tiny samples with outstanding spatial resolution can be achieved. The HYPERION 2000 is fully automated and can be equipped with single element detectors. The HYPERION 3000 hyperspectral imaging microscope utilizes integrated Focal-Plane-Array (FPA) detector.

Thermogravimetric Analysis

The coupling of INVENIO with a Thermogravimetric Analysis (TGA) system allows to in-situ monitor the complete thermal decomposition steps of chemical compounds. The decomposition products during a TGA run can be simultaneously identified with FTIR technique. TG-FTIR offers fast and accurate results on material behavior under variation of temperature and atmosphere.

Polarization Modulation

With dual channel ADC technology and integrated demodulator in the powerful electronics unit the INVENIO offers fully digitized signal processing. Together with PMA 50 module and a Photoelastic Modulator (PEM) outstanding performance for double modulation techniques can be achieved, such as Polarization Modulated Infrared Reflection Absorption Spectroscopy (PM-IRRAS) for measuring ultra-thin layers and Vibrational Circular Dichroism (VCD) of chiral molecules.



FT-Raman Module

The RAM II module combines fast and easy sample handling and excellent suppression of fluorescence offered by FT-Raman. Switching between infrared and Raman is easily achieved via software. An optional FT-Raman microscope can be coupled to the RAM II module and at the same time combined with the SENTERRA II dispersive Raman microscope.

Support

OPUS Software

Bruker's OPUS is an easy-to-use, powerful, all-in-one spectroscopy software which will be delivered with the FTIR spectrometer. It includes the most comprehensive collection of data acquisition, processing and evaluation functions optimized for applications in the fields of both routine laboratory analysis and advanced R&D. There are various software packages and functions available for reaction monitoring, library search and identification, multivariate quantification, video assisted measurement, 3D data visualization, and Quality Control Workflows. The OPUS-TOUCH Software is optimally adapted for the integrated touchscreen of INVENIO. It features a state-of-the-art touch-controlled user interface for intuitive and comfortable IR-analysis. The OPUS interface is completely customizable. Either for quality control laboratories requesting restricted operator access, or for demanding R&D applications benefiting from the full flexibility and power of the software by granting full access, OPUS will meet your requirements thanks to its extended user management and settings.

Validation Solution

Today's analytical laboratories must comply with regulatory requirements. Bruker offers comprehensive system validation providing data integrity with modern database fully compliant with the FDA regulations.
Bruker's OPUS Validation Program (OVP) was developed to help regulated companies to comply with GMP/GLP/cGMP requirements in the most cost-effective manner. This OPUS package supports the automated internal validation unit (internal filter wheel), traceable standards, and Pharmacopoeia instrument qualification protocols. OVP permits combination of standards, tests, acceptance criteria, and required test interval for OQ & PQ operational and performance qualification tests.

Service

Bruker is staffed by expert scientists and engineers that have an in-depth knowledge of instrumentation and applications. Our products specialists will assist you in the selection and use of sampling accessories, choice of optical components and software operation. We offer customized instruction and support packages to fit your needs. We host customer trainings and online webinars yearly to extend your knowledge. Bruker FTIR spectrometers are designed to provide years of dependable trouble-free operation. Professional installations, comprehensive application support as well as a high standard of post-delivery service are commitments Bruker makes to each of its customers.

Technologies used are protected by one or more of the following patents:
US 7034944; DE-102018206519-B3

Bruker Optics is ISO 9001 and ISO 13485 certified.

Laser class 1 product.

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Bruker Optics Inc.
Billerica, MA · USA
Phone +1 (978) 439-9899
Fax +1 (978) 663-9177
info.bopt.us@bruker.com

Bruker Optik GmbH
Ettlingen · Germany
Phone +49 (7243) 504-2000
Fax +49 (7243) 504-2050
info.bopt.de@bruker.com

Bruker Shanghai Ltd.
Shanghai · China
Phone +86 21 51720-800
Fax +86 21 51720-899
info.bopt.cn@bruker.com