

# INVENIO R

- The new intuitive FTIR R&D Spectrometer

Innovation with Integrity

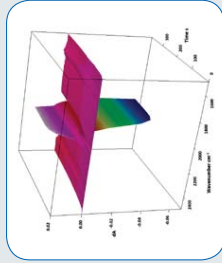
FTIR

# Application Examples

INVENIO R represents the entry level of Bruker's R&D FTIR spectrometers. INVENIO, as the name implies, will accompany the users to "invent" and "discover" in demanding analytical and R&D application fields. The innovative technology, intelligent and elegant design set standards for the next generation of FTIR spectrometers. The new optical beam path provides excellent SNR (signal-to-noise ratio), broad spectral range covering FIR to UV/VIS and highest flexibility for sophisticated experimental set-ups. The optional integrated touch panel enables easy work flow and comfortable operation. The unique and pioneering MultiTect™ detector technology supports up to 5 fully automated room temperature detectors. Together with the further available DigiTect™ detector position and the Transit™ channel for quick MIR measurements, INVENIO can be equipped with 7 automated internal detectors to make your daily work more enjoyable.

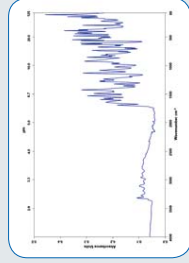


## Rapid Scan Combined with Spectroelectrochemistry



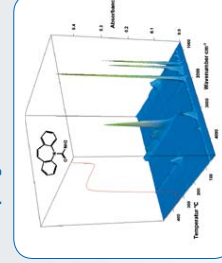
The 3D plot shows the oxidation of a ferrocyanide solution at potentials ranging from -0.3 V to 0.8 V. The change of the two characteristic bands during the whole oxidation process from getting started until equilibrium has been recorded with rapid scan, which enables a temporal resolution of better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

## Bruker FM Spectrum



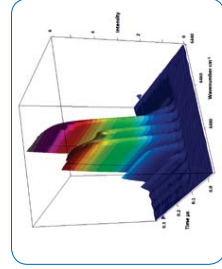
Sulfathiazole measured with INVENIO using Platinum Diamond ATR, standard internal IR source and the ultra-wide range BRUKER FM optical components from 4000  $\text{cm}^{-1}$  to 80  $\text{cm}^{-1}$  in a single step measurement without any gap.

## TGA Coupling



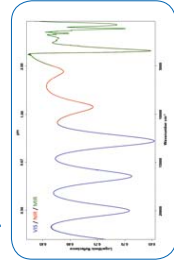
The OPUS 3D plot shows the thermal decomposition of carbamazepine up to 500°C. The products have been identified with the help of a spectra library and the spectrum search function in OPUS software to be acetone at around 62°C, isocyanic acid after 230°C and ammonia from 445°C on. The example demonstrates that a TGA-FTIR coupling is well suited to follow the complete decomposition steps of a pharmaceutical active agent.

## Step Scan TRS



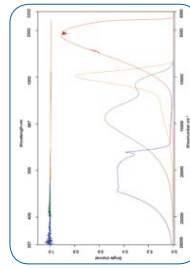
The OPUS 3D plot shows the switch-on of a MIR laser diode within 100 ns. The matchless temporal resolution in ns range is achievable independently of the high spectral resolution of 2  $\text{cm}^{-1}$  to clearly resolve all modes of the laser emission.

## Hemispherical Reflectance



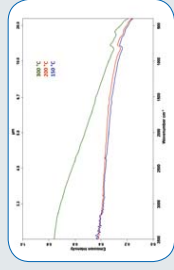
The above total reflectance spectrum of a coated glass mirror was measured by using two integrating spheres. The perfect fit of three different spectral ranges from ca. 23000  $\text{cm}^{-1}$  to 400  $\text{cm}^{-1}$  was achieved by automatic switching of two sources, two different types of beamsplitters as well as three detectors. The interference in the visible range can be used to determine the thickness of the coating on top of the mirror surface.

## Visible Spectral Range



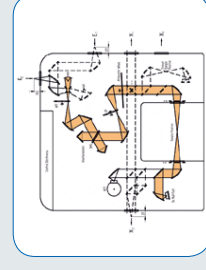
Background single beam spectra and 100% lines measured in the UV/VIS and near IR ranges using 8  $\text{cm}^{-1}$  spectral resolution and different aperture sizes. The internal near IR source, the NIR/VIS/UV broad band beamsplitter as well as three MultiTect™ detectors have been used for maximum short wavelength efficiency.

## Emission Studies

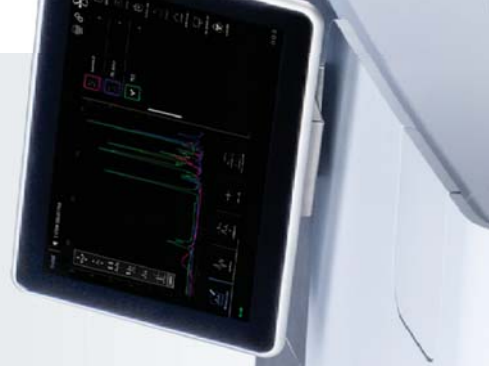


Emittance measurement above room temperature are e.g. of interest for the characterization of absorber material used for solar thermal power plants. The above spectra show a coated copper surface measured at different elevated temperatures using the emission adaptor AS40 mounted at one of the input beam ports of the INVENIO and the standard room temperature detector.

## Multiple input/output ports



The INVENIO offers outstanding flexibility. As shown in the simplified optical diagram, two beam exit ports on the right, one beam exit port on the left and two beam input ports on the right and rear side are available. A fourth exit port is available on request. This allows for e.g. simultaneous connection of external sources, the RAM II FT-Raman module, a fiber optics coupling unit and the HYPERION microscope.



# Features

- Optimized footprint for laboratory benches
- Sealed and desiccated optics bench, optionally purgeable
- RockSolid™ based permanently aligned and wear-free interferometer for easy beamsplitter change
- 3 exit and 2 input beam ports software selectable, fourth exit port available on request
- OPUS software for operation and evaluation
- Integrated touch panel option with dedicated OPUS-TOUCH R&D software for user friendly handling
- Elegant LED light bar indicating instrument status
- Innovative 5x MultiTect™ detector technology
- User exchangeable DigiTect™ detector slot
- Transit™ Channel with board level MIR DTGS detector for quick transmittance results
- Fully digitized signal processing using dual channel 24-bit dynamic range ADC
- BRUKER FM technology covering 6000 cm<sup>-1</sup> to 80 cm<sup>-1</sup> in one single measurement
- Easy upgrade for near IR, far IR and UV/VIS spectral ranges
- Superior Rapid Scan, Slow Scan and Step Scan performance for modulated and time resolved spectroscopy
- Compatible with all VERTEX accessories and external modules
- Optional direct emission beam path bypassing the sample compartment
- Sample compartment cover can be removed and attached within 3 s

## Spectral Resolution

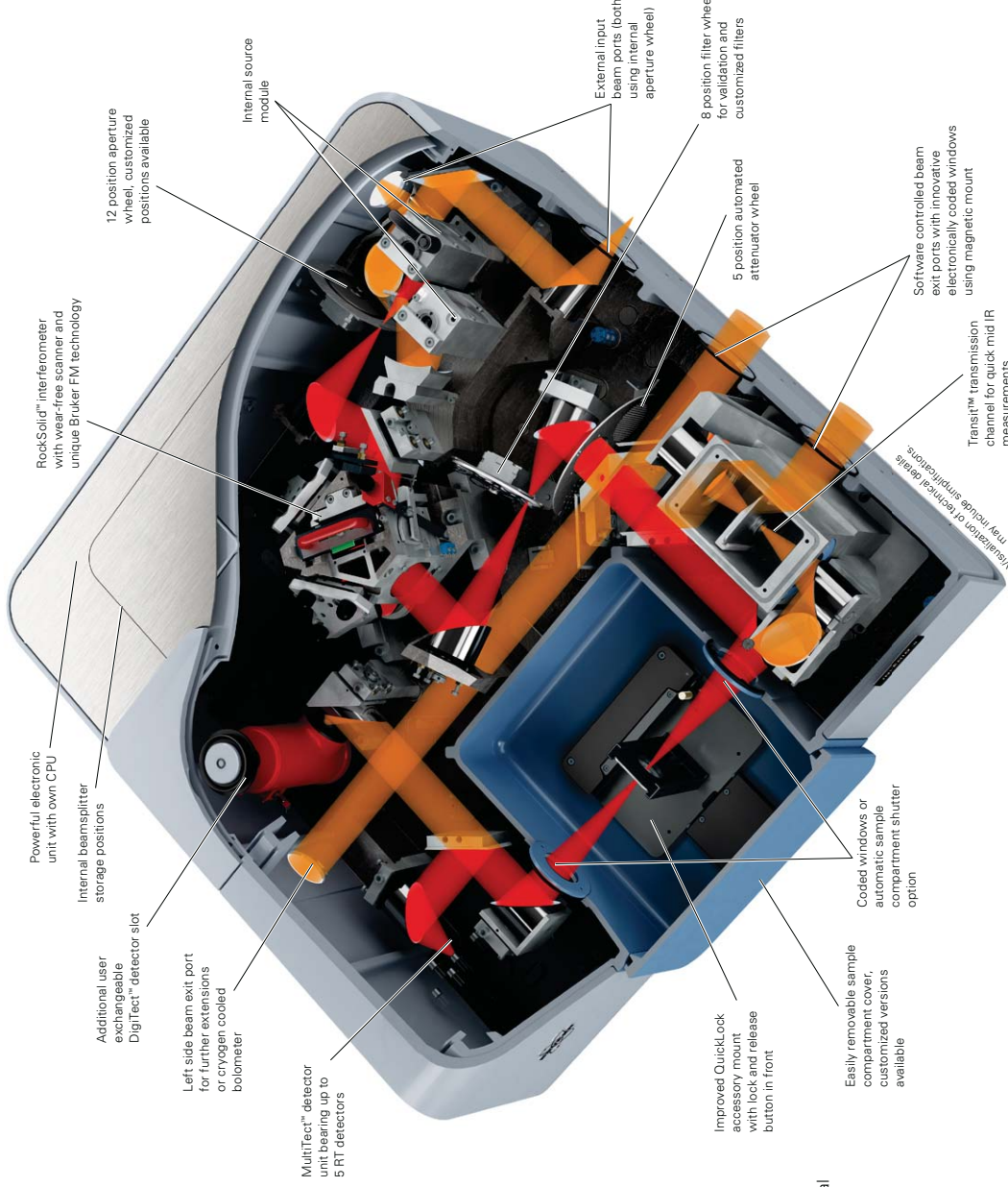
INVENIO's spectral resolution of better than 0.16 cm<sup>-1</sup> fulfills the requirements for almost any measurement. No matter if condensed phase samples such as solids and liquids, or low temperature crystalline samples, or even gaseous samples, INVENIO can handle them.

## Spectral Range Extension

INVENIO R can be optionally equipped with light sources, numerous beamsplitters and detectors to cover the entire spectral range from 15 cm<sup>-1</sup> to 28,000 cm<sup>-1</sup> from the very far IR region, through the mid and near IR to the visible and ultraviolet region. Thanks to the permanently aligned RockSolid™ interferometer, the unique MultiTect™ detector technology, the multiple internal and external source positions and the optics prepared for multiple spectral ranges, changing spectral range is a very easy task.

## Unique Bruker FM Technology

The Bruker FM far and mid IR technology includes the unique ultra-wide range beamsplitter and the wide range DLATGS detector. In one single measurement, without any change of optical components, the complete far and mid IR spectral range is accessible. To cover the broad range from 6000 cm<sup>-1</sup> to 80 cm<sup>-1</sup> the standard internal IR source combined with the FM components is completely sufficient.



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



MultiTect™ detector unit with up to 5 software controlled RT or TE stabilized detectors.



Additional DigiTect™ detector slot for liquid N<sub>2</sub> cooled, fast, high gain and other detectors.



Permanently aligned interferometer and internal BMS storage positions for easy and reliable BMS exchange.



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



Various external accessories, such as the TGA module, can be coupled to INVENIO.

# • INVENIO R

## Integrated Touch Panel

The integrated touch panel is optionally available, to handle R&D standard tasks. The touch panel cannot only be moved left and right but also be tilted along two axes. A dedicated OPUS-TOUCH R&D software is installed in the panel PC for simplified workflow and intuitive operation. In case of high-end R&D applications a desktop PC can also be connected.

## 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. The signal is directly digitized in place by a dual-channel ADC with 24-bit dynamic range. An additional DigiTect™ user exchangeable detector position for MCTs or other special detectors is available.

## Transit™ Measurement Channel

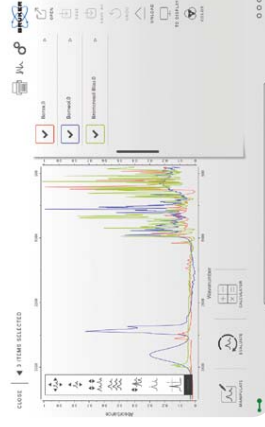
INVENIO can be optionally configured with a second transmission channel for fast and convenient mid IR measurements, such that bulky research setups in the main compartment don't have to be removed. Pellet holders, a magnetic holder for films, clamp holders for different kinds of flat samples and most 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 novel 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.



Homescreen of TOUCH R&D software (dark user theme).



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

## Next Generation Intelligent R&D Spectrometer

The innovative instrument design of INVENIO R includes many 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 new generation electronics unit with its own CPU is very powerful and provides many future options. Furthermore, the optics of INVENIO R is ready prepared for multiple spectral range upgrades, such that purchase of the corresponding optical components (source, BMS and detectors) completes a spectral range extension. Altogether, INVENIO sets a milestone for next generation intelligent R&D FTIR spectrometers.

# • External Accessories

## 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 or voluminous for the sample compartment, or in case more than one application should be carried out alternately with one spectrometer, or simply to keep the internal sample compartment free for more routine like measurements, external accessories and modules are available. INVENIO has 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<sup>-1</sup>. 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.



## Hyphenated Techniques

The coupling of INVENIO with a Thermogravimetric Analysis (TGA) system delivers substantial information in addition. Coupling with FTIR is the ideal solution to simultaneously identify the gases released during a TGA run. TG-FTIR offers fast and accurate results on material behavior under variation of temperature and atmosphere.

## 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.

## Photoluminescence (PL) Module

The PL II photoluminescence module allows to analyze e.g. compound semiconductor material at room or low temperature. The PL II module is available either with visible (532 nm) or near IR (1064 nm) internal excitation lasers. Furthermore, an optional laser input port allows to feed in external customer lasers.



## Polarization Modulation Accessory

With dual channel ADC technology and integrated demodulator in the powerful electronics unit the INVENIO offers fully digitized signal processing. This ensures outstanding performance for double modulation techniques utilizing a Photoelastic Modulator (PEM), such as Photoelastic Modulation Infrared Reflection Absorption Spectroscopy (PM-IRRAS) for measuring ultra-thin layers and Vibrational Circular Dichroism (VCD) of chiral molecules.



## • 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 wizard, 3D data visualization, and Quality Control Wizard. The OPUS-TOUCH Software is optimally adapted for the integrated touchscreen of INVENIO. It has 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 users 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 setting.

### 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

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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

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