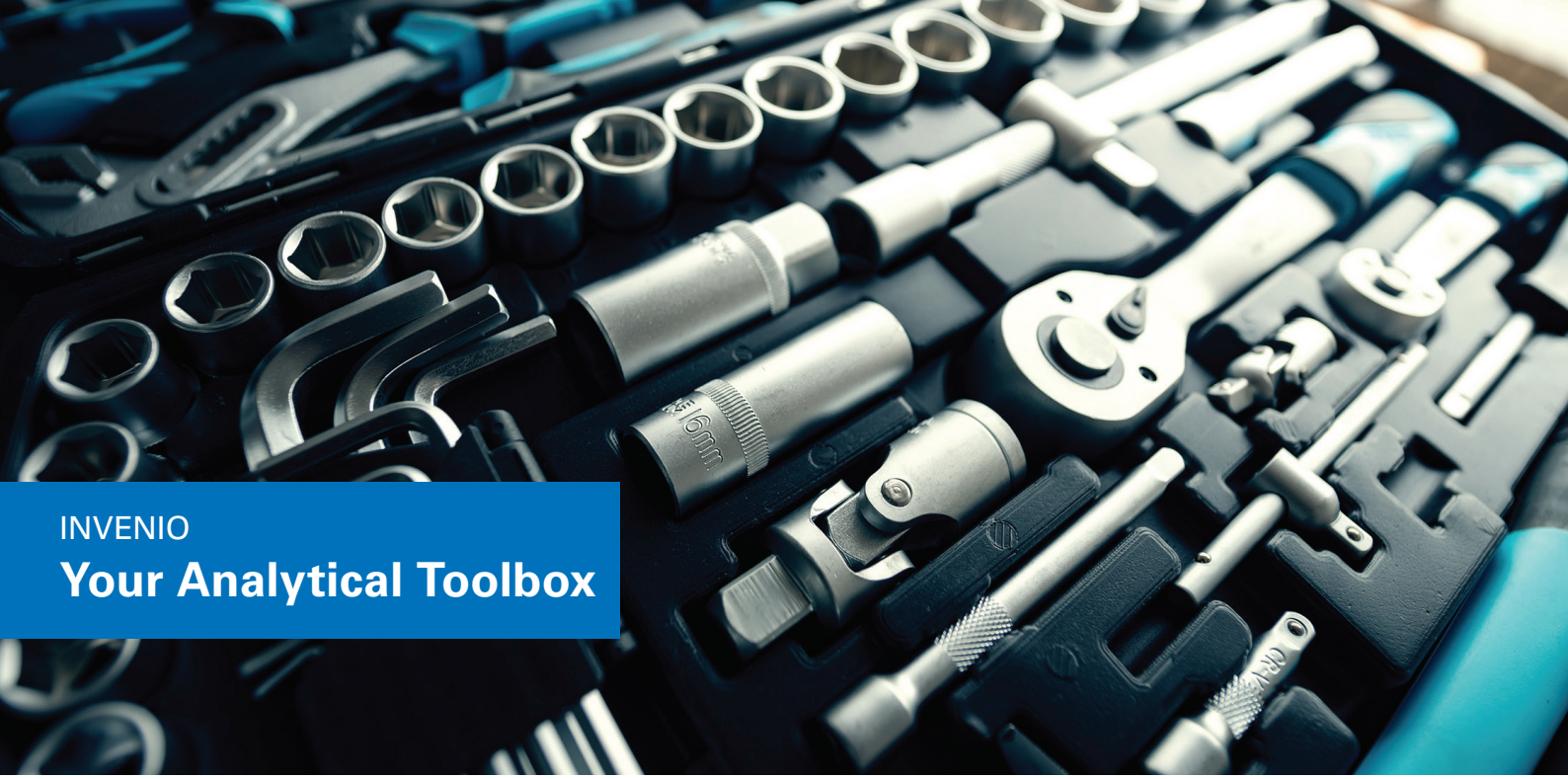
BRUKER

FT-IR SPECTROSCOPY

INVENIO

The Analytical FT-IR Toolbox. Pick. Upgrade. Evolve.

Innovation with Integrity



INVENIO

Your Analytical Toolbox

The Right Tool at Hand

The INVENIO is an FT-IR toolbox – and this analogy fits like a glove. Just think about your toolbox at home. The INVENIO can be your highly productive analytical tool or a powerful multispectral workstation as well as everything in between. It's your choice.

PICK

Select the right tools for the right job for your toolbox and get started.

UPGRADE

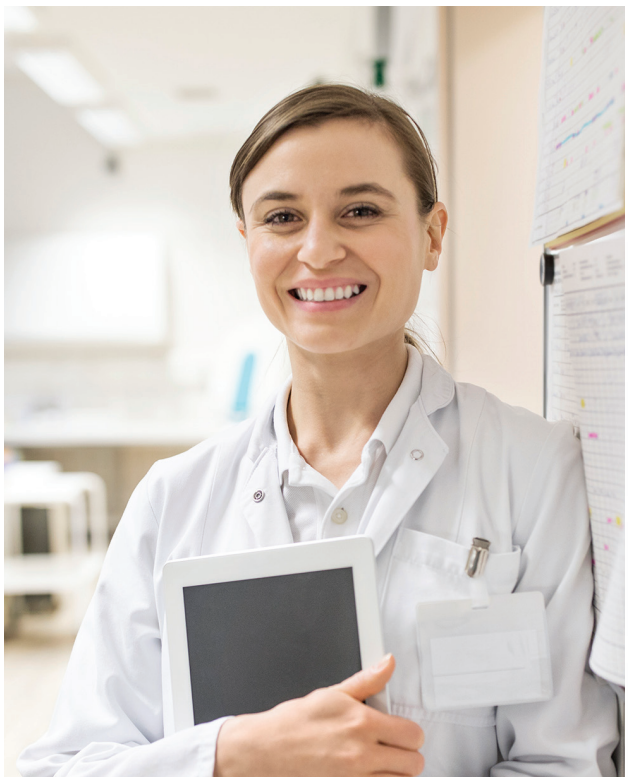
With a change of your job, you need new tools. Just add and use them.

EVOLVE

As your job demands more from you, you can demand more from INVENIO.

Your Benefits

- ✓ The most precise, trouble-free and fastest components are used to provide measurement data with the desired accuracy, repeatability and **performance** (e.g. INTEGRAL™ interferometer).
- ✓ With unlimited upgrade options you can extend the system's **functionality** and add new capabilities. Now or later, but always at your convenience (e.g. through upgrades at customer).
- ✓ The INVENIO boosts **productivity** in completing any analytical tasks with on-the-fly measurement channel selection and a straightforward user experience (e.g. up to 7 detectors).
- ✓ INVENIO is built to provide maximum **robustness**, effectively compensating any unexpected interferences during the measurement caused by the environment (e.g. RockSolid™ interferometer).
- ✓ Operational errors are entirely avoided by using intelligent software and hardware monitoring tools, increasing the **fault tolerance** within your FT-IR tool chain (e.g. OPUS TOUCH).



Performance

Functionality

Productivity

Robustness

Fault Tolerance

Markets and Applications

Research and Development

Core Demand

Performance

Functionality

Do science like never before

Explore new frontiers in your scientific research. The INVENIO provides you with the **performance** and **functionality** you need to excel.

Essential Features

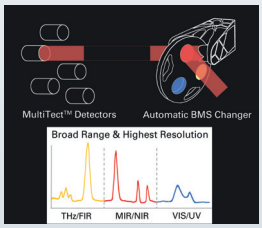
Up to three output and two input beam ports are offered to **enhance the functional scope** of INVENIO. This enables a multitude of measurements techniques such as photoluminescence, FT-Raman, IR thermogravimetry or microscopy.

DigiTect™ provides you with an additional slot for e.g. liquid-N_2 cooled and NIR detectors. These enable greater bandwidths, faster response times and thus provide greater **performance and functionality.**

Upgrades and Extensions*

Step Scan, **Rapid Scan** and **interleaved TRS** allow for time-resolved spectroscopy down to the ns timescale. Use the gained fundamental insights beneficially to raise your products to a new level.

The Integral interferometer features an automated 3x beam splitter changer. **MultiTect™ detector** technology enables automatic control of up to 5 RT detectors. Together with DigiTect and Transit options **up to 7 internal detectors** are available. Combining Integral and MultiTect allows for single-click analyses of the spectral range from **FIR to VIS/UV**.



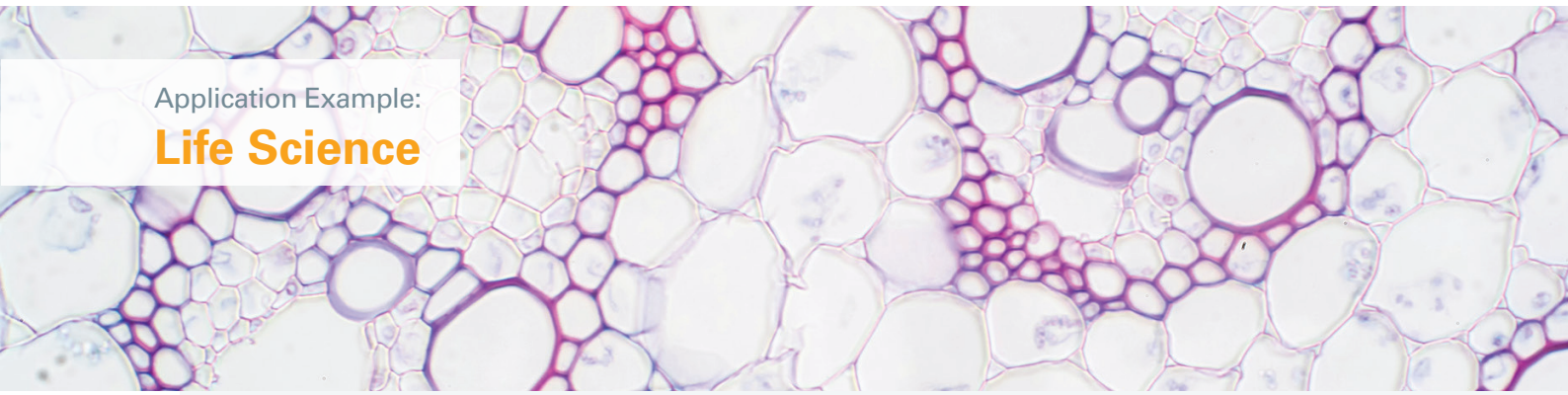
**All above features are also available as in-field upgrades.*

Application Example:

Academia

INVENIO is the right choice whether you want to investigate new materials, determine causal relationships or understand physical or chemical properties of complex systems. Profit from the unrivaled performance INVENIO offers and use extensions and upgrades to gain new insights into your research topics.

- Identification of Chemicals
- In-situ reaction kinetics, e.g. electrochemichal research or catalysis
- Emission spectroscopy



Application Example:

Life Science

As it enables to increase the quality of life of humans, LifeScience is a fast and sustainable growing industry. INVENIO assists in driving your innovations to develop profitable products and to satisfy society's basic need for health.

- Secondary structure determination and stability analysis of proteins
- Quality control of proteins, vaccines or cell media
- Drugs formulation development
- Investigation of particle formation in vaccines and drugs

Application Example:

Material Research

Biomedical materials, thin-films, polymers or semiconductors are the driving force for innovative products and sustainable business growth. Use INVENIO's functionality to push the performance and versatility of materials to a new level.

- Thermal stability analysis for e.g. Polymers and Pharmaceuticals
- Thin layer development for e.g. Optical coating, passivation or protection
- Charge carrier analysis and band structure investigations
- Low temperature solid state physics such as superconductivity

Markets and Applications

Analytical Service

Core Demand

Robustness

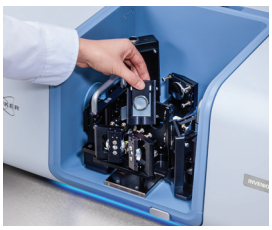
Functionality

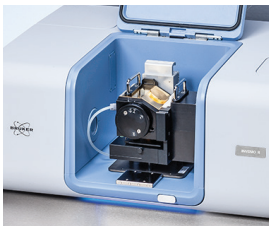
Always prepared for new customers

Become the most **reliable and versatile partner** of your customers by serving any request you get. The **highest build quality** of the INVENIO platform guarantees repeatable measurements over the entire lifetime.

Essential Features

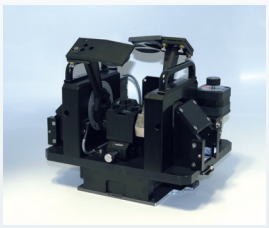
The **RockSolid™ Interferometer** is wear free and offers unrivaled reliability and **robustness** by utilizing cube-corner mirrors and Bruker FM option for simultaneous MIR/FIR measurements.





QuickLock, with electrical interface monitoring and its frontal one-button locking and release mechanism, ensures **faultless exchange** and **robust operation** of accessories. The automated parameter setting and verification of system performance guarantees optimal working conditions.

Upgrades and Extensions*



Let the **functionality** of INVENIO keep pace with the demands of your customers through adding new capabilities by a broad range of accessories and external modules from Bruker. Upgrades to improve core specifications of INVENIO at a later stage are available.

Double your **productivity** with the **Transit Platinum ATR**. It allows to perform routine measurements in ATR configuration in a parallel measurement channel while not affecting other functionalities of your setup.

**All above features are also available as in-field upgrades.*

Application Example:

CRO | CTOs

Contractual Research and Testing Organizations (CROs and CTOs) handle development and analysis tasks from their clients. The greater the functionality of their equipment, the more services can be offered. INVENIO is your reliable partner that grows with demands and allows you to extend your business.

- Incoming goods inspection
- Quality control of raw materials and failure analysis
- Identification and characterization of chemical substances

Application Example:

Environmental Testing

Improve quality of life by INVENIO's capabilities to analyze liquids, gases and solids for contamination, pollutants or hazardous material. Use INVENIO also to analyze the chemical and structural properties of minerals and gemstones.

- Identifying of microplastics
- Gas analysis of the atmosphere
- Classification and differentiation between polymorphs of minerals
- Oil pollution in water

Application Example:

Agriculture

INVENIO offers simple and effective testing solutions for the determination of nutritional elements in agricultural samples. Testing is carried out with speed, accuracy, precision and cost-efficiency. This allows to maximize production yield by e.g. fertilizer management and to deliver health-safe goods to food industry.

- Optimizing fertilizer management by soil analysis
- Identification of contaminations
- Analysis of chemical and physical parameters

Markets and Applications

Quality Control Labs

Core Demand

Productivity

Fault Tolerance

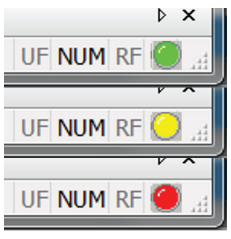
Safety and reliability come first

INVENIO's platform approach makes it easy to meet quality requirements without compromising on **productivity**. The simple, **fault-tolerant operation** together with its robust design makes INVENIO your dependable workbench.

Essential Features

CenterGlow™ is a Bruker technology that manages the source's wearout and therefore assures optimum performance and enables **fault-free operation**.

PermaSure™ monitors device configuration and steady self-testing. **PerformanceGuard** ensures optimal performance through monitoring of all mechanical and electrical components. The status of the system is shown by an intuitive three-color display. Clicking on the display gives full details of the components used together with access to the corresponding validation tests. Together these features guarantee non-stop operation for **productivity.**



Upgrades and Extensions*

If throughput needs to be increased, the **transit channel** can be added by an upgrade. This provides a parallel FT-IR measurement channel that allows your **productivity** to scale with your demands.

OPUS TOUCH SW and the **tailored touch panel PC** minimize operator efforts to just a few screen taps, while functionality is kept uncompromised. Customization and profound user management guarantee high **fault-tolerance**.

**All above features are also available as in-field upgrades.*

Application Example:
Pharma

The pharmaceutical industry has been using FT-IR spectroscopy as a standard tool for QC/QA applications for a long time. INVENIO increases your productivity, cost-efficiency and quality for your day-to-day tasks by its fault-tolerant and robust design.

- Data Security, Integrity, Traceability, 21 CFR Part 11, cGMP, cGLP, and International Pharmacopeia compliance and beyond
- Incoming goods inspection and Identification of unknown material
- Testing of excipients, intermediates and final goods

Application Example:
Industrial

Today's industrial climate demands that your business meets more stringent standards than ever before. You should not expect anything less from your analytical and quality control tools. INVENIO will help to drive productivity and quality to meet tomorrow's demands.

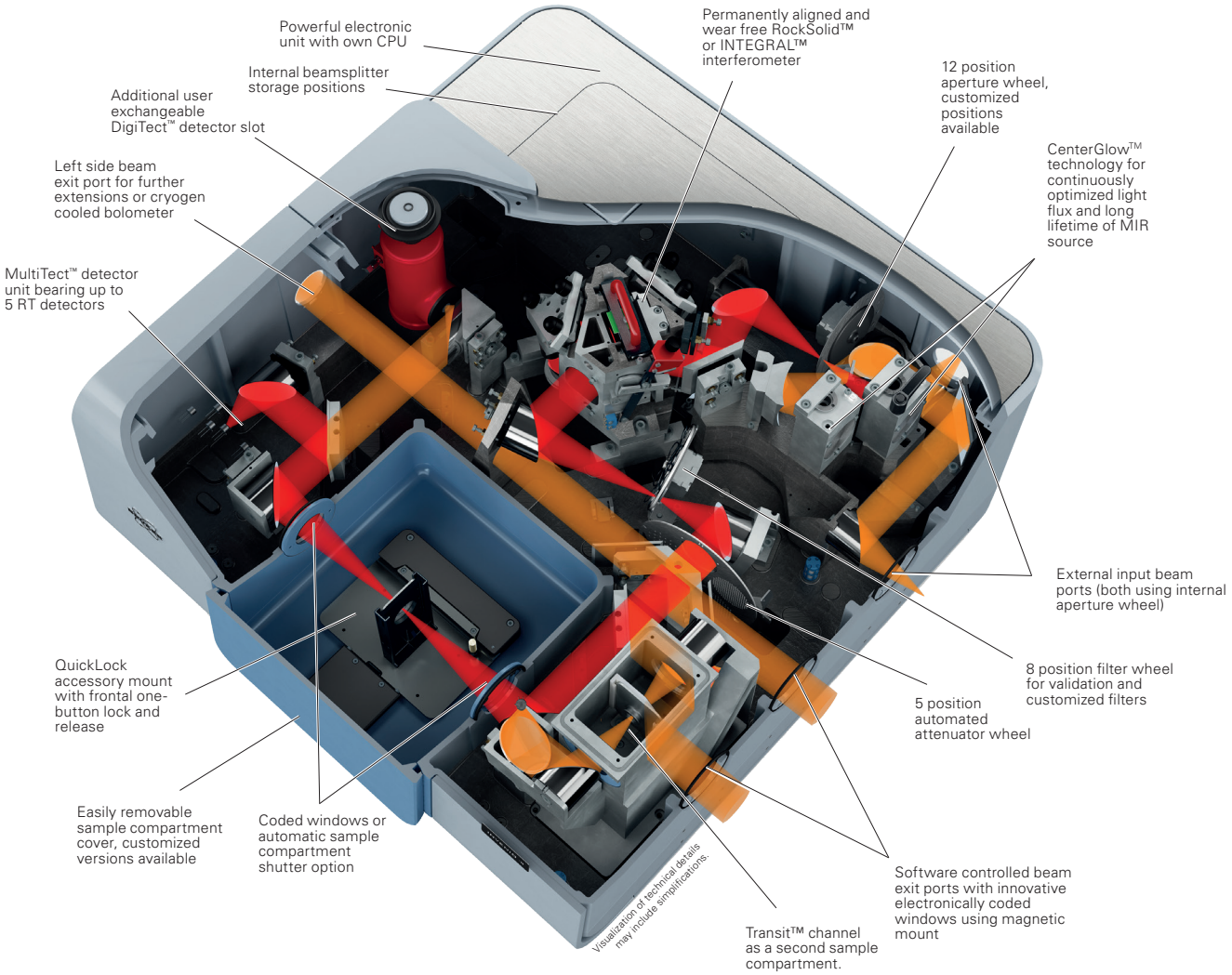
- Incoming goods inspection for many industries, e.g. Chemical or Polymer
- Semiconductor industry e.g. Impurity analysis in silicon wafers
- Quality check of lubricating and mineral oils, asphalt/bitumen analysis

Application Example:
Polymer

Polymers can be designed as desired in terms of their characteristic properties. They allow us to reduce cost, size and weight of many industrial goods. Also, they are indispensable in the food industry, as they help to keep food fresh and thus prevent waste. Choose INVENIO to cover the entire spectrum of tasks.

- Quality control of raw materials and failure analysis
- Process monitoring and investigation of reaction dynamics
- Thermal stability analysis and process optimization

INVENIO



Basic Features

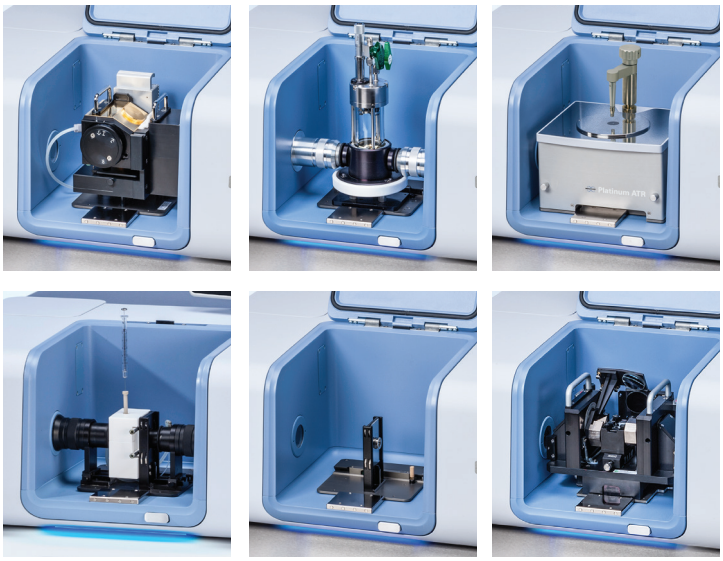
- Permanently aligned and wear-free RockSolid™ interferometer
- Electronic recognition and monitoring of all accessories and central components
- Sealed and desiccated optics bench, optionally purgeable
- Footprint optimized for laboratory benches
- OPUS is the ideal software solution for vibrational spectroscopy - precise, structured, secure
- In-field upgradability for core specifications of spectrometer

Optional Features

- BRUKER FM for covering 6000 to 80 cm^{-1} in one single measurement, for RockSolid™ interferometer
- 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
- Integrated Touch-PC with dedicated OPUS-TOUCH software for productive IR-analysis
- Integrated ATR accessory for easy cleaning
- Transit™ channel: Second sample compartment for the parallel availability of two setups
- Automated instrument tests (OQ/PQ) and complete compliance to pharma regulations
- Rapid Scan, Slow Scan and Step Scan technique for modulated and time resolved spectroscopy
- 3 exit and 2 input beam ports software selectable

Lots of Possibilities

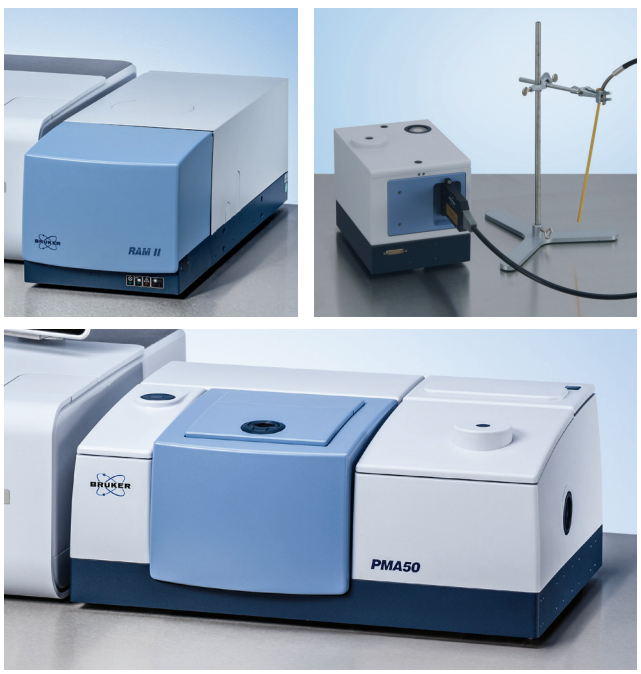
- ATR: diamond, ZnSe, GE crystals, single- and multibounce, heating option
- Reflectance: specular and diffuse
- Transmittance: focused and parallel beam, condensers, pellet and film holders, horizontal and vertical orientation
- Automatic sample changer units
- Liquid cells: demountable, fixed and variable, various path lengths, heating option
- Gas cells: variable and fixed path lengths, heating option
- Photoacoustic cells
- Cryostats: LN_2, LHe or closed cycle cooling



Accessory for main sample compartment.

- Microscope: HYPERION II for IR laser imaging and FT-IR microscopy with FPA or single pixel detector
- High-throughput screening plate reader HTS-XT
- Thermogravimetric (TG) FT-IR analysis
- Vibrational Circular Dichroism and polarization dependent transflection with PMA 50
- Additional external sample compartment XSA

- Fiber optic coupling unit with fiber probe for solids and liquids
- FT-Raman RAM II
- Photoluminescence PL II
- External integrating spheres
- Air water reflection unit
- Gas chromatography
- Liquid auto sampler



External accessories.

Hyphenated systems:
top: TG-IR coupling bottom: HYPERION (legacy device) microscope and high-througput screening extension HTS-XT.

INVENIO Core Specification

Specification	Basic	Top-End
Signal-to-Noise	60'000:1 1 min sample measurement, 4 cm^{-1}, peak-to-peak	
Wavenumber Precision @ 1,554 cm^{-1}	0.0005 cm^{-1} standard deviation of 10 repeated measurements	
Spectral Range	8'000 to 340 cm^{-1}	28'000 to 15 cm^{-1}
Spectral Resolution	0.4 cm^{-1}	0.085 cm^{-1}
Wavenumber Accuracy @1,554 cm^{-1}	0.01 cm^{-1}	0.005 cm^{-1}
Temporal Resolution @ 16 cm^{-1} Spectral Resolution	Up to 25 spectra per second	Up to 70 spectra per second with RapidScan™ option
Temporal Resolution with StepScan™ Option	-	Up to 4 ns temporal resolution with transient recorder board or 6 µs using internal ADC.
Interferometer	RockSolid™: wear-free, insensitive to mirror tilt, mechanical vibrations and temperature variation.	INTEGRAL™: patented high precision interferometer incl. automated 3x beam splitter changer.
Beamsplitters	KBr	Up to 3 beam splitters equippable to cover full range from FIR to UV. Automated beam splitter exchange.
Detectors	Temperature controlled DTGS detector.	Up to 7 detectors in parallel to cover full range from FIR to UV. Various bandwidth and gain options available.
Light Sources	CenterGlow™ MIR Globar for stable light flux.	2nd internal and two external sources equippable to cover full range from FIR to UV range.

Laser class 1 product.

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Bruker Optics is ISO 9001, ISO 13485, ISO 14001 and ISO 50001 certified.

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