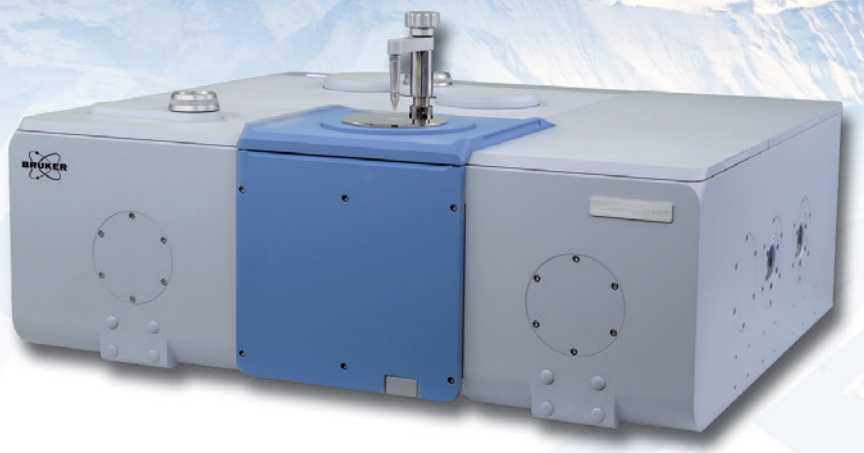
BRUKER

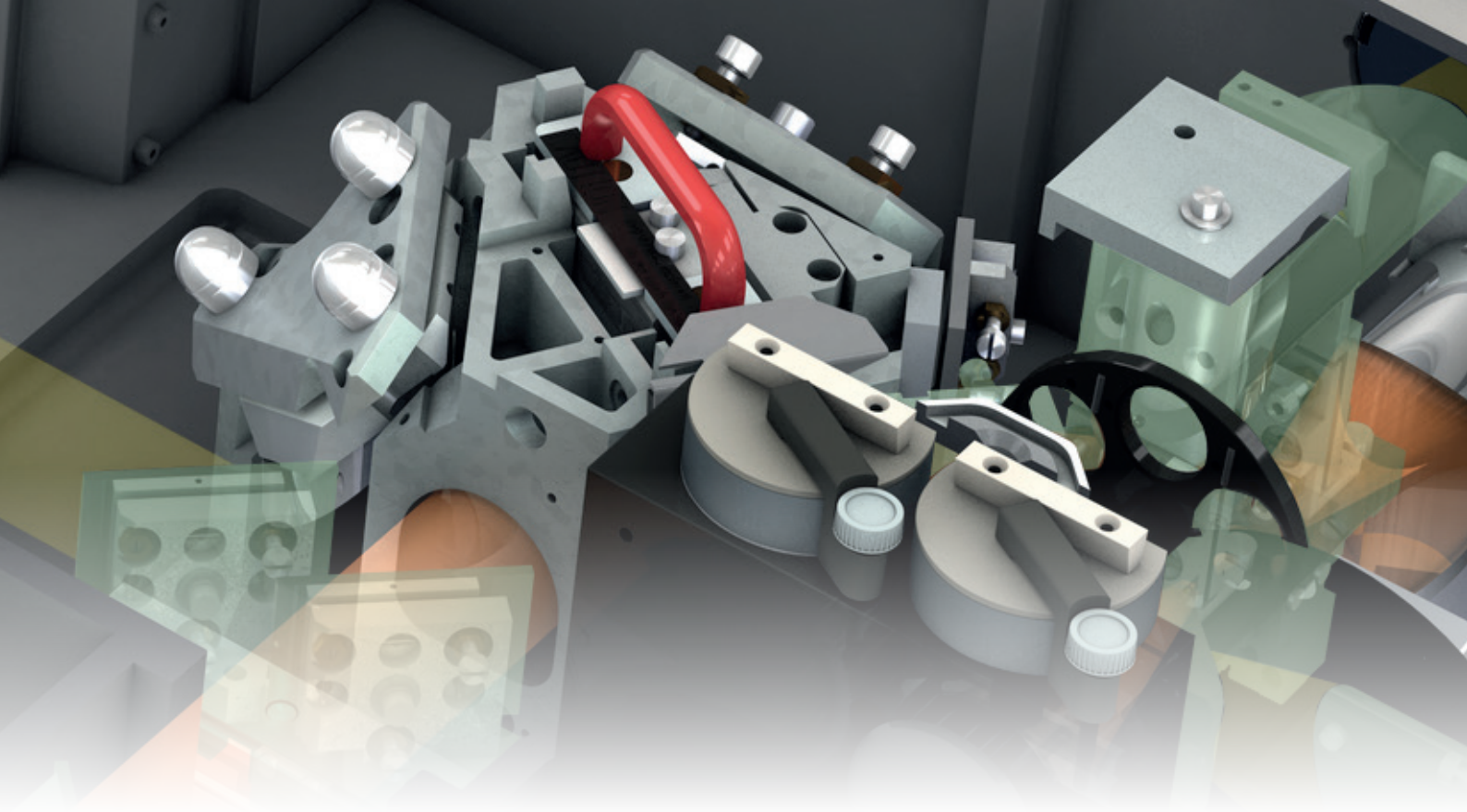


FT-IR TECHNOLOGY

BRUKER FM

Fourier Transform FIR-MIR Research Functionality

Innovation with Integrity



In 2014, Bruker introduced the world's first FT-IR spectrometer technology capable of covering the FIR/THz and MIR in a single scan for research spectrometers utilizing RockSolid™ interferometer. No exchange of optical components or merging of spectra is needed to obtain data from the FIR/THz through the MIR. This innovative and unique development realized the dream of many spectroscopists since the introduction of FT-IR technique during the 70's of the last century. This new BRUKER FM technology once again demonstrates Bruker's leadership and expertise in continuing to improve the use of infrared analysis and to meet new challenges in various application fields.

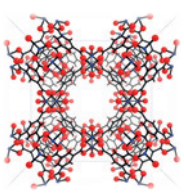
Additional Values of BRUKER FM

- Full mid and far IR spectrum in one go
- Enormous time savings due to just one single measurement
- Acquisition of the complete molecular vibrational spectral information
- No break of purge or vacuum conditions for optical component exchange
- No danger of touching or damaging expensive and sensitive optical components
- No need for complex and demanding exchange devices
- All optical components are insensitive to humidity

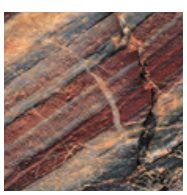
BRUKER FM Main Application Fields

- Inorganic and organometallic chemistry
- Semiconductor development and research
- Studies on polymer filler material and color pigments
- Geological and rock analysis
- Pharmaceutical fillers and active agent measurements
- Polymorphs differentiation
- Crystallinity identification
- Product and material comparison
- Low temperature matrix isolation spectroscopy

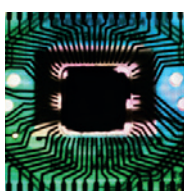
Pharma 

Organometallic chemistry 

Polymer additives 

Rock analysis 

Crystallinity 

Semiconductor 

"A Dream comes True!"

MIR-FIR Spectral Range

The MIR spectral range is traditionally defined by a spectral range from 4000 cm^{-1} to 400 cm^{-1}, mainly because the materials of the applied optical components are limited to this range. For example, the lower edge of a standard KBr beamsplitter is 400 cm^{-1}.

With the emergence of interdisciplinary research, molecular vibrational spectroscopy can no more be isolated from molecular rotational spectroscopy, the detection of overtones, Fermi resonance and lattice vibrations.

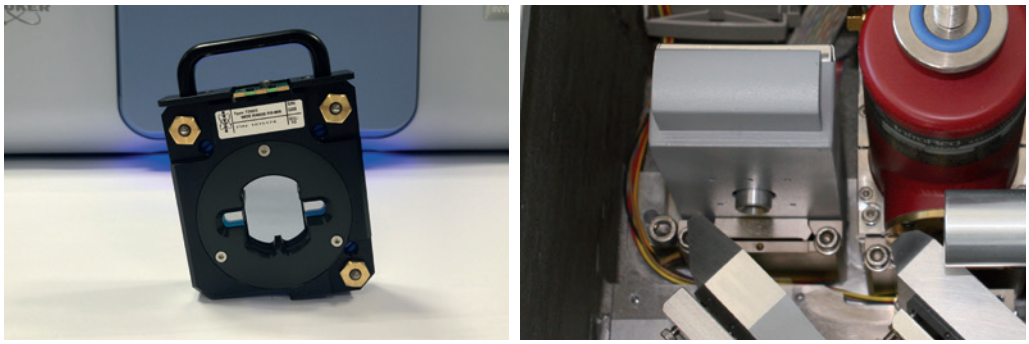


Fig. 1
Images of the broad band beamsplitter for INVENIO® R and the extended range detector in VERTEX 70v.

Therefore, a spectral range extension over the conventionally defined low MIR spectral range boundary is increasingly demanded. For example, for the characterization of organometallic complexes, semiconductor materials and polymer filler materials, the far IR spectral range must be collected in addition to the mid IR range. This means, the operator has to add or exchange different optical components to obtain data covering both spectral ranges. For example, using a VERTEX NEO R or an INVENIO® research spectrometer, the operator would have to replace the MIR KBr beamsplitter with a FIR multilayer or solid state beamsplitter, and insert the corresponding detector to measure in the far IR region from ca. 700 cm^{-1} down to 50 cm^{-1}. For the extension of the FIR/THz spectral range down to 10 cm^{-1} or even 5 cm^{-1}, a dedicated external water cooled Hg arc lamp and room temperature or liquid He cooled detector are required. In other words, to obtain all the spectral information in MIR and FIR/THz spectral ranges, manually exchange or the use of mechanical devices for automated exchange was inevitable.

As a result, higher investment and maintenance costs as well as demanding user operation significantly limited research work. The time was ripe for a revolution in the FT-IR analysis technique.

Comparison of INVENIO® Purge and VERTEX NEO R Vacuum Systems equipped with the Wide Range Components in the Far IR/THz Region

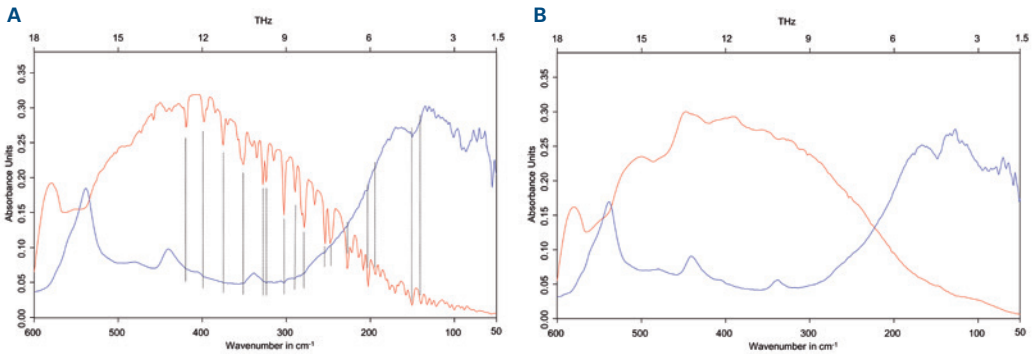


Fig. 2
A) Under excellent purge conditions, the INVENIO® R can achieve 50 cm^{-1}.
B) The VERTEX NEO R vacuum spectrometer provides virtually noise free FIR/THz spectra of a polymer composite. (red: single channel spectra; blue: absorbance spectra)

For already installed INVENIO® and VERTEX NEO R vacuum systems, BRUKER FM technology can be readily added.

Optical Components

In 2012, Bruker's innovative engineering team developed a unique ultra-wide range mid and far IR beamsplitter (T240/3) for VERTEX 70 series FT-IR spectrometers (see Bruker product note M143). It covers the full mid and far IR spectral range from 6,000 – 10 cm^{-1} for all common IR measurement techniques like transmittance, reflectance and ATR without the need for manual or automatic beamsplitter exchange. An improved version of the wide-range beamsplitter T240-T/3 with better SNR especially at 610 cm^{-1} is also available.

Then in 2014, Bruker introduced in a new extended range room temperature MIR-FIR/THz DLaTGS detector to cover the full IR range from above 12,000 cm^{-1} to ca. 20 cm^{-1} for the VERTEX instrument series (see Bruker product note M149).

In 2018, the next generation INVENIO® R entry-level R&D spectrometer has been established, and in 2025 the new VERTEX NEO high-end vacuum spectrometer was released. Both will also be available with the successful FM technology, cosisting of the ultra-wide range beamsplitter and the extended range DTGS detector.

The BRUKER FM components combined with existing IR sources make analysis of almost any sample in the FIR/THz and MIR using INVENIO® and VERTEX NEO R spectrometers quick and easy. For more information, please see Bruker application note M118.

BRUKER FM ATR Library for the Entire MIR-FIR Spectral Range

Together with BRUKER FM FIR/THz-MIR spectrometer, a smart FM ATR library for the complete mid and far IR spectral range has been announced (see Bruker application note M123 and product note S39). It greatly simplifies the spectral search and identification process, especially in the FIR/THz region. This library is the first of its kind to extend the lower limit of available spectral range from 400 cm^{-1} down to 30 cm^{-1}. With the powerful combination of the BRUKER FM and the new FM ATR library, new areas of research and development are readily accessible.

BRUKER FM Product Configuration

BRUKER FM exclusively available for the INVENIO® and VERTEX NEO R spectrometers makes the FT-IR dream of spectroscopists come true: Non-stop, no manual or automatic exchange of optical components, no need for subsequent spectra merge, covers entire MIR and FIR spectral range in one go. BRUKER FM can be customized in the following configuration packages:

Part No.	INVENIO R	VERTEX NEO R
W240(-T)/IR	6,000 - 130 cm^{-1}	
W240(-T)/IRD	6,000 - 80 cm^{-1}	
W240(-T)/BDV		6,000 - 50 cm^{-1}
with Q210/VN		4,500 - 20 cm^{-1}

BRUKER FM Example Spectra:

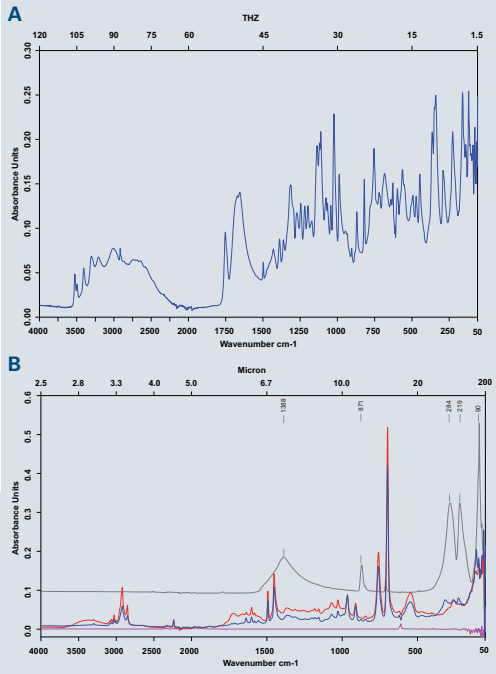


Fig. 3
A) An example spectrum of an active ingredient, ascorbic acid, collected with a VERTEX NEO R Vacuum ATR combination from 4,000 cm^{-1} to 50 cm^{-1}.
B) Acrylnitril-Butadien-Styrol-Copolymer (ABS) filled with $CaCO_3$ measured with purged INVENIO® using Platinum Diamond ATR, standard internal IR source and the BRUKER FM optical components from 6000 cm^{-1} to 80 cm^{-1} in a single step.

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

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