



BRUKER FM

- Fourier Transform FIR-MIR Research Functionality



In 2014, Bruker introduced the world's first FTIR 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 FTIR 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

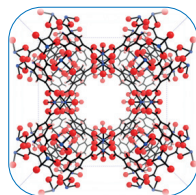
BRUKER FM Main Application Fields

- 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

"A dream comes true!"



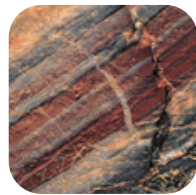
Pharma



Organometallic chemistry



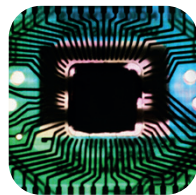
Polymer additives



Rock analysis



Crystallinity

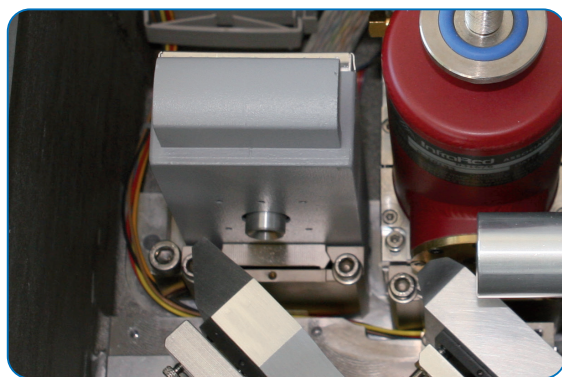
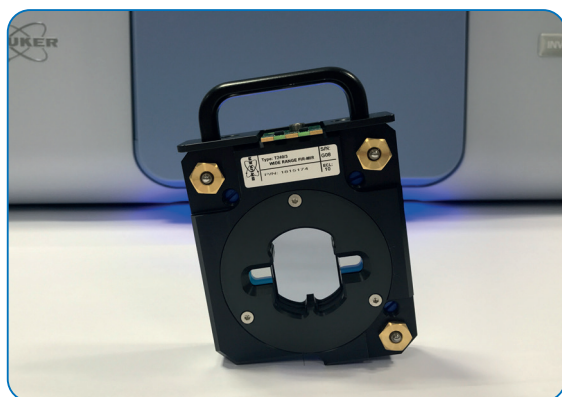


Semiconductor

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.



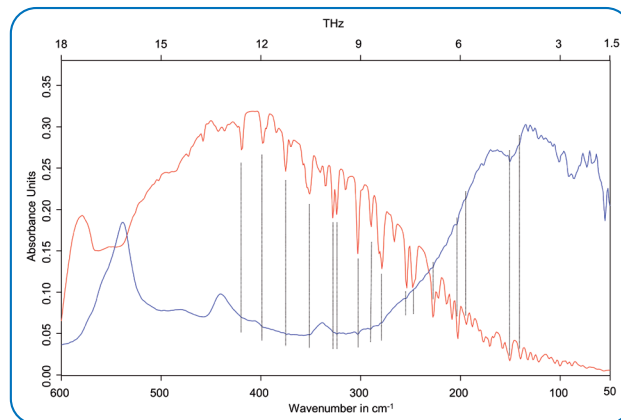
Images of the broad band beamsplitter for INVENIO® R and the extended range detector in VERTEX 70v.

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 series or an INVENIO® research spectrometer, the operator would have to replace the MIR KBr beamsplitter with a FIR

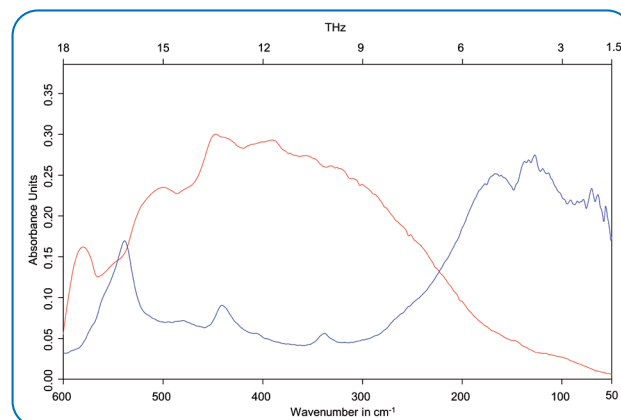
multilayer or solid state beamsplitter, and insert the corresponding detector to measure in the far IR region from ca. 700 cm^{-1} down to 50 cm^{-1} . For the extension of the FIR/THz spectral range down to 10 cm^{-1} or even 5 cm^{-1} , a dedicated external water cooled Hg arc lamp and room temperature 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 FTIR analysis technique.

Comparison of INVENIO® purge and VERTEX 70v vacuum systems equipped with the wide range components in the far IR/THz region



Under excellent purge conditions, the INVENIO® R can achieve 50 cm^{-1} .



The VERTEX 70v vacuum spectrometer provides virtually noise free FIR/THz spectra of a polymer composite. (red: single channel spectra; blue: absorbance spectra)

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 PN T240). 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 PN D201).

In 2018, the next generation INVENIO® R entry-level R&D spectrometer has been established, which will also be available with the successful FM technology, consisting 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 series spectrometers quick and easy. For more information, please see Bruker application note AN118.

BRUKER FM Product Configuration

BRUKER FM exclusively available for the INVENIO® and VERTEX 70v spectrometers makes the FTIR 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:

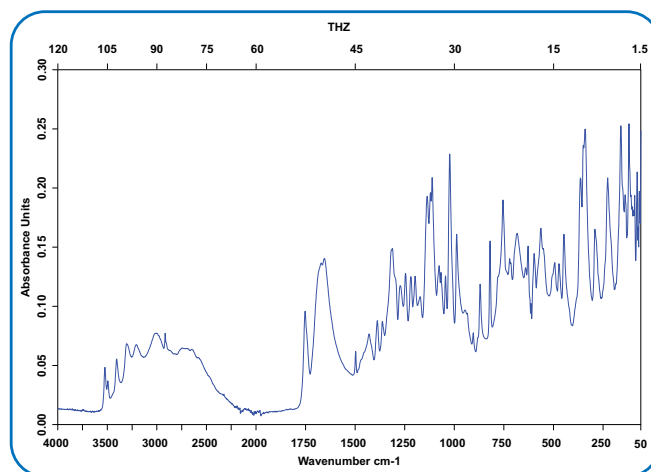
Part No.	INVENIO® R	VERTEX 70v
W240(-T)/IR	6,000 - 130 cm ⁻¹	
W240(-T)/IRD	6,000 - 80 cm ⁻¹	
W240(-T)/BDV		6,000 - 50 cm ⁻¹
with Q201/8V (ext. Hg source)		4,500 - 20 cm ⁻¹

For already installed INVENIO® and VERTEX 70v vacuum systems, BRUKER FM technology can be readily added.

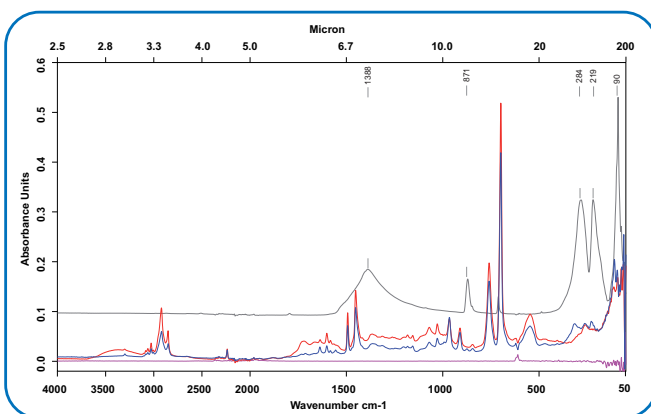
BRUKER FM ATR Library for the Entire MIR-FIR Spectral Range

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 AN 123 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 Example Spectra:



An example spectrum of an active ingredient, ascorbic acid, collected with a VERTEX 70v / Platinum ATR combination from 4,000 cm⁻¹ to 50 cm⁻¹.



Acrylnitril-Butadien-Styrol-Copolymer (ABS) filled with CaCO₃ 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.