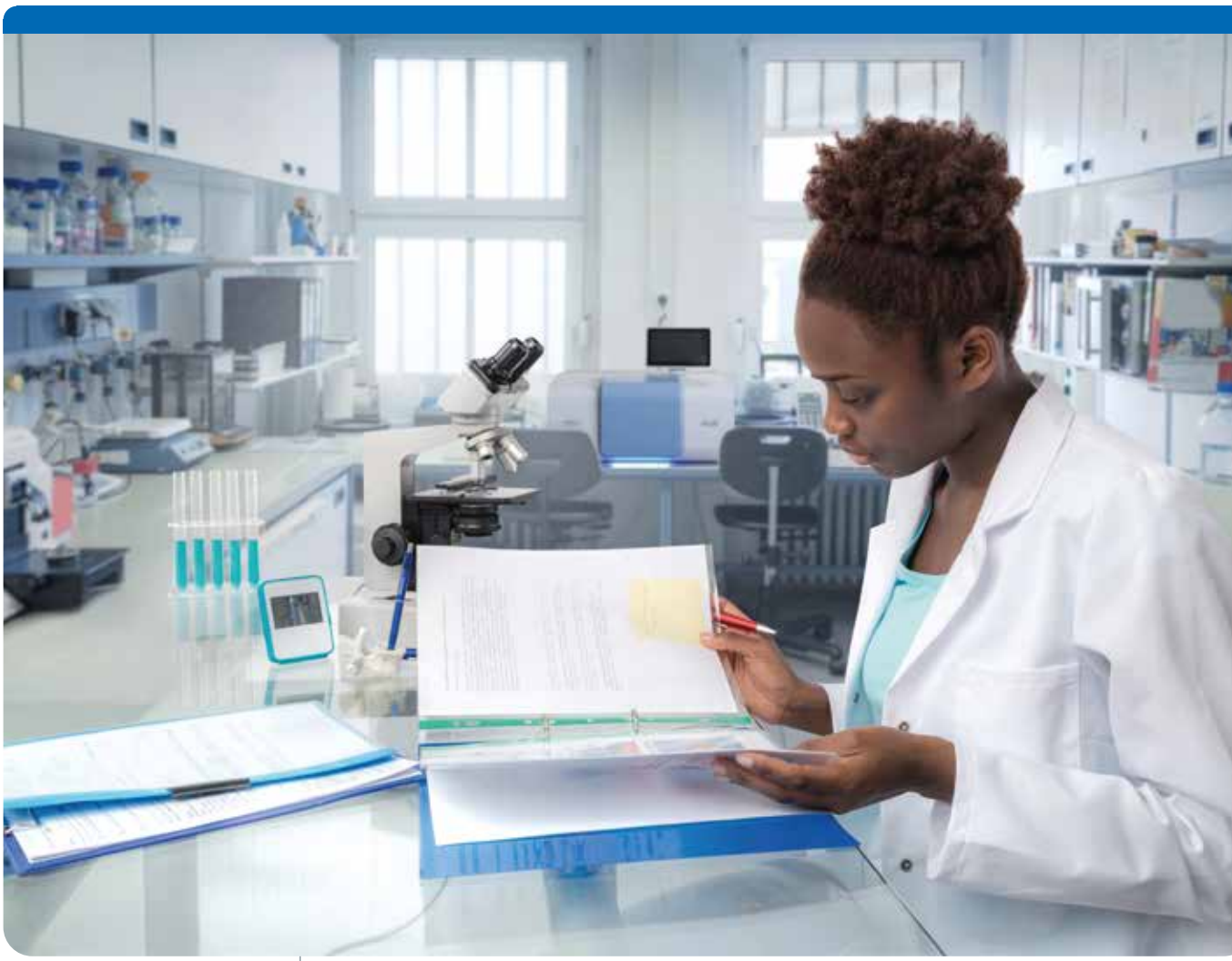
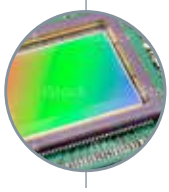


FT-IR in Academia

- Discovering Science like never Before



• Countless Possibilities
with FT-IR

Our world is moving and developing at a rate faster than ever, including science and research where the demand for results is at an increasing rate. Using FT-IR spectroscopy is one of the quickest and most straightforward methods to get information on your chemicals and materials.

Bruker is Deeply Rooted in Academia

Almost 50 years ago, our first FT-IR spectrometers were dedicated research systems, developed hand in hand with specialists who pioneered the field of infrared spectrometers.

We have preserved this pioneering spirit. This brochure presents various applications in research and development, always keeping the essential in mind. The users and their diversity.

Why use Infrared Spectroscopy ?

For many scientists, infrared spectroscopy (IR) is an everyday laboratory tool. In case you are not familiar with IR spectroscopy, the following words are addressed to you. IR spectroscopy is a true chameleon when it comes to obtaining molecular information. Infrared light excites molecular vibrations, which we in turn can interpret.

This enables us to learn more about the chemical composition of unknown samples, the course of chemical reactions and physical processes, the structure of matter, metabolism of cells, and much more. Infrared spectroscopy is a real all-rounder and can investigate almost any organic and inorganic compound in all states of matter.

• ALPHA II

Compact Benchtop System

Initially viewed with some skepticism, compact systems such as the ALPHA II have become the backbone of many science laboratories where basic chemical analysis is needed.

ENTRY LEVEL

• INVENIO

Analytical Workstation

Upgradable FT-IR platforms such as INVENIO, cover most needs in an analytical laboratory in chemistry, physics, biology, material science or interdisciplinary work.

• VERTEX 80v

Vaccum High-Performance

Vacuum spectrometers are the gold-standard in IR spectroscopy. The VERTEX 80V is unsurpassed when it comes to time resolution, broadest spectral range and ultra-sensitive measurements.

HIGH END

Feel the
Chemistry

Know Your Chemicals & Reactions

KEYWORDS: • *organic chemistry • inorganic chemistry • physical chemistry • biochemistry • food chemistry • polymer science • technical chemistry • thermochemistry • electrochemistry plant engineering • teaching*

About In-situ Reaction Monitoring

FT-IR spectroscopy allows scientists to elucidate chemical reactions down into the millisecond domain. This does not require any complicated sample preparation steps. Basically, everything is done with a single click in the software.

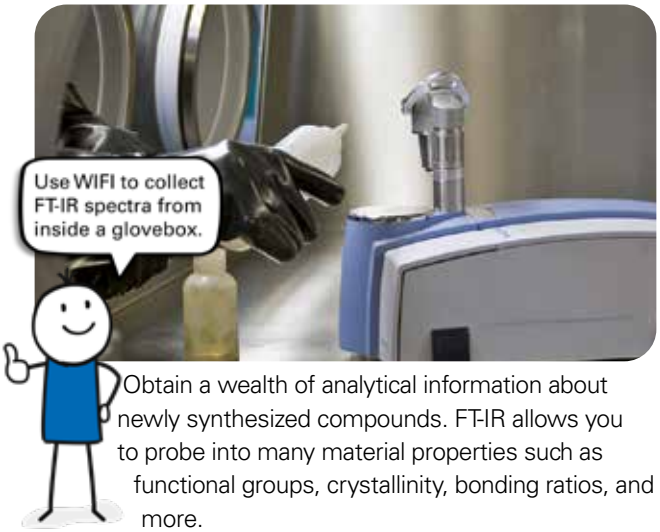
Typical processes studied are homogeneous and heterogeneous catalysis, polymerization and gas phase reactions. Infrared spectroscopy offers many different (inert) sampling methods to tailor the experiment to the samples.

If you're a chemist, you are by trade familiar with infrared spectroscopy. It was among the first routinely used spectroscopic techniques to identify functional groups of newly synthesized compounds.

Even today, FT-IR spectroscopy is one of the living, breathing backbones of analytical chemistry in a modern science lab.

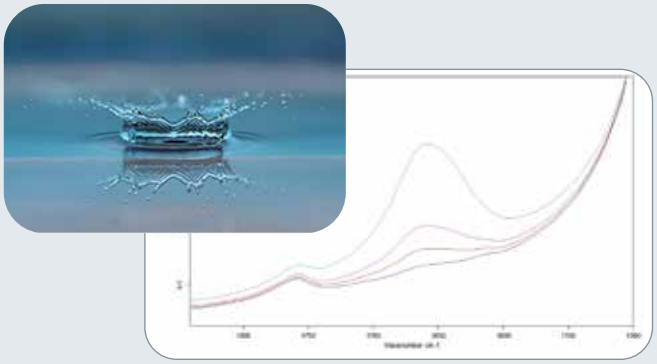
For undergraduate and graduate students alike, it is easy to learn and utilize, it delivers clear results quickly, and it fits into any glovebox.

Characterization of **Chemicals**



Obtain a wealth of analytical information about newly synthesized compounds. FT-IR allows you to probe into many material properties such as functional groups, crystallinity, bonding ratios, and more.

Quantification of Components

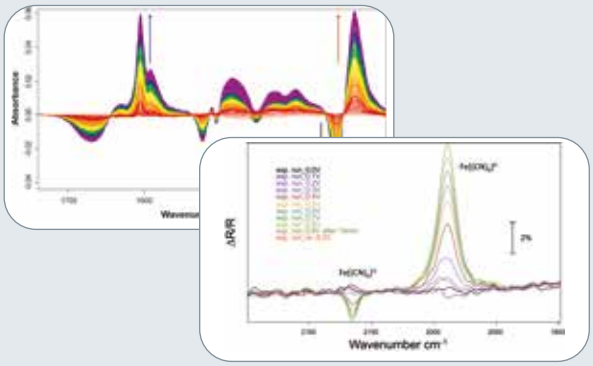


FT-IR spectroscopy can quantify contents in solids, liquids and gases quickly with high reliability. It is very well possible to detect and evaluate low concentrations below 0.1% in transmission.

Study **Reaction Kinetics**

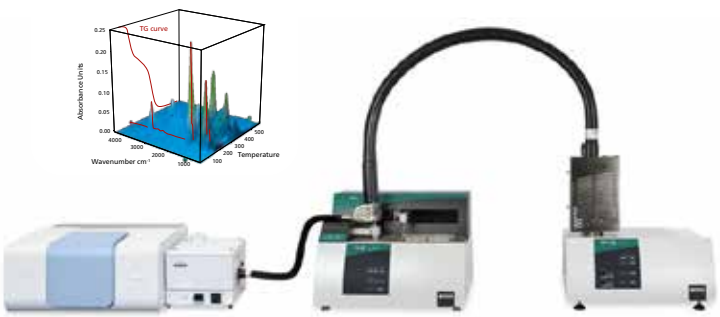
Developing a better synthetic route or making a chemical process more efficient demands extensive knowledge about the reaction. Our spectrometers provide you with kinetic information down to the millisecond scale with rapid scan technique.

Catalysis and **Electrochemistry**



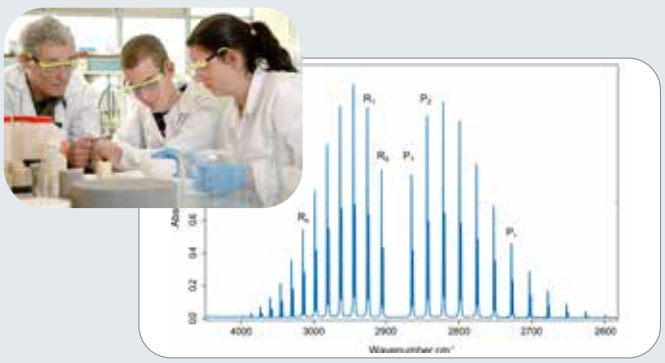
Study the chemistry of catalysts and the kinetics of catalytic processes. Use a broad scope of spectroscopic techniques like spectroelectrochemistry to investigate new homogeneous or heterogeneous catalysts.

Polymer Research

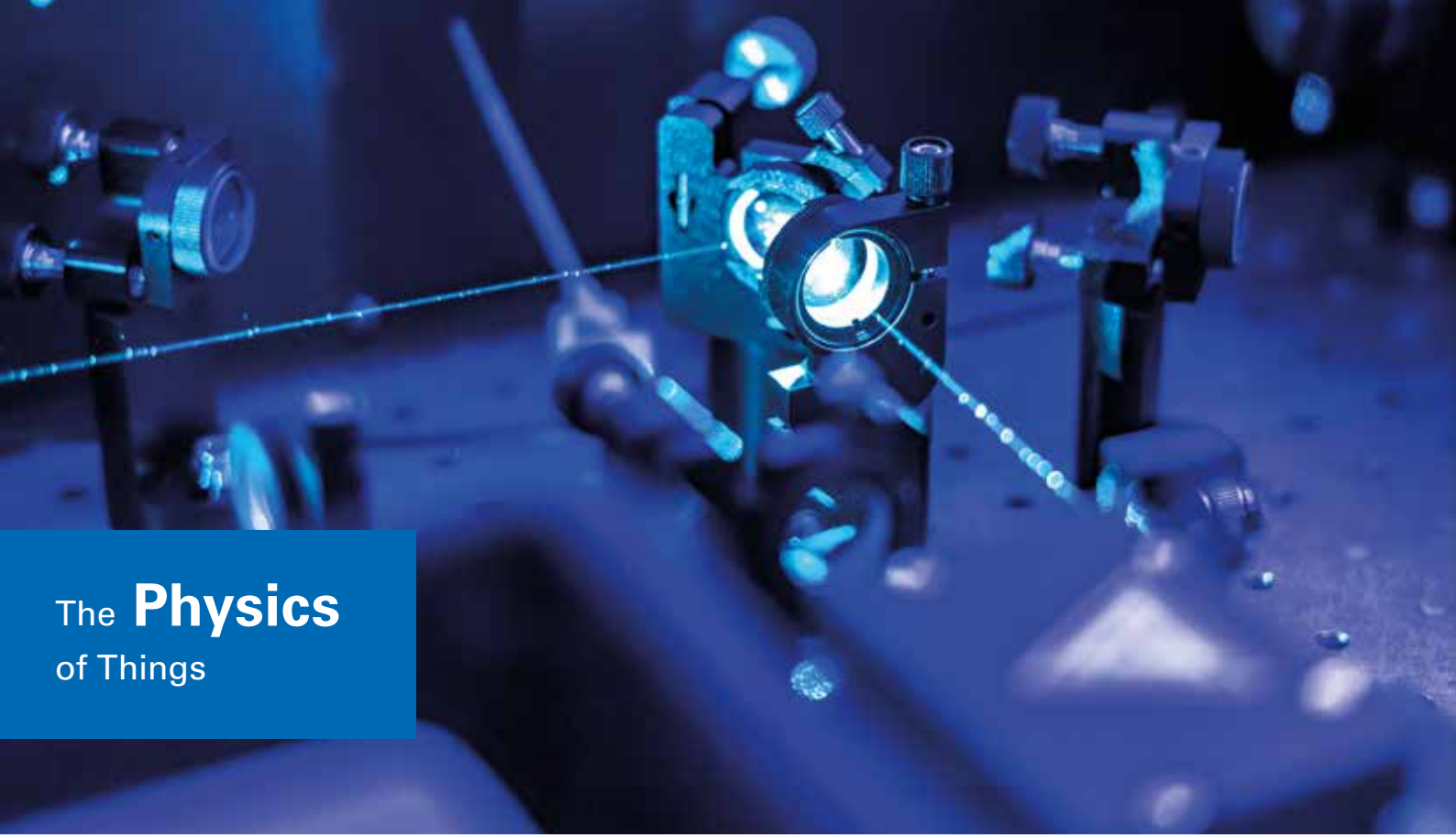


The combination of FT-IR with thermogravimetric analysis (TGA) delivers substantial information about material behavior under varying temperatures and environments, delivering essential parameter to improve processes, such as 3D printing.

Teaching Undergraduate Labs



Infrared spectroscopy is a great way to teach students about the fundamentals of molecular movement. Our FT-IR spectrometers are easy-to-use, robust and survive the toughest chemistry labs and improper operation by students.



The **Physics** of Things

We Support the Spectroscopist

KEYWORDS: • *semiconductors* • *optoelectronics* • *material development* • *molecular physics* • *solid state physics* • *time resolved spectroscopy*

What is the Benefit of using Vacuum FT-IR?

Water vapor and carbon dioxide are the usual atmospheric interferences in FT-IR spectroscopy and both have their most intense absorption bands in the MIR and FIR/THz spectral regions. As a result, most spectrometers are sealed with drying agent or purged by dry air or nitrogen.

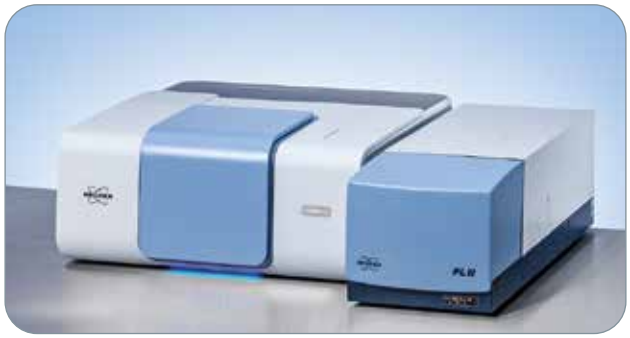
However, if you wants to achieve the maximum sensitivity in the IR, even this is not sufficient. Only vacuum spectrometers can remove any H_2O/CO_2 artifacts caused by residual impurities, allowing the high-end potential of FT-IR spectroscopy to be fully exploited.

For a physicist, spectroscopy is a handy tool to understand the fundamental science of all things. In their hands a spectrometer unlocks its full potential and goes beyond the chemistry into the atomic scale.

Bruker spectrometers are flexible and versatile instruments that cover a broad range of applications and spectral ranges.

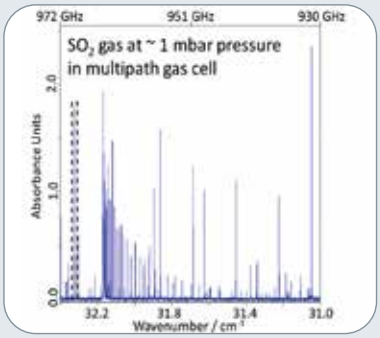
Whether you characterize a physical process in the nanosecond domain or investigate meta materials, our spectrometers and microscopes are built to do advanced science.

FT-IR **Photoluminescence**



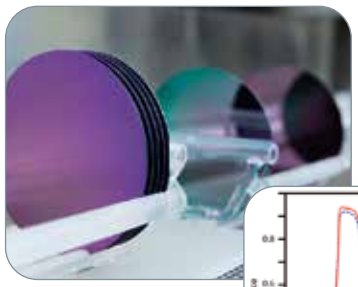
Photoluminescence (PL) spectroscopy is an important tool for semiconductor research and development, since the sample PL emission induced by laser excitation gives deep insight into e.g. band structure and charge carrier details.

FIR/THz-Spectroscopy

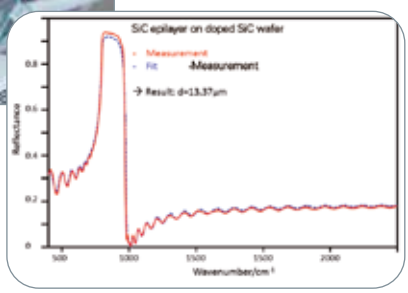


Although still a pioneering research field, terahertz spectroscopy is used to characterize the energy gap in superconducting materials. It is also used in solid state research or atmospheric gas studies.

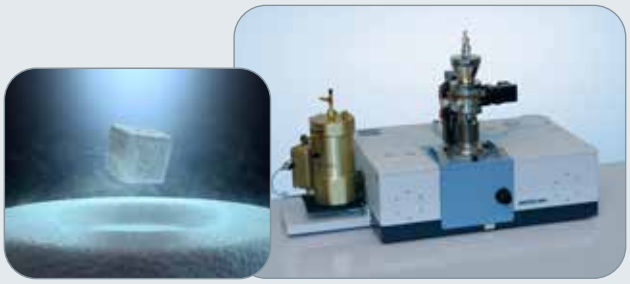
Semiconductor Development



FT-IR can simultaneously quantifiy Carbon, Oxygen and shallow impurities (B, P, As etc.). Additionally, it can study passivation layers on silicon wafers and characterization of other and even ultra-thin layers.

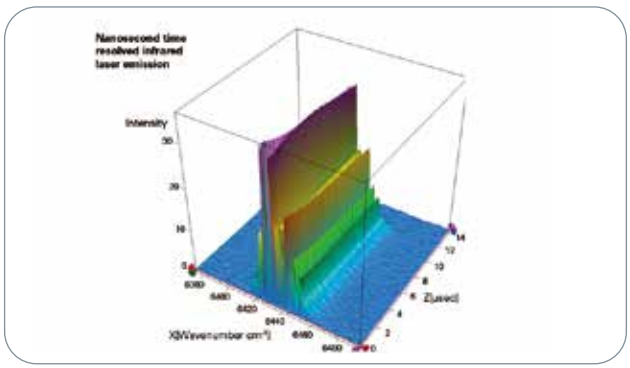


Solid State Physics



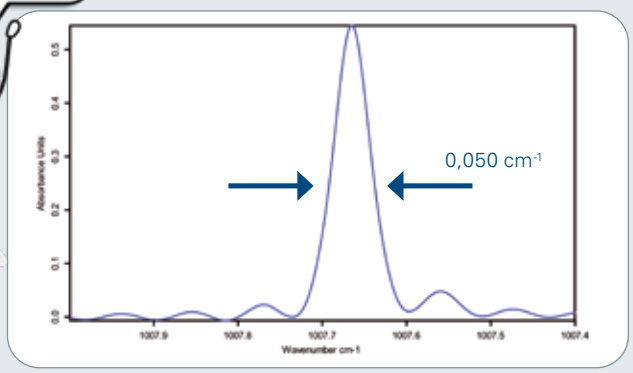
FT-IR spectroscopy at lower temperatures (down to a few Kelvin) unravels dedicated optical properties of solid-state materials, that only appear at deeper temperatures, e.g. superconductivity or certain photoluminescence signals. Individual cryostat solutions and innovative cooling techniques are available for different research applications and industry quality analysis.

Characterization of **Optoelectronics**

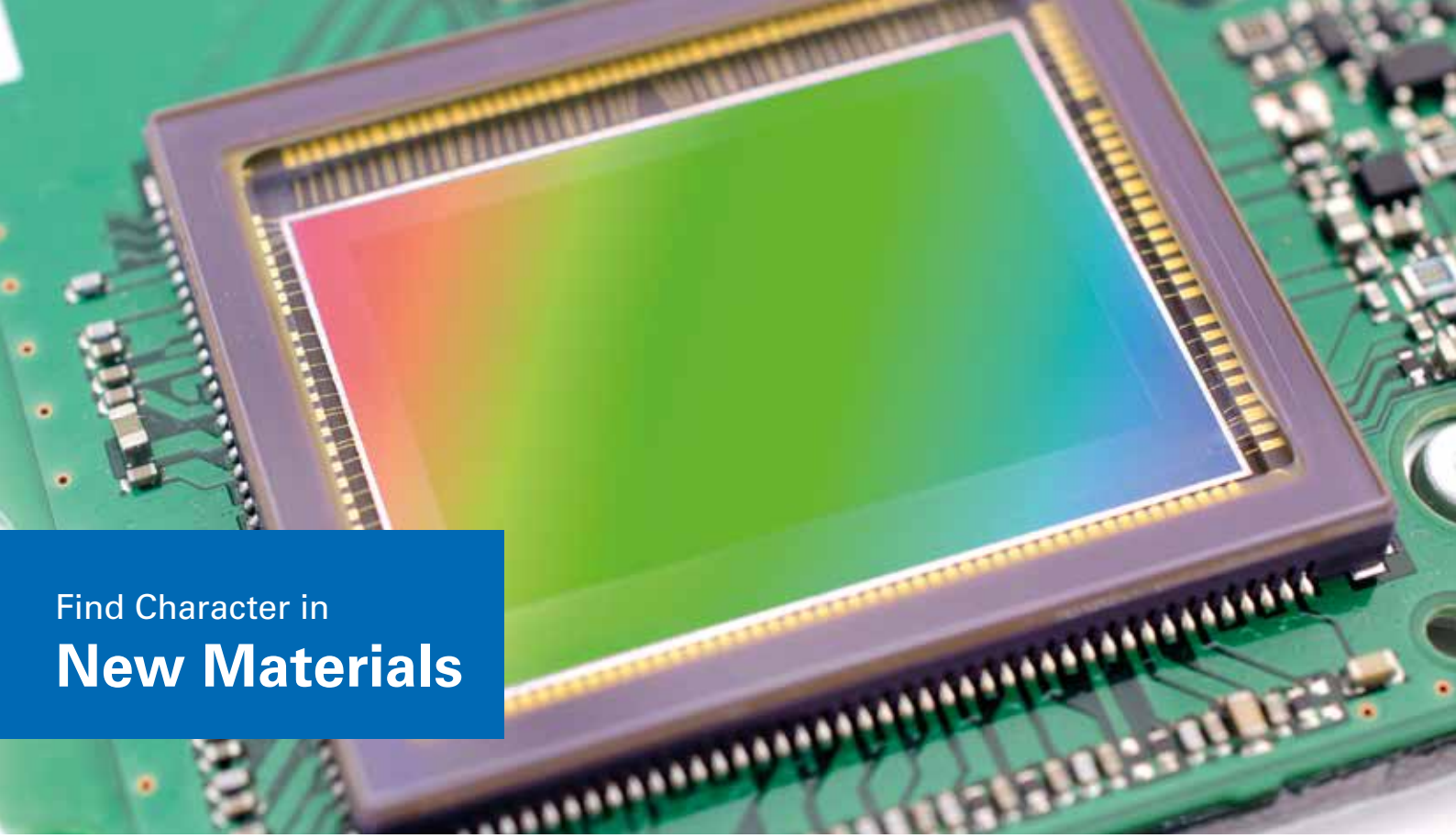


FT-IR spectroscopy is the ideal tool to analyze the emission of lasers, LEDs or in general electroluminescence. It even allows time resolved emission measurements down to the low ns range.

High-Resolution IR Analysis



Standard IR spectroscopy rarely goes beyond a spectral resolution of 2 cm^{-1}. However, when gases are investigated, higher resolutions are favorable to thoroughly characterize gaseous samples.



Find Character in

New Materials

Spectroscopy Unlocks a Materials Secrets

KEYWORDS: • *nanotechnology* • *physics* • *sensors* • *optical materials* • *graphene* • *battery research*

About Hyphenation and Coupled Techniques

Coupled, or hyphenated techniques are what make FT-IR spectroscopy so versatile in routine lab analysis. It means, that the FT-IR spectroscopy is directly coupled to a second method of analysis.

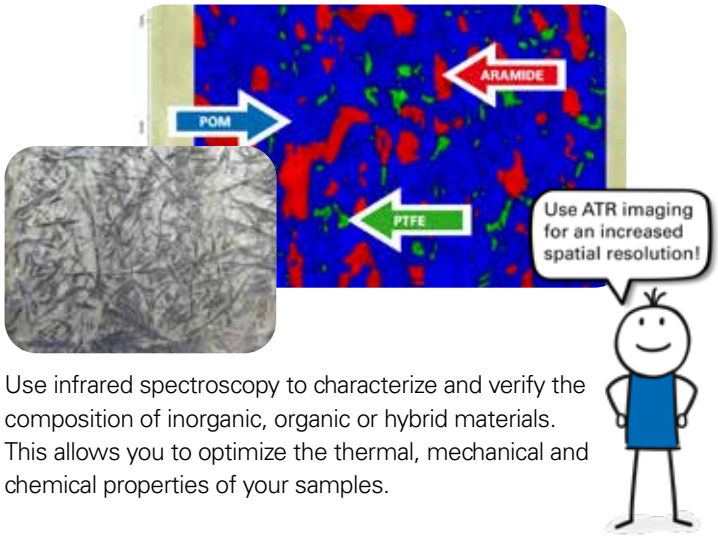
This can be microscopy, when you want to chemically investigate a sample on the micrometer scale or thermogravimetric analysis if you want to take a closer look at a samples thermal stability.

Bruker offers a wealth of hyphenated techniques and coupling methods to provide you with an end to end solution that covers all your needs.

Today's everyday technical devices never would have been possible without ground-breaking new materials. IR is essential to understand and determine their amazing optical, electronical and chemical properties.

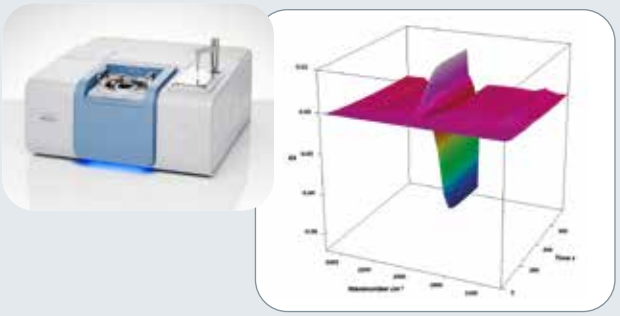
The quality and purity of materials directly impacts the performance of the end product. Using FT-IR spectroscopy is a convenient way to fine-tune your production parameters to obtain optimal material quality.

Ceramics and **Composites**



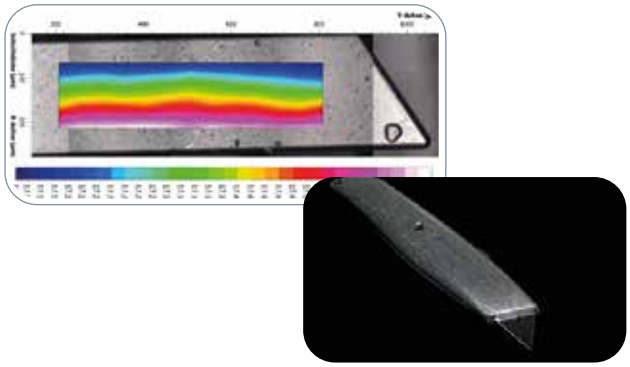
Use infrared spectroscopy to characterize and verify the composition of inorganic, organic or hybrid materials. This allows you to optimize the thermal, mechanical and chemical properties of your samples.

Battery and **Energy Storage**



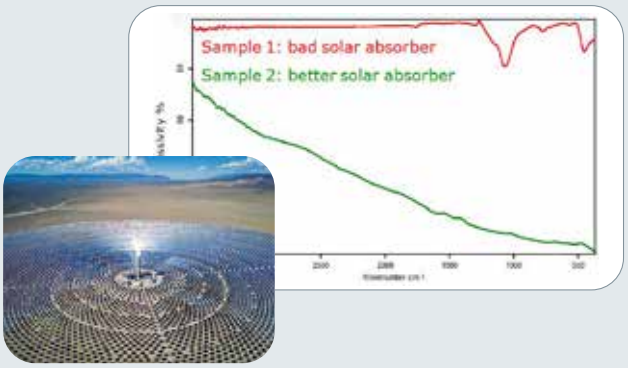
Researchers can monitor the electrochemical process in-situ in the solutes and electrodes of a lab-level battery model system to tune the anode, cathode materials, electrolyte composition, temperature etc.

Functionalized **Surfaces**



Gather insights in the chemistry of coatings and thin layers down to even monolayers. FT-IR allows you to investigate surface reactions chemical properties of functionalized surfaces.

Thermal Emission Studies

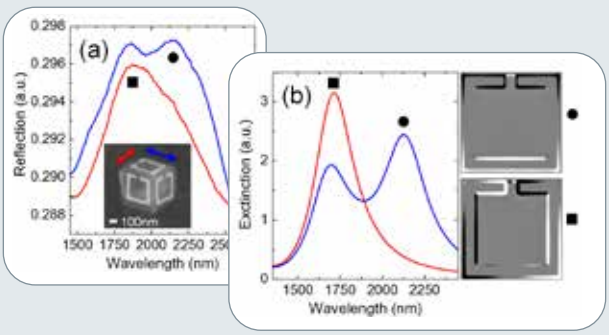


Optical properties of solar thermal materials can be characterized using FT-IR emission experiments. The surface emissivity of such materials is directly related to their heat transfer capabilities and energy conversion efficiencies.

Optical Materials Development

Transmittance, reflectance and absorption properties of optical materials, e.g. for lenses and mirrors, can be determined with highest accuracy.

Meta Materials



As appropriately designed, meta materials can affect waves of electromagnetic radiation. A powerful spectroscopic workstation is required to characterize the meta material sufficiently.

Spring into

Biology and Life Sciences

Take Your Biological Research to the Next Stage

KEYWORDS: • *protein stability* • *secondary structure* • *cancer* • *research* • *biomaterials* • *cellular imaging* • *high-throughput screening* • *quantification* • *raman* • *big pharma* • *thermal stability* • *microscopy*

About the Use of IR Sprectroscopy in Water

Water is known for its strong IR absorption. But by using the right equipment IR spectroscopy in water is not only feasible but delivers great results.

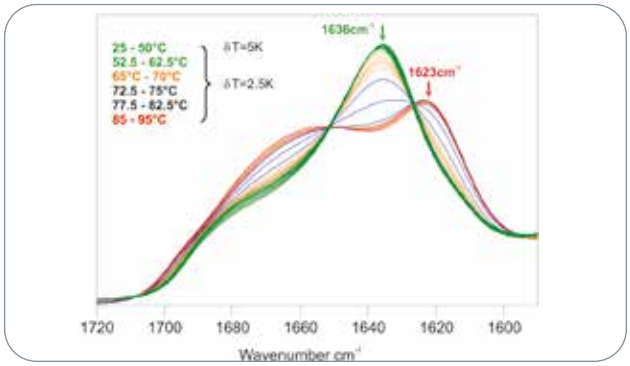
This is especially useful, when you want to look at bioactive molecules like proteins in their natural environment. The secret behind FT-IR spectroscopy in water is a carefully assembled dedicated spectrometer system.

By using this, a multitude of components and active ingredients in aqueous solution can be characterized and investigated.

The importance of biomedical engineering and research is increasing in modern science. FT-IR helps to better understand diseases and biological processes. It is also a valuable routine powerhouse and assists in developing assists in developing and manufacturing new drugs.

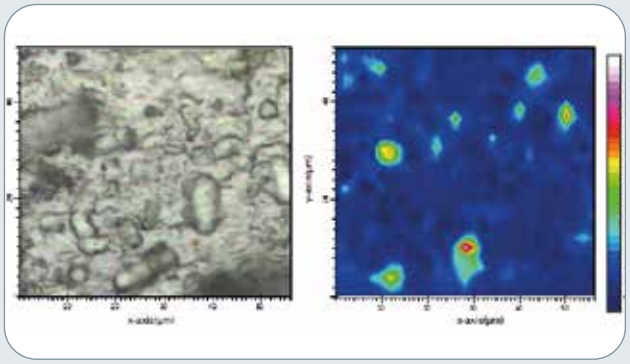
With Bruker's close ties to the sciences, it is hardly surprising that we became closely involved with the pharmaceutical industry as well. Global pharma and biopharma companies have been using FT-IR spectroscopy for both research and QA/QC processes due to its effiiency and ease of use.

Elucidate **Protein Structure** and **Dynamics**



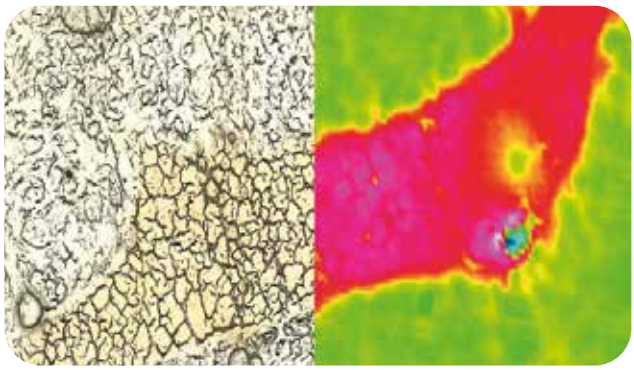
For a protein, the shape and frequency of the C=O and N-H vibrations are characteristic of its structure. It enables users to monitor protein stability and to determine their secondary structure with high sensitivity.

Drugs Formulation Development



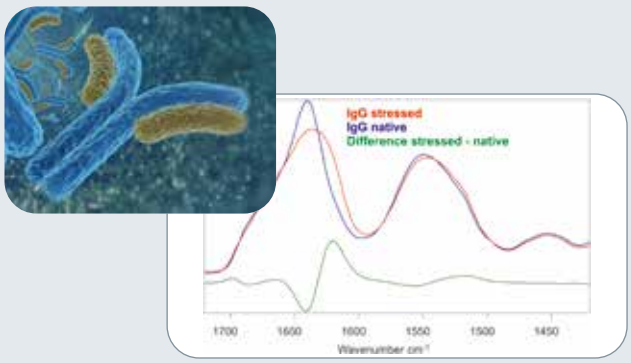
Use IR spectroscopy for active pharmaceutical ingredient (API) and excipient compatibility studies. Potential physical and chemical interactions can be assessed in the preformulation phase.

Start with **Tissue | Cell Imaging**



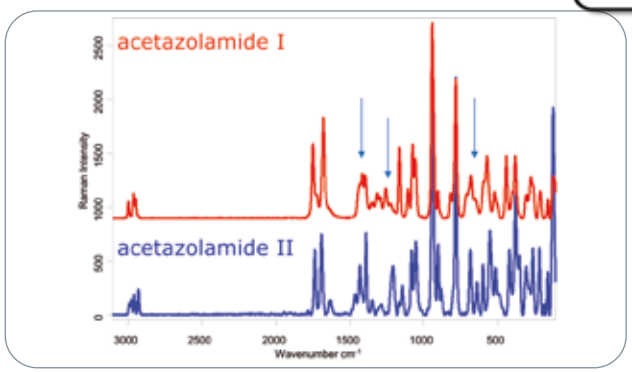
Infrared spectroscopy can be easily transferred to the low micrometer scale. Here, they use spatially resolved methods to elucidate disease patterns and markers and generate high-contrast tissue images.

Antibody Research



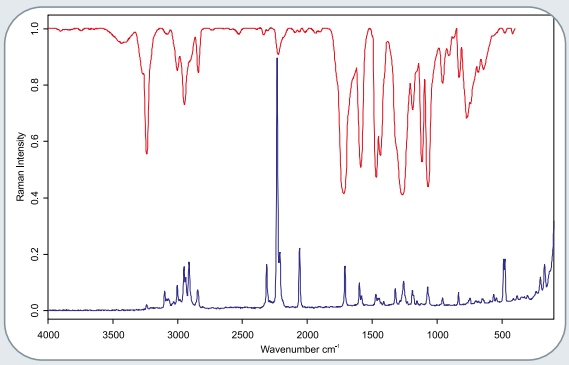
Formulations containing monoclonal antibodies are an intriguing topic for IR spectroscopy. It is possible to elucidate the stability of antibodies in a formulation and thus to optimize the drug.

Characterize **Molecular Drugs**



Study the structure of small molecular APIs and their mechanism of action. By using time-resolved spectroscopy, FIR and even FT-Raman you are able to assess and optimize an APIs efficacy.

Study of **Natural Herbs & Materials**



Study of natural compounds provides a promising resource for the developmet of new medical applications and pharmaceutical formulations. Combine two powerful FT-IR (red) and Raman (blue) spectroscopy allows easy idenfication of unknown coumpounds.

We are living for

Environmental Science

Understanding Human Impact on Nature

KEYWORDS: • *soil analysis* • *agri science* • *water analysis* • *microscopy* • *sustainability*

About FT-IR Sampling and Sample Preparation

Sample preparation is critical to the quality of the analysis. This is as true for microplastic studies as it is for the testing of nutrients in soil.

Since IR spectroscopy has been an indispensable part of chemical analysis for decades, many specialized techniques have evolved that reduce the amount of sample preparation required and even improve the quality of analysis.

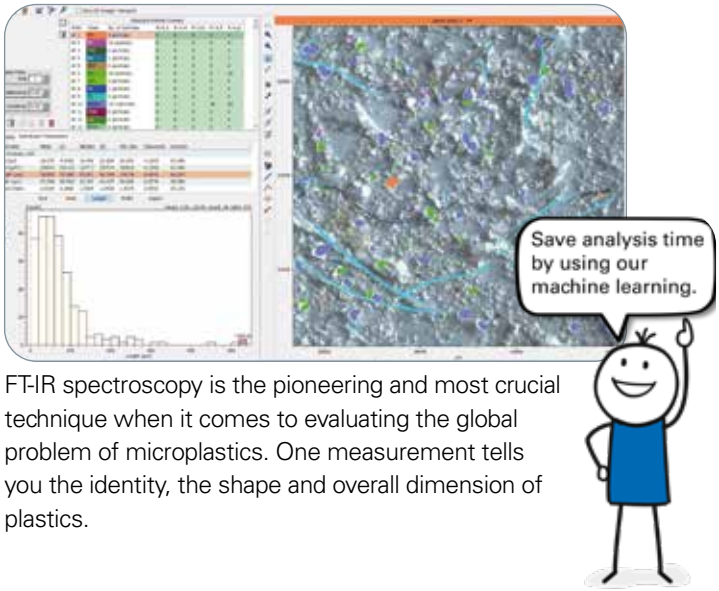
These dedicated techniques often require specific accessories that allow it to tailor an IR spectrometer precisely to environmental samples and their analyses.

Technological advances have caused us to exploit and use natural resources at a tremendous rate. Today, an evergrowing number of people are living on our planet and science is the only way of improving all our lives while still reducing our ecological footprint.

As a method of chemical investigation, infrared spectroscopy is commonly applied to monitor evironmental pollutants in water, soil and air. Typical examples are oil in water, microplastics or toxic gases.

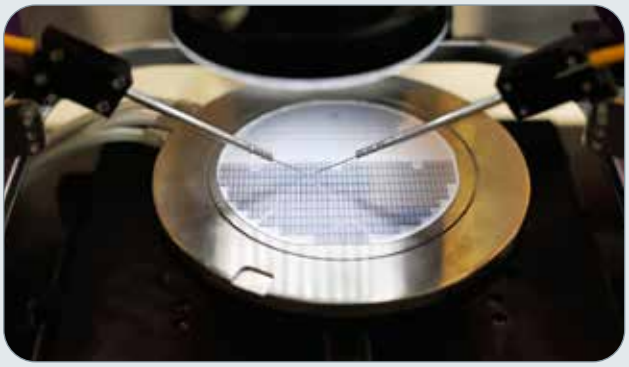
But that's not all. FT-IR spectroscopy can make agricultural efforts more effective and the mining for natural resources like ore, oil and gas safer.

Assess the Threat of **Microplastics**



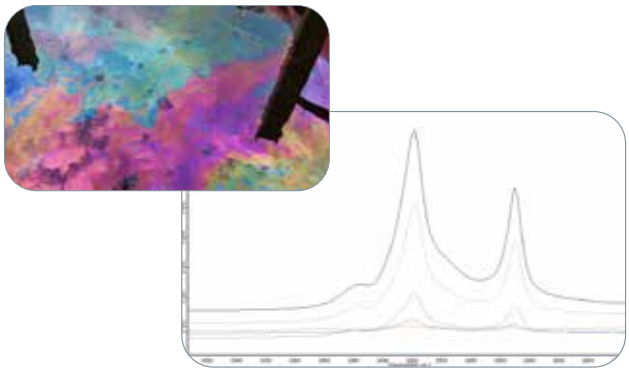
FT-IR spectroscopy is the pioneering and most crucial technique when it comes to evaluating the global problem of microplastics. One measurement tells you the identity, the shape and overall dimension of plastics.

Quality Control for **Solar Energy**



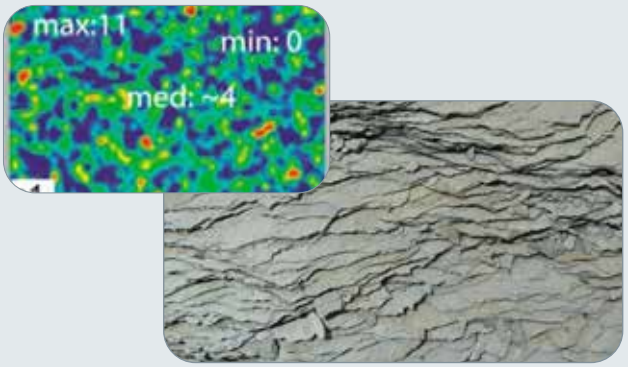
Quality control to maximize efficiency is critical in the competitive photovoltaic industry. Elemental impurities and disruptions of the crystal lattice have a profound impact on the mechanical and electrical properties of silicon. Therefore, quantification of impurities is of essential importance for solar research and process control.

Oil Pollution in Water



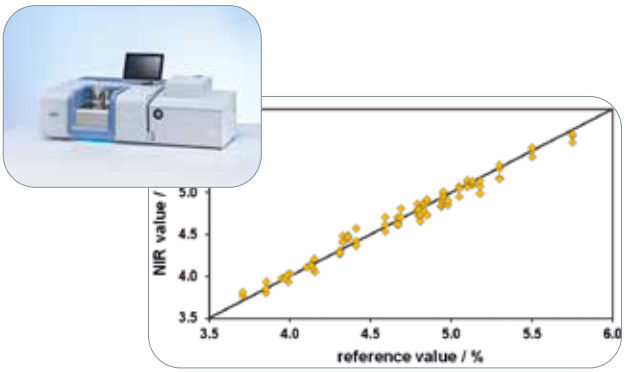
Monitoring of oil content in water is esential to protect aquatic and human life. FT-IR spectroscopy is a safe and fast ASTM approved method to quantify the amount of oil pollution in the water sample.

Minerals and Geology



In mineralogy and geology, infrared spectroscopy is a broadly applied technique. It can classify minerals, find organic hotspots in shale and differentiate polymorphs.

Soil Analysis for Agriculture



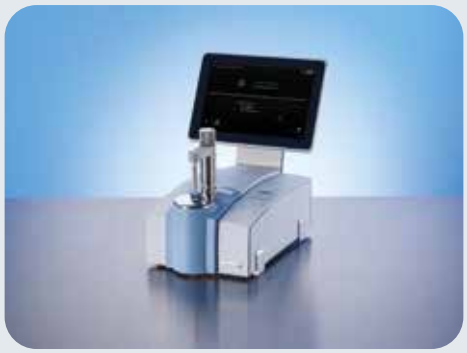
Besides checking for contaminations like microplastics or toxic chemicals, IR spectroscopy allows you to monitor soil composition to optimize fertiizer management and increase crop yields.

Learn About **Our Atmosphere**

Gas analysis is one of the key applications of IR – whether remotely on site or with collected samples and in the lab. You can quantify components in mixtures and assess chemical reactions in minutes.

Bruker Offers the Full FT-IR Portfolio

FT-IR Spectrometers



The **ALPHA II** is our compact routine instrument that is primarily aimed at chemical characterization. It fits into any glovebox, is easy to operate, has WLAN and can withstand even the roughest laboratory work.

The **INVENIO** is our all-rounder FT-IR platform. This freely configurable spectrometer platform allows you to choose exactly what you need for your laboratory. And if your demand changes? Simply upgrade the INVENIO at any time.

For high-end research and development at the frontiers of spectroscopy, the **VERTEX** series is the perfect companion. It provides you the highest achievable temporal and spectral resolution, the broadest spectral range from UV to FIR while maintaining highest sensitivity thanks to vacuum optics.

FT-IR Microscopes

With the **HYPERION**, there are no limits to µ-FT-IR research. Dedicated objectives to analyze monolayers, delicate and fragile samples, emission experiments and the highest spatial resolution are among its signature features.

The **LUMOS II** is our routine FT-IR imaging microscope for material science with a focus on high sample throughput, ease of use and robustness. The LUMOS II contains all optical parts and is what experts call a "stand-alone" FT-IR microscope.

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