

## Application Note AN N283

### Why FT-NIR Spectroscopy?

FT-NIR technology offers a lot of advantages compared to classical wet-chemical and chromatographic analyses. It is quick, cost-effective and safe, since no hazardous chemicals are used. It simply measures the absorption of near-infrared light of the sample at different wavelengths. The recorded NIR spectrum is characterized by overtones and combinations of the fundamental molecular vibrations of molecules containing C-H, N-H or O-H groups, making NIR spectroscopy first choice for the analysis of organic materials in the chemical industries, pharmaceutical industries, the food and feed and agricultural industries.

#### Advantages of FT-NIR Spectroscopy

FT-NIR spectroscopy provides relevant advantages compared to other analytical methods:

##### - Easy and Accurate Analysis

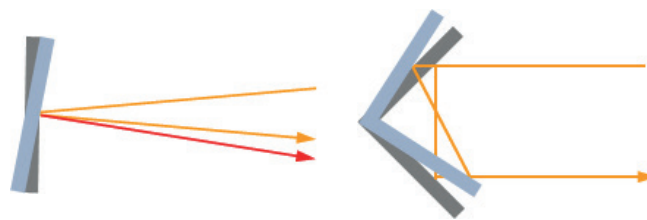
Since NIR methods require no sample preparation, the amount of sampling error is significantly reduced, improving the accuracy and reproducibility of the analysis.



Modern software interfaces guide the user step by step to the analysis results

##### - Cube Corner Design

Bruker's patented "Rock-Solid-Interferometer" uses Cube Corner mirrors, in contrast to flat mirrors which are used in the classical "Michelson Interferometer". Cube Corner mirrors guarantee an ultra-precise guidance of the light beams passing the interferometer, even if external vibrations occur.



A small tilt in the mirror will reflect the light in a wrong angle. Cube Corner mirrors are not affected by tilt.

##### - Direct Calibration Data Transfer – No Standardization

Spectrometers based on the so-called "Fourier Transform" (FT) technology provide high wavenumber accuracy and permit the transfer of calibration models from one FT instrument to another without time consuming standardization routines.

##### - No Sample Preparation

For an NIR measurement in the lab, the sample is simply filled into a glass vial or Petri dish, because glass is transparent in the NIR spectral region. Since NIR light not only analyzes the surface but penetrates deeper into the material, it is ideal for measuring heterogeneous samples.

Moreover, FT analyzers provide (in contrast to scanning dispersive spectrometers) the possibility to rotate the sample during the analysis in order to scan a bigger sampling spot compared to a static measurement, leading to more representative result and higher accuracy.



Measuring through glass avoids complicated sample preparation affected by tilt.

#### - No Waste, No Chemicals

In contrast to time consuming wet chemical analysis, the NIR method produces no wastes, causes no pollution, and requires no chemical reagents.

#### - Fiber Optics

By using fiber optic probes, NIR spectra can be collected directly from both solids and liquids directly inside containers, e.g. in the warehouse. Under process conditions the probes are mounted directly into the reactor transmitting the light over long distances (> 100 m) to the spectrometer.



#### Applications

With only one measurement, multiple components can be analyzed in less than one minute in solid samples as well as in liquids. This opens an array of applications, making FT-NIR a valuable tool for raw materials inspections in the warehouse, in process-control and final quality testing.

#### - Raw Materials Identification

Every organic material has a unique NIR spectrum – like a fingerprint. Therefore, NIR is widely used as a reliable tool for substance identifications and authentications, especially for inspecting incoming raw materials. Fully automated software routines provide quick information if a tested raw material is identical with the expected substance (identification) and if it meets its dedicated specifications (authentication).

#### - Multi Component Quantitative Analysis

The amount of light absorbed by the sample depends on the concentrations of its ingredients (Beer's Law). To quantify the amount of different ingredients the spectrometer determines the light loss at the related frequencies. Since the NIR spectrum contains the analytical information of every component simultaneously, the operator receives all quantitative information by collecting just one spectrum.

For markets with standardized products, e.g. food or feed industry, Bruker offers complete solutions with precalibrated systems. Regardless if the instrument is delivered ready-to-use or if users create their own calibrations, a fast analysis of multiple components simultaneously will help to save both, time and money.

#### - In-line Process Control

With fiber optic probes, the point of analysis can be inserted directly into the reactor or container. Typical examples are the surveillance of

- Chemical reactions
- Blend processes
- Distillations and rectifications
- Crystallizations
- Drying Processes

Specific quality parameters can be controlled in real-time directly in the process, rendering time consuming lab analysis unnecessary. Since results are obtained within a few seconds, a statistically significant amount of data can be created. This allows in many areas the NIR spectrometer the direct control of processes, leading to shorter cycle times, better product quality and less out-of-spec batches.

#### Summary: Fast and Easy Analysis at Low Cost

Especially in comparison to wet chemical analysis, NIR offers practical as well as economic advantages:

- Direct sample measurement
- Highly accurate results
- Direct calibration data transfer
- Ideal for heterogenous samples
- Fast measurements provide quick results

#### ● Bruker Scientific LLC

Billerica, MA · USA  
Phone +1 (978) 439-9899  
info.bopt.us@bruker.com

#### Bruker Optics GmbH & Co. KG

Ettlingen · Germany  
Phone +49 (7243) 504-2000  
info.bopt.de@bruker.com

#### Bruker Shanghai Ltd.

Shanghai · China  
Tel.: +86 21 51720-890  
info.bopt.cn@bruker.com

[www.bruker.com/optics](http://www.bruker.com/optics)

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