International Crystal Labs

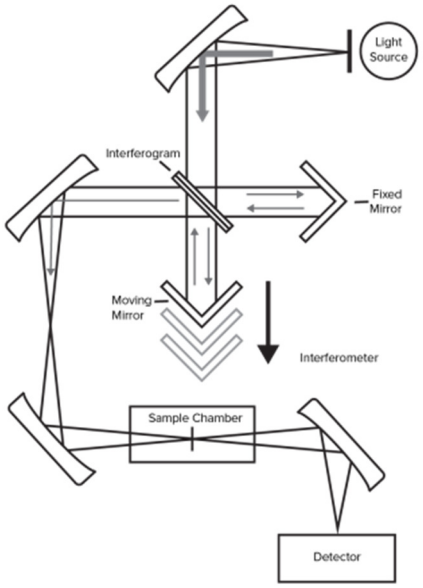
FTIR and Infrared Chemical Analysis Explained
Part One: The Essential FTIR

What is FT-IR Spectroscopy?

FT-IR stands for Fourier Transform InfraRed, the preferred method of infrared spectroscopy. Generally speaking, in infrared spectroscopy IR radiation is passed through or reflected off a sample for analysis.

Therefore, while much of the infrared energy is Transmitted through the spectrometer, a portion of the energy is Absorbed by the sample. The discreet measurement of the differential provides a resultant spectrum which represents the molecular absorption signature of the sample.

Like a fingerprint, no two unique molecular structures produce the same infrared spectrum. This makes infrared spectroscopy useful for many different types of molecular analysis.



Infrared spectroscopy has been a workhorse technique for scientific analysis in the laboratory for over sixty years. As modern FTIR spectrometers have become more powerful, rugged, and reliable, their use has further migrated into the factory and into the field as well. For all manner of testing where the chemical (and occasionally biological) constituency of a sample or mixture is wanted, the FTIR is playing an increasingly important role. For example:

- *It can identify unknown materials in a sample or mixture*
- *It can determine the quality or consistency of a sample or batches of samples*
- *It can determine the concentrations (amounts) of the various components in a mixture*

Among several major advantages of using FTIR spectroscopy are the fact that it is an accurate and sensitive method for multiple component analysis. That is to say, many different compounds can be simultaneously measured together, in their native state and in the presence of one another. Sensitive and accurate, the FTIR provides simultaneous multi-component analysis without the sample-destructing effects of pyrolysis or separation (as in chromatography, for example). This helps explain why FTIR is such an indispensable tool: for stand-alone analysis or for verifying and corroborating the performance and accuracy of alternative analyzers and methodology, the FTIR is essential.

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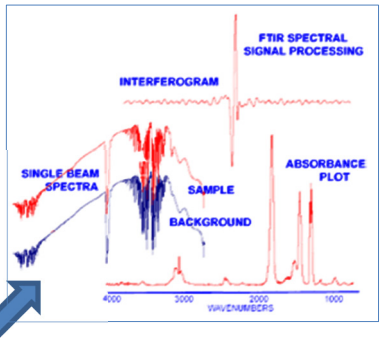
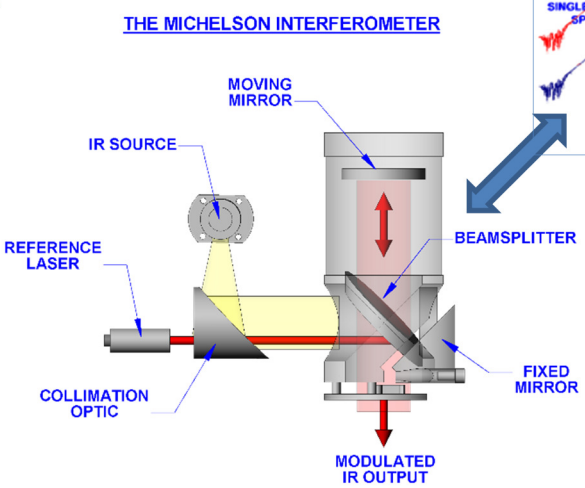
Part Two: The FTIR Generation

FTIR: A Brief History

Prior to the advent of the computer, infrared spectroscopy was performed in analogue form, where in a dispersive spectrometer, a diffraction grating was rotated ever so slowly in front of the infrared source in order to span the infrared spectrum and plot the IR intensity across a range of frequencies. With somewhat limited sensitivity and precision, the chart recorder plot was analyzed and measured for absorbance in relation to frequency with the aid of an old-fashioned caliper set and a slide rule. Infrared Spectrometers were used in laboratories for all manner of chemical analysis in the solid, liquid, and gas phase.

When it became possible to digitize the infrared response across the range, a Michelson Interferometer was employed in order that the frequency scans could be co-added together. The resultant accumulation of scans sped up the data collection process and simultaneously improved the signal to noise function of the IR instrument dramatically.





How Does FTIR Work?

In the FTIR, the interferometer scans of the infrared frequencies are encoded into the data collection software, and the quickly scanned signal accumulations are transformed into a broad range spectrum of signal intensities. These signal intensities are expressed in a line graph as a function of wavelength which is known as a spectrum. The signal can be measured very quickly, usually on the order of one second or so, and thus the time element per sample may be reduced to a matter of a few seconds; as scan time is increased, very good measurement sensitivity can be achieved in a modest observation time.

Currently, modern FTIR spectrometers are deployed worldwide in a variety of industrial and scientific settings. Since its inception in 1962, International Crystal Laboratories has helped raise the FTIR generation as The Source of spectroscopy optics, supplies, and accessories for the FTIR optical laboratory and a globally diverse community of optical spectroscopists.

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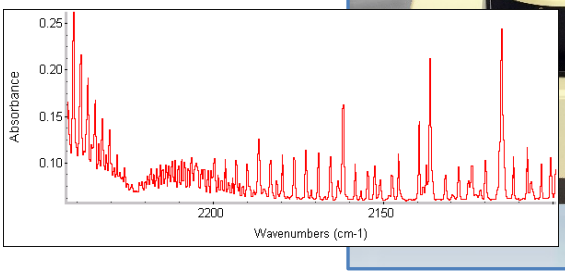
FTIR and Infrared Chemical Analysis Explained
Part Three: The FTIR Advantage

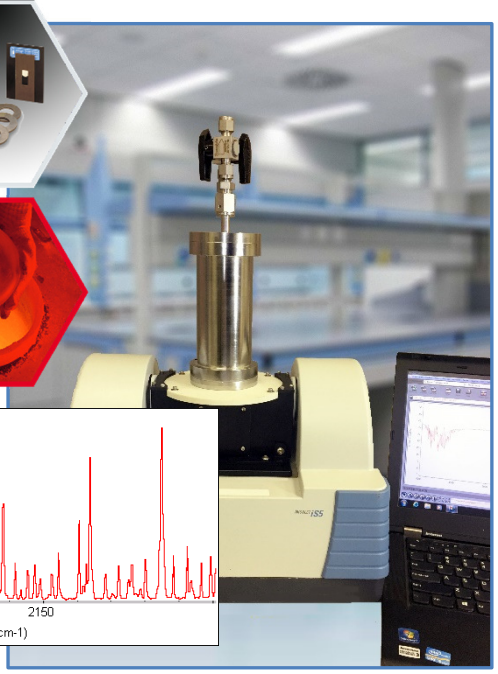
FTIR Power

FTIR is a powerful and economical way in which to conduct a chemical analysis of a substance or mixture by measuring the infrared spectrum and analyzing the data. By recognizing the infrared signature of a chemical and by measuring the intensity of its absorbance, both a Qualitative and Quantitative analysis are derived.

FTIR spectroscopy is particularly useful for simultaneously measuring multiple different components in a mixture. As no two compounds produce the exact same infrared spectrum, a library of chemical signatures can be archived as reference. And as every chemical has its own unique molecular "fingerprint", the broad spectral range of the infrared region and the highly resolute ability of the FTIR, a rich and detailed chemical fingerprint is seen. Simultaneous multiple component analysis is a key advantage of FTIR technology.

Another powerful aspect of FTIR is the range of applicability. Samples of almost any type are measured in a variety of test cells, sample vessels or accessories. ICL is The Source for optics, cells, and accessories of any type, and for all manner of optical laboratory supplies and solutions worldwide. Nearly any sample, product or phase of matter including solids, liquids, gases and phases in between like films, pastes, polymers, and so forth can be measured with great advantage in an FTIR spectrometer.





Advantages of FT-IR

• Speed: Because all the frequencies are measured simultaneously, most measurements by FT-IR can be made in a matter of seconds rather than several minutes (*the Felgett advantage*).

• Sensitivity: Sensitivity is dramatically improved with FT-IR for many reasons. The detectors employed are much more sensitive, the optical throughput is much higher which results in much lower noise levels, as does co-adding the fast scans signal averaging the IR energy (*the Jacquinot advantage*).

• Mechanical Simplicity: The moving mirror in the interferometer is the only continuously moving part in the instrument. Thus, there is very little possibility of mechanical breakdown. The FTIR is exceptionally reliable and easy to program or automate.

• Internally Calibrated: These instruments employ a HeNe laser as an internal wavelength reference making the standard FTIR instrument essentially self-calibrating (*the Connes advantage*).

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