ANALYTICAL ANSWERS

Fourier Transform Infrared Spectroscopy (FTIR)

Fourier Transform Infrared Spectroscopy (FTIR) is a technique which is used to analyze the chemical composition of many organic chemicals, polymers, paints, coatings, adhesives, lubricants, semiconductor materials, coolants, gases, biological samples, inorganics and minerals. FTIR can be used to analyze a wide range of materials in bulk or thin films, liquids, solids, pastes, powders, fibers, and other forms. FTIR analysis can give not only qualitative (identification) analysis of materials, but with relevant standards, can be used for quantitative (amount) analysis.

FTIR can be used to analyze samples up to 11 millimeters in diameter, and either measure in bulk or the surface. Standard FTIR analysis covers the wavelength range of 2.5 to 25 um (4000 - 350 cm^{-1}) and the instrument range can be expanded to cover 1 to 25 um (10,000 to 350 cm^{-1}).

FTIR Applications include:

Materials Evaluation

Identification
- Solids, liquids or gases

Quantitative composition
Identification
- Polymers and polymer blends

Self-assembled monolayers
Mineral identification
Solvent diffusion studies
Infrared emission
Protein studies
Environmental-based (pH, temperature, etc.) studies

Failure Analysis

Coating composition
Coating thickness
Surface cleanliness
Solvent purity
Semiconductor wafer coating, doping, process development and verification.
Analysis of surface degradation

Quality Control

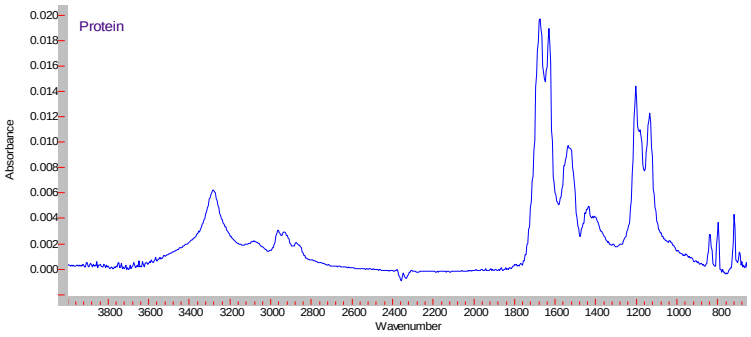
Process material degradation
Time-based studies
- Polymer, paints and coatings cures.

Process contamination
Analysis of lubricants, coolants, power transfer fluids and greases for degradation or contamination.
Optical filter performance
Optics characterization

Principle of Operation:

A beam of infrared light is focused on the sample. Depending on the sample composition, differing amounts of light are absorbed at different wavelengths. This pattern of light absorption is unique for almost every organic compound and many inorganics. From the pattern of light absorbed, identification of the composition (qualitative analysis) is made from the pattern of light absorbed. Quantitative analysis (amount of each compound present) is also possible when the sample thickness or sampling depth is controlled. User-provided reference samples aid in positive substance identification and compositional verification.

Data Output:



The FTIR spectrum is a plot of infrared light absorbed by the sample as a function of wavelength or frequency. FTIR data can be presented as a single plotted spectrum, multiple unknowns and reference spectra overlaid or 'stacked' on the same plot, or in comparison to AAI's extensive commercial collection (over 25,000) of infrared spectra and other associated physical data.

Sample Constraints:

Samples for FTIR analysis can be liquids, solids or gases. For direct transmission measurements solids are typically no thicker than approximately 10 microns. Liquids and gases are placed in cells and can be examined as is or diluted.

Attenuated Total Reflectance (ATR) FTIR is used to obtain IR spectra of surface and to perform depth profiling. Surface characterization in the range of 0.3 to 4 microns is easily performed on flat samples 10 mm by 10 mm.

Our Attenuated Total Reflectance (ATR) accessories allow collection of the IR spectra of many strongly infrared absorbing materials, such as carbon-filled polymers and aqueous systems. For aqueous systems, ATR is the preferred technique for quantitative analysis and as little as 1ml can be analyzed. For polymers and surface studies, flat or flexible samples are ideal. Brittle and very hard samples can be examined using a diamond crystal. Different ATR crystals and optics also allow depth profiling of polymers over the range of 0.3 to 4 micrometers.