FOURIER TRANSFORM-INFRARED SPECTROSCOPY

DESCRIPTION OF TECHNIQUE

Fourier Transform-Infrared Spectroscopy (FTIR) is an analytical technique used to identify organic (and in some cases inorganic) materials. This technique measures the absorption of infrared radiation by the sample material versus wavelength. The infrared absorption bands identify molecular components and structures.

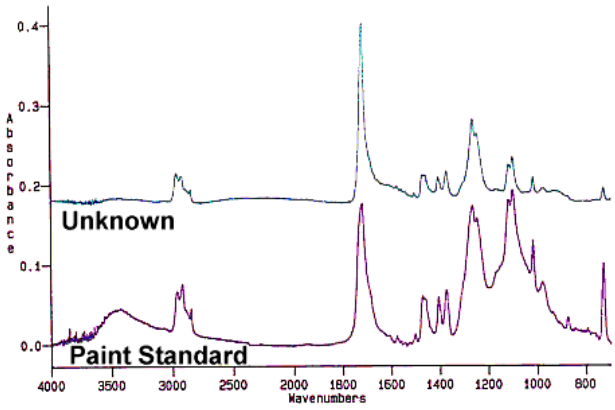
When a material is irradiated with infrared radiation, absorbed IR radiation usually excites molecules into a higher vibrational state. The wavelength of light absorbed by a particular molecule is a function of the energy difference between the at-rest and excited vibrational states. The wavelengths that are absorbed by the sample are characteristic of its molecular structure.

The FTIR spectrometer uses an interferometer to modulate the wavelength from a broadband infrared source. A detector measures the intensity of transmitted or reflected light as a function of its wavelength. The signal obtained from the detector is an interferogram, which must be analyzed with a computer using Fourier transforms to obtain a single-beam infrared spectrum. The FTIR spectra are usually presented as plots of intensity versus wavenumber (in cm^{-1}). Wavenumber is the reciprocal of the wavelength. The intensity can be plotted as the percentage of light transmittance or absorbance at each wavenumber.

ANALYTICAL INFORMATION

Qualitative Material Identification - To identify the material being analyzed, the unknown IR absorption spectrum is compared with standard spectra in computer databases or with a spectrum obtained from a known material. Spectrum matches identify the polymer or other constituent(s) in the sample. Absorption bands in the range of 4000 - 1500 wavenumbers are typically due to functional groups (e.g., -OH, C=O, N-H, CH_3, etc.). The region from 1500 - 400 wavenumbers is referred to as the fingerprint region. Absorption bands in this region are generally due to intramolecular phenomena and are highly specific to each material. The specificity of these bands allows computerized data searches within reference libraries to identify a material.

Quantitation - Quantitative concentration of a compound can be determined from the area under the curve in characteristic regions of the



FTIR Spectrum for Paint Analysis

IR spectrum. Concentration calibration is obtained by establishing a standard curve from spectra for known concentrations.

TYPICAL APPLICATIONS

- Identification of foreign materials
  - Particulates
  - Fibers
  - Residues
- Identification of bulk material compounds
- Identification of constituents in multilayered materials
- Quantitation of silicone, esters, etc., as contamination on various materials

SAMPLE REQUIREMENTS

Sample requirements vary depending on the sample form and instrument. Samples may be in liquid, solid or gaseous form. When using a microscope attachment on the spectrometer, the analysis area can be as small as 10 µm. Thin organic films on a reflective surface (e.g., gold) can be analyzed in situ using the microscope's reflectance mode. The outer 1-10 µm of a material can be analyzed using attenuated total reflectance (ATR).