FTIR Analysis

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Introduction

FTIR (Fourier Transform Infrared) analysis provides spectral information that is essentially a molecular fingerprint for organic, polymeric, and in some case inorganic materials. This technique is extremely useful for identifying base polymer compositions and organic contaminants. The FTIR spectrum of the unknown material can be compared for "best matches" with libraries of spectra that have been cataloged for known materials.

An example of an FTIR spectrum for Poly(oxymethylene) or POM or DelrinTM (DuPont trademark) is shown as Fig. A. The x-axis is wavenumber (cm^{-1}), which is the inverse of wavelength (cm). The y-axis is absorbance normalized on a scale of 0 – 1 where 0 = no absorption and 1 = maximum absorption.

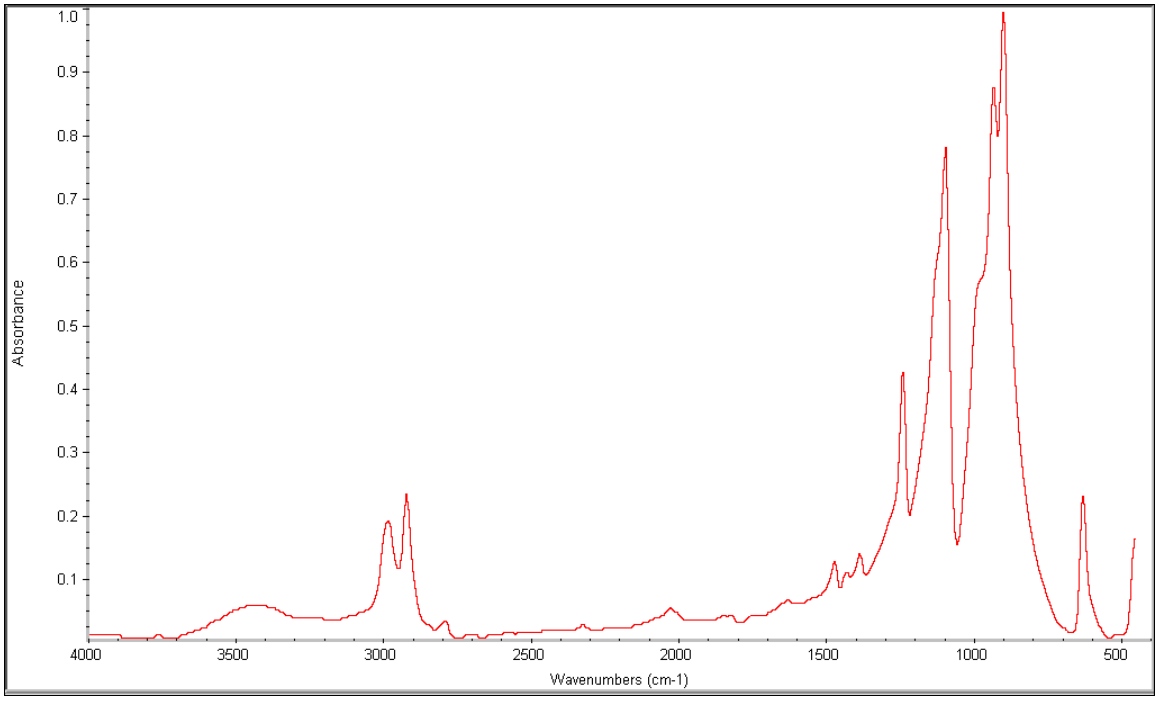

Fig. A - FTIR spectrum for Poly(oxymethylene) or POM or Delrin™.

The monomer for POM is shown in Fig. B. The major peak at wavenumber 903 cm^{-1} is due to the C-O-C symmetric stretch absorption. The peak at wavenumber 1097 cm^{-1} is due to the C-O-C asymmetric stretch. The peak at wavenumber 2923 cm^{-1} is due to the CH2-O asymmetric stretch. All of these vibration modes are indications of the specific molecular bonding within the sample and can be used to identify the material.

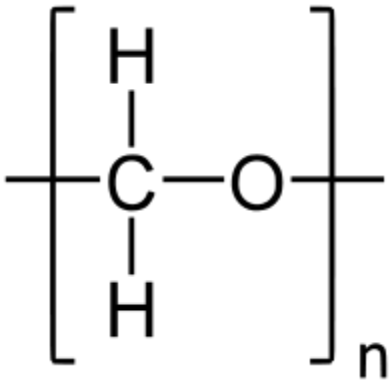

Fig. B - Poly(oxymethylene) or POM or Delrin™ monomer.

The library of FTIR spectra available in this laboratory includes more than 9400 spectra of organic, polymeric, and inorganic materials. These spectra are compared to the unknown sample spectra using computer software to identify the "best match". Many times this type of library search is sufficient to answer the frequent question "what is this material or substance?"

Web based libraries of FTIR spectra can also be searched online when a suitable match is not available using reference spectra on hand. The online database contains nearly 71,000 FTIR spectra that can be compared with the unknown material.

The Spectrometer

This laboratory utilizes a Nicolet IR200 FT-IR system with a single-reflection ATR (Attenuated Total Reflectance) attachment for nearly all the FTIR analysis tasks performed. The system allows us to examine solids and liquids. Generally only a small sample of material (a few milligrams) is required to obtain a spectrum.

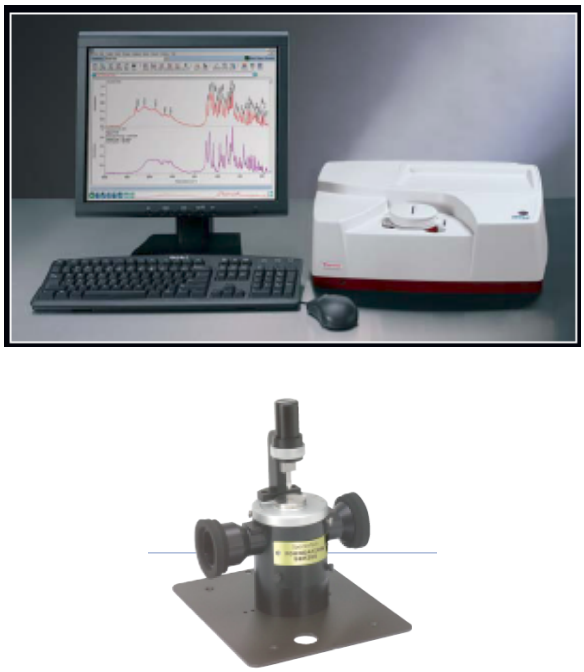

Fig. C - Nicolet IR200 FT-IR system and single-reflection ATR attachment.

Sampling

Liquid samples are straight forward requiring only a drop of liquid on the ATR lens. Solid samples usually require that samples are prepared by shaving material (e.g. plastic) off of the part that is thin enough to obtain a good FTIR spectrum. Organic films (e.g. contamination) can be analyzed by rinsing a surface with an organic solvent (e.g. isopropyl alcohol) and allowing the solvent to evaporate leaving the residue on the ATR lens.

Examples

A partial listing of examples of FTIR analysis performed in this laboratory is shown below.

Liquids

- Identification of liquid condensate from processing plant
- Identification of liquid residue on printed wiring assembly
- Identification of unknown liquid (brake fluid)
- Identification of unknown liquid on electrical contact

Solids

- two part epoxy potting mix ratio
- identification of thermo plastic elastomer (SantopreneTM)
- identification of fabric constituents
- identification of Teflon tape debris in water system
- identification of thermo plastic elastomer (KratonTM)
- material verification (DelrinTM)
- comparison of “good” & “bad” material (polyphenylene sulfide)
- material verification (Nylon 6,6)
- material verification (HDPE)
- identification of no-clean solder flux residue
- material verification (poly methyl methacrylate)
- comparison of two different Nylon parts
- identification of contamination (plasticizer)
- verification of material (polycarbonate ABS).