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MTEC MODEL 200 PHOTOACOUSTIC DETECTOR

FTIR Spectrometer Accessory for Solids and Semi-Solids

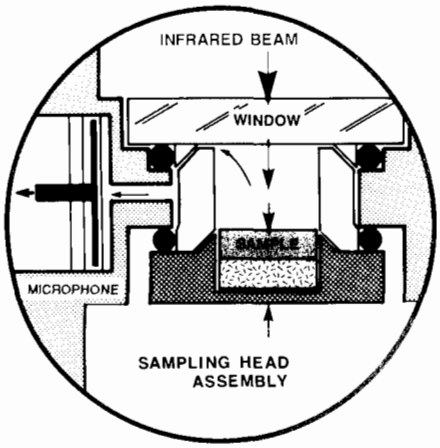


- Handles macro and micro-samples with little or no preparation
- Operates in diffuse reflectance, absorbance, and transmittance modes to best fit sample properties
- Compatible with qualitative and quantitative FTIR applications software
- Allows rapid sample change without breaking FTIR purge
- Operates in all FTIR manufacturer's instruments and spectral regions
- Provides a single accessory solution for most solid and semi-solid analyses

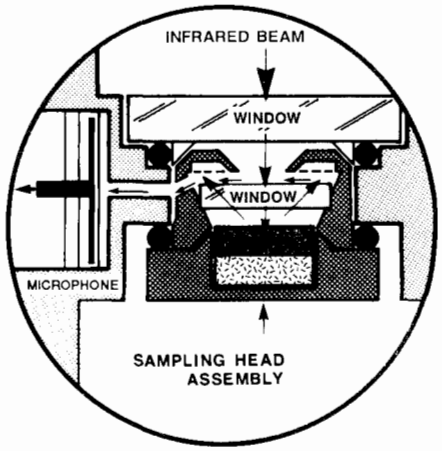
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SAMPLING MODES OF THE MTEC MODEL 200

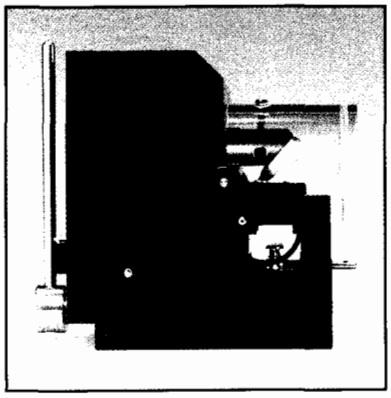
■ ABSORBANCE MACROSAMPLING



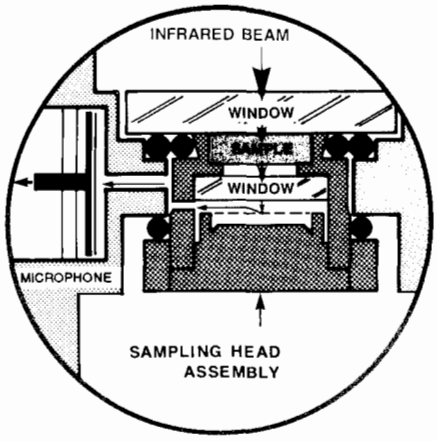
■ DIFFUSE REFLECTANCE



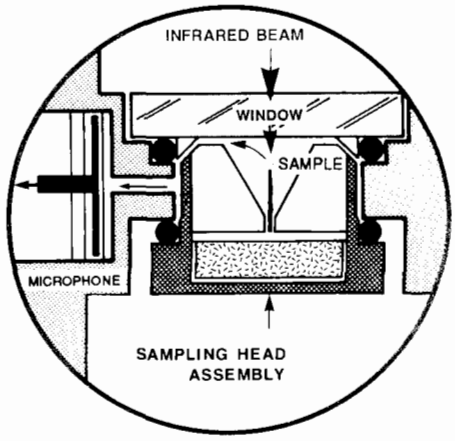
MTEC MODEL 200

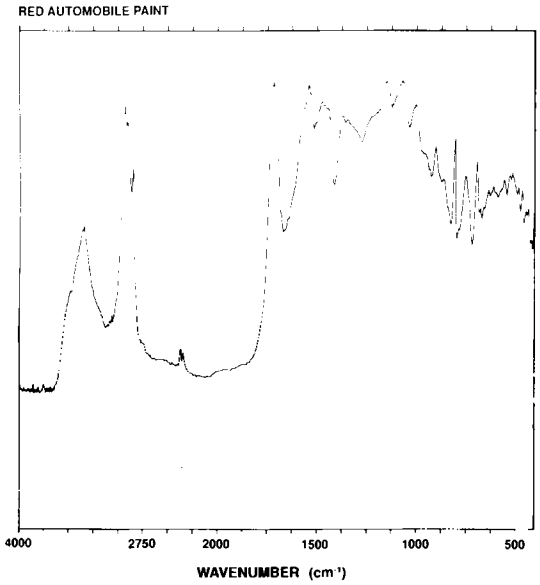


■ TRANSMITTANCE

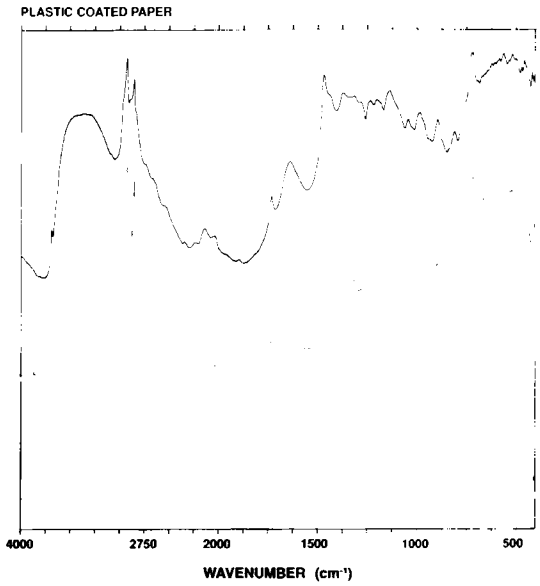


■ ABSORBANCE MICROSAMPLING

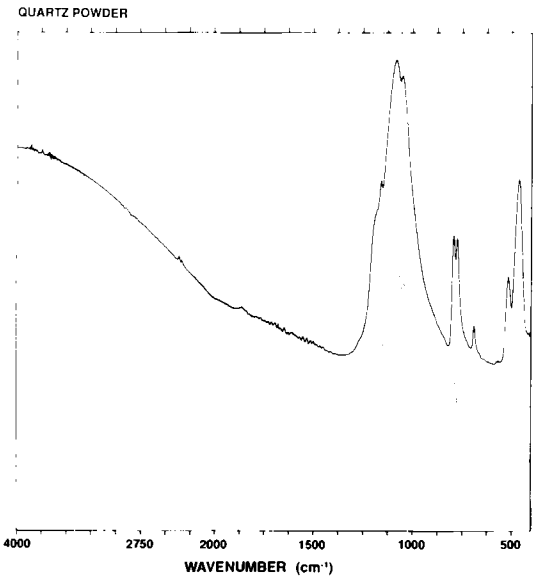




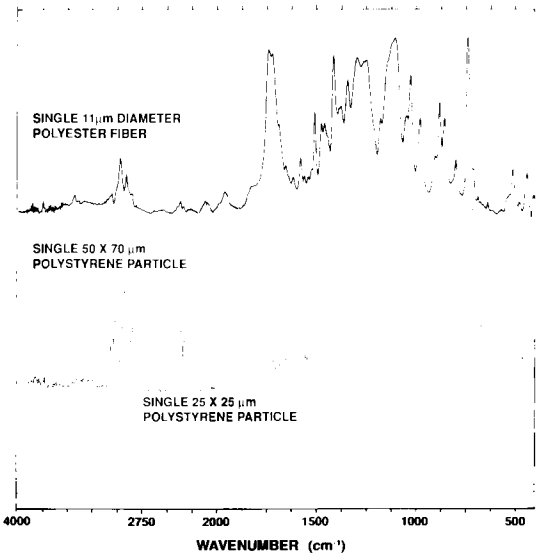
■ Absorbance (top) and Kubelka-Munk plotted diffuse reflectance (bottom) spectra of a red automotive paint. Direct measurement of absorbance by photoacoustic detection is clearly the preferred method for this opaque sample. The absorbance spectrum was obtained in 20 seconds.



■ Kubelka-Munk plotted diffuse reflectance spectrum (top) and absorbance spectra (bottom two) of a plastic coated paper at 8cm $^{-1}$ resolution. The absorbance spectra were measured with deep (upper) and shallow (lower) sampling depths by varying the FTIR mirror velocity to examine the coating and paper together and the plastic alone.



■ Transmittance spectra of an intensely scattering quartz sample (particle size 2 - 5μm) measured by the FTIR instrument's pyroelectric detector (top), and by the transmittance sampling head of the photoacoustic detector (bottom). These spectra illustrate the flatter baseline afforded by the photoacoustic detector for quantitative analyses.



■ Microsample spectra (top to bottom) of an 11μm single polyester fiber (32 scans) and of single polystyrene particles with dimensions of 50μm X 70μm (128 scans) and 25μm X 25μm (1000 scans). These spectra demonstrate the high sensitivity of the photoacoustic microsampling technique.

INSTRUMENT SPECIFICATIONS

- Peak-to-peak noise less than 0.04% at 2000cm^{-1} for 8cm^{-1} resolution, 32 scans, OPD velocity 0.1cm/s, carbon black powder sample and without FTIR-imposed limitations.
- Microphone nominal sensitivity 50 mV/Pa.
- Mirror focusing factor: 2 to 1.
- Spectral range defined by window material (KBr standard, UV to 400 cm^{-1}).
- Gain range: 1 - 128X from the control module, in steps of 2 and 0.1, 0.5, 1, 5, 10X from the preamplifier board.
- Maximum sample size: 10mm diameter X 7mm height.
- Provision for helium-purged and desiccated sample chamber.
- Dimensions including convenient clearances: height 11.7cm, length 16cm, width 17cm, minimum beam height 6.35cm.
- Shipping weight 9kg.

MODEL 200 SYSTEM PACKAGE

- Photoacoustic Detector with KBr window and center focus mirror
- Power supply / Gain control module with batteries and cable
- Kinematic mount
- Power supply battery charger
- Kinematic vibration isolation mount
- Liquid crystal infrared beam imager
- Five small and five large removable sample cups, sample funnel, and tweezers
- Instrument manual
- Storage case
- One year warranty



THE OPTIONS AND SPECIAL ITEMS

■ The MTEC product list contains a listing of all optional components and of cables and mounting baseplates for specific commercial FTIR instruments.

ORDERING INFORMATION

■ MTEC products are available from all major FTIR manufacturers and from:

MTEC Photoacoustics, Inc.
P.O. Box 1095
111 Lynn Avenue
University Towers
North Entrance-Lower Level
Ames, Iowa 50010 U.S.A.
Telephone: 515-292-7974
Telefax: 515-292-7125
Telex: 269266

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MULTISAMPLING OPTIONS

■ **Option SH003** for Diffuse Reflectance, Absorbance, and Transmittance Sampling

SH003 allows rapid switching between diffuse reflectance, absorbance, and transmittance sampling by simply exchanging the sampling heads shown in the foreground of the photograph. Each sampling head is designed for the preferred type of measurement for a particular sample property:

- the diffuse reflectance head for high light-scattering
- the absorbance head for opaqueness
- the transmittance head for transparency

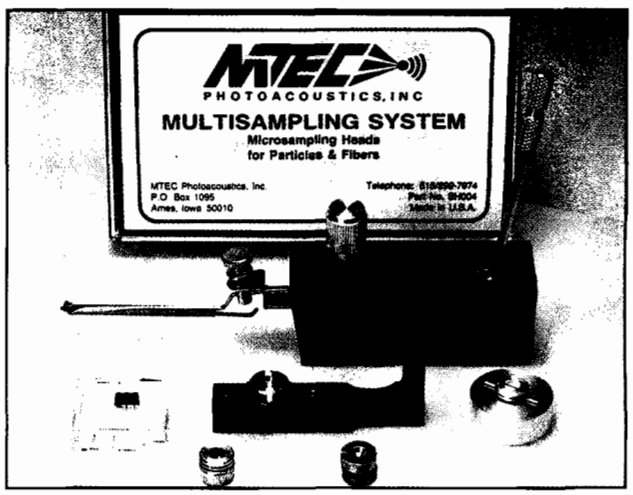
Many samples have a mixture of these properties, hence, often only spectra taken with multisampling will reveal all of the spectroscopic information on a particular sample as illustrated on the Applications page.



■ **Option SH003.** Three sampling heads shown in the foreground for diffuse reflectance, absorbance, and transmittance are positioned alternately in a common fixture to measure each of the three light fractions that occur in FTIR spectroscopy of solids.

■ **Option SH004** for Microsampling of Single Particle and Fiber Specimens

This option in combination with the user's laboratory microscope or other magnifier allows microsamples in the tens of micrometer size range and larger to be analyzed without pressing, aligning and aperturing. Single particles are picked up electrostatically with a fine tungsten needle with the aid of a micromanipulator, a procedure commonly used by microscopists. Single fibers are handled with fine tweezers and mounted in a special clamp ring. Both the needle and ring supports are automatically aligned for analysis when placed in the microsampling head. Microsampler spectra are shown on the Applications page.



■ **Option SH004.** The microsampling components (left to right) for single fibers and single particles are shown in the foreground. In the middle are the tungsten needles, sample holder fixture, and fiber-mounting stage and in the background the micromanipulator.

■ Optimized Spectra

Solid and semi-solid samples are a challenging sample category for FTIR analysis because of their diverse properties: micro to macro sizes, transmitting to opaque optical densities, specular to light-scattering reflectances. Photoacoustic detection provides a cost-efficient, single-accessory approach that accomodates diverse properties and significantly simplifies FTIR analysis of solids. The new MTEC Model 200 Photoacoustic Detector handles micro- and macro-samples with little or no sample preparation. It performs absorbance, diffuse reflectance and transmittance measurements as required depending on sample properties by simply exchanging the accessory's sampling heads. With these capabilities the MTEC Model 200 provides optimized spectra on a wider range of solid and semi-solid samples and provides more operational ease than any other FTIR accessory.

■ Photoacoustic Detection

Infrared absorbance is measured with photoacoustic detection via an acoustic signal that evolves from the sequence of infrared absorption, heat evolution and thermal expansion. The sample's infrared absorbance spectrum is obtained directly by photoacoustic detection when the absorbing material is directly irradiated by the infrared beam. Alternatively, when the absorbing material is a black absorber positioned near the front of or behind the sample, the sample's diffuse reflectance or transmittance spectrum, respectively, is measured. These different sampling modes are explained schematically on the Sampling Modes page and typical spectra are plotted on the Applications page.

■ Controlled Sampling Depth

When the photoacoustic detector is operated in the absorbance mode, the sampling depth and effective optical density of the sample are independent of the physical sample thickness. The sampling depth is proportional to (sample thermal diffusivity / FTIR mirror velocity)$^{1/2}$ due to the signal generation role of absorption-excited thermal oscillations. These thermal waves are caused by the intensity modulation due to the FTIR interferometer and decay during propagation through the sample. The net result is that spectra are measured directly on micro- and macro-samples without sample preparation to reduce the sample's optical density. Furthermore, depth-varying information can be obtained by varying the mirror velocity as presented in one of the examples on the Applications page.

■ Multisampler Operation

The MTEC Model 200 has two sampling options which, by the use of interchangeable sampling heads, extend the accessory's capabilities beyond the standard capability of measuring macrosample absorbance spectra. Options SH003 and SH004 allow the MTEC Model 200 to switch in several seconds between diffuse reflectance, absorbance, transmittance and microsample measurements. The sampling heads are illustrated schematically on the Sampling Modes page and spectra are presented on the Applications page.

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