TECHNICAL NOTE

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Examination of Automobile Rubber Bumper Guards by Attenuated Total Reflectance Spectroscopy Using a Fourier Transform Infrared Spectrometer

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ABSTRACT: A piece from an automobile rubber bumper guard was found at the scene of a hit-and-run accident and was compared to a sample obtained from the front bumper guard of a suspect's vehicle. The samples were examined by attenuated total reflectance spectroscopy using a Fourier transform infrared spectrometer with data system.

KEYWORDS: criminalistics, rubber, automobiles

Automobile rubber bumper guard material may be of evidentiary value in hit-and-run accident investigations. In previous studies these materials have been examined by pyrolysis gas chromatography [*1*] and synchronous excitation spectrofluorometry [*2*].

Attenuated total reflectance (ATR) is a useful technique for obtaining the infrared spectra of many samples that cannot be examined by normal transmission methods. Fourier transform infrared spectrometers with associated microcomputers are especially suited to ATR techniques. Compared with dispersive infrared spectrometers they have greater energy throughput, higher resolution, better wavelength calibration, and higher signal to noise ratio; hundreds of scans can be run and added together in just a few minutes. Also, beam condensers and ATR sample holders are more easily aligned.

Materials and Methods

The bumper guard samples examined were two exhibits from a hit-and-run accident investigation. Exhibit A, a strip of light-blue rubber-like material approximately 25 by 6 mm (1 by ¼ in.), was recovered from the accident scene. Exhibit B was a control sample obtained from the front bumper guard of the suspect's automobile, a 1977 Plymouth.

A Nicolet Model 7199B FT-IR Spectrometer System equipped with a liquid-nitrogen-cooled mercury cadmium telluride (MCT) detector (Nicolet Model NIC-D7010B MCT) hav-

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ing a range of 5000 to 400 cm^{-1} was used. This equipment included the Nicolet 1180-E data system.

A Harrick 50- by 10- by 3-mm KRS-5 crystal with a 45° angle of incidence was mounted in the Nicolet ATR sample attachment. No beam condenser was used.

To have better contact between the sample and the KRS-5 crystal, a portion of the rubber sample was first placed in a KBr pellet press and pressed flat under several kilonewtons (tons-force) pressure. Instrument settings for both samples were these:

AFN = HG	(Apodization function: Happ-Genzel)
APT = FL	(Source aperture: full)
BDL = 10	(Beam delay time before sampling a disturbed beam)
COR = NO	(Correlate interferogram before signal averaging?)
FIT = YS	(Fit the plot curve between discrete data points?)
FSZ = 22528	(File size of data blocks on scratch pad disk)
GAN = 8	(Gain of amplifer board)
HPS = 1	(High pass filter setting)
LPS = 6	(Low pass filter setting)
MIR = SB	(Mirror position for sample bench)
NDP = 4096	(Number of data points collected per scan)
NPD = 60	(Number of data points used in phase calculation)
NPT = 256	(Number of transform points used in phase calculation)
NSD = 500	(Number of scans)
NSK = 0	(Number of skipped points between white light and start of data collection)
NTP = 8192	(Number of transform points)
PTS = 13	(Number of data points used in smoothing algorithm)
SGH = 8	(Switched gain for beyond the 1024th point)
SGL = 1	(Switched gain for the first 1024 points)
SMO = NO	(Smooth plot output with PTS algorithm?)
SSP = 2	(Sample spacing)
VEL = 37	(Velocity of moving mirror carriage)

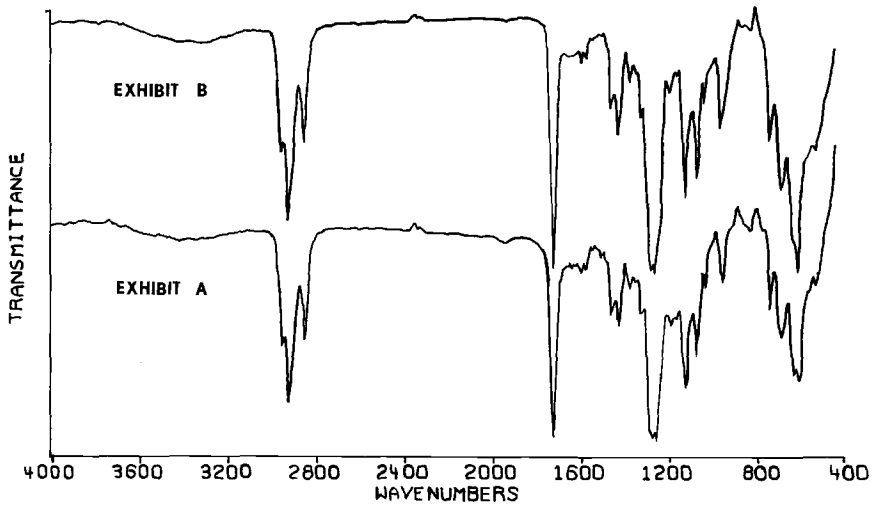

FIG. 1—*ATR spectra of piece of rubber bumper guard material found at accident scene* (Exhibit A) *and sample taken from suspect's vehicle* (Exhibit B).

Results and Discussion

The spectra obtained from the two exhibits are shown in Fig. 1. Each represents 500 separate scans that were added together. With each sample it took just over 6 min to obtain the 500 scans.

An added advantage of the ATR technique is that it is nondestructive. Portions of the same samples were subsequently examined by synchronous excitation spectrofluorometry [*2*] and by the pyrolysis gas chromatography method of Chih-An Hu [*3,4*].

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References

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