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Application Note

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Micro-Spectroscopic Interrogation of Automobile Paints

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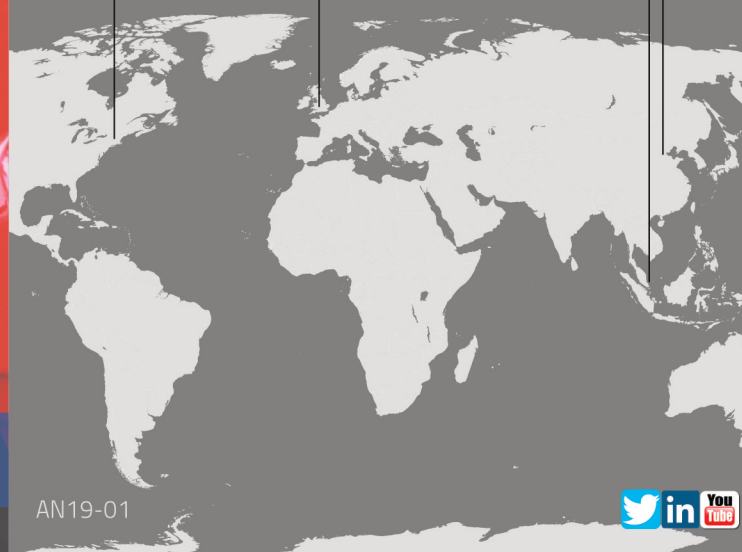


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Inside: Learn how the SurveyIR can be used to give spatial resolution to your IR spectra.

Introduction

In 2009, 246 million motor vehicles were registered in the US with 10.8 million of them being involved in an accident [1]. Many accidents resulting in injuries and fatalities are the result of criminal and irresponsible driving, leading to the need to identify suspect vehicles. Identifying potential subjects in an accident routinely involves the collection of paint chips or smears. This is especially the case in hit-and-run accident investigations where chips may form the only identifying link to the suspect vehicle.

Fortunately, vehicle manufacturers continuously change the chemical makeup of their paints. Automobile paints are comprised of binders (resins), dispersants, additives, and dyes. The components of paint exhibit unique spectral features when analyzed with Fourier Transform Infrared Spectroscopy (FT-IR). The investigation of an automobile paint chip is presented in this note.

The SurveyIR™ is a FT-IR Microspectroscopy accessory designed to deliver the ultimate user experience for a broad range of microanalysis techniques. SurveyIR's compact configuration and alignment free optical design facilitates simple mounting in the FT-IR spectrometer sample compartment.

- ▶ Minimal Setup
- ▶ Simple, repeatable measurement procedure
- ▶ Large depth of field
- ▶ Large field of view
- ▶ Options for Transmission, Reflection and ATR analysis modes
- ▶ High throughput design enables the use of your standard FTIR detector.
- ▶ No need for liquid N2 saving on your instrument running costs.

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AN19-01



Specac's
SurveyIR®

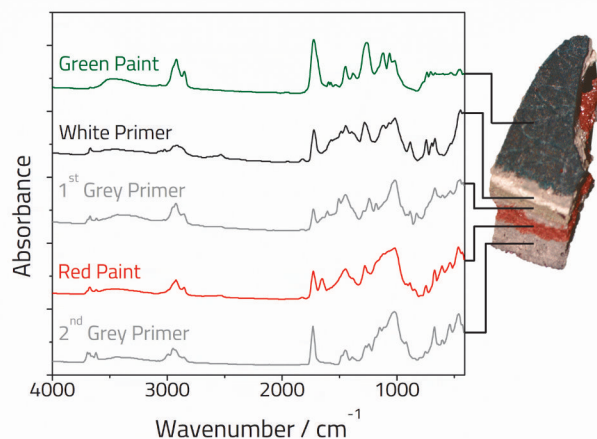


Figure 1: IR spectra from different layers in the paint chip (right).

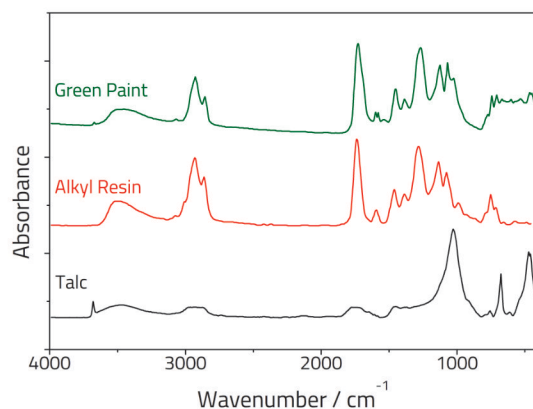


Figure 2: Spectra of Green Paint (Black) with 2 identified components: Alkyd Resin (Red) and Talc (Blue).

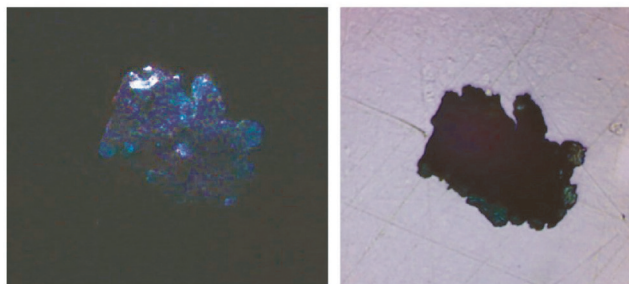


Figure 3: Green paint layer (Fig 1) shown in oblique illumination (A) and transmitted light illumination (B).

The high spectral throughput design enables the use of a standard FTIR DTGS detector saving on the use of liquid N_2 . This detector also offers superior quantitative measurements due to its improved linear response relative to standard FTIR microscopes that require the use of MCT detectors due to low throughput.

Experimental

One of the most challenging parts of automobile paint identification is the sample itself. Ideally, large amounts of paint would allow for a range of tests to be conducted. However, this is not always the case and, just a small paint chip or smear may be all that is available for analysis.

A paint sample containing five paint layers was collected from a vehicle shown in Fig. 1. A tungsten needle was used to extract small chips from each layer. The small chips were then rolled flat on plain glass microscope slides and transferred to KBr 13x2 mm windows. Corresponding spectra of each layer were recorded at 8 cm^{-1} resolution on a commercially available spectrometer equipped with a SurveyIR.

Results and Discussion

The ability to differentiate paint layers can be readily seen in the IR spectra shown in Fig. 1. An additional advantage of SurveyIR, through use of the instrument mounted DTGS detector, is the observation of bands in the lower frequency range, 700-400 cm^{-1} . Most microspectroscopy systems are limited in spectral range and require liquid nitrogen cooling. The observation of bands in this range is especially important regarding paints, as the spectra of inorganic additives in paint give rise to distinctive spectra in this region (Fig. 2). Some common features exist throughout all the samples such as the strong intense band seen around 1730 cm^{-1} . This band is due to C=O stretching, most likely from common alkyd resins used in modern paints. In addition, the spectrum of talc is observed, exhibiting varying intensities throughout the different layers. Talc is a very common additive in paint.

A novelty of the SurveyIR is the ability to quickly switch between viewing illuminations while simultaneously viewing the sample. For this sample, transmitted light allows the user to

visualize the sample edges and some color of the sample can be seen in Fig. 3, b. The oblique illumination (dark field illumination) provides much more detail regarding the surface of the paint, accentuating the color. This can be useful in the case of small paint smears. Compared to chips, a paint smear may be too small to remove from the surface and the clip-on ATR gives the investigator the ability to analyze the sample on the surface while the oblique illumination provides the best contrast to locate the sample.

The top green paint layer shows a strong correlation with an alkyd resin-based paint as displayed in Fig. 2. Due to the vast number of different compositions of alkyd resins, an exact library match of the resin used can be difficult to make. The other component in the green paint that can be identified is Talc which helps pigments adhere to vehicle surfaces, resulting in increased durability. The pigment in the green paint layer was not identified. This could be due to a relatively low concentration of the pigment and its spectrum was masked by the other constituents.

Conclusions

The spectra shown in Fig. 1 are unique from one layer to the next and can be analyzed individually as shown with the first green paint layer (Fig. 2). The wealth of information gathered from all the different paint layers creates indisputable evidence in the case that this car was involved in an accident. The general ability of FTIR spectroscopy to assist in the identification of paint samples to be later used in a criminal case is well known. The SurveyIR microspectroscopy enhances the investigation of paint chips or smears by providing both illumination and sampling options covering a wide range of samples. The SurveyIR can be used to analyze coatings and is applicable to forensic investigations and industrial coatings analysis.

References

- [1] "Motor Vehicle Accidents--Number and Deaths." The United States Census Bureau, 30 Sept. 2011.