Module 4F

Forensic Examination of Paints

Forensic Science Teacher Professional Development

Part 6 Forensic Examination of Paints

- Many objects are coated with paint for either protective or aesthetic reasons.
- Paint samples are mostly encountered in hit-and-run or burglary cases.
- Forensic examination of paint samples is conducted with nondestructive methods first, followed by destructive methods.

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- One of the nondestructive methods is microscopic examination to determine the following physical properties:
  - Color, surface texture, contamination, and weathering features
  - Striations due to wear, impact, application techniques, or underlying surface irregularities
  - Paint layering order and thickness
  - Pigments or dyes
  - Vehicles, resins, modifiers

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- For example, under a stereomicroscope, we can determine the sequence of layers of automotive paints.
- Physical separation of mixed paint samples may be possible with the use of needles, tweezers, or scalpels under a microscope.
- The layer sequence of a paint sample can be determined by examining the cross section of the paint sample.

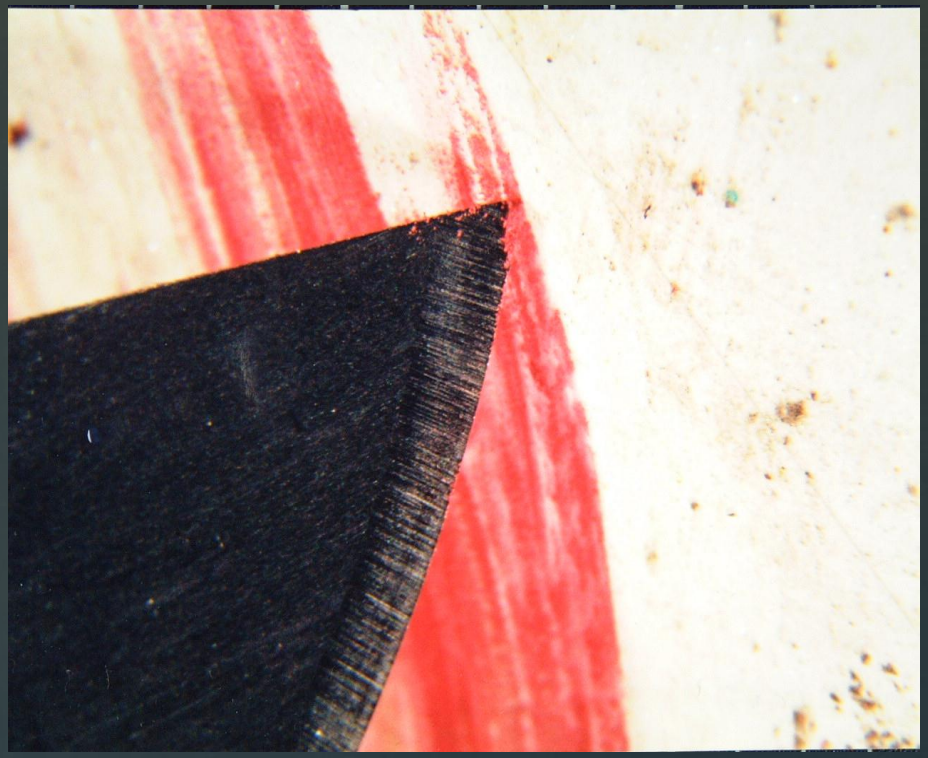

Figure 23 Separation of smeared red paint samples from a white substrate under a stereomicroscope

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- Depending on the resources and instruments available in a trace lab, procedures to complete the examination of paint samples may be different.

- ASTM (American Society of Testing and Materials) has published the SWGMAT standard protocol, *ASTM E1610 - 02(2008) Standard Guide for Forensic Paint Analysis and Comparison*, for paint sample examinations.

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- Forensic Paint Analysis and Comparison Guidelines can also be found from the Paint Subgroup of the Scientific Working Group on Materials Analysis (SWGMAT) (formerly the Technical Working Group on Materials Analysis [TWGMAT]).

Review the link:

http://www.swgmat.org/Forensic%20Paint%20Analysis%20and%20Comparison%20Guidelines.pdf

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- Here, we will briefly introduce the use of Fourier Transform Infrared Spectroscopy-Microscope (Micro-FTIR) (Figure 24) and pyrolysis – gas chromatograph/mass spectrosplitmetry (Py-GC/MS) (Figure 25) for the analysis of paint samples.

Figure 24 Microscope coupled with a Fourier Transform Infrared Spectrometer

Figure 25 A pyrolysis – gas chromatograph/mass spectrometry

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- Paint samples are sometimes embedded with resins before cross-sectioning. Figure 26 shows a microscopic view of the cross section of a paint sample embedded with poly methyl methacrylate. The orange area indicates the aperture where the infrared spectrum is acquired.

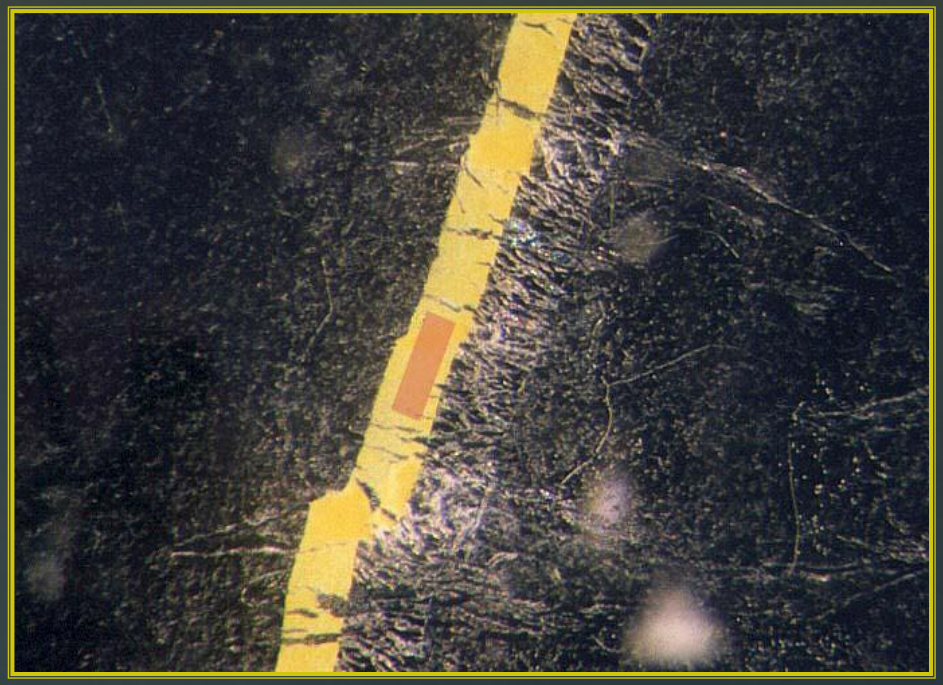

Figure 26 Microscopic examination of the cross section of a paint sample

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- From the infrared spectrum of a paint sample, the chemical property of the sample can be determined and characterized. Figure 27 shows a typical micro-FTIR spectrum of a paint sample. In some cases, the type of pigment can also be detected by using Micro-FTIR.

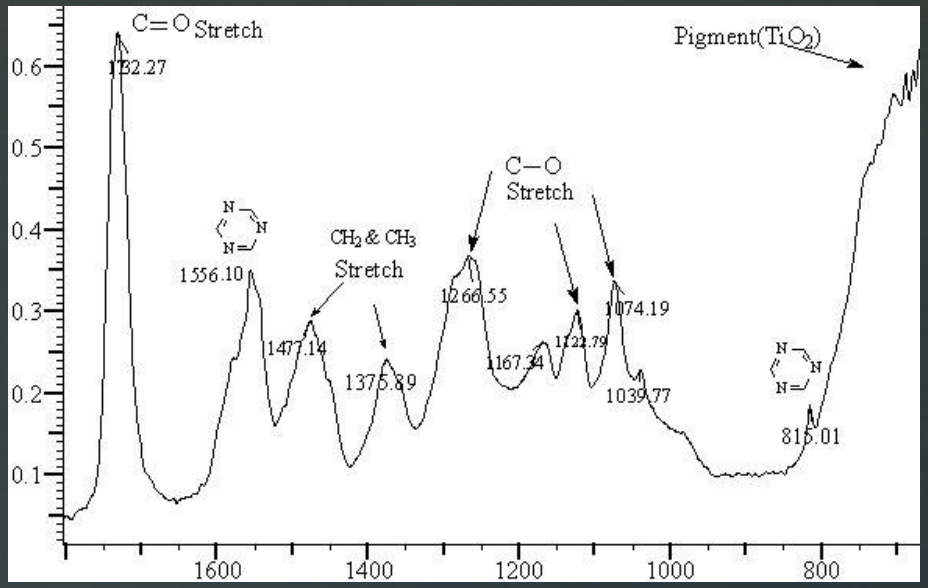

Figure 27 **A typical Micro-FTIR spectrum for a paint sample**

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- Py-GC/MS is another powerful analytical instrument for the analysis of paint samples.
- Polymers are first pyrolyzed into their building block molecules and then analyzed by a GC/MS. Ingredients of paint samples, such as acetic acid, isobutanol, butanol, ethyl acrylate, methyl methacrylate, ethyl methacrylate, 2-ethylacrolein, butanoic acid, 2-hydroxy ethyl methylacrylate, etc., can be readily identified.
- Different binder systems, such as acrylic or polyester-melamine, can also be determined by Py-GC/MS. However, Py-GC/MS is a destructive analytical method.
- It should be performed as the last step in an analytical scheme of paint samples. Fortunately, samples required for a Py-GC/MS analysis fall into the milligram level.

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Figure 28 shows an example of using Py-GC/MS to differentiate two different paint samples.

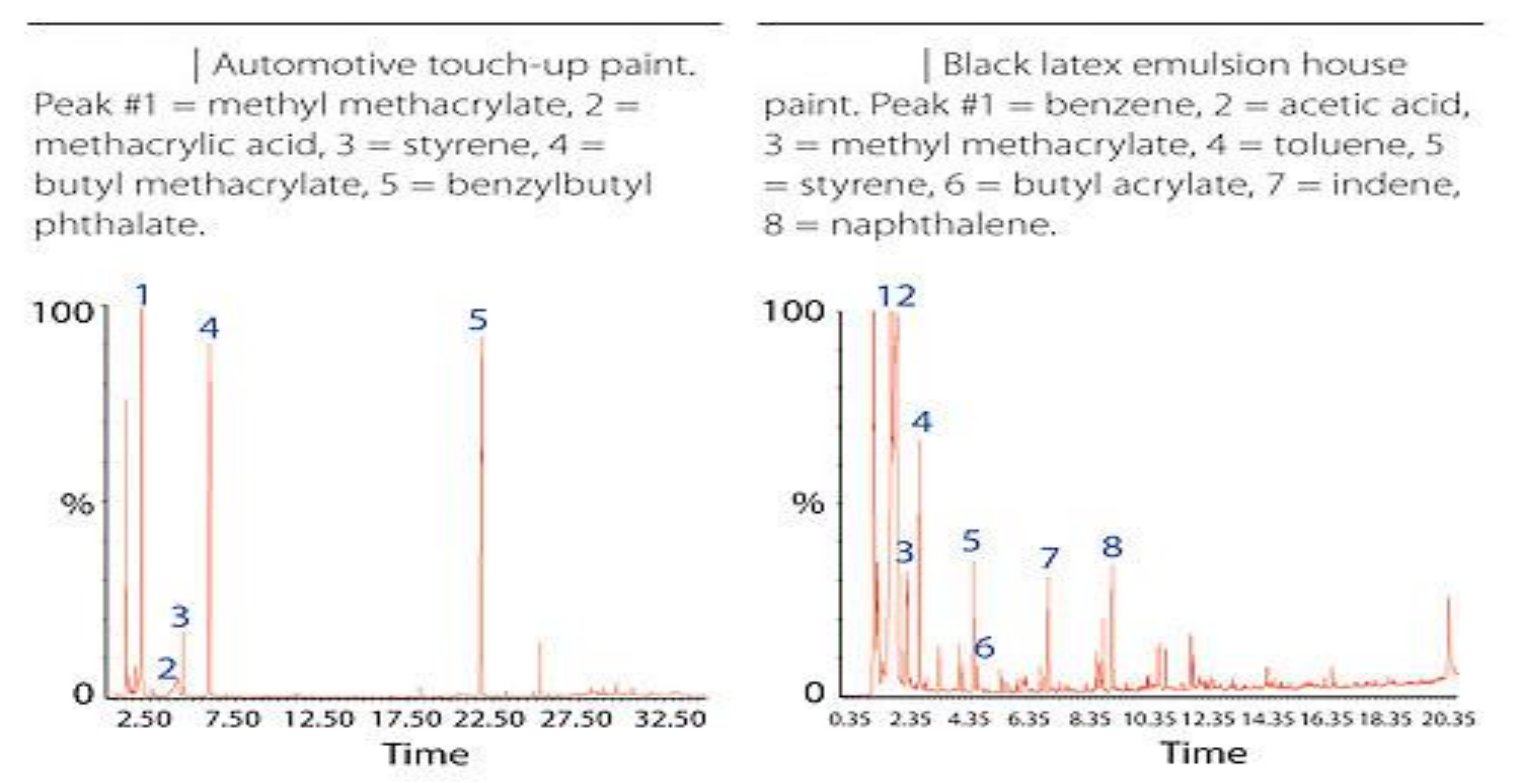

Figure 28 An example of using Py-GC/MS to differentiate two different paint samples
http://www.pcimag.com/PCI/Home/Images/pci0209-CDS-F3-4-lg.jpg

End of Module 4F

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