B86 Total Imaging Analysis of Paint

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After attending this presentation, attendees will understand a new approach to the analysis of paint samples (or any lamellar exemplars).

This presentation will impact the forensic science community by demonstrating an alternative approach to paint analysis which may then become available in additional laboratories.

The analysis of paint evidence has a long history as a subdiscipline of trace evidence. Automotive paint, in particular, can be probative in hit-and-run cases. These paints are analyzed for their class properties and can be cross-referenced to databases such as Paint Data Query (PDQ). Routine paint analysis involves optical characterization of component layers followed by chemical analyses of those layers via vibrational spectroscopy (Infrared (IR) and Raman), pyrolysis gas chromatography, Scanning Electron Microscopy with Energy Dispersive X-ray (SEM/EDX) analysis, and Laser-Induced Breakdown Spectroscopy (LIBS), to name a few. Many of these are non-destructive, inducing little damage to original evidence.

Recent advances in IR imaging provides the paint examiner with a new tool. Particularly useful are instruments that have the capability to capture microscopic IR images with a Total Attenuated Reflection (ATR) device. These devices allow for better energy throughput to the sample than traditional IR microscopes. It should be noted that all of these devices collect data using interferometers (Fourier Transform). IR techniques alone assist in the identification of the majority of organic components of binders and extenders as well as some inorganic components. Inorganic components not captured with IR may be found in an X-ray analysis using SEM/EDX.

Traditionally layer characterizations (e.g., number of layers, colors, and dimensions) are performed by optical microscopy. Difficulties may arise when adjacent layers appear as the same color and cannot be observed with visible light, whether polarized or not. These layers may become apparent when using various light sources, although these manipulations tend to be subjective in nature and prone to artifact. Alternative contrast sources have been shown to help develop the number of layers in a paint sample, one of which is backscatter electron detection in an SEM.

Results will be presented of a paint analysis scheme which not only takes into account the visible images but images in the IR and X-ray regions. One acrylic mounted paint chip can be used throughout the experimental process. The IR images are color-enhanced representations of IR space in which each pixel represents an IR spectrum in the energy range of $4{,}000^{-1}$-750 cm^{-1}. X-ray maps of constituent elements are provided for each sample alongside a back-scatter electron detection image of the lamellae. The maps are acquired using a variable pressure option on an SEM and hence no sample preparation is required to avoid charging of the sample and image degradation over the course of the map acquisition. Validation samples will be provided that show structural and spectroscopic replication of known PDQ samples.

The techniques discussed in this presentation may be extended to other lamellar materials such as food packaging.

Paint, FTIR Imaging, X-Ray Mapping

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