ZEISS EVO
Forensic Paint Analysis

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Introduction

As most surfaces are painted, paint is a significant source of trace evidence and can reveal vital information to forensic scientists. Paint is a coating and made of four principal components; solvent, binder, pigment and filler.

- Solvents are present to aid the manufacturing and application processes but are evaporated and removed during the application and drying processes.
- Binders improve the adhesion and cohesion properties, keeping the pigment within the paint and ensuring that the paint remains attached to the substrate.
- Pigments are inorganic or organic particles that provide color and opacity.
- Filler influences the gloss and toughness of the surface.

Forensic paint analysis is used to determine the fundamental facts in vehicular accidents and homicide cases (particularly in respect to accident dynamics) or in identifying the participating vehicles. Forensic paint analysis is also used to investigate damages, scrawling, graffiti and burglary cases.
Paint residues are generally found on the suspects, suspected burglary tools or other devices used to carry out criminal activity. Other areas in which forensic paint analysis can be used is archaeology and historical science. A painting or an artwork can be accurately authenticated (forgery cases) through a combination of forensic stylistic analysis and paint analysis.

Paint in Forensic Science

In addition to the color, the number and sequence of the paint layers are the main factors that can link distinguishable paint specimens. Vehicle manufacturers use multi-layer sequences. This helps the forensic scientists in their primary investigation envisaging the origin of the sample. Paint is often a multilayer composite material and the "control samples" should therefore contain all layers of the undamaged paint. A conclusion can only be made when each layer of the sample is compared with the corresponding layer in a "control sample".
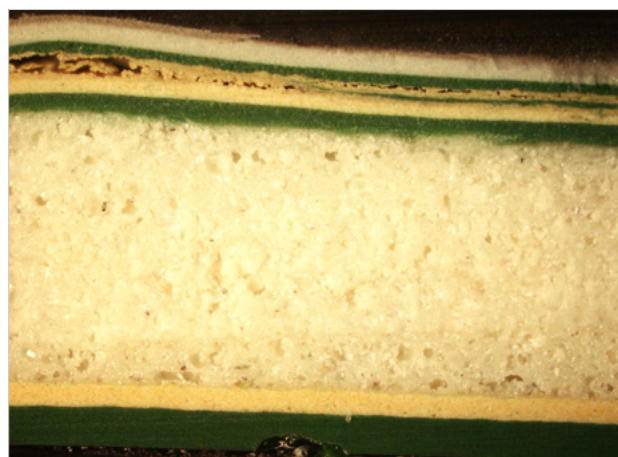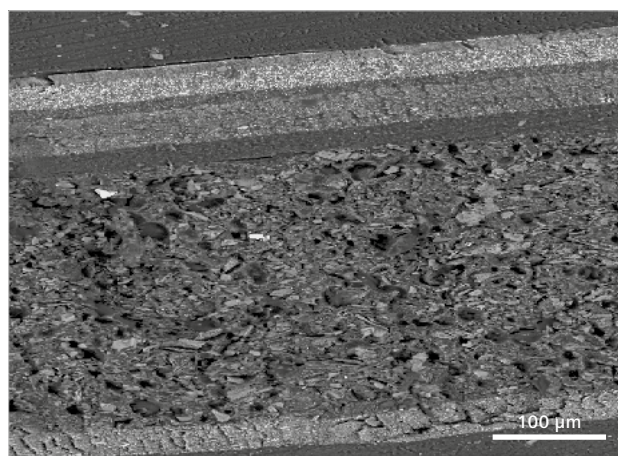

Figure 1 *11 layers*

Figure 2 *11 layers*

Scanning Electron Microscopy (SEM)

Optical light microscopes are used as a primary tool for identification of the paint's color and the number of layers. SEMs are regarded as useful instruments in forensic paint analysis and reveal more detailed information with regards to each layer. SEM images are used for the characterization and comparison of the paint structure, based upon layer number, layer thickness, distribution and size of the pigment particles, and the presence of contaminants. Fig. 1 and 2 show the light microscope and SEM images taken from a paint chip. The images reveal information on the pigments and the number of layers of the specimen.

Raman Spectroscopy, Infrared Spectroscopy, fluorescent microscopy and polarized light microscopy are examples of complementary techniques that are also used for identifying the chemical composition and for comparison of different types of paint flakes, chips, and smears.

The imaging and compositional results can then be compared to the "control paint sample" by a forensic specialist.

The control paint sample is taken from a known source by a trained crime scene investigator. The comparisons of crime scene samples and control samples are regularly used as evidence in courts of law.

Energy Dispersive X-ray Spectroscopy (EDS)

SEMs equipped with EDS systems are used to determine the elemental composition of the paint in different layers. Variable pressure (VP) imaging is also used for the imaging and analysis of insulating paint layers. The backscattered detector image of the paint chip in Fig 3 reveals: the presence of layers, individual textures, and the variation of thicknesses across the layers. The EDS spectrum in Fig. 4 provides information about the chemical composition of the marked layer of the paint flake. The ninth layer contains: C, O, K, S, P, Cl, Na, Si, Ti, Al, Mg, and Zn.
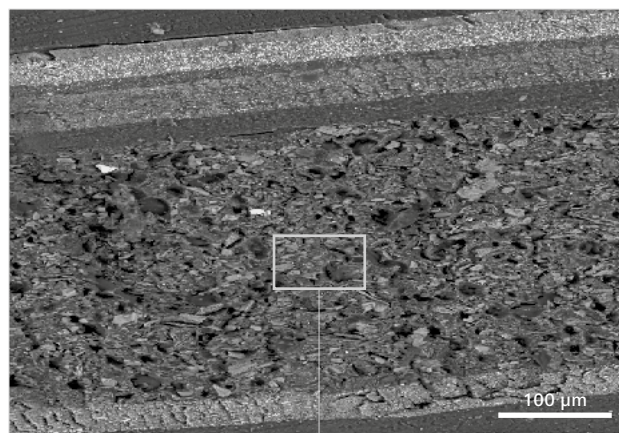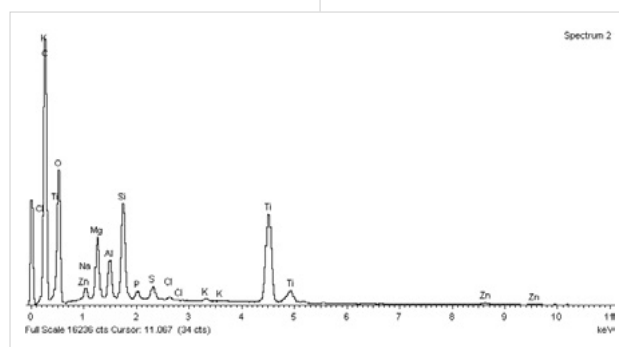

Figure 3 *BSD image*

Figure 4 *EDS*

Recommended configuration

- EVO MA 10,15, 25
- HDBSD
- VPSE Detector (G3)
- EXTIF cable
- Third party EDS detector
- Joystick
- Chamberscope

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