B91 A Forensic Analysis of Automotive Paint Evidence Using Direct Analysis in Real-Time Mass Spectrometry (DART®-MS)

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After attending this presentation, attendees will have a fundamental understanding of the significance of automotive paint evidence as it pertains to automobile crashes, hit-and-run accidents, and vehicular homicides. Furthermore, attendees will be familiar with a novel rapid analytical protocol involving DART®-MS for the chemical interrogation of automotive paint evidence.

This presentation will impact the forensic science community by demonstrating a unique analytical methodology for the forensic analysis of automotive paint evidence. The following research seeks to highlight the potential of this technique for the analysis of paint and polymer evidence in an effort to add another instrumental method to the current suite of analytical techniques available to the forensic examiner.

While no current universal methodology exists for forensic paint examination, general frameworks for the analysis of paint evidence can be obtained through guidelines developed by the Scientific Working Group on Materials Analysis (SWGMAT) and the American Society for Testing and Materials (ASTM).[1,2] These guidelines advise that forensic examiners use a combination of microscopic and instrumental techniques to characterize both the organic and inorganic components of the paint samples. Most forensic paint examinations begin with optical microscopy, followed by Infrared (IR) spectroscopy and, if necessary, pyrolysis-Gas Chromatography (py-GC), often interfaced to a Mass Spectrometer (MS). Py-GC/MS is the most discriminating technique available to the forensic paint examiner for differentiating between samples with similar binder compositions. Although the discriminating capability of this technique is high, it is a destructive technique and sample analysis is extremely time intensive.

As a result, DART®-MS was employed to investigate if this technique can pyrolyze and characterize automotive paint coatings. DART®-MS is an ambient ionization technique capable of rapidly analyzing samples in any physical state with high resolution and accurate mass detection, while requiring minimal sample preparation. An optimized protocol has been developed and used to pyrolyze a small subset of automotive clear coats obtained from black vehicles. The mass spectral data were compared to results obtained from a standard py-GC/MS protocol developed by the Florida Department of Law Enforcement. Preliminary data indicate that DART®-MS with a gas heater temperature of 550°C is able to pyrolyze and analyze automotive coatings within five minutes, a significant improvement on current py-GC/MS methodologies. Interpretation of the data obtained from both instrumental techniques revealed that the information was complementary in nature. Additional analysis of the paint samples was conducted using the ionRocket DART®-MS system, which enables more precise temperature control and a greater temperature gradient. Approximately 10 to 20 automotive clear coats were then characterized using the DART®-MS protocol and multivariate statistics (cluster analysis, principal component analysis, and linear discriminant analysis) were utilized to assess the chemical diversity of the clear-coat population (intra- vs. inter-sample variability).

Reference(s):

1. Scientific Working Group for Materials Analysis (SWGMAT). Forensic paint analysis and comparison. *Forensic Science Communications.* 2002, 1 (2).

2. ASTM E-1610-02. *Standard guide for forensic paint examination*. ASTM International, West Conshohocken, 2002.

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