B182 A Comparison of Direct Analysis in Real-Time High Resolution Mass Spectrometry (DART®-HRMS) and Pyrolysis-Gas Chromatography/Mass Spectrometry (Py-GC/MS) in Automotive Paint Analysis

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Learning Overview: After attending this presentation, attendees will understand the benefits of using DART®-HRMS in comparison to Py-GC/MS when analyzing automotive paint evidence.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by introducing a rapid ionization technique for the analysis of automotive paint evidence. Furthermore, a comparison of the discriminatory capabilities of both techniques will be demonstrated.

Currently, there are three common analytical techniques used for the analysis of automotive paint: microscopy, infrared spectroscopy, and Py-GC/MS. Py-GC/MS is the gold standard when it comes to automotive paint analysis due to its ability to differentiate between paint samples that are indistinguishable by infrared spectroscopy. The reason for the high discriminatory capability of Py-GC/MS is the technique's sensitivity to binders, additives, and cross-linking agents. However, a disadvantage of Py-GC/MS is that the technique is time consuming and destructive to actual case samples.

A preliminary study determined that DART®-HRMS could discriminate black car paint samples and provided comparable results to Py-GC/MS.[1] Therefore, a larger study was conducted to determine if DART®-HRMS provides better or comparable discriminatory results to Py-GC/MS while also having the advantage of analyzing samples in a fraction of the time. DART®-HRMS is a rapid screening technique that uses soft ionization. The technique requires little sample preparation and rapidly analyzes samples in four minutes under ambient conditions. Moreover, DART®-HRMS has the capability to measure the mass of large and high-weight molecules, such as polymers commonly found in automotive paints. Both techniques were compared to assess how the data obtained from DART®-HRMS related to that of Py-GC/MS.

A cross-section of the paint was cut with a scalpel from 100 samples that were obtained from automotive body shops around the Orlando, FL, area and from a junkyard in Pembroke Pines, FL. A VHX 6000 Keyence digital microscope was utilized to visualize the cross sections and determine layer systems of each sample. The clear coat and base coat of the 100 samples were analyzed using DART®-HRMS in positive ionization mode. Several samples were analyzed, in triplicate, in negative ionization mode on the DART®-HRMS; however, no additional information was obtained. The clear coats of the set of 100 samples were also analyzed in duplicate with Py-GC/MS for comparative purposes. Principal Component Analysis (PCA), Hierarchical Cluster Analysis (HCA), and Linear Discriminant Analysis (LDA), were performed on the data to determine the classification potential of each instrumental technique. HCA was performed to identify unsupervised clusters within the data. Then, PCA was utilized to reduce the dimensionality of the data set to make it easier to visualize the patterns in each dataset. Last, LDA was performed to determine the accuracy of the models. The multivariate statistics performed on the data demonstrated that DART®-HRMS can be as discriminating as Py-GC/MS. DART®-HRMS has the potential to be a great addition to the analytical techniques currently used for the analysis of automotive paint due to the method's rapid analysis time.

This research was supported by the 2017 Forensic Science Foundation's Lucas Grant.

Reference(s):

1. Maric, M.; Marano, J.; Cody, R.B.; Bridge, C. DART-MS: A New Analytical Technique for Forensic Paint Analysis. *Analytical Chemistry* 2018.

Automotive Paint, DART®-HRMS, Py-GC/MS