B52 Forensic Fiber Analysis by Thermal Desorption/Pyrolysis Direct Analysis in Real Time Mass Spectrometry (TD/Py-DART®-MS)

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Learning Overview: After attending this presentation, attendees will better understand an alternative method for fiber analysis.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by presenting how TD/Py-DART®-MS could be used to analyze the polymer backbone of the fiber and other chemical residues from different fiber treatments during manufacturing.

The DART®-MS and TD/Py system can be used to distinguish among different types of fibers and provide orthogonal information for fiber identification. This research is a pioneer for gradient heating controlled Py-DART®-MS, which will hold great potential across a broad range of topics in the analytical chemistry area and impact the forensic science community, especially within forensic fiber analysis.

The forensic examiner should perform a combination of methods to characterize the fiber evidence in order to provide a complete and specific description of the item and rigorously assess its uniqueness and value as evidence.[1-3] The identification or the comparison of fibers requires an examiner to perform at least two of the analytical techniques for each of the following categories: generic class, physical characteristics, and color. Morphological comparison of fiber evidence by microscopic techniques is required in forensic case work since it can offer characteristic information of fibers in all three categories. Additional analysis is required for each category and, ideally, orthogonal techniques should be used (inorganic/organic, spectroscopy/chromatography/mass spectrometry, etc.) to provide the most discriminating information.[4-6] Ambient MS methods such as DART®-MS can be an alternative method for fiber analysis. The objectives of this research were: (1) to evaluate the potential of DART®-MS for fiber analysis, and (2) to classify fiber samples based on their types by using DART®-MS technique and chemometrics.

The pyrolysis device, IonRocket®, was coupled with DART®-MS to assist the analysis. The IonRocket® system is an ideal unit for the analysis of polymers with which the samples can be heated up to 600°C with accurate temperature gradient control for DART®-MS analysis. The temperature was increased at the rate of 100°C per minute, so data with three dimensions consisting of *m/z*, time (=temperature), and intensity was generated, which further enhanced the discriminating power comparing with sole DART®-MS analysis when chemometrics was applied. TD/Py-DART®-MS was used to analyze fiber evidence efficiently and effectively because it provided an objective evaluation for a greater variety of characteristics of fiber evidence than the optical microscopic method and eliminates the need for complicated sample preparation procedures necessary for other MS-based instrumental analyses. A wide array of information related to the physical properties (e.g., melting point, sublimation point, and degradation temperature) and chemical composition of fiber evidence was achieved from TD/Py-DART®-MS analysis.[7] The versatility of the analysis can increase the discriminating power (specificity) and improve the accuracy of results for fiber evidence while still providing timely results for investigators. Principal component analysis was successfully applied to classify the fibers based on the materials of textile fibers.

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Fiber, DART®-MS, Chemometrics

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