B17 Ambient Ionization Mass Spectrometry (AMS): A New Forensic Tool for Adhesive Tape Evidence Discrimination

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Learning Overview: After attending this presentation, attendees will be better informed about AMS techniques for the analysis of tape evidence. In particular, the methodology will explore analyzing different types of adhesive tapes to identify discriminating mass spectral properties. AMS techniques were utilized in new ways to aid forensic investigations in exploiting novel evidence items, such as tape.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an additional technique for analyzing forensic adhesive tape evidence. This technique was optimized to distinguish the manufacturer of the tape samples. This new technique is able to provide data in real time that has the potential to expedite a forensic investigation. Additionally, this technique could be optimized for other sample types. The optimization of the different types of AMS sources could lead to a wider applicability of this methodology as a tool in discriminating other evidence types commonly encountered in the crime scene.

Adhesive tapes are often found at crime scenes, and these tapes supply numerous investigative leads, if treated properly. Trace evidence (hair, fibers, etc.) are often found on tapes, along with DNA and fingerprints. Physical tear matches can also be performed to link a piece of tape to the original roll it came from. There is also one other way that forensic professionals analyze adhesive tapes, and that is via chemical analysis. Chemical analysis of adhesive tapes is where the adhesive and/or backside layer of the tape are analyzed to get its chemical composition. The chemical information is used to differentiate the tapes by type and/or brand, which is important because it allows investigators to make connections between suspects and the tape evidence. Several chemical analysis techniques, including Fourier Transform Infrared (FTIR), Pyrolysis-Gas Chromatography/Mass Spectrometry (Py-GC/MS), Isotope Ratio Mass Spectroscopy (IRMS), Laser Ablation-Inductively Coupled Plasma/Mass Spectrometry (LA-ICP/MS), Nuclear Magnetic Resonance (NMR), and Energy-Dispersive X-Ray Spectroscopy (EDX), have been shown to yield different accuracy in distinguishing tape brands, but, while they offer several advantages, they may require intensive sample preparation, complex instrumentation with limited accessibility, or are destructive in nature. AMS is a relatively new, easy-to-use, cost-effective, and portable technique that allows direct desorption/ionization from sample substrates with little-to-no sample preparation to yield chemical analysis in real-time.

The purpose of this study was to develop and evaluate different AMS approaches, such as direct desorption Flowing Atmospheric Pressure Afterglow (FAPA), and Laser-assisted Desorption (LD) AMS for analyses capabilities of adhesive tapes. With these different approaches, multiple different tape types were analyzed, including silver duct tape and black electrical tape. There were numerous manufacturers of each tape tested to be able to distinguish and categorize the types of tape, and the brands of each tape. Data were analyzed using Principle Component Analysis (PCA) and the Partial Least Squares (PLS) method in order to find the covariance and correlations that lead to the discrimination of tapes by manufacturer. This technique captured an array of structural information for each tape under study, thereby highlighting promising results of ambient ionization techniques as a forensic tool.

Adhesive Tape, Ambient Ionization, Manufacturer