D49 Trace Detection Ion Mobility Spectrometry Analysis of Illicit Narcotics

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The goal of this presentation is to highlight the feasibility of using ion mobility spectrometry (IMS) for the rapid field identification of trace narcotics. The practical considerations addressed in the presentation should allow drug screeners to have a better understanding of ideal parameters that commercial instruments should be operated under as well as aid in the identification of sources of false positives.

This presentation will impact the forensic community and/or humanity by demonstrating how IMS is a practical tool for the rapid screening of illicit narcotics with high sensitivity. Its ability to detect particles invisible to the naked eye makes this technique ideally suited for detecting trace amounts of explosives, narcotics, and other forensic- related substances. The forensic community should have a better understanding of the environmental background levels that exist regarding drug screening as well as possible sources of false positives. Also, understand the sensitivity of the commercial instruments used to screen for drugs.

Current national priorities in homeland security have led to an unprecedented level of utilization of trace explosive detection systems for counter terrorism and law enforcement. The most commonly deployed trace explosives detectors are based on chemical analysis by ion mobility spectrometry (IMS). People who carry or handle explosives are likely to transfer residues on surfaces that they come in contact with or retain residues on their clothes. This residue contains discrete particles of explosive that can be sampled by an IMS system. Due to the low vapor pressure of most explosives (and narcotics), direct vapor sampling of these materials by IMS is problematic. Therefore, in most IMS systems, the particles collected are converted to vapor by thermally assisted desorption. IMS is essentially a molecular size analyzer, which measures the atmospheric pressure mobility of charged analyte molecules and compares them to a reference library of a known explosive and/or narcotic. Since most narcotics are efficiently detected by ion mobility spectrometry, this has raised the intriguing possibility of (dually) using the existing and widely deployed IMS explosives detection instruments as trace narcotics detection systems for interdiction of narcotics and controlled substances. Such a capability may be of particular interest to U.S. Customs and Border Patrol, the Drug Enforcement Agency (DEA), FBI, US Coast Guard and State and Local Law Enforcement.

This work highlights the ongoing research at the National Institute of Standards and Technology (NIST) aimed at determining the feasibility of using ion mobility spectrometry (IMS) for the rapid field identification of trace narcotics. A series of practical experiments measured fingerprint IMS spectra as well as the linear dynamic range and detection limits for a series of illicit narcotics including cocaine, heroin, THC, and methamphetamine. Typical detection limits for these compounds are in the range of 0.1-100ng, which corresponds to the detection of one single particle with a diameter of a few tenths of a micrometer. A multivariate parameter approach was used to determine optimal instrumental conditions for the different narcotics. Parameters explored include desorber temperature, drift/tube temperature, and inlet temperature. Due to the significant concern of determining that the target compound was correctly identified, a database was developed of false positive alarms and interferences resulting from a wide variety of over-the-counter medications, household, and personal care products. Excipients and/or diluents commonly found in street narcotics were also carefully screened to determine their effect, if any, on IMS response. In addition, practical sampling issues were studied including optimal swiping procedures for best sensitivity as well as the influence of possible environmental background signatures that may be relevant to trace narcotics detection (for example, the widespread contamination of US currency by Cocaine). The identification and confirmation of compounds leading to false positive alarms was evaluated by using gas chromatography/mass spectrometry (GC/MS) from extracts taken from the swipes. From these experiments, it has been determined that IMS is a practical tool for the rapid screening of illicit narcotics with high sensitivity. Its ability to detect particles invisible to the naked eye makes this technique ideally suited for detecting trace amounts of explosives, narcotics, and other forensic-related substances. One significant issue of concern is the potential for a high degree of false positive alarms due to environmental background and the low resolution of the technique. This suggests that the combination of IMS with an initial separation step such as GC may be important for continued development of this approach for practical field analysis.

Illicit Narcotics, Trace Detection, Ion Mobility Spectrometry

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