A149 Air Sampling and Detection of the Plastic Explosives C-4 and Semtex Via Their Volatile Chemical Markers by SPME-IMS

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After attending this presentation, attendees will understand some principles of solid phase microextraction - ion mobility spectrometry and the improved detection methodology for low vapor pressure plastic explosives.

This presentation will impact the forensic community by providing law enforcement agencies with an IMS instrumental configuration that is capable of responding to low vapor explosives via their volatile chemical markers.

This research utilizes solid phase microextraction (SPME) as an air sampling and preconcentration technique to collect the volatile chemical markers of plastic explosives C-4 and Semtex followed by detection using ion mobility spectrometry (IMS). Currently, sampling of explosives is most commonly performed via the physical removal of particles from suspected surfaces or by high volume air sampling of containers for explosive particles, following detection using analytical techniques. However, in the case of plastic explosives C-4 and Semtex, the parent compounds cyclotrimethylenetrinitramine (RDX), and pentaerythritol tetranitrate (PETN) have very low vapor pressures, making them unavailable in the headspace for air sampling. This project targets the odor signature compounds present in the headspace of the explosives, rather than the explosives themselves because these compounds are much more readily present in surrounding air due to their high vapor pressures.

The analytical instrument used in this research is a commercially available IMS fitted with a novel solid phase micro-extraction (SPME) interface previously designed in the Almirall research group. This interface allows for the desorption of SPME fibers used in the sampling and pre-concentration of volatile compounds of drugs and explosives. The IMS instrumental conditions such as drift tube's temperature, drift and carrier flow rates, reactant gas, and operating mode have been optimized systematically to simultaneously detect multiple volatile markers of the plastic explosives.

This presentation will report the odor signatures found in the headspace of explosives C-4 and Semtex using SPME-GC/MS as a confirmatory technique, and the optimized operating conditions of the IMS instrument in order to achieve the best response for the odor signature compounds, cyclohexanone, 2-E-1-hexanol, and 2,3-dimethyl, 2,3-dinitrobutane (C-4), cyclohexanol, methacrylic acid, butyl ester/ethylene ester (Semtex), as well as the IMS instrument's limit of detections and linear dynamic ranges for each of the odor signature compounds. Headspace sampling and detection of the actual C-4 and Semtex explosive mixtures will be reported. In addition, the minimum SPME extraction times and the SPME equilibrium extraction time will be reported.

Ion Mobility Spectrometry, Solid Phase Microextraction, Plastic Explosives

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