B90 Demonstration of the Utility of a Planar Geometry Solid Phase Microextraction Device for Use With Ion Mobility Spectrometers

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After attending this presentation, attendees will understand the principles and utility of a novel planar SPME geometry coupled to IMS. This presentation will impact the forensic community by demonstrating a novel SPME extraction geometry that when coupled to IMS will provide forensic examiners increased sensitivity for threat agents without compromising the ease of use, reusability, and ruggedness of commercially available SPME.

Solid Phase MicroExtraction (SPME) is a simple technique that is useful for the pre-concentration and extraction of trace level explosives from air or aqueous samples. The use of SPME is advantageous for explosives analysis since it requires no elution solvent which would otherwise dilute the already trace level samples. A representative portion of the analyte is extracted from the sample matrix and introduced entirely into the analytical instrumentation for detection. An Ion mobility spectrometer (IMS) has been successfully coupled to SPME,[1] and is commonly used in screening checkpoints around the world for the routine detection of explosives and illicit drugs. This interface converts IMS from a particle sampler to a vapor sampler, increasing sensitivity and enabling the extraction of the taggants and odor signatures of explosives rather than simply the parent compounds. Furthermore, the interface utilizes a modified-syringe geometry for the SPME extraction device, yet unlike a gas chromatograph, IMS is not limited by this configuration for sample introduction. A planar coated substrate used as the SPME exhibits increased surface area and capacity in comparison to the commercially available modified-syringe SPME. The current study aims to demonstrate that the planar SPME geometry exhibits improved extraction efficiency, and is as reusable, rugged, and user-friendly as the commercially available SPME when coupled to IMS. The sampling scheme is static, whereby a known amount of analyte is contained in a vessel in which the extraction device is exposed. The sampling occurs at equilibrium and then the SPME, either planar or modified syringe, is thermally desorbed into the heated port of the IMS or the SPME-IMS interface, respectively. This can simulate a scenario where the extraction device is placed in a fixed volume space such as a cargo hold or a shipping container, allowed to sample, and is then desorbed into an IMS. The extraction phases evaluated for planar SPME are PDMS and sol-gel PDMS.[2] The latter is introduced as an alternative to PDMS, an already versatile liquid phase, as a result of its enhanced thermal stability which is useful in applications which require high desorption temperatures. The techniques used to coat the planar substrates with the extraction phase (PDMS or sol-gel PDMS) are also statistically evaluated for repeatability of coating thickness, since this is important for obtaining consistent extraction efficiencies. Additionally, the planar SPME also requires minimal surface roughness for uniform extraction, which is monitored by SEM imaging. Lastly, a study of the performance of the planar SPME when exposed to a moving current of 2,4,6-trinitrotoluene (TNT) in air demonstrates this geometry's capability to sample effectively by either dynamic or static extractions.

References:

1 JM Perr, KG Furton, JR Almirall. Solid phase microextraction ion mobility spectrometer interface for explosive and taggant detection. *J. Sep. Sci.* 2005, *28*, 177-183.

2 WL Liu, Y Hu, J Zhao, Y Xu, Y Guan. Physically incorporated extraction phase of solid-phase microextraction by sol-gel technology. *J. Chromatogr. A*. 2006, *1102 (1-2)*, 37-43.

SPME, IMS, Explosives

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