B88 Construction and Development of a SPME/IMS Interface for Detection of Explosive Compounds and Taggants Evaluated by SPME/GC/MS

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This presentation describes the construction and optimization of an interface for introduction of a solid phase microextraction fiber (SPME) into an ion mobility spectrometer (IMS). The detection limits of the IMS are calculated based on calibration and SPME equilibrium curves created using SPME/GC/MS. The following explosives: 2,4,6-trinitrotoluene (TNT) and 2,6-dinitrotoluene (DNT) and the following taggants: dimethyldinitrobutane (DMNB), 2-nitrotoluene (2-NT), and 4-nitrotoluene (4-NT), were used as model compounds to evaluate the interface. The absolute detection limits for the SPME/GC/MS method were also calculated and based on three times the signal to noise (3S/N) from five point calibration curves. The utility of the SPME/IMS interface was also evaluated by sampling from different sized containers in order to decrease the concentration of the explosive compound and simulate real world application.

This research offers a method of screening large volumes of enclosed space for explosive compounds and taggants using a newly developed interface between solid phase microextraction (SPME) and an ion mobility spectrometer. This instrumental technique offers speed, rapid presumptive screening, field use, and easy data interpretation.

A system to sample large volumes of enclosed space such as may be found in a large room, a cargo container, or the fuselage of an airplane for the volatile components of explosive formulations is described. Massive screening of luggage, personnel, and cargo is difficult due to the small amount of material that is available for detection and the time constraints placed upon screeners. Analysis strategies for these two types of trace samples are evaluated in order to create an effective method for extraction, separation, analysis, and interpretation that will be suitable to the investigators needs, i.e., a simple and rapid identification of ultralow levels of material using a field portable sampling system.

Solid phase microextraction (SPME) provides improvements over the use over other extraction methods due to its selectivity, field portable capability, cost, ease of use, shorter extraction times, and solvent free extractions. Ion mobility spectroscopy (IMS) affords a low cost, rapid, and portable method for presumptive analysis of organic materials, such as explosives. These instruments have become widely used in our nations airports and their installation base is very large. Ion mobility spetrometry separates ions based on their gas phase mobility in weak electric fields. Ionization through a radioactive B emitter at atmospheric pressure can be controlled so only certain groups of compounds are ionized, i.e., explosives. The IMS is known to be an extremely sensitive technique with capabilities of detecting explosives in the low picogram range and it is very easy to use and interpret the results. The sensitivity of the IMS can be attributed to the negligible loss of ions or neutrals to vacuum pumps, the walls of the cells, or recombination processes. This presentation will briefly describe the applications of the SPME/IMS interface to simple, rapid identification utilizing a field portable sampling system.

A Varian 3400 Gas Chromatography is coupled to a Saturn 2000 Ion Trap Mass Spectrometer detector with MSn capabilities and used as a benchmark method of the identification of the analytes of interest. A GE Ion Track Itemiser® 2 ion mobility spectrometer was used in conjunction with an in-house designed SPME/IMS interface. The operation and detection limits of the interface/IMS system when used with SPME as a pre-concentration and sampling device of large enclosed volumes are presented and discussed.

Explosive Compounds, Taggants, SPME/IMS

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