

## **Hand-Portable GC-TMS Instrument for Measurement of Chemical Agents and Hazardous Compounds in Harsh Environments**

Douglas W. Later<sup>1</sup>, Samuel E. Tolley<sup>1</sup>, Jesse A. Contreras<sup>2</sup>, Jacolin A. Murray<sup>2</sup>, H. Dennis Tolley<sup>2</sup>, Stephen A. Lammert<sup>1</sup>, Edgar D. Lee<sup>1</sup> and Milton L. Lee<sup>2</sup>

<sup>1</sup> Torion Technologies, Provo, UT 84602

<sup>2</sup> Brigham Young University, Provo, UT 84602

There is an increasing demand for hand-portable and small footprint analytical instrumentation that can be used for dedicated target compound monitoring and detection in harsh environments, such as field measurement applications. In this presentation, we describe a completely hand-portable self-contained GC-TMS system comprised of a low thermal mass toroidal gas chromatograph (GC) and a miniature toroidal ion trap mass spectrometer (TMS). The capillary GC system contains a 5-m X 100-um i.d. capillary column coated with 5% phenylmethylpolysiloxane stationary phase. Sample introduction is achieved by a novel solid phase micro-extraction (SPME) syringe device customized for single-handed operation and recording of injection custody information. The SPME injection port is a custom designed low thermal mass device that enables rapid heating. Mass analysis is performed using a miniature toroidal ion trap that allows the use of lower RF voltages and higher pressures, reducing power consumption and vacuum requirements while still maintaining dynamic range and good detection sensitivity and selectivity. Included in the instrument are the batteries, carrier gas supply, and microprocessor control. This GC-TMS, is easy to use, and requires minimum training for operators to become proficient in its use.

The complete GC-MS system is mounted in a 18-1/2" x 14-1/16" x 6-15/16" (47 cm x 35.7 cm x 17.6 cm) water tight, crushproof, dust proof protective case, and weighs less than 10.1 Kg (23.6 lbs) including batteries (~330 W-hr) and on-board helium tank. The average power consumption of 5.2 W-hr per sample, which allows for greater than 50 runs before the batteries need changed. The portable helium gas supply can be used for greater than 150 consecutive samples. A 6" LCD screen allows for monitoring the total-ion chromatogram as well as mass spectra of eluting compounds.

The high heating efficiency of the injector and column arrangement makes it ideal for fast heating and cooling cycles while minimizing power consumption. A complete sample analysis, including data analysis and cool down, is much less than 5 min. At the end of each analysis, mass spectra are compared against an on-board library for analyte identification. Library files that match the GC-TMS fingerprint of an analyte are listed and displayed along with a corresponding threat index, and match confidence level. Linear mass calibration of the system was obtained over a mass range of 50 to >500 m/z with unit-mass resolution. Detection of target chemicals will be demonstrated for several chemical agents including GA, GB, GD, GF, HD, and VX, as well as TICs and TIMs.

This project was funded by the Department of Defense, Defense Threat Reduction Agency (DTRA-01-03-C-0047) and Dugway Proving Ground (W911S6-06-C-0011).