Development of Portable GC/MS System with Benchtop Performance for Critical DoD Applications

Philip Tackett, Leonard Rorrer, Dan Sutton, Krystal Roark, Brent Rardin, Mitch Wells

FLIR Detection, Inc. 3000 Kent Ave. West Lafayette IN 47906

In 2014, the US Department of Defense released a set of product requirements for the next-generation chemical detector (NGCD). These requirements focused on a series of performance specifications for a portable chemical detector that could detect a range of threats in all chemical phases; solid, liquid, and vapor. Based on these specifications, a developmental effort was undertaken to design a compact GC/MS system that was capable of analyzing samples from all chemical phases as well as meeting size, weight, and power goals such that the instrument was portable enough to be carried to the samples of interest. Additionally, multiple modes of operation were identified. These modes include a real-time gas phase sampling (chemical survey) mode and a confirmatory (GC/MS) mode. The multi-mode operation of the instrument necessitated the integration of multiple inlets. For real-time gas-phase sampling, a membrane inlet (MIMS) was fixed to the instrument and coupled with a heated sampling line to pull samples into the instrument and through the MIMS. For confirmatory modes, a split/splitless injector coupled to a custom low-thermal mass GC column was designed to handle liquid and solid samples. Additionally, an air preconcentration system was designed to complement the real-time gas phase sampling with confirmatory analysis through the GC. For mass analysis, a single quadrupole mass analyzer was developed and integrated. The use of this mass analyzer provides high quality mass spectra that are capable direct integration to the NIST mass spectral library in real-time. The performance of the system and the individual inlets was performed by sampling various classes of compounds (TICs, CWAs, drugs, and VOCs). The development process focused on using several stages of instrument revision with each stage used to identify and refine the analytical performance of the individual components and the system as a whole.