

Chip-Scale Mass Spectrometry: Yet another contender for Harsh Environments? OR can it help redefine “Harsh Environments”?

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Detect-Ion

Detect-Ion will present a novel low-SWaP trace chemical sensing platform (called “ACHILLES”) recently developed through the collective investment from IARPA MAEGLIN and DARPA SIGMA+ CWMD programs. ACHILLES (short for “Autonomous Chemical Intelligence for Long Endurance Mission”) is a fieldable vapor analysis system (10 L; 13.2 lbs.; 60 W) enabled by a 1-amu resolution chip-scale mass spectrometry and has been validated in two complementary ionization modes (electron impact ionization and photoionization) for detection of a broad range of chemicals threats prioritized by US DoD and intelligence community needs. ACHILLES is a unique integration of three novel subsystems; namely air-sampler/preconcentration, separation and detection stages [Precon/TDGC-MS] to deliver benchtop gas chromatograph mass spectrometer-quality chemical analysis in a small, ruggedized package within minutes. ACHILLES identifies a broad range of complicated mixtures of semi-volatile and volatile organic compounds (VOCs) including, but not limited to, common solvents, precursors, toxic industrial chemicals, environmental pollutants, chemical weapon agent’s surrogates, opioids, and narcotics. Chemically these species include alkanes, phosphonate esters, ketones, aldehydes, carbonyls, alcohols, amines etc. ACHILLES’s sensitivity at concentrations as low as parts per trillion combined with the identification algorithm enables near-real-time situational awareness of existing and/or emerging chemical threats in ambient air in a fully autonomous manner. ACHILLES’s low thermal mass GC stage makes it a particularly unique sensor with a broad dynamic range thus allowing detection of very minute chemical signatures in a complex chemical matrix, such as a typical urban environment. The current variant of ACHILLES is a vapor-phase analysis system which can be powered by a miniature battery and/or power supply. The system has a pre-programmed autonomous power saving mode which powers up the components of the system for lowest energy consumption. The system start-up time is ,90 s and can be programmed for sampling time ranging from 10 s to 24 hrs. ACHILLES has been evaluated independently by government Testing and Evaluation (T&E) team (Naval Research Laboratory, WDC) through a series of three benchmark test campaigns and flight-tested on C-130J aircraft by AFRL for real time detection of Methyl Salicylate. Detect-Ion will discuss ACHILLES technology; sensing performance demonstrated in calibrated test environments; highlights of recent deployments in operational environments, with some of these environments considered “harsh” for traditional mass spectrometry instrumentation; and a few low-risk diversifications of ACHILLES that we are exploring. In summary, we will discuss how our perspective of harsh environments has evolved based on our recent experiences and stakeholder’s mission requirements.