REVOLUTIONARY DIAGNOSTICS – NONTRADITIONAL APPROACHES FOR DEVELOPING BREAKTHROUGH CAPABILITIES AGAINST EMERGING THREATS

A Low-cost, Low-power, Miniature Sector Arrayed Mass Spectrometer For Chemical And Biological Detection Applications

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Mass spectrometers are often considered the "gold standard" for chemical and biological identification, though compromises in performance are often made to enable placement outside of a laboratory setting. Leidos has developed a miniature, low-power magnetic sector mass spectrometer capable of identifying a wide range of threats using a compact design with laboratory-quality performance. The core sensing technology utilizes a focal plane array charge coupled device (CCD) that simultaneously and continuously monitors all threats. The core technology has applications in handheld, portable, mobile, fixed-site, and leave-behind applications.

The sensor incorporates technology that enables low size, weight, and power (SWaP) characteristics. It capitalizes on the fundamental principle that mass separation can be performed without any power consumption in a magnetic field. This is in stark contrast to ion trap, time-of-flight, and quadrupole mass spectrometers that require power to separate ions via electrostatic or RF fields. Unlike typical Fourier transform or beam mass spectrometers that utilize magnetic fields with either superconducting or power consuming electromagnets, this device uses a small permanent magnet to accomplish separation. Furthermore, the short path length of the instrument facilitates operation at pressures greater than what are typically required for mass spectrometers, further lowering auxiliary power requirements and facilitating further SWaP reduction.

The system's typical mass range spans from 3 – 500 atomic mass units, which is in the range of all known vapor and liquid threats. The actual range can be readily adapted to the desired application. Detection limits are on the order of nanograms for a range of gaseous and liquid compounds with a dynamic range of five orders of magnitude. This enables its use as a trace-level threat detector that will not "go blind" at higher threat levels. This system has undergone internal and government testing and the current performance characteristics of the instrument will be presented along with tailored application examples in chemical (chemical warfare agents; CWA), biological (Vitamin D), and environmental (perfluorinated alkyl substances; PFAS) measurements. Our developments to further reduce SWaP will also be presented.

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