

POINT DETECTION FOR BOTH CHEMICAL AND
BIOLOGICAL WARFARE AGENTS¹

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The Block II Chemical Biological Mass Spectrometer (CBMS) is a new vehicle-borne point detection (as well as reconnaissance) instrument that integrates chemical and biological warfare agent detection and identification into a single unit that is lighter, smaller, and less power-intensive than separate detectors. The instrument is soldier-friendly in operation and self-diagnosing in fault location, and resists nuclear radiation, temperature extremes, vibration and shocks from wheeled vehicle transport.

The CBMS is modular in design and construction. It consists of a central mass spectrometer/electronics module, a sample interface module, a bioconcentrator module, and a soldier display module. The heart of the CBMS is an ion trap mass spectrometer that can be operated using ethanol chemical ionization (CI) or electron ionization (EI) in full scan and tandem mass spectrometry (MS/MS) modes. The mass spectrometer is interfaced to three sampling systems via the sample interface module. Respirable (2-10 μm) particulate airborne biological agents (ITF6A list) are isolated, concentrated and delivered to a pyrotube by the bioconcentrator module. The bioparticles are heated in the presence of an esterifying agent, and the derivatized phospholipid membrane fatty acids and other biomarkers are transferred to the mass spectrometer via a mode select valve, transfer line, and capillary interface. Chemical agent (nerve, blister, riot agent, and other military chemicals) vapors are sampled via a heated Silicosteel™ capillary line and are directed to the mass spectrometer via the mode select valve. Liquid chemical warfare agents on the ground are sampled by the reconnaissance vehicle ground wheel/heated probe system which connects with the Block II CBMS. Chemical agents are identified on the basis of CI-MS/MS or EI-MS/MS scans. Full scans can be used to detect non-target agents. Linear discriminant analysis is used to make the bioagent identifications. The soldier operates the instrument using the soldier display unit, which also sounds and displays the alarms and transfers them to a central computer.

Many technological advances and state of the art instrument features have been integrated to permit these capabilities. These include opposed jet virtual impaction in the isolation and concentration of the respirable bioaerosol, thermolytic hydrolysis-esterification in the biosample treatment and an open-split capillary interface with the mass spectrometer to permit more polar biomarkers to be analyzed, butyl esters for improved MS/MS of fatty acid biomarkers, a turbomolecular pump to allow greater pumping capacity, CI for enhancement of the molecular ions of biomarkers and chemical agents and for minimization of false positive and false negative interferences, and special circumvention circuitry for radiation protection. Automatic switching between full scan and MS/MS and between EI and CI is accomplished by novel multiscan functions with multiplexed modes and scans with broadband notches for multiple ion detection and confirmation.

The Block II CBMS is undergoing tests with biological and chemical agents. It has been selected for trials on the JSLNBCRS HMMWV and LAV platforms and on the Block II FOX.

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