Needs and Challenges in the Field Detection and Identification of Military Chemical Threats

NBC Defense- All Hazards...All Services

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Agenda

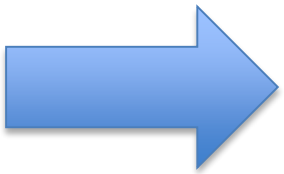
- Mission Space / Environments
- Current Capability
- Current Gaps
- Acquisition Programs and Demonstrations
- The Future

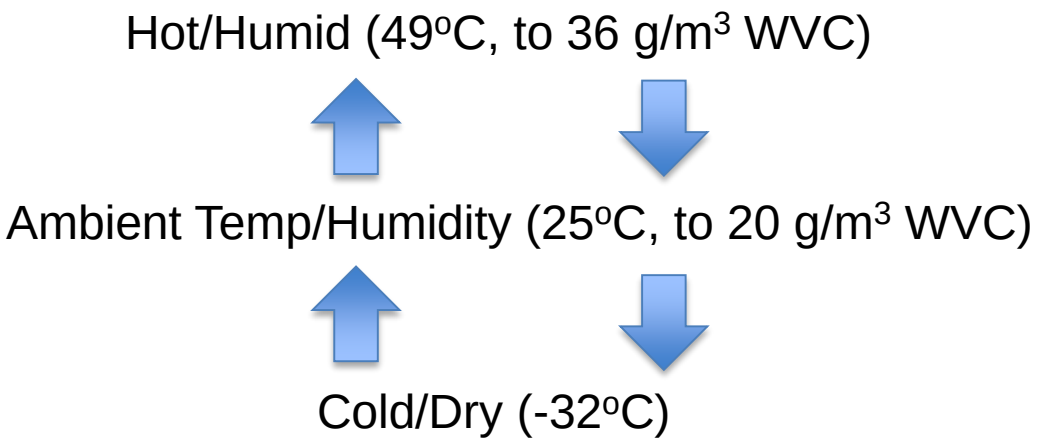
Mission Space / Environments

- Mounted Chemical / Biological Reconnaissance
- Dismounted Chemical / Biological Reconnaissance
- Site Assessment
- Decontamination Assurance
- Medical Diagnostics

Varied Levels of Fidelity:
(1) Presumptive Identification, (2) Field Confirmatory, (3) Theater Validation, (4) Definitive

- Marine
- Urban
- Battlefield
- Forest/Desert/Plains





Mission Space / Environments

- The Next Generation Chemical Detector Program's Performance Specification dated 26 August 2013 includes 77 "common background chemicals and chemicals that may be encountered by warfighters during Next Generation Chemical Detector (NGCD) missions."

- "The Government may evaluate system compliance to the NGCD Performance Specification requirements…by using some or all of these substances during testing."
- The 77 include complex chemical mixtures that are frequently encountered during military operations and are extremely challenging backgrounds for mass spectrometer based systems (without front end separation)
  - Diesel Fuel Vapors
  - Oil
  - Aqueous Film Forming Foam
  - Exhaust

Chemical Detection: Capabilities

- Current Capability:
  - **Automatically** warn the force of a **traditional chemical warfare vapor** attack (JCAD, M256A2)
  - **Manually detect liquid traditional chemical warfare agents** (M8, M256A2)
  - Point **detection and identification for liquid and vapor traditional chemical warfare agents** (JCAD, M256A2, ThermoScientific RMX/FT [DR SKO])
  - **Manually detect and classify liquid traditional chemical warfare agents** (M8, M256A2)
  - **Field confirmatory identification** of sampled **traditional agents** (ALS)

Chemical Detection: Capability Gaps

- Capability Gaps:
  - **Less than pure**
  - **Less than bulk**
  - Agents, Toxic Industrial Materials (TIMs)
  - Limited early warning (range)
  - **Limited** capability for **Non-Traditional Agents (NTAs)**, **Low Volatility Agents**
  - Detection and identification of Toxic Industrial Chemicals and Materials (TICs & TIMs)

Chemical Detection: Capability Gap Closure

Modernization:

- Develop chemical detection systems capable of accurately detecting, identifying, quantifying and classifying relevant NTAs, TIMs, low-volatility, and liquid and solid chemical warfare agents at the lowest levels of military operational significance (NGCD 1-3, Dismounted Reconnaissance – Sets, Kits, Outfits [DR SKO])
- Develop personal detection devices that can be worn by response personnel and inform responders and command health centers of hazard levels (NGCD 4)
- Develop detectors of sufficient sensitivity to confirm that decontamination processes have neutralized or eliminated contamination on personnel and equipment so that operations can resume without the use of protective equipment (Decontamination – Family of Systems [DFOS])
- Develop detectors capable of operating at ranges significant enough to provide warning to forces in the field. Sensor data must be relayed to and integrated with other information systems to support operations and enable additional analysis

Chemical Detection: Capability Gap Closure

Mid-Term Modernization (FY17-20):

- **Improve detection systems' ability to detect and identify** NTAs, low-volatility agents (vapor/aerosol), TICs, explosives and traditional chemical warfare agents (liquid, solid, vapor and aerosol) **at less than pure, less than bulk, and/or below health effects levels**.
- Improve the means of validating and confirming decontamination processes. **Detection** systems or other means must be developed **to confirm** that **decontamination processes** have eliminated or neutralized contamination on personnel and equipment to levels that permit operations with **no protective equipment**.
- **Wearable** chemical agent and **physiology monitors** for enhanced sensor density and situational awareness.
- Improve the **integration of chemical detectors**. Detector information must be relayed to other information systems to support operations and enable additional analyses.

Chemical Detection: Capability Gap Closure

Far-Term (FY21+):

- Develop an **automated, net-centric, single sensor package to detect and identify** NTAs, low-volatility agents (vapor/aerosol), TICs, explosives and traditional chemical warfare agents (liquid, solid, vapor and aerosol).
- Improve **monitoring of surface contamination**.
- **Improve the portability** of chemical detectors. Personal detection devices must be developed that can be worn by response personnel and rapidly inform responders and command health centers to hazard levels.
- **Non-intrusive, non-contact** detection and identification of chemical agents in munitions, tanks, or storage vessels.

Acquisition Programs and Demonstrations - NGCD

Description

- Multiple detection products for **multi phase of matter sampling, location of liquid and solids on surfaces, and vapor and aerosol monitoring**.
  - Detector Alarm – Provides NTA aerosol detection, (e.g chemical event warning) AND improved CWA and TIC vapor detection (e.g. naval ship contamination survey)
  - Survey Detector – Provides rapid interrogation of NTA and CWA liquid and solid detection on surfaces, (e.g. dismounted reconnaissance)
  - Sample Analysis – Provides analytical identifier of solids, liquids, aerosols and vapors, (e.g. to support characterization of the residual hazard after a chemical event to inform protection decisions)

Capabilities Include:

- Detection, identification and quantification of NTA, Nerve, blister, and blood agents
- Detection of liquids and solids on surface
- Detection of vapors and aerosols

Status

- Technology Development Anticipated
- **Fielding: FY 2021 Q1**

Acquisition Programs & Demonstrations – DR SKO

Description:

- The Dismounted Reconnaissance Sets, Kits and Outfits (DR SKO) objectives include **identifying** potential **Weapons of Mass Destruction** (WMD) and/or WMD precursors and determining levels of protection required to access or inhabit a sensitive site. capabilities.

Capabilities include:

- Detection and Identification of liquid, solid and vapor Chemical Warfare Agents (CWA) and Toxic Industrial Chemicals
- Detection of Volatile Organic Compounds, Oxygen Levels & Lower Explosive Limits for Combustible Gases
- Detect trace levels of particles originating from explosive material

Status

- Production and Deployment
- RFI for expanded liquid/solid capability 1QFY16

Acquisition Programs and Demonstrations – JCACS

- Mission
  - Provide the Joint Force with an enhanced and integrated CBRNE operational capability to execute mission command and conduct operations to counter the range of complex CBRNE threats.
- ATD Approach
  - Mature technologies (TRL 6+) will be selected, integrated and demonstrated in three increments.
  - Operational demonstrations will be conducted at service and NGB exercises and assessments
  - Inform current and planned programs of record
  - Provide a residual capability to the Warfighter

JCACS Focus Areas (FA)

- **FA A** – **Protection.** Improve tailorable, flexible, integrated protective ensemble (Family of Systems) that enhances Warfighter performance (Respiratory, Ocular & Percutaneous Protection)
- **FA B** – **Contamination Mitigation.** Improve personnel and materiel contamination mitigation capabilities, which enhance mission effectiveness and reduce logistical requirements
- **FA C** – **Characterization**. Improve capabilities to identify, characterize, assess and exploit CBRNE hazards.
- **FA D** – **Situational Awareness.** CBRNE forces lack expeditionary communications systems that facilitate situational awareness and provide real-time reach back capability that supports timely force protection decisions.

The Goal of the ATD is to address each of these Focus Areas

Focus Area C – Characterization

Critical Issue

- **Can capabilities to identify, characterize, assess and exploit CBRNE hazards be improved**?

- Criteria: Characterization capabilities must **detect and identify chemical warfare agent vapors,** liquids and solids; collect and identify biological warfare agents from surfaces, liquids and/or powders; detect, identify and measure radiological and nuclear substances/isotopes; and **detect and identify bulk and trace explosives and toxic industrial chemicals (TICs).**

- Rationale: This capability is required to support pre and post Weapons of Mass Destruction- Elimination (WMD-E) attack assessments to resume normal operations after assuming protective measures; survey operations to determine extent of contamination; screening of personnel and equipment prior to decontamination and level of decontamination; site assessment, exploitation and destruction confirmation.

Some Possibilities for the Future

- Library-less chemical identification
  - ToF?
  - Novel means of interpreting and fusing data?
  - New techniques?
- Enhanced performance of existing detection materiel through sampling
  - Pre-concentrators
  - Selective sampling media
- Modularity – base system with mission specific accoutrements
- Identification of biological threats with MS – Hardware to support ABOid

QUESTIONS?

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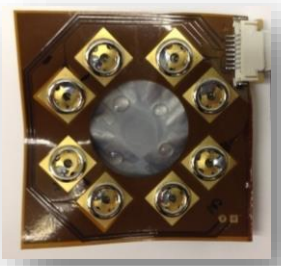
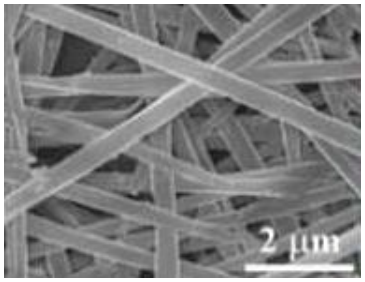
For More information, see: https://jacks.jpeocbd.army.mil/jacks/Public/FactSheets.aspx

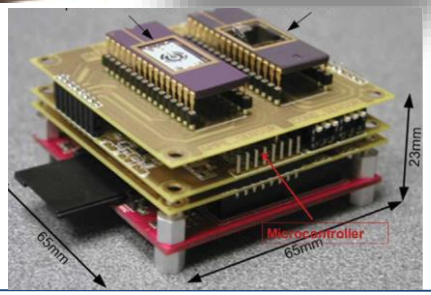
BACKUPS

NGCD 4 Individual Detector

- **Description:**
  - Wearable CWA and TIC vapor detector
  - Indicates hazardous environments and explosive atmospheres to include LEL and O2.







- **Major Partners:**
  - Government: JSTO, CTTSO, DHS
  - Contractor:
  - Users: USMC, US Army

- **Accomplishments (Past Six Months):**
  - Draft NGCD 4 market survey received May 2015
  - MGA program review May 2015
  - CTTSO Individual Air Monitor BAA June 2015
  - Nano-Electrochemical Workshop held Jan 2015
  - Colorimetric Workshop held Aug 2014
  - DHS Firefighter hazards monitor BAA 2014
- **Upcoming Events and Key Activities (Next Six Months):**
  - Final NGCD 4 market survey June 2015
  - NGCD 4 Rodeo September 2015
  - Next round of meetings with Combat Developers

- **Interest Areas:**
  - Polymers applicable to military use
  - Miniaturization of current technologies
  - NGCD 1 performance
- **Assistance Required:**
  - None

Chemical Detection : S&T Focus Areas

- Which gaps are we addressing?
  - Chemical aerosol detection and identification
  - Detection and identification of Non-Traditional Agents (NTAs), Low Volatility Agents
  - Detection and identification of Toxic Industrial Chemicals and Materials (TICs & TIMs)
  - Early warning (range) , remote unmanned, and multi-modal sensor integration
  - Limited identification of unknown and impure chemical samples
- What S&T efforts are planned or on-going?
  - Next Generation Chemical Detection Increment 3 variant (sample analysis)
  - Advanced remote concepts for liquid and vapor chemical detection
  - Next Generation Chemical Detection Increment 4 variant (on the man)
  - Next Generation Chemical Detection Increment 1 variant (detector alarm for vapor and aerosol)
  - Remote/early warning technology evaluations
  - Enhanced colorimetric sensors
  - Chemical surface detection
  - Low burden sensor support (reduction/miniaturiziation

Chemical Detection : S&T Focus Areas

- Which program (s) does the S&T support
  - Next Generation Chemical Detector (NGCD) variants 1-4
  - Reconnaissance platforms (DRSKO & NBCRV)
  - Integrated Early Warning
  - Joint Exposure Status Sensor (JESS)
  - CBRN- Sensors Integrated on Robotic Platform (CSIRP)
  - Tactical Chemical and Biological Surface Detector/Identifier
  - Improved Chemical Vapor Detector
- When is the S&T needed?
  - Mid and Far Term
- S&T “push” efforts
  - Health-based Orthogonal Lightweight Manned Early warning Suite (HOLMES)
  - Microgas Analyzer

Chemical Detection : Technology Needs

- What Enablers are needed?
  - Sensor and component miniaturization for unmanned systems
  - Low-cost, high-density sensing
  - Chemical and biological agent identifier (single unit)
  - Improved optical sensors
  - Enhanced chemistries for surface functionalization to support chemical detection and identification
  - Data fusion and decision support tools integrated with situational awareness tools
  - Ad-hoc sensor integration
- What Innovations are needed?
  - Novel sensor technologies or analysis tools
  - Component miniaturization and specialization / optimization