

PROTECTING RESPONDERS FROM TOXIC EXPOSURE

Toxic industrial chemicals (TICs) are substances that produce harmful effects if encountered in sufficient quantities or for long durations. TICs are of great concern for the Department of Homeland Security (DHS), as they can be easier for terrorists to obtain and use than chemical warfare agents. Hence, first responders need a small, rugged, wearable monitor that can tell them when they encounter TICs, which substance is present, and at what levels.

Commercially-available color-changing badges and tubes provide trace detection of many TICs of interest at low cost, but they often involve extensive hands-on manipulation and chart read-outs. Some monitors exist that can detect multiple TICs. However, those devices are expensive and there is a need for a multi-gas sensor in wearable form that costs less than \$100.

INEXPENSIVE BUT EFFECTIVE

The DHS Science and Technology Directorate (S&T) is working with TDA Research, Inc., through a Small Business Innovation Research (SBIR) award, to develop a simple, inexpensive, wearable smart chemical sensor badge. This highly sensitive and selective badge can detect multiple TICs at trace (low parts per million, or ppm) concentrations and then trigger distinct alarms at the permissible exposure limit. Moreover, calibration data establishes algorithm improvements to the short-term exposure limit and time-weighted average concentrations.

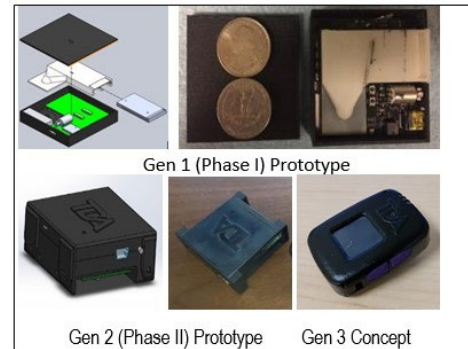
As responders can easily be the first to encounter these materials, this new sensor will alert them to the presence, nature, and magnitude of the threat.

APPLICATIONS

The capability can be transitioned to applications in homeland security and law enforcement agencies. The target commercial space can also include personal monitors to enforce worker safety and workplace exposure limits.

IMPACT

The wearable chemical sensor badge will monitor and alert first responders to exposures of TICs and provide increased data for improved situational awareness at incident scenes.



ACCOMPLISHMENTS

- Fabricated and assembled 10 hi-fidelity Gen. 2 prototype units that can detect four TICs (H₂S, NH₃, PH₃, and HCN)
- Completed initial testing of the wearable chemical sensor badge prototypes in an environmental chamber with H₂S, NH₃, PH₃ and HCN and developed calibration algorithms.
- Carried out battery life tests at 30% duty cycle with a 13-hour run time
- Completed delivery of six prototype devices to DHS
- Completed independent testing at Naval Research Laboratory, which showed the capability to detect the four target TICs
- Extended detection to a total of six TICs and included methods for differentiating oxidizers such as Cl₂ and NO₂ and acquired first responder feedback

UPCOMING MILESTONES

This project will culminate with the fabrication of 20 Generation 3 sensors that can detect six TICs. The performer will prepare detailed cost projections for large production volumes, including the operating, training, and maintenance costs for commercial product transition.

PERFORMERS AND PARTNERS

- TDA Research, Inc., Wheat Ridge, CO
- Structural firefighters
- EMS personnel
- Arson investigators