

Wearable Smart Chemical Sensor: TDA Research, Inc.



Homeland
Security

Science and Technology

LOW-COST SENSOR FOR PROTECTING RESPONDERS FROM TICs EXPOSURE

Toxic industrial chemicals (TICs) are substances that produce toxic effects if encountered in sufficient quantities and/or for long durations. TICs are a great concern for the U.S. Department of Homeland Security (DHS), since 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 alert them when they encounter TICs, and show what 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 (\$5-10), but they often involve extensive hands-on manipulation and chart read-outs. Some monitors exist that can detect multiple TICs; however, the cost is prohibitively high (more than \$500). Hence, there is a need for a multi-gas sensor in wearable form that costs less than \$100.

WEARABLE CHEMICAL SENSOR BADGE

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 that has high sensitivity and selectivity to multiple TICs at trace (low parts per million, or ppm) concentrations and triggers distinct alarms at the permissible exposure limit, the short term exposure limit, and at 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. 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.

This 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.

ACCOMPLISHMENTS TO DATE

- 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 (WCB) prototypes in the environmental chamber with H₂S and developed calibration algorithms
- Carried out battery life tests at 30 percent duty cycle with a 13-hour run time
- Performed preliminary designs for the next revision of the device
- Extended the detection to include detection methods for differentiating different oxidizers such as Cl₂ and NO₂



Gen 1 (Phase I Prototype)



Gen 2 (Phase II) Prototype

Gen 3 Concept

TDA's wearable chemical badge sensor prototype, fabricated during SBIR Phase I & Phase II, successfully demonstrated detection of H₂S, NH₃, PH₃, and HCN in air.

UPCOMING MILESTONES

Delivery is planned for six prototype devices to DHS for independent testing at Naval Research Laboratory, each of which with capability to detect at least four target TICs. We will also complete a techno-economic analysis and estimate the response time, sensitivity, and selectivity for each of the TICs. Finally, we will prepare detailed cost projections at large volumes, including operating, training, and maintenance costs.

PERFORMERS/PARTNERS

TDA is collaborating with Texas Tech University for the design and fabrication of the sensors to detect four or more TICs using TDA's proprietary sensing media.

