'Lab-on-a-glove' could bring nerve-agent detection to a wearer's fingertips

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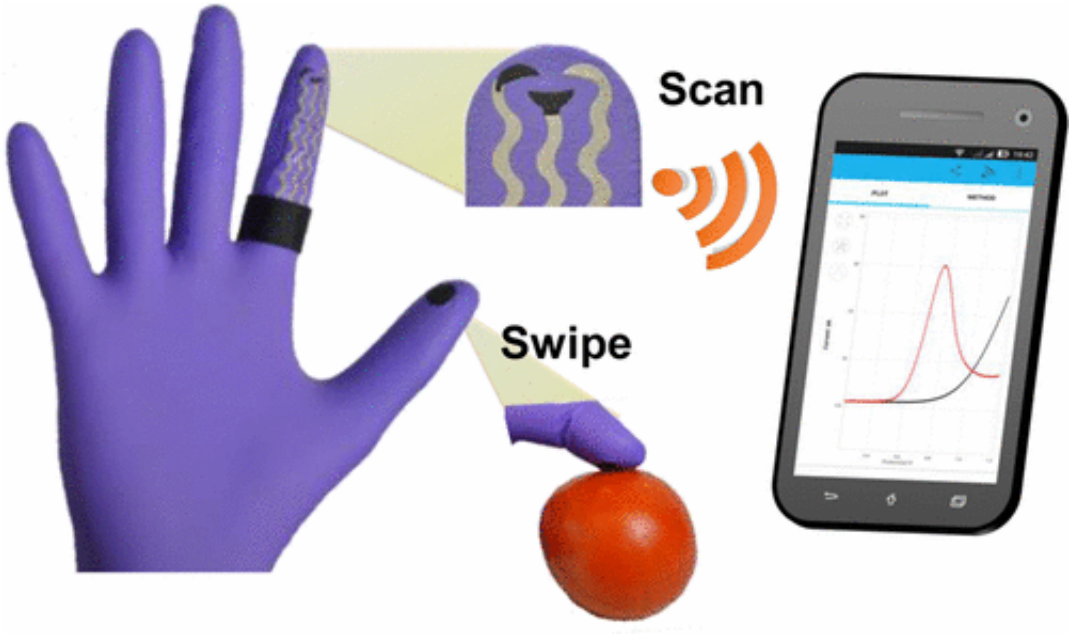

Credit: American Chemical Society

There's a reason why farmers wear protective gear when applying organophosphate pesticides. The substances are very effective at getting rid of unwanted bugs, but they can also make people sick. Related compounds—organophosphate nerve agents—can be used as deadly weapons. Now researchers have developed a fast way to detect the presence of such compounds in the field using a disposable "lab-on-a-glove." The report on the glove appears in the journal *ACS Sensors*.

Organophosphate nerve agents, including sarin and VX, are highly toxic and can prevent the nervous system from working properly. Organophosphate pesticides are far less potent but work in a similar way and can cause illness in people who are exposed to them, according to the U.S. Centers for Disease Control and Prevention. Detecting either type of these sets of compounds accurately and quickly could help improve both defense and food security measures. So, Joseph Wang and colleagues set out to develop a wearable sensor that could meet the requirements of field detection.

The new wearable, flexible glove biosensor carries out the sampling and electrochemical biosensing steps on different fingers, with the thumb finger used for collecting the nerve-agent residues and an enzyme immobilized on the index finger. The researchers created stretchable inks to print the collection and sensing elements on these fingers. Detection of the collected residues is performed when the thumb touches the printed enzyme-based organophosphate biosensor on the glove index finger. So, a user would swipe the thumb of the glove on a surface for testing, then touch the thumb and index fingers together for the electrochemical analysis. For real-time results, the voltammetric data are sent via a reusable Bluetooth device on the back of the glove to a user's mobile device. Testing showed that the glove could detect organophosphate pesticides methyl parathion and methyl paraoxon on various surfaces—including glass, wood and plastic—and on produce. The researchers say the sensor could be used in both security and food safety settings.

More information: Rupesh K. Mishra et al. Wearable Flexible and Stretchable Glove Biosensor for On-Site Detection of Organophosphorus Chemical Threats, *ACS Sensors* (2017). DOI: 10.1021/acssensors.7b00051

Abstract

A flexible glove-based electrochemical biosensor with highly stretchable printed electrode system has been developed as a wearable point-of-use screening tool for defense and food security applications. This disposable-mechanically robust "lab-on-a-glove" integrates a stretchable printable enzyme-based biosensing system and active surface for swipe sampling on different fingers, and is coupled with a compact electronic interface for electrochemical detection and real-time wireless data transmission to a smartphone device. Stress-enduring inks are used to print the electrode system and the long serpentine connections to the wireless electronic interface. Dynamic mechanical deformation, bending, and stretching studies illustrate the resilience and compliance of the printed traces against extreme mechanical deformations expected for such on-glove sampling/sensing operation. An organophosphorus hydrolase (OPH)-based biosensor system on the index finger enables rapid on-site detection of organophosphate (OP) nerve-agent compounds on suspicious surfaces and agricultural products following their swipe collection on the thumb finger. The new wireless glove-based biosensor system offers considerable promise for field screening of OP nerve-agents and pesticides in defense and food-safety applications, with significant speed and cost advantages. Such "lab-on-a-glove" demonstration opens the area of flexible wearable sensors to future on-the-hand multiplexed chemical detection in diverse fields.

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