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PANTHER sensor from MIT Lincoln Laboratory quickly detects pathogens

Researchers at MIT Lincoln Laboratory have developed a powerful sensor that can detect airborne pathogens such as anthrax and smallpox in less than three minutes.

The new device, called PANTHER (for PAthogen Notification for THreatening Environmental Releases), represents a "significant advance" over any other sensor, said James Harper of Lincoln Lab's Biosensor and Molecular Technologies Group. Current sensors take at least 20 minutes to detect harmful bacteria or viruses in the air, but the PANTHER sensors can do detection and identification in less than 3 minutes.

The technology has been licensed to Innovative Biosensors, Inc. (IBI) of Rockville, MD. In January, IBI began selling a product, BioFlash, that uses the PANTHER technology.

"There is a real need to detect a pathogen in less than three minutes, so you have time to take action before it is too late," said Harper, the lead scientist developing the sensor.

The PANTHER sensor uses a cell-based sensor technology known as CANARY® (after the birds sent into mines to detect dangerous gases), and can pick up a positive reading with only a few dozen particles per liter of air.

The device could be used in buildings, subways and other public areas, and can currently detect 24 pathogens, including anthrax, plague, smallpox, tularemia and *E. coli*.

"There's really nothing out there that compares with this," said Todd Rider of Lincoln Lab's Biosensor and Molecular Technologies Group, who invented the CANARY sensor technology.

Rider started developing CANARY in 1997 when he realized that there were no sensors available that could rapidly detect pathogens. His idea was to take advantage of nature's own defense system — specifically the B cells that target pathogens in the human body." B cells in the body are very fast and very sensitive," Rider said.

The CANARY concept uses an array of B cells, each specific to a particular bacterium or virus. The cells are engineered to emit photons of light when they detect their target pathogen. The device then displays a list of any pathogens found.

CANARY is the only sensor that makes use of immune cells. Other available sensors are based on immunoassays or PCR (polymerase chain reaction), which take much longer and/or are not as sensitive as CANARY.

Rider and colleagues first reported the success of CANARY (which stands for Cellular Analysis and Notification of Antigen Risks and Yields) in the journal Science in 2003. Since then, they have been working to incorporate the technology into a portable device that could be used in a variety of settings where environmental threats might exist.

The new device, PANTHER, takes the CANARY technology and combines it with an air sampler that brings pathogens into contact with the detector cells. The prototype sensor is about a cubic foot and weighs 37 pounds and is well suited to building-protection applications. With minor modifications it could also enhance biological detection capabilities for emergency responders.

This prototype of the PANTHER device is about one cubic foot and weighs 37 pounds. Photo

CANARY has been tested in rural and coastal environments as well as urban ones. It could eventually be used on farms or in food-processing plants to test for contamination by *E. coli*, salmonella, or other food-borne pathogens.

Another potential application is in medical diagnostics, where the technology could be used to test patient samples, giving rapid results without having to send samples to a laboratory.

"Instead of going to the doctor's office and waiting a few days for your test results, with CANARY you could get the results in just a minute or so," said Rider.

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