Nano World: Nano-loaded wireless sensors

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Devices the size of a dime armed with reprogrammable sensors, laden with nanoparticles and wirelessly networked with each other could help sniff the air for bombs and toxins on battlefields, experts tell UPI's Nano World.

The company developing the sensor, Owlstone Nanotech in New York, announced its first production model sensor on May 15, which at roughly larger than the size of a VCR cassette is already significantly smaller and less expensive than existing technology. The company plans to have dime-size devices toward the end of 2007.

"Their sensing technology really does represent a major step forward when it comes to chemical and biological sensors, which currently mostly detect only one thing at a time, whether sarin or mustard gas, and also often can't detect in real time and cost tens if not hundreds of thousands of dollars. Owlstone's sensors can cost effectively detect in real time and detect mixes of compounds," said MEMS analyst Marlene Bourne, founder of Scottsdale, Ariz.-based industry analyst firm Bourne Research.

Airborne chemical detectors typically pass molecules down tubes where they get electrified. By monitoring how fast ionized molecules move through a uniform electric field, sensors can determine what a given molecule is. The problem is such ion mobility spectrometry systems require complex and bulky tubes, pumps and ionizing sources, which often prove difficult to assemble, fragile and often limited for handheld applications.

A silicon device invented by electrical engineer Andrew Koehl, co-founder and president of products at Owlstone, could help overcome such limitations. Instead of determining the identity of all molecules entering into them, each device uses electric fields to reject all molecules save one. This means these sensors do not require the lengths of tubing other airborne chemical detectors usually do, allowing drastic miniaturization. In addition, instead of requiring power-intensive pumps to drive ions through lengthy pipes, electric fields are sufficient to move molecules through the reduced tubing.

"The device uses deposits of metal nanoparticles to help in the performance and lifetime of the system, to protect the devices from the chemicals it is supposed to detect, which can be somewhat aggressive," Owlstone co-founder and president of operations Billy Boyle explained.

To detect a specific chemical, the sensors are loaded with the unique zigzag pattern a compound travels in within electric fields. The devices can typically detect a given chemical in concentrations as low as a few parts per billion. A device could even monitor several compounds simultaneously. Moreover, each solid-state device has no moving parts, making them virtually immune to interference from mechanical vibrations or sudden physical shocks.

The chemicals that sensors target can stick to and foul devices. Boyle explained they have incorporated heating elements into their system to drive off any compounds "that have stuck inside the sensor."

Moreover, Owlstone plans to incorporate wireless connectivity into its next-generation devices. Not only would this allow devices to communicate their findings with a central station or authorized personnel with cell phones or PDAs, it could also help enable the reprogramming of each device from a distance to detect nearly any chemical without having to alter the hardware or firmware.

"You could have networks of sensors at airports instead of just detectors you run bags through," Boyle said. "You could drop thousands of these into a battlefield to detect and track chemical threats and relay that information wirelessly."

"We are starting off with a Bluetooth wireless configuration, but many others are worked on at this point," Koehl said.

Since the sensors are manufactured using conventional semiconductor and microelectromechanical technology, Owlstone expects to cheaply manufacture each dime-sized device for less than five dollars. Owlstone is a subsidiary of Advance Nanotech in New York, which has secured $3 million in funding to help Owlstone develop.

Owlstone plans to focus on partnerships within defense, law enforcement, homeland security and industrial applications for 2006. For instance, sensors could help monitor airborne or dissolved compounds in oil refineries or drug production. Potential consumer applications include home smoke alarms or air-quality monitors that detect common gases in buildings such as formaldehyde, which can lead to cancer. Environmental uses could include pollution detectors in smokestacks or emission-control devices in automobiles.

"You could have medical diagnostics that looks for indicators in the breath. You could even integrate things into your PDAs or mobile phones," Boyle added.