Food, water safety provide new challenges for today's sensors

May 24 2012

Sensors that work flawlessly in laboratory settings may stumble when it comes to performing in real-world conditions, according to researchers at the Department of Energy's Oak Ridge National Laboratory.

These shortcomings are important as they relate to safeguarding the nation's food and water supplies, said Ali Passian, lead author of a Perspective paper published in *ACS Nano*. In their paper, titled "Critical Issues in Sensor Science to Aid Food and Water Safety," the researchers observe that while sensors are becoming increasingly sophisticated, little or no field testing has been reported.

"Although sensor researchers are keenly aware of the various issues challenging their particular technologies, outsiders may perceive an overestimated level of performance, or in certain cases, the availability of 'uber-sensors,'" the researchers wrote. Co-authors are Rubye Farahi and Laurene Tetard of ORNL and Thomas Thundat of the University of Alberta.

Salmonella, *E. coli*, pesticides and mercury are among key targets for sensors, so a clear public understanding of their capabilities – and limits – is essential, particularly because food and water make for highly complex chemical and biological environments, Passian said.

"Given the current physics of sensors, these hazards pose especially difficult challenges that will require further research and successful demonstration," Passian said.

The researchers explored paths necessary to ensure that sensors work as intended and can help protect the public – a goal they are confident can be achieved.

"While human and animal sensory capabilities are highly specific and can recognize the molecular fingerprints of many potentially harmful substances, developing similar and superior sensing capabilities is faced with many challenges for which nanoscience may provide new solutions," Passian said.

Nanosensors take on a variety of shapes, sizes and architecture. In some devices, nanoparticles (gold, silicon, magnetic composites or polymers) or nanowires (gold, polymers or composites) that react in the presence of the targeted substance are incorporated into the instrument.

Advantages of nano-sized particles in sensors include low cost, high surface-to-volume ratios, high sensitivity, unique optical and electrical properties and fast response, but these are intertwined with offsetting traits.

A number of issues are inherent in the design and operation of nanosensors. For example, the fact the nano-sized particles are so tiny can reduce the probability of interactions with the substance to be measured. Consequently, sensor developers are burdened with reaching a balance between reliability, cost effectiveness, portability, robustness and mass producibility.

Passian and the co-authors also stressed the need for a real-time flow of information to allow for quicker response time to assess risk, damage and notification of the affected populations. Ultimately, while many quality control measures are in place in the United States and other countries, requirements will continue to be refined.

"With the ever-growing global population and unpredictable natural phenomena such as earthquakes, early development of better sensor technology for food and water safety is vitally important," Passian said.

More information: The paper is available at: pubs.acs.org/doi/full/10.1021/nn204999j

Provided by Oak Ridge National Laboratory