New biosensor will guard water supplies from toxic threats

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Supported by a $953,958 grant from the Defense Advanced Research Projects Agency (DARPA), researchers at the University of California San Diego will develop a sophisticated new biosensor that can protect the nation's water supplies from a wide range of toxins, including heavy metals and other poisons.

The project, led by Jeff Hasty, director of the BioCircuits Institute at UC San Diego, will combine next-generation sequencing, synthetic biology, and microfluidic technologies to engineer a highly specific array of biosensors that will continuously monitor water supplies for the presence of toxins.

The DARPA funding has the potential for an additional $655,130 in a second year of support.

"The novel device will detect sub-lethal quantities of heavy metals such as mercury, arsenic and cadmium – as well as cyanide and organophosphate pesticides – with very high specificity," said Hasty. "Unlike current testing methods, which are costly and can only be performed sporadically, our technology will be a low-cost, continuous 'first response' system. It will signal if more thorough analytical chemistry tests should be employed."

The BioCircuits Institute, one of 20 organized research units at UC San Diego, has extensive experience developing algorithms for pattern recognition – including chemical discrimination – using artificial sensors

with broad responses to a wide range of chemicals.

The heart of the detection device will be a microfluidic chip that continuously directs water to colonies of microbial cells that act as detectors. "The device is engineered to generate macroscopic signals so that specialized optics are unnecessary," Hasty said. "This will set the stage for the conversion to electrical signals that will enable the use of low-cost electronics."

"We're using common lab strains of bacteria because the genetics and molecular behavior are safe, well-known, and sensitive to the toxins we want to detect," said Hasty. "The workings of the biosensor will be protected by a tough, temperature-controlled case that blocks exposure to ultraviolet radiation."

"The device will be deployed in open bodies of water, and will need almost no infrastructure to continuously monitor water quality," Hasty said. "It will detect far more toxins than conventional test strips – and do so without needing trained personnel."

In addition to helping protect the nation's water supplies from terrorist contamination or accidental pollution, the device might well lead to patentable technology.

"Working with the university's Technology Transfer Office," Hasty said, "we will be looking for a local company to license and commercialize our device."

Provided by University of California - San Diego