Tiny 'lab-on-a-chip' detects pollutants, disease and biological weapons

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For centuries, animals have been our first line of defense against toxins. A canary in a coalmine served as a living monitor for poisonous gases. Scientists used fish to test for contaminants in our water. Even with modern advances, though, it can take days to detect a fatal chemical or organism.

Until now. Working in the miniaturized world of nanotechnology, Tel Aviv University researchers have made an enormous -- and humane -- leap forward in the detection of pollutants.

A team led by Prof. Yosi Shacham-Diamand, vice-dean of TAU's Faculty of Engineering, has developed a nano-sized laboratory, complete with a microscopic workbench, to measure water quality in real time. Their "lab on a chip" is a breakthrough in the effort to keep water safe from pollution and bioterrorist threats, pairing biology with the cutting-edge capabilities of nanotechnology.

"We've developed a platform -- essentially a micro-sized, quarter-inch square 'lab' -- employing genetically engineered bacteria that light up when presented with a stressor in water," says Prof. Shacham-Diamand. Equipment on the little chip can work to help detect very tiny light levels produced by the bacteria.

Instead of using animals to help detect threats to a water supply, Prof. Shacham-Diamand says "Our system is based on a plastic chip that is more humane, much faster, more sensitive and much cheaper."

Tiny Lab-on-Chip Boosts Accuracy

"Basically, ours is an innovative advance in the 'lab on a chip' system," says Prof. Shacham-Diamand. "It's an ingenious nano-scale platform designed to get information out of biological events. Our solution can monitor water with never-before-achieved levels of accuracy. But as a platform, it can also be used for unlimited purposes, such as investigating stem cell therapies or treating cancer."

According to published literature, Tel Aviv University is one of the top five universities in the world pioneering the "lab on a chip" concept. The nanolabs can be used to evaluate several biological processes with practical applications, such as microbes in water, stem cells, or breast cancer development. Prof. Shacham-Diamand's active lab group publishes a major paper about once a month in this field, most recently in the journal *Nano Letters*.

Environmental, Medical and Defense Uses for "Mini-Labs"

Partnering with other Israeli scientists, Tel Aviv University is currently building and commercializing its water-testing mini-labs to measure and monitor how genetically engineered bacteria respond to pollution such as E. coli in water. Cities across Israel have expressed interest in the technology, as has the state of Hawaii.

But other uses are being explored as well. Funded by a $3 million grant from the United States Department of Defense Projects Agency (DARPA), the new lab-on-a-chip could become a defensive weapon that protects America from biological warfare. His system, Prof. Shacham-Diamand says, can be also modified to react to chemical threats and pollution. With some tweaking here and there, it can be updated as new threats are detected.

Prof. Shacham-Diamond's research has also attracted the interest of cancer researchers around the world. He recently addressed 400 physicians at a World Cancer Conference who are seeking new devices to measure and monitor cancer and pharmaceuticals. "They need sensors like Tel Aviv University's lab on a chip. It's a hot topic now," says Prof. Shacham-Diamond.

Source: American Friends of Tel Aviv University