Scientists Create Nano Nose With Aim of Sniffing Out Diseased Cells

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A team of scientists from the University of Massachusetts Amherst has created a kind of molecular nose that uses nanoparticle-based sensors to sniff out and identify proteins. The sensors, which can be trained to detect a wide variety of proteins, could eventually serve as a medical diagnostic tool by sniffing out the proteins made by sickly cells.

The research appears in the May issue of the journal *Nature Nanotechnology*, with advance online publication on April 22. Led by UMass Amherst's Vincent Rotello and Uwe Bunz of the Georgia Institute of Technology, several scientists collaborated on the work.

"The goal is to make a sensor that works like the cancer-sniffing dogs we have been hearing about in the news," says UMass Amherst chemist Rotello.

Current methods for detecting proteins usually rely on specific receptors that bind like a lock and key with their specific protein. Researchers fill a tray with these molecular "locks" and see what sticks when they add protein "keys" to the tray. While precise, the technique is costly and in order to detect a particular protein key, you have to have its particular lock.

Rotello's team wanted to design a detection method that operated more holistically, like the human nose, which uses a combination of receptors to interpret and identify smells. A protein that was exposed to this molecular nose would stimulate a group of sensing receptors in a

signature pattern that could be read like a fingerprint. Unknown or new proteins would have a unique signature as well and could be identified with much less effort than standard techniques.

So the scientists set out to build a molecular nose using gold nanoparticles, materials that can be precisely manipulated into a variety of shapes and sizes. They added a florescent dye to their sensors, so they could see which ones were interacting with a particular protein. All proteins have a unique shape—one might have sections with an electrical charge, for example, or particular kind of chemical bond. Depending on its shape each protein stimulates only certain sensors to release dye and glow, the intensity of the glow varies with protein shape as well. With a computer's assistance, the researchers can then read the glow pattern like a fingerprint and identify the protein that's present.

Rotello's team used six different kinds of nanoparticles to sense for seven different proteins, some of which were intentionally very similar. Ninety-four percent of the time the sensors correctly identified the given protein. The scientists also worked out a technique for dealing with varying protein concentrations, which can sometimes confuse analyses. And by combining their raw data with statistical analyses, the researchers were able to correctly identify 56 randomly selected proteins with 96 percent accuracy.

The chemical nose approach provides a distinct method of sensing that has the potential to be more reliable (fewer false negatives and false positives) and cheaper than current technology, says Rotello. The research team is currently focusing on sensors for detecting the malformed proteins produced by cancer cells, but the technique holds promise as a means for detecting a wide variety of diseases, he says.

Source: University of Massachusetts Amherst